JOHN DEERE
WORLDWIDE COMMERCIAL & CONSUMER EQUIPMENT DIVISION

Wide Area Mower
1600, 1620, and 1600 Turbo

TM1682 DEC05

TECHNICAL MANUAL

JOHN DEERE

North American Version
Litho in U.S.A.

INTRODUCTION

Manual Description

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

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

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

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

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

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

Safety

Specifications and Information

Engine

Electrical

Power Train

Hydraulics

Steering

Brakes

Attachments

Miscellaneous

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

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INTRODUCTION

Recognize Safety Information



MIF

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

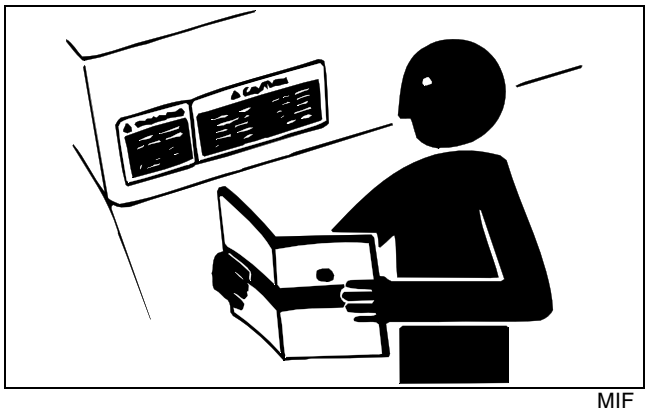
Follow recommended precautions and safe servicing practices.

Understand Signal Words

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

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

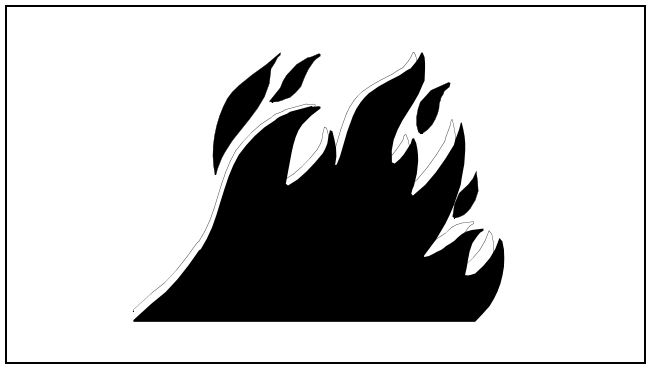
Replace Safety Signs



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

Be Prepared for Emergencies



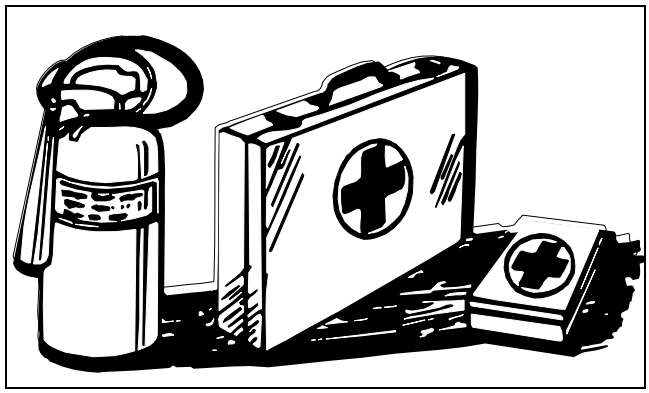
MIF

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

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

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

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



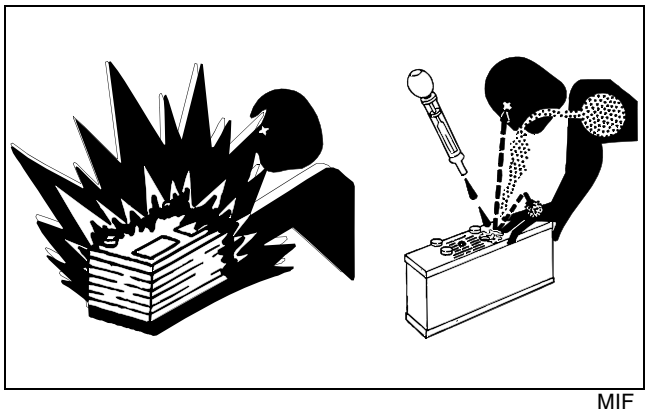
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Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

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

Prevent Battery Explosions



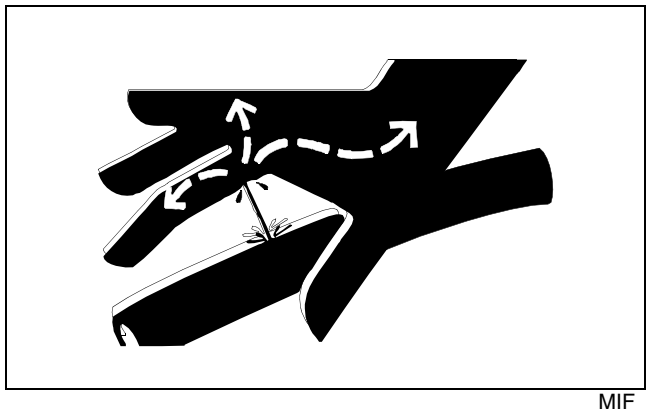
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- Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.
- Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.
- Do not charge a frozen battery; it may explode. 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:**
  a. Filling batteries in a well-ventilated area.
  b. Wearing eye protection and rubber gloves.
  c. Avoiding breathing fumes when electrolyte is added.
  d. Avoiding spilling or dripping electrolyte.
  e. Using proper jump start procedure.
- **If you spill acid on yourself:**
  a. Flush your skin with water.
  b. Apply baking soda or lime to help neutralize the acid.
  c. Flush your eyes with water for 10-15 minutes.
  d. Get medical attention immediately.
- **If acid is swallowed:**
  a. Drink large amounts of water or milk.
  b. Then drink milk of magnesia, beaten eggs, or vegetable oil.
  c. Get medical attention immediately.

Avoid High-Pressure Fluids



MIF

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

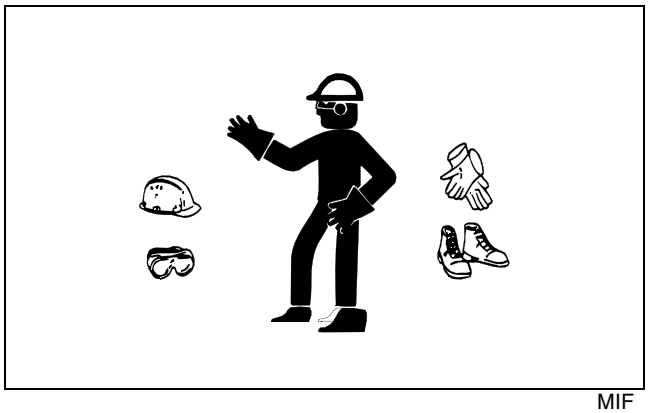
Avoid Heating Near Pressurized Fluid Lines

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.

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.

Wear Protective Clothing



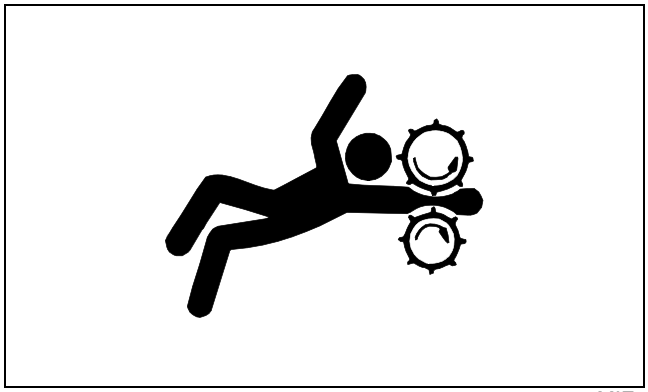
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Wear close fitting clothing and safety equipment appropriate to the job.

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

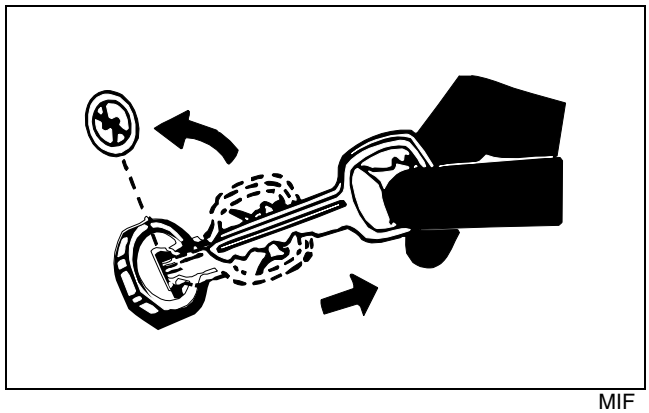


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Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

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

Park Machine Safely

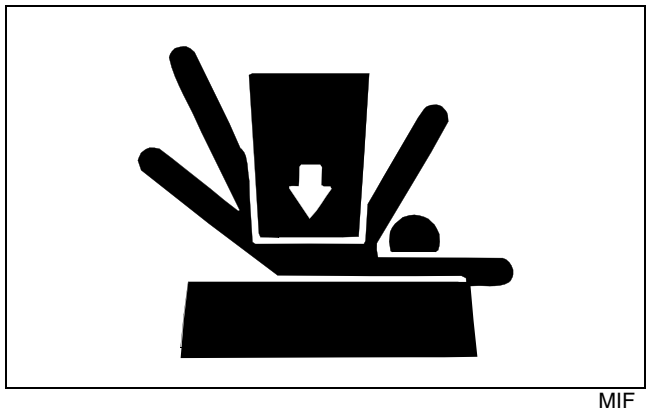


MIF

Before working on the machine:

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

Support Machine Properly and Use Proper Lifting Equipment



MIF

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

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

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

Work in Clean Area

Before starting a job:

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

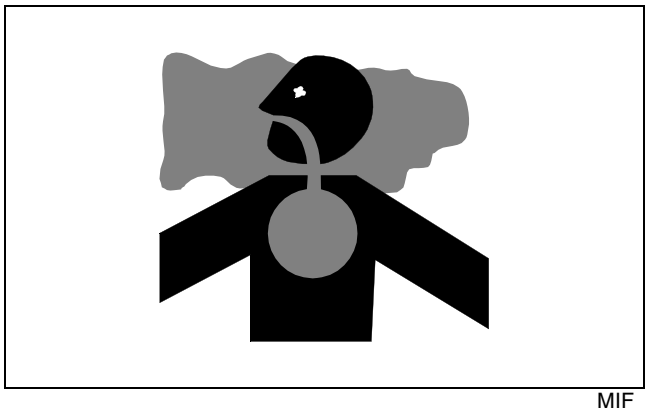
Using High-Pressure Washers

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

Illuminate Work Area Safely

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

Work in Ventilated Area



MIF

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

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

WARNING: California Proposition 65 Warning

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

Remove Paint before Welding or Heating

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

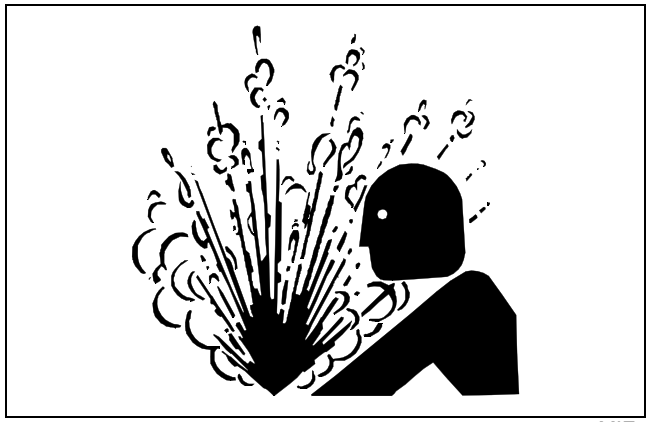
Avoid Harmful Asbestos Dust

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

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

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

Service Cooling System Safely

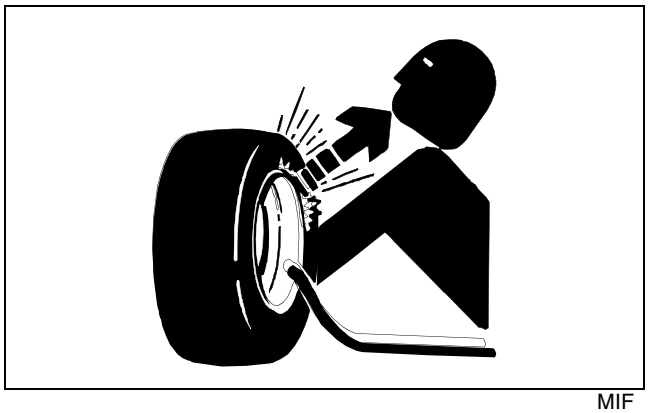


MIF

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

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

Service Tires Safely

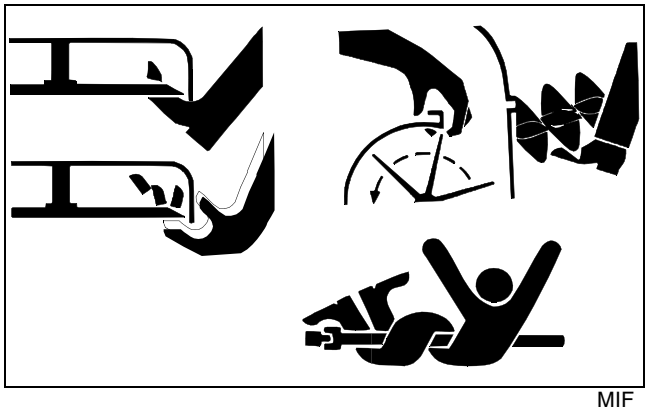


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Explosive separation of a tire and rim parts can cause serious injury or death.

- Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.
- Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion. Welding can structurally weaken or deform the wheel.
- When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and NOT in front of or over the tire assembly. Use a safety cage if available.
- Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.

Avoid Injury from Rotating Blades, Augers, and PTO Shafts

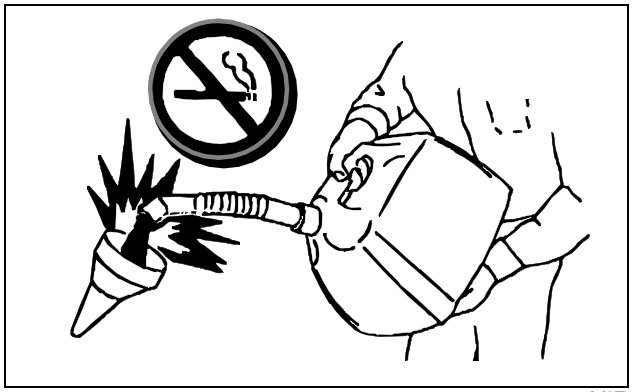


MIF

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

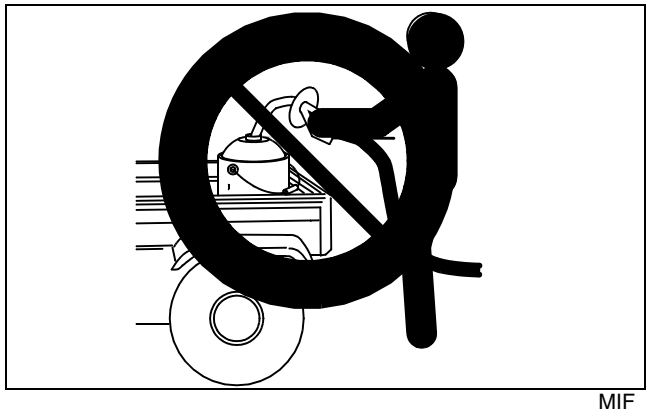
Handling Fuel Safely

Fuel and fuel vapors are highly flammable:



MIF

- Do not refuel machine while you smoke, when machine is near an open flame or sparks, or when engine is running. Stop engine and allow to cool before filling.
- Never remove the fuel cap or add fuel with the engine running.
- Never fill fuel tank or drain fuel from a machine in an enclosed area. Fill fuel tank outdoors.
- Prevent fires. Clean up spilled fuel immediately.
- Do not store machine with fuel in tank in a building where fumes may reach an open flame or spark.
- Prevent fire and explosion caused by static electric discharge. Use only non-metal, portable fuel containers approved by the Underwriter's Laboratory (U.L.) or the American Society for Testing & Materials (ASTM). If using a funnel, make sure it is plastic and has no screen or filter.

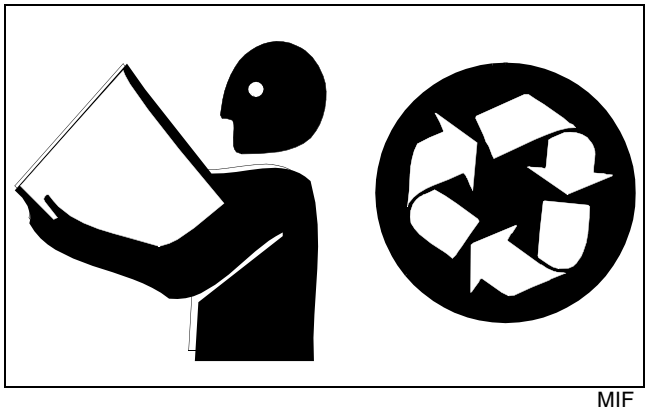


MIF

- Static electric discharge can ignite gasoline vapors in an ungrounded fuel container. Remove the fuel container from the bed of a vehicle or the trunk of a car and place on the ground away from the vehicle before filling. Keep nozzle in contact with container opening while filling.

- When practical, remove equipment from trailers or truck beds and refuel them on the ground. If this is not possible, use a portable, plastic fuel container to refuel equipment on a truck bed or trailer.
- For gasoline engines, do not use gas with methanol. Methanol is harmful to your health and to the environment.

Handle Chemical Products Safely



MIF

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

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

Dispose of Waste Properly

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

Live with Safety



MIF

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

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Specifications

Engine (Yanmar TNE Engines)

Engine Model Number - 1600 and 1620 . . . . . Yanmar 4TNE88
Engine Model Number - 1600 Turbo . . . . . Yanmar 4TNE84T
Engine Type . . . . . 4-Cycle, 4-Cylinder, In-Line Turbocharged Diesel
Cooling . . . . . Liquid Cooled
Slow Idle Speed . . . . . 700 rpm
Fast Idle Speed (Non-adjustable) . . . . . 3200±50 rpm
Injection Type . . . . . Direct
Air Cleaner . . . . . Dry, Replaceable Dual Element

Bore x Stroke

4TNE88 . . . . . 88x90 mm (3.465x3.540 in.)
4TNE84T . . . . . 84x90 mm (3.307x3.540 in.)

Displacement

4TNE88 . . . . . 2.19 L (133.6 cu in.)
4TNE84T . . . . . 2.0 L (122 cu in.)

Gross Output

4TNE88 . . . . . 38 kW (51 hp)
4TNE84T . . . . . 44 kW (59 hp)

Net Output

4TNE88 . . . . . 37 kW (49 hp)
4TNE84T . . . . . 42.7 kW (57.3 hp)

Engine (Yanmar TNV Engines)

Engine Model Number - 1600 Turbo . . . . . Yanmar 4TNV84T
Engine Type . . . . . 4-Cycle, 4-Cylinder, In-Line Turbocharged Diesel
Cooling . . . . . Liquid Cooled
Slow Idle Speed . . . . . 700 rpm
Fast Idle Speed (Non-adjustable) . . . . . 3200±50 rpm
Injection Type . . . . . Direct
Air Cleaner . . . . . Dry, Replaceable Dual Element
Bore x Stroke . . . . . 84x90 mm (3.307x3.540 in.)
Displacement . . . . . 2.0 L (122 cu in.)
Gross Output . . . . . 44 kW (59 hp)
Net Output . . . . . 42.7 kW (57.3 hp)

Capacities

Engine Oil (with Filter) (TNE Engine)	6.6 L (7 qt)
Engine Oil (with Filter) (TNV Engine)	7.4 L (7.8 qt)
Fuel Tank	83 L (22 gal)
Coolant	7.5 L (8 qt)
Hydraulic System	58.7 L (15.5 gal)
Hydraulic System - 1600 Turbo S.N. (050001-)	50.7 L (13.4 gal)
Hydrostatic Transmission	13.3 L (3.5 gal)
Rear Axle	4.7 L (5 qt)

Travel Speeds

High Range

Forward	0–23.3 km/h (0–14.4 mph)
Reverse	0–11.6 km/h (0–7.2 mph)

Low Range

Forward	0–13.7 km/h (0–8.6 mph)
Reverse	0–7.2 km/h (0–4.3 mph)

Tire Dimensions

Front Drive Tire[1]	26x12.00-12 (4 ply)
Rear Tire[1]	20x10-8 (4 ply)
Front Drive Tire - 1600 Turbo S.N. (040001-)	26x12.00-12 (6 ply)
Rear Tire - 1600 Turbo S.N. (040001-)	18x9.5-8 (6 ply)
Mower Deck Caster Tire	11x4-5

Tire Inflation Pressures

Machine Front Tire[1]	138 kPa (20 psi)
Machine Rear Tire[1]	138 kPa (20 psi)
Machine Front Tire - 1600 Turbo S.N. (040001-)	207 kPa (30 psi)
Machine Rear Tire - 1600 Turbo S.N. (040001-)	193 kPa (28 psi)
Mower Deck Caster Tire	275 kPa (40 psi)

Dimensions

Height	2 m (78 in.)
Width (Mower Decks Raised)	2.2 m (84.5 in.)
Width (Mower Decks Lowered)	3.3 m (131 in.)
Length (With Mower Deck)	3.4 m (133 in.)
Length (Without Mower Deck)	2.6 m (101 in.)
Wheelbase	1.6 m (61 in.)
Weight (With Mower Decks)	1814 kg (4000 lbs)
Ground Clearance	18 cm (7 in.)
Cutting Width	3.3 m (131 in.)

1. 1600 Turbo S.N. (-040000) see SIB 05-11-70-2

Mower Decks

Front Mower Deck

Cutting Width	**1.6 m (62 in.)**
Cutting Height	**2.5–15.2 cm (1–6 in.)**
Number of Blades	**3**

Side Mower Decks

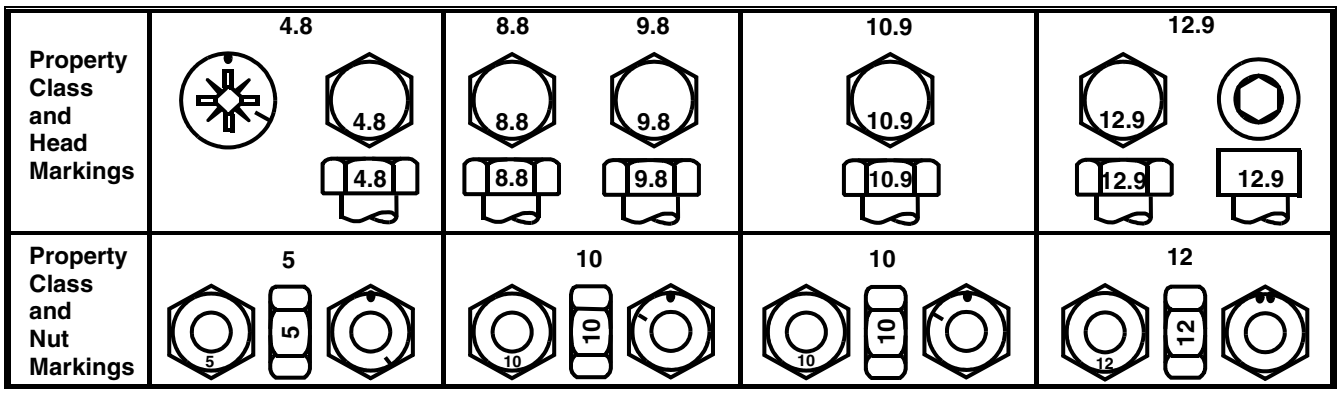
Cutting Width	**1 m (40 in.)**
Cutting Height	**2.5–14 cm (1–5.5 in.)**
Number of Blades	**2**

Recommended Lubricants

Engine Oil	**John Deere PLUS–50™ (15W-40)**
	John Deere TORQ-GARD™ Supreme (5W-30)
Engine Coolant	**John Deere COOL-GARD™ Pre-Diluted Diesel Engine Anti-Freeze/Summer Coolant™**
	John Deere COOL-GARD™ Diesel Engine Anti-Freeze/Summer Coolant Concentrate™
Hydraulic Oil	**John Deere HY-GARD™ J20C**
Hydrostatic Oil	**John Deere HY-GARD™ J20C**
Grease	**See Service Lubrication Section**

Repair Specifications

Metric Fastener Torque Values



MIF (TS1163)

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

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

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

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

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

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

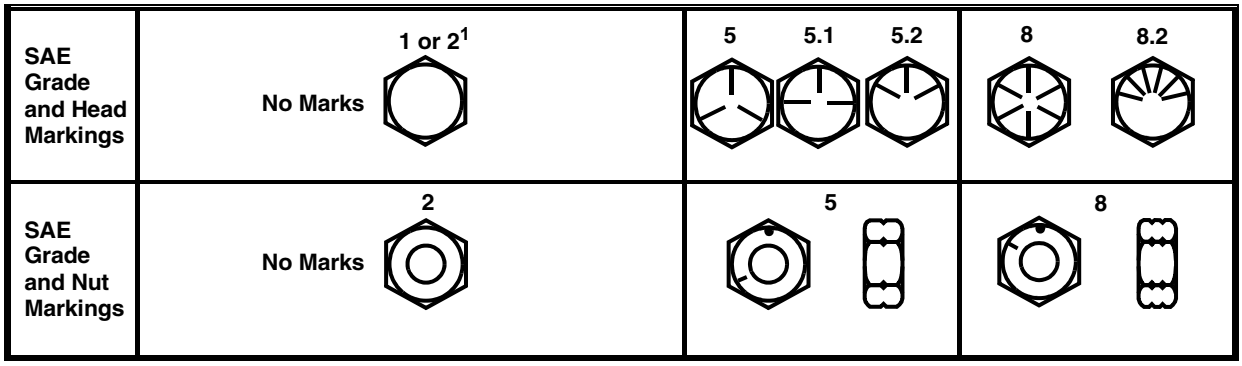
Tighten toothed or serrated-type lock nuts to the full torque value.

Reference: JDS-G200.

Metric Fastener Torque Values - Grade 7

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

Inch Fastener Torque Values



MIF (TS1162)

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

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

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

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

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

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

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

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

Reference: JDS-G200.

Hydraulic Fitting Service Recommendations

37° and 45° JIC/SAE Flare Fitting Torques

NOTE: Torque tolerance is + 15 - 20%

Nominal Tube OD/Hose ID				37° and 45° JIC Flare Tube/Hose End		
Metric Tube OD	Inch Tube OD			Thread Size	Tube Nut/ Swivel Nut Torque	
mm	Dash Size	in.	mm	in.	N•m	lb-ft
6	-4	0.250	6.35	7/16-20	16	12
8	-5	0.312	7.94	1/2-20	21	15
10	-6	0.375	9.52	9/16-18	29	21
12	-8	0.500	12.70	3/4-16	63	46
16	-10	0.625	15.88	7/8-14	74	54
	-12	0.750	19.05	1-1/16-12	113	85
25	-16	1.000	25.40	1-5/16	164	121
32	-20	1.25	31.75	1-5/8-12	226	167
38	-24	1.50	38.10	1-7/8-12	271	200

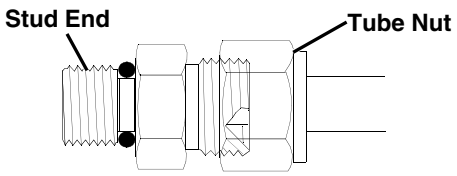
Straight Fitting or Special Nut Torque

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

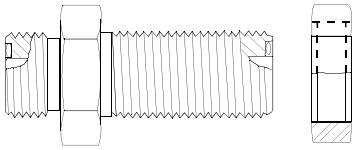
1. Torque tolerance is ± 10 percent.

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

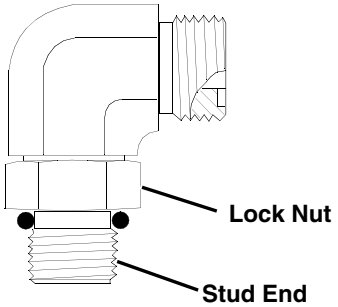
Face Seal Fittings with Inch Stud End Torques



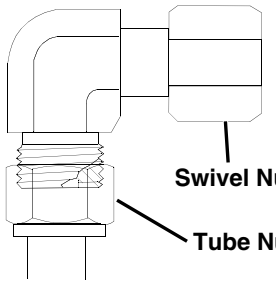
Stud Straight and Tube Nut



Bulkhead Union and Bulkhead Lock Nut



90° Adjustable Stud Elbow



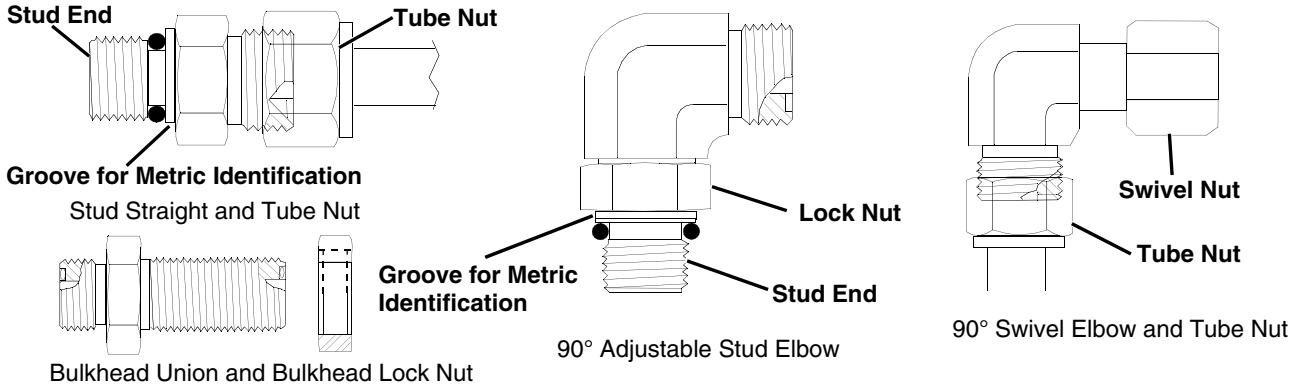
90° Swivel Elbow and Tube Nut

MIF

NOTE: Torque tolerance is + 15 - 20%

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

Face Seal Fittings with Metric Stud End Torques

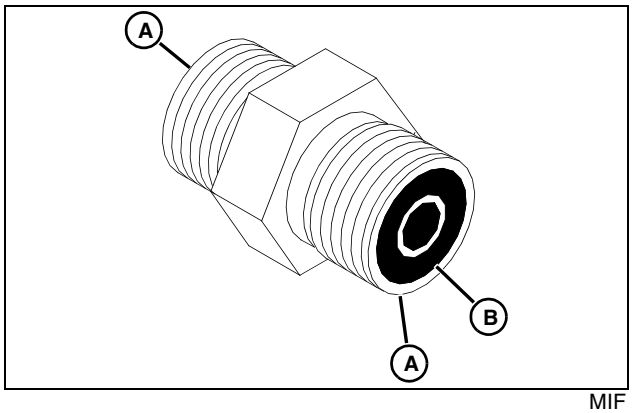


MIF

NOTE: Torque tolerance is + 15% - 20%

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

O-Ring Face Seal Fittings



MIF

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

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

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

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

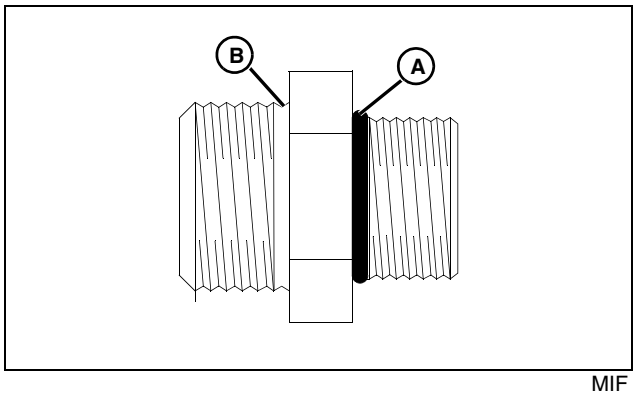
5. Index angle fittings and tighten by hand-pressing joint together to ensure O-ring remains in place.

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

6. Tighten fitting or nut to torque value shown on the chart per dash size stamped on the fitting.

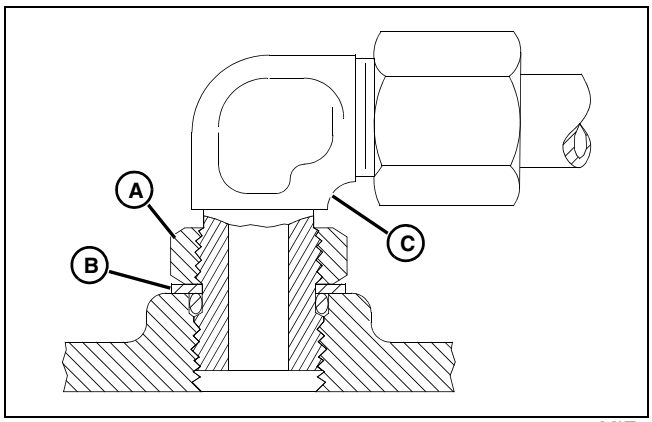
O-Ring Boss Fittings

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



MIF

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



MIF

3. For angle fittings, loosen special nut (A) and push special washer (B) 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 (C), turn the fitting counter-clockwise a maximum of one turn.

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

Diesel Fuel Specifications

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.

In **Europe**, diesel fuel is usually specified to **EN590** and sold in 5 different classes or 6 different grades.

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°C (-4°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%**.

Bio-Diesel Fuels with bio-degradable properties that meet specification DIN 51606, or equivalent, may be used.

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

CAUTION: Avoid injury! 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.

4-Cycle Diesel 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 15-40**
- **TORQ-GARD SUPREME™ - SAE 5W-30**

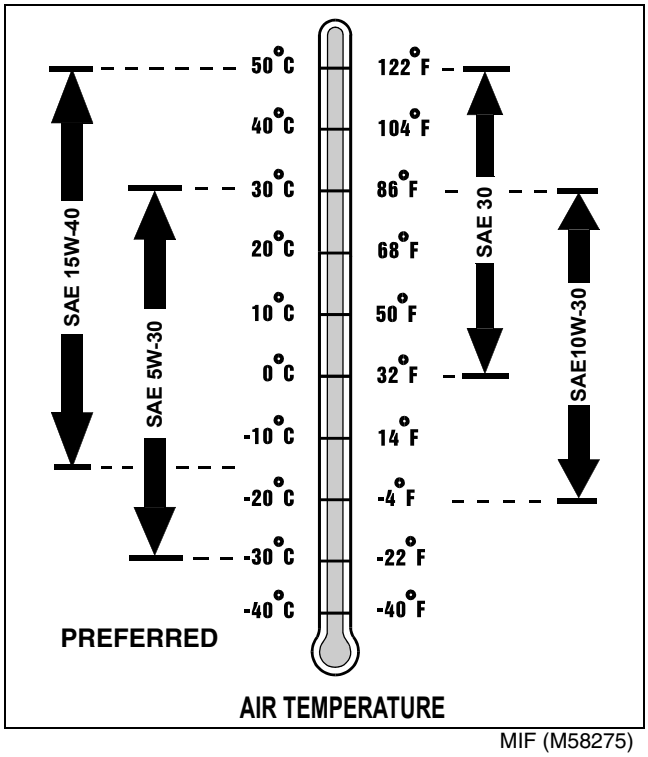
The following John Deere oils are **also recommended**, based on their specified temperature range:

- **TURF-GARD™ - SAE 10W-30**
- **PLUS-4™ - SAE 10W-30**
- **TORQ-GARD SUPREME - SAE 30**

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

- SAE 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.

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



MIF (M58275)

Hydrostatic Transmission and Hydraulic Oil

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

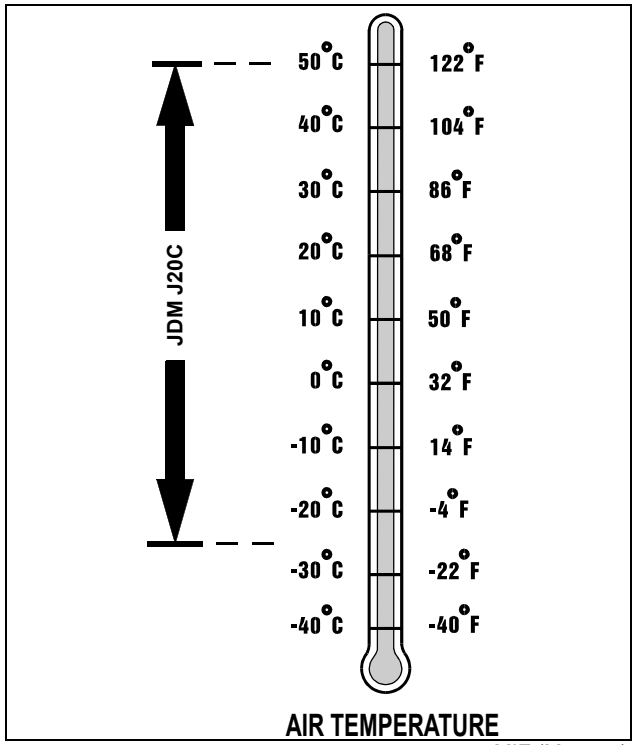
IMPORTANT: Avoid damage! DO NOT use engine oil or "Type F" (Red) Automatic Transmission Fluid in this transmission. DO NOT mix any other oils in this transmission. DO NOT use BIO-HY-GARD™ in this transmission.

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

- **HY-GARD™ - J20C.**

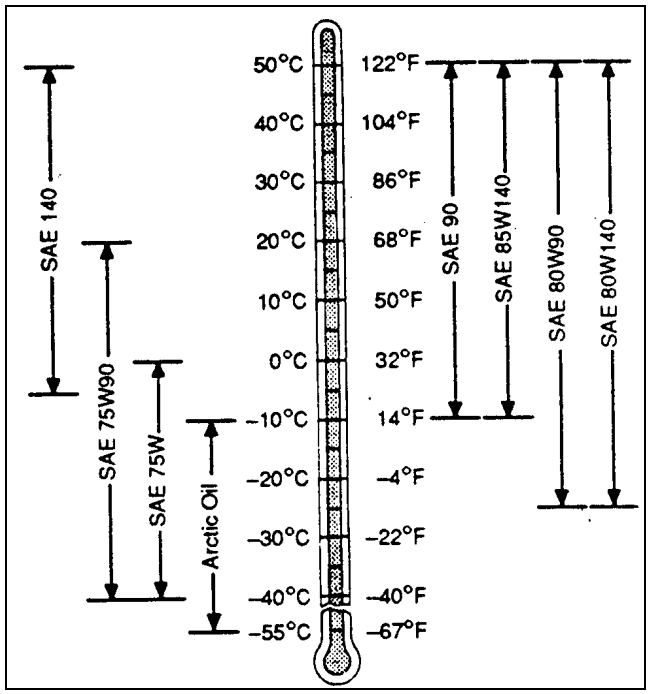
Other oils may be used if above recommended John Deere oil is not available, provided they meet the following specification:

- John Deere Standard JDM J20C.



MIF (M58275)

Mechanical Four Wheel Drive (MFWD) Oil



- John Deere GL-5 Gear Lubricant is recommended.
- Other oils may be used provided they meet the following specifications:
  - API Class GL-5.

Anti-Corrosion Grease

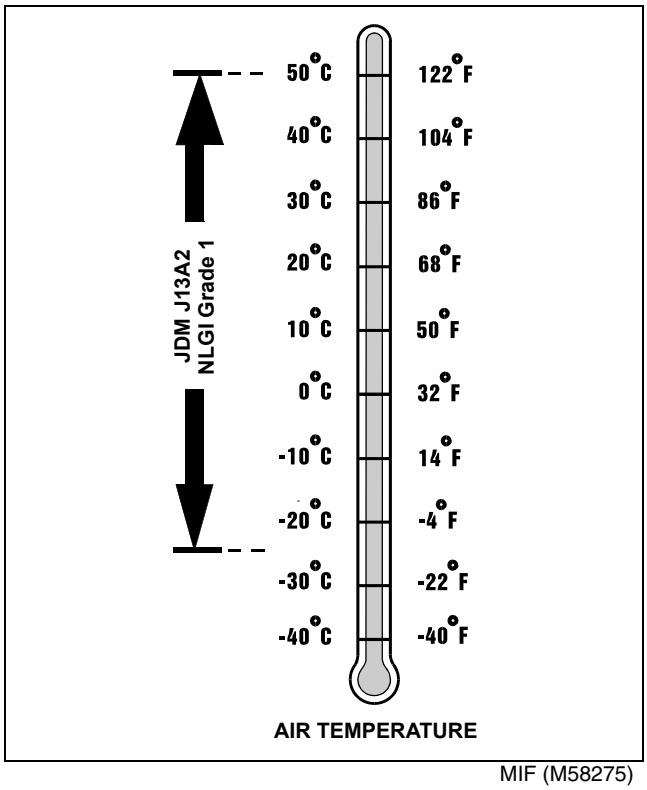
This anti-corrosion grease is formulated to provide the best protection against absorbing moisture, which is one of the major causes of corrosion. This grease is also superior in its resistance to separation and migration.

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

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

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

- John Deere Standard JDM J13A2, NLGI Grade 1.



MIF (M58275)

Chassis and Roller Water Resistant Grease

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

The following water resistant grease is **PREFERRED**:

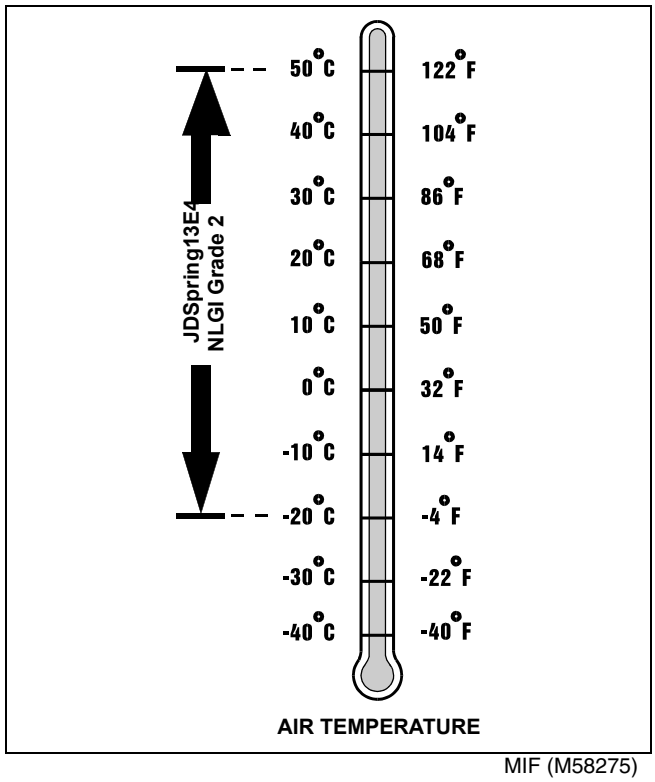
- **Special Purpose HD Water Resistant Grease - TY24425.**

The following water resistant grease may also be used:

- **Multi-Purpose HD Lithium Complex Grease - TY24416.**

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

- John Deere Standard JDM J13E4, NLGI Grade 2.



MIF (M58275)

Chassis and Mower Spindle Grease

This premium, multi-purpose grease is specially formulated as a high-temperature, extreme-pressure grease, especially effective in rolling contact applications.

The following water resistant grease is **PREFERRED**:

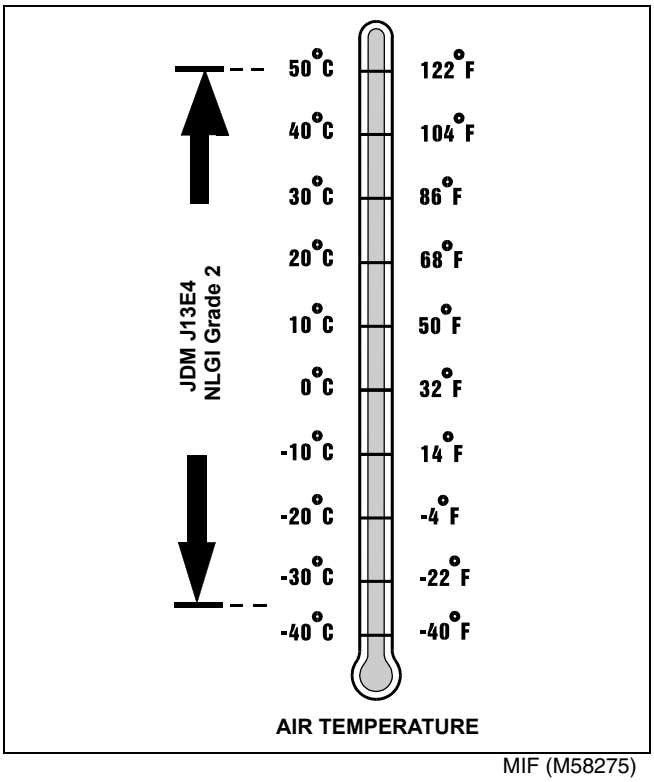
- **Multi-Purpose SD Polyurea Grease - TY6341.**

The following multi-purpose grease may also be used:

- **Multi-Purpose HD Lithium Complex Grease - TY24416.**

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

- John Deere Standard JDM J13E4, NLGI Grade 2.



MIF (M58275)

Diesel and Gasoline Engine Coolant

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

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

- **PRE-DILUTED DIESEL ENGINE ANTI-FREEZE/ SUMMER COOLANT - TY16036**

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

The above preferred pre-diluted anti-freeze provides:

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

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

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

If either of above recommended engine coolants are not 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: Avoid damage! To prevent engine damage, DO NOT use pure anti-freeze or less than 50% anti-freeze mixture in the cooling system. DO NOT mix or add any additives/ conditioners to the cooling system in Lawn and Grounds Care/Golf and Turf Division equipment. Water used to dilute engine coolant concentrate must be of high quality - clean, clear, potable water (low in chloride and hardness - Table 1) is generally acceptable. DO NOT use salt water. Deionized or distilled water is ideal to use. Coolant that is not mixed to these specified levels and water purity can cause excessive scale, sludge deposits, and increased corrosion potential.

Property	Requirements
Total Solids, Max	340 ppm (20 grns/gal)
Total Hardness, Max	170 ppm (10 grns/gal)
Chloride (as Cl), Max	40 ppm (2.5 grns/gal)
Sulfate (as SO4), Max	100 ppm (5.8 grns/gal)

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

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

Diesel and Gasoline Engine Coolant Drain Interval

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

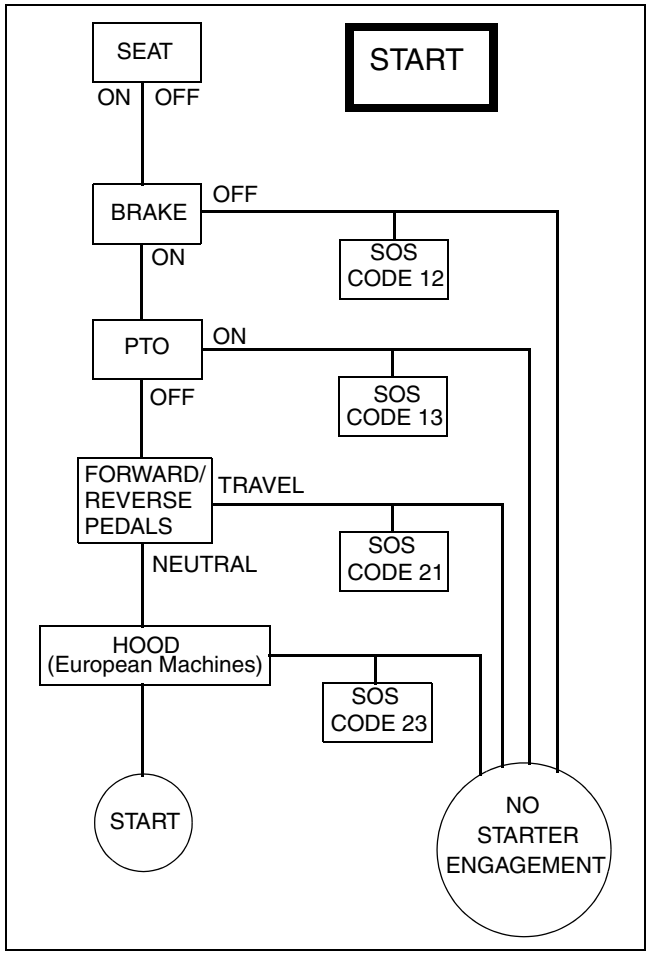
When using **John Deere Concentrate (TY16034)** Automobile and Light Duty Engine Service coolants, drain and flush the cooling system and refill with fresh coolant mixture every **24 months or 2,000 hours** of operation, whichever comes first.

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

General Information

Interlock System

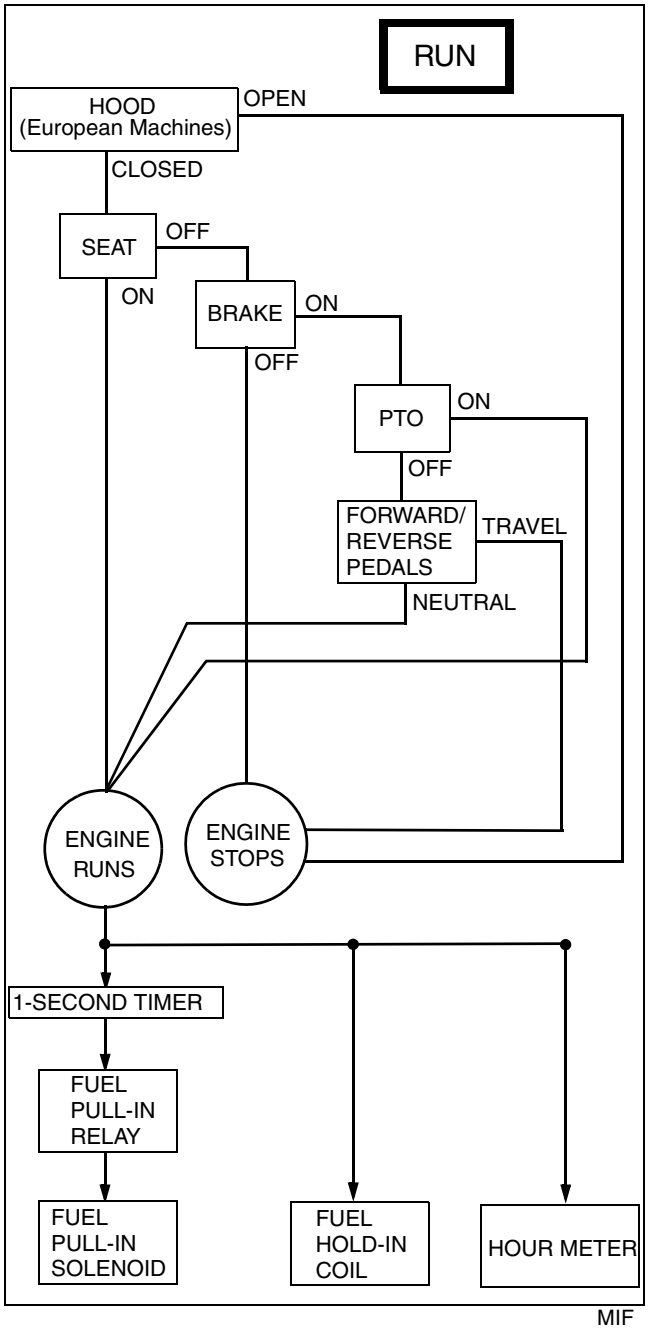
It is important to understand the interlock system and how it works. Before performing the checkout procedures, become familiar with the interlock system so that an interlock function will not be mistaken for a machine problem.



MIF

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

- Operator on seat and/or park brake engaged.
- PTO switch in OFF position.
- Forward/reverse pedals in NEUTRAL position.
- Hood closed (European machines) or hood switch bypass in place (North American machines).



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

- Operator must be on the seat and/or the park brake must be engaged.
- Hood closed (European machines) or hood switch bypass in place (North American machines).

With the park brake not engaged and the operator rises off the seat, the engine will stop.

If the forward/reverse pedals are moved out of the NEUTRAL position and the park brake engaged, the engine will stop.

If the operator is mowing and rises off the seat, the mower decks and engine will stop.

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

- Operator in the operator seat.
- Throttle lever moved to the FAST position.
- Cutting units lowered to the ground.
- Speed range lever in LOW position.
- Park brake not engaged.
- PTO switch in the ON position.

If the operator is mowing and the park brake is depressed, the mower decks will stop rotating.

Product Identification

Record Identification Numbers

Wide Area Mower 1600 Turbo

If you need to contact an Authorized Service Center for information on servicing, always provide the product model and identification numbers.

You will need to locate the identification numbers for the product. Record the information in the spaces provided below.

DATE OF PURCHASE:

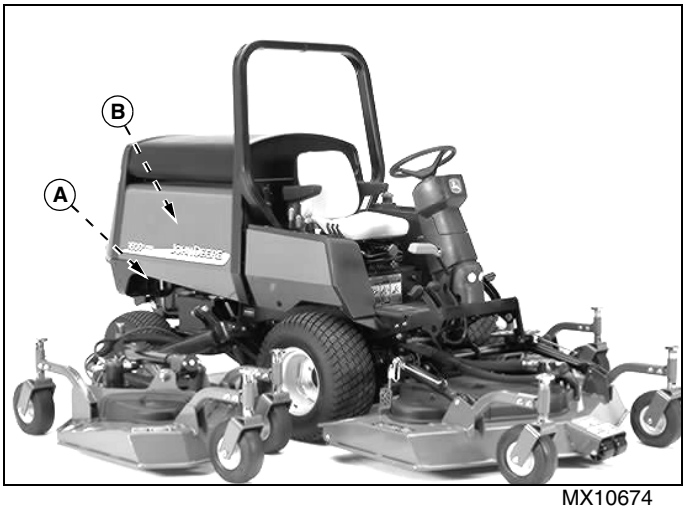
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DEALER NAME:

_____

DEALER PHONE:

_____



MX10674

PRODUCT IDENTIFICATION NUMBER (A):

— — — — — — — — — — — — — — — — —

ENGINE SERIAL NUMBER (B):

— — — — — — — — — — — — — — — — —

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Specifications

General Engine Specifications (Yanmar TNE Engines)

Engine Model Number - 1600 and 1620	Yanmar 4TNE88
Engine Model Number - 1600 Turbo	Yanmar 4TNE84T
Engine Type	4-Cycle, 4-Cylinder, In-Line Turbocharged Diesel
Cooling	Liquid Cooled
Slow Idle Speed	700 rpm
Fast Idle Speed (Non-adjustable)	3200±50 rpm
Injection Type	Direct
Air Cleaner	Dry, Replaceable Dual Element

Bore x Stroke

4TNE88	88x90 mm (3.465x3.540 in.)
4TNE84T	84x90 mm (3.307x3.540 in.)

Displacement

4TNE88	2.19 L (133.6 cu in.)
4TNE84T	2.0 L (122 cu in.)

Gross Output

4TNE88	38 kW (51 hp)
4TNE84T	44 kW (59 hp)

Net Output

4TNE88	37 kW (49 hp)
4TNE84T	42.7 kW (57.3 hp)

Test and Adjustment Specifications (Yanmar TNE Engines)

Slow Idle Speed	700 rpm
Fast Idle Speed (Non-adjustable)	3200±50 rpm
Fan/Alternator Drive Belt Deflection at 98 N (22 lb-force)	10-15 mm (0.400-0.600 in.)
Valve Stem-to-Rocker Arm Clearance	0.15-0.25 mm (0.006-0.010 in.)

Cylinder Compression

Models 1600/1620 (Min)	2744 kPa (398 psi)
Model 1600 Turbo (Min)	2447 kPa (355 psi)
Difference between Cylinders (Max)	296 kPa (43 psi)

Engine Oil Pressure at 3200 RPM	344 ± 48 kPa (50 ± 7 psi)

Rotor Shaft Axial Play

Standard	0.03-0.06 mm (0.0012-0.0024 in.)
Wear Limit	0.09 mm (0.0035 in.)

Rotor Shaft Radial Play

Standard	0.08-0.13 mm (0.0031-0.0051 in.)
Wear Limit	0.17 mm (0.0067 in.)

Fuel Supply Pump Pressure (Min)	29 kPa (4.3 psi)
Fuel System Leakage Test Pressure	34-69 kPa (5-10 psi)
Fuel System Leakage Test Pressure (Max)	103 kPa (15 psi)
Throttle Lever Fast Idle Stop Position (Distance from End of Frame Slot)	6 mm (0.25 in.)
Fuel Injection Nozzle Opening Pressure	19 615-20 595k Pa (2845-2987 psi)
Fuel Injection Nozzle Leakage at 11 032 kPa (1600 psi)	No leakage for a minimum of 10 seconds

Slow Hand

Lever Movement	Chatter sound
Lever Movement	Fine stream spray pattern

Fast Hand

Lever Movement	Fine atomized spray pattern

Radiator Cap Opening Pressure	90 ± 14 kPa (13 ± 2 psi)
Cylinder Leakage Test Pressure (Max)	2448 kPa (355 psi)
Thermostat Opening Temperature - Beginning	69-72°C (156-162°F)
Thermostat Opening Temperature - Fully Open	85°C (184°F)
Coolant Temperature Switch Operating Temperature	107-113°C (225-235°F)

Repair Specifications (Yanmar TNE Engines)

Models 1600/1620 Cooling System Capacity	9.5 L (2.5 gal)
Model 1600 Turbo Cooling System Capacity	7.5 L (8 qt)
Models 1600/1620 Engine Oil Crankcase Capacity (with Filter)	5.8 L (6.1 qt)
Model 1600 Turbo Engine Oil Crankcase Capacity (with Filter)	6.6 L (7 qt)
Oil Filter Block Cap Screw Torque	27 N•m (20 lb-ft)
Oil Cooler Mounting Cap Screw Torque	30 N•m (22 lb-ft)

Rocker Arm Assembly

Rocker Arm Shaft Outside Diameter (Wear Limit)	15.95 mm (0.628 in.)
Rocker Arm Bearing Inside Diameter (Wear Limit)	16.09 mm (0.633 in.)
Rocker Arm-to-Shaft Clearance (Wear Limit)	0.14 mm (0.006 in.)
Push Rod Bend (Max)	0.03 mm (0.001 in.)

Cylinder Head

Cylinder Head Mounting Cap Screw Final Torque	88 N•m (65 lb-ft)
Valve Recession (Max)	1.0 mm (0.04 in.)
Cylinder Head Distortion (Max)	0.15 mm (0.006 in.)
Intake Valve Seat Width (Standard)	1.07-1.24 mm (0.042-0.049 in.)
Exhaust Valve Seat Width (Standard)	1.24-1.45 mm (0.049-0.057 in.)
Intake Valve Seat Width (Wear Limit)	1.74 mm (0.068 in.)
Exhaust Valve Seat Width (Wear Limit)	1.94 mm (0.076 in.)
Intake Valve Seat Angle	30°
Exhaust Valve Seat Angle	45°
Intake and Exhaust Valve Seat Angle Narrowing Angle	70°
Valve Guide Inside Diameter (Wear Limit)	8.1 mm (0.32 in.)
Valve Guide-to-Valve Stem Oil Clearance (Max)	0.20 mm (0.008 in.)
Intake and Exhaust Valve Margin (Min)	0.50 mm (0.02 in.)

Intake and Exhaust Valve Stem Outside Diameter (Wear Limit)	7.90 mm (0.311 in.)
Valve Spring Free Length	42 mm (1.653 in.)
Valve Spring Inclination (Max)	1.10 mm (0.04 in.)
Valve Guide Installed Height (above Spring Seating Surface)	15.0 mm (0.590 in.)
Flywheel Cap Screw Torque	86 N•m (63 lb-ft)
Crankshaft Pulley Cap Screw Torque	117 N•m (86 lb-ft)

Oil Pump

Gear Backlash (Max)	0.12 mm (0.005 in.)
Rotor Shaft-to-Bore Clearance (Max)	0.2 mm (0.008 in.)
Outer Rotor-to-Pump Body Clearance (Max)	0.25 mm (0.020 in.)
Outer Rotor-to-Pump Body Recess (Max)	0.15 mm (0.006 in.)
Inner Rotor-to-Outer Rotor Clearance (Max)	0.15 mm (0.006 in.)

Idler Gear

Shaft Outside Diameter (Wear Limit)	45.93 mm (1.808 in.)
Bushing Inside Diameter (Wear Limit)	46.08 mm (1.814 in.)
Shaft-to-Bushing Clearance (Max)	0.15 mm (0.006 in.)
Timing Cover Mounting Plate Cap Screw Torque	25 N•m (220 lb-in.)
Connecting Rod Side Play (Max)	0.40 mm (0.016 in.)
Connecting Rod Bearing-to-Crankshaft Clearance (Max)	0.16 mm (0.006 in.)

Piston

Piston Ring-to-Groove Clearance (First Compression Ring)	0.070-0.105 mm (0.003-0.004 in.)
Piston Ring-to-Groove Clearance (Second Compression Ring)	0.035-0.070 mm (0.001-0.004 in.)
Piston Ring-to-Groove Clearance (Oil Ring)	0.025-0.060 mm (0.001-0.002 in.)
Piston Ring End Gap - First Compression Ring (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - First Compression Ring (Max)	1.50 mm (0.059 in.)
Piston Ring End Gap - Second Compression Ring (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - Second Compression Ring (Max)	1.50 mm (0.059 in.)
Piston Ring End Gap - Oil Rings (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - Oil Rings (Max)	1.50 mm (0.059 in.)
Piston Pin Outside Diameter (Wear Limit)	25.90 mm (1.019 in.)
Piston Pin Bore Inside Diameter (Wear Limit)	26.02 mm (1.024 in.)
Piston Pin-to-Piston Bore Clearance (Wear Limit)	0.12 mm (0.005 in.)
Models 1600/1620 Standard Size Piston Outside Diameter (Wear Limit)	87.90 mm (3.461 in.)
Model 1600 Turbo Standard Size Piston Outside Diameter (Wear Limit)	83.90 mm (3.303 in.)
Models 1600/1620 0.25 mm (0.010) Oversize Piston Outside Diameter (Wear Limit)	88.15 mm (3.470 in.)
Model 1600 Turbo 0.25 mm (0.010) Oversize Piston Outside Diameter (Wear Limit)	84.15 mm (3.313 in.)

Connecting Rod

Connecting Rod Cap Screw Torque	49 N•m (36 lb-ft)
Connecting Rod Bearing Inside Diameter (Wear Limit)	51.01 mm (2.008 in.)
Piston Pin Bushing Inside Diameter (Max)	26.10 mm (1.03 in.)
Piston Pin-to-Connecting Rod Clearance (Wear Limit)	0.20 mm (0.007 in.)
Piston Pin-to-Connecting Rod Bore Clearance (Wear Limit)	0.20 mm (0.007 in.)
Crankshaft End Play	0.09-0.27 mm (0.004-0.011 in.)

Main Bearings

Main Bearing Cap Screw Torque	98 N•m (72 lb-ft)
Main Bearing-to-Crankshaft Journal Clearance (Wear Limit)	0.15 mm (0.006 in.)
Main Bearing Thickness (Wear Limit)	1.995 mm (0.08 in.)

Crankshaft

Connecting Rod Journal Outside Diameter (Wear Limit)	47.91 mm (1.88 in.)
Main Bearing Journal Outside Diameter (Wear Limit)	53.91 mm (2.12 in.)
Crankshaft Bend (Max)	0.02 mm (0.001 in.)
Piston Cooling Nozzle Orifice Diameter	1.77 mm (0.069 in.)
Piston Cooling Valve Torque	15 N•m (11 lb-ft)

Cam Follower

Outside Diameter (Wear Limit)	11.93 mm (0.470 in.)
Bore Inside Diameter-Engine Block (Wear Limit)	12.05 mm (0.474 in.)
Cam Follower-to-Bearing Clearance (Wear Limit)	0.12 mm (0.005 in.)

Camshaft

End Play (Standard)	0.05-0.25 mm (0.002-0.010 in.)
End Play (Max)	0.40 mm (0.016 in.)
Timing Gear Backlash (Max) - All (Except Oil Pump Gear)	0.07-0.15 mm (0.003-0.005 in.)
Timing Gear Backlash (Max) - Oil Pump Gear	0.11-0.19 mm (0.004-0.008 in.)
Retainer Cap Screw Torque	11 N•m (96 lb-in.)
Camshaft Bend (Max)	0.02 mm (0.001 in.)
Lobe Height (Wear Limit)	38.40 mm (1.512 in.)
End Journal Outside Diameter (Wear Limit)	44.85 mm (1.766 in.)
Intermediate Journal Outside Diameter (Wear Limit)	44.85 mm (1.766 in.)
Camshaft Journal-to-Timing Gear End Bushing Clearance (Wear Limit)	0.130 mm (0.005 in.)
Camshaft Journal-to-Intermediate Bushing Clearance (Wear Limit)	0.115 mm (0.004 in.)
Camshaft Journal-to-Flywheel End Bushing Clearance (Wear Limit)	0.110 mm (0.004 in.)

Cylinder Block (Models 1600/1620)

Standard Bore Inside Diameter	88.00-88.03 mm (3.464-3.465 in.)
Standard Bore Inside Diameter (Wear Limit)	88.20 mm (3.472 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter	88.25-88.28 mm (3.474-3.475 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter (Wear Limit)	88.45 mm (3.482 in.)

Cylinder Block (Model 1600 Turbo)

Standard Bore Inside Diameter	84.00-84.03 mm (3.307-3.308 in.)
Standard Bore Inside Diameter (Wear Limit)	84.20 mm (3.315 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter	84.25-84.28 mm (3.317-3.318 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter (Wear Limit)	84.45 mm (3.325 in.)

Starting Motor

Brush Length (Min)	8.50 mm (0.335 in.)

Alternator

Pulley Retaining Nut Torque	69 N•m (51 lb-ft)
Rotor Slip Ring Outside Diameter (Wear Limit)	14 mm (0.55 in.)
Brush Exposed Length (Max)	10.5 mm (0.41 in.)
Brush Length (Min)	4.5 mm (0.17 in.)

Fuel Tank Capacity (Models 1600/1620)	57 L (15 gal)
Fuel Tank Capacity (Model 1600 Turbo)	87 L (22 gal)
Fuel Injector Line Nut Torque	32 N•m (24 lb-ft)
Fuel Injector Clamp Nut Torque	5 N•m (44 lb-ft)
Fuel Injector Retaining Nut Torque	8 N•m (72 lb-in.)
Fuel Injector Separator Plate Contact Surface	0.10 mm (0.004 in.)

General Engine Specifications (Yanmar TNV Engines)

Engine Model Number - 1600 Turbo	Yanmar 4TNV84T
Engine Type	4-Cycle, 4-Cylinder, In-Line Turbocharged Diesel
Cooling	Liquid Cooled
Slow Idle Speed	700 rpm
Fast Idle Speed (Non-adjustable)	3200±50 rpm
Injection Type	Direct
Air Cleaner	Dry, Replaceable Dual Element
Bore x Stroke	84x90 mm (3.307x3.540 in.)
Displacement	2.0 L (122 cu in.)
Gross Output	44 kW (59 hp)
Net Output	42.7 kW (57.3 hp)

Test and Adjustment Specifications (Yanmar TNV Engines)

Slow Idle Speed	700 rpm
Fast Idle Speed (Non-adjustable)	3200±50 rpm
Fan/Alternator Drive Belt Deflection at 98 N (22 lb-force)	10-15 mm (0.400-0.600 in.)
Valve Stem-to-Rocker Arm Clearance	0.15-0.25 mm (0.006-0.010 in.)
Cylinder Compression (Min)	2447 kPa (355 psi)
Difference between Cylinders (Max)	296 kPa (43 psi)
Engine Oil Pressure at 3200 RPM	344 ± 48 kPa (50 ± 7 psi)

Rotor Shaft Axial Play

Standard	0.03-0.06 mm (0.0012-0.0024 in.)
Wear Limit	0.09 mm (0.0035 in.)

Rotor Shaft Radial Play

Standard	0.08-0.13 mm (0.0031-0.0051 in.)
Wear Limit	0.17 mm (0.0067 in.)

Fuel Supply Pump Pressure (Min)	29 kPa (4.3 psi)
Fuel System Leakage Test Pressure	34-69 kPa (5-10 psi)
Fuel System Leakage Test Pressure (Max)	103 kPa (15 psi)
Throttle Lever Fast Idle Stop Position (Distance from End of Frame Slot)	6 mm (0.25 in.)
Fuel Injection Nozzle Opening Pressure	19 615-20 595k Pa (2845-2987 psi)

Fuel Injection Nozzle Leakage at 11 032 kPa (1600 psi)	No leakage for a minimum of 10 seconds
Slow Hand	
Lever Movement	Chatter sound
Lever Movement	Fine stream spray pattern
Fast Hand	
Lever Movement	Fine atomized spray pattern
Radiator Cap Opening Pressure	90 ± 14 kPa (13 ± 2 psi)
Cylinder Leakage Test Pressure (Max)	2448 kPa (355 psi)
Thermostat Opening Temperature - Beginning	69-72°C (156-162°F)
Thermostat Opening Temperature - Fully Open	85°C (184°F)
Coolant Temperature Switch Operating Temperature	107-113°C (225-235°F)

Repair Specifications (Yanmar TNV Engines)

Cooling System Capacity	7.5 L (8 qt)
Engine Oil Crankcase Capacity (with Filter)	7.4 L (7.8 qt)
Oil Filter Block Cap Screw Torque	27 N•m (20 lb-ft)
Oil Cooler Mounting Cap Screw Torque	30 N•m (22 lb-ft)
Rocker Arm Assembly	
Rocker Arm Shaft Outside Diameter (Wear Limit)	15.95 mm (0.628 in.)
Rocker Arm Bearing Inside Diameter (Wear Limit)	16.09 mm (0.633 in.)
Rocker Arm-to-Shaft Clearance (Wear Limit)	0.14 mm (0.006 in.)
Push Rod Bend (Max)	0.03 mm (0.001 in.)
Cylinder Head	
Cylinder Head Mounting Cap Screw Final Torque	88 N•m (65 lb-ft)
Valve Recession (Max)	0.8 mm (0.03 in.)
Cylinder Head Distortion (Max)	0.15 mm (0.006 in.)
Intake Valve Seat Width (Standard)	1.07-1.24 mm (0.042-0.049 in.)
Exhaust Valve Seat Width (Standard)	1.24-1.45 mm (0.049-0.057 in.)
Intake Valve Seat Width (Wear Limit)	1.74 mm (0.068 in.)
Exhaust Valve Seat Width (Wear Limit)	1.94 mm (0.076 in.)
Intake Valve Seat Angle	30°
Exhaust Valve Seat Angle	45°
Intake and Exhaust Valve Seat Angle Narrowing Angle	70°
Valve Guide Inside Diameter (Wear Limit)	6.8 mm (0.27 in.)
Valve Guide-to-Valve Stem Oil Clearance (Max)	0.15 mm (0.006 in.)
Intake and Exhaust Valve Margin (Min)	0.50 mm (0.02 in.)
Intake and Exhaust Valve Stem Outside Diameter (Wear Limit)	5.90 mm (0.232 in.)
Valve Spring Free Length	36.9 mm (1.452 in.)
Valve Spring Inclination (Max)	1.30 mm (0.05 in.)
Valve Guide Installed Height (above Spring Seating Surface)	8.5 mm (0.335 in.)
Flywheel Cap Screw Torque	86 N•m (63 lb-ft)
Crankshaft Pulley Cap Screw Torque	117 N•m (86 lb-ft)

Oil Pump

Rotor Shaft OD to Side Cover Hole ID Clearance	0.01-0.04 mm (0.001-0.002 in.)
Wear Limit	0.20 mm (0.08 in.)
Inner Rotor and Outer Rotor-to-Pump Body Side Clearance	0.03-0.09 mm (0.001-0.004 in.)
Wear Limit	0.15 mm (0.006 in.)
Outer Rotor to Pump Body Clearance	0.12-0.21 mm (0.005-0.008 in.)
Wear Limit	0.30 mm (0.012 in.)
Inner Rotor to Outer Rotor Clearance Wear Limit	0.12 mm (0.005 in.)

Idler Gear

Shaft Outside Diameter (Wear Limit)	45.90 mm (1.807 in.)
Bushing Inside Diameter (Wear Limit)	46.08 mm (1.814 in.)
Shaft-to-Bushing Clearance (Max)	0.175 mm (0.007 in.)

Timing Cover Mounting Plate Cap Screw Torque	25 N•m (220 lb-in.)
Connecting Rod Side Play (Max)	0.40 mm (0.016 in.)
Connecting Rod Bearing-to-Crankshaft Clearance (Max)	0.16 mm (0.006 in.)

Piston

Piston Ring-to-Groove Clearance (First Compression Ring)	0.075-0.110 mm (0.003-0.004 in.)
Piston Ring-to-Groove Clearance (Second Compression Ring)	0.045-0.080 mm (0.002-0.003 in.)
Piston Ring-to-Groove Clearance (Oil Ring)	0.025-0.060 mm (0.001-0.002 in.)
Piston Ring End Gap - First Compression Ring (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - First Compression Ring (Max)	0.49 mm (0.059 in.)
Piston Ring End Gap - Second Compression Ring (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - Second Compression Ring (Max)	0.49 mm (0.019 in.)
Piston Ring End Gap - Oil Rings (Standard)	0.20-0.40 mm (0.007-0.016 in.)
Piston Ring End Gap - Oil Rings (Max)	0.49 mm (0.059 in.)
Piston Pin Outside Diameter (Wear Limit)	25.965 mm (1.022 in.)
Piston Pin Bore Inside Diameter (Wear Limit)	26.039 mm (1.025 in.)
Piston Pin-to-Piston Bore Clearance (Wear Limit)	0.10 mm (0.004 in.)
Piston Outside Diameter (Wear Limit)	83.90 mm (3.303 in.)
Oversize Piston Outside Diameter 0.25 mm (0.010) (Wear Limit)	84.15 mm (3.313 in.)

Connecting Rod

Connecting Rod Cap Screw Torque	49 N•m (36 lb-ft)
Connecting Rod Bearing Inside Diameter (Wear Limit)	47.96 mm (1.888 in.)
Piston Pin Bushing Inside Diameter (Max)	26.068 mm (1.03 in.)
Piston Pin-to-Connecting Rod Clearance (Wear Limit)	0.10 mm (0.004 in.)
Piston Pin-to-Connecting Rod Bore Clearance (Wear Limit)	0.20 mm (0.007 in.)

Crankshaft End Play	0.09-0.27 mm (0.004-0.011 in.)

Main Bearings

Main Bearing Cap Screw Torque	98 N•m (72 lb-ft)
Main Bearing-to-Crankshaft Journal Clearance (Wear Limit)	0.15 mm (0.006 in.)
Main Bearing Thickness (Wear Limit)	1.995 mm (0.08 in.)

Crankshaft

Connecting Rod Journal Outside Diameter (Wear Limit)	47.91 mm (1.88 in.)
Main Bearing Journal Outside Diameter (Wear Limit)	53.91 mm (2.12 in.)
Crankshaft Bend (Max)	0.02 mm (0.001 in.)
Piston Cooling Nozzle Orifice Diameter	1.77 mm (0.069 in.)
Piston Cooling Valve Torque	15 N•m (11 lb-ft)

Cam Follower

Outside Diameter (Wear Limit)	11.95 mm (0.470 in.)
Bore Inside Diameter-Engine Block (Wear Limit)	12.05 mm (0.474 in.)
Cam Follower-to-Bearing Clearance (Wear Limit)	0.09 mm (0.004 in.)

Camshaft

End Play (Standard)	0.05-0.25 mm (0.002-0.010 in.)
End Play (Max)	0.40 mm (0.016 in.)
Timing Gear Backlash (Max) - All (Except Oil Pump Gear)	0.07-0.15 mm (0.003-0.005 in.)
Timing Gear Backlash (Max) - Oil Pump Gear	0.11-0.19 mm (0.004-0.008 in.)
Retainer Cap Screw Torque	11 N•m (96 lb-in.)
Camshaft Bend (Max)	0.02 mm (0.001 in.)
Lobe Height (Wear Limit)	38.40 mm (1.512 in.)
End Journal Outside Diameter (Wear Limit)	44.89 mm (1.767 in.)
Intermediate Journal Outside Diameter (Wear Limit)	44.875 mm (1.766 in.)
Camshaft Journal-to-Timing Gear End Bushing Clearance (Wear Limit)	0.240 mm (0.009 in.)
Camshaft Journal-to-Intermediate Bushing Clearance (Wear Limit)	0.225 mm (0.009 in.)
Camshaft Journal-to-Flywheel End Bushing Clearance (Wear Limit)	0.210 mm (0.008 in.)

Cylinder Block

Standard Bore Inside Diameter	84.00-84.03 mm (3.307-3.308 in.)
Standard Bore Inside Diameter (Wear Limit)	84.20 mm (3.315 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter	84.25-84.28 mm (3.317-3.318 in.)
0.25 mm (0.010 in.) Oversize Bore Inside Diameter (Wear Limit)	84.45 mm (3.325 in.)

Starting Motor

Brush Length (Min)	8.50 mm (0.335 in.)

Alternator

Pulley Retaining Nut Torque	69 N•m (51 lb-ft)
Rotor Slip Ring Outside Diameter (Wear Limit)	14 mm (0.55 in.)
Brush Exposed Length (Max)	10.5 mm (0.41 in.)
Brush Length (Min)	4.5 mm (0.17 in.)
Fuel Tank Capacity	83 L (22 gal)
Fuel Injector Line Nut Torque	32 N•m (24 lb-ft)
Fuel Injector Clamp Nut Torque	5 N•m (44 lb-ft)
Fuel Injector Retaining Nut Torque	39 N•m (29 lb-in.)
Fuel Injector Separator Plate Contact Surface	0.10 mm (0.004 in.)

Diagnostics

Engine Exterior

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position.

Symptom: Engine Exterior

(1) Exterior Engine Surface. Are leaks evident on external surface of engine?

Yes - Check gaskets, seals, plugs, cylinder head, block, and intake manifold and breather. Repair as needed.

No - Go To Step (2)

(2) Muffler.
Is muffler free of obstructions?
Is muffler in good condition without holes or dents?

No - Replace muffler.

Engine Oil/Lubrication System

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position.

Symptom: Engine Oil/Lubrication System

(1) Engine Oil Dipstick.
Check engine oil level and observe the condition of the oil.
Is oil level between the ADD and FULL marks?
Is oil in good condition, not burnt, and free of metal particles, fuel, and coolant?

Yes - Go To Step (2)

No - Add/drain oil to bring level to the FULL mark.

(2) Engine running at SLOW idle.
Oil Pressure Sender Port.
Is oil pressure to specification?

No - Repair oil pump or pressure regulating valve as needed.

Specifications

Engine Oil Pressure at 3200 RPM. 344 ± 48 kPa (50 ± 7 psi)

Air Intake System

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Engine running at FAST idle.

Symptom: Air Intake System

(1) Air Filter Restriction Indicator. Does the plunger in the gauge indicate the filter needs servicing?

Yes - Service air cleaner filter elements.

No - Go To Step (2)

(2) Air Cleaner Housing. Is housing in good condition, sealed, and undamaged?

Yes - Go To Step (3)

No - Replace air cleaner housing assembly.

(3) Air Cleaner Hoses.
Are clamps tight?
Are hoses in good condition, free of cracks and holes?

No - Clamps are not tight. Tighten clamps.

No - Hoses are in poor condition or have cracks or holes. Replace hoses.

Cooling System

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position unless indicated otherwise.

Symptom: Cooling System

(1) Coolant Overflow Bottle and Radiator.
Is coolant between marks on tank when engine is warm and is coolant in radiator full to top of filler neck?
Is coolant free of contamination, no oil, no fuel, and not discolored brown?
Are radiator fins free of debris?
Is radiator free of damage and free of leaks?
Is the radiator cap tight?

Yes - Go To Step (2)

No - Coolant is not between the marks. Add proper coolant mix.

No - Coolant is contaminated. Drain and flush cooling system. Check for source of contamination. Refill cooling system with correct coolant.

No - Radiator fins have debris. Clean or replace radiator.

No - Radiator is damaged and/or leaks. Repair or replace radiator.

No - Radiator cap is not tight. Pressure test radiator cap.

(2) Radiator Hoses.
Are hoses cracked or leaking?
Are hose clamps loose?

Yes - Pressure test cooling system.

No - Go To Step (3)

(3) Fan/Alternator Drive Belt.
Is belt properly tensioned?
Is belt in good condition, not glazed nor cracked?

Yes - Go To Step (4)

No - Belt is not properly tensioned. Adjust belt tension.

No - Belt is glazed or cracked. Replace belt.

Symptom: Cooling System

(4) Fan Blade. Are fan blades damaged or warped?

Yes - Replace fan.

No - Go To Step (5)

(5) Thermostat.
Is the thermostat free of corrosion, rust, and debris?
Test opening temperature of thermostat. Is the opening temperature within specifications?

No - Thermostat has corrosion, rust, or debris. Replace thermostat.

No - Opening temperature is not within specifications. Replace thermostat.

Specifications

Thermostat Opening Temperature - Beginning 69-72° C (156-162° F)
Thermostat Opening Temperature - Fully Open . . 85° C (185° F)

Fuel System

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position unless indicated otherwise.

Symptom: Fuel System

(1) Fuel Tank. Is fuel level correct with proper grade of fuel, not contaminated, and contains no water?

Yes - Go To Step (2)

No - Drain and clean fuel tanks. Add fresh fuel.

(2) Fuel Filter. Is filter element free of debris.

Yes - Go To Step (3)

No - Replace filter element.

(3) Fuel Filter Shutoff Valve. Is shutoff valve in ON position?

Yes - Go To Step (4)

No - Move valve to ON position.

Symptom: Fuel System

(4) Fuel Line and Clamps.
Are fuel lines/hoses in good condition, not cracked nor leaking?
Are fuel hose clamps tight?

Yes - Go To Step (5)

No - Hoses are cracked or leaking. Replace fuel lines/hoses.

No - Clamps are loose. Tighten clamps.

(5) Throttle Lever and Cable.
Is cable adjusted correctly?
Does cable move freely, without binding?

Yes - Go To Step (6)

No - Cable is incorrectly adjusted. Adjust throttle cable.

No - Cable is binding. Replace throttle cable.

(6) Injection Pump Timing Inspection. Is timing correct?

Yes - Go To Step (7)

No - Perform injection pump static timing adjustment. Remove pump as the LAST possible solution. Have pump tested by qualified service repair shop.

(7) Fuel Shutoff Solenoid.
Move key switch to RUN position (for this step only).
Is fuel shutoff solenoid engaged?

Yes - Go To Step (8)

No - If solenoid will not pull in and hold, check electrical circuit.

(8) Fuel Filter, Fuel Pump.
Crank the engine.
Does fuel level increase in the fuel filter and is the fuel pump operating?
Is fuel present in the fuel pump return hose?

Yes - Go To Step (9)

No - Fuel level does not increase or pump is not operating. Test fuel pump pressure. If pressure is low, have pump tested by a qualified service repair shop.

No - Fuel is not present in the return hose but fuel pump pressure is OK. Replace fuel filter.

Symptom: Fuel System

(9) Fuel Injection Nozzle Fuel Lines.
Move key switch to START position (for this step only) and crank the engine.
Loosen the fuel lines at the fuel injection nozzles.
Is fuel present at the fuel injection nozzles?

Yes - Go To Step (10)

No - Check fuel lines to fuel injection nozzles for obstructions.

(10) Fuel Injection Nozzles.
Check the spray patterns and crack pressures of the fuel injection nozzles.
Are spray patterns and crack pressures correct?

Yes - Go To Step (11)

No - Repair or replace fuel injection nozzle assemblies.

(11) Run the engine under load.
Does the engine run smoothly under load and is the engine slow idle speed to specifications?

No - Adjust slow idle speed.

Specifications

Engine RPM at Slow Idle . . . . . .700 rpm

Engine Performance

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position unless indicated otherwise.

Symptom: Engine Performance

(1) Intake and Exhaust Valves.
With engine cold, check valve clearances.
Are clearances to specification?
Are valves free, not sticking?

Yes - Go To Step (2)

No - Adjust valve clearances.

(2) Injector Ports.
Check cylinder compression.
Is compression to specification?

Yes - Go To Step (3)

No - Repair as necessary.

Symptom: Engine Performance

(3) Flywheel and Starting Motor. Move key switch to START position and crank engine. Is engine cranking speed to specification?

No - Perform See “Starting Motor Loaded Amperage Draw Test” on page 362

Specifications

Valve Clearance . . . . . 0.15-0.25 mm (0.006-0.010 in.)

Cylinder Compression

Models 1600/1620 (Min) . . . . . 2744 kPa (398 psi)
Model 1600 Turbo (Min) . . . . . 2447 kPa (355 psi)
Difference between Cylinders (Max). . . 296 kPa (43 psi)

Engine Cranking Speed (Min) . . . . . .225 rpm

Turbocharger - Model 1600 Turbo

Test Conditions:

- Park machine safely. (See “Park Machine Safely” on page 3.)
- Key switch in OFF position.

Symptom: Turbocharger - Model 1600 Turbo

(1) Compressor and Turbine Wheel. Does turbine wheel rub against housing?

Yes - Inspect turbocharger. (See “Turbocharger Seven-Step Inspection - Model 1600 Turbo” on page 48.)

No - Go To Step (2)

(2) Compressor and Turbine Housing. Is oil present in compressor or turbine housing?

Yes - Inspect turbocharger. (See “Turbocharger Seven-Step Inspection - Model 1600 Turbo” on page 48.)

No - Go To Step (3)

(3) Compressor and Turbine Fins. Are compressor or turbine fins damaged?

Yes - Inspect turbocharger. (See “Turbocharger Seven-Step Inspection - Model 1600 Turbo” on page 48.)

Checks, Tests, and Adjustments

Air Filter Restriction Indicator Check

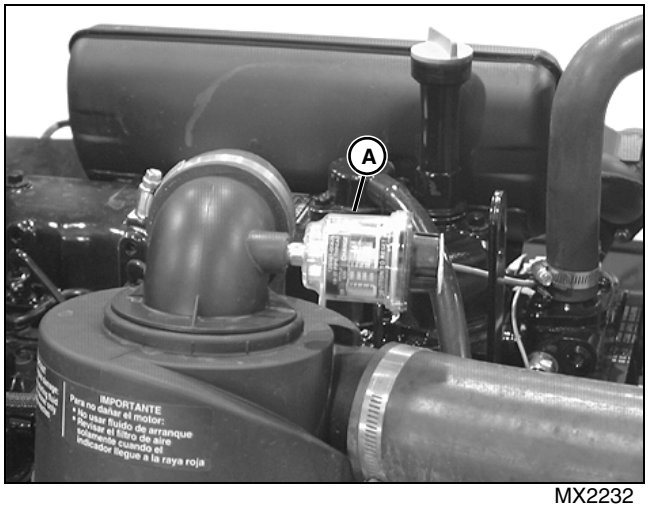
Conditions

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

Procedure

1. Raise hood.

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



MX2232

Picture Note: Models 1600/1620 Shown

2. Inspect the housing (A) for cracks or other damage.

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

Normal

- The housing should be free of cracks or other damage.
- **Models 1600/1620:** The plunger should be in the green area of the gauge.
- **Model 1600 Turbo:** The plunger should be in the yellow area of the gauge.

If Not Normal

- If the housing is cracked or damaged, replace the indicator.
- If plunger is in the red area of the gauge, service the air cleaner filter elements.

Fan and Alternator Drive Belt Tension Check and Adjustment

Reason

To maintain correct fan/alternator drive belt tension.

Special or Required Tools

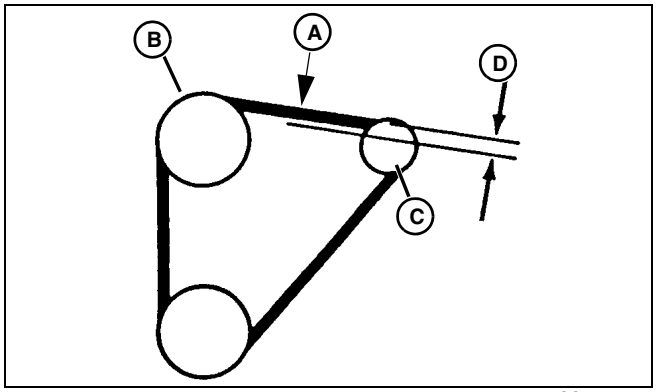
Tool Name	Tool No.	Tool Use
Belt Tension Gauge	JDG529 or JDST28	Used to test belt deflection.
Straightedge	NA	Used to test belt deflection.

Check Procedure

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

4. Raise hood.

5. Disconnect battery negative (-) battery cable.



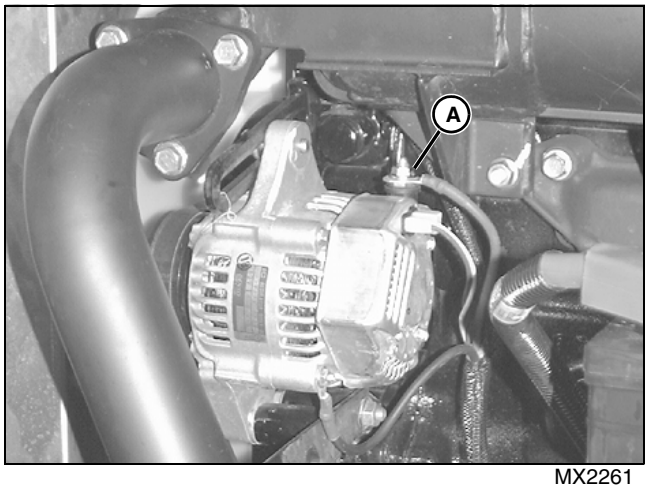
M54014

6. Apply specified force to the belt at the midpoint (A) between the fan/coolant pump pulley (B) and the alternator pulley (C). Check belt deflection (D) using JDG529 or JDST28 Belt Tension Gauge and a straightedge. The belt deflection should be to specification.

Results

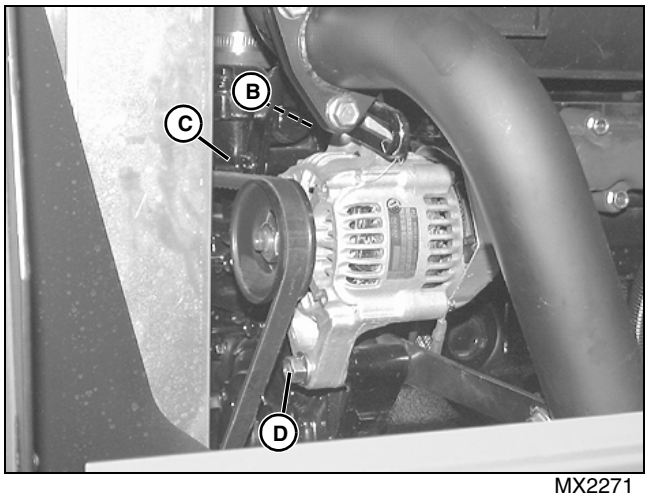
If deflection is not within specification, perform Adjustment Procedure.

Adjustment Procedure



MX2261

1. Disconnect red wire (A) from alternator.



MX2271

2. Loosen top cap screw (B), mounting bracket cap screw (C), and lower cap screw (D).

3. Apply force to the alternator housing until tension is correct.

4. Tighten cap screws.

Specifications

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

Valve Clearance Adjustment

Reason

To obtain correct rocker arm-to-valve stem clearance, to ensure proper opening and closing of the intake and exhaust valves.

Special or Required Tools

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

Procedure

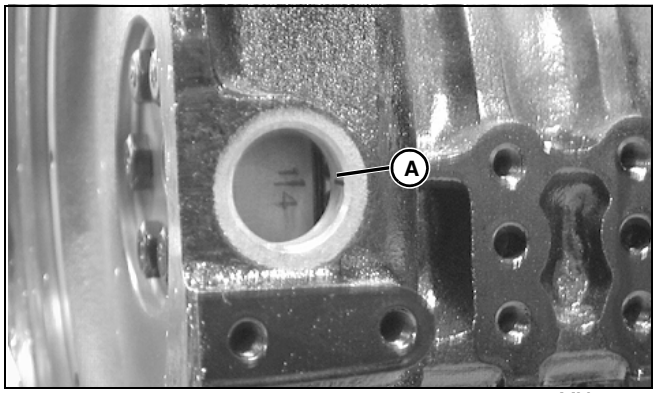
1. Park machine safely. (See “Park Machine Safely” on page 3.)

2. Allow machine to cool.

3. Raise hood.

4. Remove rocker arm cover.

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



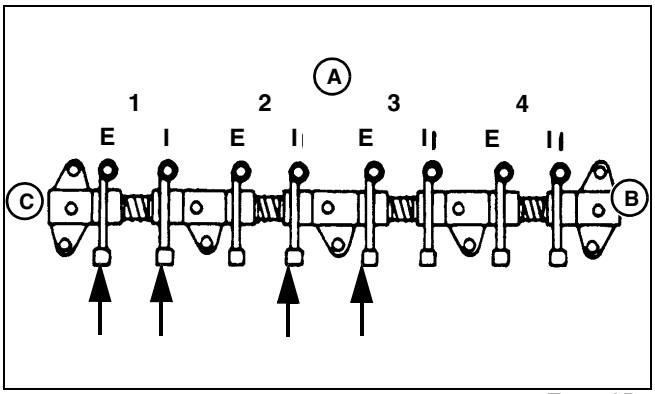
MX2387

5. Turn the crankshaft pulley clockwise until the number 1 cylinder TDC mark (A) on the flywheel aligns with the index mark on the flywheel housing or plate.

NOTE: Number 1 cylinder is the closest to the flywheel.

6. Try to move both number 1 cylinder rocker arms or push rods.

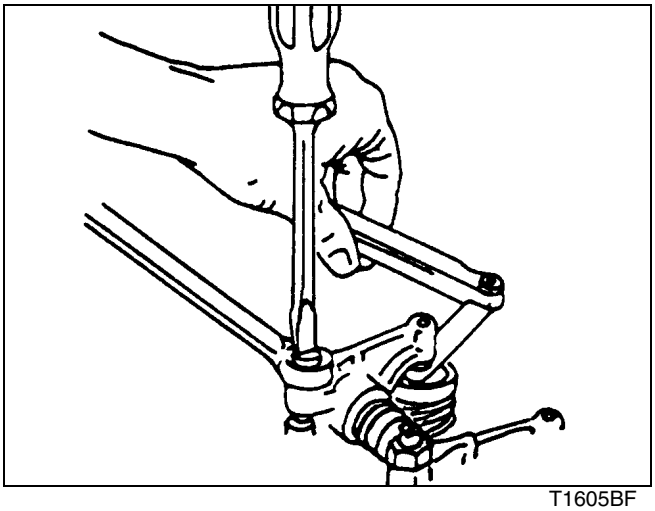
NOTE: If rocker arm push rods are not loose, rotate flywheel one revolution (360°). If both rocker arm push rods are loose, the piston is at TDC on compression stroke.



T6479AB

A - Cylinders
B - Fan End
C - Flywheel End

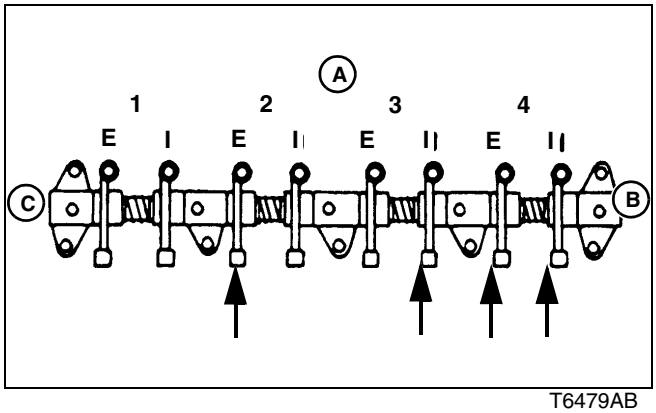
7. Measure and adjust valve clearance on the valves (arrows) with number 1 piston at TDC.



T1605BF

8. To adjust valves, loosen nut and turn adjusting screw until clearance is to specification. Hold screw while tightening nut.

9. Turn crankshaft pulley one revolution (360°). This puts the piston in number 4 cylinder at TDC compression stroke.



T6479AB

A - Cylinders
B - Fan End
C - Flywheel End

10. Measure and adjust valve clearance on the valves (arrows) with number 2 and 4 pistons at TDC.

Specifications

Valve Clearance . . . . . 0.15-0.25 mm (0.006-0.010 in.)

Valve Lift Check

Reason

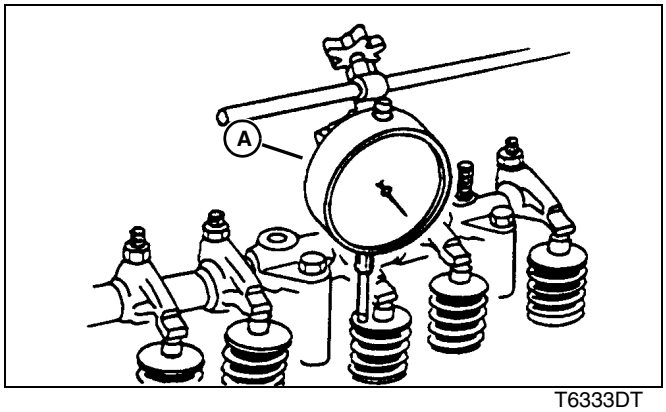
To check for wear on the cam lobes, followers, and/or push rods.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Dial Indicator	NA	Used to measure valve lift.

Procedure

1. Remove rocker arm cover.
2. Adjust valve clearance.



T6333DT

3. Fasten the dial indicator (A) 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 clockwise (as viewed 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 valves. If one or more valves show less lift than the others, remove and inspect the camshaft, followers, and push rods.
- If the camshaft, followers, and push rods are within specification, remove and inspect the cylinder head.

Cylinder Compression Pressure Test

Reason

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

Special or Required Tools

Tool Name	Tool No.	Tool Use
Compression Gauge Assembly	JT01682	Used to measure pressure in cylinders.
Adapter	JDG560	Used to attach compression gauge assembly to cylinders.

Procedure

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

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

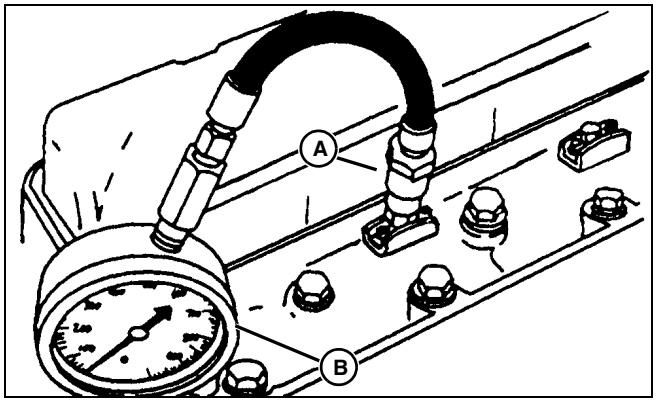
3. Turn key switch to STOP position.

4. Raise hood.

5. Move fuel shutoff valve on fuel filter to OFF position.

6. Disconnect the fuel shutoff solenoid wiring connector.

7. Remove fuel injection nozzles.



T6333EU

8. Install the TEFLON® heat protector in the injector port.

9. Install JDG560 Adapter (A) and JT01682 Compression Gauge Assembly (B) in injector port.

IMPORTANT: Avoid damage! DO NOT run starting motor for more than ten seconds at a time.

10. Crank engine for five seconds with starting motor.

11. Record pressure reading for each cylinder.

Results

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

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

Specifications

Cylinder Compression

Models 1600/1620 (Min) . . . . . 2744 kPa (398 psi)
Model 1600 Turbo (Min) . . . . . 2447 kPa (355 psi)
Difference between Cylinders (Max) . . 296 kPa (43 psi)

Engine Oil Pressure Test

Reason

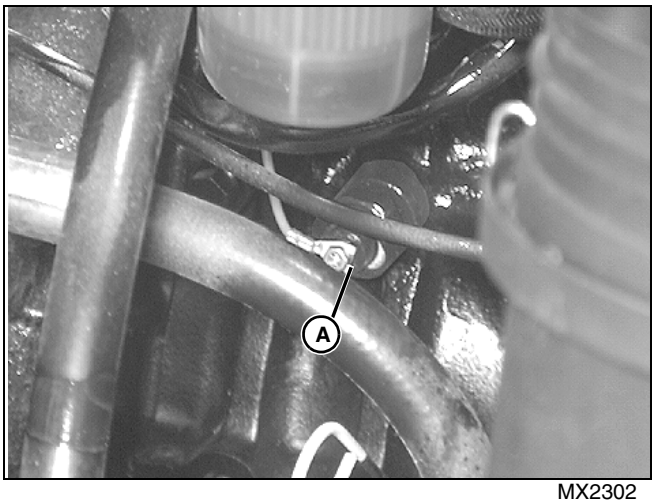
To determine if the engine bearings or lubrication system components are worn.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hose Assembly	JT03017	Used to connect pressure gauge to connector.
Pressure Gauge 700 kPa (100 psi)	JT07034	Used to measure oil pressure.
Connector	JT03349	Used to connect hose assembly to oil pressure switch.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.



MX2302

3. Remove oil pressure switch (A).
4. Install JT03349 Connector.
5. Connect JT03017 Hose Assembly and JT05577 Pressure Gauge.

IMPORTANT: Avoid damage! If oil pressure reading is below 58 kPa (8.5 psi), STOP ENGINE IMMEDIATELY and determine cause.

6. Monitor oil pressure while cranking engine. If no oil pressure is present, discontinue cranking engine. Determine and correct cause before running engine.
7. Start engine and run engine at SLOW idle (700 rpm) for approximately five minutes to heat oil.
8. Run engine at FAST idle (3200 rpm) and check oil pressure. Gauge should read a minimum oil pressure to specification.

Results

If oil pressure is not within specification, inspect oil pump and oil pressure regulating valve for wear or damage. Replace parts as needed.

Specifications

Engine Oil Pressure
at 3200 RPM . . . . . 344 ± 48 kPa (50 ± 7 psi)

Air Intake System Leakage Test

Reason

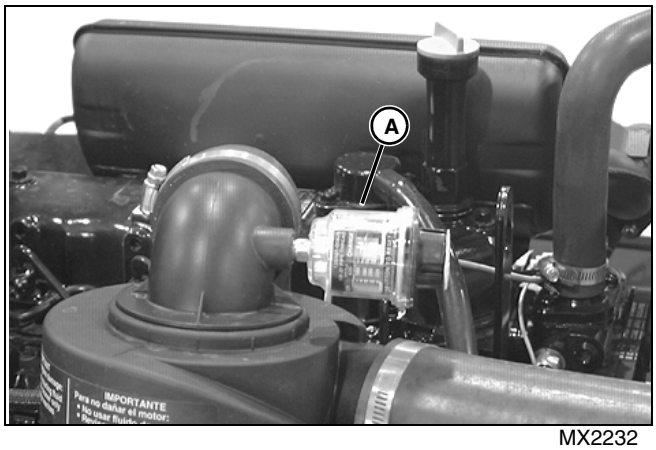
To check for leaks in the air intake system.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Air Pressure Regulator	NA	Used to regulate air pressure from manifold.
Test Fitting	NA	Used to connect air hose to manifold.

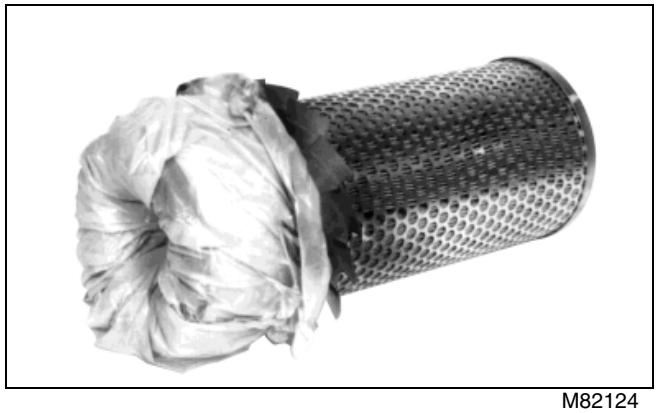
Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.



MX2232

3. Remove air filter restriction indicator (A) and install test fitting to pressurize air intake system.
4. Connect air pressure regulator to manifold using hose and fitting from air cleaner.



M82124

5. Remove air cleaner cover and both filter elements.

6. Put small plastic bag over end of small filter element. Install small filter element into air cleaner housing.

7. Pressurize air intake system to specification. If air intake system cannot be pressurized, turn engine slightly to close valves.

8. Spray soap solution over all connections from air cleaner to intake manifold and check for leaks.

Results

Find leaks and repair or replace parts as necessary.

Specifications

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

Extending Turbocharger Life - Model 1600 Turbo

Turbochargers are designed to last the life of the engine, but, because they operate at such high speeds (100,000 rpm or more), a moment's carelessness can cause them to fail in seconds.

The major causes of turbocharger failure are:

- Lack of lube oil (quick starts and hot shutdowns)
- Oil contamination
- Ingestion of foreign objects
- Restricted oil drainage
- Low oil level
- Operation on excessive side slopes
- Abnormally high exhaust temperatures

Lack of Lube Oil

Oil not only lubricates the turbocharger's spinning shaft and bearings, it also carries away heat. When oil flow stops or is reduced, heat is immediately transferred from the hot turbine wheel to the bearings, which are also heating up because of the increased friction due to the lack of oil. This combination causes the turbocharger shaft temperature to increase rapidly.

If oil flow does not increase and the process continues, bearings will fail. Once the bearings fail (which can happen in just seconds) seals, shaft, turbine and compressor wheels can also be damaged.

The principle causes of turbocharger bearing lubrication problems are low pressure; a bent, plugged, or undersized oil lube supply line; plugged or restricted oil galleries in the turbocharger; or improper machine start-up and shutdown procedure.

Oil levels and pressure should always be closely monitored and all worn hoses and lines should be replaced. The turbocharger oil supply line should be checked frequently to make sure it is not kinked or bent and it should always be replaced with a line of equal size, length, and strength.

IMPORTANT: Avoid damage! Allow engine to idle for two minutes before shutting down after running under load to avoid damage to turbocharger.

The easiest way to damage a turbocharger is through improper start-up and shutdown procedures. Always idle the engine for at least two minutes (no load) after start-up and before shutdown. Warming the engine up before applying a load allows oil pressure to build up and lines to fill with oil.

Idling the engine before shutdown allows the engine and turbocharger to cool. "Hot" shutdowns can cause the turbocharger to fail because after high-speed operation the turbocharger will continue to rotate long after the engine has been shut off and oil pressure has dropped to zero. This will cause heat to build up and possible bearing damage. It can also cause carbon and varnish deposits to form.

Oil Contamination

A second cause of turbocharger failures is contaminated oil. It can be caused by a worn or damaged oil filter or not changing the lube oil at recommended intervals. Expecting the oil filter to remove dirt, sand, metal chips, etc., from the oil before they reach the engine or turbocharger can be a costly mistake because contaminated oil may completely bypass the engine oil filter if the oil filter or oil cooler is clogged, if the filter element is improperly installed, or if the oil is thick during cold weather.

Four good ways of avoiding oil contamination are:

- Always inspect the engine thoroughly during major overhaul. Look especially for any sludge or debris left in lube oil galleries.
- Change lube oil at recommended intervals. Analysis of oil samples at filter change periods can help identify potentially harmful contaminants in the oil.
- Clean the area around the oil fill cap before adding oil.
- Use a clean container when adding oil.

Ingestion of Foreign Objects

The third cause of turbocharger damage is the ingestion of foreign objects. Foreign objects or particles can be ingested and cause damage to the turbocharger on both compressor and turbine sides. This is easy to avoid.

On the compressor side, foreign objects usually take the form of dust, sand, or shreds of air cleaner element that enter through improperly installed air cleaner elements. Leaky air inlet piping (loose clamps or torn rubber joints) or torn pleats in dry-type air cleaner elements also create problems.

The result is erosion of compressor blades that can cause the delicately balanced wheel to wobble.

IMPORTANT: Avoid damage! Whenever an internal engine failure (valve, valve seat, piston) occurs, a thorough inspection of the turbocharger MUST BE performed before returning engine to service.

Restricted Oil Drainage

A fourth cause of turbocharger damage is restricted lube oil drainage. The lubricating oil carries away heat generated by friction of the bearings and from the hot exhaust gases. If drainage back to the sump is impeded, the bearings will overheat with damage that will ultimately lead to failure.

There are two primary reasons for restricted drainage:

- A blocked drain tube, due to either damage or a buildup of sludged oil.
- High crankcase pressure, due to restricted crankcase breather or excessive engine blow-by.

Periodically check both the turbocharger oil drain tube and engine breather tube for damage or restriction. Correction of these conditions leads to longer turbocharger life.

Low Oil Level

Check engine oil level periodically according to your operator's manual. Proper oil level will prevent turbocharger failure.

Operation on Excessive Side Slopes

Operating equipment on excessive side slopes will prevent oil from being transferred up to the turbocharger, causing overheating wear of moving parts.

Abnormally High Exhaust Temperatures

A fifth cause of turbocharger damage is abnormally high exhaust temperatures. This can cause coking of oil which can lead to bearing failure. Extreme over-temperature operation can cause wheel burst.

There are two basic causes of over-temperature:

- Restricted air flow
- Overpowering the engine

In either case, the engine has more fuel than available air for proper combustion. This over-fueled condition leads to elevated exhaust temperatures.

Causes of restricted air flow can include:

- Damaged inlet piping
- Clogged air filters
- Excessive exhaust restriction
- Operation at extreme altitudes

Overpowering generally is due to improper fuel delivery or injection timing. If over-temperature operation has been identified, an inspection of the air inlet and exhaust systems should be performed. Also, check the fuel delivery and timing.

Turbocharger Seven-Step Inspection - Model 1600 Turbo

The following inspection procedure is recommended for systematic failure analysis of a suspected failed turbocharger. This procedure will help to identify when a turbocharger has failed, and why it has failed, so the primary cause of failure can be corrected.

Proper diagnosis of a non-failed turbocharger is important for two reasons.

1. Identification of a non-failed turbocharger will lead to further investigation and repair of the cause of a performance complaint.

2. Proper diagnosis eliminates the unnecessary expense incurred when a non-failed turbocharger is replaced.

NOTE: To enhance the turbocharger inspection, use an inspection sheet (Form No. DS-2280 available from Distribution Service Center) to list the inspection steps in the proper order and show potential failure modes for each step. Check off each step of the inspection and record any details or problems obtained during inspection. Retain this with the work order for future reference.

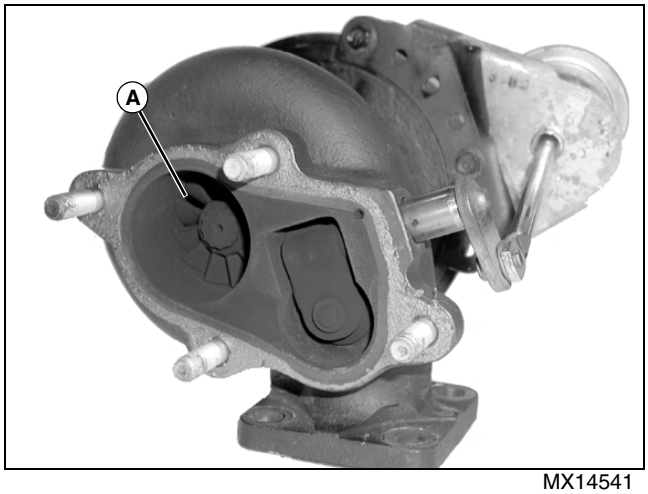
The seven recommended inspection steps, which are explained in detail on the following pages, are:

- Compressor Housing Inlet and Compressor Wheel
- Compressor Housing Outlet
- Turbine Housing Inlet
- Turbine Housing Outlet and Turbine Wheel
- External Center Housing and Joints
- Internal Center Housing
- Turbo Bench Test

Compressor Housing Inlet and Compressor Wheel

NOTE: Foreign object damage may be extensive or minor. In either case, the source of the foreign object must be found and corrected to eliminate future damages.

Use a good light source for this check.



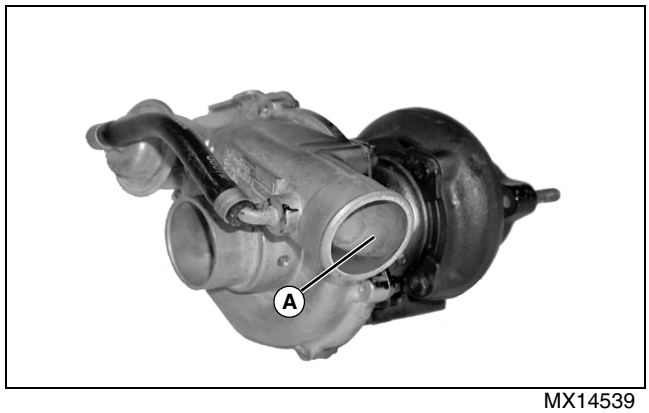
MX14541

1. Check compressor inlet and blade (A) for foreign object damage.

2. Check compressor inlet for wheel rub on the housing. Look very closely for any score marks on the housing itself and check the tips of the compressor wheel blades for damage.

3. Mark findings on your checklist and continue the inspection.

Compressor Housing Outlet

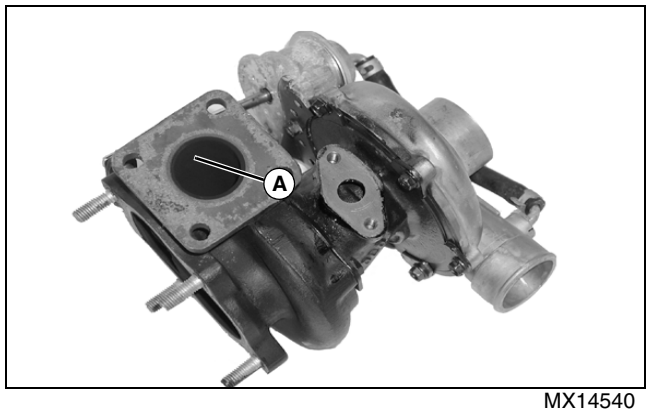


MX14539

1. Check compressor housing outlet (A). The outlet should be clean and free of dirt or oil.

2. Mark the checklist if dirt or oil is found and continue the inspection.

Turbine Housing Inlet

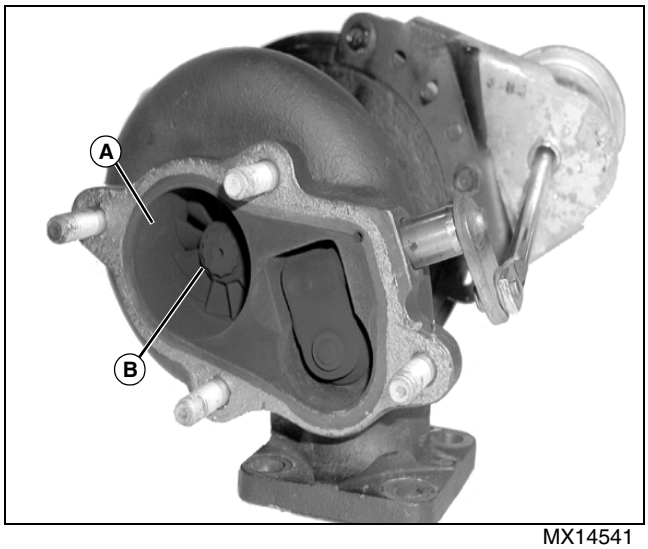


MX14540

Check the turbine housing inlet port (A) for oil in housing, excessive carbon deposit, or erosion of walls.

NOTE: If the inlet is wet with oil or has excessive carbon deposits, an engine problem is likely. Wall erosion (cracking or missing pieces) indicates excessive exhaust temperature.

Turbine Housing Outlet and Turbine Wheel

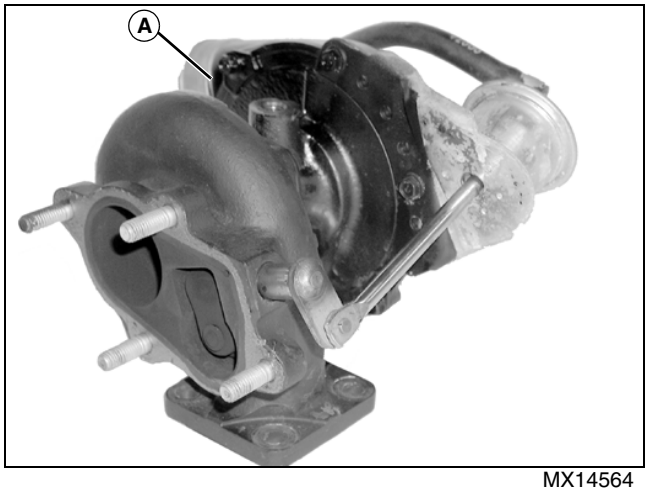


MX14541

1. Use a flashlight to look up inside the turbine housing outlet (A) and check blades (B) for foreign object damage.

2. Inspect the wheel blades and housing for evidence of wheel rub. Wheel rub can bend the tips of the blades with the housing showing wear or damage.

External Center Housing and Joints

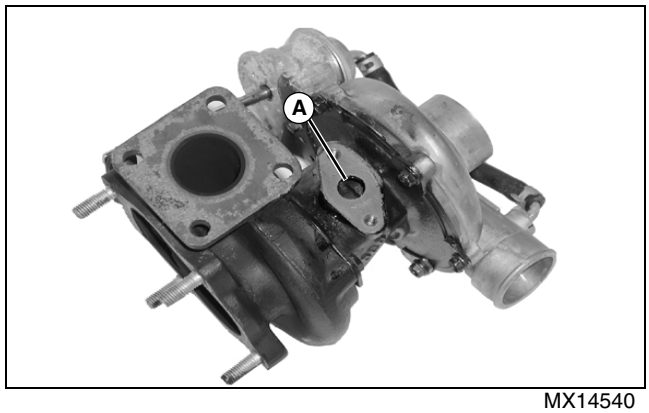


MX14564

Visually check the outside of the center housing (A), all connections to the compressor housing, and turbine housing for oil.

NOTE: If oil is present, make sure it is not coming from a leak at the oil supply or return line.

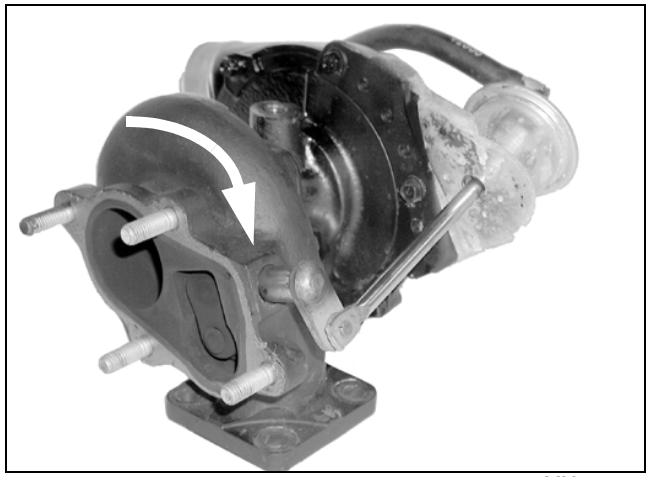
Internal Center Housing



MX14540

Using a flashlight, look through the oil return hole (A) to check the condition of the shaft and/or bearings. There should not be excess carbon deposits on the shaft or in the housing.

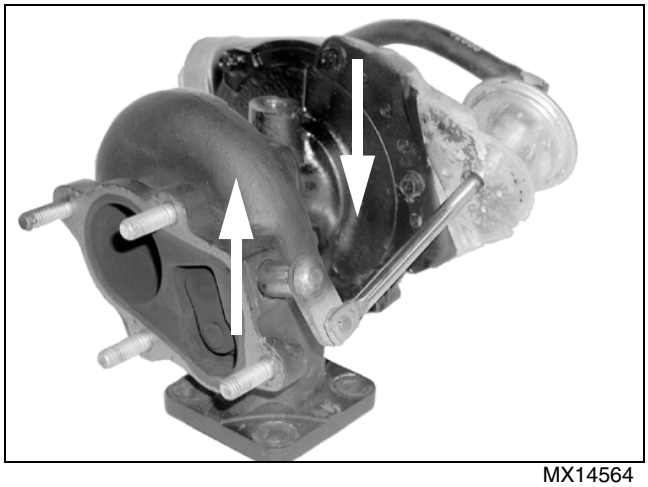
Turbo Bench Test



MX14564

1. Mount the turbocharger in a vise.

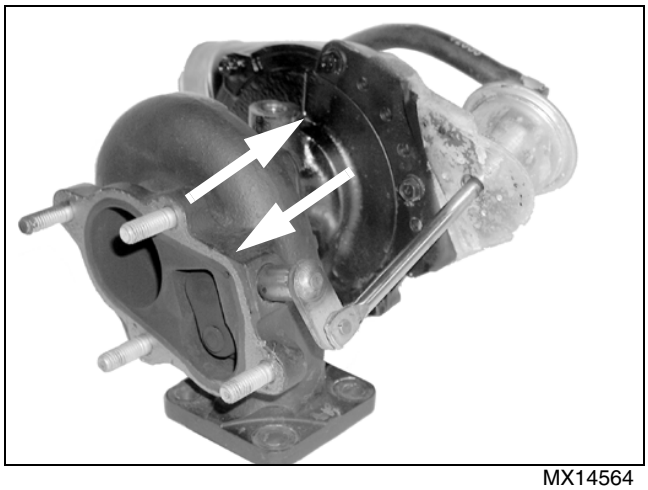
2. Rotate the shaft, using both hands, to check rotation and clearance. The shaft should turn freely, however, there may be a slight amount of drag.



MX14564

3. Pull up on the compressor end of the shaft and press down on the turbine end while rotating shaft. Neither the compressor wheel not the turbine wheel should contact the housing at any point.

NOTE: There will be some "play" because the bearings inside the center housing are free floating.



MX14564

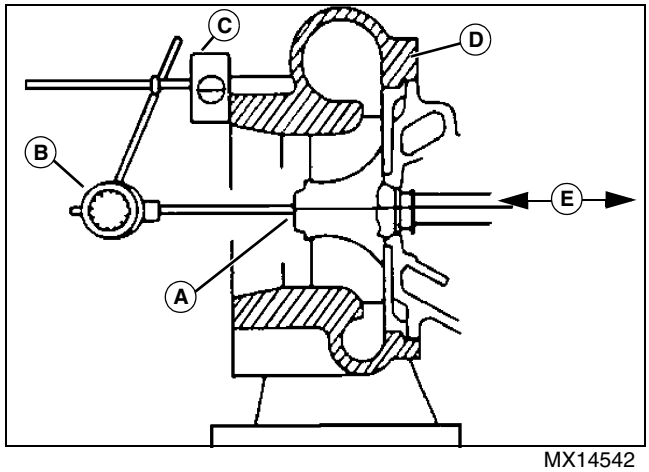
4. Check shaft end play by moving the shaft back and forth while rotating. There will be some end play, but not to the extent that the wheels contact the housing.

IMPORTANT: Avoid damage! Before you finalize your conclusion that the turbocharger has not failed, it is strongly recommended to check rotor shaft axial and radial play. (See procedures later in this group.) These procedures are not required if a failure mode has already been identified.

NOTE: These diagnostic procedures will allow you to determine the condition of the turbocharger. If the turbocharger has failed, analysis of your inspection notes should direct you to the specific areas of the engine to correct the problems causing the turbocharger failure. It is not unusual to find that a turbocharger has not failed. If your turbocharger passes all the inspections, the problem lies somewhere else.

Check Turbocharger Rotor Shaft Axial Play - Model 1600 Turbo

This test will give an indication of the condition of the axial bearing within the center housing and rotating assembly.



MX14542

A - Shaft End
B - Dial Indicator
C - Magnetic Base
D - Turbine Housing
E - Axial Direction

1. Mount magnetic base (C) so that indicator tip rests on end of shaft (A). Preload indicator tip and zero dial on indicator (B).

2. Move shaft axially back and forth by hand.

3. Observe and record total dial indicator movement.

If axial play is not within specification, replace turbocharger.

Specifications

Rotor Shaft Axial Play

Standard . . . . . 0.03-0.06 mm (0.0012-0.0024 in.)
Wear Limit . . . . . 0.09 mm (0.0035 in.)

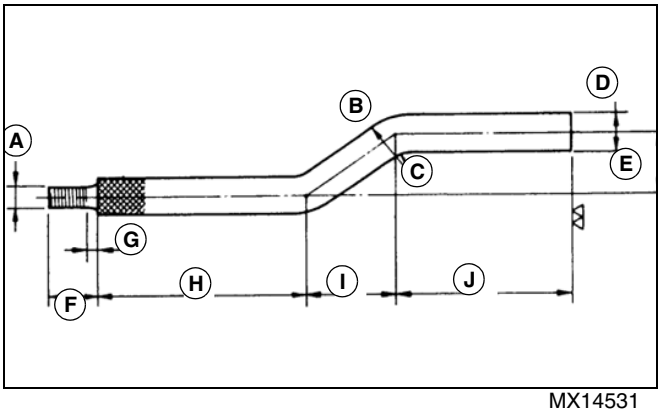
Check Turbocharger Rotor Shaft Radial Play - Model 1600 Turbo

This test will give an indication of the condition of the radial bearing within the center housing and rotation assembly.

NOTE: Prelube center housing bearing prior to performing radial play test. (See "Prelube Turbocharger - Model 1600 Turbo" on page 135.)

1. Purchase an extended indicator tip from a local supplier with the following approximate dimensions:

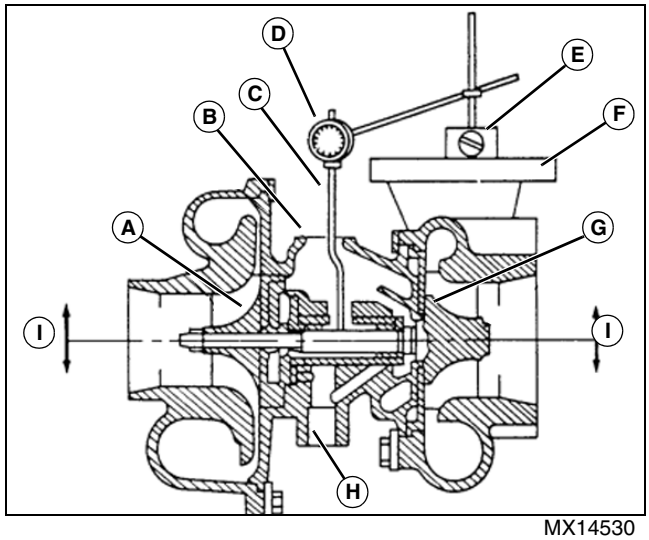
- Length: 76 mm (3.0 in.)
- Diameter: 5.0 mm (0.197 in.)



MX14531

A - M2.6, P0.45
B - Radius: 10 mm (0.3937 in.)
C - Radius: 5 mm (0.1968 in.)
D - Diameter: 5 mm (0.1968 in.)
E - Distance: 7 mm (0.2755 in.)
F - Length: 8 mm (0.3149 in.)
G - Length: 1 mm (0.0393 in.)
H - Length: 40 mm (1.5748 in.)
I - Length: 10 mm (0.3937 in.)
J - Length: 15 mm (0.5905 in.)

2. Heat and bend to size as shown.



MX14530

A - Compressor Wheel
B - Oil Return Cavity
C - Extension Adapter
D - Dial Indicator
E - Magnetic Base
F - Turbocharger Mounting Flange
G - Turbine Wheel
H - Oil Inlet
I - Radial Direction

3. Position dial indicator (D) with extension adapter (C) onto turbocharger mounting flange (F), so that tip rests on shaft by extending through oil return cavity (B).

4. Grasp rotation shaft at both ends and move the shaft toward the indicator then away from the indicator (arrows) by applying moderate force.

5. Observe and record total indicator movement.

6. If total indicator reading is not within specification, replace turbocharger.

Specifications

Rotor Shaft Radial Play

Standard . . . . . 0.08-0.13 mm (0.0031-0.0051 in.)
Wear Limit . . . . . 0.17 mm (0.0067 in.)

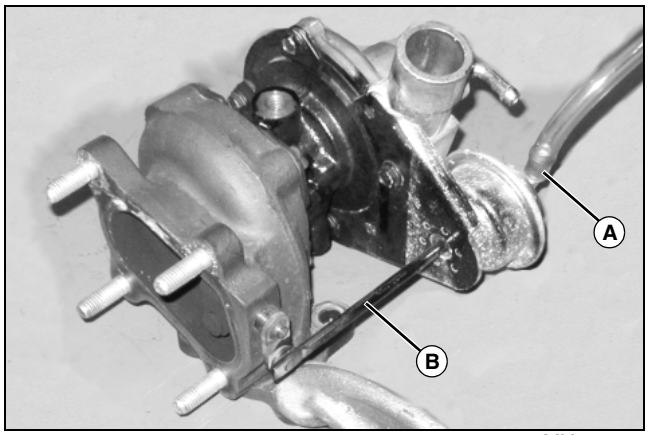
Turbocharger Waste Gate Test

Equipment

- Pressure regulating valve - Allowing gradual adjustment in a range from 0 to 200 kPa (0 to 29 psi).

Procedure

1. Park machine safely. See Parking Safely in the Safety Section.
2. Allow engine to cool.
3. Raise hood.
4. Check hose to waste gate actuator for kinks or cracks. Replace if damaged.



MX34308

5. Disconnect hose from waste gate actuator (A).
6. Connect a regulated air source to actuator fitting.

IMPORTANT: Avoid damage! Do not apply more than 400 kPa (58 psi) to the actuator.

7. Vary pressure to waste gate actuator from 0 - 193 kPa (0 - 20 psi). Check results below.
8. Apply 117 kPa (17 psi) to actuator, shut off and seal air supply. Wait one minute and measure pressure in actuator.

Results

- Actuator rod (B) should move in and out freely as pressure is varied.
- If rod does not move freely, disconnect turbocharger waste gate linkage. Check for movement and repair or replace components as necessary.
- After 117 kPa (17 psi) is applied, the pressure should not drop below 103 kPa (15 psi) after one minute. Replace actuator if pressure drop exceeds specification.

Fuel Pump Supply Pressure Test

Reason

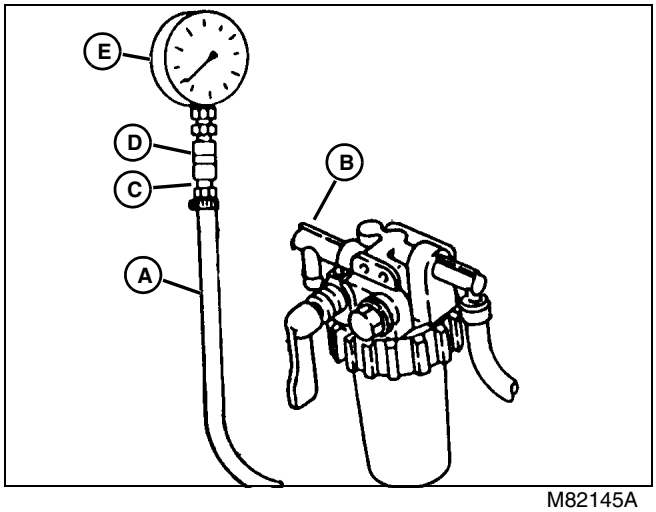
To determine supply pump operating pressure.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hose Fitting	JT03274	Used to connect gauge to supply pump-to-filter filter hose.
Female Quick Coupler	JT01609	Used to connect hose fitting to gauge.
Gauge w/ Male Quick Coupler (0-150 psi)	JT03115	Used to measure pressure.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.



M82145A

3. Disconnect supply pump-to-filter hose (A) at fuel filter (B).
4. Assemble JT03274 Hose Fitting (C), JT01609 Female Quick Coupler (D), and JT03115 Gauge (E).
5. Connect gauge/fitting assembly to supply pump-to-filter hose (A).
6. Disconnect wire connector to fuel shutoff solenoid.

IMPORTANT: Avoid damage! DO NOT run starting motor for more than ten seconds at a time.

7. Crank engine using the starting motor. Gauge should read more than specification.

Results

If pressure is below specification, replace fuel supply pump.

Specifications

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

Fuel System Leakage Test

Reason

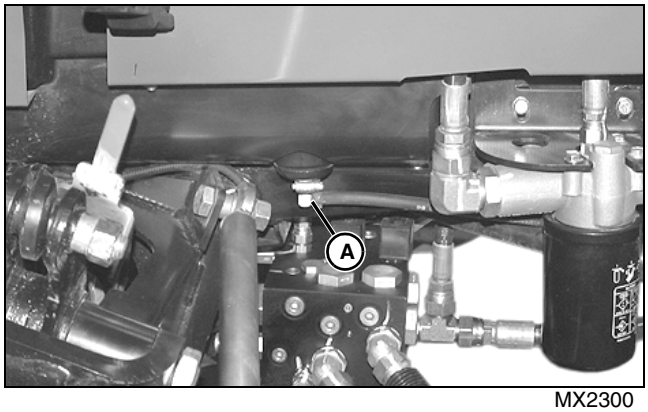
To check for leaks in the fuel system.

Procedure

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

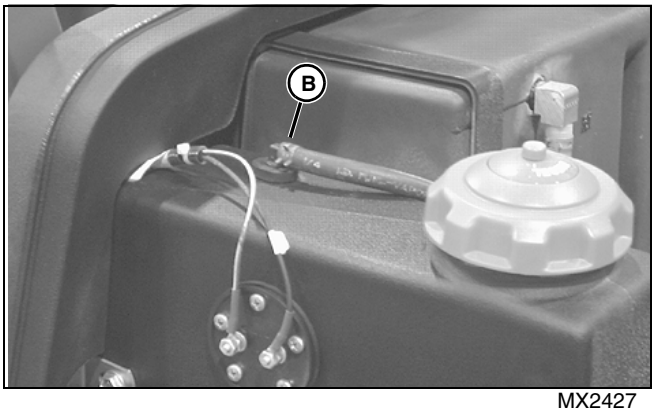
2. Raise hood.

NOTE: Fuel tank capacity for Models 1600/1620 is approximately 57 L (15 gal). Tank capacity for the 1600 Turbo model is approximately 83 L (22 gal).



MX2300

3. Disconnect fuel line (A) and cap fitting, or drain fuel into a properly marked container.



MX2427

4. Disconnect fuel return line (B) at the fuel tank.

5. Place fuel return line into a suitable container to catch drained fuel.

CAUTION: Avoid injury! DO NOT apply more than 103 kPa (15 psi) air pressure to the fuel system. Damage to the injection pump or personal injury may result.

6. Apply specified air pressure to fuel supply hose until all fuel is drained from the system.

7. Plug end of fuel return hose.

8. Apply specified air pressure to fuel system at fuel supply line. DO NOT exceed maximum specified pressure.

9. 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.

Specifications

Fuel System Leakage
Test Pressure . . . . . 34-69 kPa (5-10 psi)
Fuel System Leakage
Test Pressure (Max) . . . . . 103 kPa (15 psi)

Fuel System Bleeding Procedure (Yanmar TNE Engines)

Reason

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

Procedure

NOTE: The engine is equipped with an automatic air venting system, which makes the fuel system self-bleeding.

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

2. Raise hood.

3. Verify that all fuel line connections are tight.

4. Turn fuel filter shutoff valve to OPEN position.

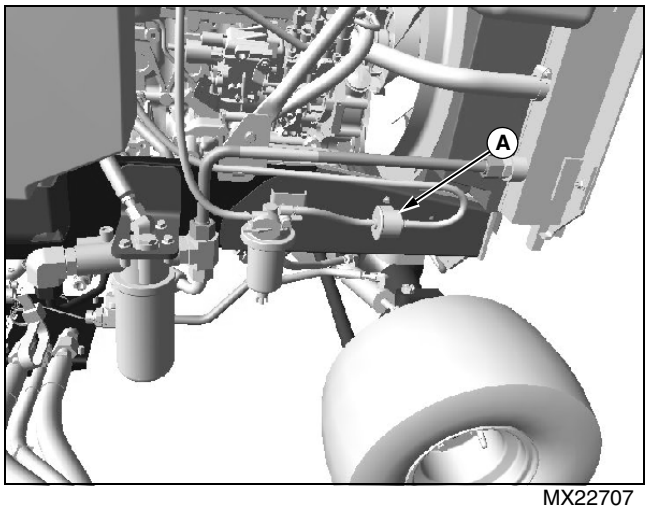
5. Fill fuel tank.

6. Operate hand primer lever on the fuel supply pump for approximately one minute to bleed most of the air back to the tank through the fuel return lines.

Fuel System Bleeding Procedure (Yanmar TNV Engine)

NOTE: It may be necessary to prime the fuel system after running out of fuel or changing the fuel filter.

1. Make sure the machine is on a level surface, not a slope.
2. Turn off PTO switch.
3. Lower attachments to the ground.
4. Lock the park brake.



MX22707

5. Turn key switch to RUN position for 2 minutes prior to starting engine. The fuel pump (A) will pressurize the fuel and remove any air in the system
6. Start engine. If engine will not start, repeat previous step.

Slow Idle Speed Adjustment

Reason

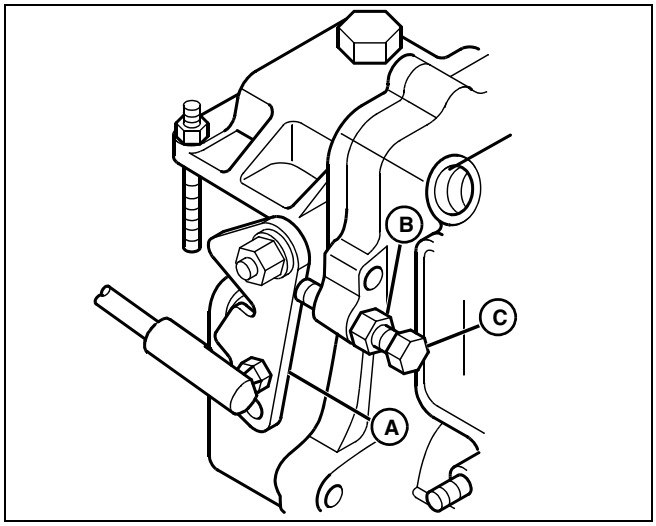
To achieve proper slow idle rpm setting. Provides adequate rpm to keep engine running smoothly without stalling.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hand Held Digital Tachometer	JT05719	Used to check engine speed at crankshaft pulley.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Start engine and run for five minutes, to bring machine to operating temperature.
3. Raise hood.
4. Move throttle lever to SLOW idle position.
5. Use JT05719 Hand Held Digital Tachometer to check engine speed at crankshaft pulley.



MIF (M91893)

6. Visually check that the injection pump throttle lever (A) is against the slow idle stop screw. Check slow idle speed. Slow idle speed should be to specification.

If slow idle rpm does not meet specifications, loosen jam nut (B) and turn screw (C). After adjustment, tighten jam nut.

7. After slow idle speed adjustment, adjust throttle cable.

Specifications

Slow Idle Speed . . . . . .700 rpm

Fast Idle Speed Adjustment

IMPORTANT: Avoid damage! The FAST idle adjustment is pre-set by the engine manufacturer to comply with strict California Air Resources Board/Environmental Protection Agency (CARB/EPA) emissions requirements and is NOT adjustable. Tampering with the FAST idle adjustment may result in severe fine or penalties.

IMPORTANT: Avoid damage! DO NOT attempt to adjust the FAST idle setting. It is NOT adjustable. If it is determined that either the fuel injection pump or governor assembly are in need of repair, they must be replaced ONLY as complete assemblies. Only an authorized factory trained technician is allowed to remove and install these assemblies. If replacement is necessary, remove and install the fuel injection pump and/or governor assembly as complete, individual assemblies.

Because the FAST idle speed is NOT adjustable, the throttle cable adjustment becomes very critical to proper engine operation. Therefore, first MAKE SURE that the throttle cable obtains its full range of motion, stop-to-stop, before performing any diagnostic procedures.

Torque Capsule Adjustment

NOTE: The torque capsule adjustment is pre-set by the engine manufacturer to comply with strict California Air Resources Board/Environmental Protection Agency (CARB/EPA) emissions requirements and is NOT adjustable. Tampering with the torque adjustment may result in severe fines or penalties.

IMPORTANT: Avoid damage! DO NOT attempt to adjust the torque capsule. It is NOT adjustable.

If it is determined that either the fuel injection pump or governor assembly are in need of repair, they must be replaced ONLY as complete assemblies. Only an authorized factory trained technician is allowed to remove and install these assemblies. If replacement is necessary, remove and install the fuel injection pump and/or governor assembly as complete, individual assemblies.

Because the torque capsule is NOT adjustable, the throttle cable adjustment becomes very critical to proper engine operation. Therefore, first MAKE SURE the throttle cable obtains its full range of motion, stop-to-stop, before performing any diagnostic procedures.

Throttle Cable Check and Adjustment

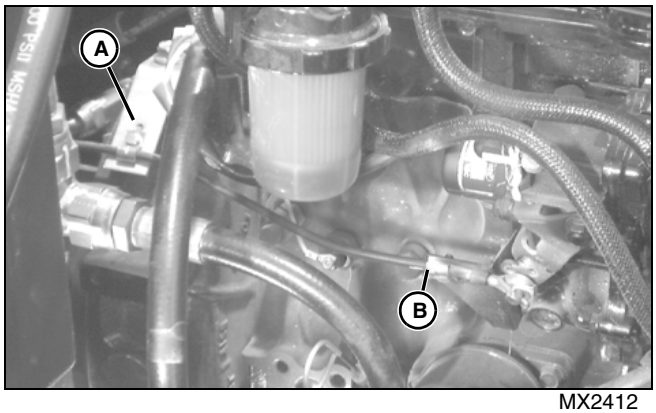
Reason

To ensure the full range of throttle response.

Check

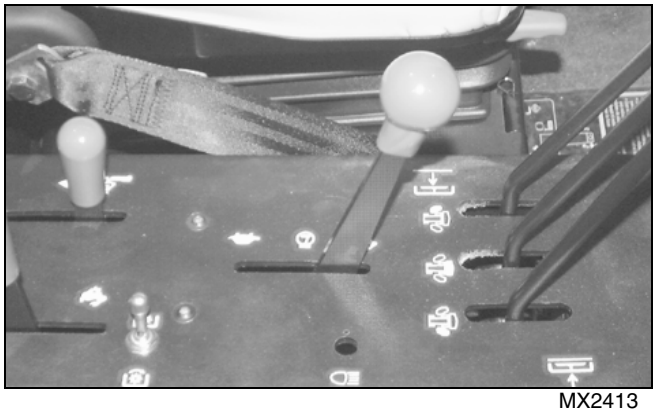
1. Park machine safely. (See “Park Machine Safely” on page 3.)

NOTE: Air cleaner assembly and support bracket removed for photo clarity only.



MX2412

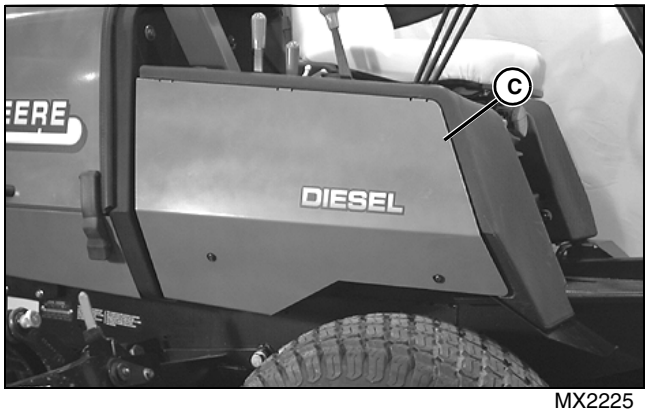
2. Raise hood.
3. Loosen throttle cable clamps (A and B).


MX2413

4. Move throttle lever toward FAST idle position. The throttle lever should be specified distance away from the end of the frame slot.

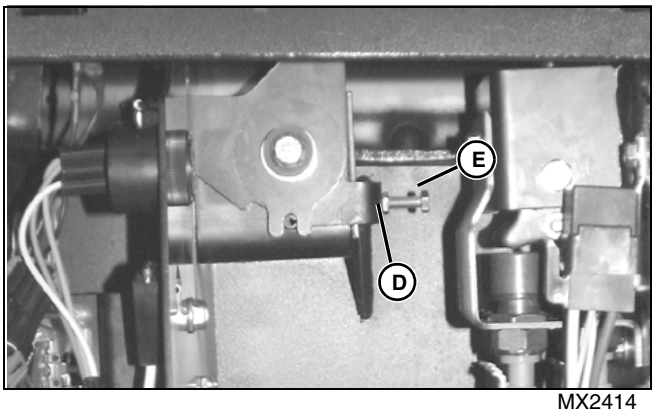
- **If the lever fast idle stop position is not correct,** go to Adjustment.
- **If the lever fast idle stop position is correct,** move throttle lever through full range and check for binding.

Adjustment - S.N. (-030000)



MX2225

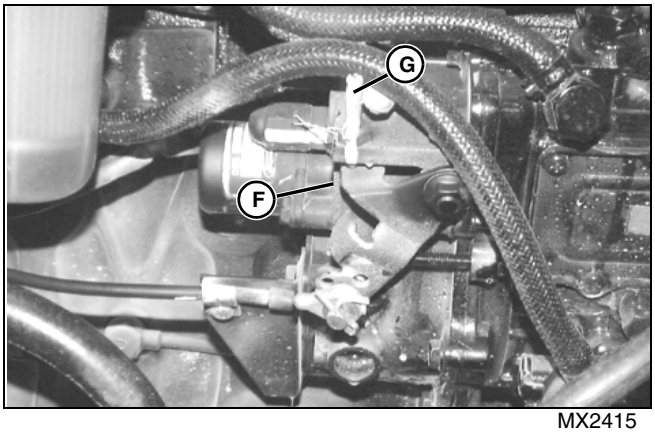
5. Remove access panel (C).



MX2414

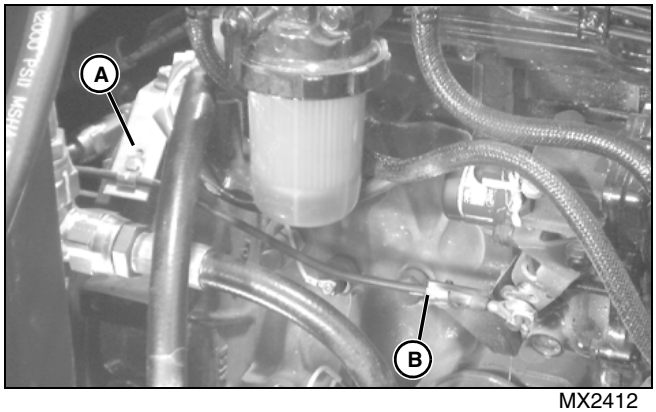
6. Loosen jam nut (D).

7. Turn screw (E) to adjust stop position. Turn screw clockwise to increase gap, or counterclockwise to decrease gap.



MX2415

8. Hold pump throttle lever (F) against fast idle stop (G). Pull throttle cable tight.



MX2412

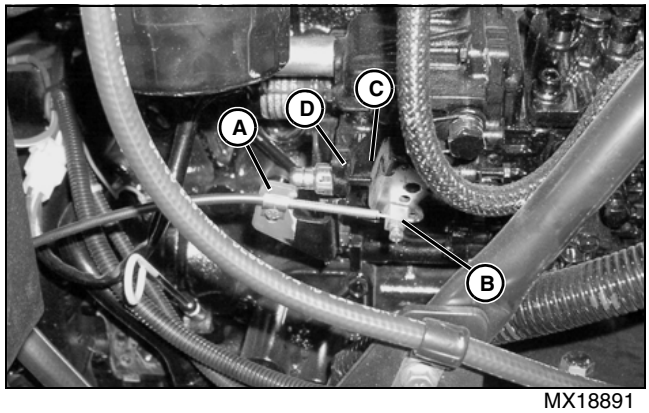
9. Tighten cable clamps (A and B).

10.Move throttle lever through full range and check for binding.

Throttle Lever Fast Idle Stop Position (Distance from End of Frame Slot) . . . . . 6 mm (0.25 in.)

Adjustment - S.N. (030001-)

NOTE: Models S.N. (030001-) have no adjustment at the throttle control lever.



MX18891

1. Loosen cable clamp (A) and cable anchor (B) screw and jam nut.

2. Move throttle lever on console to full throttle, then pull back 3 mm (0.125 in.)

3. Hold pump throttle lever (C) against fast idle stop (D).

4. Ensure cable wire is located in hole of cable anchor (B). Tighten cable clamp (A).

5. Tighten cable anchor (B) screw and jam nut.

6. Move throttle lever through full range and check for binding.

Fuel Injection Nozzle Test

IMPORTANT: Avoid damage! The fuel injection nozzles are pre-set by the engine manufacturer to comply with strict California Air Resources Board/Environmental Protection Agency (CARB/EPA) emissions requirements and are adjustable ONLY by authorized diesel service facilities. Tampering with fuel injection nozzle adjustment may result in severe fine or penalties.

Reason

To check the operation of the fuel injection nozzles.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Diesel Fuel Injection Nozzle Tester	D01109AA	Used to test injection nozzle opening pressure.
Adapter Set	D01110AA	Used to attach nozzle tester to nozzle.
Straight Adapter	23622	Used to attach nozzle tester to nozzle.
Container	NA	Used to hold fuel injection nozzle leakage

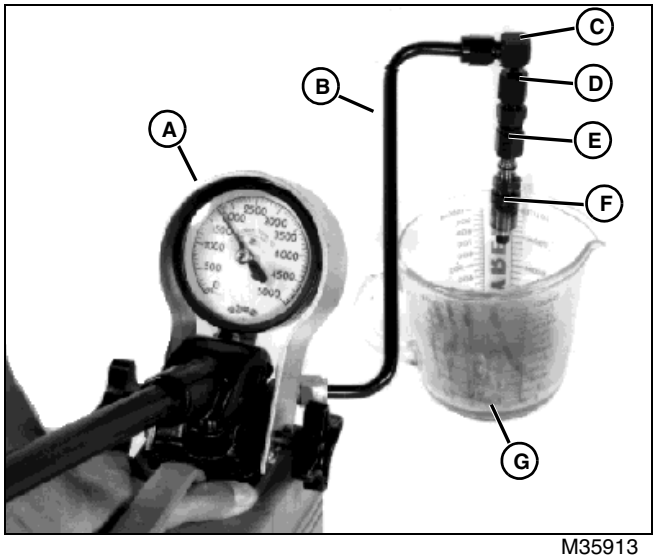
Connections

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

1. Remove carbon deposits from injection nozzle.

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



M35913

A - D01109AA Diesel Fuel Injection Nozzle Tester
B - 3635A Fuel Line Assembly
C - 23617 90° Adapter
D - 23621 Adapter
E - 23622 Adapter
F - Fuel Injection Nozzle
G - Container

2. Connect fuel injection nozzle to D01109AA Diesel Fuel Injection Nozzle Tester (A) using parts from D01110AA Adapter Set and 23622 Straight Adapter (E).

Procedure 1

Test fuel injection nozzle opening pressure following the nozzle tester manufacturer's instructions. The nozzle should open at specified pressure.

Procedure 1 Results

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

Procedure 2

Test fuel injection nozzle leakage following the nozzle tester manufacturer's instructions.

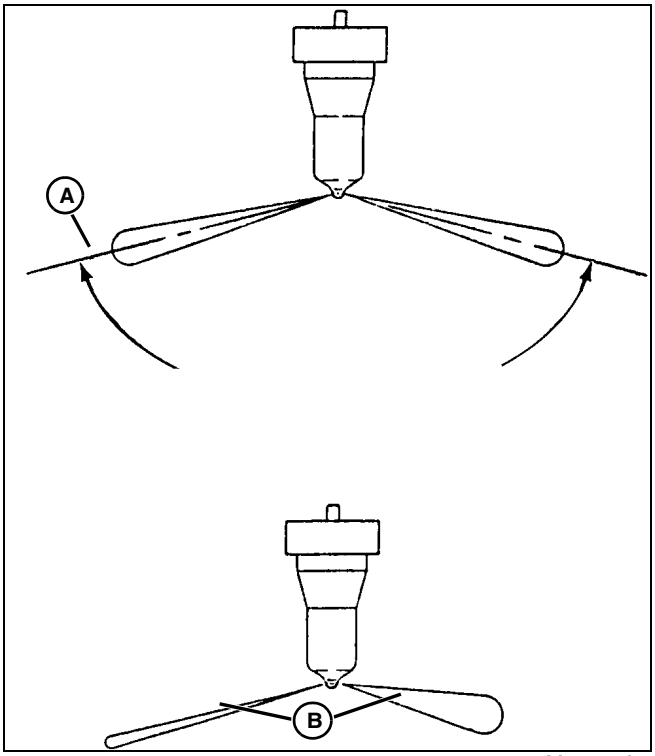
1. Dry nozzle completely using a lint-free cloth.
2. Pressurize nozzle to 11 032 kPa (1600 psi).
3. Watch for leakage from nozzle spray orifice. There should be no leakage within the specified time.

Procedure 2 Results

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

Procedure 3

Test fuel injection nozzle chatter and spray pattern following the nozzle tester manufacturer's instructions.



M82121A

A - Correct Spray Pattern/Angle (Approximately 150°)

B - Poor Spray Pattern

1. Pressurize nozzle to specified opening pressure.
2. Listen for “chatter” sound and watch spray pattern.

Procedure 3 Results

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

Specifications

Fuel Injection Nozzle Opening Pressure . . . . . 19 615-20 595 kPa (2845-2987 psi)

Fuel Injection Nozzle Leakage at 11 032 kPa (1600 psi) . No leakage for a minimum of 10 seconds

Slow Hand

Lever Movement. . . . . Chatter sound

Lever Movement. . . . . .Fine stream spray pattern

Fast Hand

Lever Movement. . . . . .Fine atomized spray pattern

Injection Pump Timing Adjustment

NOTE: DO NOT attempt to adjust the fuel injection pump timing. For most engine problems, the fuel injection pump timing will not have to be adjusted. If the engine performed well at one time, then performance dropped, the fuel injection timing is NOT the problem. Fuel injection timing, once set by the engine manufacturer, should NOT change during the life of the engine.

IMPORTANT: Avoid damage! Fuel injection pump timing should NOT change during the life of the engine unless the pump has been altered illegally, or there is excessive wear to the camshaft injection pump cam lobes and lifters.

First check the fuel quality, fuel supply, fuel injectors, air intake system, and engine compression in all cylinders before considering fuel injection timing problems.

If all other possibilities have been ruled out and it is determined that the fuel injection pump and governor assembly are in need of repair, they must be replaced ONLY as complete assemblies.

Only an authorized factory trained technician is allowed to remove and install these assemblies.

Cooling System Pressure Test

Reason

To inspect the cooling system for leaks.

Special or Required Tools

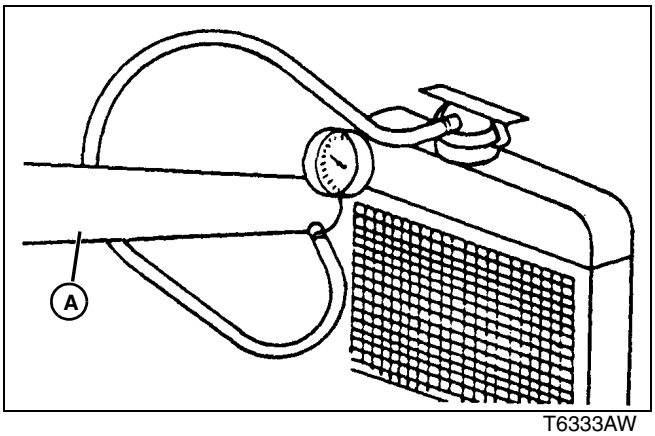
Tool Name	Tool No.	Tool Use
Cooling System Pressure Pump	D05104ST	Used to pressurize cooling system.
Radiator Pressure Test Kit (Adapters)	JDG692	Used to measure radiator pressure.

Procedure

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

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

3. Raise hood.



T6333AW

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

5. Apply specified maximum pressure to cooling system.

6. Check for leaks throughout cooling system.

Results

- Pressure should hold to specification. If pressure decreases, check for leaks. Repair leaks or replace parts as necessary.
- If pressure test still indicates leakage after all external leaks have been stopped, a defective head gasket, cracked block, or cylinder head may be the cause. Perform Cylinder Leakdown Test.

Specifications

Cooling System Pressure
Test Pressure (Max) . . . . . 90 kPa (13 psi)

Cylinder Leakage Test

Reason

To determine if compression pressure is leaking from the cylinder.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Adapter	JDG472	Measure cylinder leakage.

Procedure

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

2. Raise hood.

3. With coolant at proper level and radiator cap tight, run engine for five minutes to bring to operating temperature.

CAUTION: Avoid injury! Do not remove radiator cap. The coolant will be hot and under pressure. Explosive release of fluids from pressurized cooling system can cause serious burns.

4. Remove cap from coolant overflow bottle.

5. Check for bubbles coming from overflow hose at bottom of overflow bottle.

If bubbles are present, isolate source of compression leak:

a. Remove fuel injection nozzles.

b. Install JDG472 Adapter in injection port of cylinder to be tested.

c. Move piston to bottom of stroke with intake and exhaust valves closed.

d. Connect hose from compressed air source to adapter.

e. Apply specified maximum air pressure into cylinder.

f. Check for bubbles in coolant overflow bottle or air escaping from muffler, air cleaner or oil dipstick tube.

g. Repeat for each cylinder.

Results

- **If bubbles are present in the coolant overflow bottle,** check for cracks in cylinder head and block. Check for damaged head gasket.
- **If air escapes from muffler,** check for worn exhaust valve.
- **If air escapes from air cleaner,** check for worn intake valve.
- **If air escapes from engine oil dipstick tube,** check for worn piston rings.

Specifications

Cylinder Leakage Test Pressure (Max). . 2448 kPa (355 psi)

Radiator Cap Pressure Test

Reason

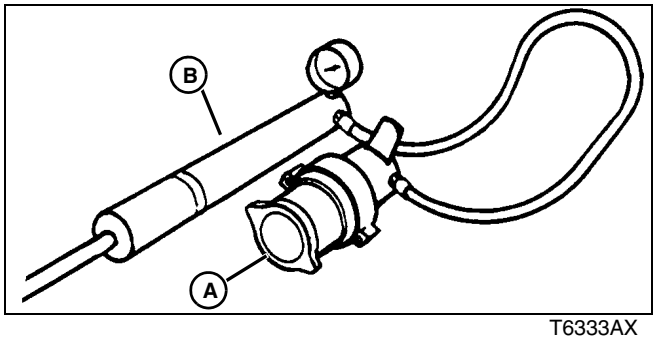
To check that the radiator cap opens at the correct pressure.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Cooling System Pressure Pump	D05104ST	Used to measure pressure valve opening pressure.
Radiator Pressure Test Kit (Adapters)	JDG692	Used to measure radiator pressure.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Turn key switch to STOP position, and allow engine to cool.
3. Raise hood.
4. Remove radiator cap.



T6333AX

5. Install radiator cap (A) on D05104ST Cooling System Pressure Pump (B).
6. Apply pressure. Pressure valve in cap should open at specification.

Results

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

Specifications

Radiator Cap Opening Pressure 90 ± 14 kPa (13 ± 2 psi)

Thermostat Opening Test

Reason

To determine the opening temperature of the thermostat.

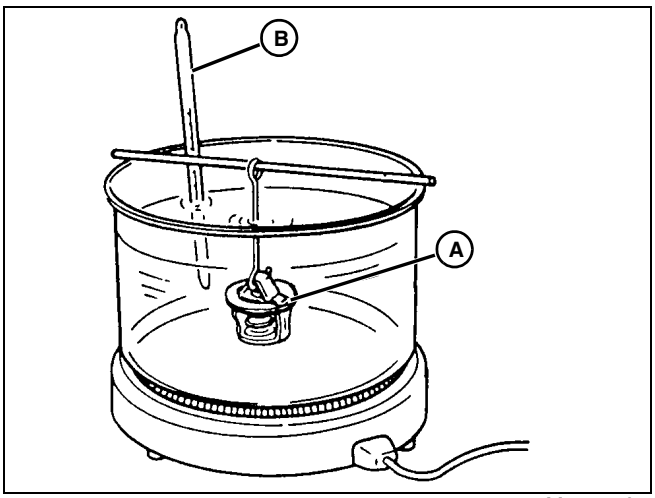
Special or Required Tools

Tool Name	Tool No.	Tool Use
Thermometer	NA	Used to measure temperature of thermostat opening and closing.
Glass Container	NA	Used to hold water.
Heating Unit	NA	Used to heat water.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.
3. Remove thermostat.

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



M82122A

4. Suspend thermostat (A) and a thermometer (B) in a container of water.

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

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

Results

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

Specifications

Thermostat Opening Temperature - Beginning . . . . . 69-72°C (156-162°F)

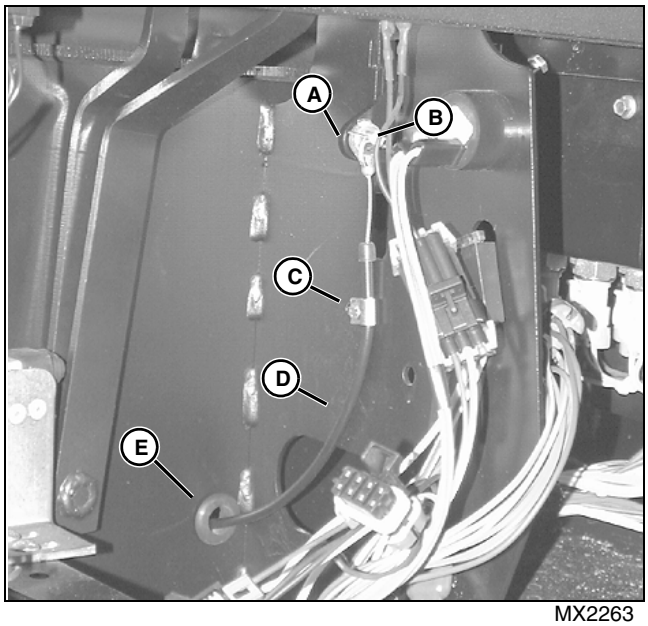
Thermostat Opening Temperature - Fully Open . . . . . 85°C (184°F)

Repair

Throttle Cable Removal and Installation - S.N. (-030000)

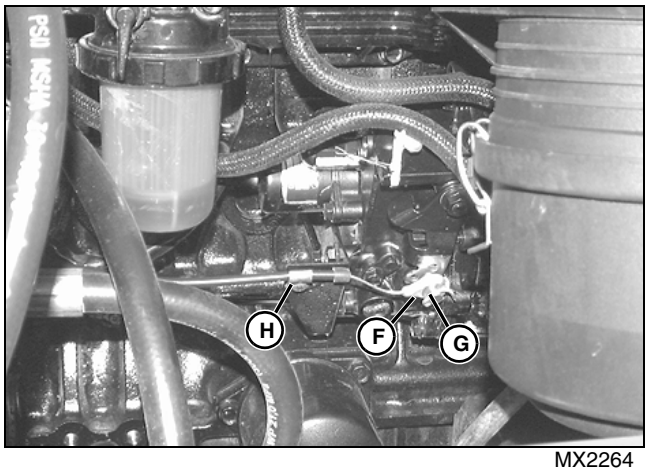
Removal

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Move throttle lever to slow idle position.
3. Remove electronic control module.



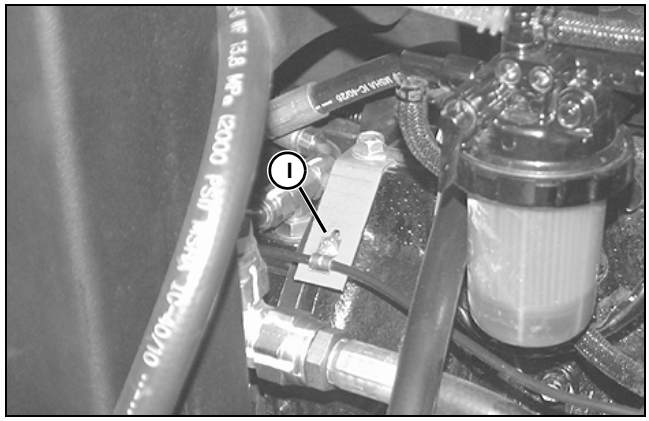
MX2263

4. Remove cotter pin (A) and anchor pin (B).
5. Loosen clamp screw (C).
6. Remove cable (D).
7. Route cable through grommet (E).



MX2264

8. Remove cotter pin (F) and anchor pin (G).
9. Loosen clamp screw (H).



MX2265

10. Loosen clamp screw (I).
11. Remove cable.

Installation

Installation is done in the reverse order of removal.

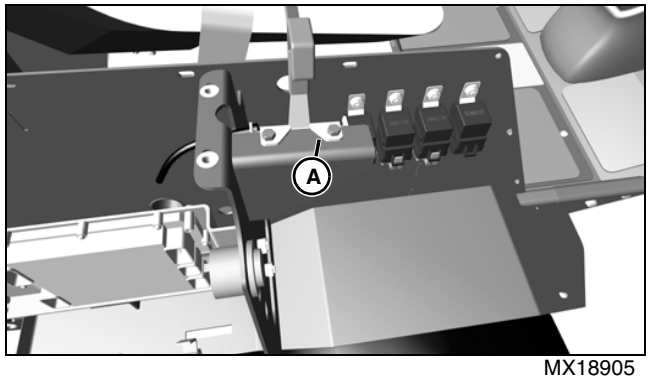
Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 56.)

Throttle Cable Removal and Installation - S.N. (030001-)

Removal

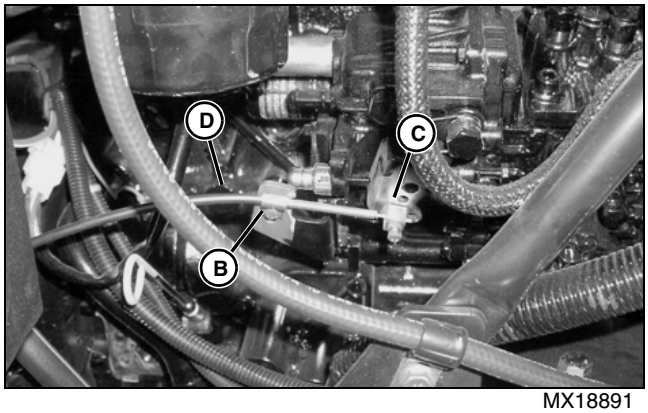
NOTE: Throttle control and cable must be replaced as an assembly.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Move throttle lever to slow idle position.
3. Remove control console to access throttle lever attachment hardware. (See “Console Cover Removal and Installation” on page 662.)
4. Note throttle cable routing to ease installation.



MX18905

5. Remove cap screws and nuts retaining throttle control (A).



MX18891

6. Loosen clamp screw (B) at engine.
7. Loosen cable anchor (C).
8. Remove cable (D).

Installation

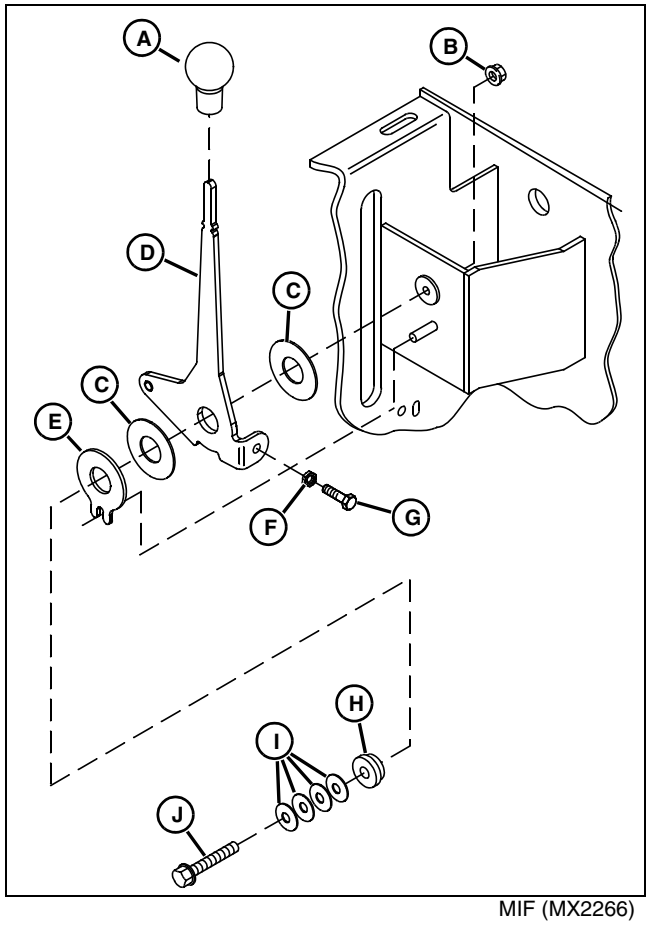
Installation is done in the reverse order of removal.

Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 56.)

Throttle Lever Assembly Removal and Installation - S.N. (-030000)

Removal

1. Remove console cover.
2. Disconnect throttle cable from lever.



MIF (MX2266)

A - Knob
B - Flange Nut
C - Friction Washer (2 used)
D - Throttle Lever
E - Locking Plate
F - Nut
G - Cap Screw
H - Spacer
I - Spring Washers (4 used)
J - Flange-Head Cap Screw

3. Remove flange nut (B).
4. Remove flange-head cap screw (J).
5. Remove spring washers (I), spacer (H), locking plate (E), friction washers (C), and lever (D).
6. Inspect all parts for wear or damage. Replace as needed.

Installation

Installation is done in the reverse order of removal.

- Install spring washers in pairs, with cupped surfaces facing.

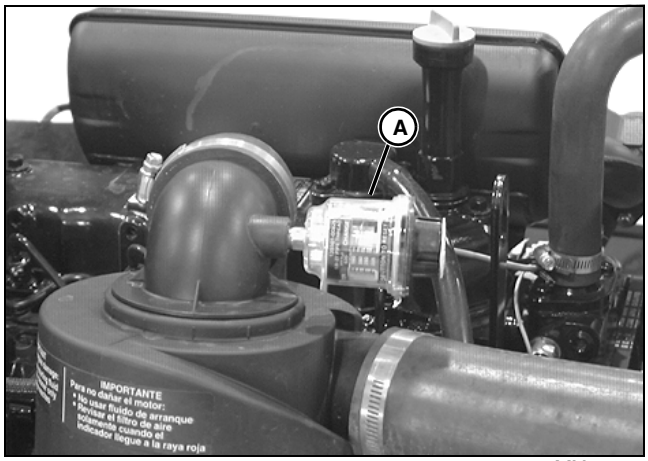
• DO NOT over-tighten flange-head cap screw; tighten only enough to hold the throttle lever in desired position. Over-tightening can cause stiff throttle movement.

Air Filter Restriction Indicator Removal and Installation

Removal

NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.



MX2232

3. Remove air restriction indicator (A).
4. Inspect housing for cracks or other damage. Replace as needed.

Installation

Installation is done in the reverse order of removal.

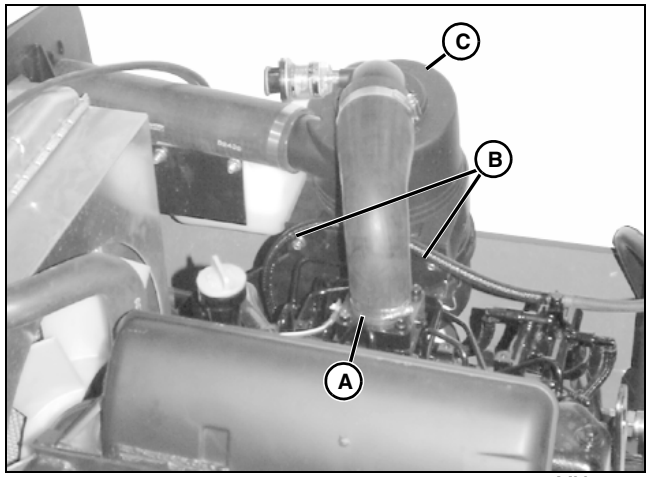
Install the air restriction indicator onto the adapter until snug.

Air Cleaner Assembly Removal and Installation

Removal

NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.

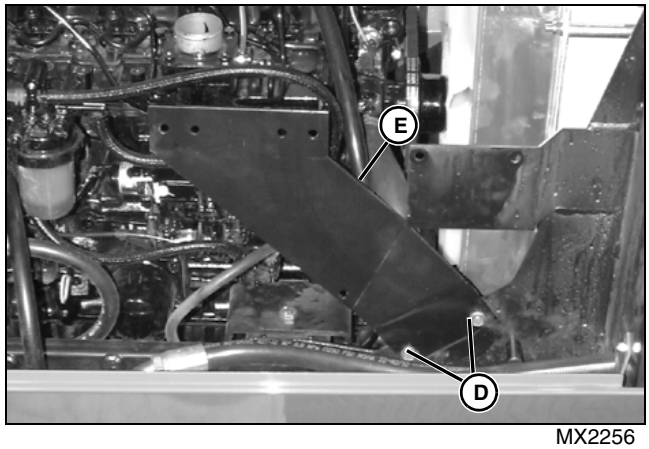
1. Park machine safely. (See “Park Machine Safely” on page 3)
2. Raise hood.



MX2255

3. Loosen intake hose clamp (A) on intake manifold or turbocharger, if equipped.
4. Remove two flange nuts (B) or cap screws under air cleaner, if equipped with turbocharger.
5. Remove air cleaner assembly (C).

NOTE: Radiator overflow tank removed for photo clarity only.



MX2256

6. **On Models 1600/1620:** If greater access to the engine is required, remove two flange-head cap screws (D) and nuts and support bracket (E).

Installation

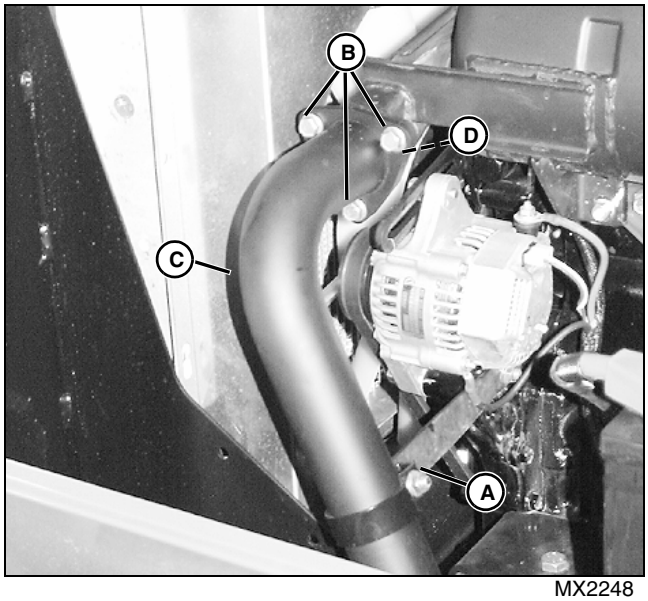
Installation is done in the reverse order of removal.

Muffler Removal and Installation - Models 1600 and 1620

Removal

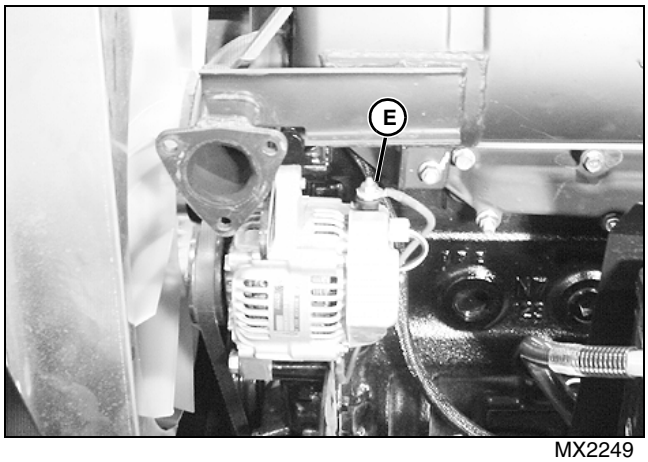
CAUTION: Avoid injury! To prevent possible burns, allow engine to cool before removing muffler.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.
3. Disconnect battery negative (-) battery cable.



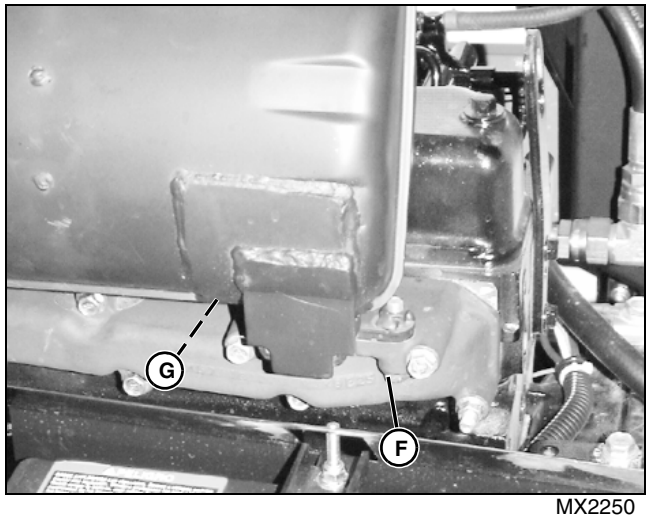
MX2248

4. Remove clamp (A).
5. Remove three flange-head cap screws and nuts (B).
6. Remove exhaust pipe (C) and gasket (D).



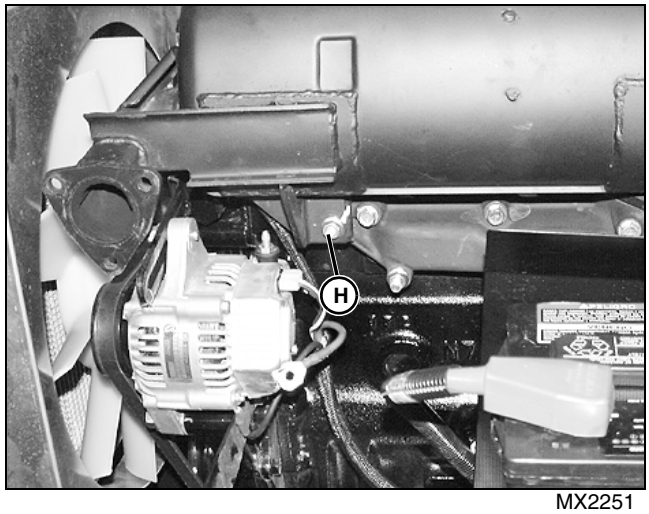
MX2249

7. Disconnect red wire (E) from alternator.



MX2250

8. Remove flange-head cap screw (F).
9. Remove nut (G).



MX2251

10. Remove flange-head nut (H) and stud.
11. Remove muffler and gaskets.

Installation

Installation is done in the reverse order of removal.

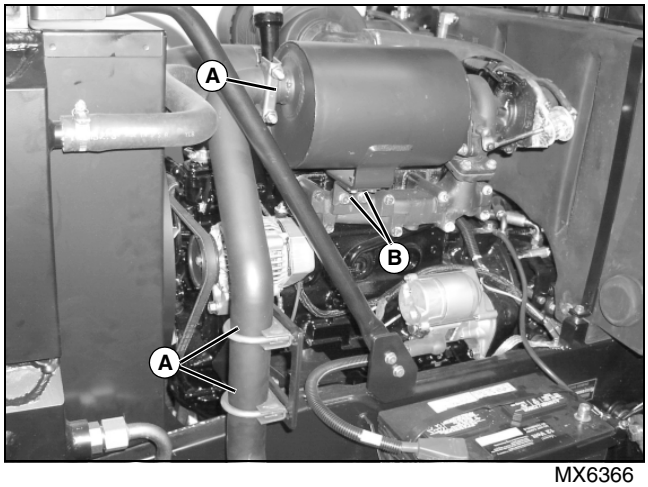
- Install new gasket on exhaust manifold.
- Install new gasket on muffler-to-exhaust pipe joint.

Muffler Removal and Installation - Model 1600 Turbo

Removal

CAUTION: Avoid injury! To prevent burns, allow engine to cool before removing muffler.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.
3. Disconnect battery negative (-) cable.



MX6366

4. Remove three clamps (A) and exhaust pipe.
5. Remove cap screws (B).



MX6367

6. Remove four nuts (C) and remove muffler and gasket.

Installation

Installation is done in the reverse order of removal.

Install new gasket between turbocharger and muffler.

Radiator Removal and Installation - Models 1600 and 1620

Removal

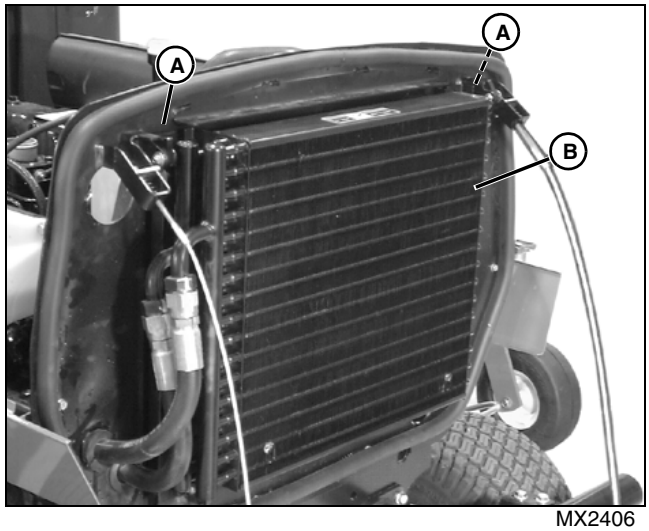
CAUTION: Avoid injury! Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Turn key switch to STOP position and allow the engine to cool.
3. Remove hood.
4. Remove air cleaner assembly and bracket.
5. Loosen radiator cap to first stop to relieve pressure.
6. Remove radiator cap.

NOTE: Cooling system capacity is approximately 9.5 L (2.5 gal).

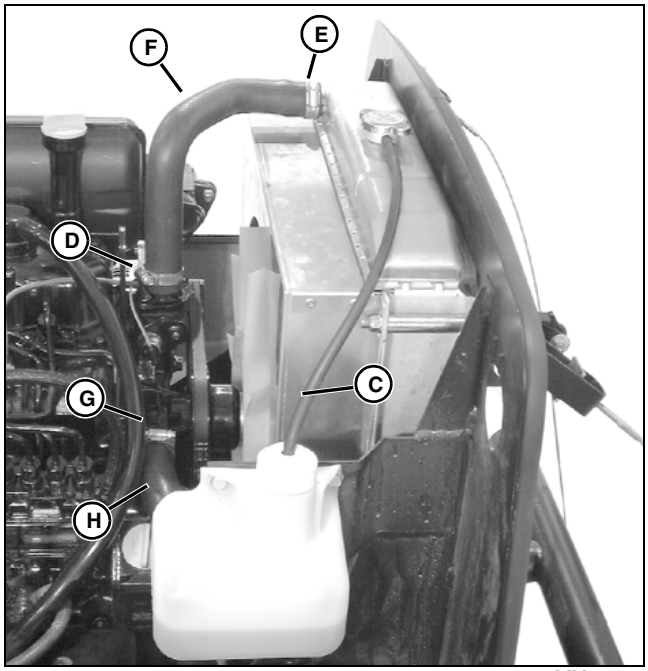
7. Drain coolant from radiator/engine. Drain valve is located on the lower right side of the radiator.

IMPORTANT: Avoid damage! Use caution when moving oil cooler aside to prevent damaging fins.



MX2406

8. Release latches (A) and tilt the oil cooler (B) away from radiator.



MX2407

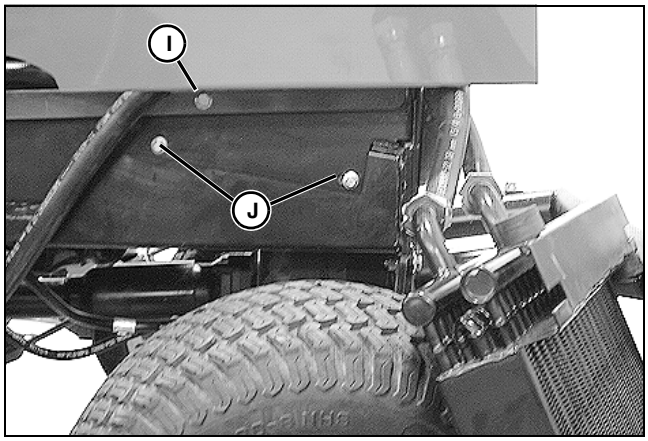
9. Remove hose (C) from overflow tank.

10.Loosen hose clamps (D and E).

11.Remove upper hose (F).

12.Loosen hose clamp (G).

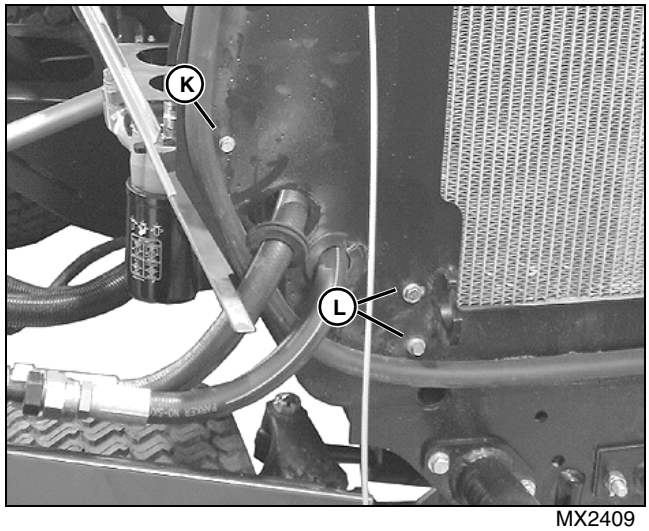
13.Disconnect lower hose (H).



MX2408

14.Remove cap screw, nut, and spacer (I) on both sides of the machine.

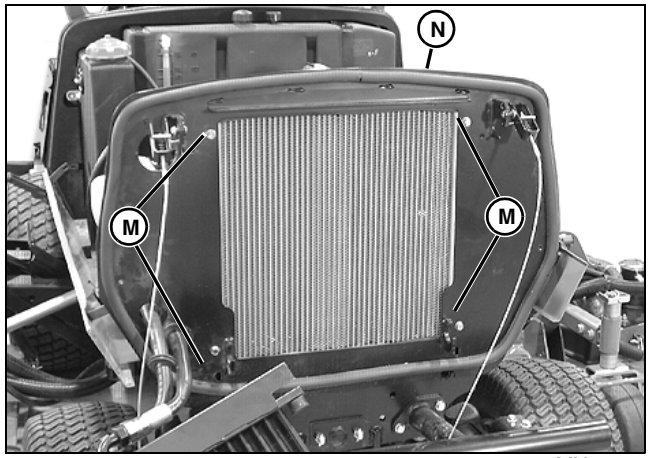
15.Remove cap screws (J) on both sides of the machine.



MX2409

16.Remove cap screw and nut (K) on both sides of the machine.

17.Remove two cap screws (L) on both sides of the machine.



MX2410

18.Remove four cap screws, nuts, and spacers (M).

19.Slide the radiator support (N) to the rear of the machine.

20.Remove radiator and shroud.

Installation

Installation is done in the reverse order of removal.

Radiator Removal and Installation - Model 1600 Turbo

Removal

CAUTION: Avoid injury! Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

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

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

3. Loosen radiator cap to first stop to relieve pressure.

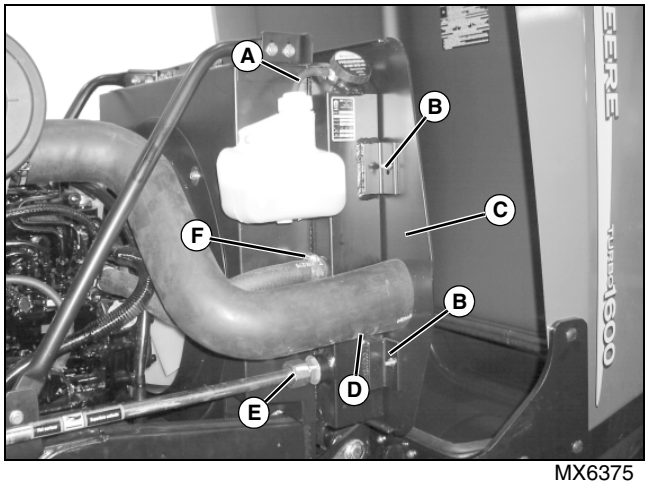
4. Remove radiator cap.

NOTE: Cooling system capacity is approximately 7.5L (8 qt)

5. Drain coolant from radiator/engine. Drain valve is located on the lower right side of the radiator, just above the oil cooler section.

NOTE: Hydraulic system capacity is approximately 58.7L (15.5 gal)

6. Drain hydraulic fluid from system.



MX6375

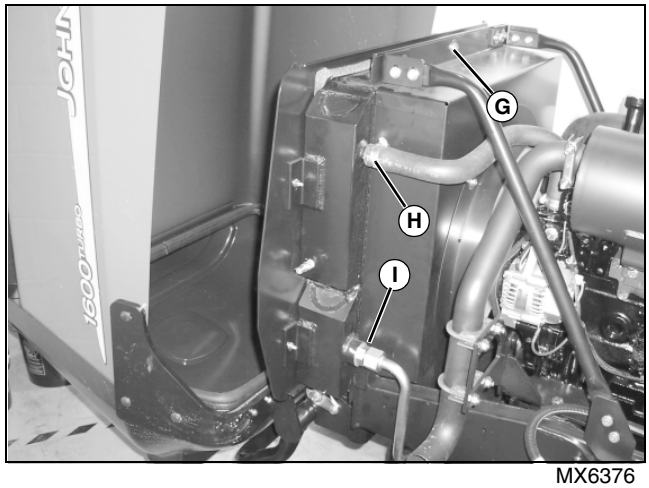
7. Disconnect overflow tube (A) from radiator filler neck.

8. Remove clip and pull air cleaner intake hose (D) from plate (C).

9. Remove two cap screws and nuts (B) from each side of plate and remove plate.

10. Disconnect radiator hose (F).

11. Disconnect oil cooler line (E).

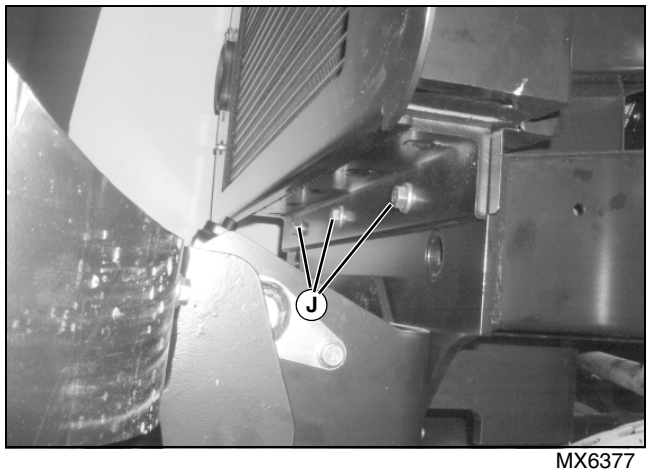


MX6376

12. Disconnect radiator hose (H).

13. Disconnect oil cooler line (I).

14. Remove five cap screws and nuts (G) connecting top of radiator to fan shroud.



MX6377

15. Remove cap screws (J) and remove radiator.

Installation

Installation is done in the reverse order of removal.

Radiator Inspection

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

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

1. Check radiator for debris lodged in fins. Clean radiator using compressed air or pressure washer.

2. Inspect radiator for bent fins, cracks and damaged seams. Repair or replace radiator if necessary.

Thermostat Removal and Installation

Removal

CAUTION: Avoid injury! Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

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

2. Raise hood.

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

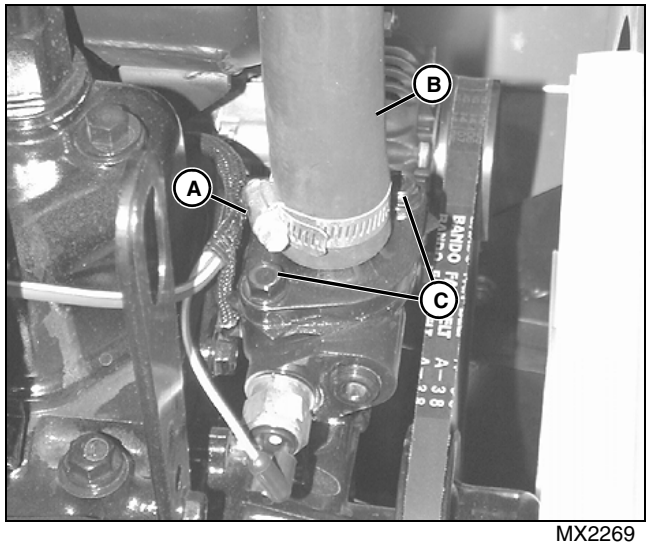
4. Loosen radiator cap to first stop to relieve pressure.

5. Remove radiator cap.

NOTE: Models 1600/1620 cooling system capacity is approximately 9.5 L (2.5 gal).

Model 1600 Turbo cooling system capacity is approximately 7.5 L (8 qt).

6. Drain coolant from radiator/engine. Drain valve is located on the lower right side of the radiator.



MX2269

7. Loosen hose clamp (A).

8. Remove radiator hose (B) from thermostat cover.

9. Remove two cap screws (C) from cover and remove cover and O-ring.

10. Remove thermostat from housing.

11. If thermostat is to be reinstalled, test thermostat.

Installation

Installation is done in the reverse order of removal.

- Install thermostat in housing with spring end inside coolant pump.
- Place O-ring over thermostat and place cover over thermostat on coolant pump.
- Fill cooling system to correct level with coolant of correct specifications.

Coolant Temperature Switch Removal and Installation

Removal

CAUTION: Avoid injury! Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

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

2. Raise hood.

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

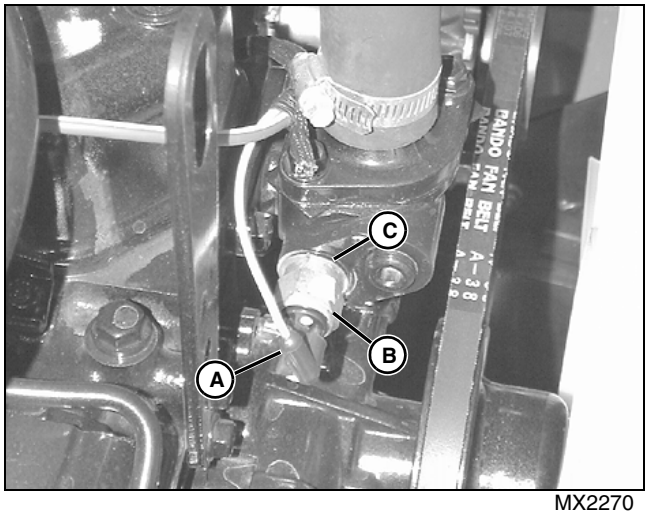
4. Loosen radiator cap to first stop to relieve pressure.

5. Remove radiator cap.

NOTE: Models 1600/1620 cooling system capacity is approximately 9.5 L (2.5 gal).

Model 1600 Turbo cooling system capacity is approximately 7.5 L (8 qt).

6. Drain coolant from radiator. Drain valve is located on the lower right side of the radiator.



MX2270

7. Disconnect orange wire (A) on temperature switch.

8. Remove switch (B) and copper washer (C).

9. Repeat steps 7 and 8 for temperature sender on other side of thermostat housing, if needed.

10. Test switch and/or sender.

Installation

Installation is done in the reverse order of removal.

Fill cooling system to correct level with coolant of correct specifications.

Fan and Alternator Drive Belt Removal and Installation

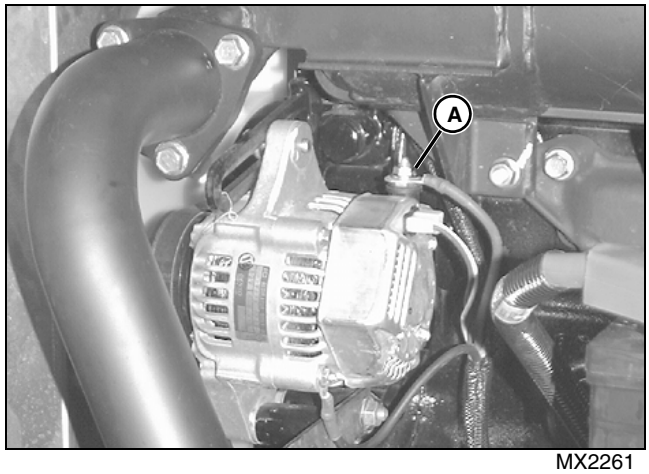
Removal

NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.

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

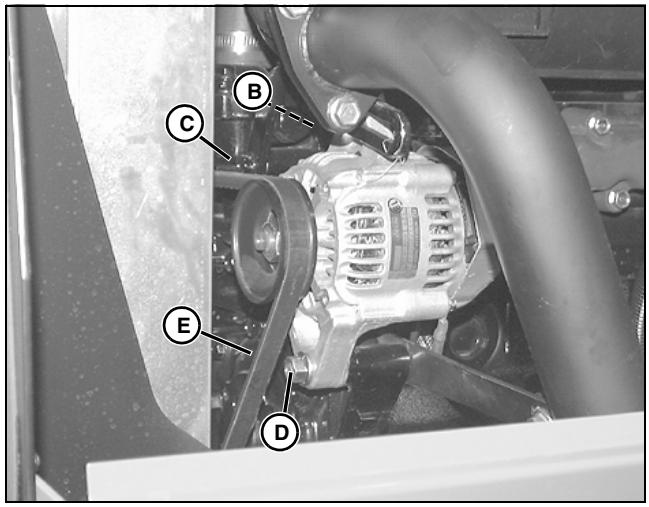
2. Raise hood.

3. Disconnect battery negative (-) battery cable.



MX2261

4. Disconnect red wire (A) from alternator.

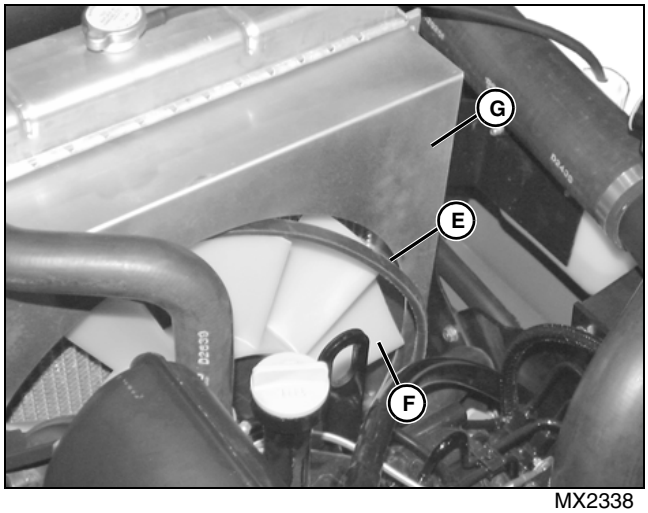


MX2271

5. Loosen top cap screw (B), mounting bracket cap screw (C), and lower cap screw (D).

6. Push alternator toward engine to loosen belt.

7. Remove drive belt (E) from alternator pulley.



MX2338

8. Carefully work the belt (E) between the fan (F) and fan shroud (G) and remove the belt.

9. Inspect belt for cracking, damage, or signs of wear. Replace as needed.

Installation

Installation is done in the reverse order of removal.

Adjust belt tension.

Engine Removal and Installation

Removal

NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.

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

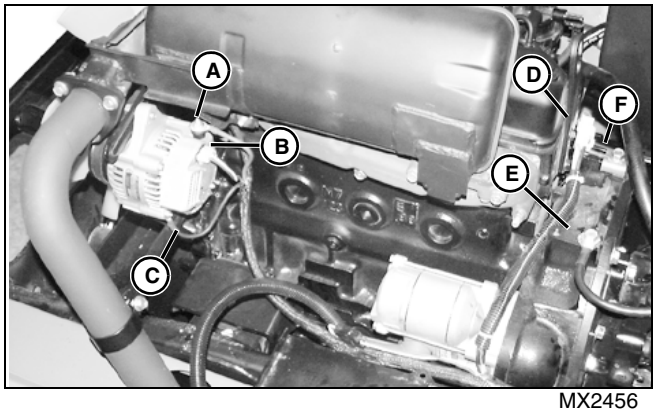
2. Remove hood.

3. Remove battery, negative (-) cable first, and remove splash guard.

4. Remove air cleaner assembly and support bracket.

5. Remove radiator.

NOTE: Mark all wires, hoses, and cables before disconnecting to ensure proper installation during assembly.



MX2456

6. Disconnect red wire (A) from alternator.

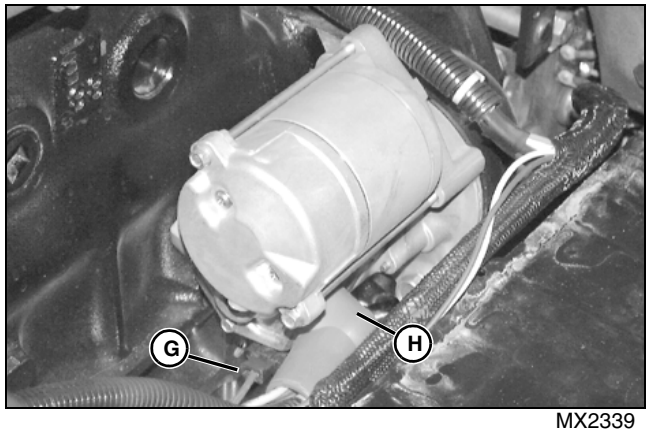
7. Disconnect wiring connector (B).

8. Disconnect black wire (C).

9. Disconnect fuel injection pump solenoid wiring connector (D).

10. Disconnect battery ground cable (E).

11. Disconnect throttle cable bracket (F) from engine block.



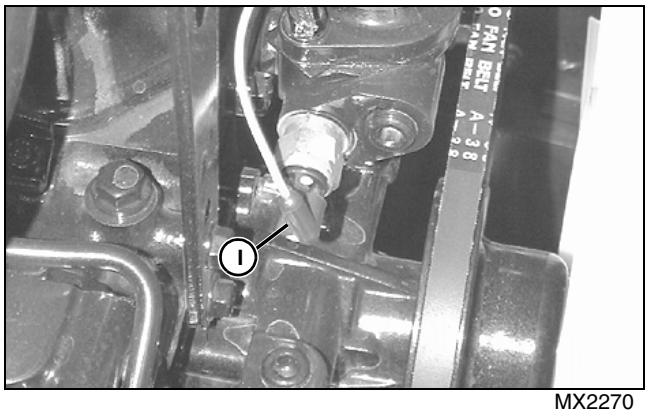
MX2339

12. Disconnect violet wire (G) from solenoid.

13. Disconnect wires (H) from solenoid battery terminal.

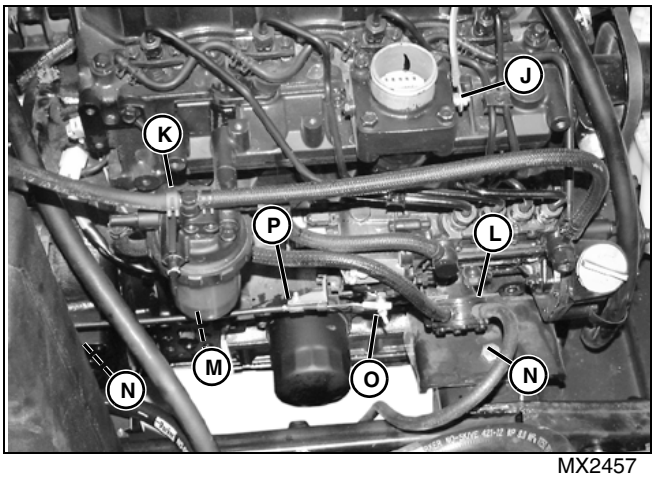
14. **Model 1600 Turbo:** Disconnect ground strap between starter housing and mower frame.

NOTE: Model 1600 Turbo: Remove wire at coolant temperature switch and sender. Both are located on thermostat housing.



MX2270

15.Disconnect wire (I) at coolant temperature switch.



MX2457

16.Disconnect wire (J) at air pre-heater.

17.Disconnect and plug fuel return hose (K) at fuel filter.

18.Disconnect and plug fuel inlet hose (L) at fuel pump, or drain fuel into a properly marked container.

19.Disconnect oil pressure sender wire (M).

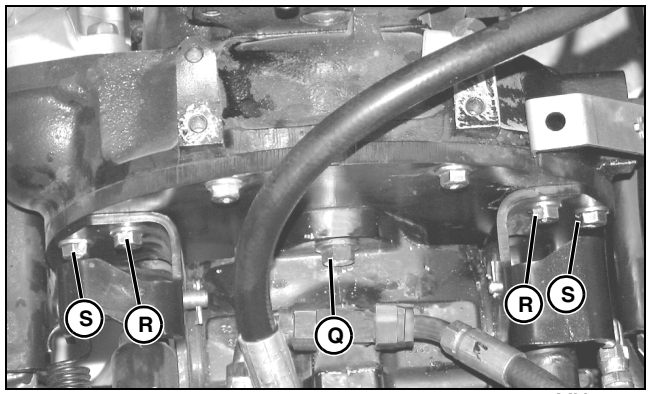
20.Remove four engine mounting cap screws (N) from engine mounts (two per side).

NOTE: Mark throttle cable to ensure proper installation.

21.Remove cotter pin (O) and disconnect throttle cable from throttle shaft pivot.

22.Loosen nut on throttle cable bracket (P) and remove throttle cable from engine.

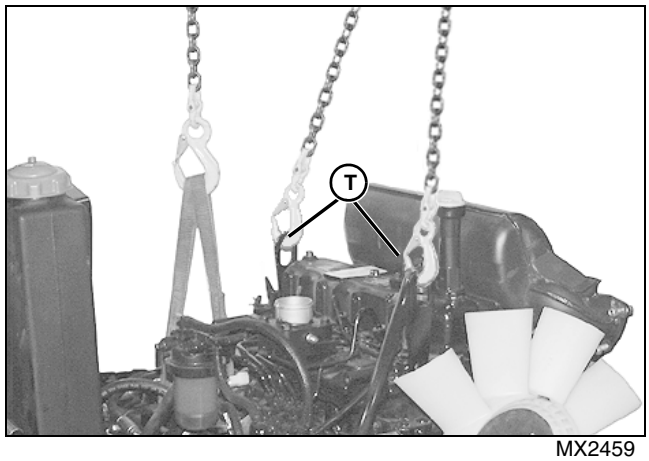
IMPORTANT: Avoid damage! Support triple pump to avoid damage to hydraulic hoses and components.



MX2458

23.Remove two cap screws (Q) from triple pump flange.

24.Remove four short cap screws (R) and four long cap screws (S) from top and bottom of triple pump mounting flange and side brackets.



MX2459

25.Support the triple pump assembly.

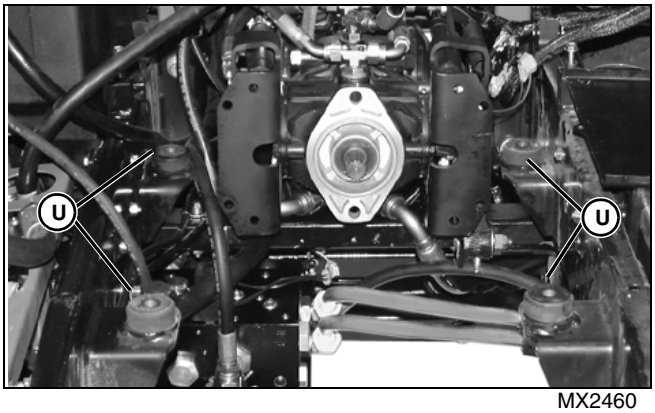
26.Attach a hoist to the engine lifting eyes (T).

27.Remove engine from machine.

NOTE: Models 1600/1620 crankcase capacity (with filter) is approximately 5.8 L (6.1 qt).

Model 1600 Turbo crankcase capacity (with filter) is approximately 6.6 L (7 qt).

28.If the engine is to be repaired, remove drain plug and drain crankcase.

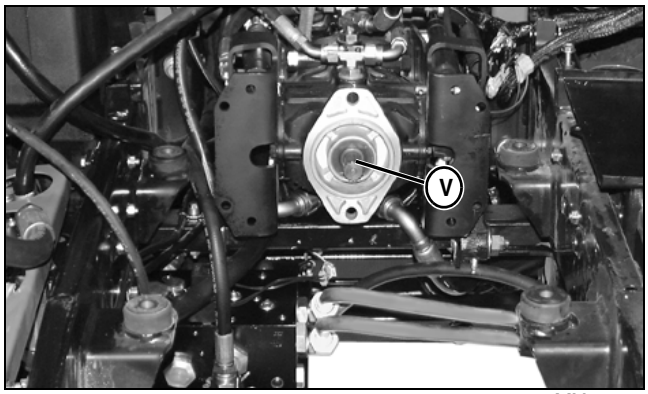


MX2460

29.Inspect engine mount pads (U) for wear or damage. Replace as necessary.

Installation

Installation is done in the reverse order of removal.



MX2460

- Align teeth on input shaft of triple pump (V) with teeth on flex-drive coupler plate.

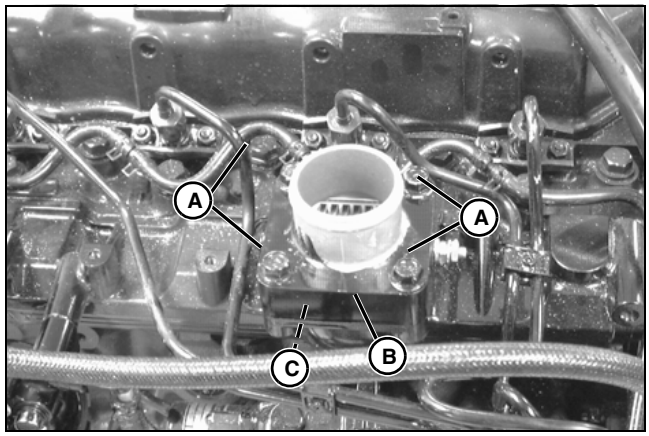
NOTE: If the engine has been rebuilt (cylinder rebored or deglazed, etc.), the oil should be changed after the first 20 hours (maximum) of operation.

- Fill engine to proper level with oil of correct specifications.
- Fill cooling system to correct level with coolant of correct specifications.
- Adjust throttle cable.
- Bleed air from fuel system.

Air Pre-Heater Removal and Installation

Removal

NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.



MX2343

1. Remove four cap screws (A).
2. Remove air heater assembly (B) and gasket (C).
3. Test air pre-heater element.

Installation

Installation is done in the reverse order of removal.

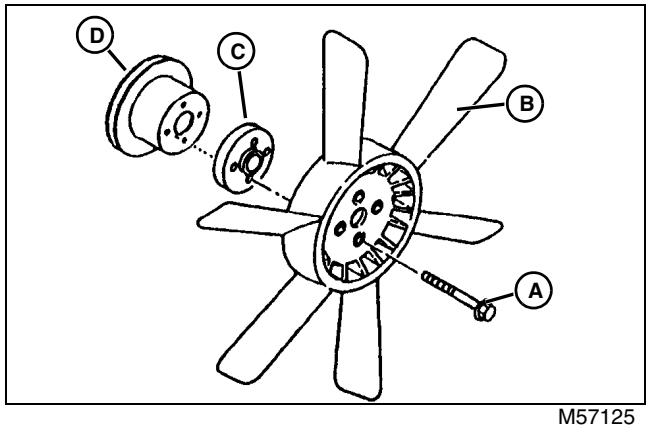
Use a new gasket for installation.

Coolant Pump Removal and Installation

Removal

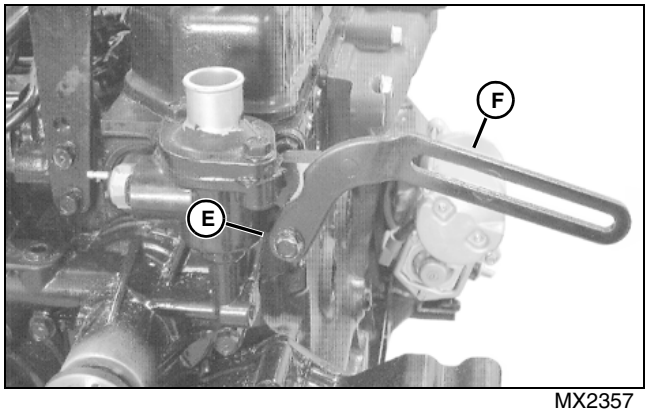
NOTE: Cooling system capacity is approximately 7.5 L (8 qt).

1. Remove alternator.



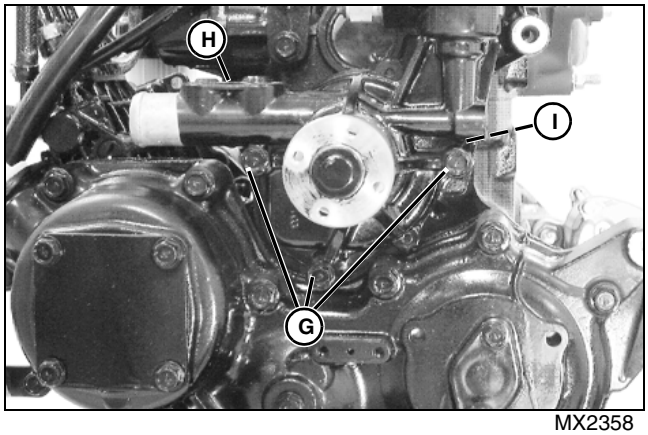
M57125

2. Remove four cap screws (A) and washers.
3. Remove fan (B) and spacer (C).
4. Remove pulley (D).



MX2357

5. Remove cap screw (E) and alternator bracket (F).

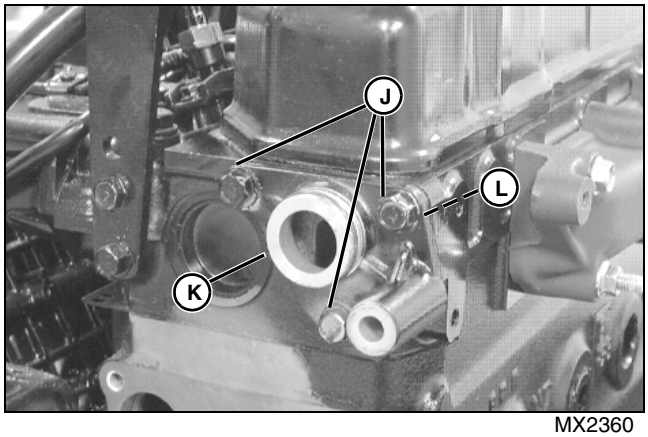


MX2358

6. Remove three cap screws (G).

7. Remove coolant pump (H) and gasket (I).

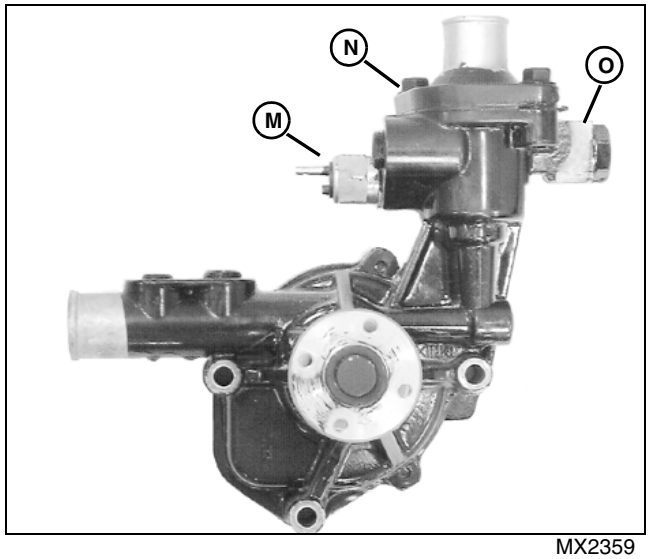
8. Remove gasket residue from coolant pump and engine block mating surfaces.



MX2360

9. If the head is to be removed, remove three cap screws (J), adapter (K), and gasket (L).

NOTE: Model 1600 Turbo will have a temperature sensor mounted in place of plug (O).

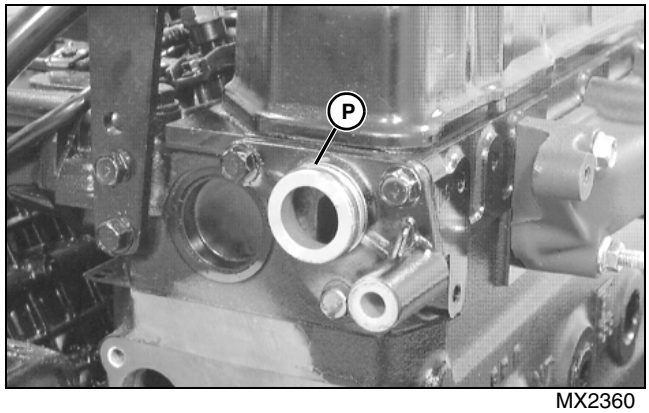


MX2359

10.If the coolant pump is to replaced, remove the coolant temperature switch (M) and thermostat (N).

Installation

Installation is done in the reverse order of removal.

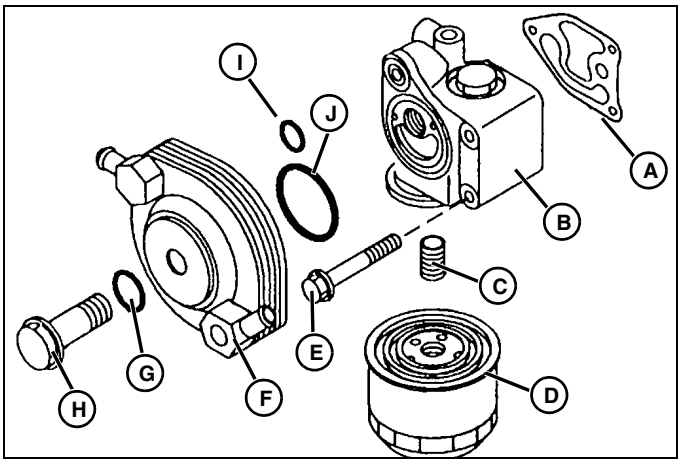


MX2360

- Inspect O-ring (P). Replace as needed.
- Use new gaskets (I and L) for installation.

Engine Oil Cooler Removal and Installation - Model 1600 Turbo

Removal



MX14562

1. Drain cooling system.
2. Remove oil filter (D).
3. Disconnect coolant hoses.
4. Remove mounting cap screw (H), oil cooler (F), and O-rings (G, I, and J)
5. Remove three cap screws (E), oil filter mounting block (B), and gasket (A).
6. Inspect all parts for physical damage, plugging, or leakage which may allow mixing of oil and coolant. Replace as necessary. DO NOT attempt to repair oil cooler.
7. Pressure test oil cooler:
   a. Plug one end of coolant inlet or outlet passage.
   b. Apply regulated air pressure of 206-480 kPa (30-70 psi) to other end.
   c. Dip oil cooler into water and check for leaks.
   d. **Optional test:** If a leak did not appear, use a hot water bath to attempt to open cracks.
   e. Replace oil cooler if necessary.

Installation

Installation is done in reverse order of removal.

- Lubricate new O-rings with clean engine oil.
- Tighten cap screws to specification.
- Tighten mounting cap screw to specification.
- Close drain valve and fill radiator with proper coolant to top of filler neck.

Specifications

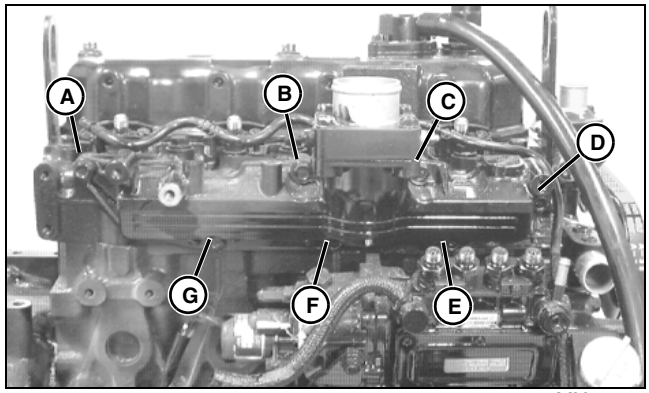
Oil Filter Block Cap Screw Torque . . . . 27 N•m (20 lb-ft)
Oil Cooler Mounting
Cap Screw Torque . . . . . 30 N•m (22 lb-ft)

Intake Manifold Removal and Installation

Removal

NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.

1. Remove fuel filter.
2. Remove fuel Injection lines.



MX2349

3. Remove seven cap screws (A-G).
4. Remove intake manifold and gasket.

Installation

Installation is done in the reverse order of removal.

Use a new gasket for installation.

Turbocharger Removal and Installation - Model 1600 Turbo

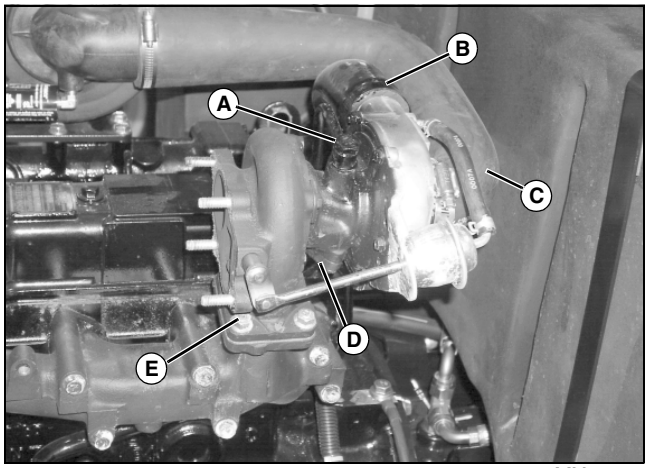
Removal

CAUTION: Avoid injury! Muffler may be hot. Allow muffler to cool before removing. A hot muffler can cause serious burns.

IMPORTANT: Avoid damage! When cleaning turbocharger, DO NOT spray directly into compressor turbine housing. If inspection is required of turbocharger, do not clean exterior prior to removal. Doing so may wash away evidence of a potential failure mode

If inspection is not required, thoroughly clean exterior of turbocharger and surrounding area to prevent entry of dirt into the air intake system during removal.

1. Remove muffler.



MX6379

2. Remove turbocharge-to-intake manifold hose (B).
3. Remove air cleaner-to-turbocharger hose (C).
4. Remove oil supply line (A) with copper washers on top and bottom surface of oil supply line.
5. Remove oil drain line (D).
6. Remove four nuts (E).
7. Remove turbocharger and gasket.
8. Close all openings using caps and plugs to prevent contamination.

Installation

Installation is done in the reverse order of removal.

- Prelube turbocharger: Fill oil inlet or drain port with clean oil and turn rotating assembly (by hand) to properly lubricate bearings.
- Install new gasket between exhaust manifold and turbocharger.
- Install new O-ring on oil drain line.
- Install new copper washers on oil supply line.

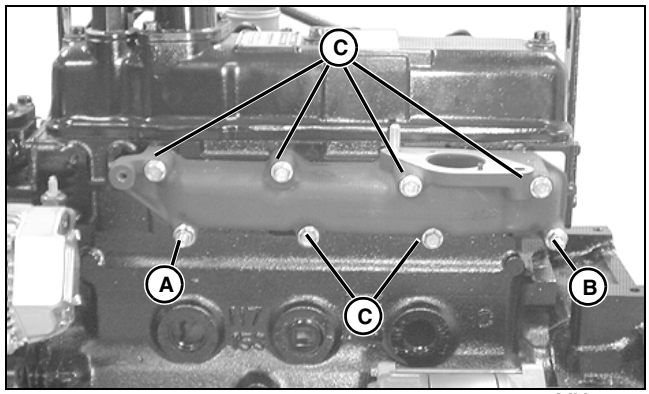
IMPORTANT: Avoid damage! A new or repaired turbocharger does not have an adequate oil supply for immediate start-up of engine. Perform the following steps to prevent damage to turbocharger bearings.

1. Disconnect fuel shutoff connector.
2. Crank engine over with starter until oil pressure light goes out. DO NOT crank engine longer than 30 seconds at a time to avoid damaging the starter.

Exhaust Manifold Removal and Installation

Removal

NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.



MX2350

1. Remove two nuts (A and B).
2. Remove six caps screws (C).
3. Remove manifold and gasket.
4. Clean all mating surfaces thoroughly.

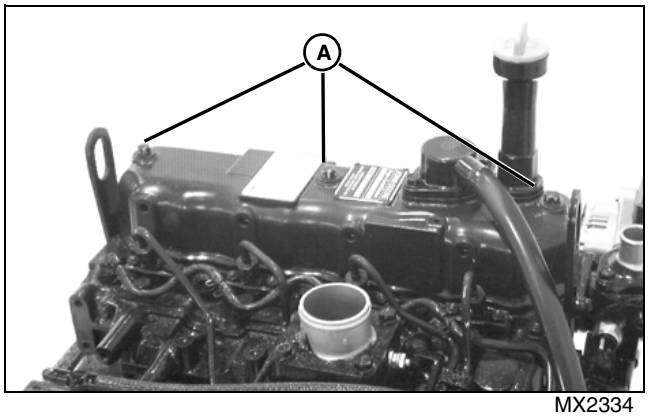
Installation

Installation is done in the reverse order of removal.

Install new gasket between exhaust manifold and cylinder head.

Rocker Arm Cover Removal and Installation

Removal



MX2334

1. Remove three special nuts (A).
2. Remove rocker arm cover.
3. Clean cylinder head and rocker arm cover mating surfaces.

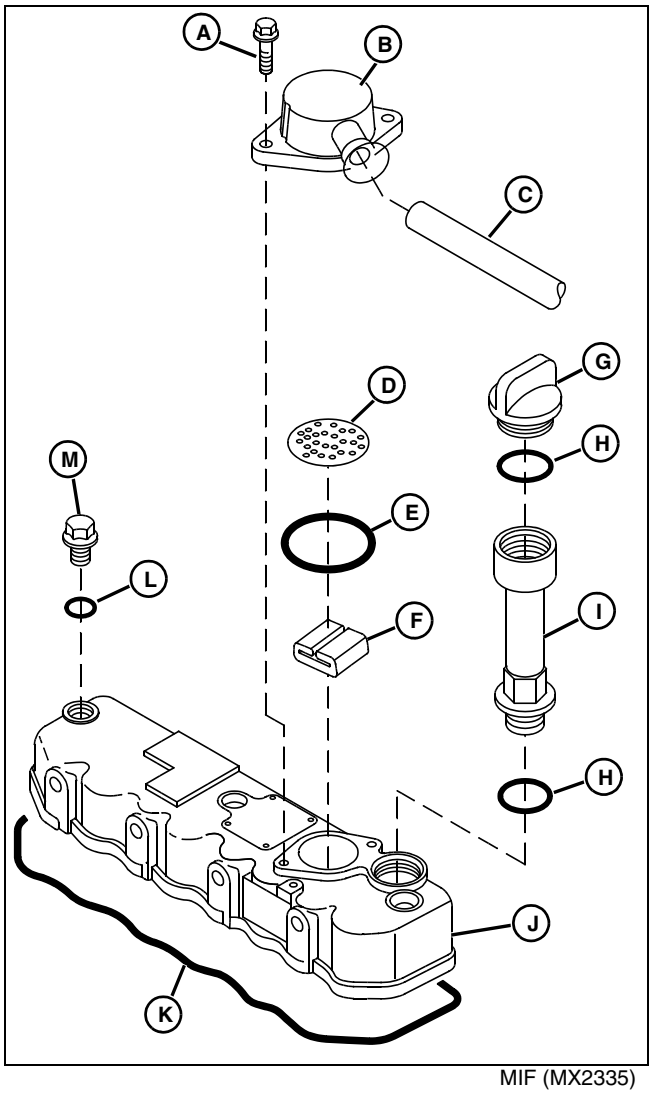
Installation

Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! DO NOT overtighten the special nuts securing rocker arm cover to engine.

Inspect gasket before reinstalling rocker arm cover. Replace if damaged.

Rocker Arm Cover Service



MIF (MX2335)

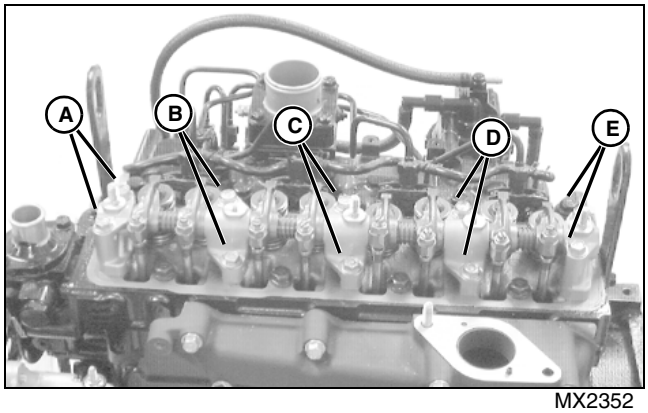
A - Cap Screw (2 used)
B - Breather Cover
C - Hose
D - Plate
E - O-Ring
F - Screen
G - Cap
H - O-Ring
I - Oil Filler Extension
J - Cover
K - Gasket
L - O-Ring (3 used)
M - Special Nut (3 used)

- Inspect all parts for damage. Replace parts as needed.
- Clean screen (F) using cleaning solvent, and allow to dry before installing.

Rocker Arm Assembly Removal and Installation

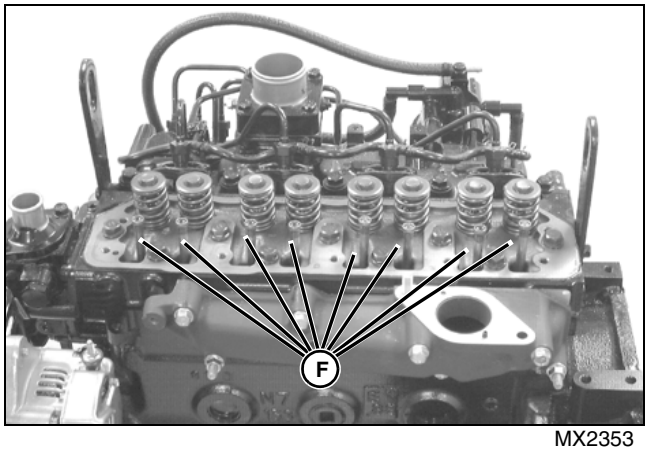
Removal

1. Remove rocker arm cover.



MX2352

2. Remove rocker arm support mounting cap screws (A-E).
3. Remove rocker arm assembly from cylinder head.



MX2353

4. Lift push rods (F) from cylinder head and note location to ensure correct installation.

Installation

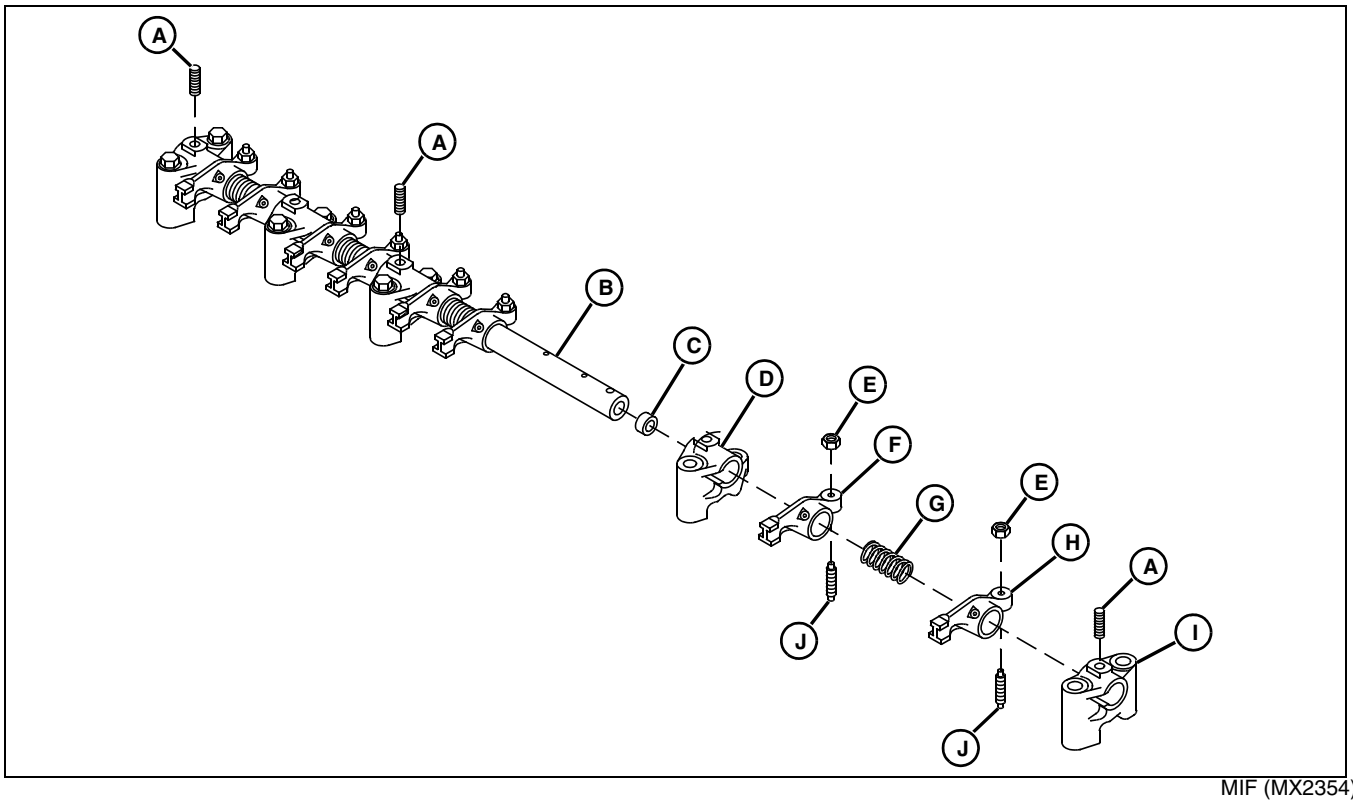
Installation is done in the reverse order of installation.

- Lubricate all parts with clean oil during assembly.

NOTE: Push rods should be installed in same locations they were removed from.

- Install push rods in cylinder head with ball-shaped end down in head.
- Check to be sure valve caps are installed on end of all valves.
- Adjust valve clearance.

Rocker Arm Assembly Disassembly and Assembly



MIF (MX2354)

A - Stud (3 used)
B - Shaft
C - Plug (2 used)
D - Center Support (3 used)
E - Jam Nut (8 used)
F - Rocker Arm (Exhaust) (4 used)
G - Spring (4 used)
H - Rocker Arm (Intake) (4 used)
I - End Support (2 used)
J - Adjustment Screw (8 used)

1. Install double nuts on studs (A) to remove.

NOTE: Note location of rocker arm components to ensure installation on rocker arm shaft at the same location as they were removed from.

2. Slide rocker arm assembly components (D-J) off rocker arm shaft (B) while noting location for reassembly.

3. Inspect rocker arm components and push rods.

Rocker Arm Assembly Component Inspection

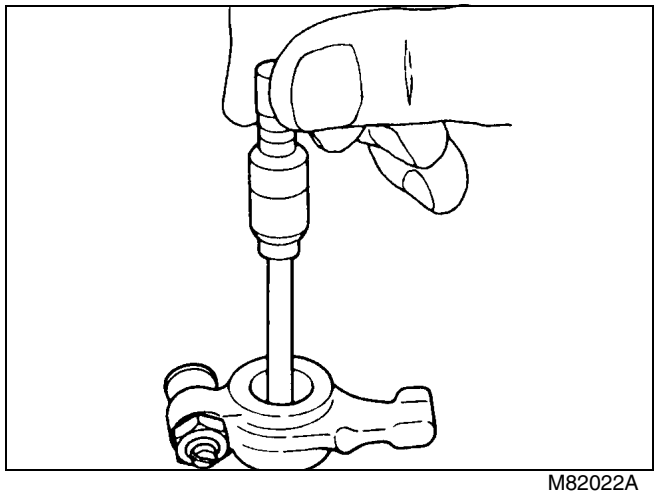
Rocker Arm Shaft



M35262

Measure outside diameter of rocker arm shaft at each rocker arm location. Replace rocker arm shaft if diameter measures less than specification.

Rocker Arm

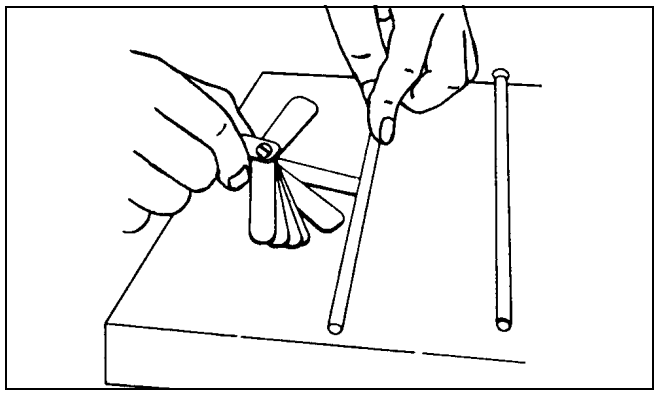


M82022A

1. Measure inside diameter of rocker arms and supports. Replace rocker arms and/or supports if inside diameter is greater than specification.

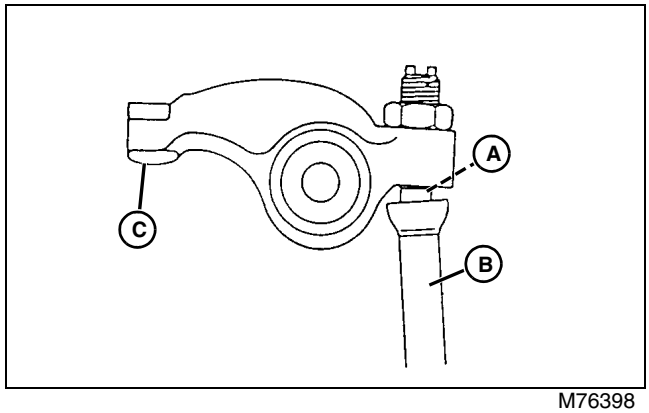
2. Subtract outside diameter of rocker arm shaft from inside diameter of rocker arms/supports to determine clearance. Replace shaft and rocker arms/supports if clearance is greater than specification.

Push Rods



M98811

1. Use the corner of a known flat surface to check bending of the push rod since both ends of the push rods have raised edges. Replace push rod(s) if bend is greater than specification.



M76398

2. Check the surface of adjusting screw (A) that contacts the push rod for wear. Replace push rod (B) or adjusting screw if worn.

3. Check the contact surface (C) that comes in contact with the valve stem for wear. Replace rocker arm if necessary.

Specifications

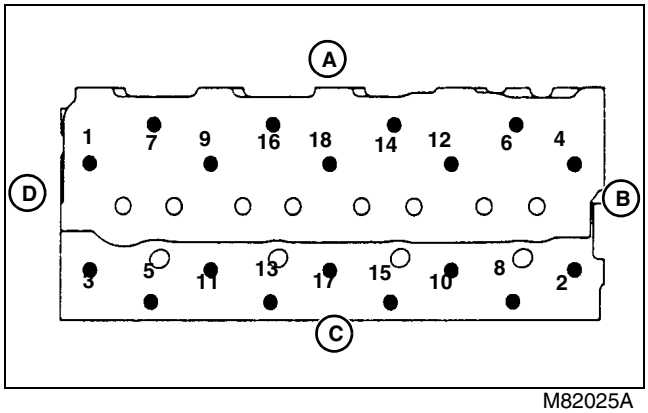
Rocker Arm Shaft
Outside Diameter (Min) . . . . . 15.95 mm (0.628 in.)
Rocker Arms/Support
Inside Diameter (Max) . . . . . 16.09 mm (0.633 in.)
Rocker Arm Shaft-to-Rocker
Arms/Support Clearance (Max) . . . 0.14 mm (0.006 in.)
Push Rod Bend (Max) . . . . . 0.03 mm (0.001 in.)

Cylinder Head Assembly Removal and Installation

Removal

1. Remove intake manifold.
2. Remove exhaust manifold.
3. Remove coolant pump and adapter.
4. Remove rocker arm assembly.
5. Remove fuel injector nozzle assemblies.

IMPORTANT: Avoid damage! Loosen cylinder head cap screws 1/4 turn at a time in the sequence shown to avoid warping the cylinder head.



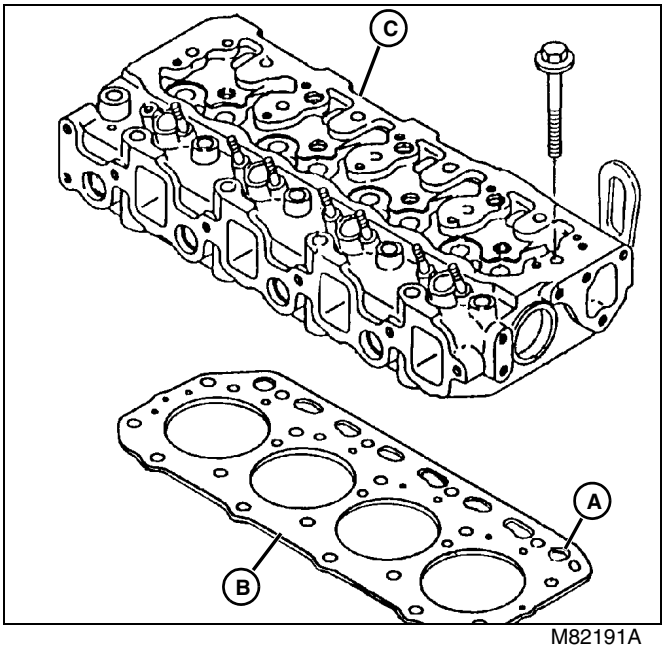
M82025A

A - Exhaust Manifold Side
B - Timing Gear End
C - Intake Manifold Side
D - Flywheel End

6. Loosen head cap screws in the sequence shown.
7. Remove cylinder head and gasket.
8. Disassemble and inspect cylinder head and valves.

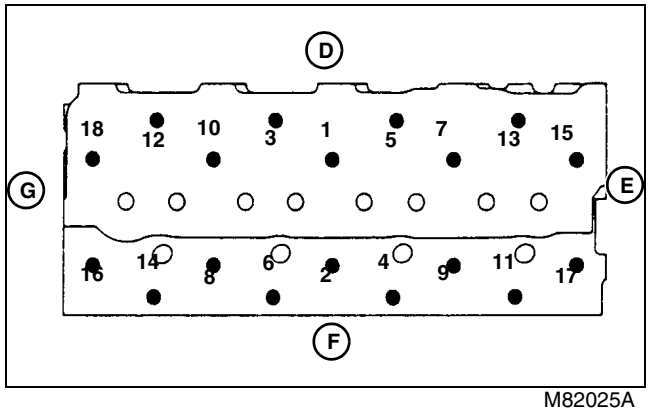
Installation

IMPORTANT: Avoid damage! Oil passage in gasket (A) must be located over oil passage in cylinder block. Install gasket as shown.



M82191A

1. Install new gasket (B).
2. Install head assembly (C).



M82025A

A - Exhaust Manifold Side
B - Timing Gear End
C - Intake Manifold Side
D - Flywheel End

3. Dip head cap screws in clean engine oil. Install and tighten in the sequence shown, in three stages:

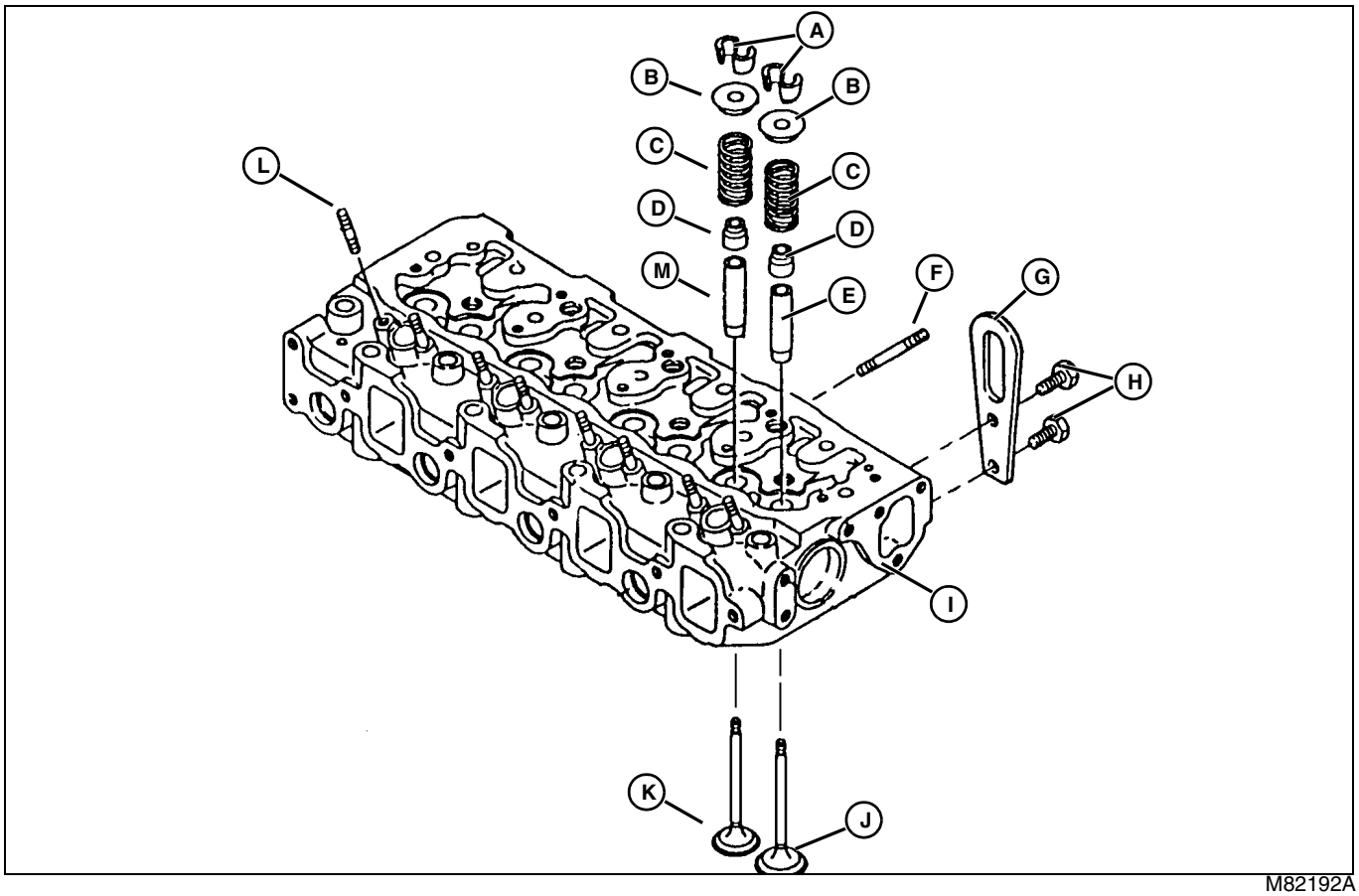
- Tighten cap screws to initial torque of 29 N•m (21 lb-ft).
- Repeat cap screw tightening to 58 N•m (43 lb-ft).
- Complete tightening cap screws to specification.

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

Specifications

Cylinder Head Mounting
Cap Screw Final Torque. . . . . 88 N•m (65 lb-ft)

Cylinder Head Assembly Disassembly and Assembly



M82192A

A - Collet (16 used)
B - Retainer (8 used)
C - Spring (8 used)
D - Stem Seal (8 used)
E - Intake Valve Guide (4 used)
F - Exhaust Manifold Stud (4 used)
G - Lifting Bracket
H - Cap Screw (2 used)
I - Cylinder Head
J - Intake Valve (4 used)
K - Exhaust Valve (4 used)
L - Stud (8 used)
M - Exhaust Valve Guide (4 used)

1. Check valve recession before disassembly.

2. Remove valve caps from valves. Valve caps should be installed on valves they were removed from.

3. Compress valve spring using a valve spring compressor and remove the collet halves (A), retainer (B), valve spring (C), and valve stem seal (D) for each valve.

4. Inspect all parts for wear or damage.

IMPORTANT: Avoid damage! DO NOT reuse stem seals if removed. Used seals will leak.

5. Install new valve stem seals over valve guides.

6. Apply clean engine oil on intake and exhaust valve stems during assembly.

7. Install springs with smaller pitch end or paint mark toward cylinder head.

8. Compress valve springs and retainer until collet halves are able to be installed in grooves of valve stem.

9. Carefully release tension on spring compressor.

10. Tap on end of valve with a plastic hammer to ensure collet halves have seated properly on valve stem.

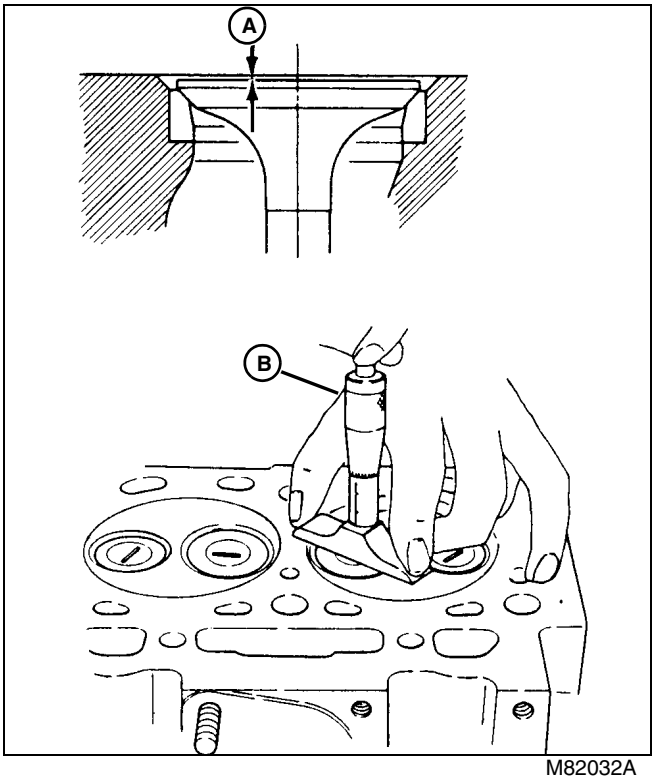
11. Repeat for remaining valves.

12. Measure valve recession if new valves were installed.

Cylinder Head Assembly Component Inspection

Check Valve Recession

1. Turn the head over (combustion chamber side up) and support the head securely with blocks.



M82032A

2. Measure valve recession (A) using a depth gauge (B). Replace valve and valve seat if measurement exceeds specification.

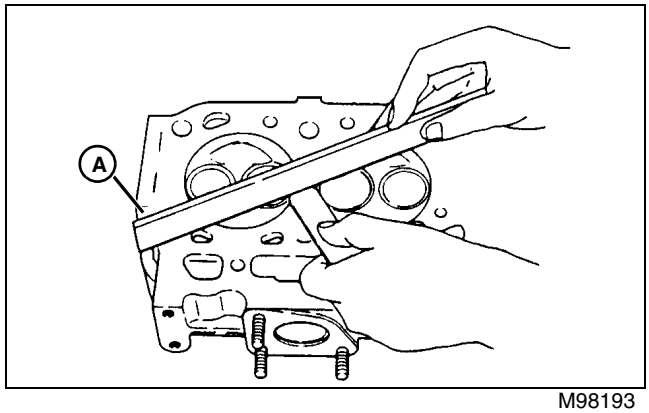
Cylinder Head

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

1. Thoroughly clean head with a suitable solvent and dry with compressed air.

2. Inspect head for cracks or damage. Replace head as needed.

3. Inspect machined surfaces for nicks or burrs.



M98193

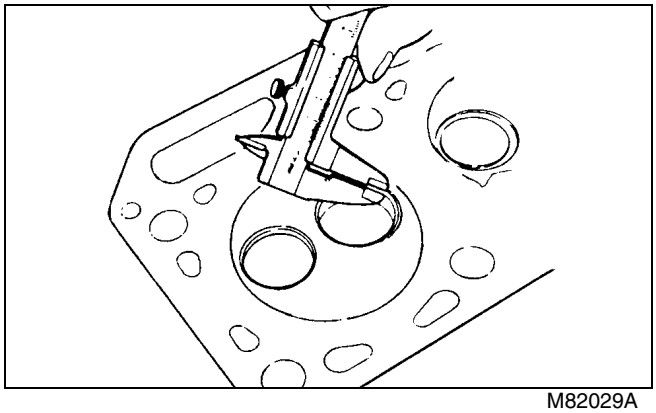
4. Place a straightedge (A) along each of the four sides and each diagonal.

5. Measure clearance between straightedge and combustion surface with a feeler gauge. Replace or resurface cylinder head if distortion is greater than specification.

IMPORTANT: Avoid damage! Remove only enough metal to make cylinder head flat; DO NOT remove more than 0.20 mm (0.008 in.).

6. If cylinder head was resurfaced:

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


M82029A

7. Measure valve seat width. If seat width is greater than wear limit, grind valve seats to meet specifications.

Valve Guide Inspection

NOTE: Clean valve guides using a valve guide brush before measuring.

Measure valve guide inside diameter.

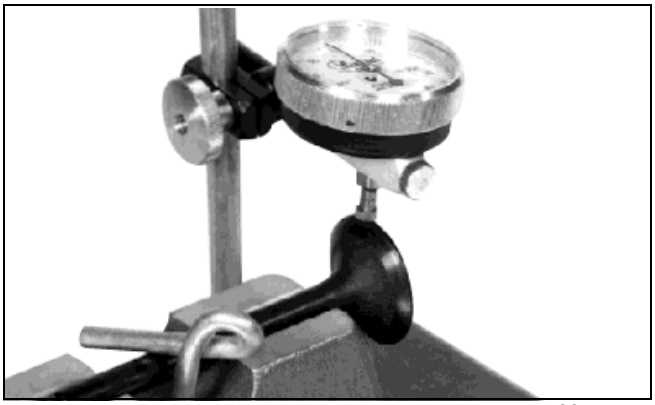
- If diameter exceeds specification, replace guide.
- If the valve stem outside diameter is less than wear limit, subtract the valve stem diameter from the valve guide diameter to determine guide-to-stem clearance.

• If valve guide-to-valve stem clearance exceeds specification, replace valve guides.

Intake and Exhaust Valves

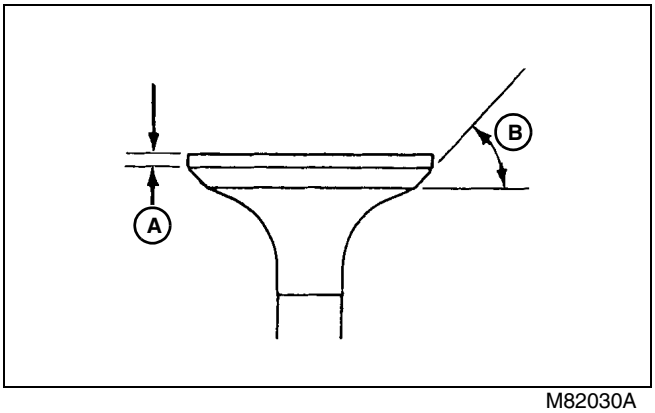
1. Remove carbon from valve head, face, and stem with a power-operated wire brush. Be sure carbon is removed, not merely burnished.

2. Inspect valve head, face, and stem for wear or damage. Replace valve as needed.



M35307

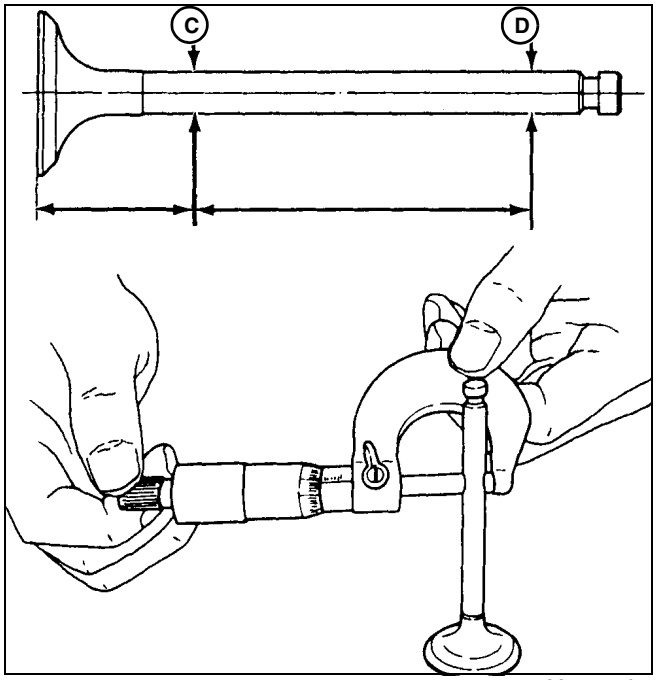
3. Check valves for out-of-round, bent, or warped condition using a valve inspection center. Replace valve as needed.



M82030A

4. If valve faces are worn, burned or pitted, grind valves to proper face angle. If valve face margin (A) is less than specification after grinding, replace valve.

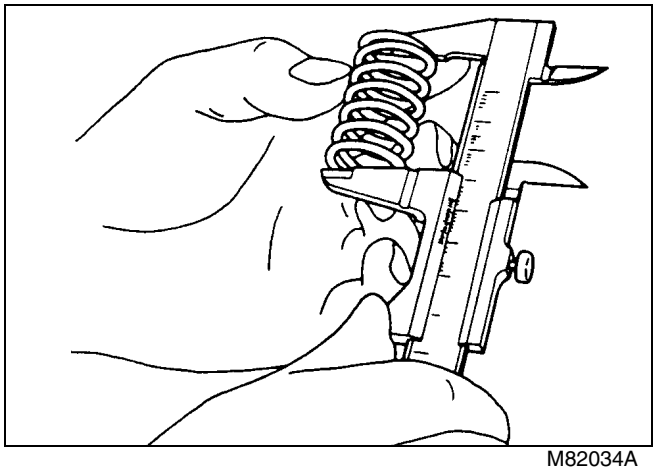
5. Check valve face angle (B). Intake valves should be 45°; exhaust valves should be 30°.



M82031A

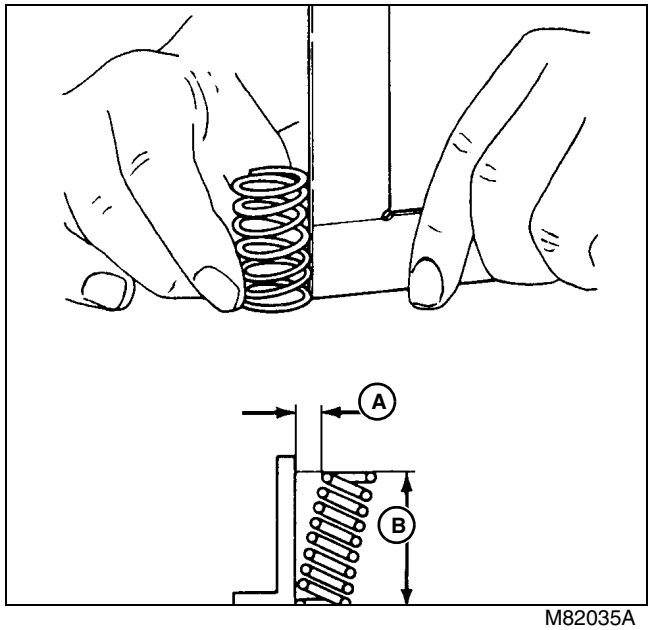
6. Measure valve stem diameter at 20 mm (0.787 in.) from the valve face (C) and 40 mm (1.575 in.) from the first location (D). Replace valve if measurement exceeds specification.

Valve Spring



M82034A

1. Measure valve spring free length. Replace spring if free length is less than specification.



M82035A

2. Measure spring inclination (A) with spring at full free length (B). Replace spring if inclination is greater than specification.

Specifications

4TNE84T and 4TNE88

Valve Recession . . . . . 1.0 mm (0.04 in.)
Cylinder Head Distortion (Max). . . . 0.15 mm (0.006 in.)
Intake Valve Seat Width (Standard). . . . . 1.07-1.24 mm (0.042-0.049 in.)
Intake Valve Seat Width (Wear Limit) . . . . . 1.74 mm (0.068 in.)
Exhaust Valve Seat Width (Standard). . . . . 1.24-1.45 mm (0.049-0.057 in.)
Exhaust Valve Seat Width (Wear Limit) . . . . . 1.94 mm (0.076 in.)
Valve Guide Inside Diameter (Max). . . 8.1 mm (0.32 in.)
Valve Guide-to-Valve Stem Clearance (Max) . . . . . 0.20 mm (0.008 in.)
Valve Face Margin (Min.) . . . . . 0.50 mm (0.02 in.)
Valve Stem Diameter (Min.) . . . . . 7.90 mm (0.311 in.)
Valve Spring Free Length (Min.) . . . . 42 mm (1.653 in.)
Valve Spring Inclination (Max). . . . . 1.10 mm (0.04 in.)

4TNV84T

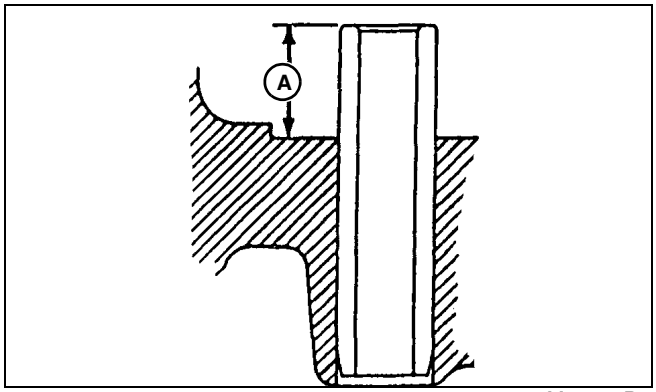
Valve Recession . . . . . 0.8 mm (0.03 in.)
Cylinder Head Distortion (Max). . . . 0.15 mm (0.006 in.)
Intake Valve Seat Width (Standard). . . . . 1.07-1.24 mm (0.042-0.049 in.)
Intake Valve Seat Width (Wear Limit) . . . . . 1.74 mm (0.068 in.)
Exhaust Valve Seat Width (Standard) . . . . . 1.24-1.45 mm (0.049-0.057 in.)
Exhaust Valve Seat Width (Wear Limit) . . . . . 1.94 mm (0.076 in.)
Valve Guide Inside Diameter (Max). . 6.08 mm (0.27 in.)
Valve Guide-to-Valve Stem Clearance (Max) . . . . . 0.15 mm (0.006 in.)
Valve Face Margin (Min.) . . . . . 0.50 mm (0.02 in.)
Valve Stem Diameter (Min.) . . . . . 5.90 mm (0.232 in.)
Valve Spring Free Length (Min.) . . . 36.9 mm (1.452 in.)
Valve Spring Inclination (Max) . . . . . 1.30 mm (0.05 in.)

Valve Guide Replacement

Special or Required Tools

Tool Name	Tool No.	Tool Use
Valve Guide Driver	JDG504	Used to install the valve guides.
8.016 mm (0.315 in.) Valve Guide Reamer	NA	Used to ream inside diameter of valve guides.

1. Disassemble and thoroughly clean the cylinder head.
2. Support the head securely with blocks.
3. Drive the valve guide(s) out.
4. Chill the replacement valve guide(s) in a freezer for about one hour prior to installation.
5. Insert the valve guide with the tapered end squarely in the bore.

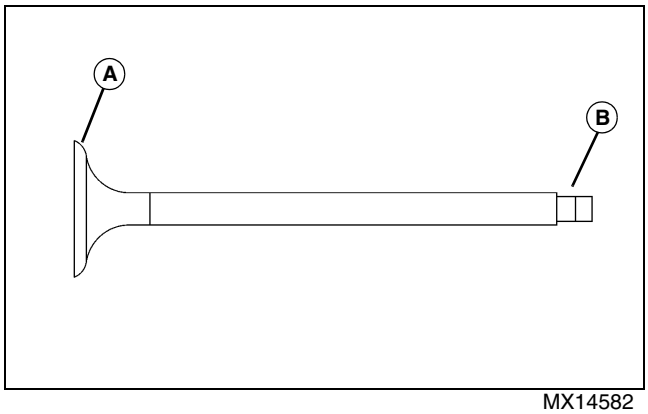


M82193B

6. Install the valve guides using a JDG504 Valve Guide Driver until the top of valve guides are 15 mm (0.590 in.) (A) from valve spring seating surface.
7. Ream the inside diameter of valve guides using an 8.016 mm (0.315 in.) valve guide reamer.

Valve Seat Removal and Installation - Model 1600 Turbo

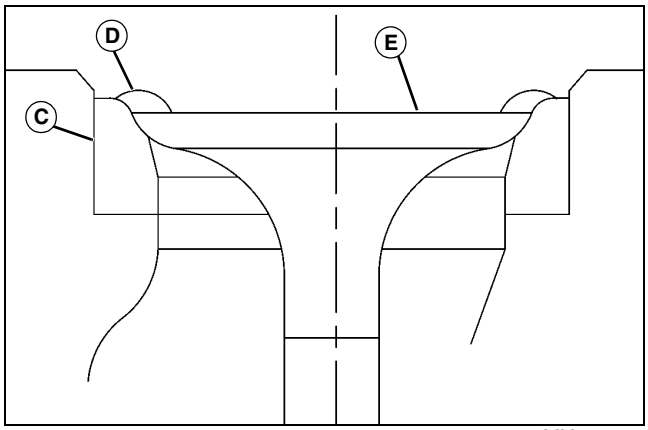
Removal



MX14582

1. Grind the circumference (A) of the intake/exhaust valve head being used to the dimension smaller than the valve seat outer diameter.

2. Grind the circumference of the stem end (B) of the valve to the same diameter as the collet groove.



MX14580

3. Install valve into seat (C) to be replaced.

4. Weld valve (E) to seat in a minimum of 3 places (D).

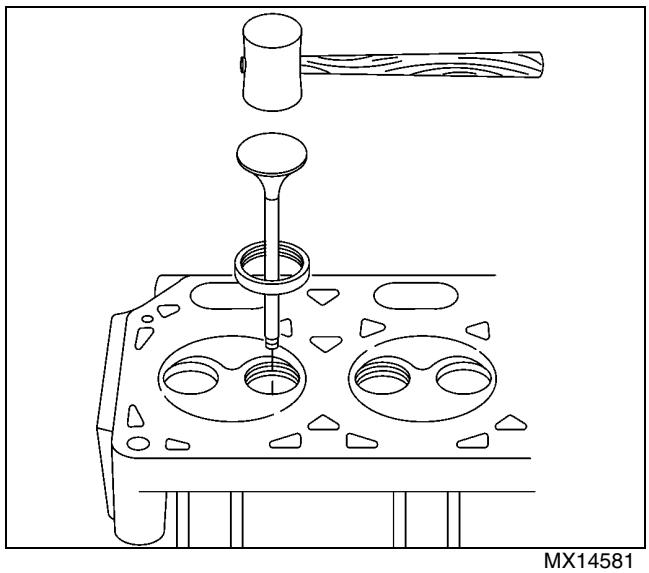
5. Using a dead blow hammer, hit stem of valve to extract seat.

Installation

Installation is done in the reverse order of removal.

1. Put the valve seat in a container which contains alcohol with dry ice to cool it sufficiently.

2. Heat the cylinder head around the area for valve seat insertion to 80-100°C (176-212°F).

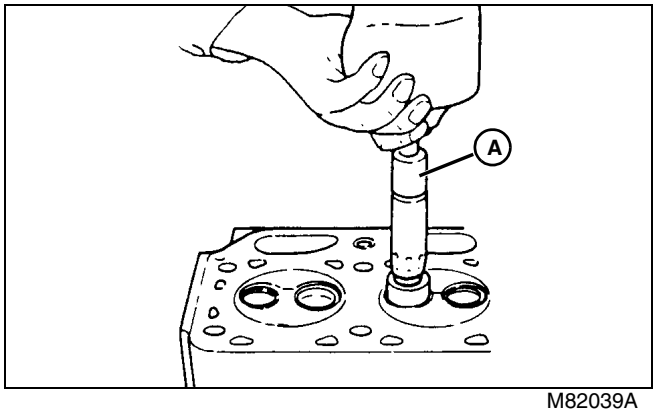

MX14581

3. With the new intake/exhaust valve, securely insert the cooled valve seat into the cylinder head by tapping on the head of the intake/exhaust valve.

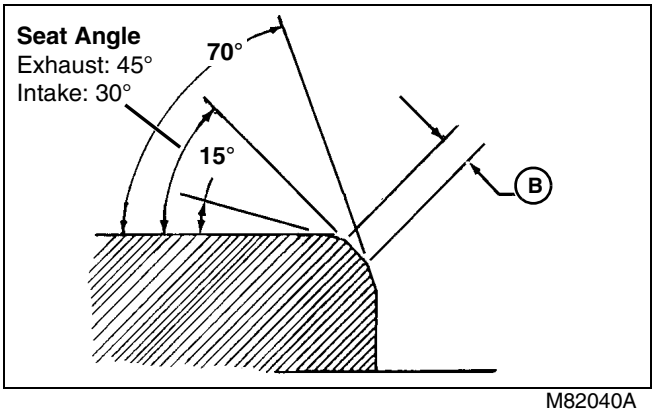
4. Set aside the cylinder head until the entire cylinder head is cooled to normal temperature.

Grind Valve Seats

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



M82039A



M82040A

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

1. Grind intake valve seat using a 30° seat grinder (A) and exhaust valve seat using a 45° seat grinder. Follow tool manufacturer's instructions.

2. Measure valve seat width (B) after grinding.

3. If seat is too wide after grinding, grind lower seat surface using a 70° seat grinder until seat width is close to specifications.

4. Grind upper seat surface using a 15° seat grinder until seat width is narrowed to specifications.

5. Lap valves.

6. Check valve recession. If valve recession exceeds maximum specifications, replace valve(s) and/or cylinder head.

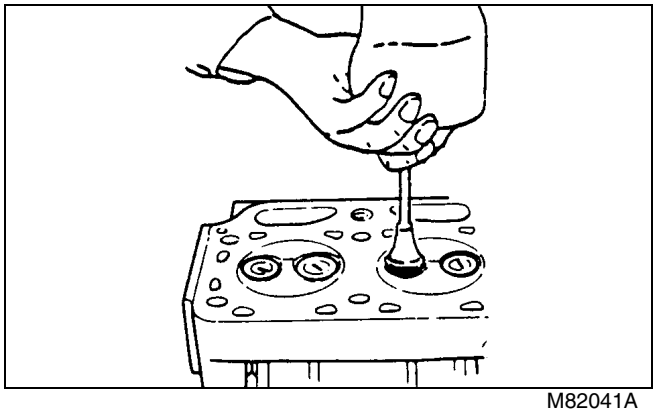
Specifications

Intake Valve Seat Width (Standard). . . . . 1.07-1.24 mm (0.042-0.049 in.)
Intake Valve Seat Width (Wear Limit) . . . . . 1.74 mm (0.068 in.)
Exhaust Valve Seat Width (Standard). . . . . 1.24-1.45 mm (0.049-0.057 in.)
Exhaust Valve Seat Width (Wear Limit) . . . . . 1.94 mm (0.076 in.)

Lap Valves

NOTE: Use a rubber-type lapping tool.

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


M82041A

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

2. Turn valve to lap valve to seat.

3. Lift valve from seat every 8 to 10 strokes. Lap until a uniform ring appears around the surface of the valve face.

4. Wash all parts in solvent to remove lapping compound. Dry parts.

5. Check position of lap mark on valve face. Lap mark must be on or near center of valve face.

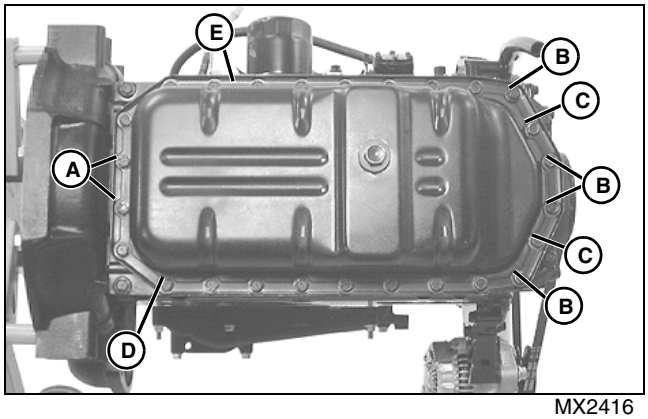
Oil Pan and Crankcase Housing Extension

Other Material

Part No.	Part Name	Part Use
TY16135 (US) 58730 (LOCTITE®)	ULTRA BLUE® RTV Silicone Form-in-Place Gasket	Applied to extension housing-to-engine block mating surface and oil pan mounting flange before installation.

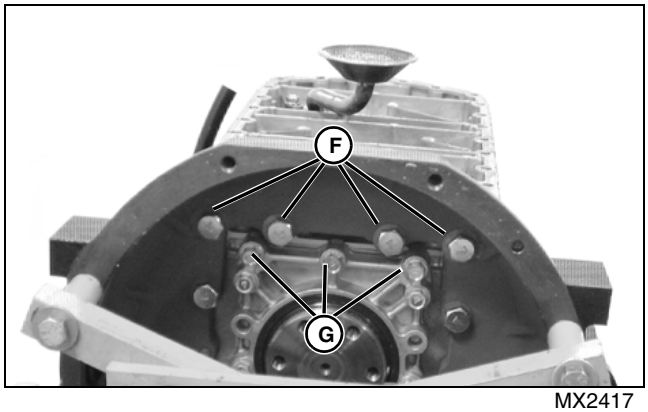
Removal/Installation

1. Remove flywheel.



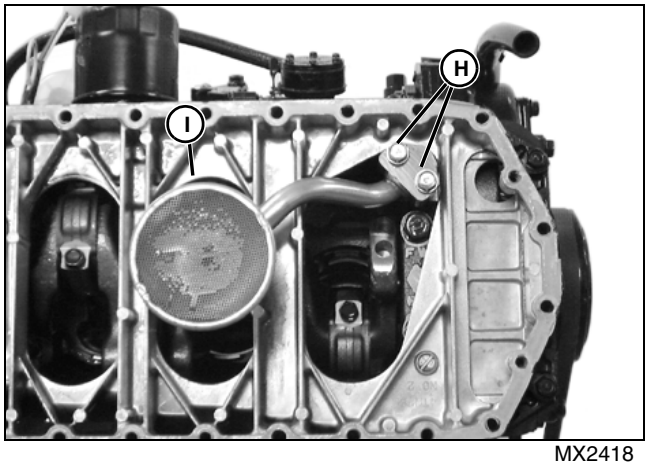
MX2416

2. Remove two M8 x 12 cap screws (A).
3. Remove four M8 x 50 cap screws (B).
4. Remove two M8 x 25 cap screws (C).
5. Remove 18 M8 x 45 cap screws (D).
6. Remove oil pan (E).



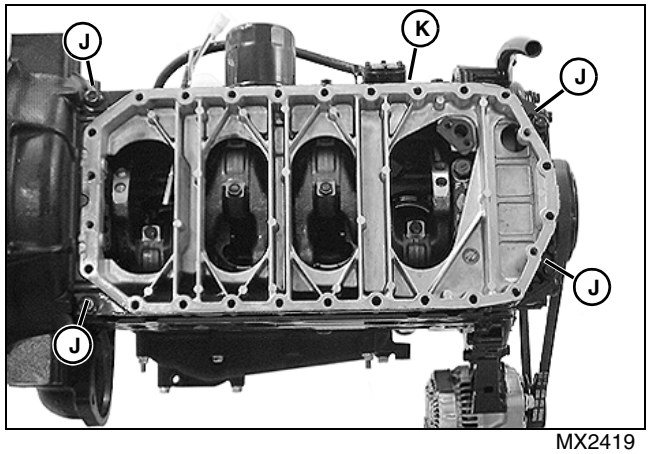
MX2417

7. Remove four flywheel-to-oil housing extension cap screws (F).
8. Remove three oil seal housing cap screws (G)



MX2418

9. Remove two cap screws (H).
10. Remove oil pump pick-up tube (I).



MX2419

11. Remove four cap screws (J).
12. Remove housing extension (K).
13. Remove sealant residue from oil pan, housing extension and engine block mating surfaces.

Installation

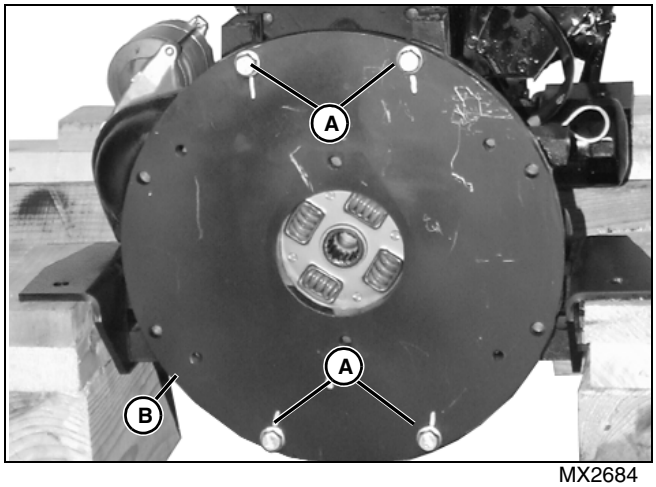
Installation is done in the reverse order of removal.

- Apply RTV adhesive to extension housing-to-engine block mating surface.
- Apply RTV adhesive to oil pan mounting flange.

Flywheel Removal and Installation

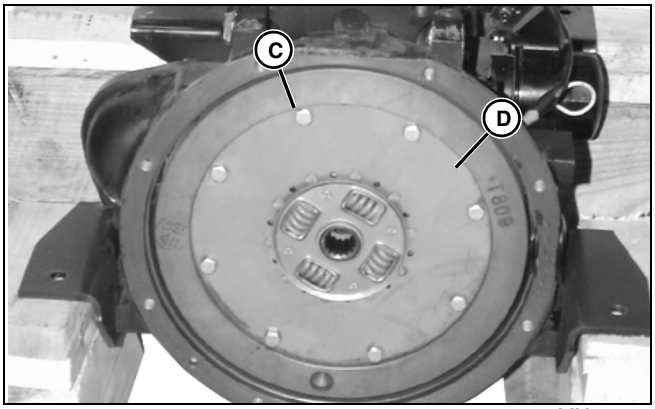
Removal

1. Remove starting motor.



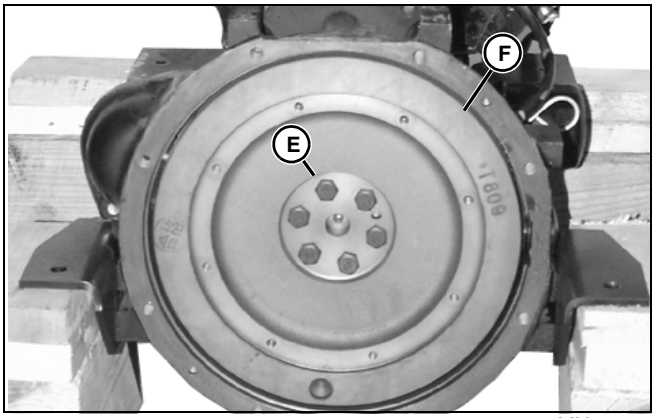
MX2684

2. Remove four cap screws (A) and remove plate (B).



MX2685

3. Remove eight cap screws (C).
4. Remove coupler (D).



MX2686

5. Remove six cap screws (E).
6. Remove flywheel (F).
7. Inspect flywheel for damage. Replace as needed.

Installation

Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! Never reuse flywheel cap screws. Always install new.

- Apply clean engine oil to threads of flywheel mounting cap screws.
- Tighten flywheel cap screws (E) to specification.
- Install coupler with long side of splined shaft toward flywheel.
- Install plate with flat side facing away from flywheel.

Specifications

Flywheel Cap Screw Torque . . . . . 86 N•m (63 lb-ft)

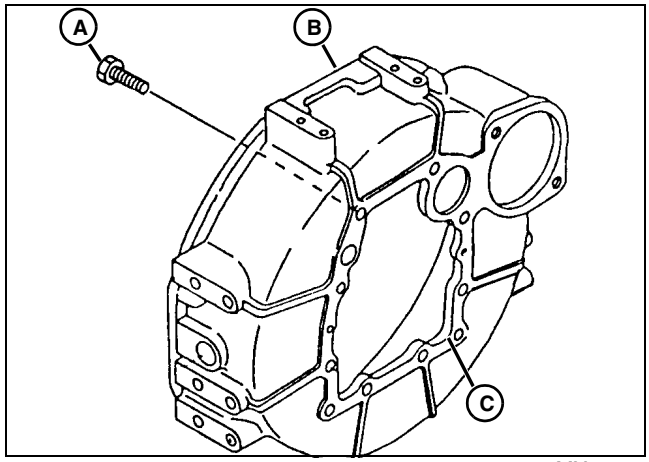
Flywheel Housing Removal and Installation

Other Material

Part No.	Part Name	Part Use
TY16135 (US) 58730 (LOCTITE®)	ULTRA BLUE® RTV Silicone Form-in-Place Gasket	Applied to housing-to-engine block mating surface before installation.

Removal

1. Remove flywheel.



MX2411

2. Remove eight cap screws (A).
3. Remove flywheel housing (B).

Installation

Installation is done in the reverse order of removal.

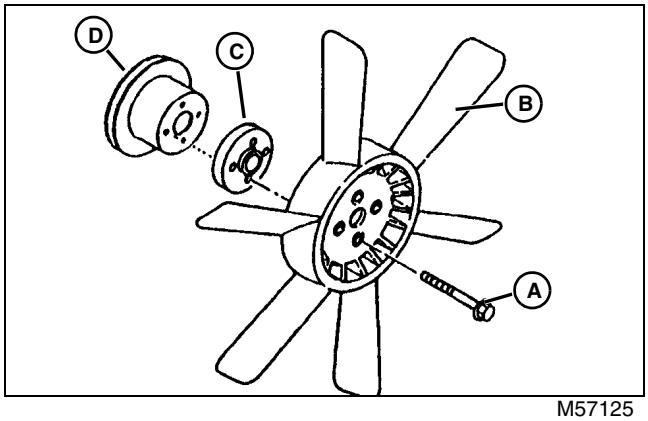
Apply RTV adhesive to the housing-to-engine block mating surface (C).

Timing Gear Cover Removal and Installation

Other Material

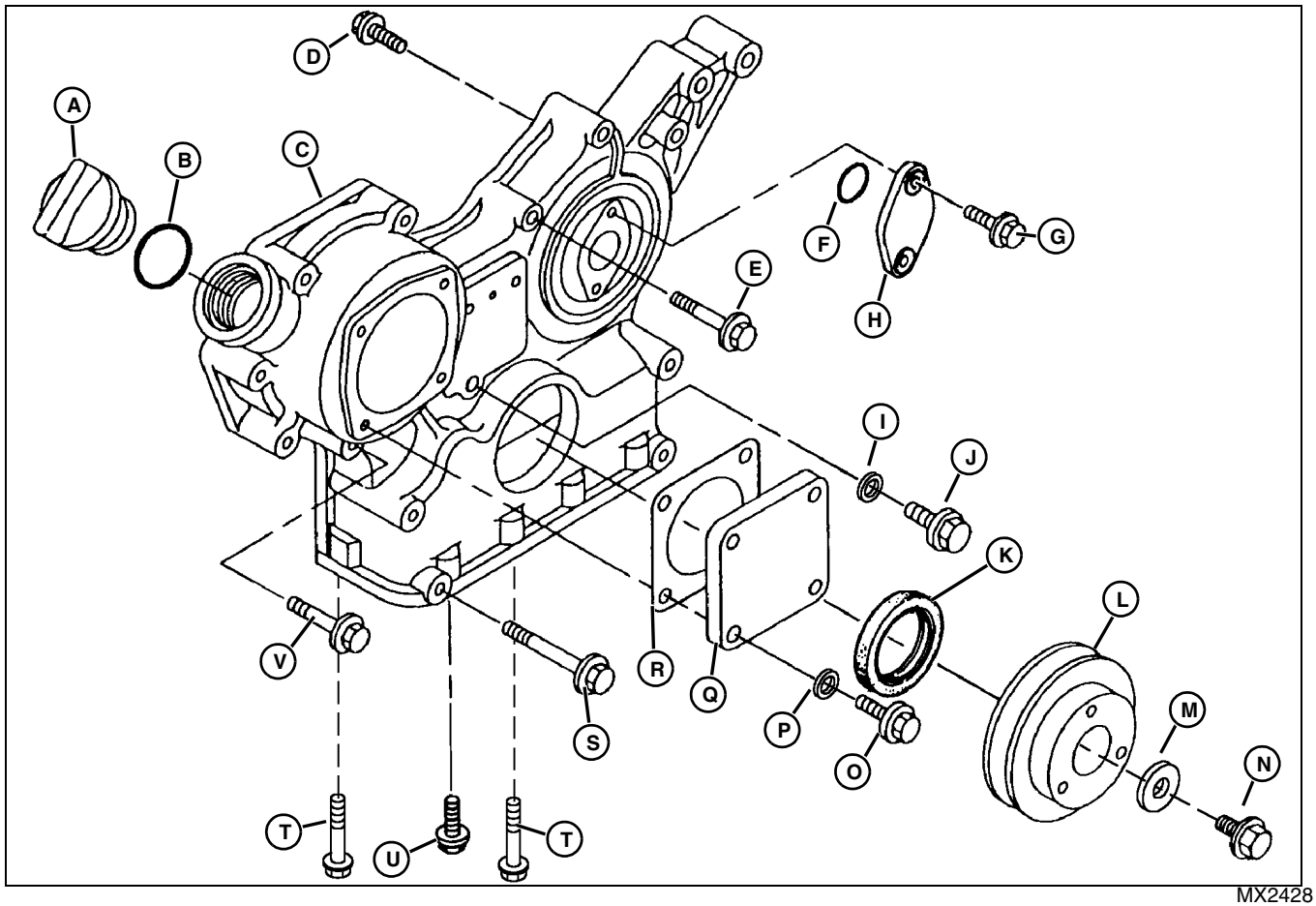
Part No.	Part Name	Part Use
TY16135 (US) 58730 (LOCTITE®)	ULTRA BLUE® RTV Silicone Form-in-Place Gasket	Applied to timing gear cover mating surfaces before installation.
T43512 (US) 242 (LOCTITE) TY9473 (Canada)	Thread Lock and Sealer (Medium Strength)	Applied to threads of crankshaft pulley cap screw.

1. Remove alternator.



M57125

2. Remove four cap screws (A) and washers.
3. Remove fan (B) and spacer (C).
4. Remove pulley (D).



MX2428

A - Cap
B - O-Ring
C - Timing Gear Cover
D - Cap Screw M8 x 20 (2 used)
E - Cap Screw M8 x 55 (3 used)
F - O-Ring
G - Cap Screw M6 x 12 (2 used)
H - End Cover
I - Seal Washer
J - Cap Screw M8 x 16
K - Seal
L - Crankshaft Pulley
M - Washer
N - Crankshaft Pulley Cap Screw
O - Cap Screw M8 x 12 (4 used)
P - Washer (4 used)
Q - Injection Pump Gear Cover
R - Gasket
S - Cap Screw M8 x 85 (4 used)
T - Cap Screw M8 x 50 (4 used)
U - Cap Screw M8 x 25 (2 used)
V - Cap Screw M8 x 45 (6 used)

5. Remove crankshaft pulley cap screw (N) and washer (M).

6. Remove pulley (L) using a puller.

NOTE: It is not necessary to remove the end cover (H) and O-ring (F) or injection pump gear cover (Q) to remove timing gear cover.

7. Remove mounting cap screws (D, E, J, and S-V).

8. Remove timing gear cover (C).

IMPORTANT: Avoid damage! Use extreme care in removal of cover. Cover is aluminum and easily damaged, broken or bent by prying. DO NOT hammer on cover at any time.

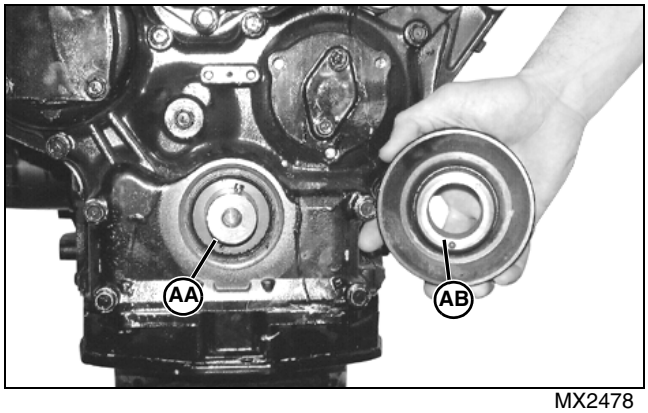
9. Remove sealant residue from the timing cover and housing mating surfaces.

10.Remove seal (K).

Installation

Installation is done in the reverse order of removal.

- Install a new seal using a driver set.
- Apply RTV silicone sealant to timing cover mating surfaces.



MX2478

- Align the hole in the crankshaft pulley (X) with the pin in the crankshaft gear (W).
- Apply thread lock and sealer (medium strength) to threads of crankshaft pulley cap screw.
- Tighten crankshaft pulley cap screw to specification.

Specifications

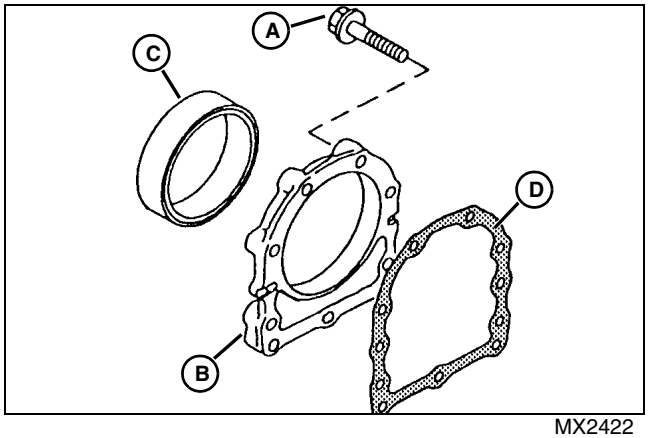
Crankshaft Pulley Cap Screw Torque 117 N•m (86 lb-ft)

Crankshaft Rear Oil Seal Replacement

Other Material

Part No.	Part Name	Part Use
TY16135 (US) 58730 (LOCTITE®)	ULTRA BLUE® RTV Silicone Form-in-Place Gasket	Applied to oil seal case mating surface before installation.

1. Remove flywheel.



MX2422

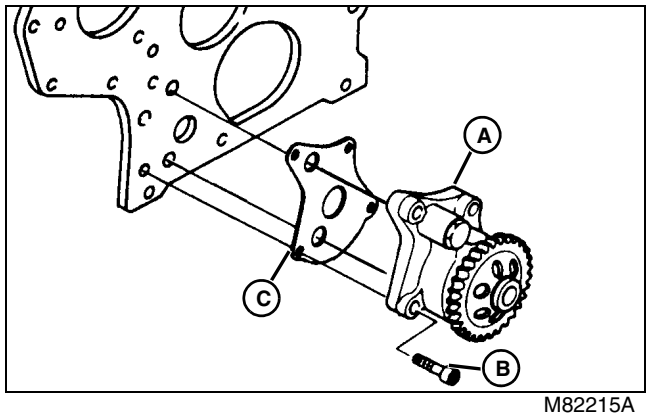
2. Remove nine oil seal case-to-cylinder block cap screws (A).
3. Remove oil seal case (B).
4. Remove oil seal (C).

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

5. Install the oil seal with the lip toward the cylinder block. Drive the oil seal into the case using a seal driver, until the seal is flush with the surface of the seal case.
6. Apply RTV adhesive (D) to the mating surface of the oil seal case before installation.

Oil Pump Removal and Installation (Yanmar TNE Engine)

1. Remove timing gear cover.
2. Check oil pump gear backlash. Replace the entire oil pump if backlash is more than specification.



M82215A

3. Remove three mounting cap screws (B).
4. Remove oil pump (A) and gasket (C).
5. Inspect all parts for wear or damage.

Installation

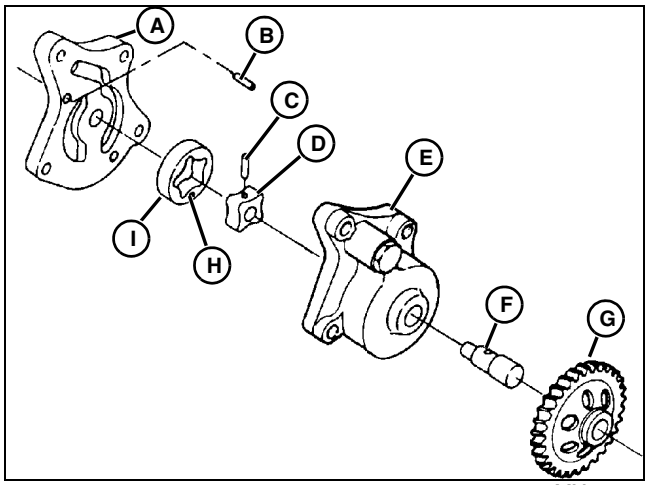
Installation is done in the reverse order of removal.

Use a new gasket for installation.

Specifications

Gear Backlash (Max) . . . . . 0.12 mm (0.005 in.)

Oil Pump Disassembly and Assembly (Yanmar TNE Engine)



MX2426

A - Backing Plate
B - Alignment Pin (2 used)
C - Pin
D - Inner Rotor
E - Pump Body
F - Rotor Shaft
G - Drive Gear
H - Alignment Mark
I - Outer Rotor

NOTE: The oil pump drive gear is press-fit to the shaft.

1. Remove drive gear (G) using a knife-edge puller and a press.
2. Remove backing plate (A)
3. Remove outer rotor (I).
4. Remove pin (C) and inner rotor (D).
5. Remove rotor shaft (F).
6. Inspect all parts for wear or damage.

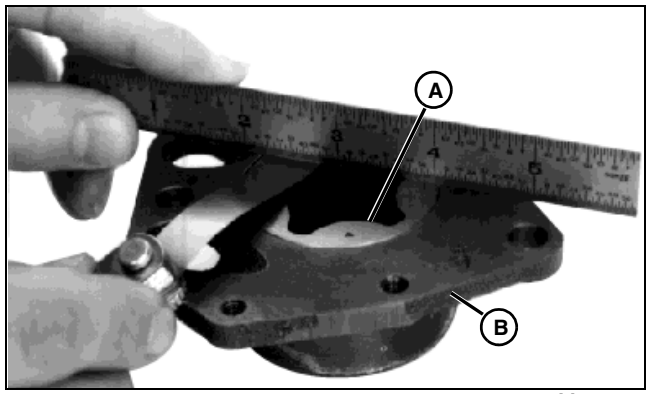
Assembly

Assembly is done in the reverse order of disassembly.

- Coat all parts with a light coat of clean engine oil before assembly.
- Install the outer rotor with the alignment mark (H) facing toward the pump body (E).

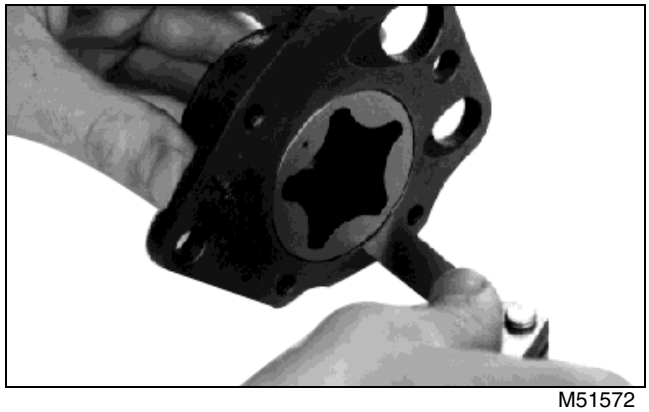
Oil Pump Inspection (Yanmar TNE Engine)

1. Measure the rotor shaft outside diameter. Record the measurement.
2. Measure the inside diameter of the rotor shaft bore. Record the measurement.
3. Subtract the rotor shaft outside diameter from the rotor shaft bore inside diameter to determine the rotor shaft-to-bore clearance. Replace the pump if the clearance is greater than specification.



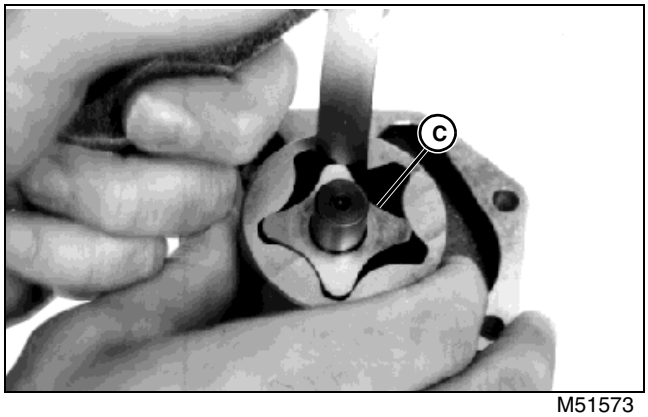
M51571

4. Install outer rotor (A) in pump body (B).
5. Place a straightedge across the pump body mounting surface and measure outer rotor recess using a feeler gauge. Replace the entire pump if clearance is greater than specification.



M51572

6. Check outer rotor-to-pump body clearance using a feeler gauge. Replace the entire pump if clearance is greater than specification.



M51573

7. Install the inner rotor (C) in the outer rotor.

8. Check clearance between the tip of the inner rotor and the outer rotor. Replace the entire pump if clearance is greater than specification.

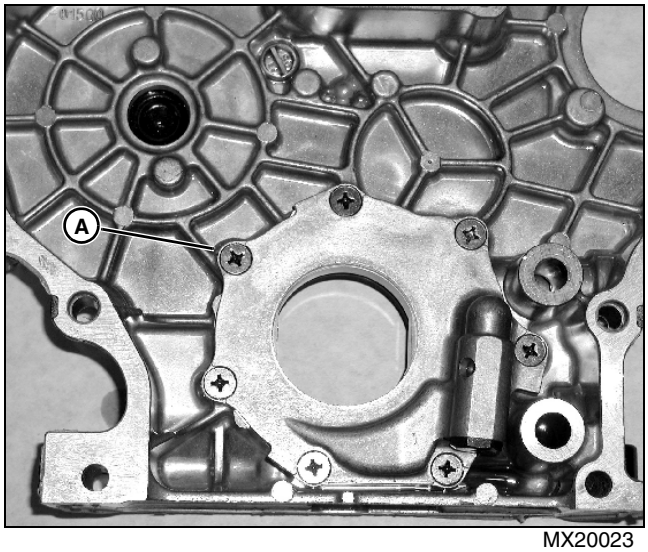
Specifications

Rotor Shaft-to-Bore Clearance (Max) 0.2 mm (0.008 in.)
Outer Rotor Recess Clearance (Max) . . . . . 0.15 mm (0.006 in.)
Outer Rotor-to-Pump Body Clearance (Max) . . . . . 0.25 mm (0.020 in.)
Inner Rotor-to-Outer Rotor Clearance . . . . . 0.15 mm (0.006 in.)

Remove, Inspect, and Install Oil Pump (Yanmar TNV Engine)

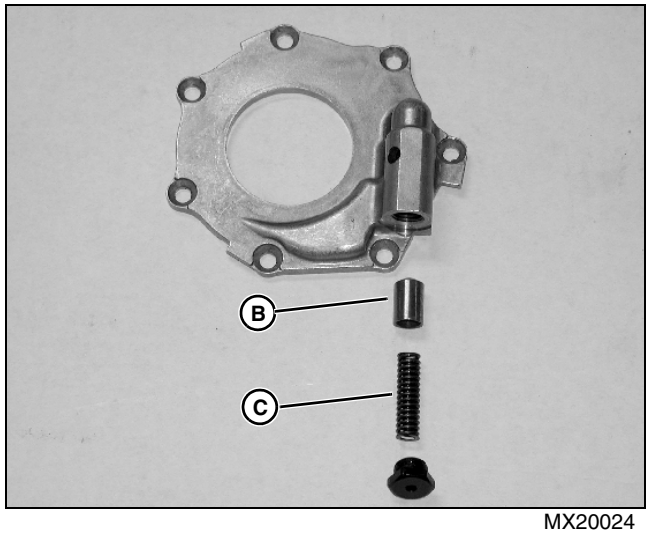
Remove

1. Remove the timing gear cover. (See “Timing Gear Cover Removal and Installation” on page 91.)



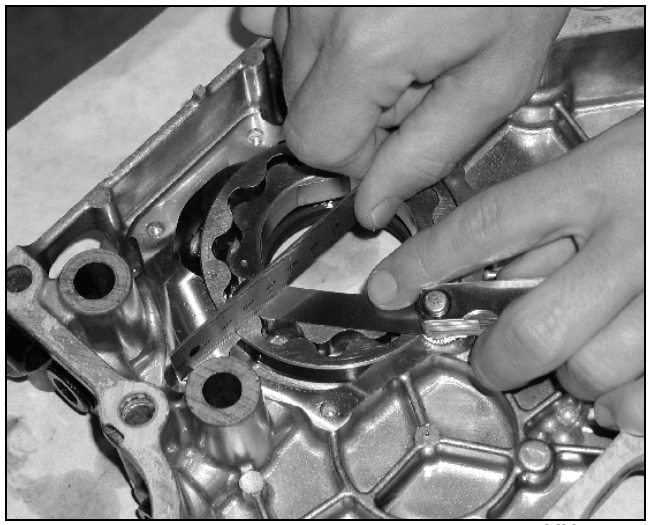
MX20023

2. Remove screws (A).



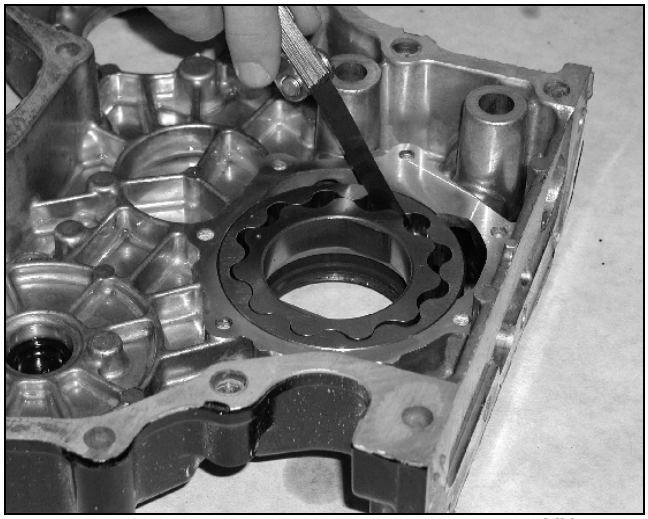
MX20024

3. Inspect pressure regulating valve poppet (B) and spring (C).



MX20025

4. Use a straightedge and feeler gauge to measure rotor recess. If rotor recess is more than wear limit, replace rotor assembly.



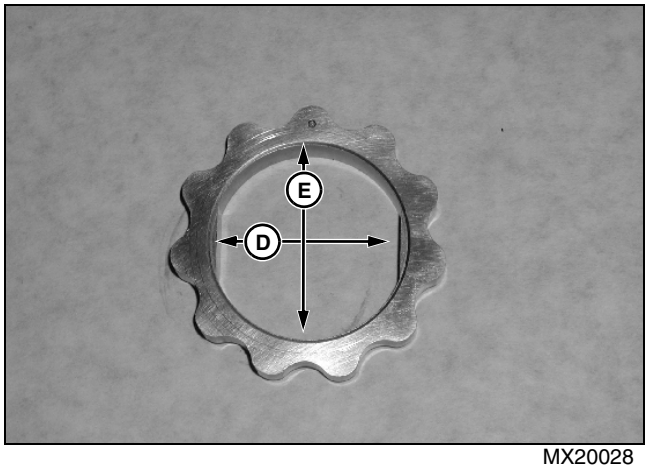
MX20026

5. Measure inner to outer rotor clearance. If clearance is more than wear limit, replace rotor assembly.



MX20027

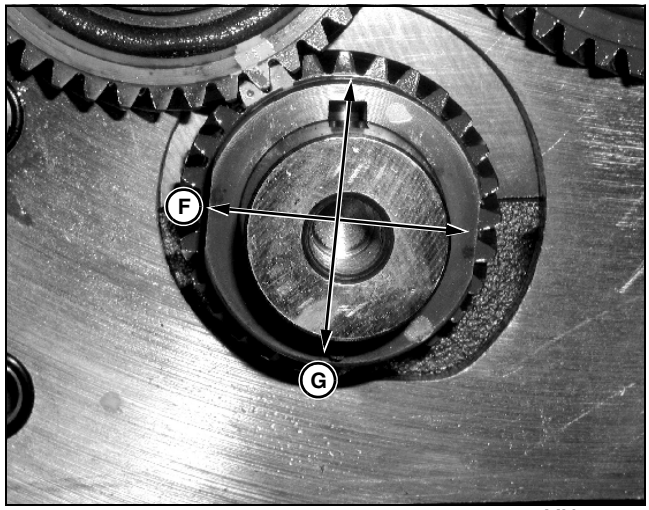
6. Measure outer rotor clearance to pump body. If clearance is more than wear limit, replace entire assembly.



MX20028

7. Measure width across flats on inner rotor (D).

8. Measure inner rotor inner diameter (E).



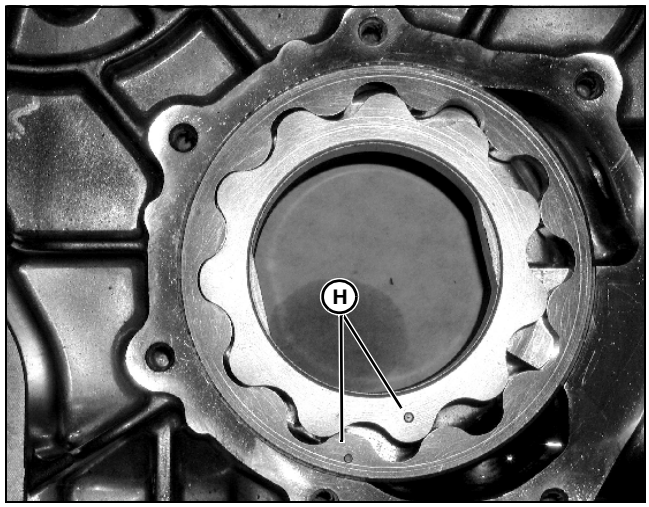
MX20029

9. Measure width across flats of crank gear (F).

10. Measure the outer diameter of crank gear (G).

Install

1. Apply clean engine oil to inner and outer rotor and pump body.



MX20030

2. Install rotors with dots (H) facing out.

3. Apply medium strength thread lock to pump cover screws. Tighten to specification.

4. Install timing cover.

Specifications

Rotor Recess

Standard . . . . . 0.02-0.07 (0.001-0.003 in.)
Wear Limit. . . . . 0.12 mm (0.005 in.)

Outer Rotor-to-Pump Body Clearance

Standard . . . . . 0.12-0.21 mm (0.005-0.008 in.)
Wear Limit . . . . . 0.30 mm (0.012 in.)

Inner-to-Outer Rotor Clearance

Wear Limit . . . . . 0.16 mm (0.006 in.)

Width Across Flats of Inner Rotor

Standard . . . . . 49.95-50.05 mm (1.967-1.974 in.)

Inner Rotor Inner Diameter

Standard . . . . . 53.05-53.15 mm (2.088-2.093 in.)

Width Across Flats of Crank Gear

Standard . . . . . 49.45-49.75 mm (1.947-1.959 in.)

Outer Diameter of Crank Gear

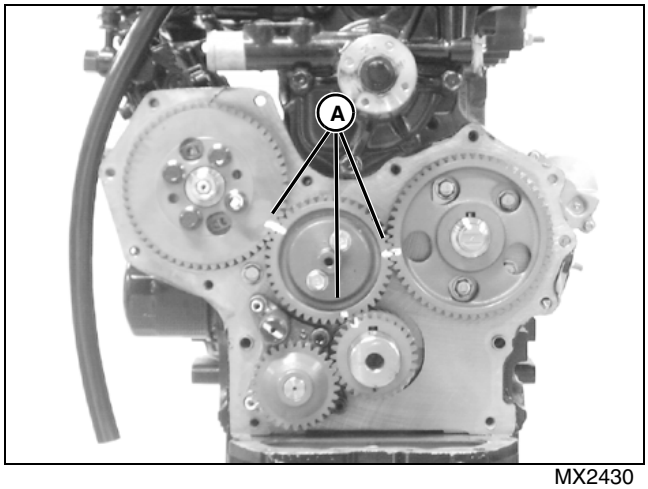
Standard . . . . . 53.45-53.55 mm (2.104-2.108 in.)

Pump Cover Screws . . . . . 7 N•m (61 lb-in.)

Idler Gear Removal and Installation

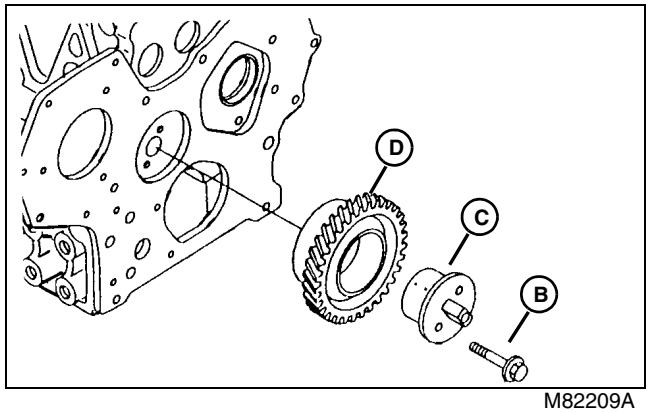
1. Remove timing gear cover.
2. Check timing gear backlash.

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



MX2430

3. Rotate the crankshaft until all timing gear alignment marks (A) align.



M82209A

4. Remove two cap screws (B).
5. Remove idler gear shaft (C) and gear (D).
6. Inspect all parts for wear or damage.

Installation

Installation is done in the reverse order of removal.

Idler Gear Inspection

1. Inspect gear for chipped or broken teeth. Replace the gear as needed.

2. Measure the idler gear shaft outside diameter. Record the measurement. Replace the shaft if the diameter measures less than specification.

3. Measure the inside diameter of the idler gear bushing. Record the measurement. Replace the bushing if the inside diameter measures greater than specification.

4. Subtract the idler gear shaft outside diameter from the idler gear bushing inside diameter, to determine the shaft-to-bushing clearance. Replace the shaft, bushing, or both if the clearance is greater than specification.

Specifications

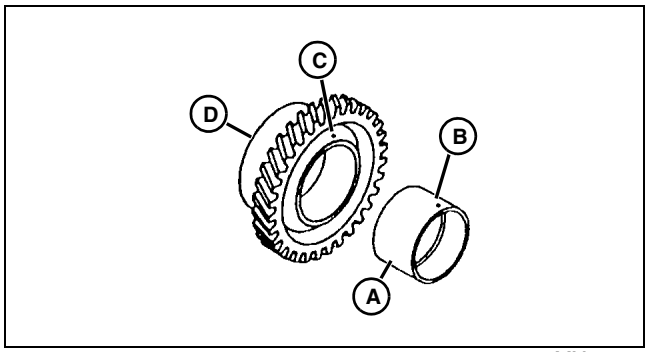
4TNE84T and 4TNE88

Idler Gear Shaft
Outside Diameter (Min) . . . . . 45.93 mm (1.808 in.)
Idler Gear Bushing
Inside Diameter (Max) . . . . . 46.08 mm (1.814 in.)
Shaft-to-Bushing Clearance (Max) . 0.15 mm (0.006 in.)

4TNV84T

Idler Gear Shaft
Outside Diameter (Min) . . . . . 45.90 mm (1.807 in.)
Idler Gear Bushing
Inside Diameter (Max) . . . . . 46.08 mm (1.814 in.)
Shaft-to-Bushing Clearance (Max) 0.175 mm (0.007 in.)

Idler Gear Bushing Replacement



MX2429

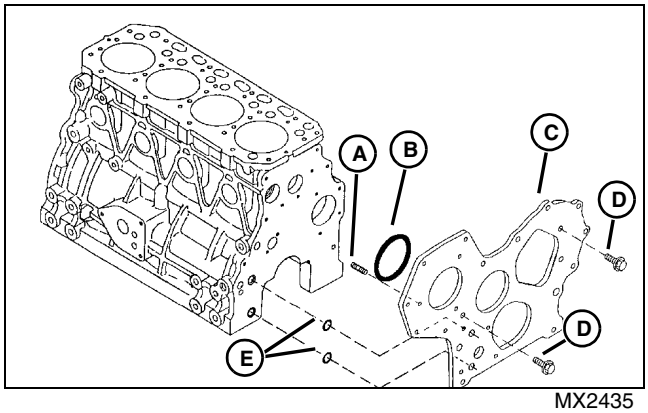
1. Remove the bushing (A) using a bearing driver.
2. Align the oil hole (B) in the bushing with the oil hole in idler gear (C), and press the bushing into the idler gear (D) using a bearing driver until the bushing is flush with the surface of the idler gear.

Timing Gear Cover Mounting Plate Removal and Installation

Other Material

Part No.	Part Name	Part Use
TY16135 (US) 58730 (LOCTITE®)	ULTRA BLUE® RTV Silicone Form-in-Place Gasket	Applied to engine block around the outer timing gear cover plate mating surface.

1. Remove camshaft.
2. Remove idler gear.
3. Remove fuel injection pump.
4. Remove oil pump.



MX2435

5. Remove four cap screws (D).
6. Remove timing gear cover plate (C) and O-rings (B and E).
7. Remove sealant residue from timing gear cover plate and engine block mating surfaces.

Installation

Installation is done in the reverse order of removal.

- Use new O-rings for installation.
- Apply a bead of RTV adhesive to the engine block, around the outer timing gear cover plate mating surface. DO NOT apply adhesive along the bottom edge of engine block.
- Tighten cap screws to specification.

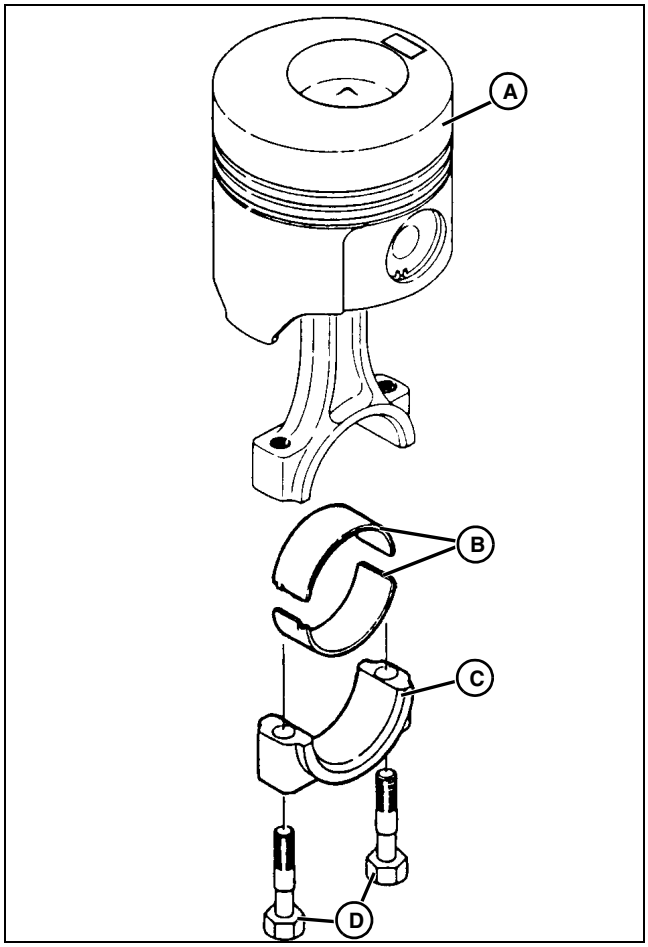
Specifications

Timing Gear Cover Mounting Plate Cap Screw Torque . 25 N•m (220 lb-in.)

Piston and Connecting Rod Assembly Removal

1. Remove oil pan and crankcase housing extension.
2. Remove cylinder head.
3. Check top of cylinder bore for ridges. These ridges can cause damage to piston if not removed.
4. If necessary, remove ridge from top of cylinder bore using a ridge reamer.

IMPORTANT: Avoid damage! Keep connecting rods (A) and caps (C) together. Rods and caps are a matched set. Note stamped numbers on each part.



M82196AB

5. Remove two cap screws (D), connecting rod cap (C), and bearing inserts (B).

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

6. Note connecting rod alignment mark in relation to the cylinders. Start at flywheel end with cylinder number 1, then number 2, etc.

7. Push piston and connecting rod out of cylinder bore using a wooden dowel.

8. Disassemble and inspect all parts for wear or damage.

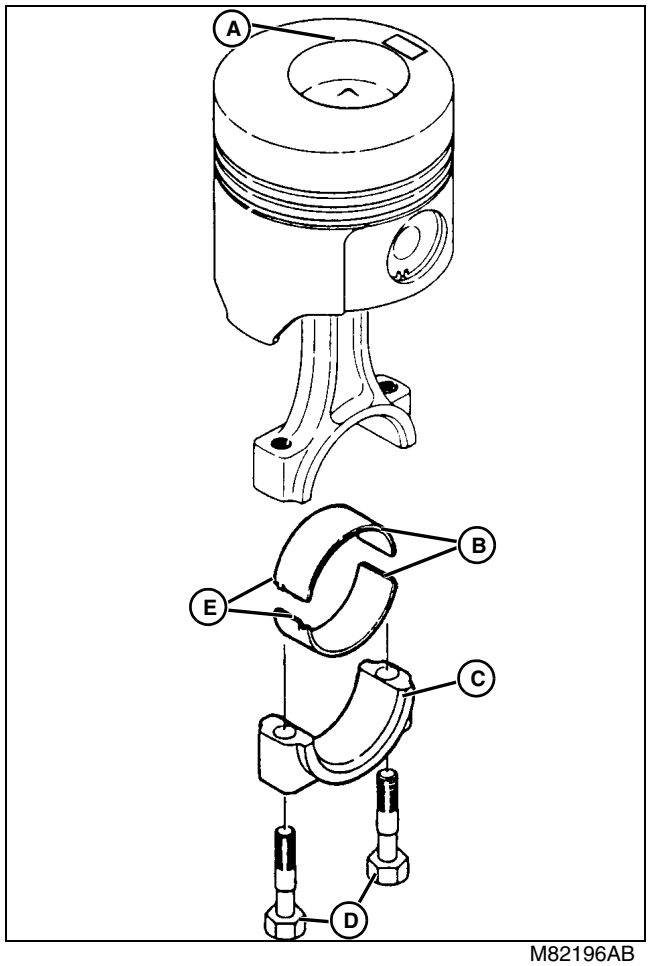
Piston and Connecting Rod Assembly Installation

NOTE: Apply clean engine oil on all parts during installation.

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

Never reuse connecting rod cap screws. Replace with new.

1. Assemble piston and connecting rod.



M82196AB

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

IMPORTANT: Avoid damage! DO NOT touch bearing insert surfaces. Oil and acid from your fingers will corrode the bearing surface.

3. Install bearing inserts (B) on connecting rod and rod cap (C), aligning tangs (E) with grooves.

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

4. Match the connecting rods to caps using the stamped numbers on each.

5. If new bearing inserts are being installed, check rod bearing clearance.

6. Install caps (C) on matching connecting rods.

7. Dip entire connecting rod cap screws (D) in clean engine oil. Install new cap screws and tighten to specification.

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

9. Install cylinder head.

10. Install oil pan and crankcase housing extension.

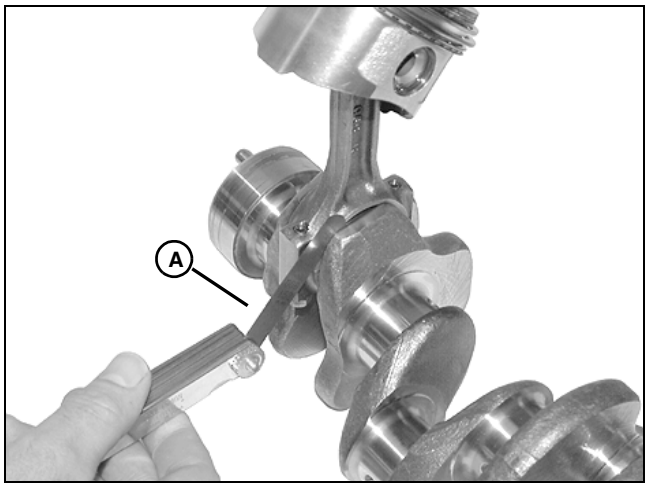
Specifications

Connecting Rod Cap Screw Torque . . 49 N•m (36 lb-ft)

Check Connecting Rod Side Play

1. Remove crankshaft from cylinder block.

2. Install connecting rod on crankshaft. Tighten connecting rod cap screws to specification.



M98862

3. Measure connecting rod side clearance using a feeler gauge (A). Replace connecting rod and/or crankshaft if clearance is greater than specification.

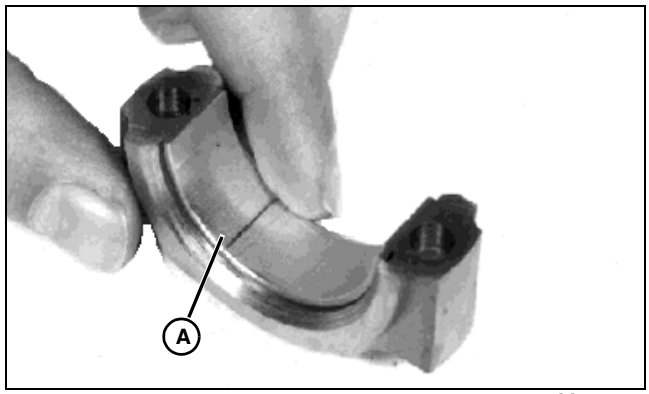
Specifications

Connecting Rod Cap Screw Torque . . 49 N•m (36 lb-ft)
Connecting Rod Side Play (Max) . . 0.40 mm (0.016 in.)

Check Connecting Rod Bearing Clearance

1. Remove connecting rod cap.

2. Wipe oil from bearing insert and crankshaft journal.



M35351

3. Put a piece of PLASTIGAGE® (A), or an equivalent, along the full length of the bearing insert approximately 6 mm (0.250 in.) off center.

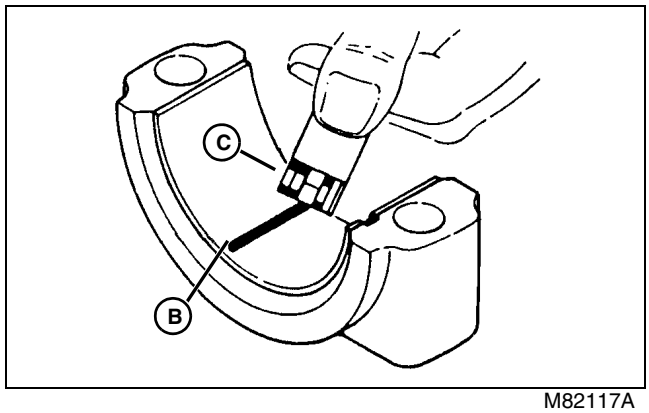
4. Turn crankshaft approximately 30° from bottom dead center.

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

5. Install connecting rod end cap and original cap screws. Tighten cap screws to specification.

6. Remove cap screws and connecting rod cap.

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



M82117A

7. Use the graduated marks (C) on the envelope to compare the width of the flattened PLASTIGAGE (B) at its widest point.

8. Determine bearing clearance. The number within the graduation marks indicates the bearing clearance in inches or millimeters depending on which side of the envelope is used. Replace the bearing inserts if clearance is greater than specification.

9. Remove PLASTIGAGE.

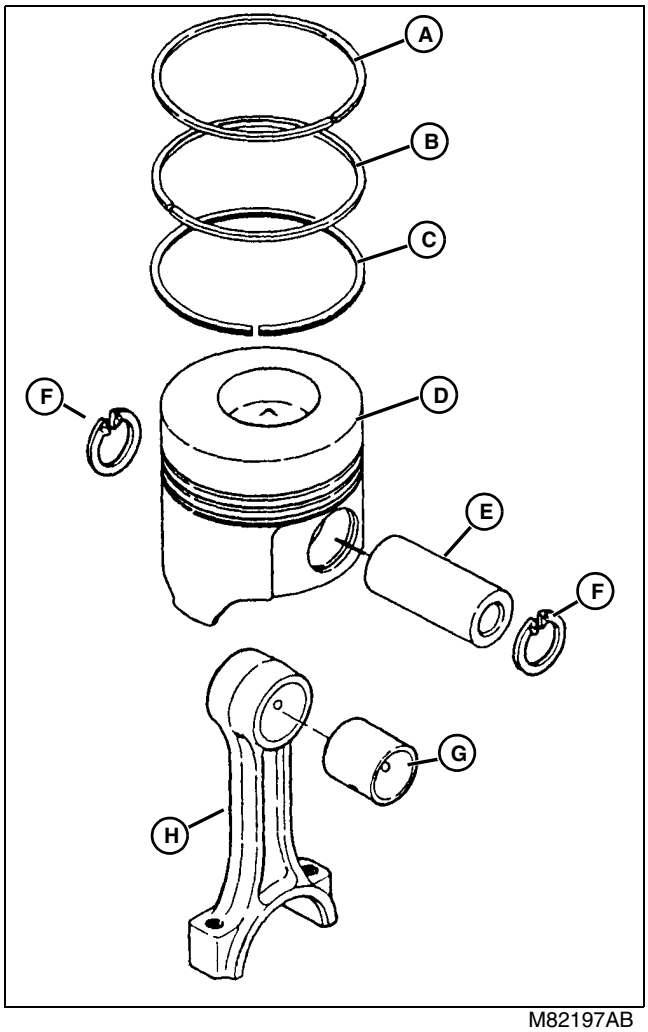
Specifications

Connecting Rod Cap Screw Torque . . 49 N•m (36 lb-ft)
Connecting Rod Bearing-to-Crankshaft Clearance (Max) . . . . . 0.16 mm (0.006 in.)

Piston and Connecting Rod Assembly Disassembly

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

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



M82197AB

A - 1st Compression Ring
B - 2nd Compression Ring
C - Oil Ring with Coil Expander
D - Piston
E - Piston Ring
F - Retaining Ring (2 used)
G - Piston Pin Bushing
H - Connecting Rod

2. Remove piston rings (A, B, and C), starting with the first compression ring (A), by gently spreading them open just enough to clear the outside diameter of the piston. This can be done by hand or with a ring expander.

3. Remove piston pin retaining rings (F).

4. Remove piston pin (E). Excessive pressure should not be necessary to remove piston pin.

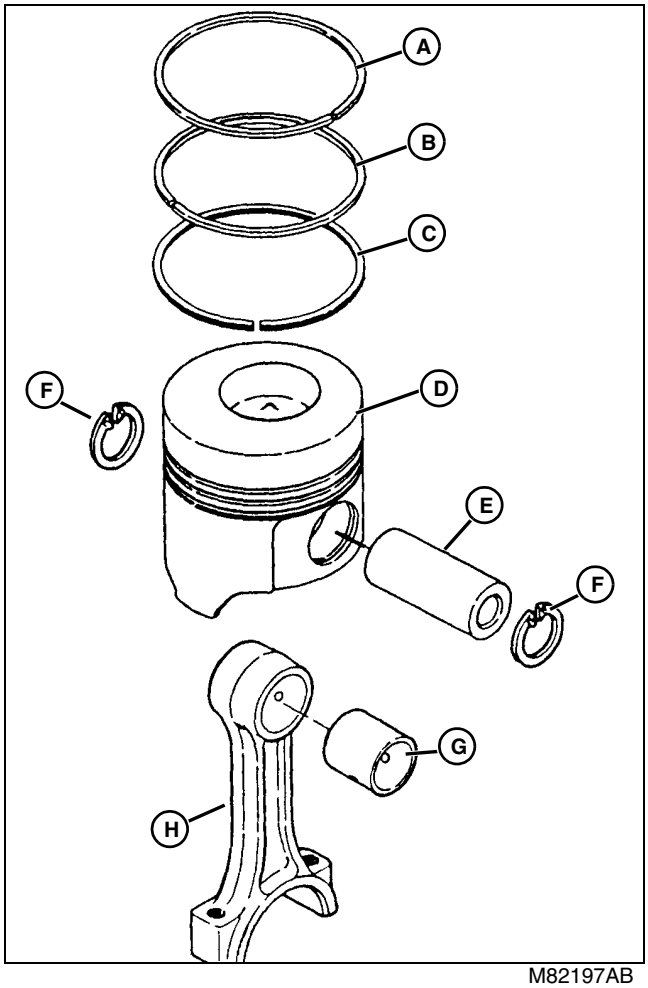
NOTE: Piston pin bushing (G) is press fit in connecting rod. Remove bushing only if replacement is necessary.

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

Piston and Connecting Rod Assembly Assembly

NOTE: Apply clean engine oil to all parts during assembly.

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

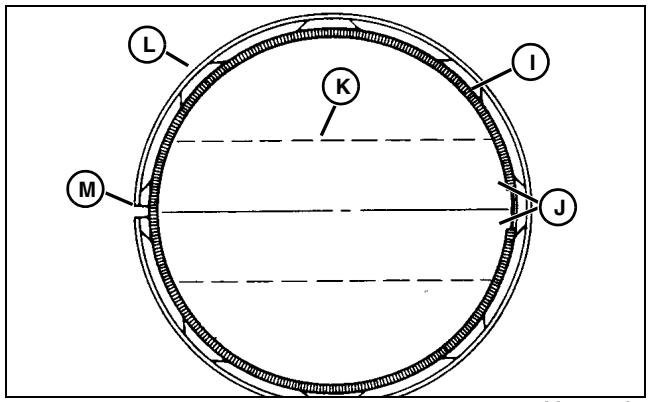


M82197AB

- **A - 1st Compression Ring**
- **B - 2nd Compression Ring**
- **C - Oil Ring with Coil Expander**
- **D - Piston**
- **E - Piston Ring**
- **F - Retaining Ring (2 used)**
- **G - Piston Pin Bushing**
- **H - Connecting Rod**

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

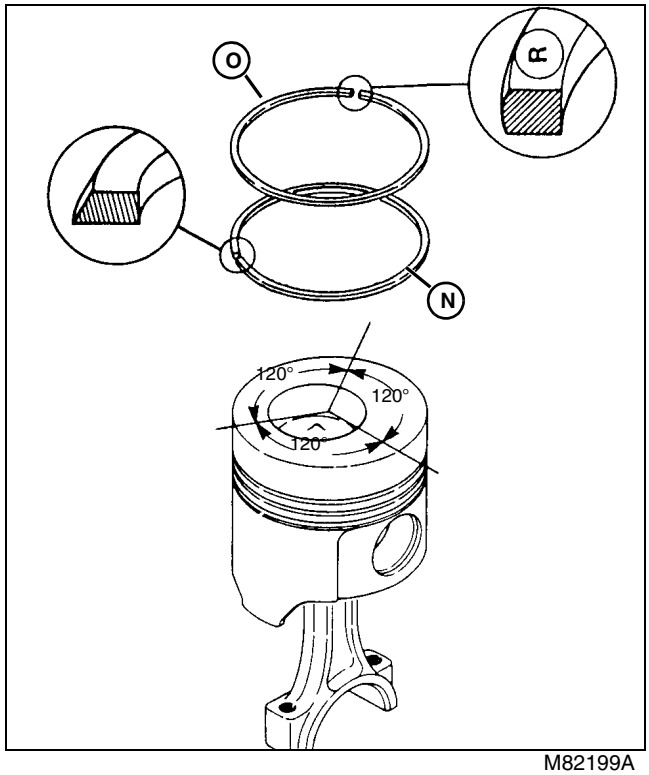
2. Install piston pin and retaining rings.



M82046A

3. Install oil ring expander (I) in bottom ring groove of piston with expander ends (J) above either end of piston pin (K).

4. Install oil ring (L) over expander with ring gap (M) opposite (180°) of expander ends.



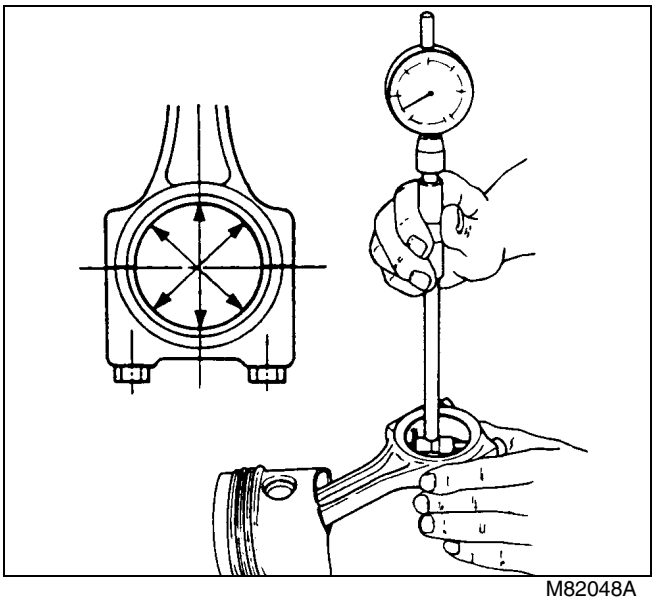
M82199A

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

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

Piston and Connecting Rod Assembly Component Inspection

Connecting Rod Bearing



M82048A

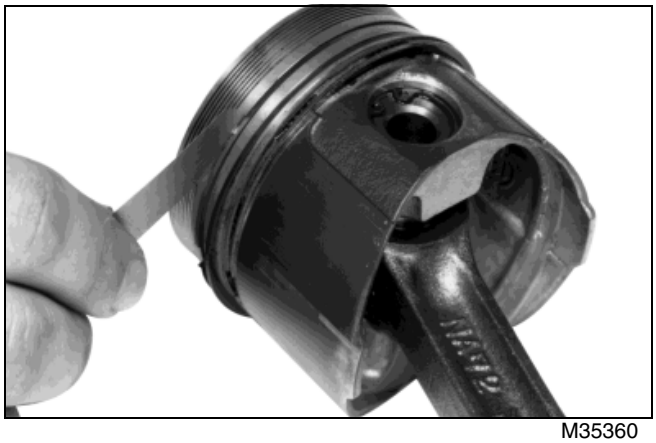
1. Measure crankshaft connecting rod journal diameter.

2. Install connecting rod cap and bearing inserts on connecting rod. Install old connecting rod cap screws and tighten to specification.

3. Measure connecting rod bearing inside diameter. Replace bearings if inside diameter is greater than specification.

4. Subtract crankshaft connecting rod journal outside diameter from rod bearing inside diameter to determine clearance. Grind crankshaft connecting rod journals and install undersized bearing inserts, or replace bearing inserts and crankshaft if clearance is greater than specification.

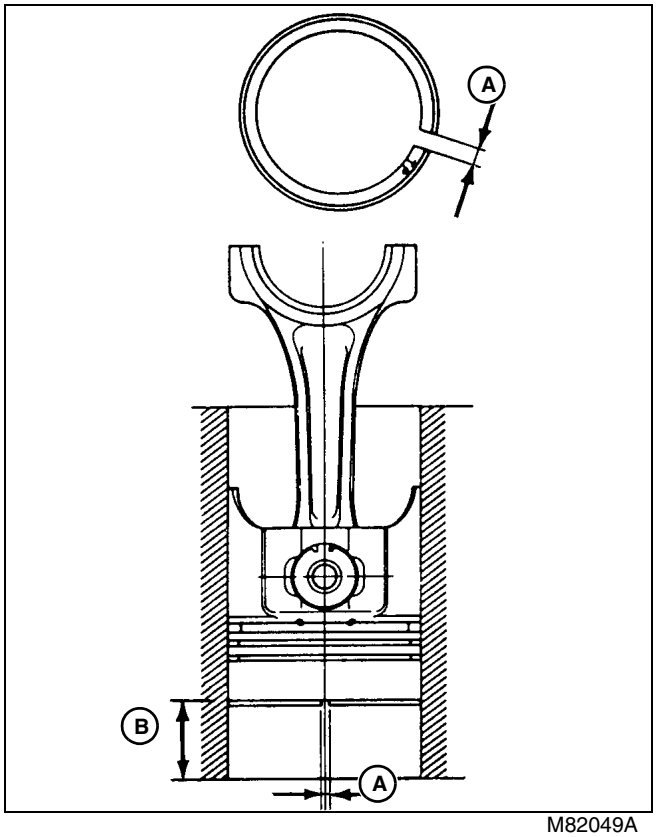
Piston Ring Groove



M35360

With rings installed on piston, measure piston ring groove clearance. Measure several places around each piston. If clearance exceeds wear limit, replace rings and/or pistons.

Piston Ring End Gap

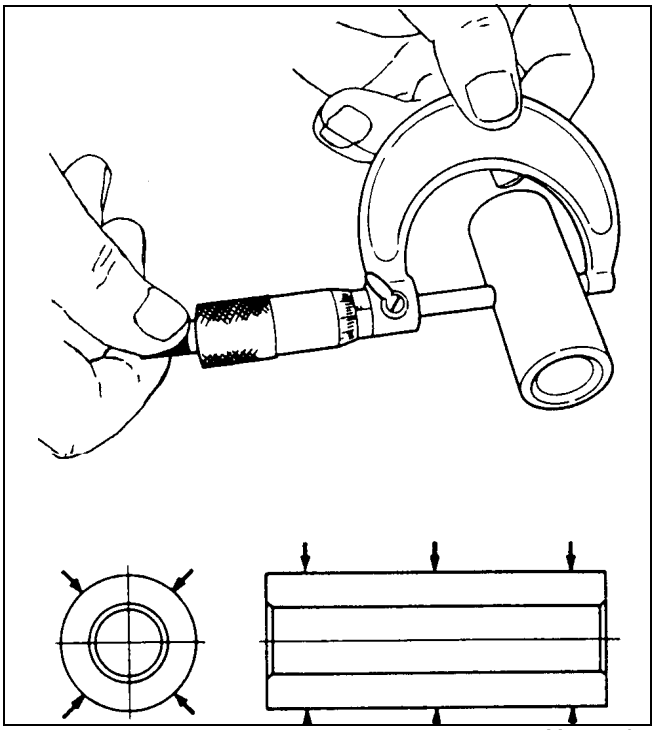


M82049A

1. Push ring into cylinder bore, using a piston, until ring is approximately 30 mm (1.181 in.) (A) from bottom of cylinder bore.

2. Measure piston ring end gap (B). Replace rings if gap is greater than specification.

Piston Pin Diameter



M82050A

Measure piston pin diameter at six places. Replace pin if any measurement is less than specification.

Piston Pin Bore Diameter

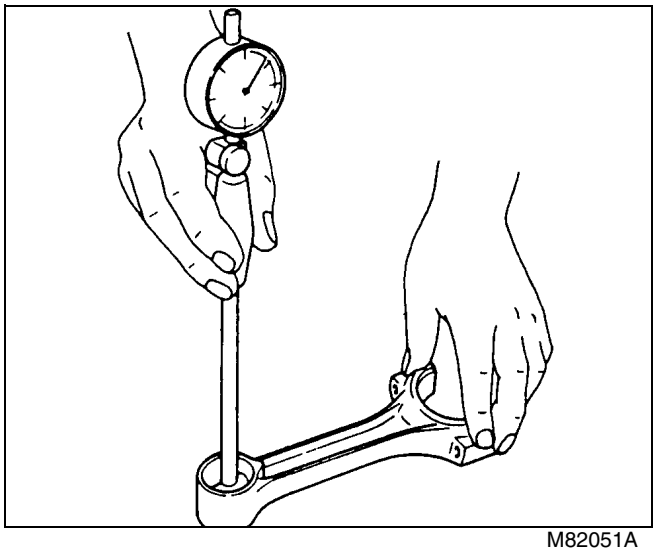


M37683

1. Measure piston pin bore diameter in piston. Replace piston if measurement is greater than specification.

2. Subtract piston pin outside diameter from piston bore inside diameter to determine piston pin-to-bore clearance. Replace piston pin and/or piston if clearance is greater than specification.

Piston Pin Bushing Diameter



M82051A

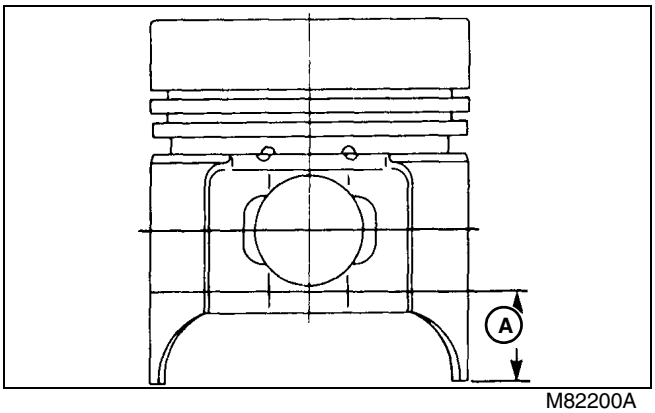
1. Measure piston pin bushing inside diameter in connecting rod. Replace bushing if diameter is greater than specification.

IMPORTANT: Avoid damage! When installing bushing, make sure to align oil hole in bushing with hole in connecting rod.

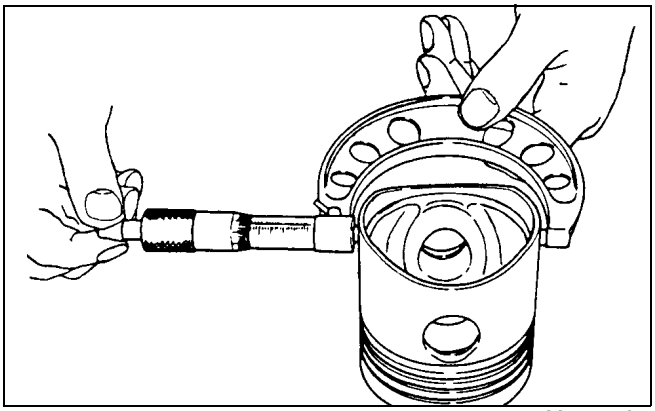
NOTE: Piston pin bushing is press fit. Replace bushing using a driver set.

2. Subtract piston pin outside diameter from bushing inside diameter to determine piston pin-to-bushing clearance. Replace bushing and/or piston pin if clearance is greater than specification.

Piston Diameter



M82200A



M82052A

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

Measure diameter of piston 24 mm (0.945 in.) (A) from the bottom of skirt and perpendicular to piston pin. Replace piston if outside diameter measures less than specification for standard or 0.25 mm (0.010 in.) oversize piston.

Specifications

4TNE84T and 4TNE88

Connecting Rod Cap Screw Torque . . 49 N•m (36 lb-ft)
Connecting Rod Bearing
Inside Diameter (Max) . . . . . 51.01 mm (2.008 in.)
Journal-to-Bearing Clearance (Max) 0.16 mm (0.006 in.)

Piston Ring-to-Groove Clearance

First Compression Ring
(Standard) . . . . . 0.070-0.105 mm (0.003-0.004 in.)
Second Compression Ring
(Standard) . . . . . 0.035-0.070 mm (0.001-0.004 in.)
Oil Ring (Standard). . . 0.025-0.060 mm (0.001-0.002 in.)

Piston Ring End Gap (Max) . . . . . 1.50 mm (0.059 in.)
Piston Pin Diameter (Min) . . . . . 25.90 mm (1.019 in.)
Piston Pin Bore Diameter (Max) . . 26.02 mm (1.024 in.)
Piston Pin-to-Bore Clearance (Max) 0.12 mm (0.005 in.)
Piston Pin Bushing
Inside Diameter (Max) . . . . . 26.10 mm (1.03 in.)
Piston Pin-to-Bushing Clearance . . 0.20 mm (0.007 in.)

Piston Outside Diameter

Models 1600/1620 Standard Piston
(Max) . . . . . 87.90 mm (3.461 in.)
Model 1600 Turbo Standard Piston
(Max) . . . . . 83.90 mm (3.303 in.)
Models 1600/1620 0.25 mm (0.010 in.) Oversize Piston
(Max) . . . . . 88.15 mm (3.470 in.)
Model 1600 Turbo 0.25 mm (0.010 in.) Oversize Piston
(Max) . . . . . 84.15 mm (3.313 in.)

4TNV84T

Connecting Rod Cap Screw Torque . . . 49 N•m (36 lb-ft)
Connecting Rod Bearing
Inside Diameter (Max) . . . . . 47.96 mm (1.888 in.)
Journal-to-Bearing Clearance (Max) 0.16 mm (0.006 in.)

Piston Ring-to-Groove Clearance

First Compression Ring
(Standard) . . . . . 0.075-0.110 mm (0.003-0.004 in.)
Second Compression Ring
(Standard) . . . . . 0.045-0.080 mm (0.002-0.003 in.)
Oil Ring (Standard) . . 0.025-0.060 mm (0.001-0.002 in.)

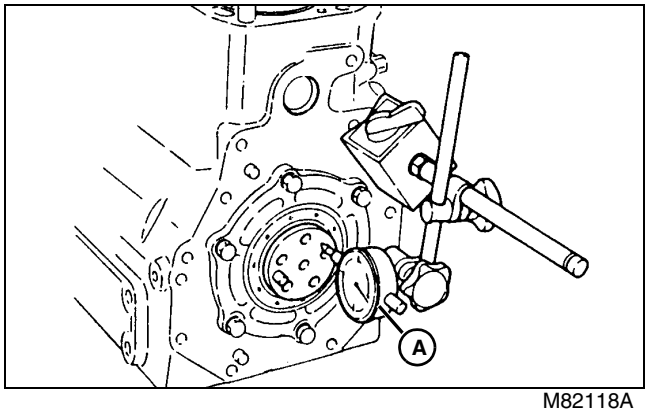
Piston Ring End Gap (Max). . . . . 0.49 mm (0.019 in.)
Piston Pin Diameter (Min) . . . . . 25.965 mm (1.022 in.)
Piston Pin Bore Diameter (Max) . 26.039 mm (1.025 in.)
Piston Pin-to-Bore Clearance (Max) 0.10 mm (0.004 in.)
Piston Pin Bushing
Inside Diameter (Max) . . . . . 26.068 mm (1.03 in.)
Piston Pin-to-Bushing Clearance . . 0.20 mm (0.007 in.)

Piston Outside Diameter

Model 1600 Turbo Standard Piston
(Max) . . . . . 83.90 mm (3.303 in.)
Model 1600 Turbo 0.25 mm (0.010 in.)
Oversize Piston (Max) . . . . . 84.15 mm (3.313 in.)

Crankshaft End Play Check

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.



M82118A

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

IMPORTANT: Avoid damage! DO NOT use excessive force when moving crankshaft to avoid damaging bearings.

2. Push crankshaft toward rear as far as possible.

3. Zero the dial indicator.

4. Using a bar, gently pry the crankshaft as far forward as possible.

5. Read the total end play on the dial indicator. Replace thrust bearings if end play is greater than specification.

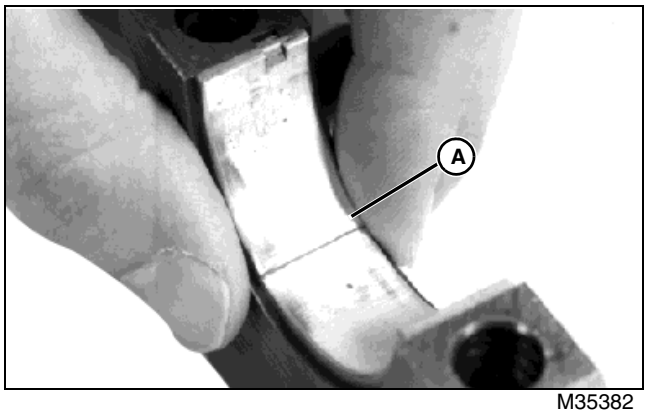
Specifications

Crankshaft End Play (Max) . . . . . 0.27 mm (0.011 in.)

Crankshaft Main Bearing Clearance Check

1. Remove main bearing cap.

2. Wipe oil from bearing insert and crankshaft journal.



M35382

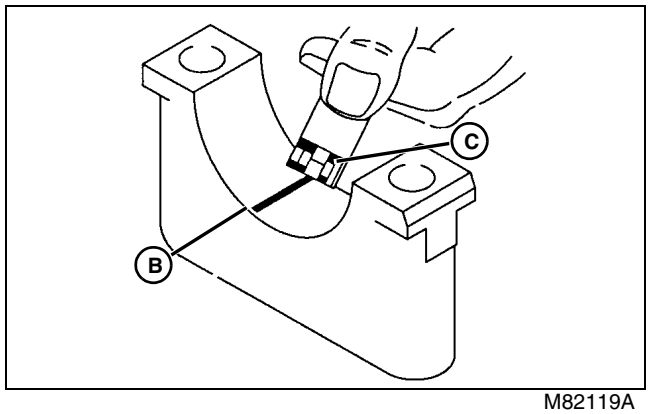
3. Put a piece of PLASTIGAGE® (A), or an equivalent, along the full length of the bearing insert approximately 6 mm (0.250 in.) off center.

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

4. Install main bearing cap and cap screws. Tighten cap screws to specification.

5. Remove cap screws and main bearing cap.

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



M82119A

6. Use the graduation marks (C) on the envelope to compare the width of the flattened PLASTIGAGE (B) at its widest point.

7. Determine main bearing clearance. The number within the graduation marks indicates the bearing clearance in inches or millimeters depending on which side of the envelope is used. Replace the bearing inserts if clearance is greater than specification.

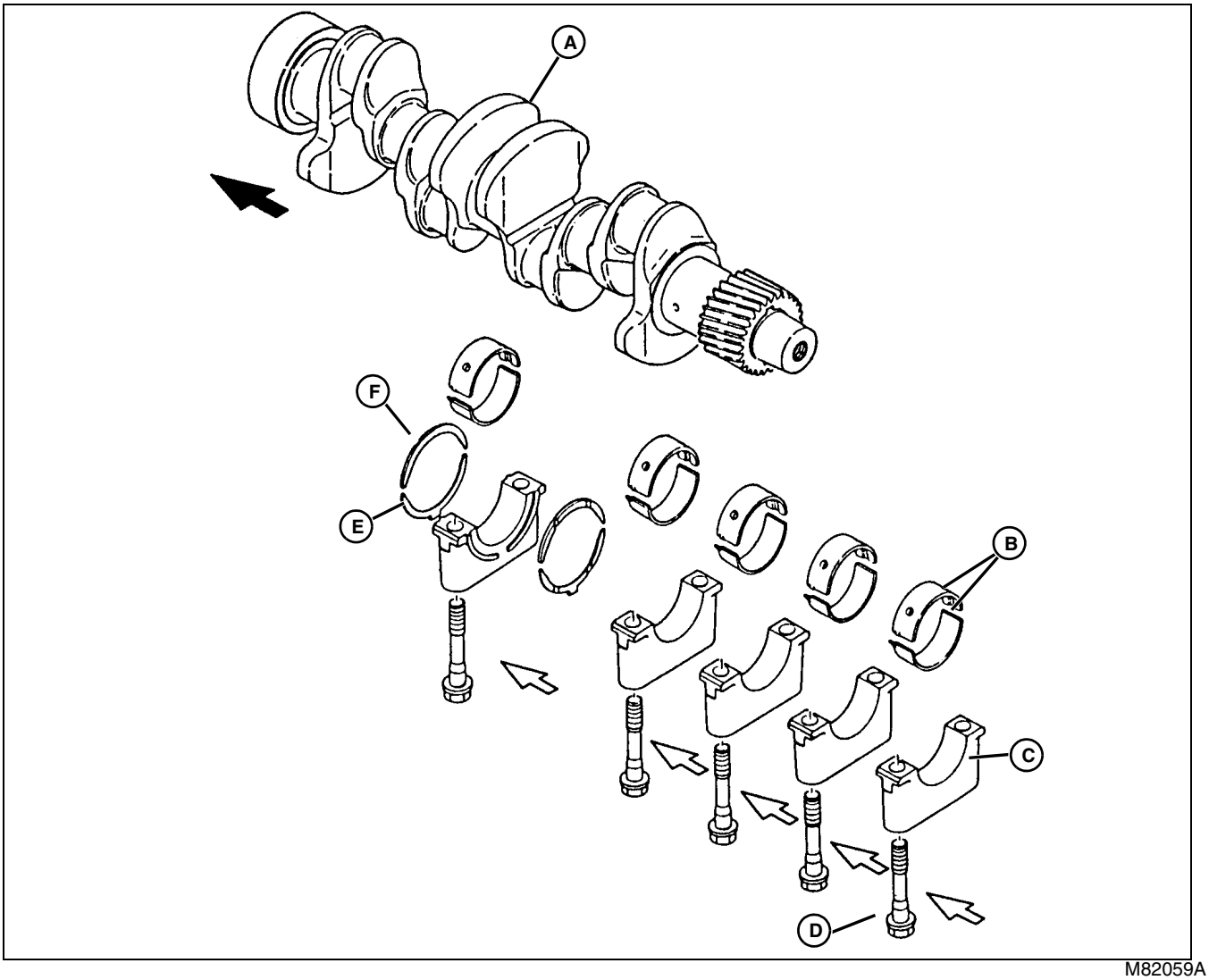
8. Remove PLASTIGAGE.

Specifications

Main Bearing Cap Screw Torque . . . . . 98 N•m (72 lb-ft)

Main Bearing-to-Crankshaft Journal Clearance (Max) . . . . . 0.15 mm (0.006 in.)

Crankshaft and Main Bearing Removal



M82059A

A - Crankshaft
B - Main Bearing Inserts
C - Main Bearing Caps (4 used)
D - Main Bearing Cap Screw (8 used)
E - Cap Thrust Bearing
F - Block Thrust Bearing

1. Check crankshaft end play.
2. Remove rear oil seal.
3. Remove crankcase housing extension.
4. Remove timing gear housing.
5. Check crankshaft main bearing clearance.

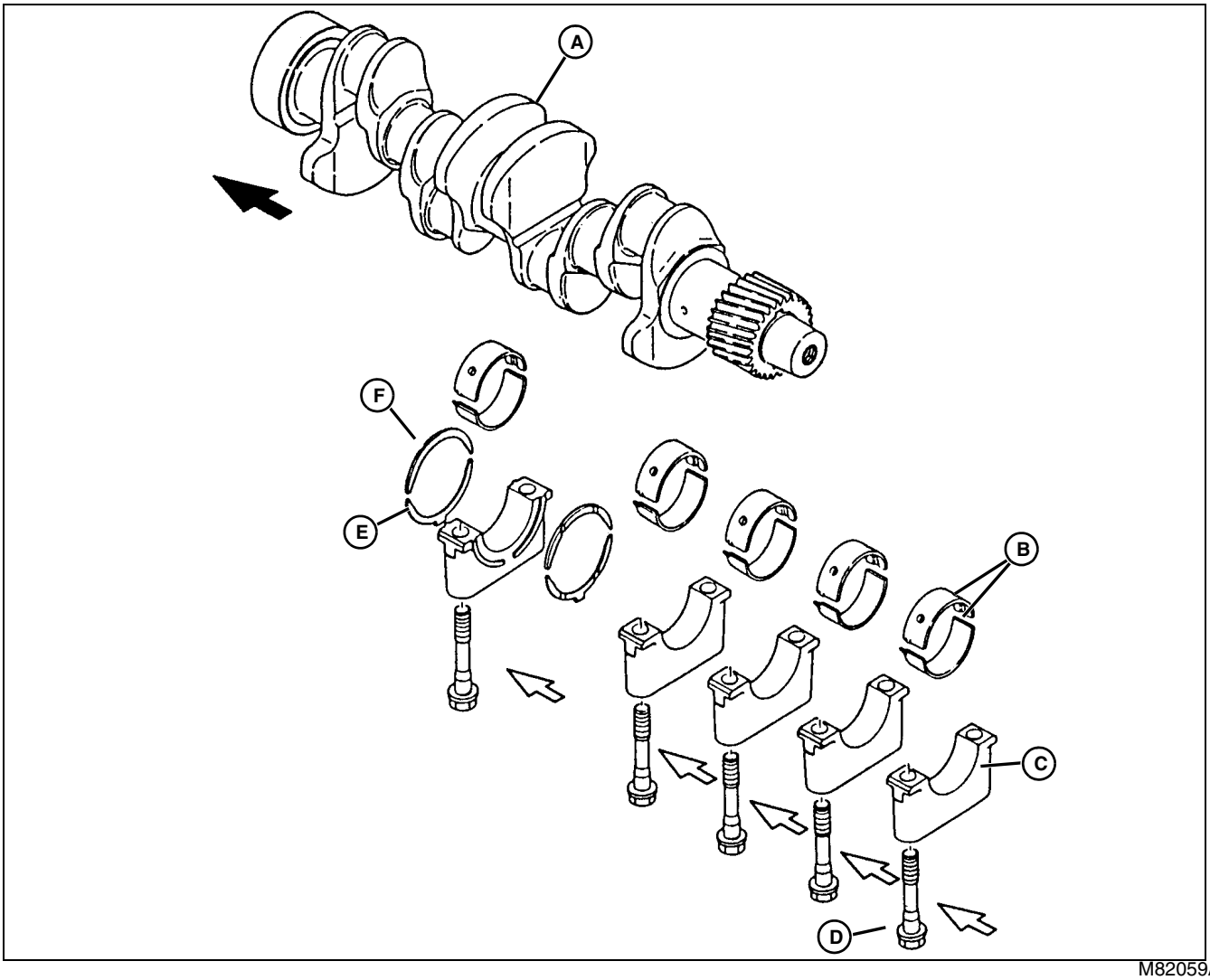
IMPORTANT: Avoid damage! Connecting rod end caps must be installed on the same connecting rods from which they were removed. Note alignment marks on caps and rods.

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

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

8. Remove main bearing cap screws (D), caps (C) and cap thrust bearings (E).
9. Remove crankshaft (A).
10. Remove block thrust bearings (F) and main bearing inserts (B).
11. Inspect all parts for wear or damage.

Crankshaft and Main Bearing Installation



M82059A

A - Crankshaft
B - Main Bearing Inserts
C - Main Bearing Caps (4 used)
D - Main Bearing Cap Screw (8 used)
E - Cap Thrust Bearing
F - Block Thrust Bearing

NOTE: Liberally apply clean engine oil on all parts during installation.

IMPORTANT: Avoid damage! DO NOT touch bearing insert surfaces. Oil and acid from your fingers will corrode the bearing surface.

1. Install grooved bearing inserts in crankshaft bearing bores, aligning tangs with slots in bores.

2. Install block thrust bearings with oil grooves facing away from engine block.

NOTE: Main bearing caps have "raised arrows" that indicate direction of installation. Arrows should point towards flywheel. Thrust bearing cap is at flywheel end and holds thrust bearings. The two end main bearing caps have no marks on the arrows.

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

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

5. Install main bearing caps in their original locations with arrows pointing toward flywheel side of engine.

IMPORTANT: Avoid damage! DO NOT use high-speed power tools or air wrenched to tighten main bearing cap screws.

6. Dip entire main bearing cap screws in clean engine oil. Install cap screws and tighten. DO NOT tighten to specification at this time.

7. Using a soft-faced hammer, tap the front end of the crankshaft, then the rear end of the crankshaft, to align the thrust bearings.

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

9. Install timing gear housing.

10. Install crankcase housing extension.

11. Install rear oil seal.

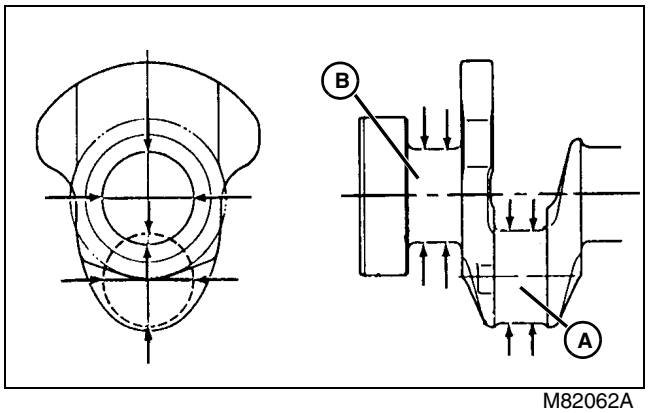
12. Install oil pan and strainer.

Specifications

Main Bearing Cap Screw Torque. . . . . 98 N•m (72 lb-ft)

Crankshaft and Main Bearing Component Inspection

1. Inspect crankshaft gear for chipped or broken teeth. Replace gear as needed.



M82062A

2. Measure crankshaft connecting rod journals (A); measure at several places around each journal.

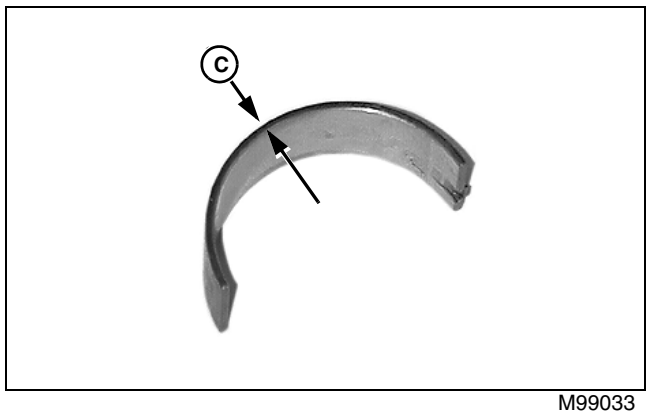
If any journal diameter is less than specification, replace crankshaft or have journals ground undersize by a qualified machine shop.

3. Measure main bearing journal diameters (B); measure several places around each journal.

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

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

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

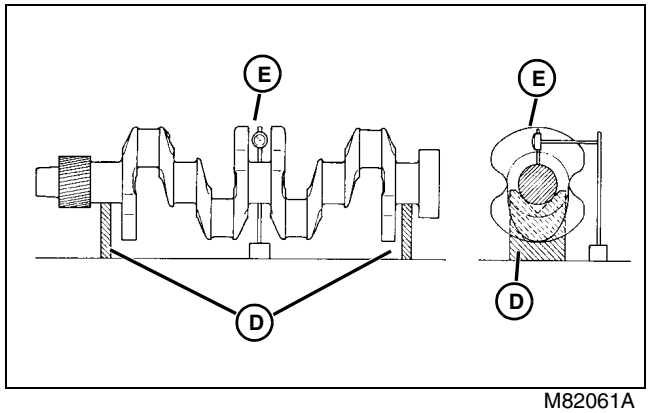


M99033

4. Measure main bearing insert thickness (C). Replace bearing inserts if bearing thickness is less than specification.

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

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



M82061A

7. Inspect crankshaft for bend using V-blocks (D) and a dial indicator (E). Turn crankshaft slowly and read variation on indicator. If variation is greater than specification, replace crankshaft.

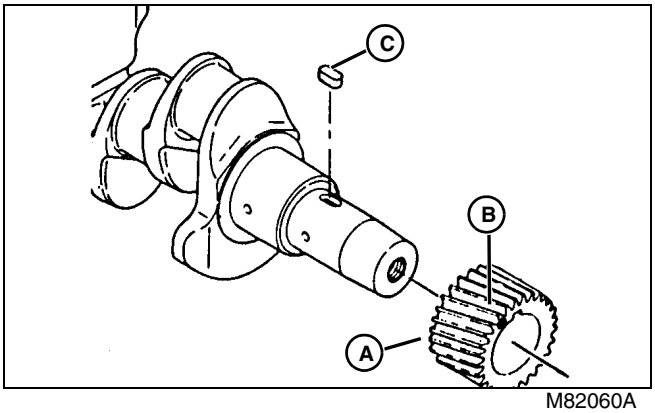
Specifications

Connecting Rod Journal
Diameter (Min) . . . . . 47.91 mm (1.88 in.)
Main Bearing Journal
Diameter (Min) . . . . . 53.91 mm (2.12 in.)
Main Bearing Insert
Thickness (Min) . . . . . 1.995 mm (0.08 in.)
Crankshaft Bend (Max) . . . . . 0.02 mm (0.001 in.)

Crankshaft Gear Replacement

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

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



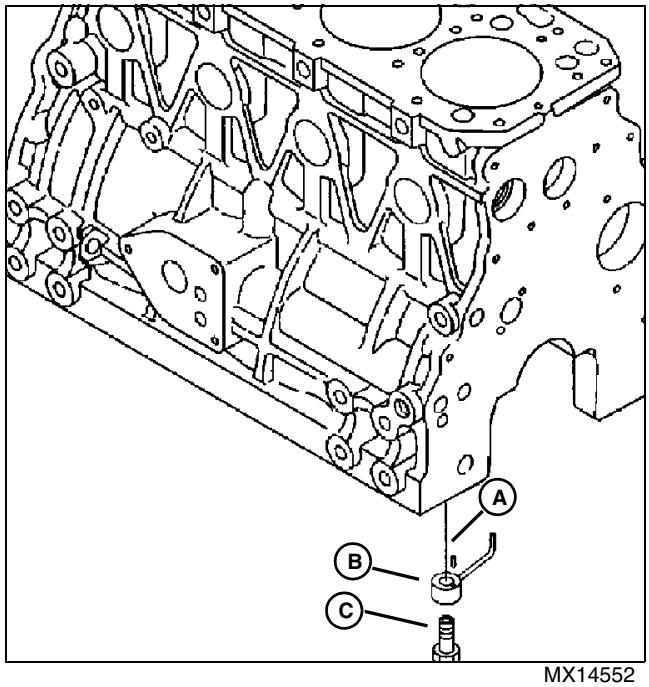
M82060A

2. Heat gear (A) to approximately 150°C (300°F). Install gear with timing mark (B) facing away from crank. Align slot in gear with key (C) in shaft. Press crankshaft into gear until gear is tight against crankshaft shoulder.

Piston Cooling Nozzle Removal and Installation - Model 1600 Turbo

IMPORTANT: Avoid damage! A piston cooling orifice failure could cause damage to pistons, piston pins, rod pin bushings and cylinders.

If a piston cooling orifice is left out, low or no oil pressure will result.



MX14552

1. Remove and clean each piston cooling nozzle (B) and valve (C). Make sure it is not plugged or damaged. Replace if questionable.

IMPORTANT: Avoid damage! Alignment pin (A) must be engaged in engine block and piston cooling nozzle to properly locate nozzle.

2. Install piston cooling nozzle, alignment pin, and valve. Tighten valve to specification.

Specifications

Piston Cooling Nozzle Orifice Diameter . . . . . 1.77 mm (0.069 in.)

Piston Cooling Valve Torque. . . . . 15 N•m (11 lb-ft)

Cam Follower Removal and Installation

Removal

1. Remove camshaft.
2. Remove oil pan and crankcase housing extension.

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

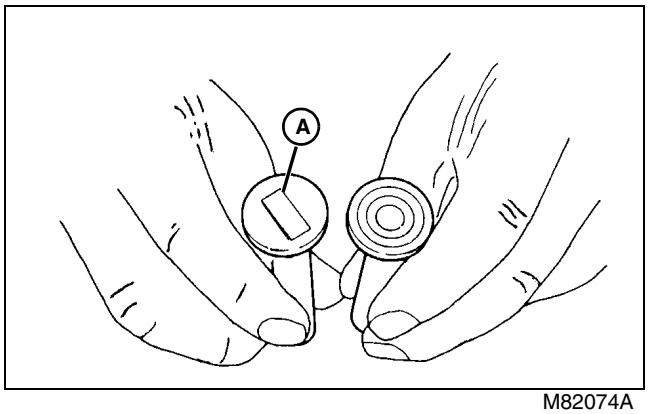
3. Mark each cam follower and cylinder block bore to aid in installation.
4. Remove cam followers.
5. Inspect for wear or damage.

Installation

Installation is done in the reverse order of removal.

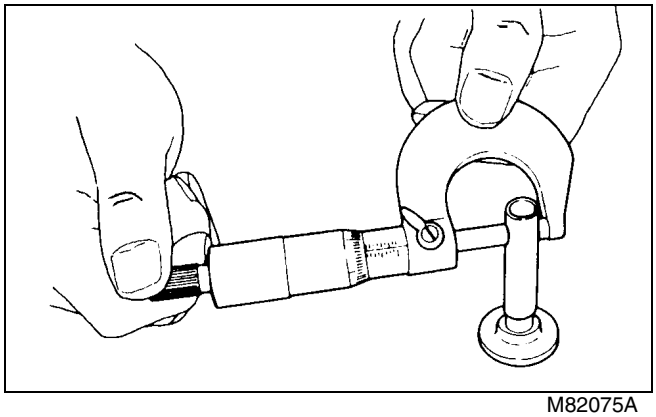
- Apply a light coat of clean engine oil to all parts during installation.
- Install cam followers in cylinder head in the same bore they were removed from with the flat contact surface toward the camshaft.

Cam Follower Inspection



M82074A

1. Inspect cam follower contact surface for abnormal wear (A). Replace as needed.
2. Use a straightedge and place it on the contact surface perpendicular to the wear mark across cam follower. Replace if surface appears to “valley” on wear mark.



M82075A

3. Measure cam follower diameter. Replace cam follower if diameter is less than specification.
4. Measure cam follower bore diameter in cylinder block. Replace cylinder block if the cam follower bore inside diameter measures greater than specification.
5. Subtract cam follower outside diameter from bore inside diameter to determine clearance. Replace cam follower, cylinder block or both if clearance is greater than specification.

Specifications

4TNE84T and 4TNE88

Cam Follower Diameter (Min) . . . . 11.93 mm (0.470 in.)
Cam Follower Bore Inside Diameter (Max) . . . . . 12.05 mm (0.474 in.)
Cam Follower-to-Bearing Clearance (Max) . . . . . 0.12 mm (0.005 in.)

4TNV84T

Cam Follower Diameter (Min) . . . . 11.95 mm (0.470 in.)
Cam Follower Bore Inside Diameter (Max) . . . . . 12.05 mm (0.474 in.)
Cam Follower-to-Bearing Clearance (Max) . . . . . 0.09 mm (0.004 in.)

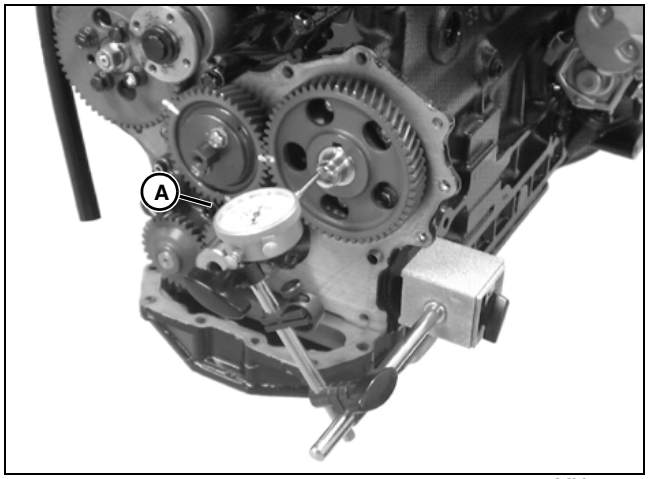
Camshaft End Play Check

Special or Required Tools

Tool Name	Tool No.	Tool Use
Dial Indicator	NA	Used to measure camshaft end play.

Procedure

1. Remove timing gear cover.



MX2431

2. Fasten dial indicator (A) to engine and position indicator tip on end of camshaft.
3. Push camshaft toward the rear as far as possible.
4. Zero the dial indicator.
5. Pull camshaft forward as far as possible.

Results

If end play exceeds specification, remove camshaft and replace thrust plate.

Specifications

Camshaft End Play
(Standard) . . . . . 0.05-0.25 mm (0.002-0.010 in.)

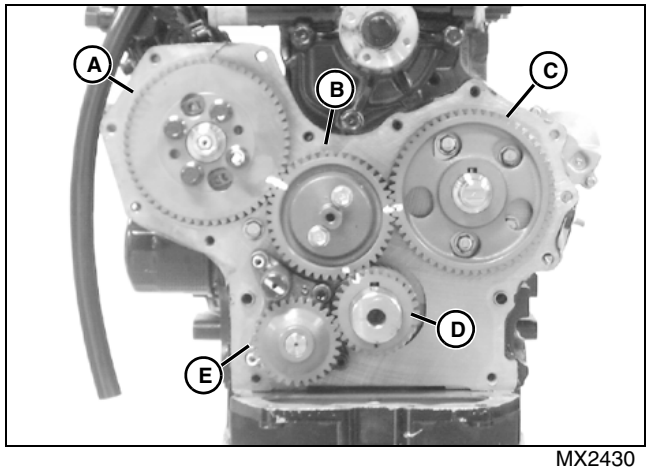
Camshaft Timing Gear Backlash Check

Special or Required Tools

Tool Name	Tool No.	Tool Use
Dial Indicator	NA	Used to measure camshaft timing gear backlash.

Procedure

1. Remove timing gear cover.



MX2430

2. Measure backlash between meshing gears (A-E).

Results

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

Specifications

Timing Gear Backlash (Max) - All
(Except Oil Pump Gear). 0.07-0.15 mm (0.003-0.005 in.)
Timing Gear Backlash (Max) -
Oil Pump Gear . . . . . 0.11-0.19 mm (0.004-0.008 in.)

Camshaft Removal

Special or Required Tools

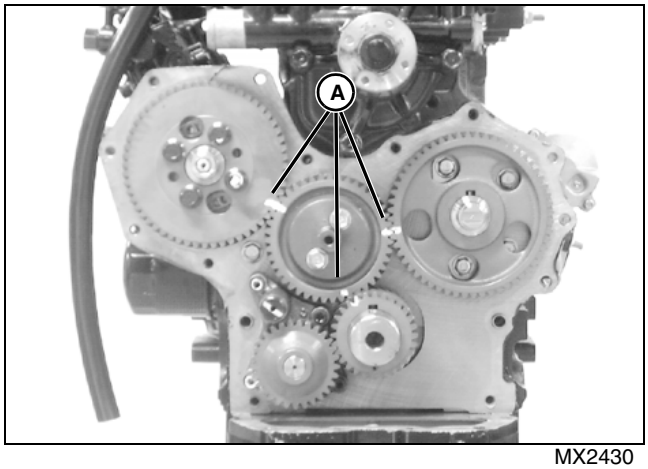
Tool Name	Tool No.	Tool Use
Magnetic Follower Holder Kit	D15001NU	Used to hold cam followers away from camshaft during camshaft removal.

1. Remove rocker arm assembly, push rods, and valve caps.
2. Remove timing gear cover.
3. Check camshaft end play.

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

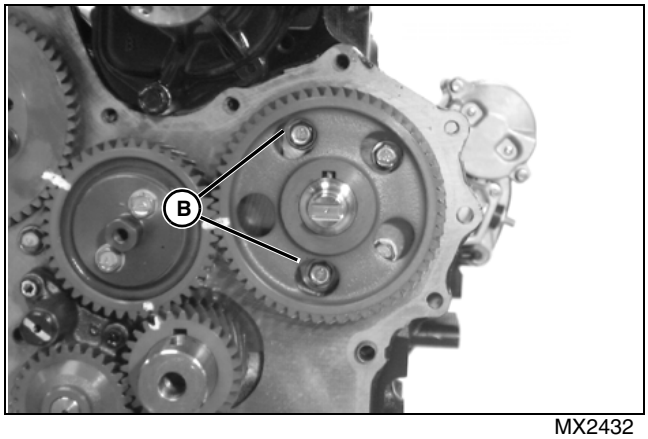
4. Hold cam followers away from camshaft using a Magnetic Follower Holder Kit such as D15001NU.

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



MX2430

5. Rotate the crankshaft until all timing gear marks (A) align.



MX2432

6. Remove two cap screws (B).

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

7. Remove camshaft.

8. Inspect camshaft for wear or damage.

Camshaft Installation

Special or Required Tools

Tool Name	Tool No.	Tool Use
Magnetic Follower Holder Kit	D15001NU	Used to hold cam followers away from camshaft during camshaft installation.

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

1. Install cam followers and hold away from camshaft using a Magnetic Follower Holder Kit such as D15001NU.

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

NOTE: Apply clean engine oil to all parts before installing.

2. Install camshaft.

3. Install and tighten retainer cap screws to specification.

4. Install timing gear cover.

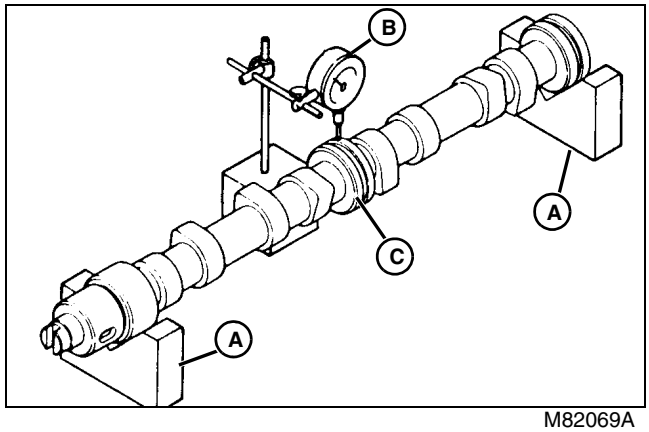
5. Install push rods and rocker arm assembly.

Specifications

Retainer Cap Screw Torque. . . . . 11 N•m (96 lb-in.)

Camshaft Inspection

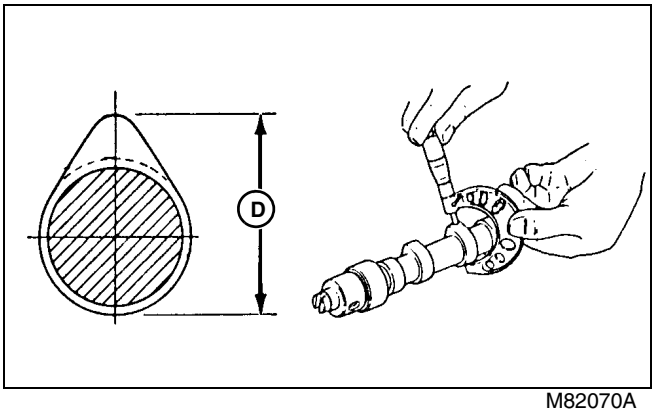
1. Inspect cam gear for chipped or broken teeth. Replace if necessary.



M82069A

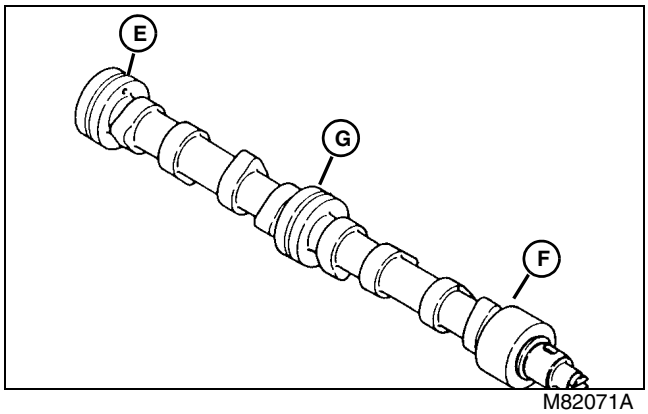
2. Inspect camshaft for bend using V-blocks (A) and a dial indicator (B) at intermediate journal (C).

3. Turn camshaft slowly and read variation on indicator. Replace camshaft if variation is greater than specification.



M82070A

4. Measure camshaft lobe height (D). Replace camshaft if any lobe height is less than specification.

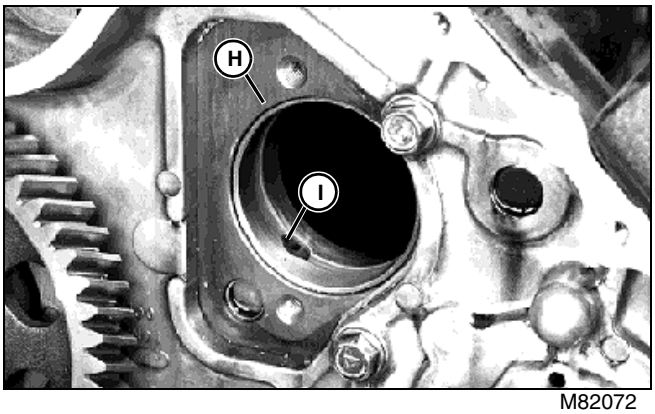


M82071A

5. Measure camshaft end journal diameters (E, flywheel side, and F, gear side). Replace camshaft if any journal diameter measures less than specification.

6. Measure camshaft intermediate journal diameter (G). Replace camshaft if journal diameter measures less than specification.

Camshaft Bushing - Timing Gear End



M82072

1. Measure camshaft bushing (H) inside diameter at the gear housing end. Record the measurement.

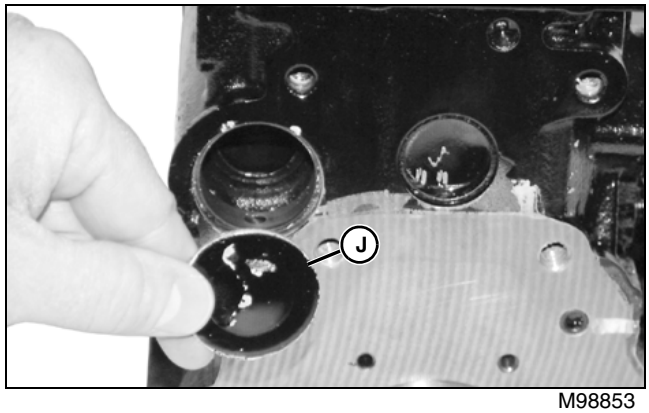
2. Subtract camshaft journal (gear side) outside diameter from camshaft bushing inside diameter to determine clearance. Replace bushing, cam, or both if clearance is greater than specification.

3. Remove the bushing (H) using a bearing puller.

4. Align the oil hole (I) in the new bushing with the oil hole in the cylinder block, and install the bushing using a bearing driver.

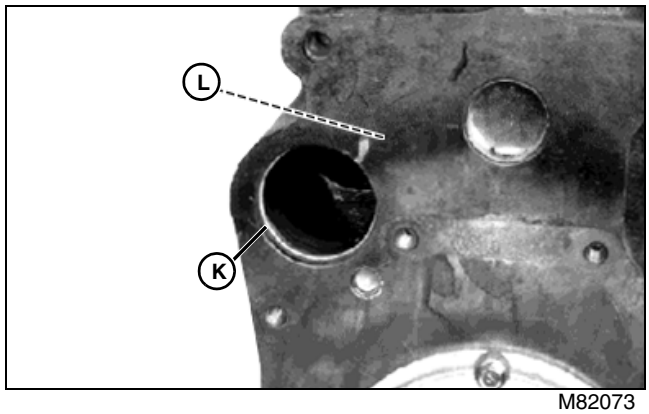
Camshaft Bushing - Intermediate and Flywheel End

1. Remove flywheel housing.



M98853

2. Remove plug (J) using a long wooden dowel. Insert the wooden dowel through the gear housing side.



M82073

3. Measure flywheel end (K) and intermediate (L) bearing inside diameters with telescoping gauge and micrometer. Record the measurement.

4. Subtract camshaft intermediate journal outside diameter from intermediate bushing inside diameter to determine clearance. Replace bushing, cam, or both if clearance is greater than specification.

5. Subtract camshaft flywheel end journal outside diameter from flywheel end bushing inside diameter to determine clearance. Replace bushing, cam, or both if clearance is greater than specification.

Specifications

4TNE84T and 4TNE88

Camshaft Bend (Max). . . . . 0.02 mm (0.001 in.)
Camshaft Lobe Height (Min) . . . . . 38.40 mm (1.512 in.)
Camshaft End Journal Diameter (Min). . . . . 44.85 mm (1.766 in.)
Camshaft Intermediate Journal Diameter (Min). . . . . 44.85 mm (1.766 in.)
Camshaft Journal-to-Timing Gear End Bushing Clearance (Wear Limit). . . . . 0.130 mm (0.005 in.)
Camshaft Journal-to-Intermediate Bushing Clearance (Wear Limit). . . . . 0.115 mm (0.005 in.)
Camshaft Flywheel End Journal-to-Bushing Clearance (Wear Limit). . . . . 0.10 mm (0.004 in.)

4TNV84T

Camshaft Bend (Max). . . . . 0.02 mm (0.001 in.)
Camshaft Lobe Height (Min) . . . . . 38.40 mm (1.512 in.)
Camshaft End Journal Diameter (Min) 44.89 mm (1.767 in.)
Camshaft Intermediate Journal Diameter (Min). . . . . 44.875 mm (1.767 in.)
Camshaft Journal-to-Timing Gear End Bushing Clearance (Wear Limit). . . . . 0.24 mm (0.009 in.)
Camshaft Journal-to-Intermediate Bushing Clearance (Wear Limit). . . . . 0.225 mm (0.009 in.)
Camshaft Flywheel End Journal-to-Bushing Clearance (Wear Limit). . . . . 0.21 mm (0.008 in.)

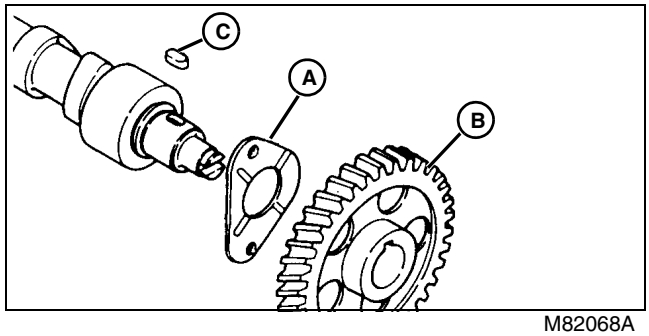
Camshaft Gear Removal and Installation

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

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

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

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



M82068A

3. Install thrust plate (A) if removed.

4. Install gear (B) with timing mark “C” side toward press table.

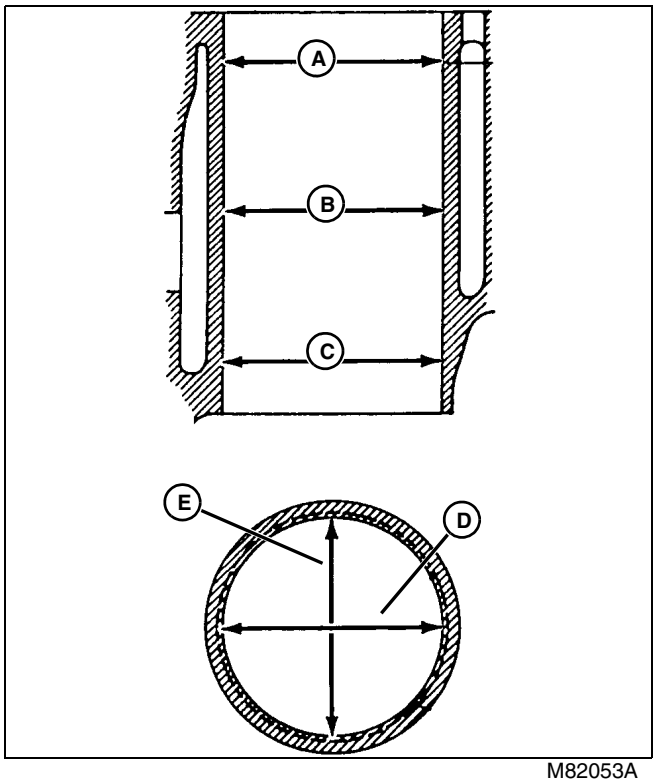
5. Align slot in gear with key (C) in shaft.

6. Press camshaft into gear until gear is tight against camshaft shoulder.

IMPORTANT: Avoid damage! Thrust plate must spin freely on camshaft.

Cylinder Inspection

1. Inspect cylinder block for cracks or damage. Replace cylinder block if any cracks are noted.



M82053A

2. Measure cylinder bore diameter at three positions: top (A), middle (B), and bottom (C). At these three positions, measure in both directions: along crankshaft centerline (D) and direction of crankshaft rotation (E).

Rebore the cylinder bores if the inside diameter measures greater than the standard bore size wear limit.

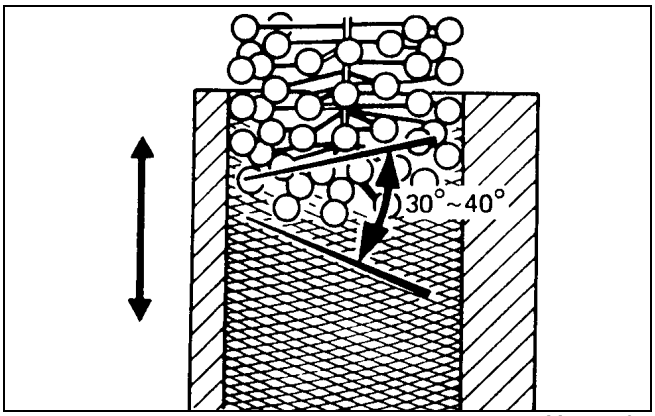
Replace the cylinder block if the cylinder bore inside diameter measures greater than the oversize bore size wear limit.

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

Cylinder Bore Deglazing

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

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



M82054A

2. Use flex-hone as instructed by manufacturer to obtain a 30-40° cross-hatch pattern as shown.

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

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

Cylinder Reboring

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

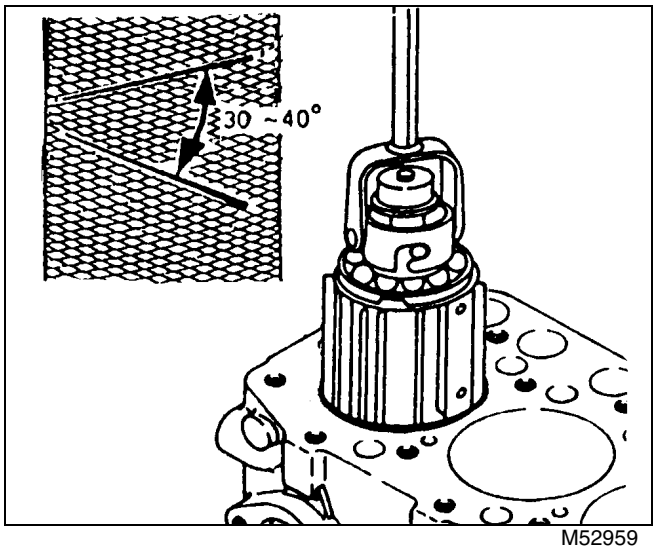
1. Align center of bore to drill press center.

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

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

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

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



M52959

5. Run drill press at about 250 rpm. Move hone up and down in order to obtain a 30-40° cross-hatch pattern.

NOTE: Measure bore when cylinder is cool.

6. Stop press and check cylinder diameter.

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

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

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

9. Check bore for size, taper, and out-of-round.

IMPORTANT: Avoid damage! DO NOT use solvents to clean cylinder bores. Solvents will not remove all metal particles and abrasives produced during honing.

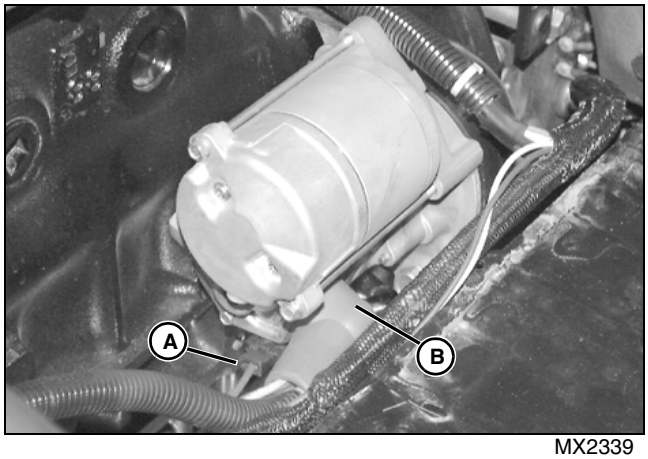
10. Clean cylinder thoroughly using warm soapy water until clean white rags show no discoloration.

11. Dry cylinder and apply a light coat of clean engine oil.

Starting Motor Removal and Installation

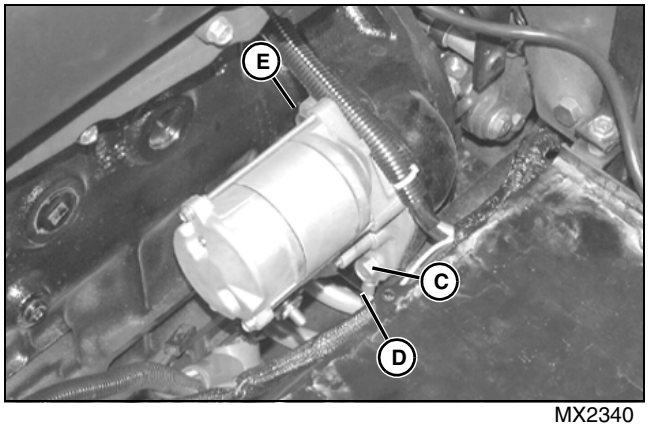
Removal

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.
3. Disconnect battery negative (-) cable.
4. **Models 1600/1620:** Remove battery and backing plate.
5. **Model 1600 Turbo:** Disconnect white wire from starter solenoid.



MX2339

6. Disconnect violet wire (A) from solenoid.
7. Disconnect wires (B) from solenoid battery terminal.



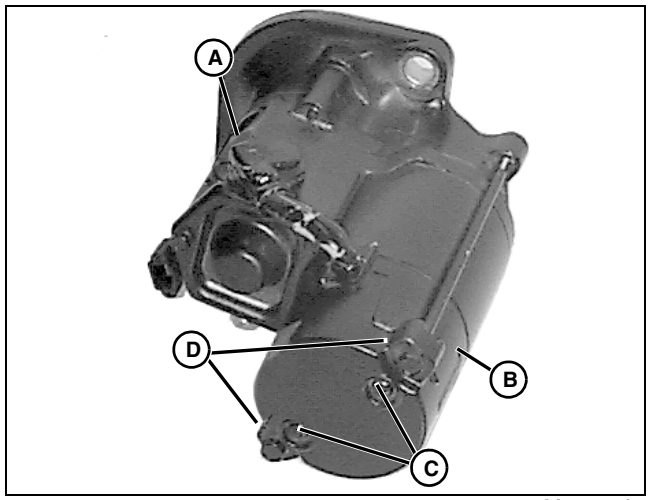
MX2340

8. Remove lower cap screw (C) and ground strap (D).
9. Remove upper cap screw (E).
10. Remove starting motor.

Installation

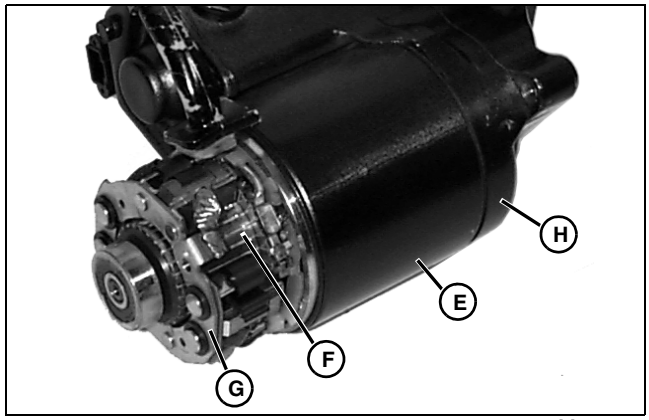
Installation is done in the reverse order of removal.

Starting Motor Disassembly and Assembly



M82233A

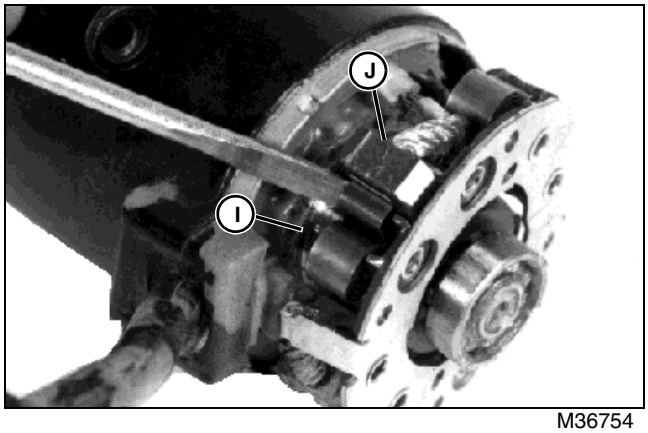
1. Disconnect field lead (A).
2. Remove two cover cap screws (C).
3. Remove two clutch housing-to-motor cap screws (D).
4. Remove rear cover (B).



M91667

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

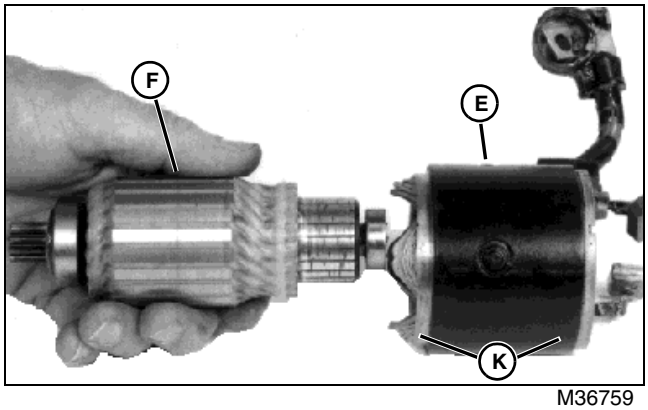
NOTE: Brushes are not serviced separately. If brushes require replacement, the entire brush holder with brushes attached must be replaced.



M36754

6. Pry the brush springs (I) away, and pull negative brushes (J) up enough to hold the brush in place.

7. Remove brush holder.



M36759

8. Remove armature from field coil housing.

9. Inspect O-rings (K) on field coil housing. Replace as needed.

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

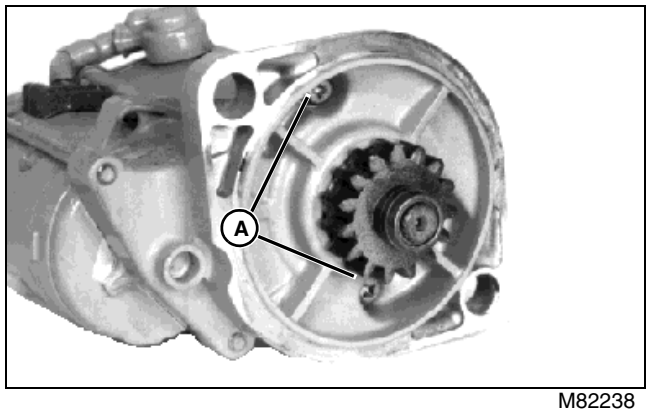
Assembly

Assembly is done in the reverse order of disassembly.

IMPORTANT: Avoid damage! When installing the rear cover, do not let field brush wires touch cover. Turn the brush holder slightly to take up slack in brush wires. Press wires inward to clear rear cover.

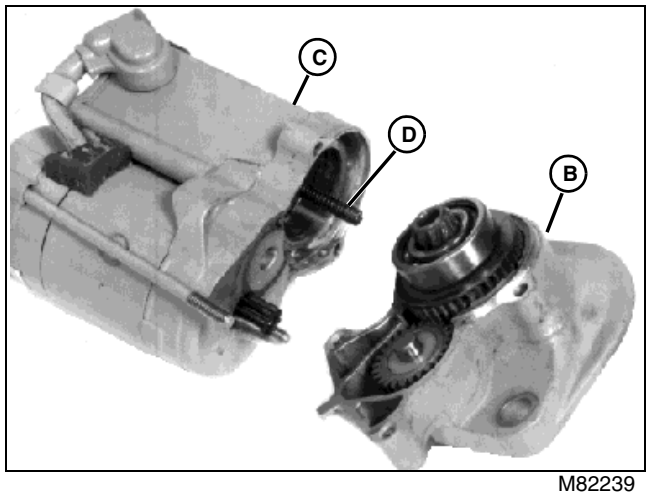
Apply multi-purpose grease to bearing cup inside rear cover.

Clutch Housing Assembly Disassembly and Assembly



M82238

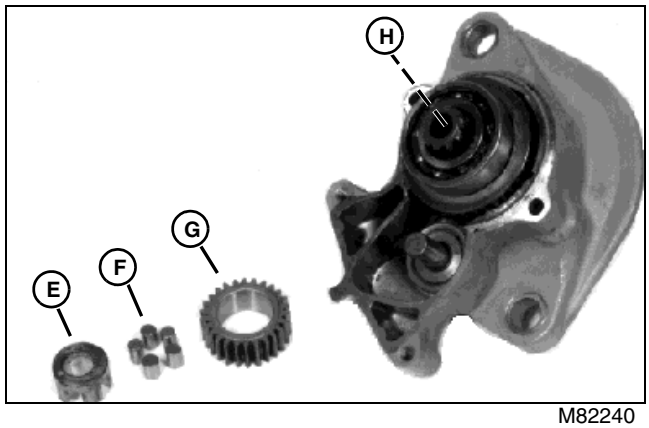
1. Remove two cap screws (A).



M82239

2. Separate the clutch housing (B) from the solenoid/motor assembly (C).

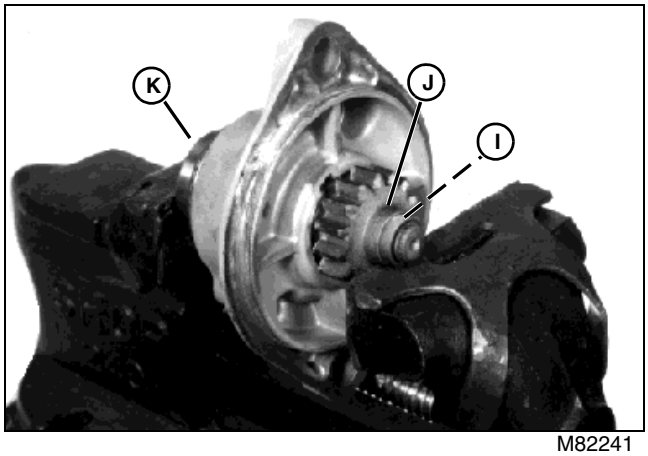
3. Remove plunger spring (D).



M82240

4. Remove retainer (E), five rollers (F), and pinion gear (G).

5. Remove steel ball (H).



M82241

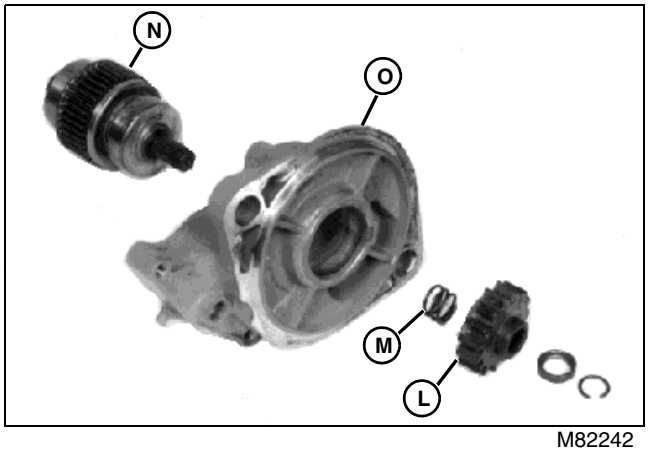
6. Place clutch housing assembly (K) in a soft-jawed vise as shown.

7. Tighten vise slowly, until the drive gear spring is fully compressed.

8. Remove circlip (I) and retainer (J).

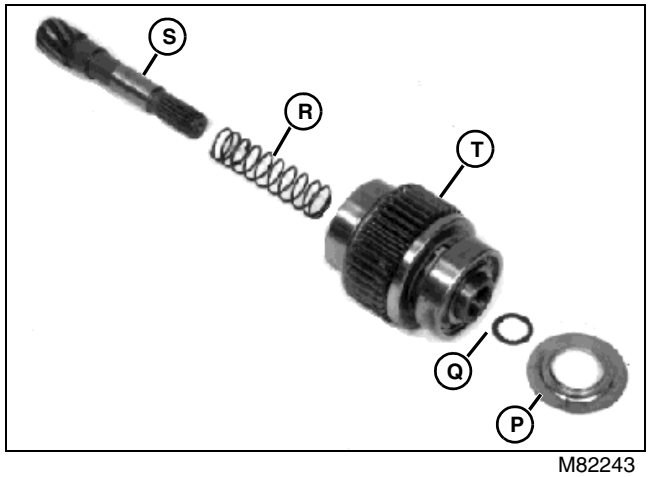
CAUTION: Avoid injury! RELEASE TENSION SLOWLY. Shaft could be propelled from clutch with considerable force, if the spring is not allowed to extend fully while in the vise.

9. While holding the clutch assembly (K), slowly open the vise until the spring is fully extended.



M82242

10.Remove drive gear (L), spring (M), and clutch assembly (N) from clutch housing (O).



M82243

11.Remove large washer (P), toothed washer (Q), spring (R), and clutch shaft (S) from housing (T).

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

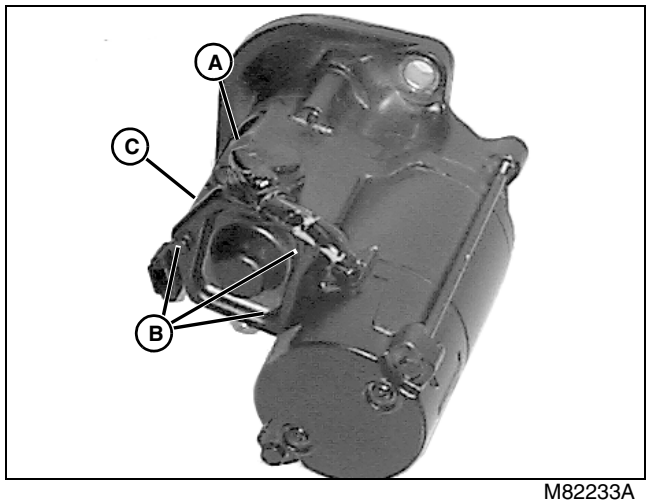
Assembly

Assembly is done in the reverse order of disassembly.

- Apply multi-purpose grease to clutch shaft (S), springs (M and R), pinion gear (G), retainer (E), rollers (F) and steel ball (H).
- Install large washer (P) with flat side toward clutch assembly.
- Install retainer (E) with cupped side away from clutch assembly.

Solenoid Disassembly and Assembly

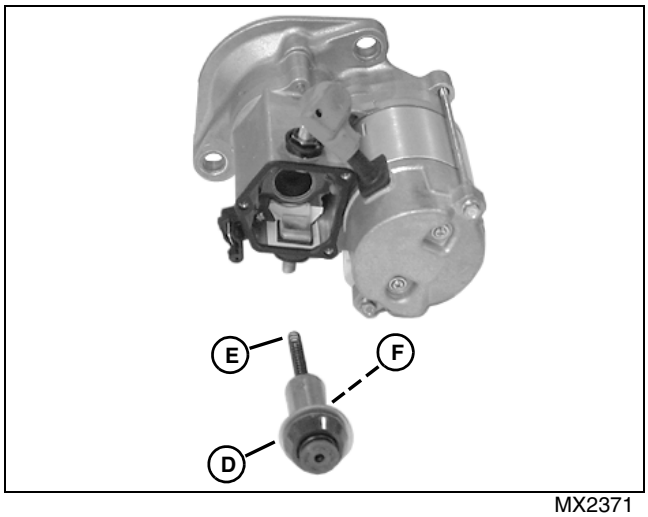
NOTE: The solenoid can be serviced without disassembling the motor/clutch housing assembly.



M82233A

1. Disconnect field lead (A).
2. Remove three cover cap screws (B).

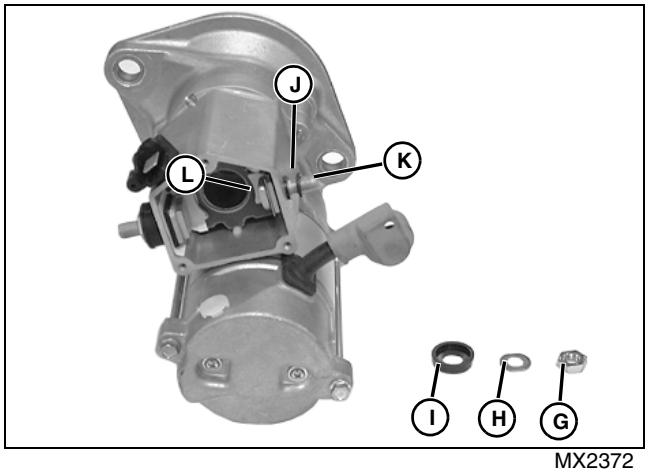
3. Remove cover (C) and gasket.



MX2371

4. Remove plunger (D) and spring (E).

5. Inspect copper washer (F) for signs of excessive burning or pitting. Clean burned areas to improve contact. Replace the entire solenoid if burnt or pitted areas cannot be cleaned.



MX2372

6. Remove nut (G), washer (H), insulator (I), and O-ring (J) (both sides).

7. Remove terminal bolt (K) and contact plate (L) (both sides).

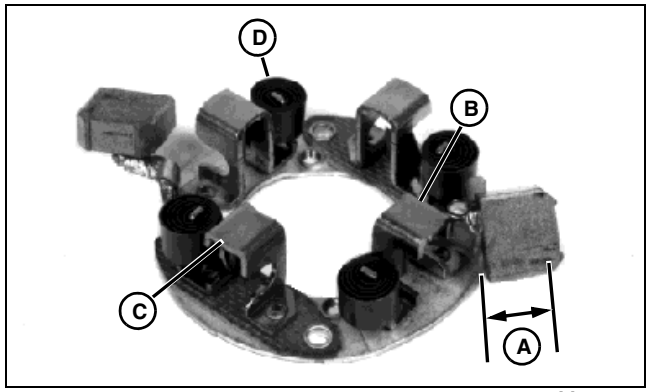
8. Inspect contact plates (L) for signs of excessive burning or pitting. Clean burnt areas to improve contact. Replace the entire solenoid if burnt or pitted areas cannot be cleaned.

Assembly

Assembly is done in the reverse order of disassembly.

Starting Motor Component Inspection

Brush Holder



M82234

1. Measure brush lengths (A). Minimum brush length is 8.5 mm (0.335 in.). Replace brush if length is below minimum.

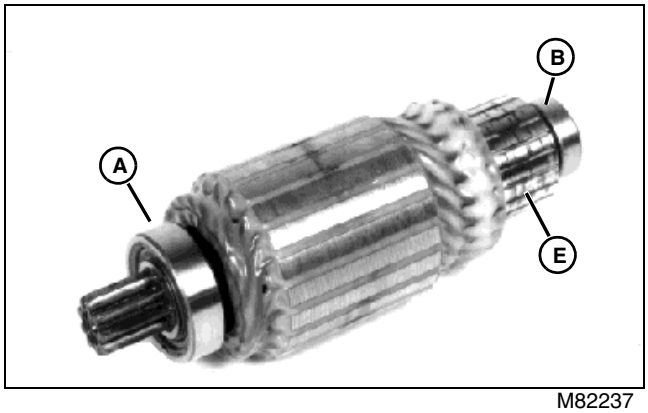
NOTE: Test brush holder using an ohmmeter or test light.

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

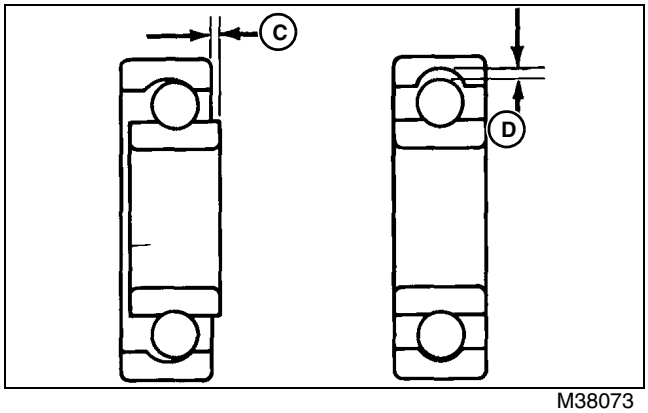
3. Inspect springs (D) for wear or damage. Replace if necessary.

Armature Assembly

IMPORTANT: Avoid damage! DO NOT clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.



M82237



M38073

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

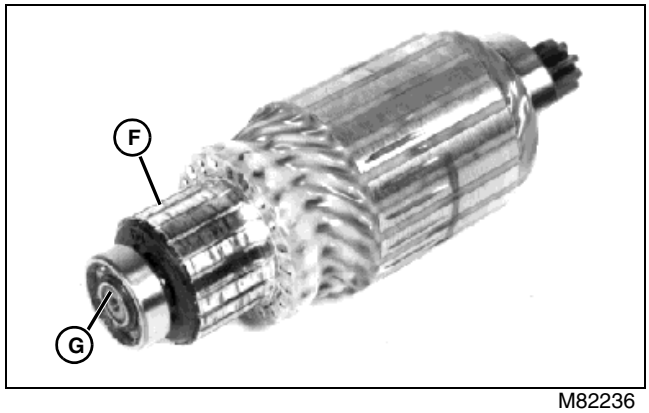
2. Inspect bearings (A and B) for axial (C) and/or radial (D) free play or rough movement. Replace bearings as needed.

IMPORTANT: Avoid damage! NEVER use emery cloth to clean commutator.

3. Inspect commutator (E). Look for roughness, burned bars, or any material which might cause short circuits between bars. If necessary, clean and touch up with 400 sandpaper. Clean all dust from armature when finished.

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

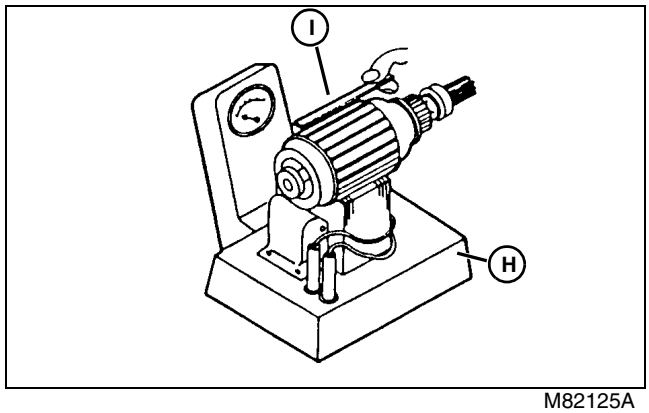
Armature windings are connected in series, so only one commutator bar needs to be checked. If the test shows continuity, a winding is grounded and the armature must be replaced.



M82236

4. Test for grounded windings. Touch one meter probe to a commutator bar (F) and the other to the armature shaft (G). If continuity is present, replace the armature.

5. Test for open circuits in the windings. Touch the meter probes to two commutator bars. If the test shows no continuity, the armature has an open circuit and the armature must be replaced.



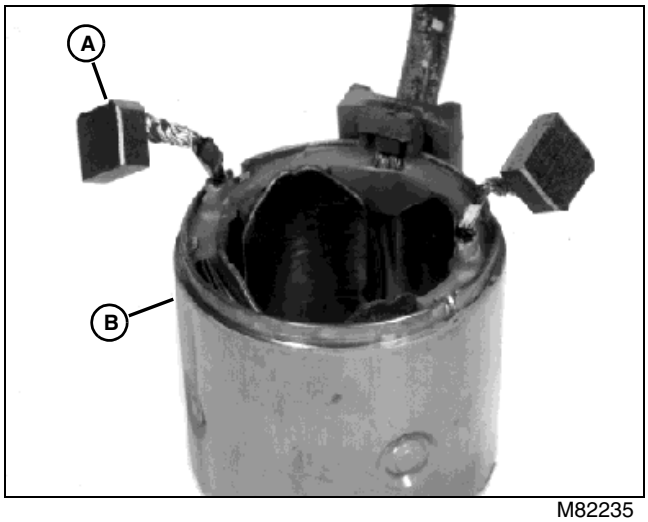
M82125A

6. Test for short circuited windings using a growler (H). Put armature in growler and hold a hacksaw blade (I) above each slot while slowly rotating armature. If coil is shorted, the blade will vibrate on the slot.

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

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

Field Coil and Housing



M82235

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

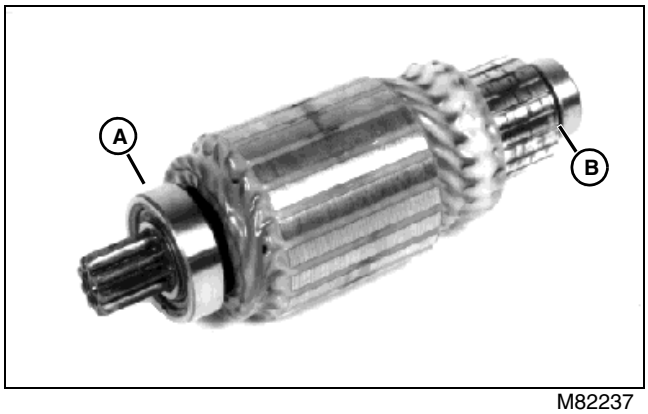
Be sure the field coil brush is not touching the housing.

1. Test for grounded field winding. Touch one meter probe to the field coil brush (A) and the other meter probe to the field coil housing (B). If continuity is present, replace the field coil.

2. Test for open field coil. Touch one meter probe to one field coil brush (A). Touch the other meter probe to the remaining field coil brushes.

3. If continuity is not read between any two brushes, the field coil is open and the entire field coil housing must be replaced.

Armature Bearing Replacement



M82237

1. Remove bearings (A and B) using a knife-edge puller.

IMPORTANT: Avoid damage! Press on bearing race only. Applying pressure to bearing outer diameter will damage bearing.

NOTE: Install both bearings with seal side toward armature.

2. Install new bearings using a press until the bearings are tight against the shoulder of the shaft.

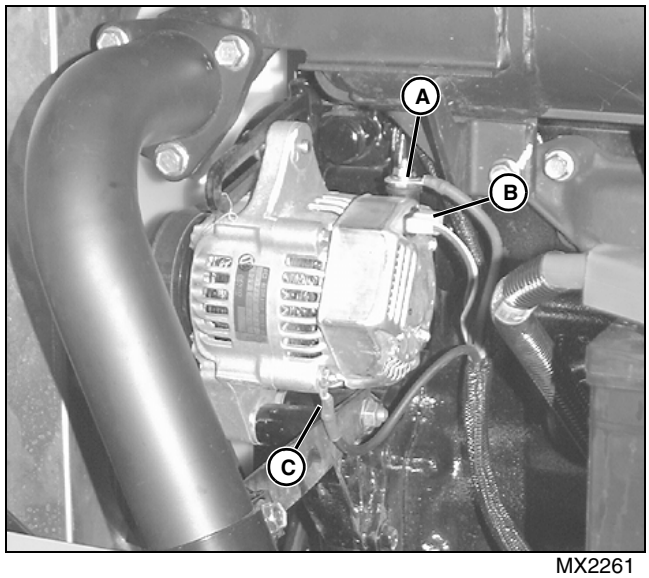
Alternator Removal and Installation

Removal

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

2. Raise hood.

3. Disconnect negative (-) battery cable.

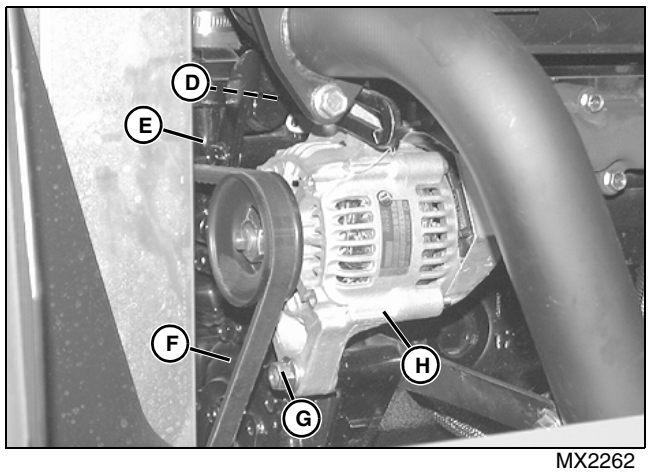


MX2261

4. Disconnect red wire (A) from alternator.

5. Disconnect wiring connector (B).

6. Disconnect black wire (C).



MX2262

7. Loosen top cap screw (D) and mounting bracket cap screw (E) and push alternator toward engine to loosen belt.

8. Remove drive belt (F) from alternator pulley.

9. Remove lower cap screw (G).

10. Remove top cap screw (D).

11. Remove alternator (H).

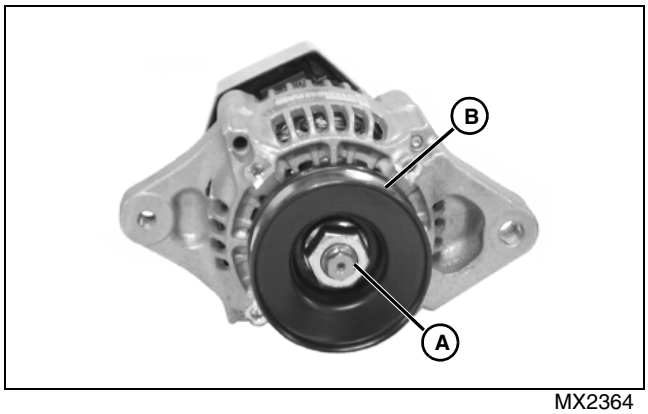
Installation

Installation is done in the reverse order of removal.

Adjust belt tension.

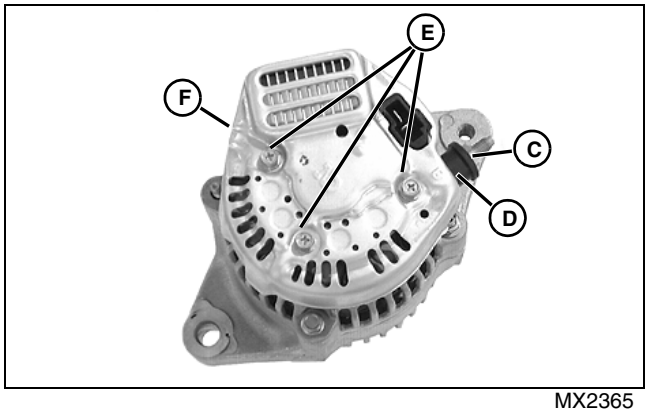
Alternator Disassembly and Assembly

NOTE: Clamp pulley in a soft-jawed vise and use an air impact wrench to remove pulley nut.



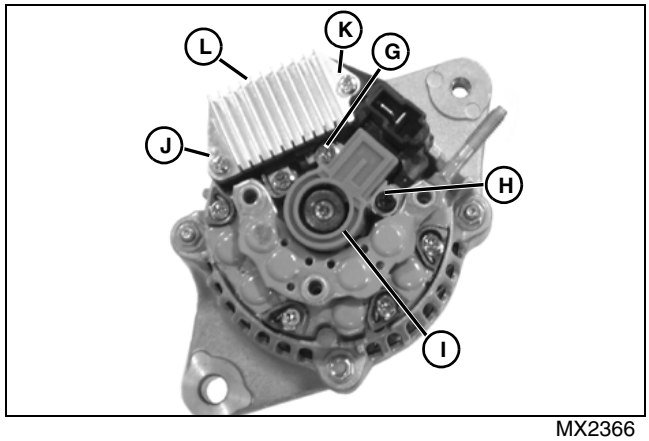
MX2364

1. Remove nut (A).
2. Remove pulley (B) using a puller.



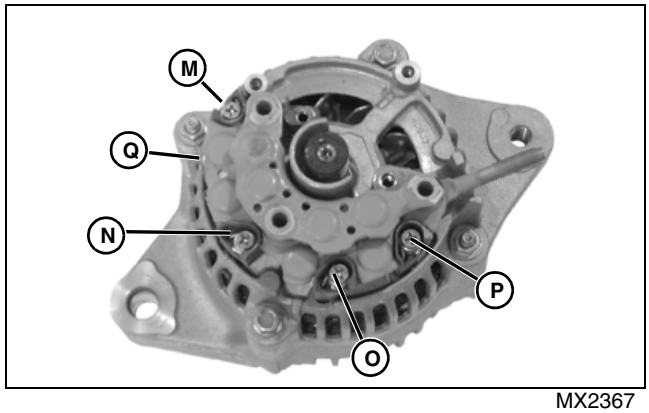
MX2365

3. Remove nut (C) and insulator (D) from battery terminal post.
4. Remove three screws (E) securing the cover to the body.
5. Remove cover (F).



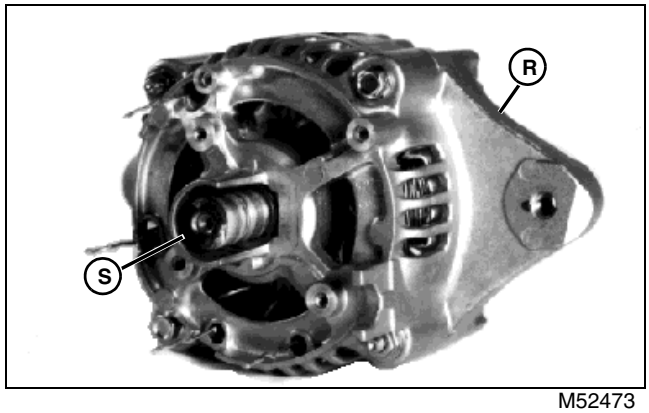
MX2366

6. Remove two screws (G, short, and H, long).
7. Remove brush holder and cover (I).
8. Remove two screws (J and K).
9. Remove regulator (L).



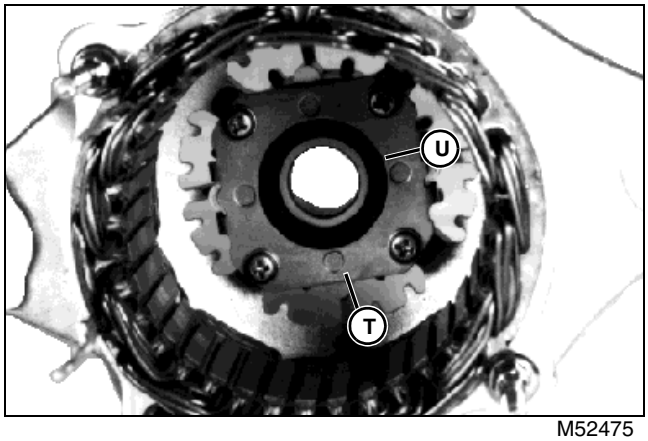
MX2367

10. Remove screws (M-P).
11. Straighten wires below each screw.
12. Remove rectifier (Q).



M52473

13. Remove rear frame (R).
14. Press rotor shaft (S) from rear frame.



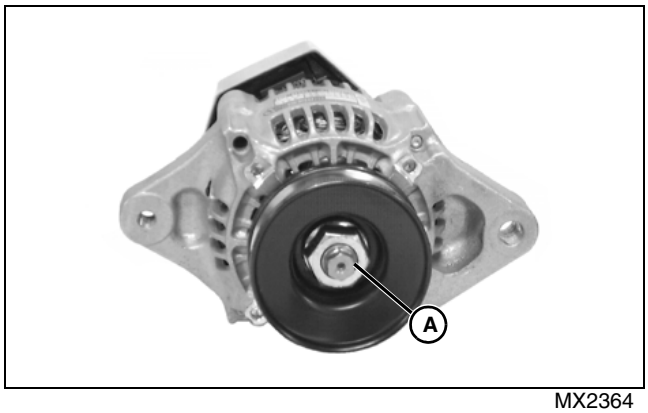
M52475

15.Remove retainer plate (T).

16.Press bearing (U) from case.

Assembly

Assembly is done in the reverse order of disassembly.



MX2364

Tighten pulley retaining nut (A) to specification.

Specifications

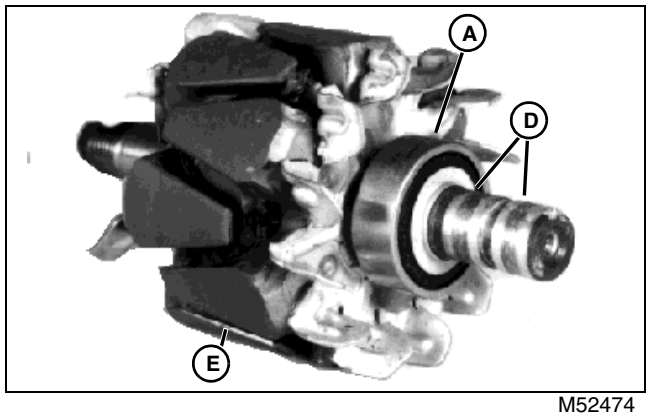
Pulley Retaining Nut Torque . . . . . 69 N•m (51 lb-ft)

Alternator Component Inspection

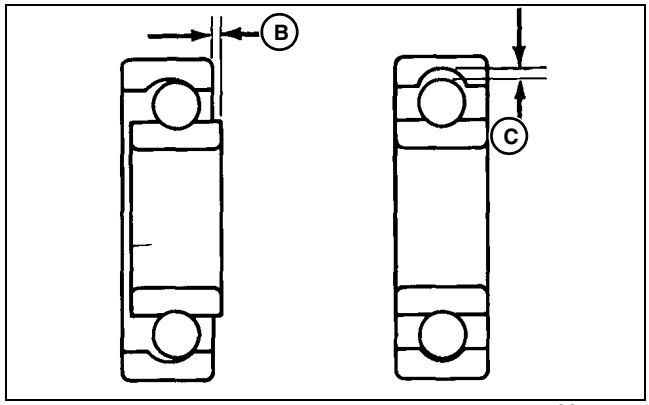
Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check for continuity during component inspection.

Rotor



M52474



M38073

1. Inspect bearing (A) for axial (B) and/or radial (C) free play or rough movement. Replace bearings as needed.

2. Inspect slip rings (D) for dirt or rough spots. If necessary, use No. 00 sandpaper or 400-grit silicone carbide paper to polish rings.

3. Measure the outer diameter of the slip rings. Replace the rotor if the diameter measures less than specification.

4. Check continuity between slip rings using an ohmmeter or continuity tester. Replace rotor if there is no continuity.

5. Check continuity between slip rings and rotor core (E). Replace rotor if there is no continuity.

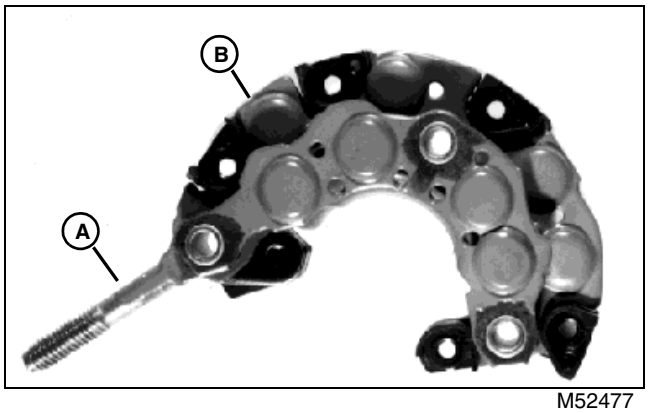
Stator

1. Inspect stator for defective insulation, discoloration or a burned odor. Replace the stator as needed.

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

2. Check for continuity between each stator lead and body. Replace the stator if there is no continuity.

Diodes

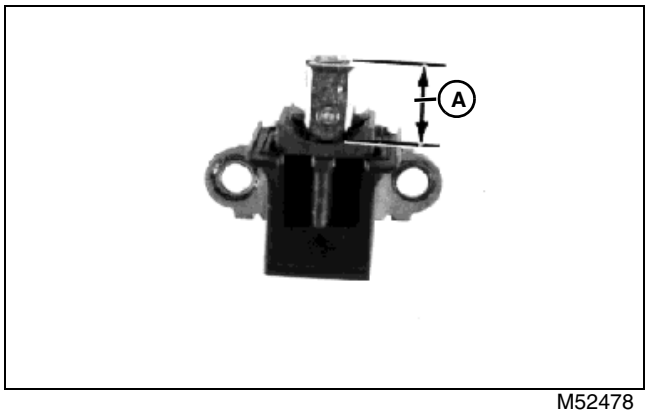


M52477

NOTE: Set ohmmeter to K ohm range.

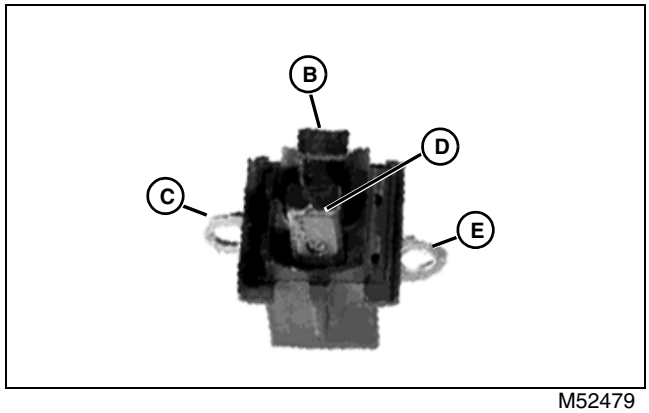
Check continuity between main lead (A) and each diode lead (B). Reverse ohmmeter leads and recheck. There should be continuity in one direction, but there should not be continuity when the leads are reversed. Replace the entire holder assembly if continuity is not correct.

Brushes



M52478

1. Measure the length of brush protruding from holder (A). The maximum length of brush protruding from the holder is 10.5 mm (0.41 in.). Replace brushes if worn to less than specification.



M52479

2. Check continuity between the brush (B) and terminal (C). Check continuity between the brush (D) and terminal (E). There should be no continuity between any other points. Replace brush if continuity is not correct.

Specifications

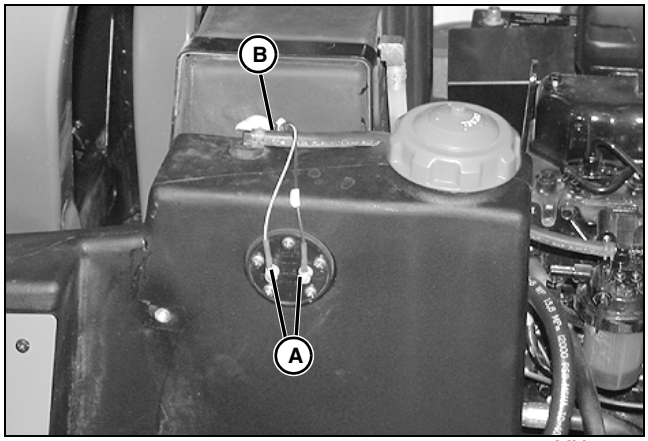
Rotor Slip Ring Outside Diameter (Wear Limit) . . . . . 14 mm (0.55 in.)
Brush Length (Min) . . . . . 4.5 mm (0.17 in.)

Fuel Tank Removal and Installation

Removal

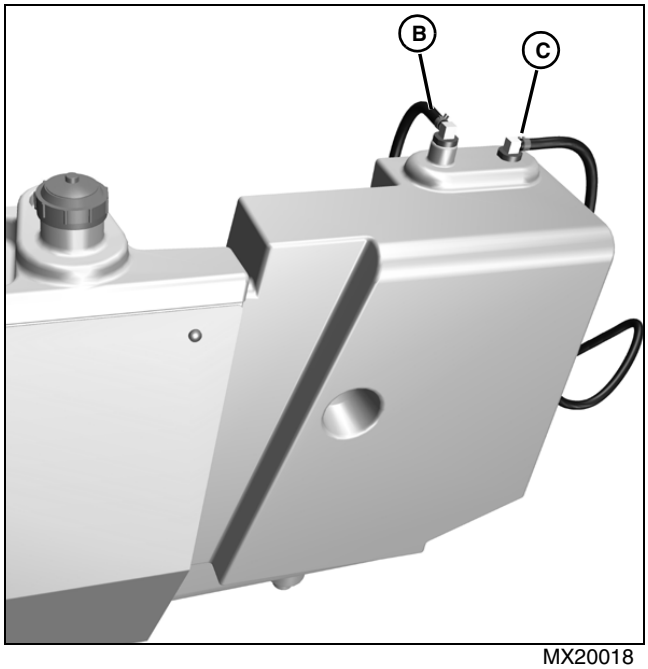
NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.

1. Remove bulkhead.



MX2299

2. **Models 1600/1620:** Disconnect fuel level sender connectors (A).



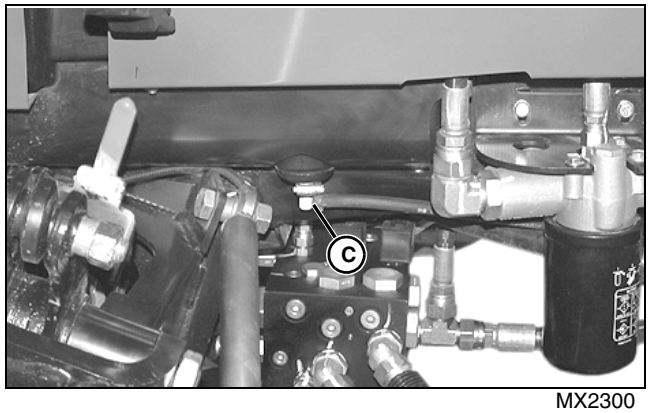
MX20018

Picture Note: S.N. (030001-)

3. Disconnect fuel return line (B).
Models S.N. (030001-): Disconnect fuel supply line (C).

NOTE: Models 1600/1620 fuel tank capacity is approximately 57 L (15 gal).

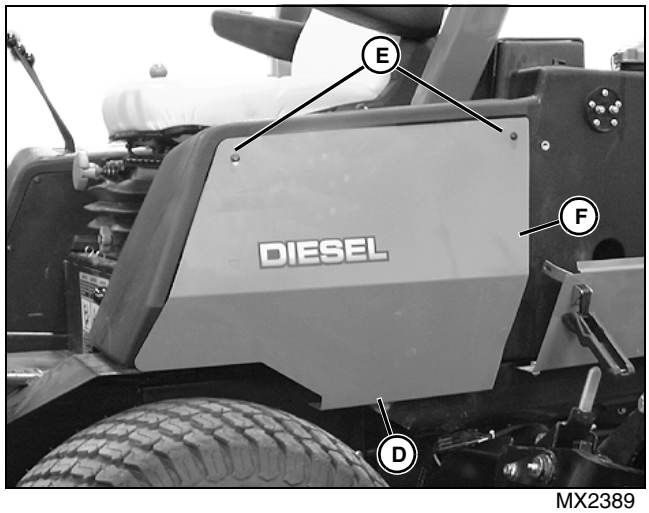
Model 1600 Turbo fuel tank capacity is approximately 83 L (22.6 gal).



MX2300

4. Models (-030000): Disconnect fuel line (C) and drain fuel into a properly marked container.

5. Models S.N. (030001-): Pump fuel into a properly marked container.

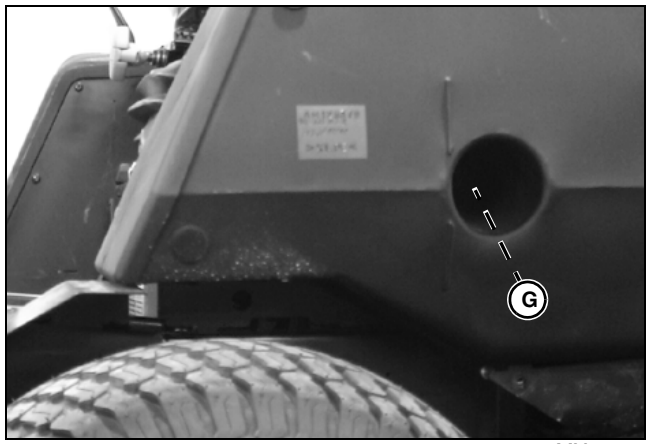


MX2389

6. Remove cap screw and nut (D).

7. Remove two screws (E).

8. Remove panel (F).



MX2390

9. Remove two cap screws (G).

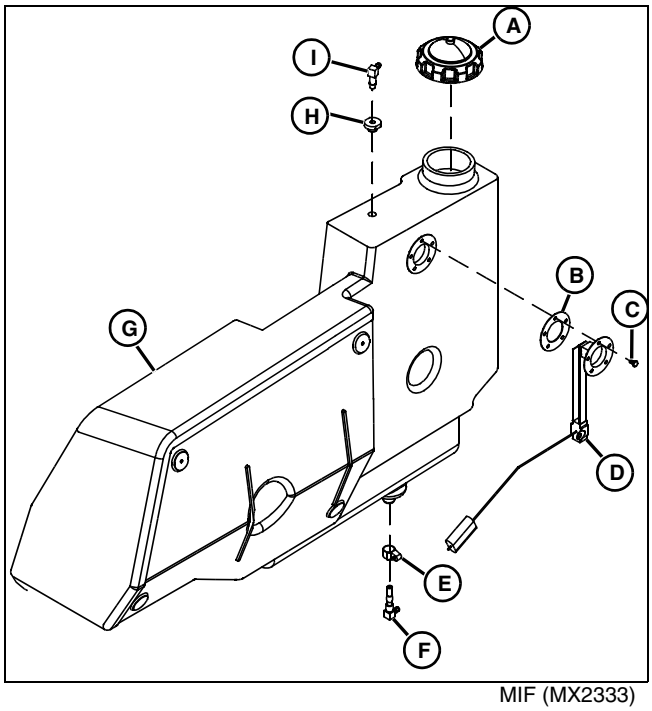
10.Remove fuel tank.

Installation

Installation is done in the reverse order of removal.

Fill tank and check for leaks. Replace tank as needed.

Fuel Tank Service



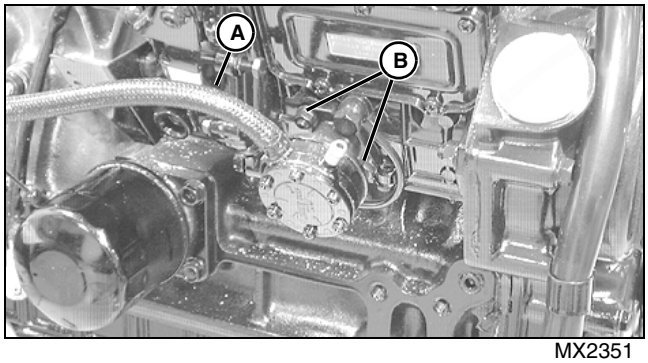
MIF (MX2333)

Picture Note: Models 1600/1620 Shown

- Inspect all parts for wear or damage. Replace parts as needed.
- **Models 1600/1620:** Use a new gasket (B) when installing sender unit (D).

Fuel Pump Removal and Installation (Yanmar TNE Engine)

Removal



MX2351

1. Disconnect fuel pump-to-fuel filter hose (A)
2. Remove two nuts (B).
3. Remove fuel pump.

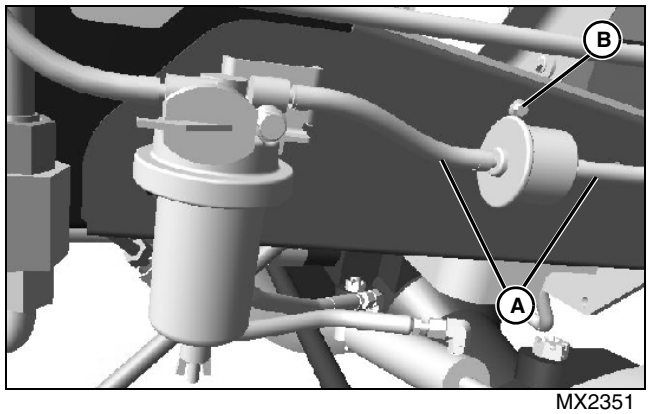
Installation

Installation is done in the reverse order of removal.

- Remove gasket residue from fuel pump and fuel injection pump mating surfaces.
- Use a new gasket for installation.
- Bleed air from fuel system.

Fuel Pump Removal and Installation (Yanmar TNV Engine)

Removal



MX2351

1. Disconnect and plug fuel hose (A)
2. Remove cap screw (B).
3. Remove fuel pump.

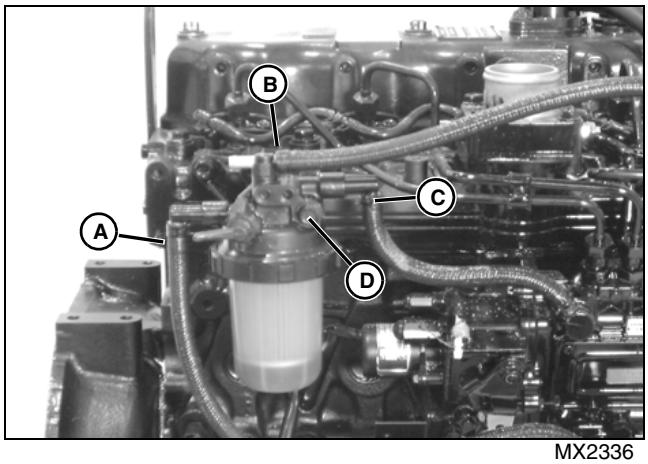
Installation

Installation is done in the reverse order of removal.

- Bleed air from fuel system.

Fuel Filter Assembly Removal and Installation (Yanmar TNE Engine)

Removal



MX2336

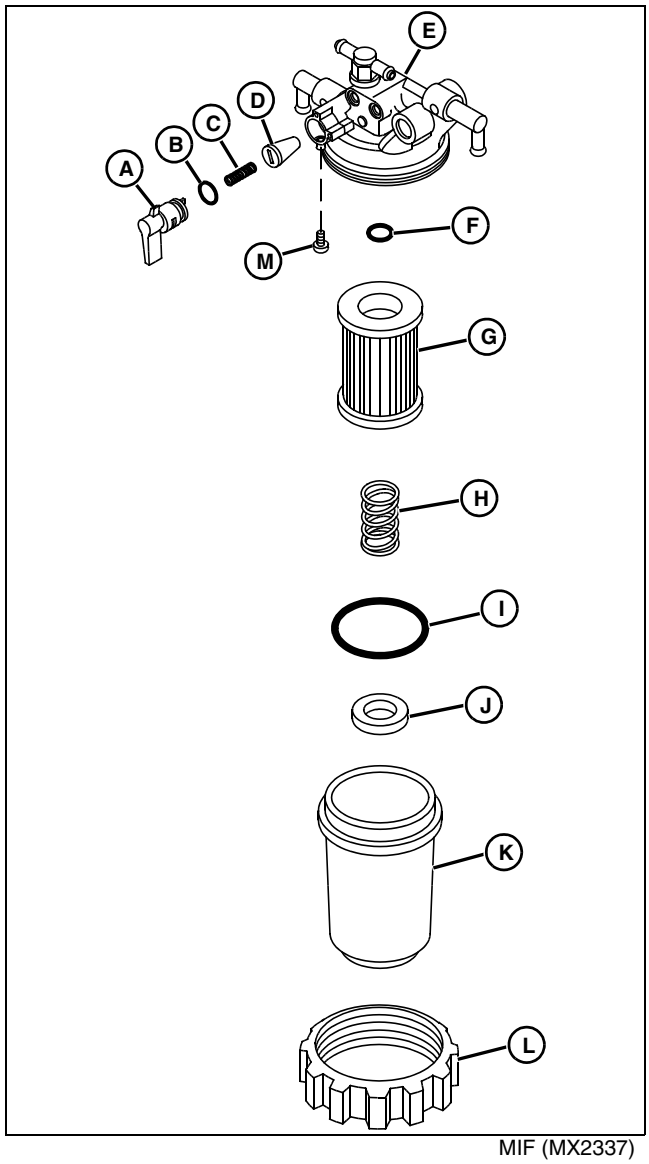
1. Disconnect fuel pump-to-fuel filter hose (A).
2. Disconnect leak-off hose (B).
3. Disconnect fuel filter-to-injection pump hose (C).
4. Remove mounting cap screw (D) and washers.
5. Remove fuel filter assembly.

Installation

Installation is done in the reverse order of removal.

Bleed air from fuel system.

Fuel Filter Assembly Service (Yanmar TNE Engine)



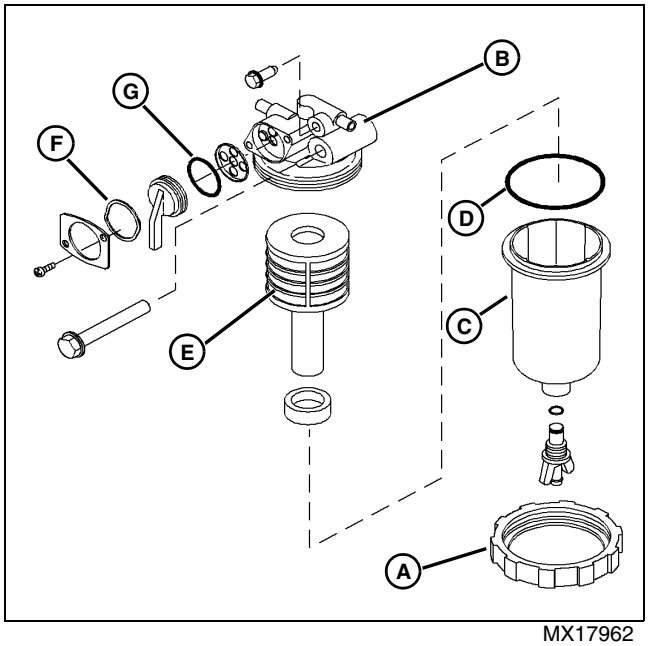
MIF (MX2337)

- Inspect all parts for wear or damage. Replace parts as needed.
- Install seat (D) with hole positioned opposite of pointer on handle (A).

Disassemble and Assemble Water Separator (Yanmar TNV Engine)

IMPORTANT: Avoid damage! Replace all copper washers on injection pump fittings. Damaged or used washers will leak.

Always use new O-ring seals when replacing separator.



MX17962

1. Remove the retaining ring (A) from the mounting base (B) while holding on to the separator bowl (C).
2. Remove the separator bowl from the mounting base.
3. Remove and replace O-ring (D) and strainer (E).
4. Remove shutoff valve cover. Inspect and replace wave washer (F) and O-ring (G) as necessary.
5. Before installing the bowl and strainer in the mounting base, verify the O-ring is in the groove inside the mounting base.
6. Install the separator bowl and the strainer in the mounting base.

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

7. Place the retaining ring over separator bowl and screw on the mounting base to retain bowl to mounting base.

Fuel Injection Line Removal and Installation

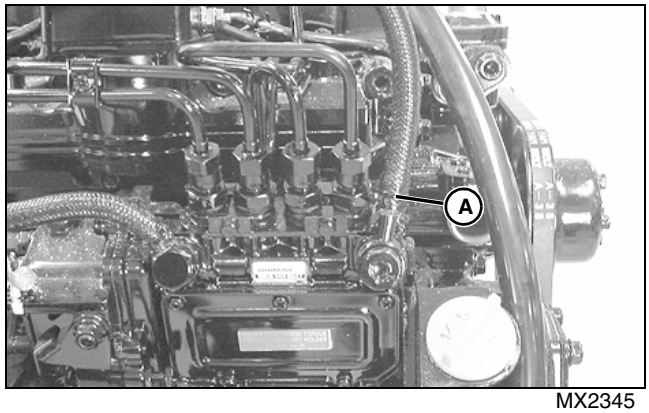
Removal

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

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

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

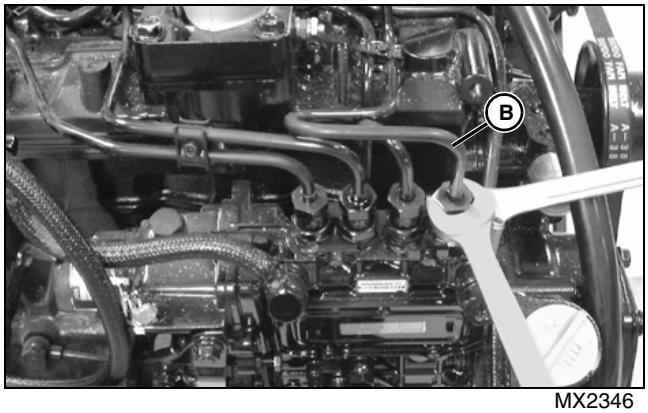


MX2345

2. Disconnect leak-off line (A) at the injection pump.

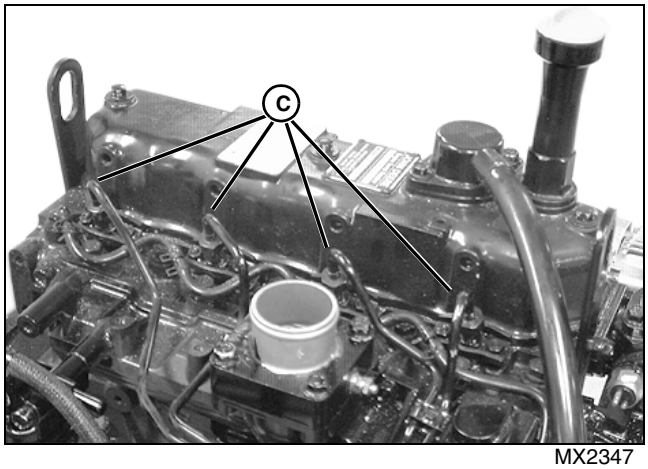
IMPORTANT: Avoid damage! When removing injection lines, DO NOT turn pump delivery valve fittings. Turning fittings may damage pump internally.

NOTE: Loosen fuel injector line connectors (on fuel injection pump and fuel injectors) slightly to release pressure in the fuel system. When loosening connectors, use another wrench to keep delivery valves from loosening.



MX2346

3. Disconnect fuel injection lines (B) at injection pump.



MX2347

4. Disconnect fuel injection lines (C) at injectors.
5. Remove fuel injection lines.

Installation

Installation is done in the reverse order of removal.

- Tighten fuel line nuts to specification.
- Bleed air from fuel system.

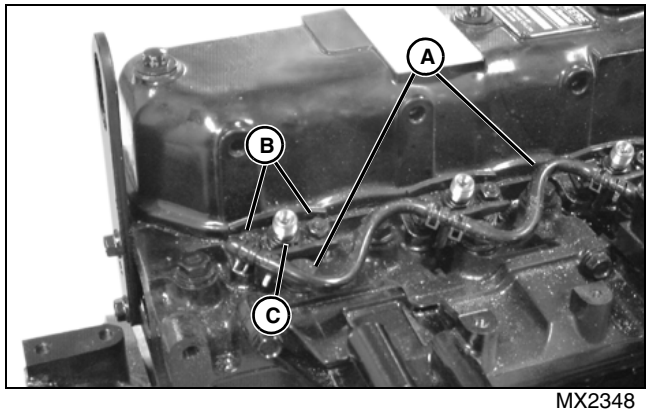
Specifications

Fuel Injector Line Nut Torque . . . . . 32 N•m (24 lb-ft)

Fuel Injection Nozzle Removal and Installation

Removal

1. Remove fuel injector lines.



MX2348

2. Disconnect leak-off hoses (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.

3. Remove nuts (B) and retaining clamp (C).

IMPORTANT: Avoid damage! Plug injection nozzle holes in head to prevent debris from falling into engine.

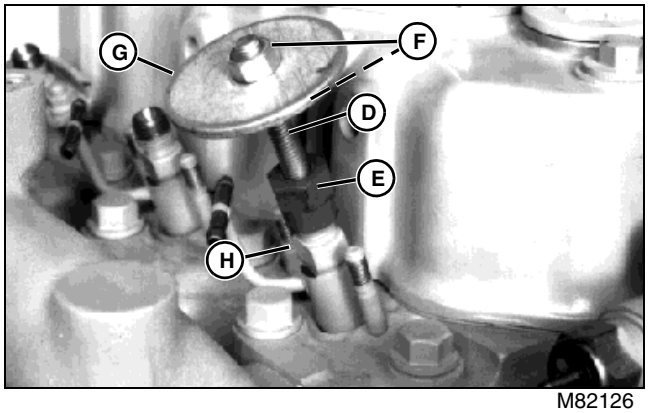
NOTE:

- ***If the ring and heat protector do not come out with the injection nozzle: Thread a cap screw into the heat protector and pull from cylinder head.***
- ***If the nozzles are stuck in the cylinder head:***

  a. Grind the head of a cap screw (D) so that it fits inside a nut (E) from an old injection line.

  b. Use two nuts (F) to attach a large flat washer (G) to the cap screw.

  c. Install the assembly onto the nozzle (H) and use a puller and slide hammer to pull the nozzle from the cylinder head.



M82126

4. Remove injection nozzle, ring, and TEFLON® heat protector.

5. Test injection nozzles.

Installation

Installation is done in the reverse order of removal.

- Use new nozzle protectors for installation.
- Tighten retaining clamp nuts to specification.
- Bleed air from fuel system.

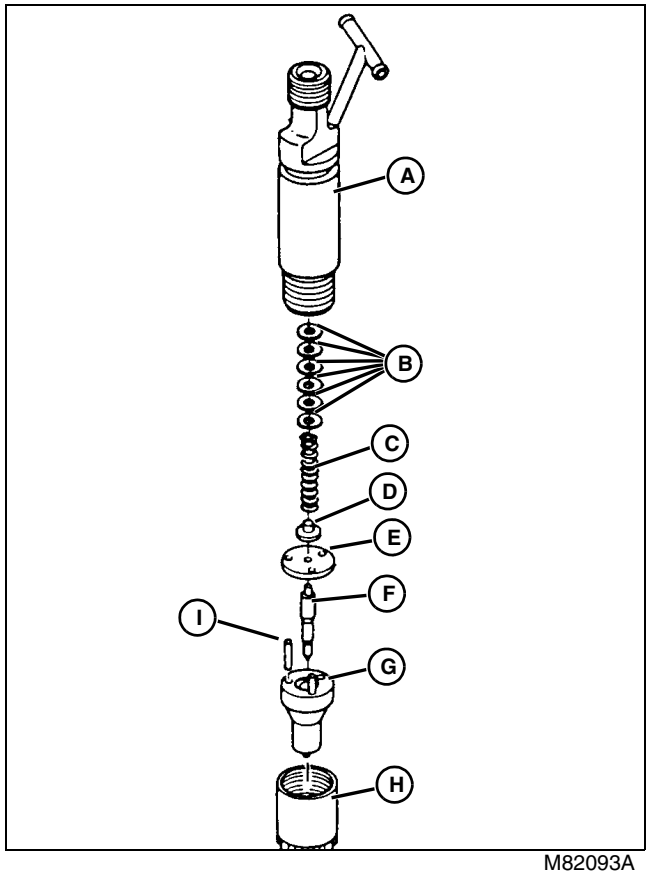
Specifications

Fuel Injector Clamp Nut Torque . . . . . 5 N•m (44 lb-ft)

Fuel Injection Nozzle Disassembly and Assembly

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

1. Clean and inspect nozzle assembly.



M82093A

2. Carefully clamp the injector body (A) in a soft-jawed vise.

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

3. Remove retaining nut (H).

4. Remove parts (B-G and I).

Assembly

Assembly is done in the reverse order of disassembly.

- Tighten retaining nut (H) to specification.
- After assembly is complete, test injection nozzle.

Specifications

Fuel Injector Retaining Nut Torque. . . . . 8 N•m (72 lb-ft)

Fuel Injection Nozzle Cleaning and Inspection

Special or Required Tools

Tool Name	Tool No.	Tool Use
Nozzle Cleaning Kit	JDF13	Used to clean fuel injection nozzles.

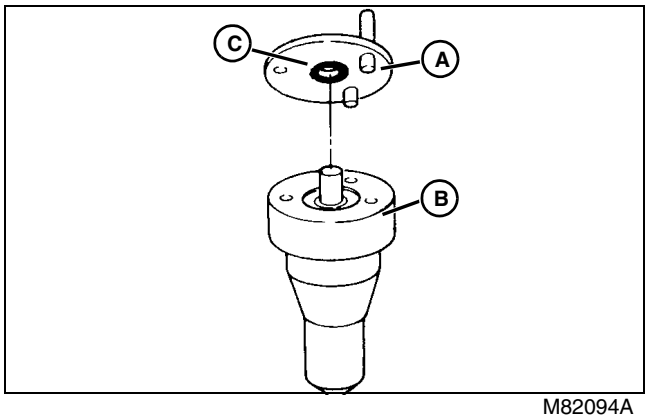
NOTE: To clean nozzles properly, JDF13 Nozzle Cleaning Kit is recommended. The cleaning kit is available through the John Deere SERVICE GARD™ Catalog.

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

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

2. Remove carbon from used nozzles, and clean by washing in diesel fuel. If parts are coated with hardened carbon or lacquer, it may be necessary to use a brass wire brush (supplied in JDF13 Nozzle Cleaning Kit).

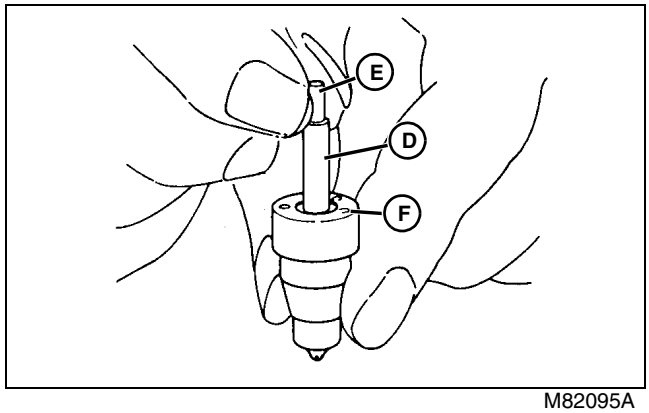
3. After removing carbon or lacquer from the exterior of nozzle, inspect sealing surfaces between separator plate and nozzle body for nicks or scratches.



M82094A

4. Inspect condition of separator plate (A) and nozzle body (B). 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 (C) of separator plate for wear or damage. Replace nozzle assembly if wear or damage is noted.



M82095A

6. Inspect the piston (large) part (D) of nozzle valve to see that it is not scratched or scored and that lower (tip) end of valve is not broken. If any of these conditions are present, replace the nozzle assembly.

7. Further inspect the nozzle assembly by performing a slide test. Use the following procedure:

a. Dip the nozzle valve (E) in clean diesel fuel. Insert valve in nozzle body (F).

b. Hold nozzle vertical, and pull valve out about 1/3 of its engaged length.

c. Release valve. Valve should slide down to its seat by its own weight.

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

Fuel Injection Pump Removal and Installation

Removal

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

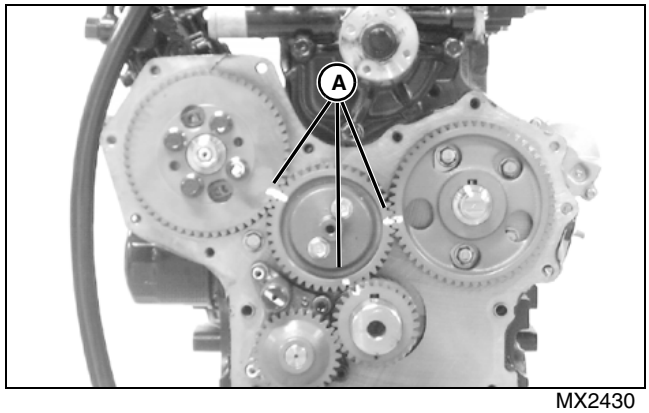
IMPORTANT: Avoid damage! If it is determined that either the fuel injection pump or governor assembly are in need of repair, they must be replaced ONLY as complete assemblies. Only an authorized factory trained technician is allowed to remove and install these assemblies. If replacement is necessary, remove and install the fuel injection pump and/or governor assembly as complete, individual assemblies.

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

NOTE: The fuel injection pump and governor is manufactured to comply with strict California Air Resources Board/Environmental Protection Agency (CARB/EPA) emissions requirements. Tampering with the fuel injection pump, fuel injection pump timing, or governor may result in severe fines or penalties.

1. Clean the injection pump lines and area around the pump using a parts cleaning solvent or steam cleaner.
2. Remove fuel injection lines.
3. Remove timing gear cover.
4. Remove fuel filter.

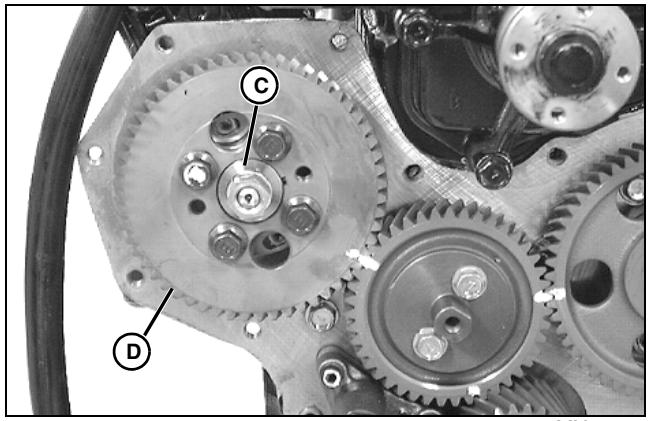
NOTE: Due to the odd number of teeth on the idler gear, the timing marks will align only periodically.



MX2430

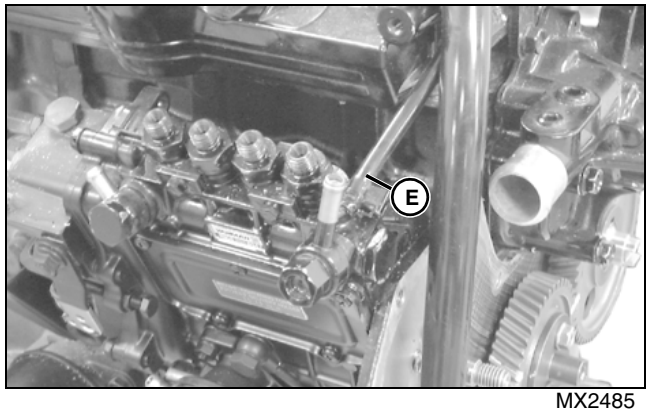
5. Rotate the crankshaft until all timing gear alignment marks (A) align.

NOTE: DO NOT rotate engine while the injection pump is removed.



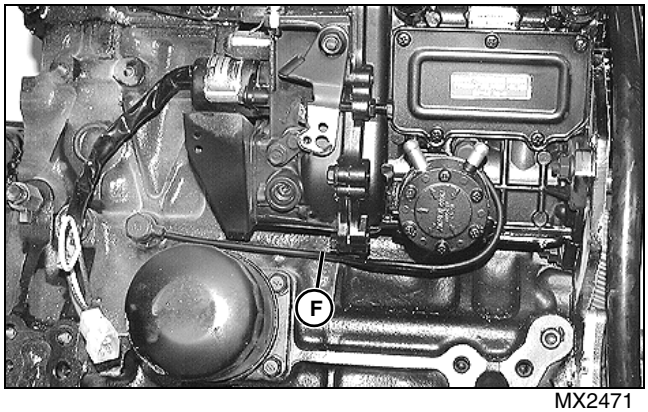
MX2355

6. Remove nut and washer (C).
7. Remove gear (D) using a gear puller.



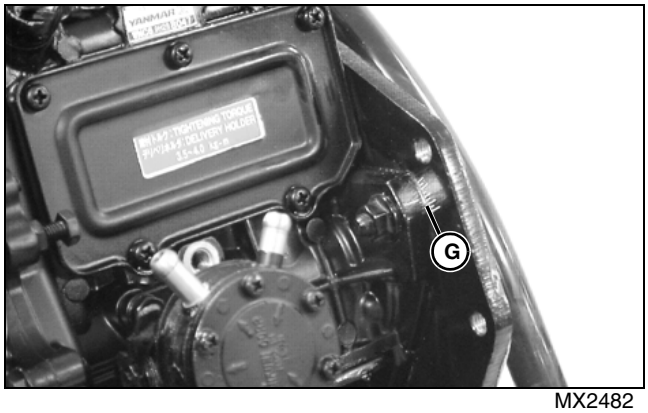
MX2485

8. Disconnect leak-off hose (E).



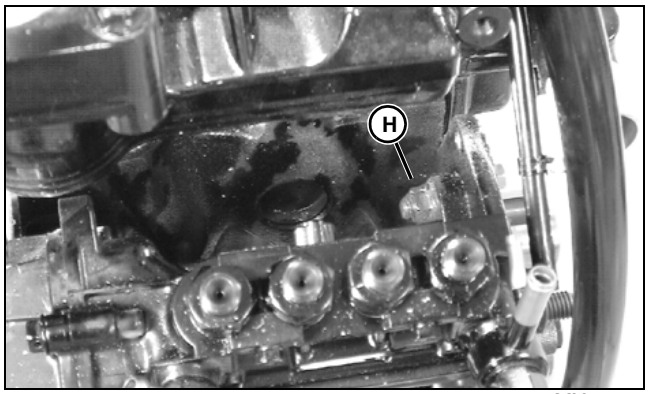
MX2471

9. Remove external oil line (F).



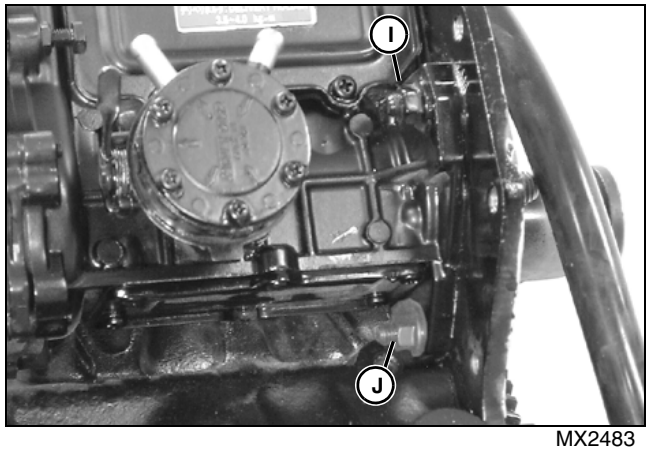
MX2482

10.Note the position of the timing marks (G) on the injection pump and timing gear mounting plate.



MX2484

11.Remove nut (H).



MX2483

12.Remove nuts (I and J).

13.Remove injection pump.

Installation

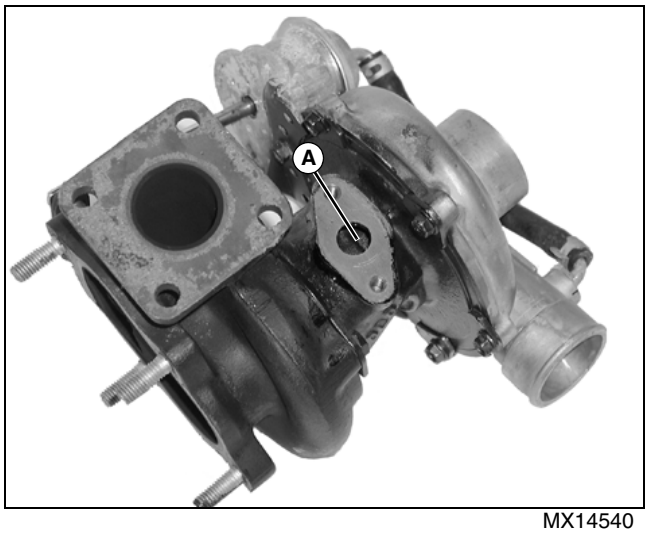
Installation is done in the reverse order of removal.

- If a new pump is being installed, check and adjust injection pump static timing.
- Bleed air from fuel system.

Repair Turbocharger - Model 1600 Turbo

Turbochargers used on the engines covered in this manual are available through service parts as a complete remanufactured assembly only. Individual components for repair are not available.

Prelube Turbocharger - Model 1600 Turbo



MX14540

IMPORTANT: Avoid damage! DO NOT spin the rotor assembly with compressed air. Damage to bearings can occur when using compressed air.

Fill oil inlet or drain port (A) with clean engine oil and spin rotating assembly (by hand) to properly lubricate bearings.

If turbocharger is to be stored for an extended period of time, lubricate internally and install protective covers on all openings.

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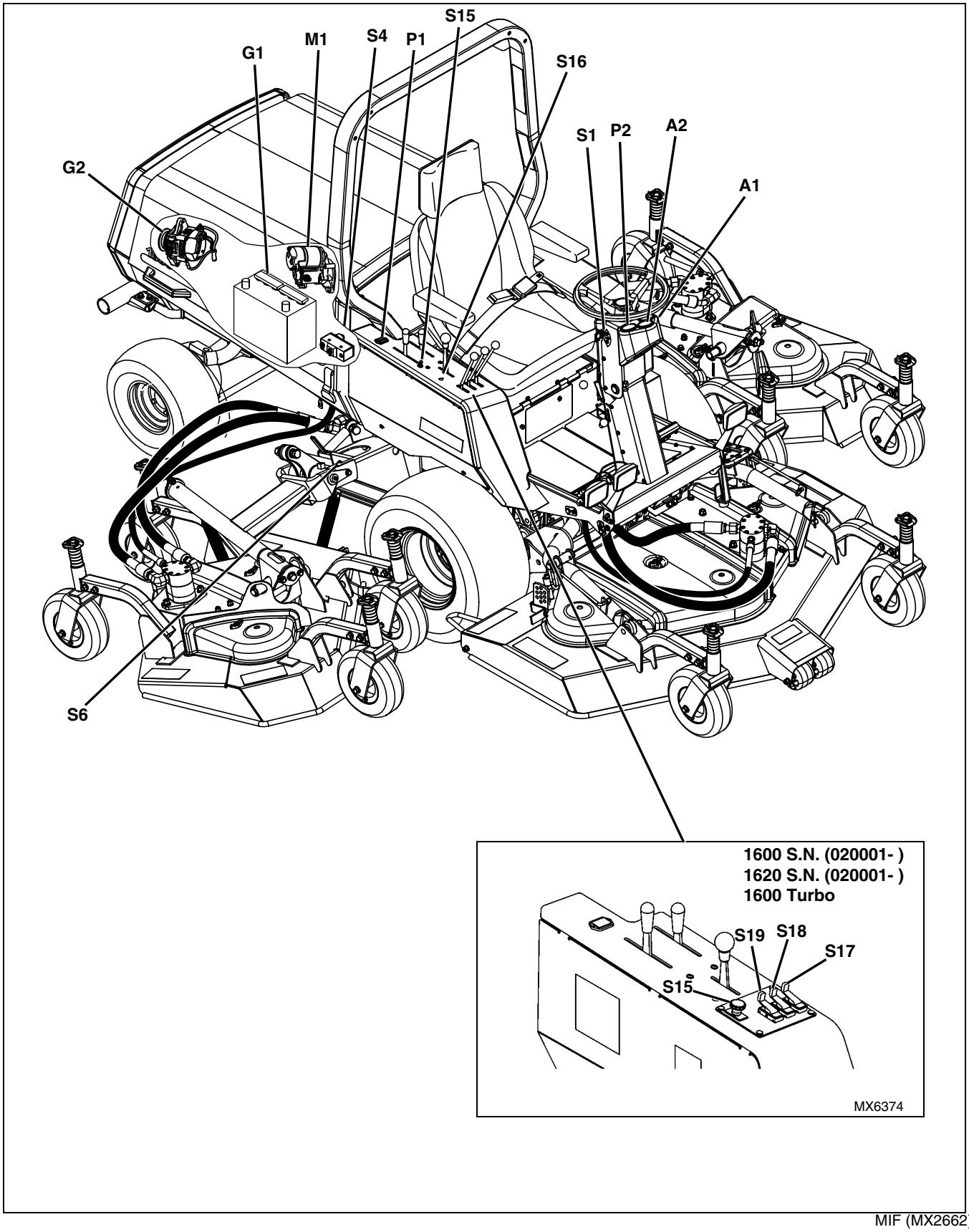
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Specifications

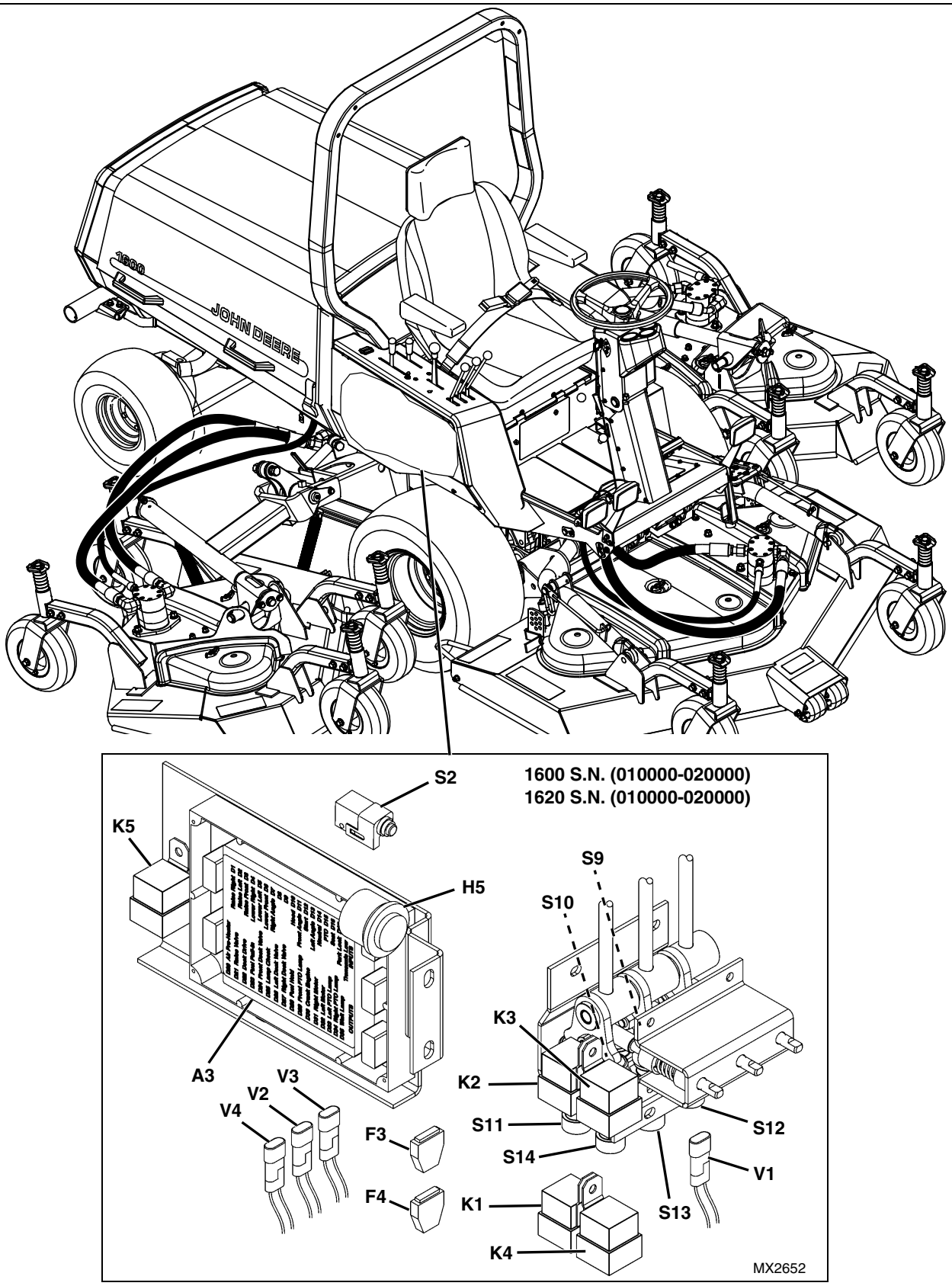
Test and Adjustment Specifications

Resistance of Engine Coolant Temperature Sensor	**46-481 ohms**
Battery	
Specific Gravity (Min)	**1.225**
Maximum Variation of Specific Gravity between Cells	**50 points**
Specific Gravity after Charging	**1.230-1.265**
Alternator - Models 1600/1620	
Unregulated Output (Min)	**35 amps**
Regulated Output Voltage	**12.2-14.7 VDC**
Alternator - Model 1600 Turbo	
Unregulated Output (Min)	**55 amps**
Regulated Output Voltage	**12.2-14.7 VDC**
Starting Motor Amperage Draw at 225 RPM (Max)	**180 amps**
Air Pre-Heater Resistance (Max)	**10 ohms**
Fuel Shutoff Solenoid	
Pull-In Coil Resistance (Approx)	**0.4 ohms**
Hold Coil Resistance (Approx)	**12.0 ohms**
Coils Combined Resistance (Approx)	**12.4 ohms**
Fuel Gauge Sensor Resistance	
Empty (Approx)	**230 ohms**
Full (Approx)	**28 ohms**
Engine Coolant Temperature Sensor	
Resistance at 71°C (160°F)	**100 ohms**
Resistance at 82°C (180°F)	**80 ohms**
Resistance at 93°C (200°F)	**60 ohms**
Resistance at 116°C (240°F)	**40 ohms**
Coolant Temperature Switch Operating Temperature	**107-113°C (225-235°F)**
Cruise Control Magnet Resistance (Approx)	**20 ohms**

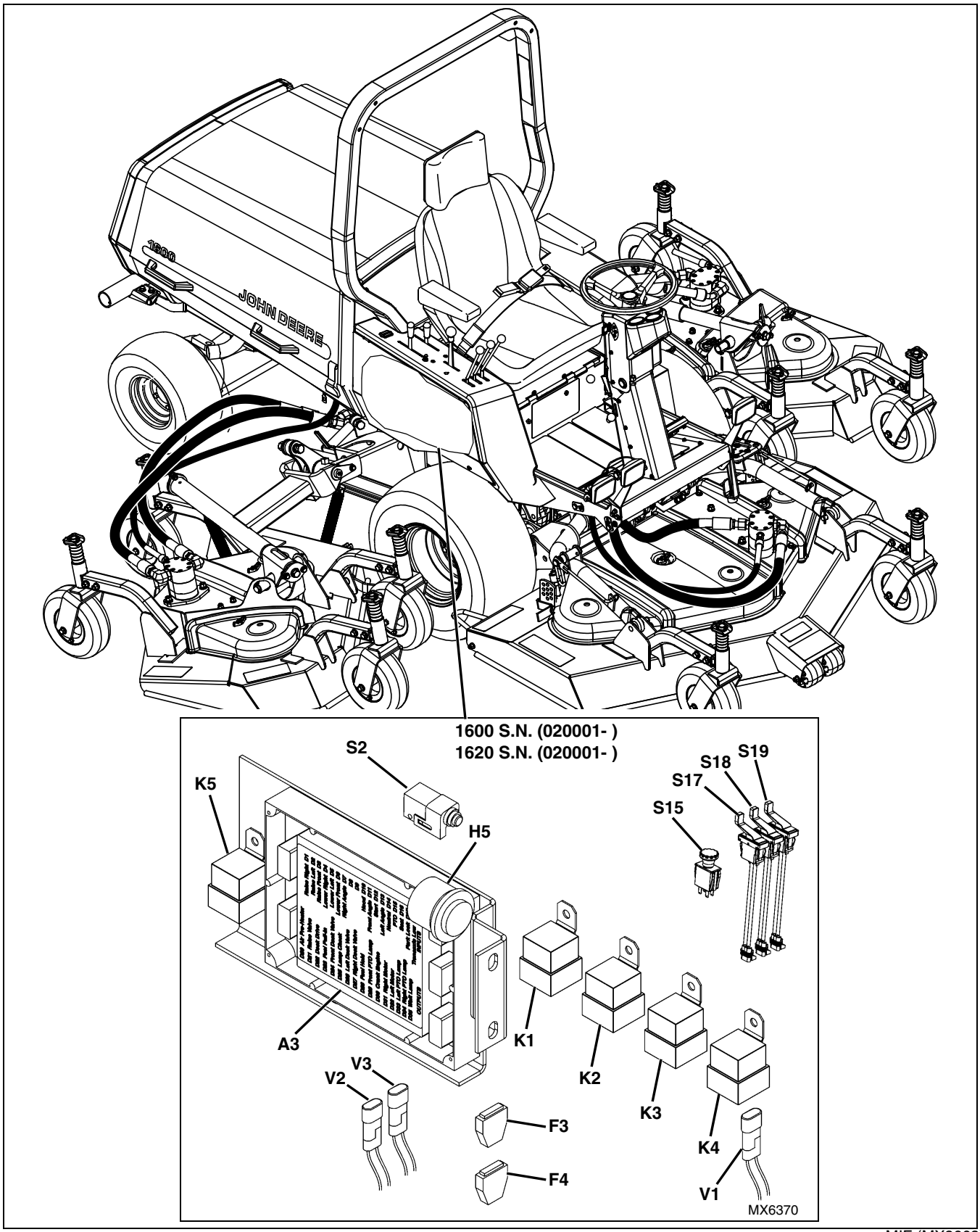
Component Location **Electrical Component Location**



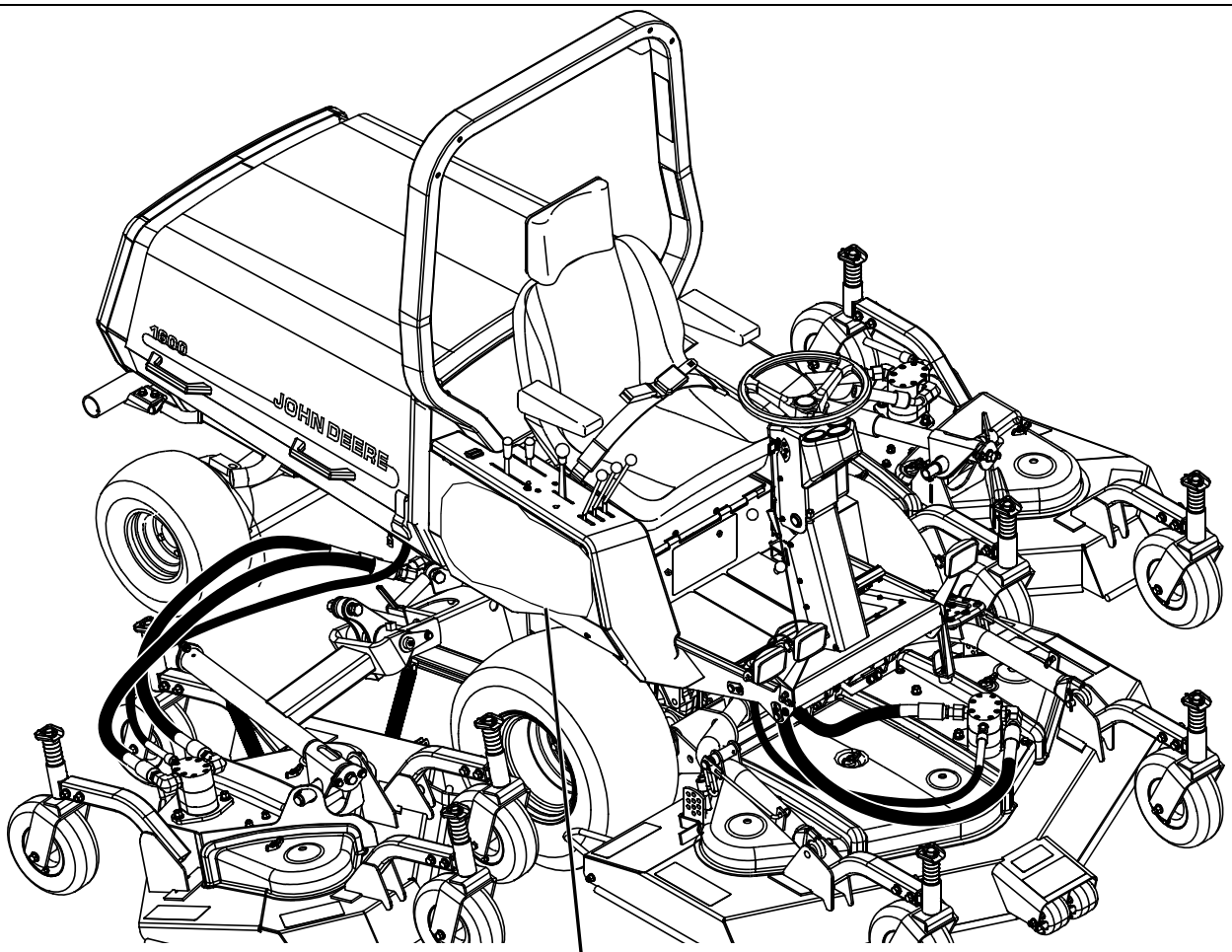
MIF (MX2662)


1600 S.N. (010000-020000)
1620 S.N. (010000-020000)
S2
K5
H5
A3
V3
V2
V4
F3
F4
S9
S10
K3
K2
S11
S12
S14
V1
K1
S13
K4
MX2652

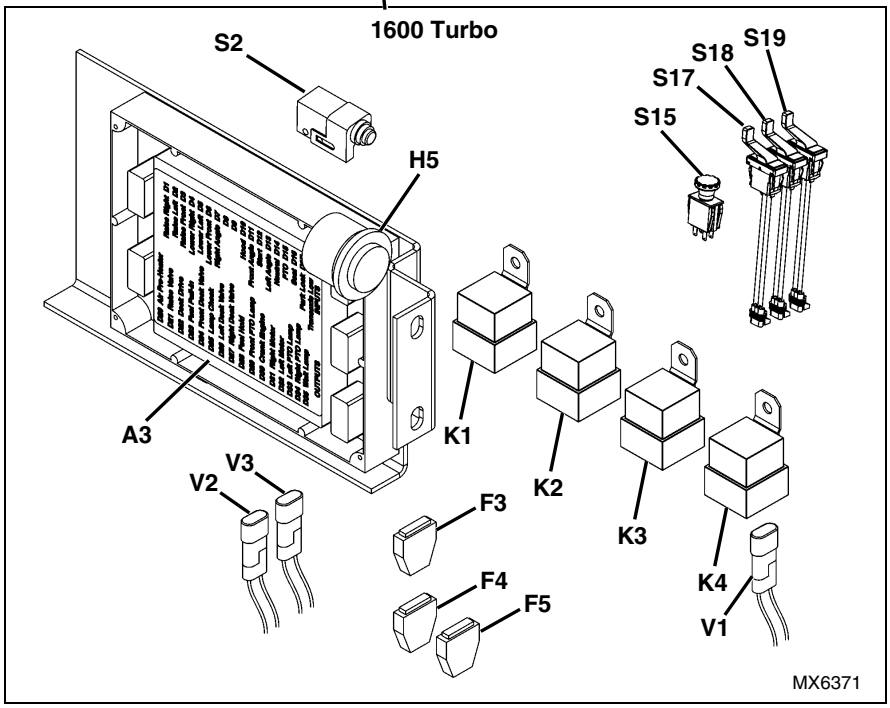
MIF (MX2662)


1600 S.N. (020001-)
1620 S.N. (020001-)
S2
K5
H5
S18
S19
S17
S15
A3
K1
K2
K3
K4
V3
V2
F3
F4
V1
MX6370

MIF (MX2662)

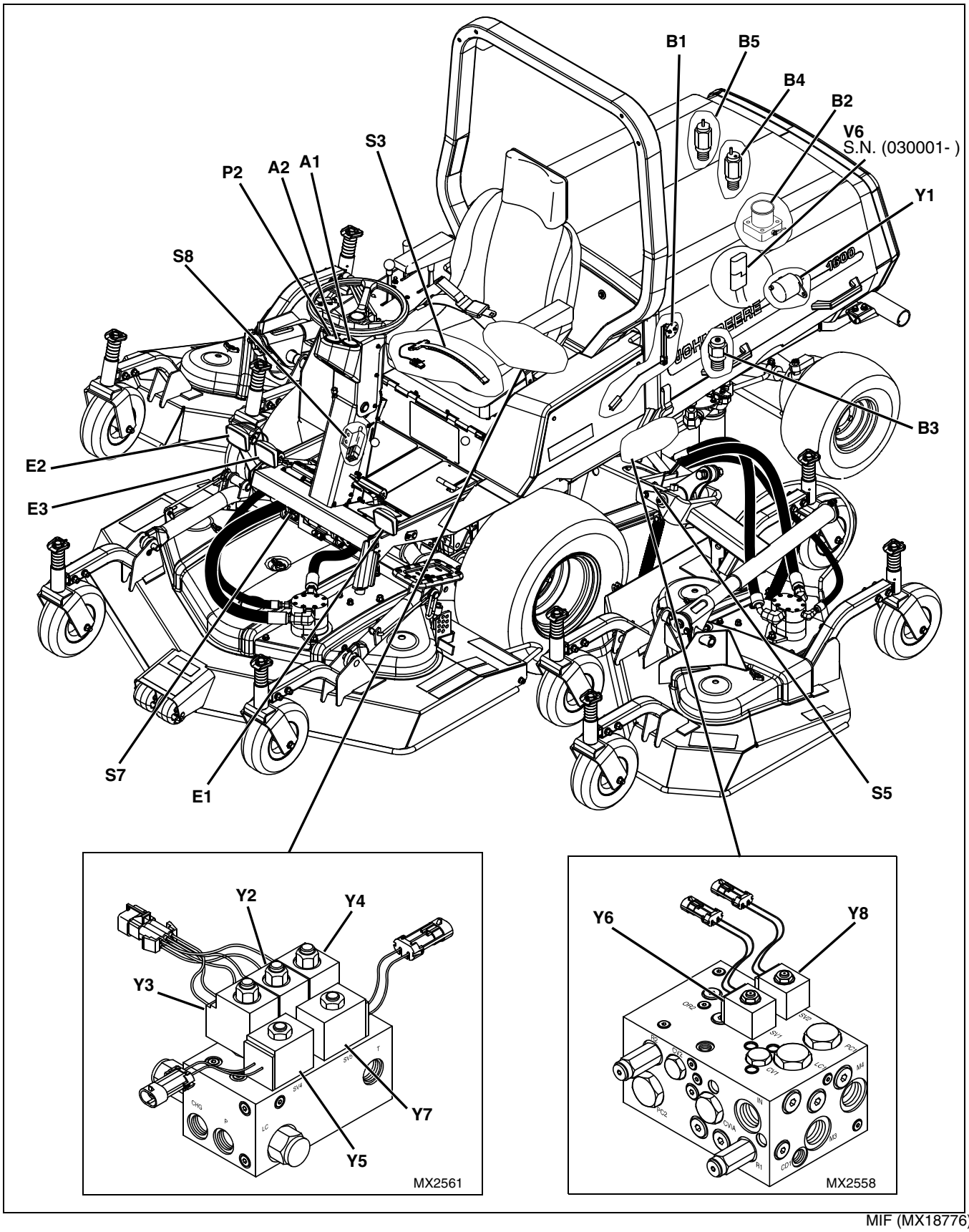


1600 Turbo

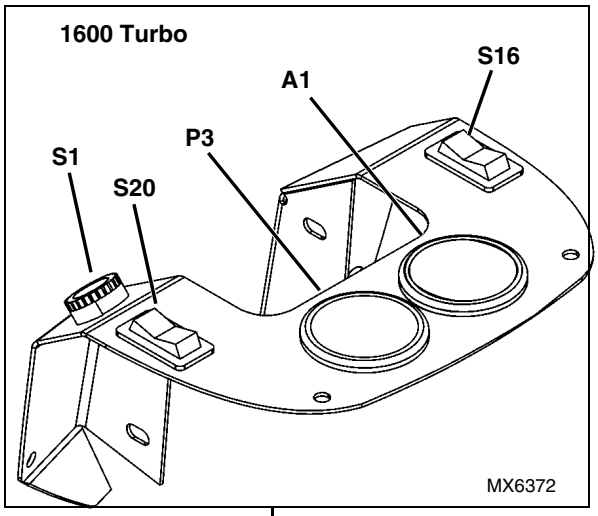


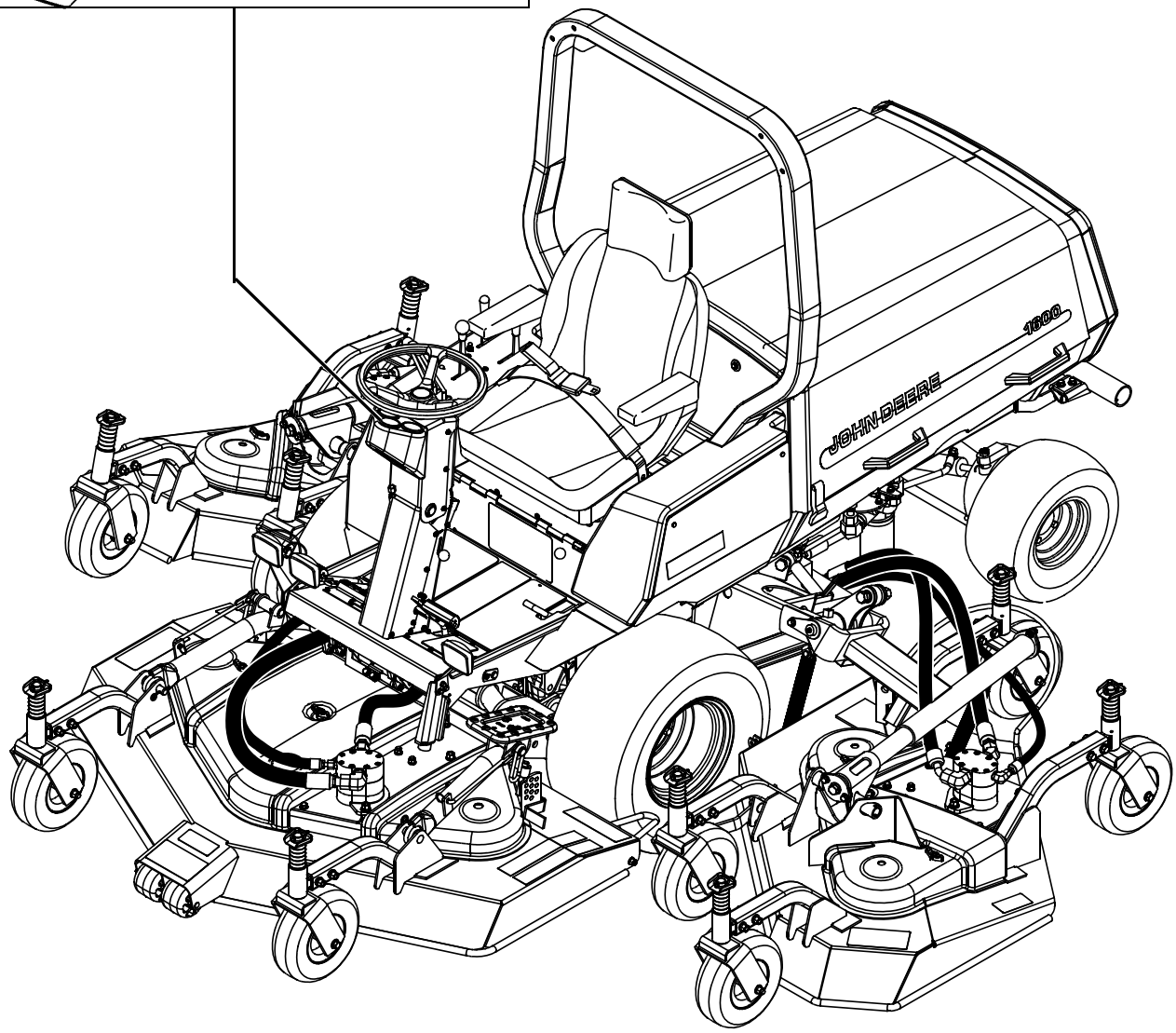
MIF (MX2662)

ELECTRICAL COMPONENT LOCATION



MIF (MX18776)





MIF (MX2663)

Schematics and Harnesses

Schematic and Wiring Harness Legend

Component

A1 -	Engine Lights Display (SE6, W1)
A2 -	PTO Lights Display (SE6, W1)[9]
A3 -	Electronic Control Module (SE7)
B1 -	Fuel Gauge Sensor (SE4, W1)[9]
B2 -	Air Pre-Heater (SE5, W1)
B3 -	Engine Oil Pressure Switch (SE6, W1)
B4 -	Coolant Temperature Switch (SE6, W1)
B5 -	Engine Coolant Temperature Sensor (SE4, W1)[5]
E1 -	Left Headlight (SE10, W2)[10, 11]
E2 -	Right Headlight (SE10, W2)[10, 11]
E3 -	Auxiliary Headlight (SE10, W2)[10, 11]
E4 -	Engine Coolant Temperature Gauge Light (SE10, W1)[5]
E5 -	Left Floodlight (W8)[6, 10]
E6 -	Left Headlight (W8)[6, 10]
E7 -	Right Headlight (W8)[6, 10]
E8 -	Right Floodlight (W8)[6, 10]
E9 -	Right Turn/Hazard Light (Amber) (W9)[6, 10]
E10 -	Right Taillight (Red) (W9)[6, 10]
E11 -	Right Turn Light (Red) (W9)[6, 10]
E12 -	Left Turn/Hazard Light (Amber) (W9)[6, 10]
E13 -	Left Taillight (Red) (W9)[6, 10]
E14 -	Left Turn Light (Red) (W9)[6, 10]
F1 -	Fusible Link (SE2, W1)
F2 -	Fusible Link (SE2, W1)
F3 -	Switched Power Fuse (SE2, W1)
F4 -	Lights Fuse (SE10, W1)
F5 -	Lights Fuse (SE10, W1)[5]
G1 -	Battery (SE1)
G2 -	Alternator (SE1, W1)
H1 -	Discharge Light (SE6)
H2 -	Air Pre-Heater Light (SE6)
H3 -	Engine Oil Pressure Light (SE6)
H4 -	Coolant Temperature Light (SE6)
H5 -	Buzzer (SE6, W1)
H6 -	Left PTO Light (SE6)[9]
H7 -	Right PTO Light (SE6)[9]
H8 -	Front PTO Light (SE6)[9]
K1 -	Start Relay (SE2, W1)
K2 -	Fuel Pull-In Relay (SE2, W1)
K3 -	Air Pre-Heater Relay (SE5, W1)
K4 -	Lights Relay (SE10, W1)[10]

K5 - Hold Coil Relay (SE2, W6)[2,4]

K6 - Road Lights Relay #1 (W9)[6, 10]

K7 - Road Lights Relay #2 (W9)[6, 10]

K8 - Road Lights Relay #3 (W9)[6, 10]

K9 - Road Lights Relay #4 (W9)[6, 10]

K10 - Road Lights Relay #5 (W9)[6, 10]

K11- Road Lights Flasher Relay (W9)[6, 10]

M1 - Starting Motor (SE2, W1)

P1 - Hour Meter (SE3, W1)

P2 - Fuel Gauge (SE4, W1)[9]

P3 - Engine Coolant Temperature Gauge (SE4, W1)[5]

R1 - PTO Switch Resistor (SE9, W1)[8]

S1 - Key Switch (SE2, W1)

S2 - Transaxle Switch (SE7, W1)[14]

S3 - Seat Switch (SE7, W1)

S4 - Neutral Switch (SE7, W1)

S5 - Left Angle Switch (SE7, W1)

S6 - Right Angle Switch (SE7, W1)

S7 - Front Angle Switch (SE7, W1)

S8 - Park Brake Lock Switch (SE7, W1)

S9 - Left Raise Switch (SE8, W1)[7]

S10 - Front Raise Switch (SE8, W1)[7]

S11 - Right Raise Switch (SE8, W1)[7]

S12 - Left Lower Switch (SE8, W1)[7]

S13 - Front Lower Switch (SE8, W1)[7]

S14 - Right Lower Switch (SE8, W1)[7]

S15 - PTO Switch (SE9, W1)

S16 - Lights Switch (SE10, W1)[10]

S17 - Left Raise/Lower Switch (SE8, W1)[5, 8]

S18 - Front Raise/Lower Switch (SE8, W1)[5, 8]

S19 - Right Raise/Lower Switch (SE8, W1)[5, 8]

S20 - Cruise Control Switch (SE11, W1)[5]

S21 - Optional Lights Switch (W8)[6, 10]

S22 - Turn Signal Switch (W9)[6, 10]

V1 - Start Relay Diode (SE2, W1)

V2 - Oil Pressure Buzzer Diode (SE6, W1)

V3 - Overtemperature Buzzer Diode (SE6, W1)

V4 - Pull-In Relay Diode (SE3, W5)[7]

V5 - Road Lights Diode Block (W9)[6, 10]

V6 - Fuel Shutoff Solenoid Diode (SE2, W1) [13]

W1 - Main Wiring Harness

W2 - Lights Wiring Harness

W3 - Battery Ground (SE1)

W4 - Harness Ground (SE1, W1)

W5 - Pull-In Coil Relay Harness

W6 - Hold Coil Relay Harness

W7 - Hold Coil Relay Ground (SE2, W6)

W8 - Optional Work Lights Harness

W9 - Optional Road Lights Harness

W10 Brake Switch Jumper Harness[13]

Y1 - Fuel Shutoff Solenoid (SE2, W1)

Y2 - Left Raise/Lower Solenoid (SE8, W1)

Y3 - Front Raise/Lower Solenoid (SE8, W1)

Y4 - Right Raise/Lower Solenoid (SE8, W1)

Y5 - Raise/Lower Select Solenoid (SE8, W1)

Y6 - Left Motor Solenoid (SE9, W1)

Y7 - Deck Drive Solenoid (SE9, W1)

Y8 - Right Motor Solenoid (SE9, W1)

Y9 - Cruise Control Magnet (SE11, W1)[5]

Connector

X1 - Key Switch Connector (W1)

X2 - Fuel Gauge Connector (W1)

X3 - Engine Lights Display Connector (SE6, W1)

X4 - PTO Lights Display Connector (SE6, W1)

X5 - Park Brake Lock Switch Connector (W1)

X6 - Start Relay Connector (W1)

X7 - Lights Relay Connector (W1)

X8 - Fuel Pull-In Relay Connector (W5)

X9 - Air Pre-Heater Relay Connector (W1)

X10 - Start Relay Diode Connector (W1)

X11 - Right Lower Switch Connector (W1)[7]

X12 - Front Lower Switch Connector (W1)[7]

X13 - Left Lower Switch Connector (W1)[7]

X14 - Left Raise Switch Connector (W1)[7]

X15 - Front Raise Switch Connector (W1)[7]

X16 - Right Raise Switch Connector (W1)[7]

X17 - Lights Switch Connector (W1, W8)

X18 - Oil Pressure Buzzer Diode Connector (W1)

X19 - Overtemperature Buzzer Diode Connector (W1)

X20 - Lights Fuse Connector (W1)

X21 - Switched Power Fuse Connector (W1)

X22 - Buzzer Connector (W1)

X23 - PTO Switch Connector (W1)

X24 - Electronic Control Module (J1) Connector (SE7, W1)

X25 - Electronic Control Module (J3) Connector (SE7, W1)

X26 - Electronic Control Module (J4) Connector (SE7, W1)

X27 - Electronic Control Module (J5) Connector (SE7, W1)

X28 - Electronic Control Module (J2) Connector (SE7, W1)

X29 - Transaxle Switch Connector (W1)

X30 - Hour Meter Connector (W1)

X31 - Hood Switch Connector (SE7, W1)

X32 - Starting Motor (V+) Connector (W1)

X33 - Alternator (V+) Connector (W1)

X34 - Alternator (Control) Connector (W1)

X35 - Coolant Temperature Switch Connector (W1)

X36 - Air Pre-Heater Connector (W1)

X37 - Alternator (Ground) Connector (W1)

X38 - Starting Motor (Solenoid) Connector (W1)

X39 - Engine Oil Pressure Switch Connector (W1)

X40 - Fuel Shutoff Solenoid Connector (W1)

X41 - Harness Ground Connector (W1)

X42 - Left Angle Switch Connector (W1)

X43 - Right Motor Solenoid Connector (W1)

X44 - Left Motor Solenoid Connector (W1)

X45 - Fuel Gauge Sensor (-) Connector (W1)

X46 - Fuel Gauge Sensor (S) Connector (W1)

X47 - Right Angle Switch connector (W1)

X48 - Neutral Switch Connector (W1)

X49 - Seat Switch Connector (W1)

X50 - Raise/Lower Solenoids Connector (W1)

X51 - Deck Drive Solenoid Connector (W1)

X52 - Raise/Lower Select Solenoid Connector (W1)

X53 - Front Angle Switch Connector (W1)

X54 - Main Harness-to-Lights Harness Connector (SE10, W1, W2)

X55 - Left Headlight Connector (W2)[9]

X56 - Optional Lights Connector (SE10[5], W1[5], W2[9], W8)

X57 - Right Headlight Connector (W2)[9]

X58 - Raise Switch-to-Main Harness Connector (SE8, W6)[2]

X59 - Raise Switch-to-Main Harness Connector (SE8, W6)[2]

X60 - Homologation Connector (W1, W6)

X61 - Left Raise/Lower Switch Connector (W1)[5, 8]

X62 - Front Raise/Lower Switch Connector (W1)[5, 8]

X63 - Right Raise/Lower Switch Connector (W1)[5, 8]

X64 - Hold Coil Relay Coil Connector (W6)[2, 4]

X65 - Hold Coil Relay Ground Connector (W6)[2, 4]

X66 - Fuel Pull-In Relay-to-Oil Pressure Switch Connector (W5)[2]

X67 - Fuel Pull-In Relay-to-Starting Motor Connector (W5)[2]

X68 - Fuel Pull-In Relay Diode Connector (W5)[2]

X69 - Hold Coil Relay Connector (W6)[2, 4]

X70 - Engine Coolant Temperature Sensor Connector (W1)[5]

X71 - Engine Coolant Temperature Gauge Connector (W1)[5]

X72 - Engine Coolant Temperature Gauge Light Connector (W1)[5]

X73 - Cruise Control Magnet Connector (W1)[5]

X74 - Cruise Control Switch Connector (W1)[5]

X75 - Auxiliary Light Fuse (F5) Connector (W1)[5]

X76 - Work Lights-to-Road Lights Harness Connector (W8, W9)[11]

X77 - Optional Lights Switch Connector (W8)[5, 8]

X78 - Right Headlight Connector (W8)[5, 8]

X79 - Left Headlight Connector (W8)[5, 8]

X80 - Left Floodlight Connector (W8)[5, 8]

X81 - Right Floodlight Connector (W8)[5, 8]

X82 - Road Lights Relays Connector (W9)[5, 8]

X83 - Flasher Relay Connector (W9)[5, 8]

X84 - Road Lights Diode Block Connector (W9)[5, 8]

X85 - Road Lights Ground Connector (W9)[5, 8]

X86 - Road Lights Ground Connector (W9)[5, 8]

X87 - Right Turn/Hazard Light (Amber) Connector (W9)[5, 8]

X88 - Right Taillight (Red) Connector (W9)[5, 8]

X89 - Right Turn Light (Red) Connector (W9)[5, 8]

X90 - Road Lights Ground Connector (W9)[5, 8]

X91 - Road Lights Ground Connector (W9)[5, 8]

X92 - Left Turn/Hazard Light (Amber) Connector (W9)[5, 8]

X93 - Left Taillight (Red) Connector (W9)[5, 8]

X94 - Left Turn Light (Red) Connector (W9)[5, 8]

X95 - Turn Signal Switch Connector (W9)[5, 8]

X96 - Fuel Shutoff Solenoid Diode Connector (W1)[13]

X97 - Brake Switch Jumper Harness Connector[13]

[1]S.N. (010000-020000) without MPTC10114 Kit installed

[2]S.N. (010000-020000) with MPTC10114 Kit installed

[3]S.N. (020001-) without MPTC10114 Kit installed

[4]S.N. (020001-) with MPTC10114 Kit installed

[5]Model 1600 Turbo

[6]Optional on Model 1600 Turbo

[7]Models 1600/1620 S.N. (-020000)

[8]Models 1600/1620 S.N. (020001-)

[9]Models 1600/1620 (All)

[10]Optional on Models 1600/1620

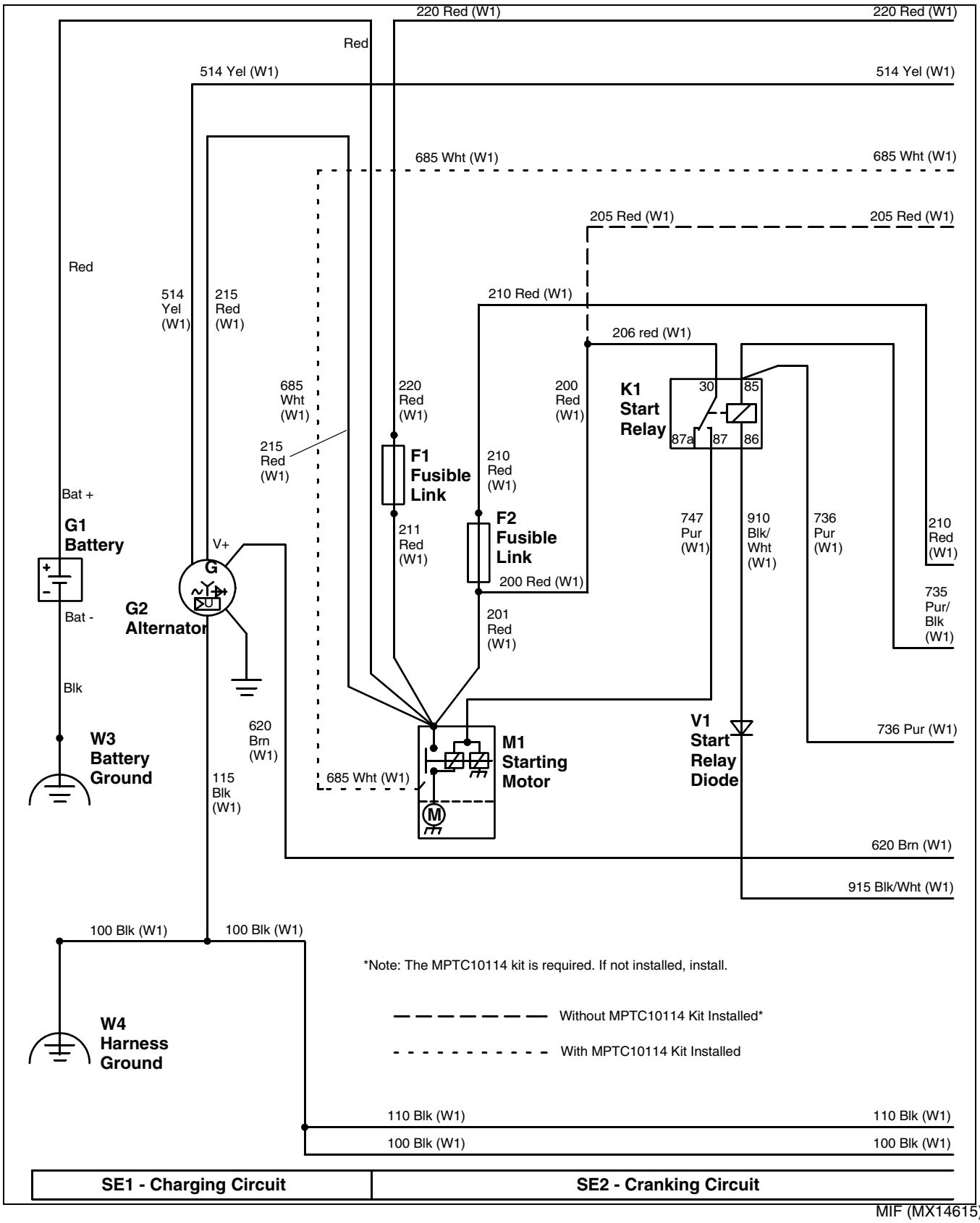
[11]Early Models Only

[12]Optional (All)

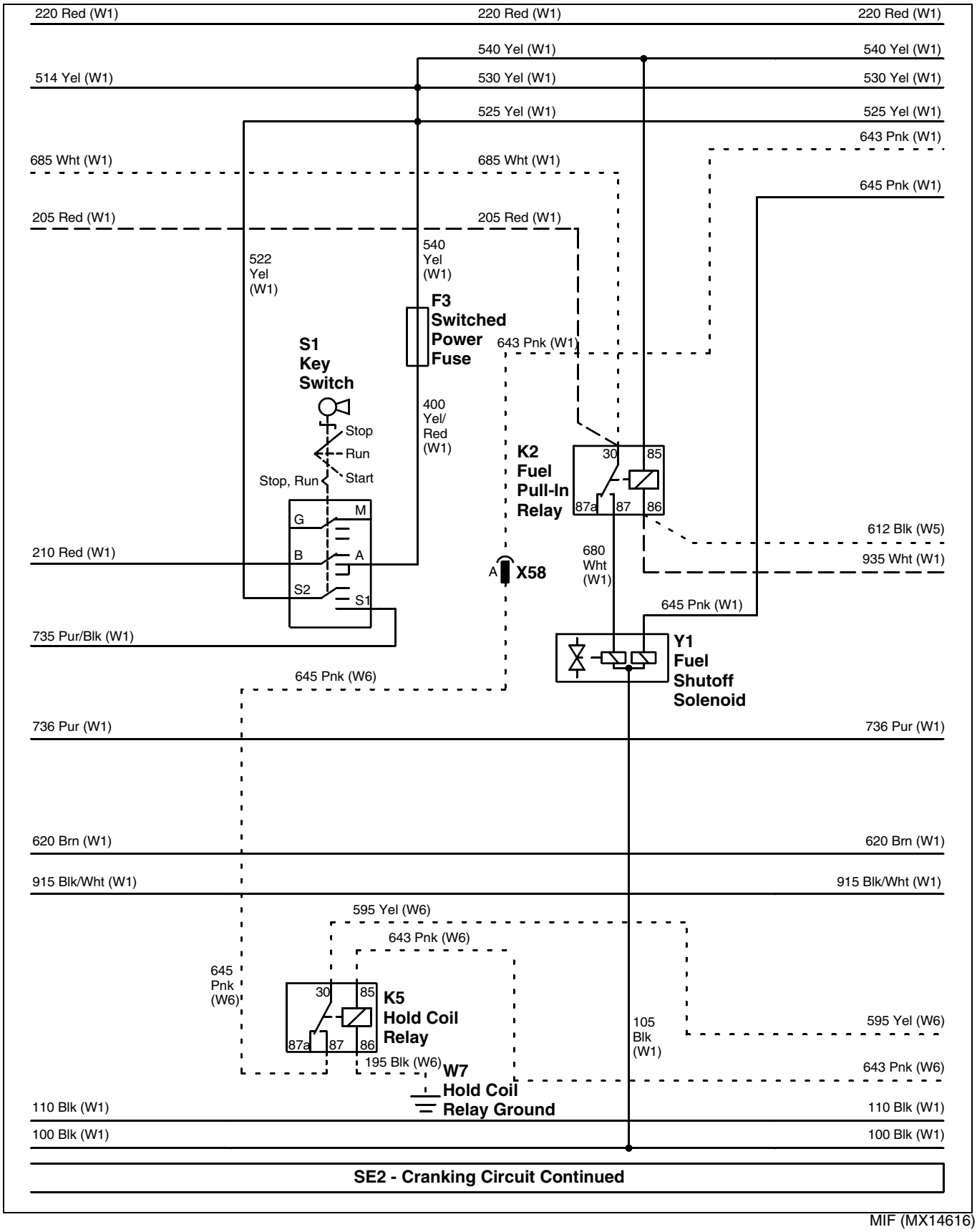
[13]Model 1600 Turbo S.N. (030001-)

[14]Models 1600 Turbo S.N. (-030000)

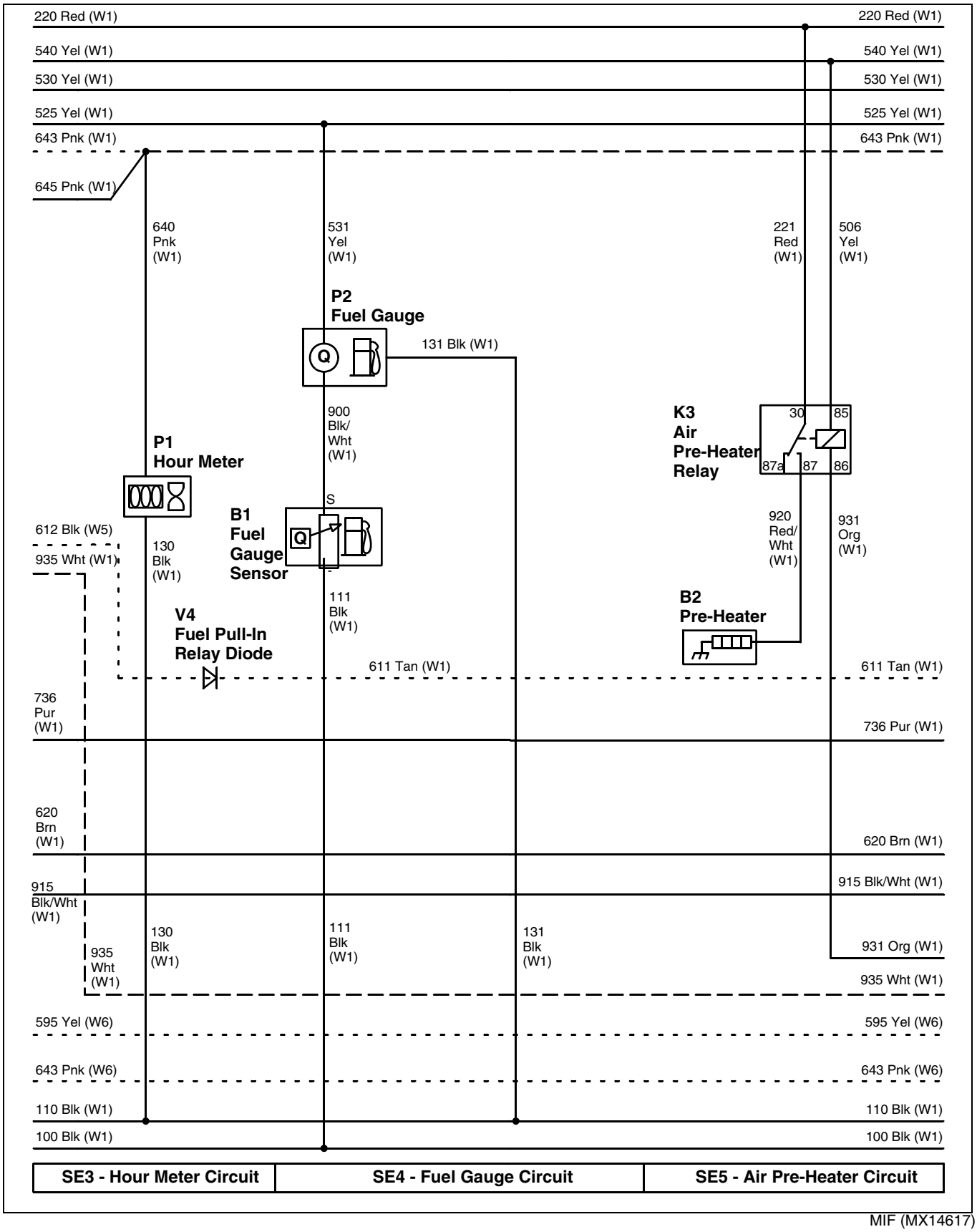
Main Schematic - Models 1600 and 1620 S.N. (010000-020000)



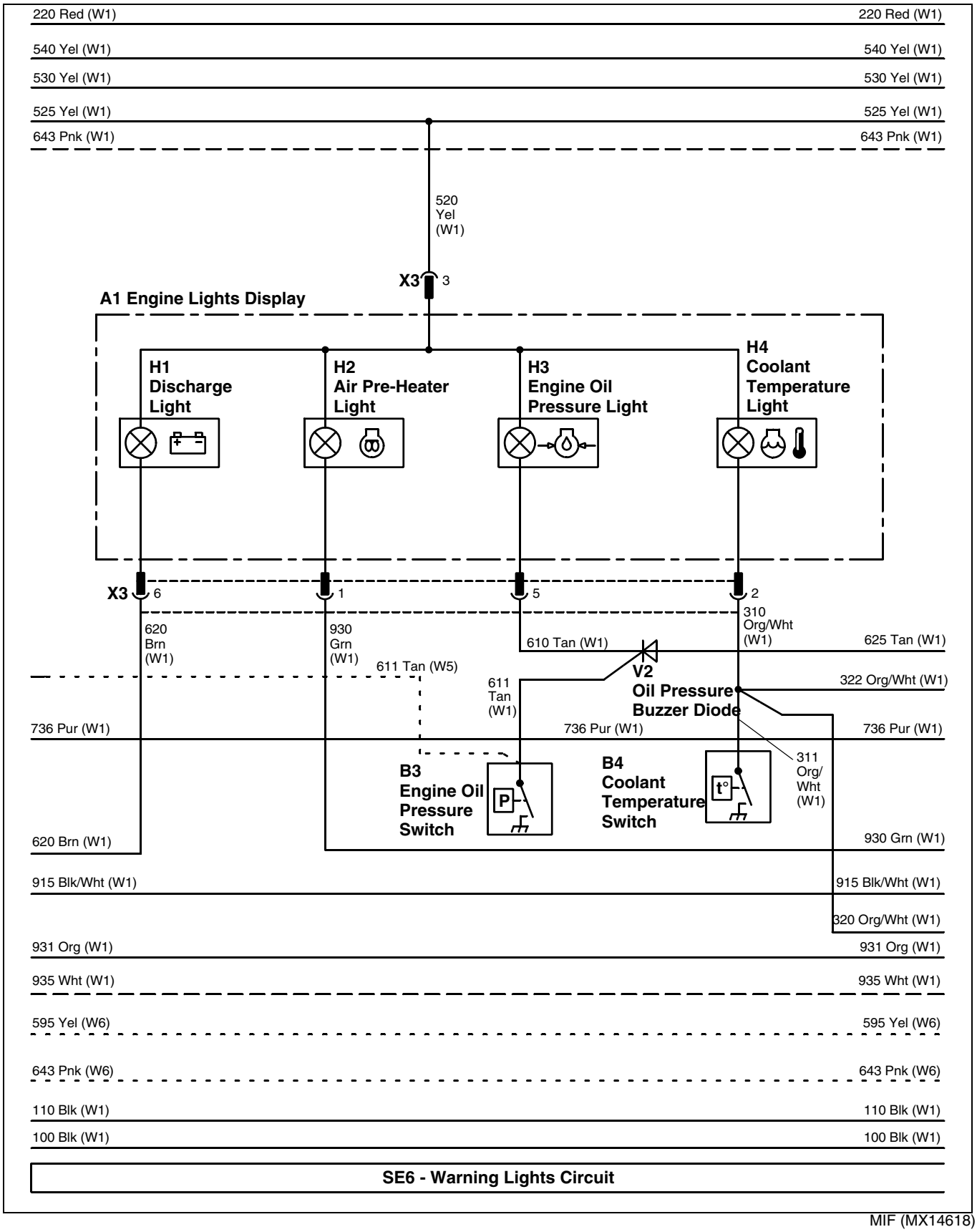
MIF (MX14615)


220 Red (W1)
220 Red (W1)
220 Red (W1)
540 Yel (W1)
540 Yel (W1)
514 Yel (W1)
530 Yel (W1)
530 Yel (W1)
525 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
685 Wht (W1)
685 Wht (W1)
645 Pnk (W1)
205 Red (W1)
205 Red (W1)
522 Yel (W1)
540 Yel (W1)
F3 Switched Power Fuse
643 Pnk (W1)
S1 Key Switch
Stop
Run
Start
Stop, Run
400 Yel/ Red (W1)
K2 Fuel Pull-In Relay
30
85
87a
87
86
612 Blk (W5)
680 Wht (W1)
935 Wht (W1)
210 Red (W1)
G
M
B
A
S2
S1
A
X58
645 Pnk (W1)
735 Pur/Blk (W1)
Y1 Fuel Shutoff Solenoid
645 Pnk (W6)
736 Pur (W1)
736 Pur (W1)
620 Brn (W1)
620 Brn (W1)
915 Blk/Wht (W1)
915 Blk/Wht (W1)
595 Yel (W6)
643 Pnk (W6)
645 Pnk (W6)
30
85
K5 Hold Coil Relay
87a
87
86
105 Blk (W1)
595 Yel (W6)
195 Blk (W6)
W7 Hold Coil Relay Ground
643 Pnk (W6)
110 Blk (W1)
110 Blk (W1)
100 Blk (W1)
100 Blk (W1)
SE2 - Cranking Circuit Continued

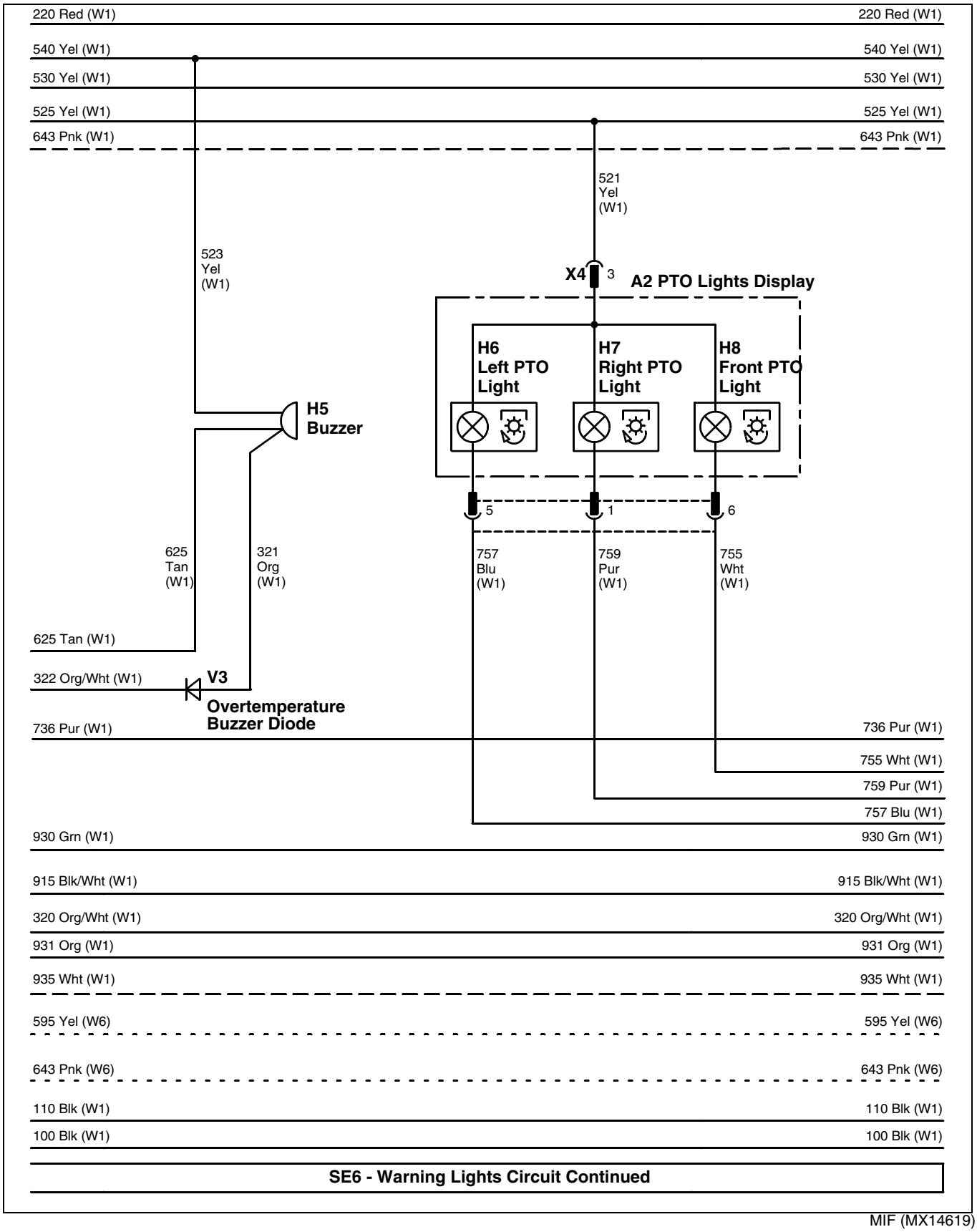
MIF (MX14616)


220 Red (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
645 Pnk (W1)
640 Pnk (W1)
531 Yel (W1)
221 Red (W1)
506 Yel (W1)
P2 Fuel Gauge
131 Blk (W1)
900 Blk/ Wht (W1)
K3 Air Pre-Heater Relay
30
85
87a
87
86
P1 Hour Meter
S
B1 Fuel Gauge Sensor
920 Red/ Wht (W1)
931 Org (W1)
612 Blk (W5)
935 Wht (W1)
130 Blk (W1)
111 Blk (W1)
B2 Pre-Heater
V4 Fuel Pull-In Relay Diode
611 Tan (W1)
736 Pur (W1)
620 Brn (W1)
915 Blk/Wht (W1)
131 Blk (W1)
595 Yel (W6)
643 Pnk (W6)
110 Blk (W1)
100 Blk (W1)
SE3 - Hour Meter Circuit
SE4 - Fuel Gauge Circuit
SE5 - Air Pre-Heater Circuit

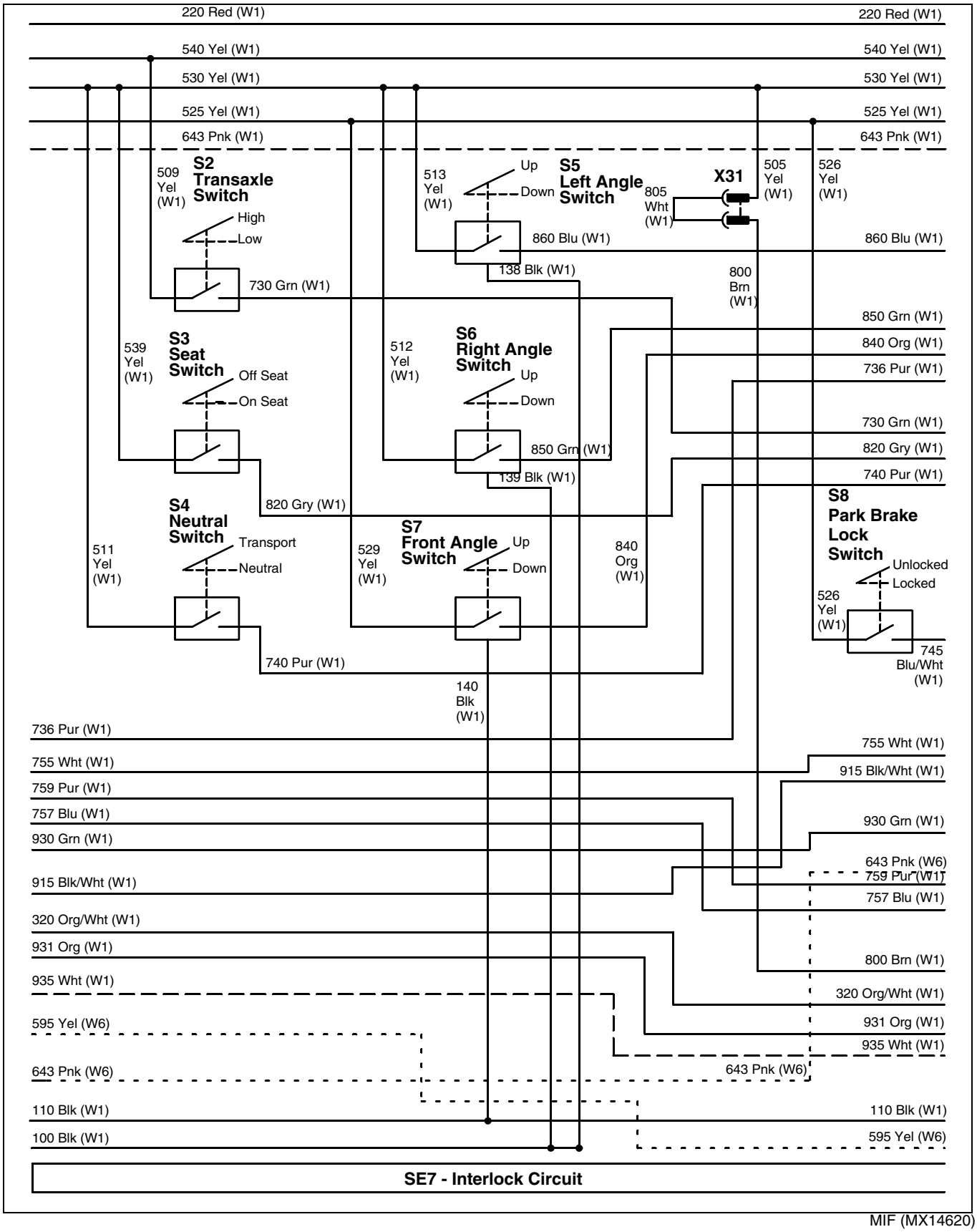
MIF (MX14617)


220 Red (W1)
220 Red (W1)
540 Yel (W1)
540 Yel (W1)
530 Yel (W1)
530 Yel (W1)
525 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
643 Pnk (W1)
520
Yel
(W1)
X3
3
A1 Engine Lights Display
H1
Discharge
Light
H2
Air Pre-Heater
Light
H3
Engine Oil
Pressure Light
H4
Coolant
Temperature
Light
X3
6
1
5
2
620
Brn
(W1)
930
Grn
(W1)
611 Tan (W5)
610 Tan (W1)
310
Org/Wht
(W1)
625 Tan (W1)
V2
Oil Pressure
Buzzer Diode
322 Org/Wht (W1)
611
Tan
(W1)
736 Pur (W1)
736 Pur (W1)
736 Pur (W1)
B3
Engine Oil
Pressure
Switch
P
B4
Coolant
Temperature
Switch
t°
311
Org/
Wht
(W1)
620 Brn (W1)
930 Grn (W1)
915 Blk/Wht (W1)
915 Blk/Wht (W1)
320 Org/Wht (W1)
931 Org (W1)
931 Org (W1)
935 Wht (W1)
935 Wht (W1)
595 Yel (W6)
595 Yel (W6)
643 Pnk (W6)
643 Pnk (W6)
110 Blk (W1)
110 Blk (W1)
100 Blk (W1)
100 Blk (W1)
SE6 - Warning Lights Circuit

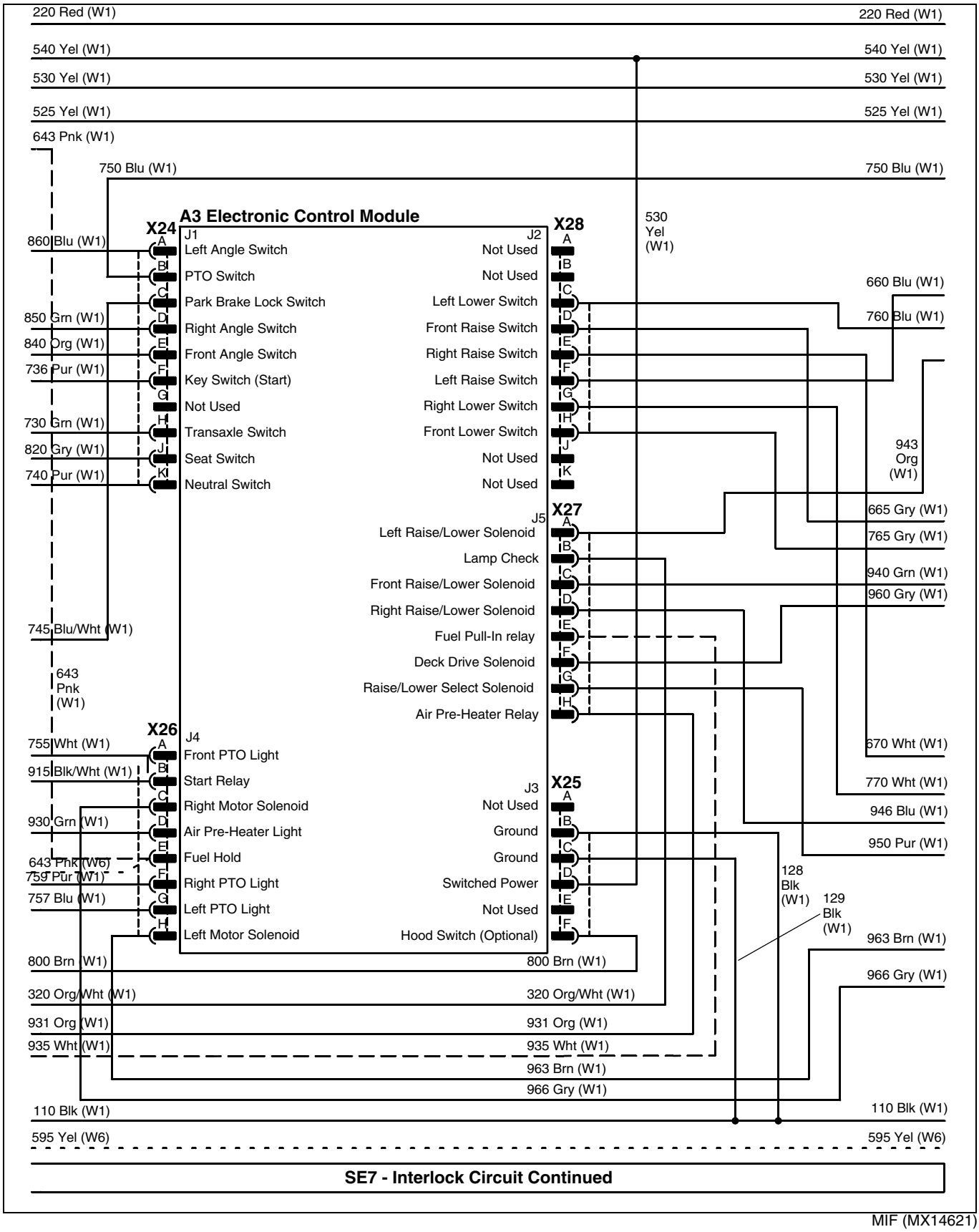
MIF (MX14618)


220 Red (W1)
220 Red (W1)
540 Yel (W1)
540 Yel (W1)
530 Yel (W1)
530 Yel (W1)
525 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
643 Pnk (W1)
521
Yel
(W1)
523
Yel
(W1)
X4
3
A2 PTO Lights Display
H6
Left PTO
Light
H7
Right PTO
Light
H8
Front PTO
Light
H5
Buzzer
5
1
6
625
Tan
(W1)
321
Org
(W1)
757
Blu
(W1)
759
Pur
(W1)
755
Wht
(W1)
625 Tan (W1)
322 Org/Wht (W1)
V3
Overtemperature
Buzzer Diode
736 Pur (W1)
736 Pur (W1)
755 Wht (W1)
759 Pur (W1)
757 Blu (W1)
930 Grn (W1)
930 Grn (W1)
915 Blk/Wht (W1)
915 Blk/Wht (W1)
320 Org/Wht (W1)
320 Org/Wht (W1)
931 Org (W1)
931 Org (W1)
935 Wht (W1)
935 Wht (W1)
595 Yel (W6)
595 Yel (W6)
643 Pnk (W6)
643 Pnk (W6)
110 Blk (W1)
110 Blk (W1)
100 Blk (W1)
100 Blk (W1)
SE6 - Warning Lights Circuit Continued

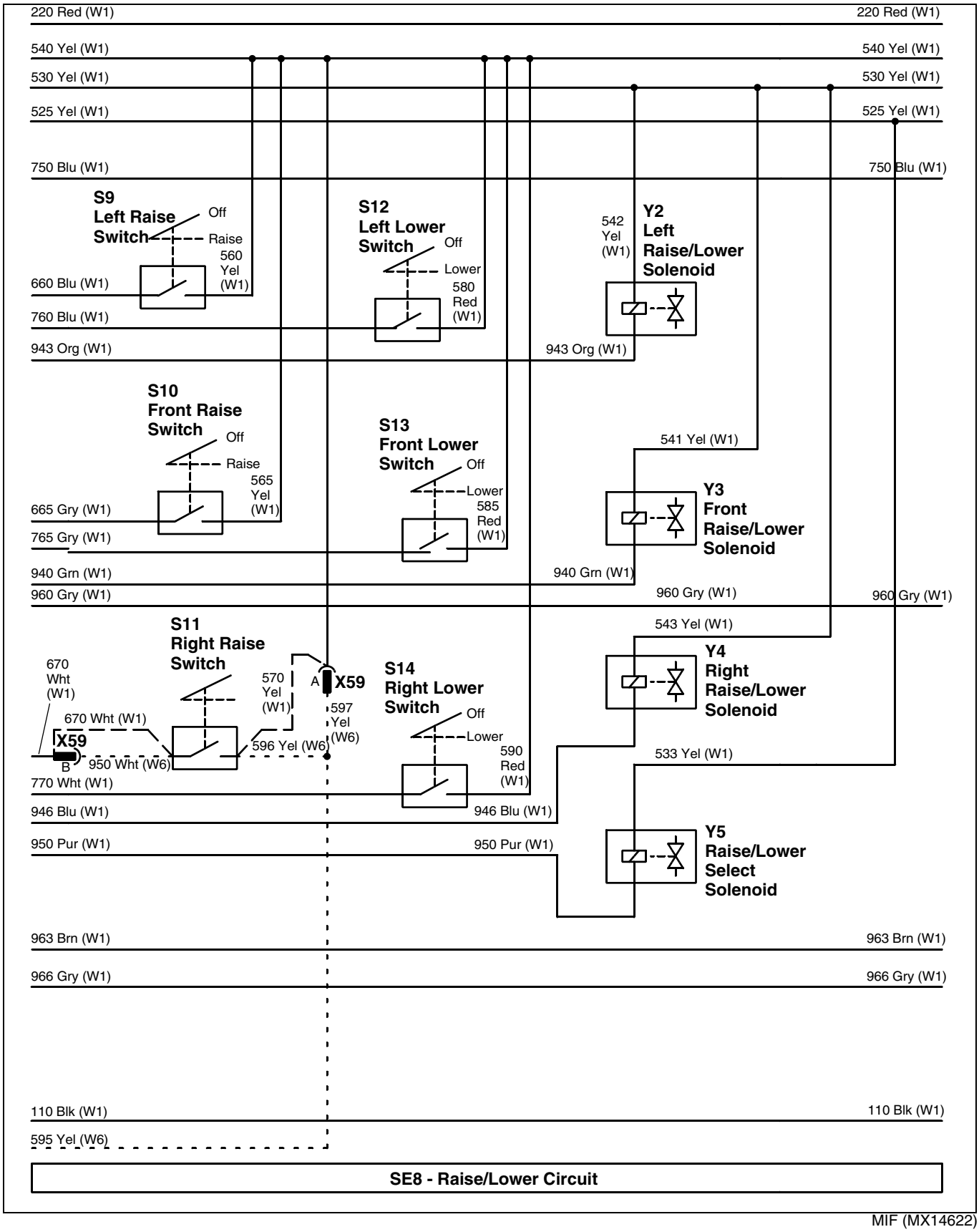
MIF (MX14619)


220 Red (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
509 Yel (W1)
S2 Transaxle Switch
High
Low
730 Grn (W1)
539 Yel (W1)
S3 Seat Switch
Off Seat
On Seat
820 Gry (W1)
511 Yel (W1)
S4 Neutral Switch
Transport
Neutral
740 Pur (W1)
513 Yel (W1)
Up
Down
S5 Left Angle Switch
805 Wht (W1)
X31
505 Yel (W1)
526 Yel (W1)
860 Blu (W1)
138 Blk (W1)
800 Brn (W1)
512 Yel (W1)
S6 Right Angle Switch
Up
Down
850 Grn (W1)
139 Blk (W1)
529 Yel (W1)
S7 Front Angle Switch
Up
Down
840 Org (W1)
140 Blk (W1)
S8 Park Brake Lock Switch
Unlocked
Locked
526 Yel (W1)
745 Blu/Wht (W1)
736 Pur (W1)
755 Wht (W1)
759 Pur (W1)
757 Blu (W1)
930 Grn (W1)
915 Blk/Wht (W1)
320 Org/Wht (W1)
931 Org (W1)
935 Wht (W1)
595 Yel (W6)
643 Pnk (W6)
110 Blk (W1)
100 Blk (W1)
SE7 - Interlock Circuit

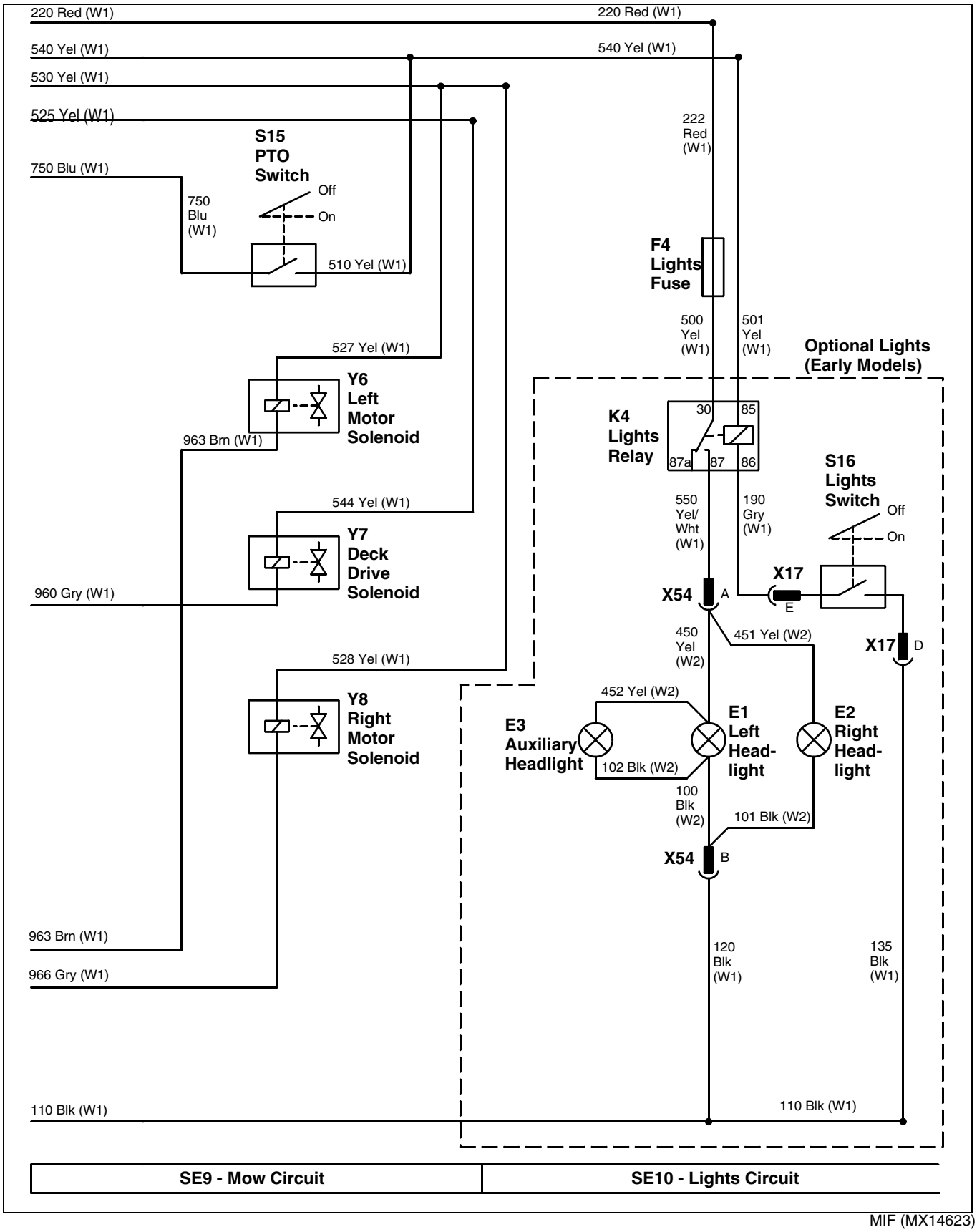
MIF (MX14620)


220 Red (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
750 Blu (W1)
A3 Electronic Control Module
X24
J1
860 Blu (W1)
A Left Angle Switch
B PTO Switch
C Park Brake Lock Switch
850 Grn (W1)
D Right Angle Switch
840 Org (W1)
E Front Angle Switch
736 Pur (W1)
F Key Switch (Start)
G Not Used
730 Grn (W1)
H Transaxle Switch
820 Gry (W1)
J Seat Switch
740 Pur (W1)
K Neutral Switch
745 Blu/Wht (W1)
643 Pnk (W1)
X26
J4
755 Wht (W1)
A Front PTO Light
915 Blk/Wht (W1)
B Start Relay
C Right Motor Solenoid
930 Grn (W1)
D Air Pre-Heater Light
E Fuel Hold
643 Pnk (W6)
759 Pur (W1)
F Right PTO Light
757 Blu (W1)
G Left PTO Light
H Left Motor Solenoid
800 Brn (W1)
320 Org/Wht (W1)
931 Org (W1)
935 Wht (W1)
110 Blk (W1)
595 Yel (W6)
J2
A Not Used
B Not Used
C Left Lower Switch
D Front Raise Switch
E Right Raise Switch
F Left Raise Switch
G Right Lower Switch
H Front Lower Switch
J Not Used
K Not Used
X28
530 Yel (W1)
J5
X27
A Left Raise/Lower Solenoid
B Lamp Check
C Front Raise/Lower Solenoid
D Right Raise/Lower Solenoid
E Fuel Pull-In relay
F Deck Drive Solenoid
G Raise/Lower Select Solenoid
H Air Pre-Heater Relay
J3
X25
A Not Used
B Ground
C Ground
D Switched Power
E Not Used
F Hood Switch (Optional)
800 Brn (W1)
320 Org/Wht (W1)
931 Org (W1)
935 Wht (W1)
963 Brn (W1)
966 Gry (W1)
110 Blk (W1)
595 Yel (W6)
128 Blk (W1)
129 Blk (W1)
660 Blu (W1)
760 Blu (W1)
943 Org (W1)
665 Gry (W1)
765 Gry (W1)
940 Grn (W1)
960 Gry (W1)
670 Wht (W1)
770 Wht (W1)
946 Blu (W1)
950 Pur (W1)
963 Brn (W1)
966 Gry (W1)
110 Blk (W1)
595 Yel (W6)
SE7 - Interlock Circuit Continued

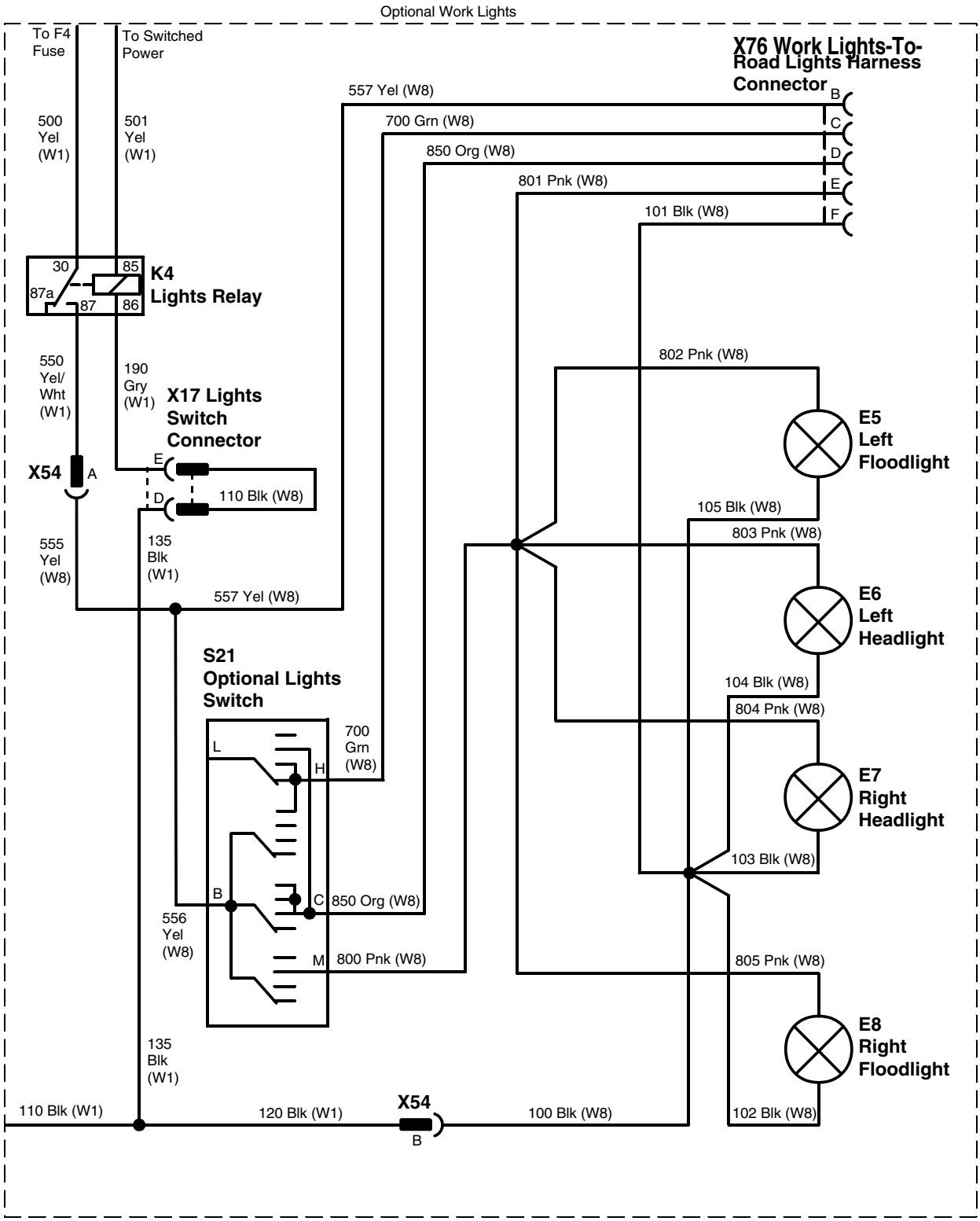
MIF (MX14621)


220 Red (W1)
220 Red (W1)
540 Yel (W1)
540 Yel (W1)
530 Yel (W1)
530 Yel (W1)
525 Yel (W1)
525 Yel (W1)
750 Blu (W1)
750 Blu (W1)
S9
Left Raise
Switch
Off
Raise
560
Yel
(W1)
660 Blu (W1)
760 Blu (W1)
943 Org (W1)
S12
Left Lower
Switch
Off
Lower
580
Red
(W1)
542
Yel
(W1)
Y2
Left
Raise/Lower
Solenoid
943 Org (W1)
S10
Front Raise
Switch
Off
Raise
565
Yel
(W1)
665 Gry (W1)
765 Gry (W1)
S13
Front Lower
Switch
Off
Lower
585
Red
(W1)
541 Yel (W1)
Y3
Front
Raise/Lower
Solenoid
940 Grn (W1)
940 Grn (W1)
960 Gry (W1)
960 Gry (W1)
960 Gry (W1)
S11
Right Raise
Switch
670
Wht
(W1)
670 Wht (W1)
X59
B
950 Wht (W6)
570
Yel
(W1)
A
X59
597
Yel
(W6)
596 Yel (W6)
S14
Right Lower
Switch
Off
Lower
590
Red
(W1)
543 Yel (W1)
Y4
Right
Raise/Lower
Solenoid
533 Yel (W1)
770 Wht (W1)
946 Blu (W1)
946 Blu (W1)
950 Pur (W1)
950 Pur (W1)
Y5
Raise/Lower
Select
Solenoid
963 Brn (W1)
963 Brn (W1)
966 Gry (W1)
966 Gry (W1)
110 Blk (W1)
110 Blk (W1)
595 Yel (W6)
SE8 - Raise/Lower Circuit

MIF (MX14622)


220 Red (W1)
220 Red (W1)
540 Yel (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
222 Red (W1)
S15 PTO Switch
750 Blu (W1)
Off
On
750 Blu (W1)
510 Yel (W1)
F4 Lights Fuse
500 Yel (W1)
501 Yel (W1)
Optional Lights (Early Models)
527 Yel (W1)
Y6 Left Motor Solenoid
963 Brn (W1)
K4 Lights Relay
30
85
87a
87
86
S16 Lights Switch
544 Yel (W1)
550 Yel/ Wht (W1)
190 Gry (W1)
Off
On
Y7 Deck Drive Solenoid
960 Gry (W1)
X17
X54
A
E
450 Yel (W2)
451 Yel (W2)
X17
D
528 Yel (W1)
452 Yel (W2)
Y8 Right Motor Solenoid
E3 Auxiliary Headlight
E1 Left Head-light
E2 Right Head-light
102 Blk (W2)
100 Blk (W2)
101 Blk (W2)
X54
B
963 Brn (W1)
120 Blk (W1)
135 Blk (W1)
966 Gry (W1)
110 Blk (W1)
110 Blk (W1)
SE9 - Mow Circuit
SE10 - Lights Circuit

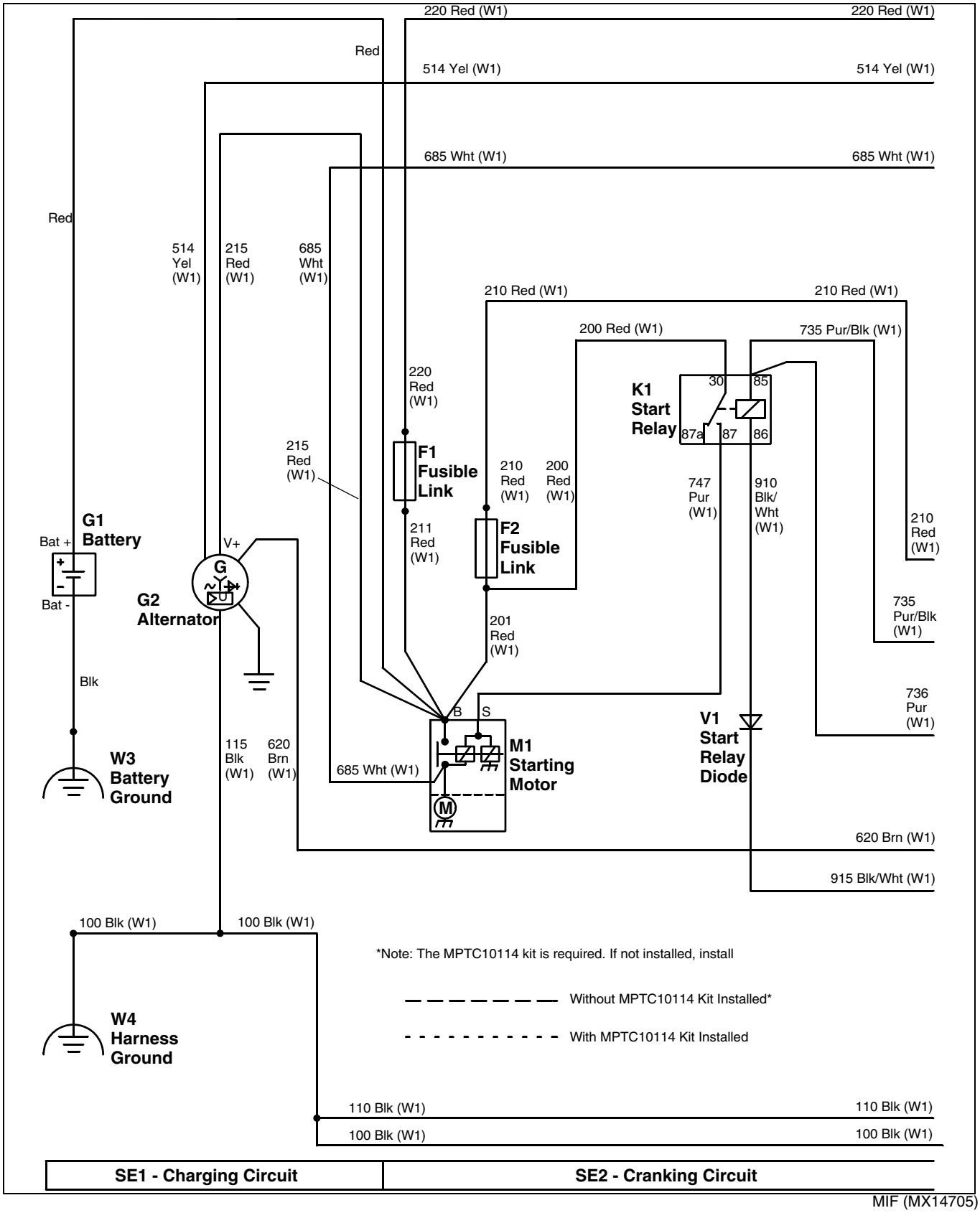
MIF (MX14623)



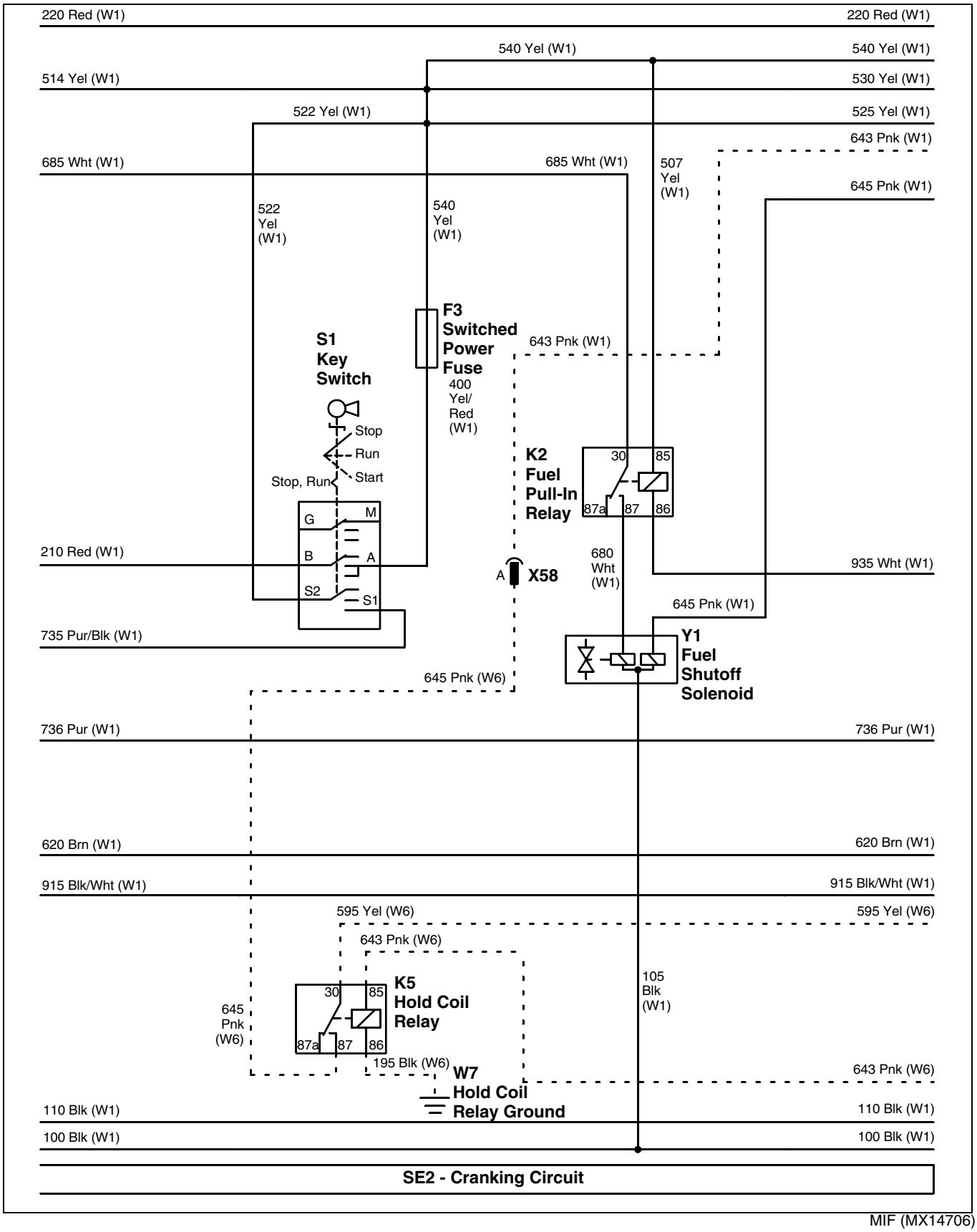
SE10 - Lights Circuit

MIF (MX14942)

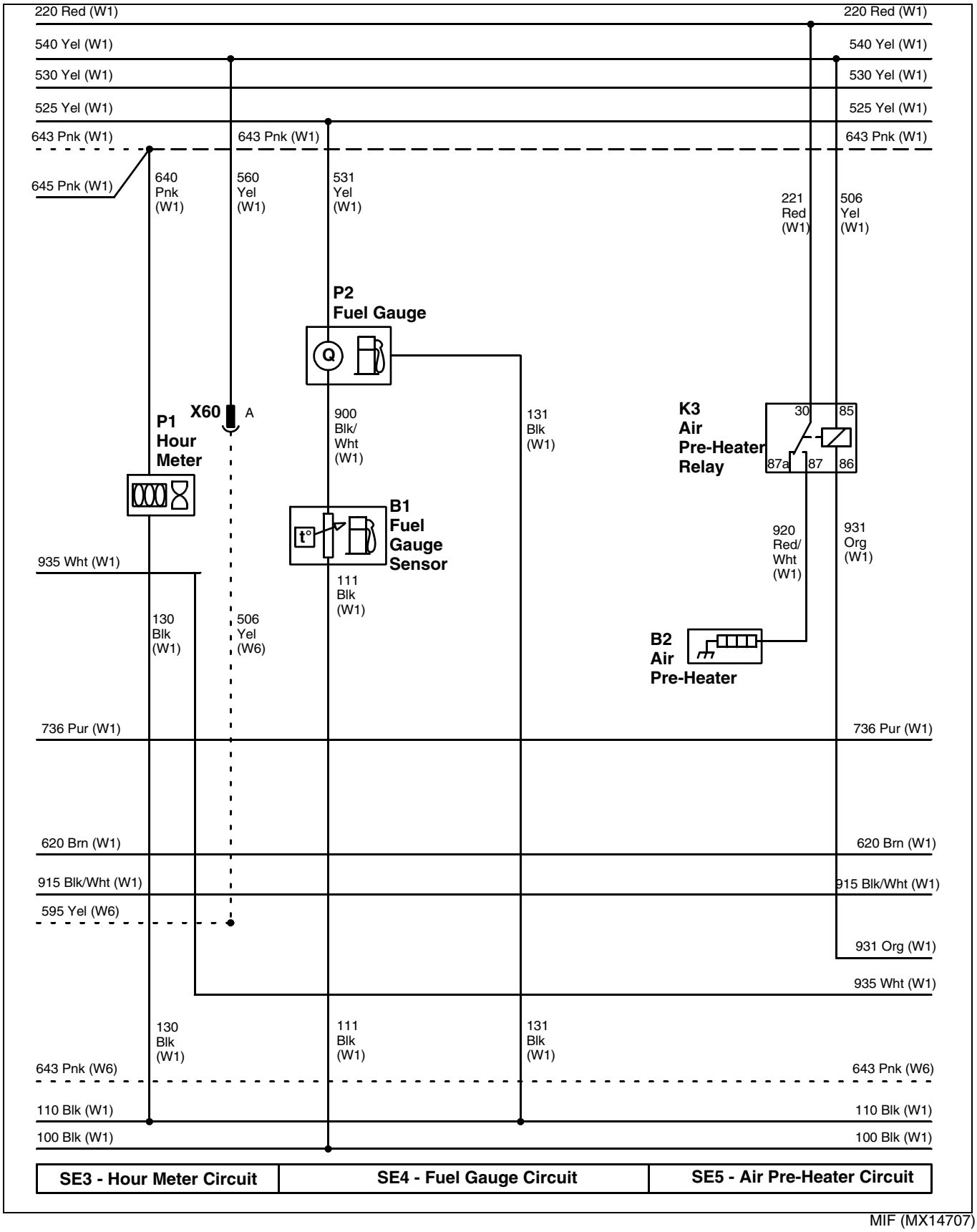
Main Schematic - Models 1600 and 1620 S.N. (020001-)



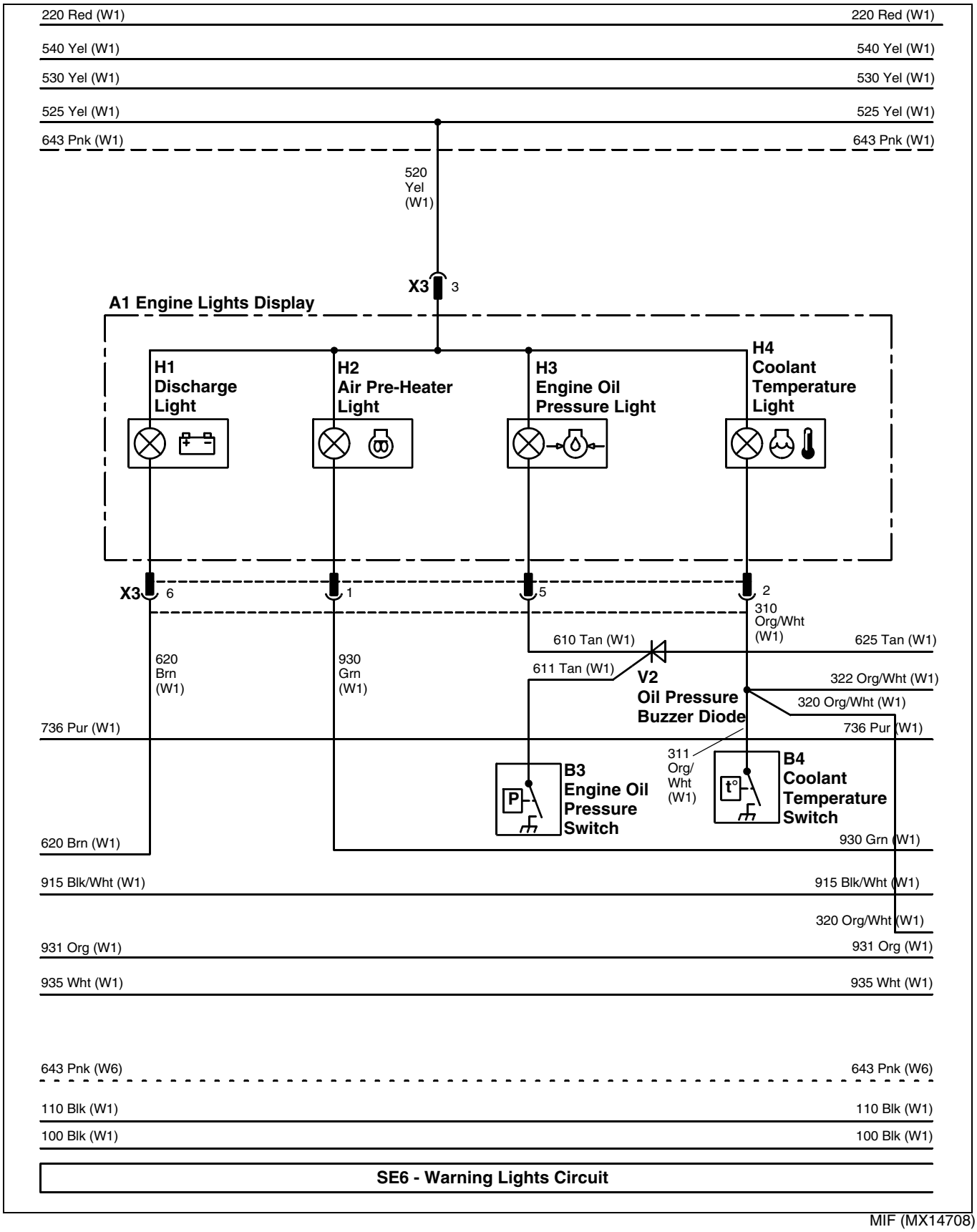
MIF (MX14705)


220 Red (W1)
220 Red (W1)
540 Yel (W1)
540 Yel (W1)
514 Yel (W1)
530 Yel (W1)
522 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
685 Wht (W1)
685 Wht (W1)
507 Yel (W1)
645 Pnk (W1)
522 Yel (W1)
540 Yel (W1)
F3 Switched Power Fuse
400 Yel/ Red (W1)
643 Pnk (W1)
S1 Key Switch
Stop
Run
Start
Stop, Run
G
M
B
A
S2
S1
K2 Fuel Pull-In Relay
30
85
87a
87
86
210 Red (W1)
A
X58
680 Wht (W1)
935 Wht (W1)
645 Pnk (W1)
735 Pur/Blk (W1)
Y1 Fuel Shutoff Solenoid
645 Pnk (W6)
736 Pur (W1)
736 Pur (W1)
620 Brn (W1)
620 Brn (W1)
915 Blk/Wht (W1)
915 Blk/Wht (W1)
595 Yel (W6)
595 Yel (W6)
643 Pnk (W6)
105 Blk (W1)
645 Pnk (W6)
K5 Hold Coil Relay
30
85
87a
87
86
195 Blk (W6)
W7 Hold Coil Relay Ground
643 Pnk (W6)
110 Blk (W1)
110 Blk (W1)
100 Blk (W1)
100 Blk (W1)
SE2 - Cranking Circuit

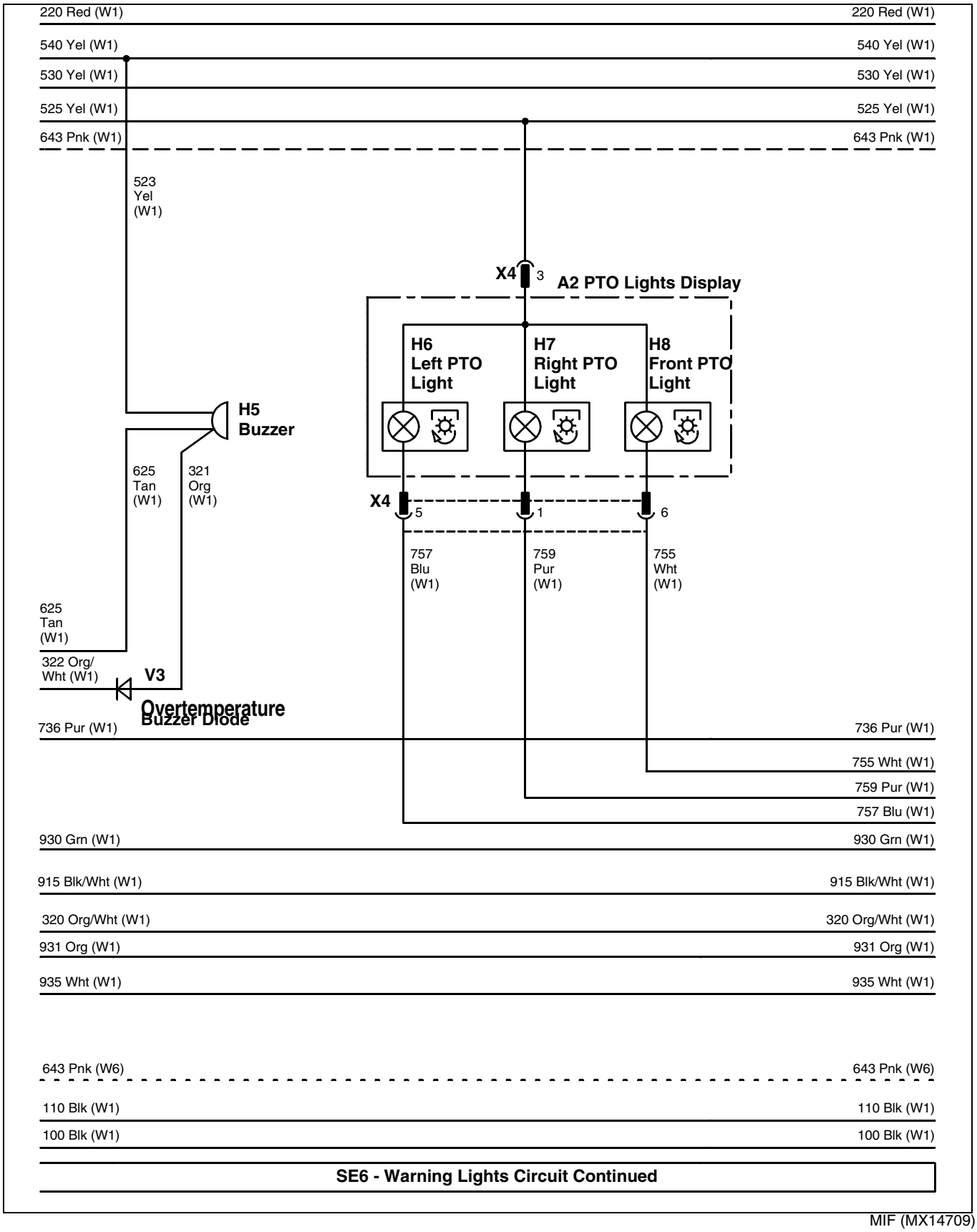
MIF (MX14706)


220 Red (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
645 Pnk (W1)
640 Pnk (W1)
560 Yel (W1)
531 Yel (W1)
221 Red (W1)
506 Yel (W1)
P2 Fuel Gauge
Q
X60
A
P1 Hour Meter
900 Blk/ Wht (W1)
131 Blk (W1)
K3 Air Pre-Heater Relay
30
85
87a
87
86
B1 Fuel Gauge Sensor
t°
920 Red/ Wht (W1)
931 Org (W1)
935 Wht (W1)
111 Blk (W1)
130 Blk (W1)
506 Yel (W6)
B2 Air Pre-Heater
736 Pur (W1)
620 Brn (W1)
915 Blk/Wht (W1)
595 Yel (W6)
643 Pnk (W6)
110 Blk (W1)
100 Blk (W1)
SE3 - Hour Meter Circuit
SE4 - Fuel Gauge Circuit
SE5 - Air Pre-Heater Circuit

MIF (MX14707)

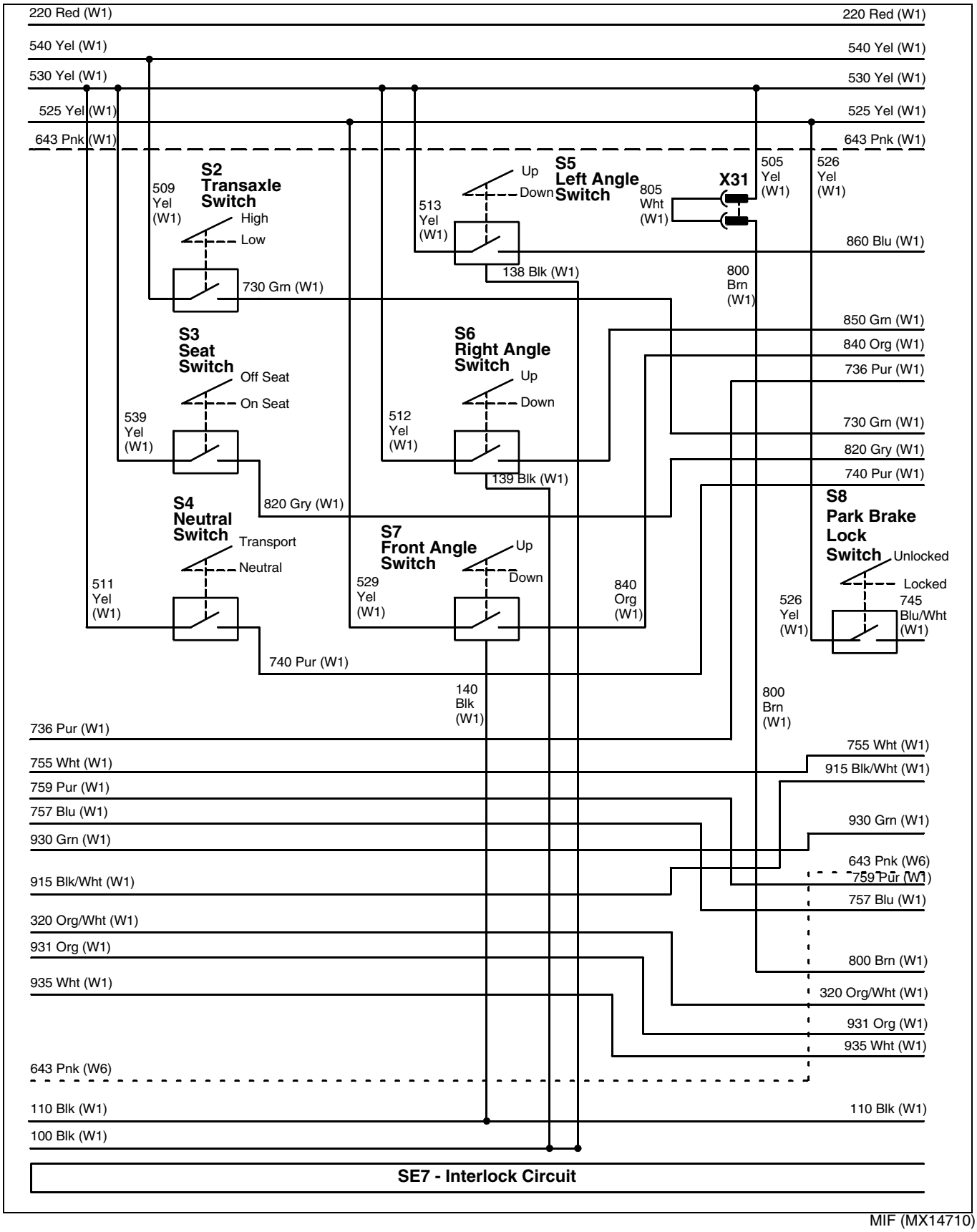

220 Red (W1)
220 Red (W1)
540 Yel (W1)
540 Yel (W1)
530 Yel (W1)
530 Yel (W1)
525 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
643 Pnk (W1)
520 Yel (W1)
X3 3
A1 Engine Lights Display
H1 Discharge Light
H2 Air Pre-Heater Light
H3 Engine Oil Pressure Light
H4 Coolant Temperature Light
X3 6
1
5
2
310 Org/Wht (W1)
610 Tan (W1)
625 Tan (W1)
620 Brn (W1)
930 Grn (W1)
611 Tan (W1)
V2 Oil Pressure Buzzer Diode
322 Org/Wht (W1)
320 Org/Wht (W1)
736 Pur (W1)
736 Pur (W1)
311 Org/ Wht (W1)
B3 Engine Oil Pressure Switch
B4 Coolant Temperature Switch
620 Brn (W1)
930 Grn (W1)
915 Blk/Wht (W1)
915 Blk/Wht (W1)
320 Org/Wht (W1)
931 Org (W1)
931 Org (W1)
935 Wht (W1)
935 Wht (W1)
643 Pnk (W6)
643 Pnk (W6)
110 Blk (W1)
110 Blk (W1)
100 Blk (W1)
100 Blk (W1)
SE6 - Warning Lights Circuit

MIF (MX14708)

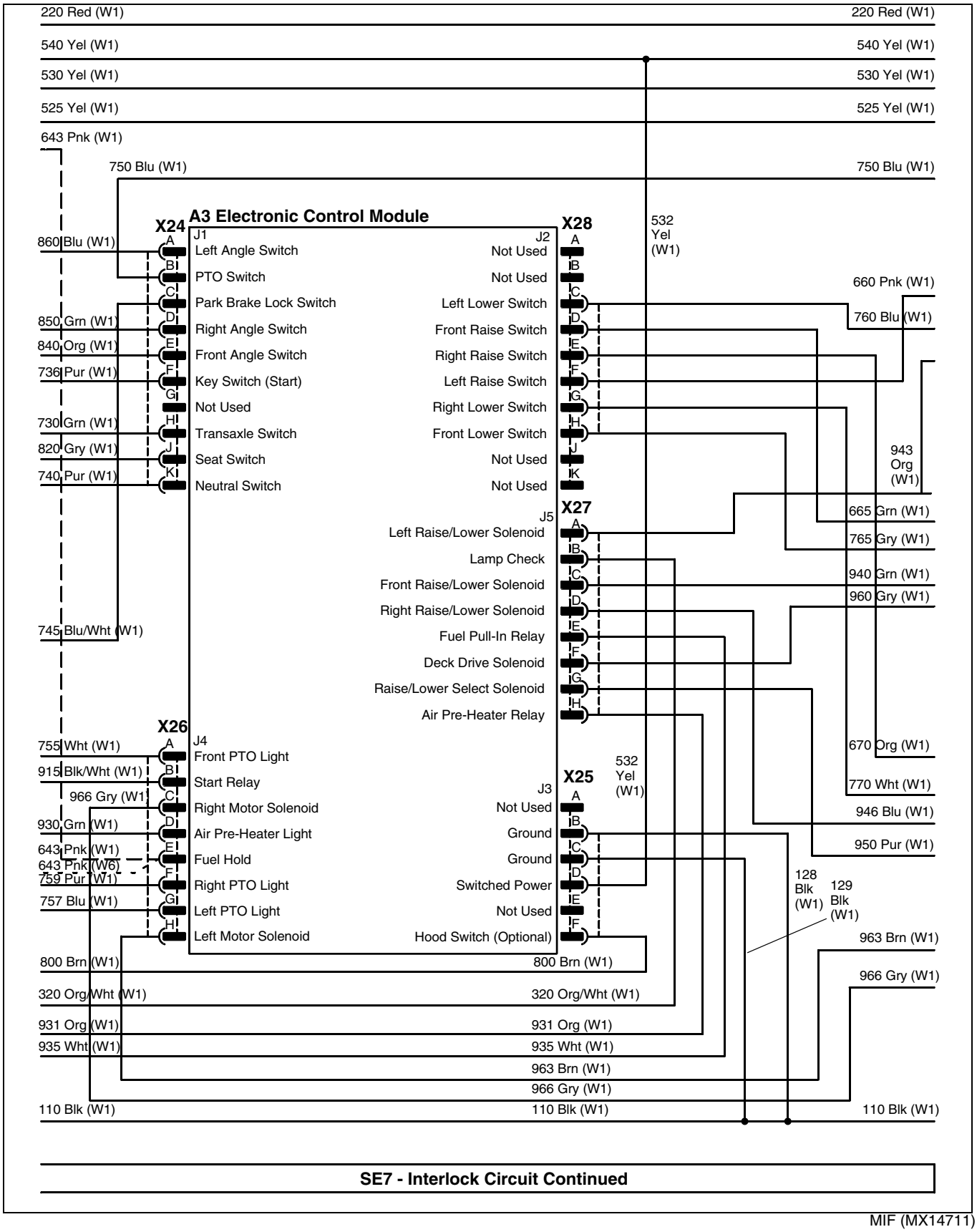


SE6 - Warning Lights Circuit Continued

MIF (MX14709)

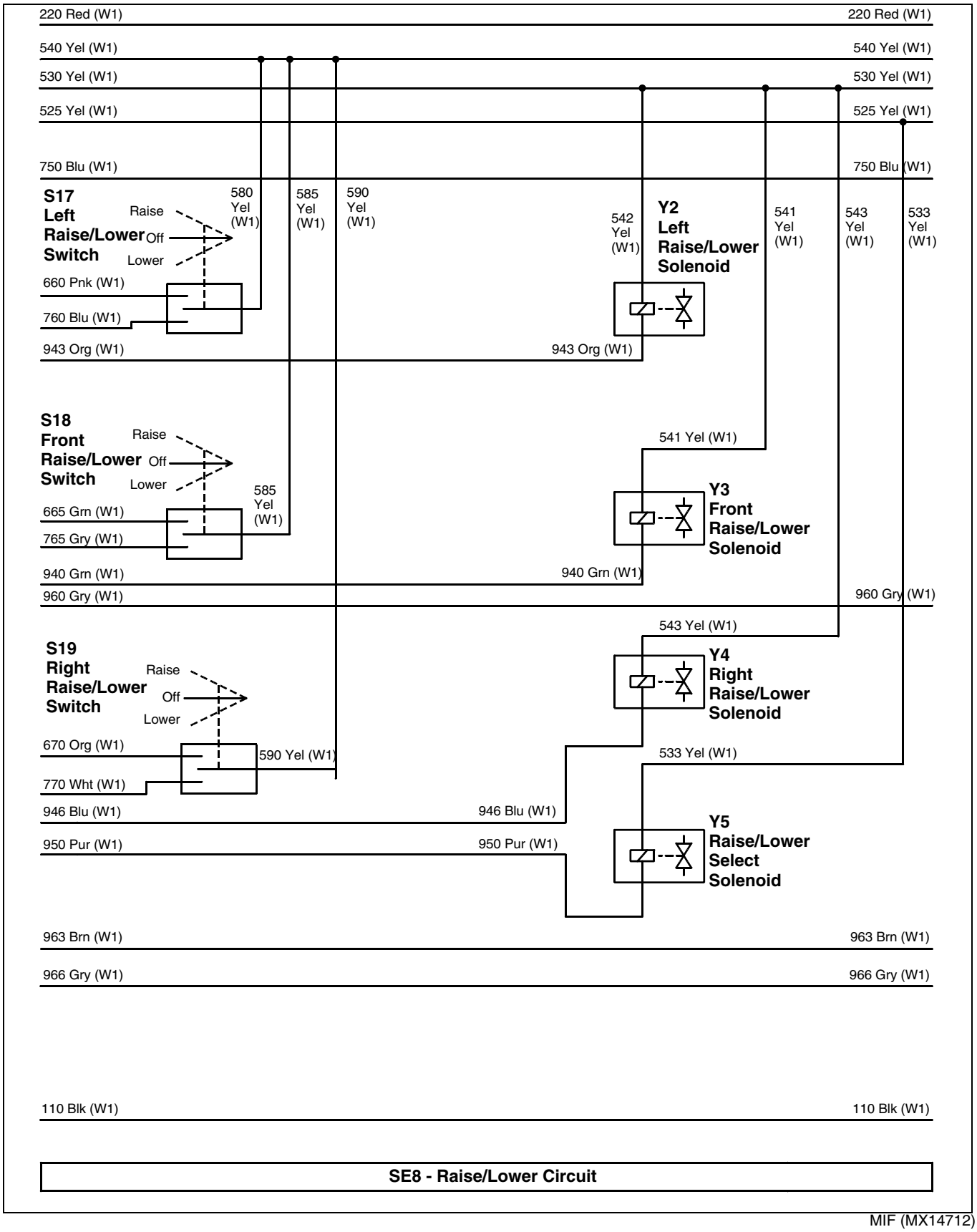

220 Red (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
S2 Transaxle Switch
509 Yel (W1)
High
Low
730 Grn (W1)
S3 Seat Switch
Off Seat
On Seat
539 Yel (W1)
820 Gry (W1)
S4 Neutral Switch
Transport
Neutral
511 Yel (W1)
740 Pur (W1)
S5 Left Angle Switch
Up
Down
513 Yel (W1)
138 Blk (W1)
805 Wht (W1)
X31
505 Yel (W1)
526 Yel (W1)
860 Blu (W1)
800 Brn (W1)
S6 Right Angle Switch
Up
Down
512 Yel (W1)
139 Blk (W1)
850 Grn (W1)
840 Org (W1)
736 Pur (W1)
730 Grn (W1)
820 Gry (W1)
740 Pur (W1)
S7 Front Angle Switch
Up
Down
529 Yel (W1)
840 Org (W1)
140 Blk (W1)
S8 Park Brake Lock Switch
Unlocked
Locked
526 Yel (W1)
745 Blu/Wht (W1)
800 Brn (W1)
736 Pur (W1)
755 Wht (W1)
915 Blk/Wht (W1)
759 Pur (W1)
757 Blu (W1)
930 Grn (W1)
643 Pnk (W6)
915 Blk/Wht (W1)
320 Org/Wht (W1)
931 Org (W1)
935 Wht (W1)
643 Pnk (W6)
110 Blk (W1)
100 Blk (W1)
SE7 - Interlock Circuit

MIF (MX14710)



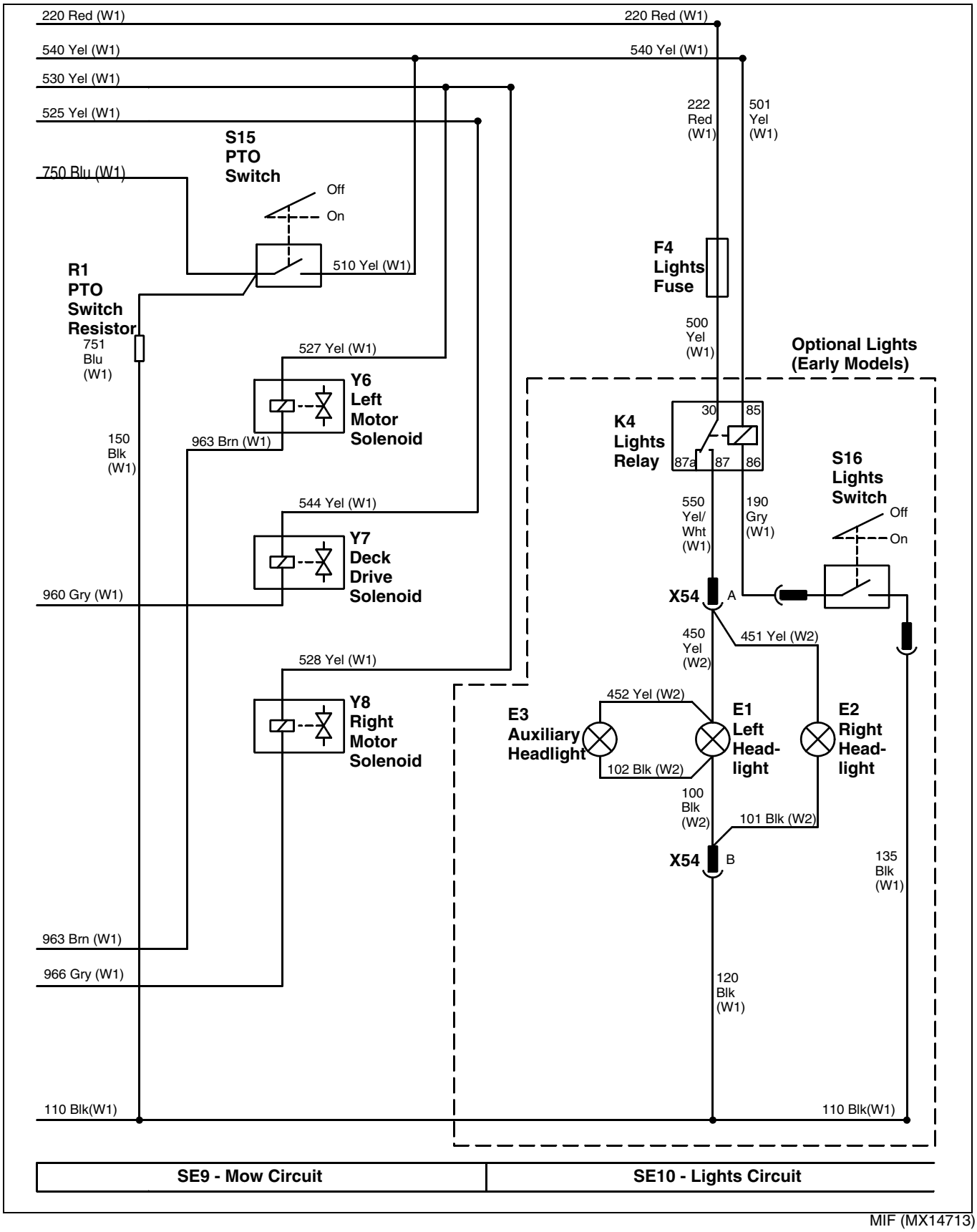
SE7 - Interlock Circuit Continued

MIF (MX14711)



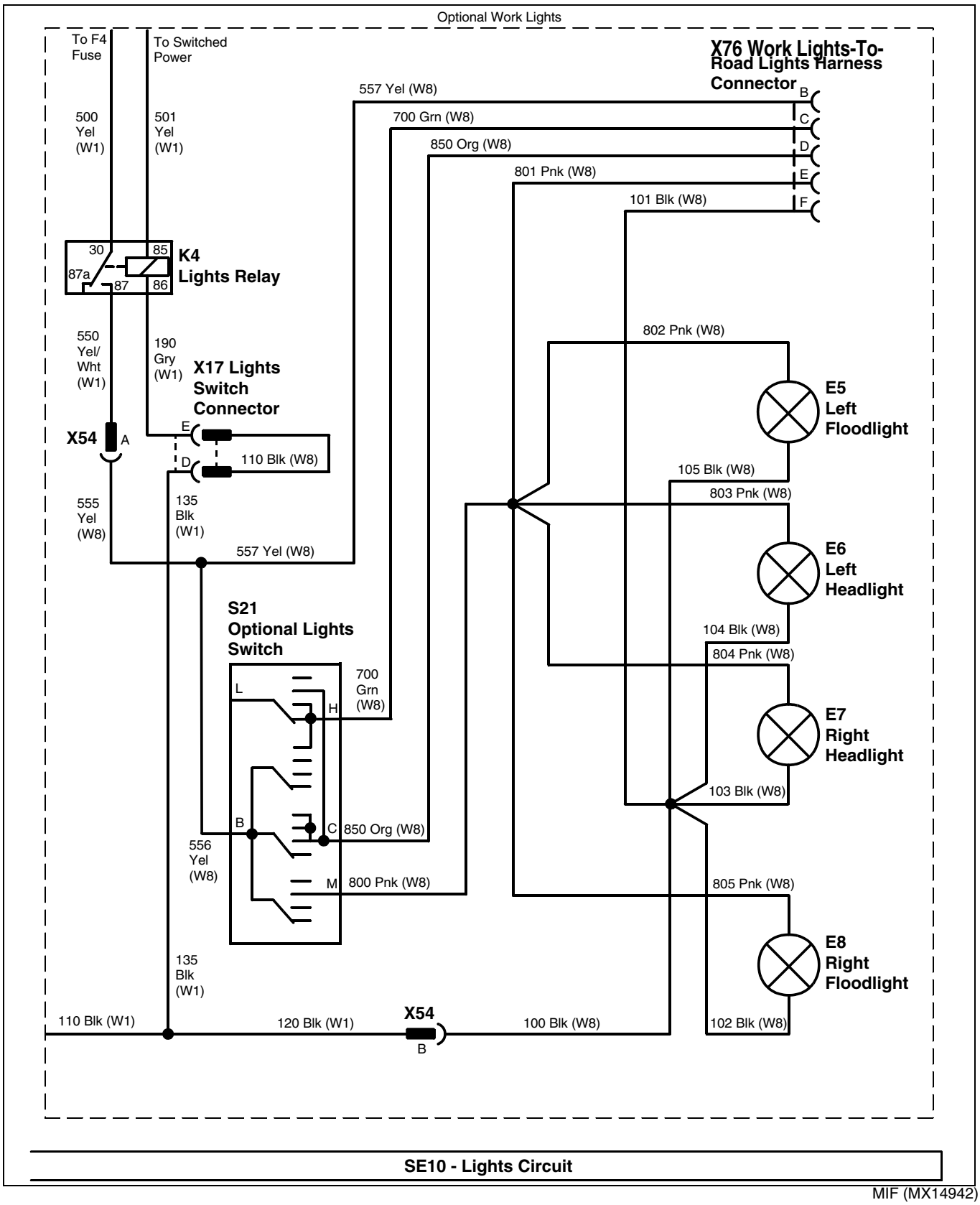
SE8 - Raise/Lower Circuit

MIF (MX14712)


220 Red (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
750 Blu (W1)
S15
PTO
Switch
Off
On
510 Yel (W1)
R1
PTO
Switch
Resistor
751
Blu
(W1)
527 Yel (W1)
Y6
Left
Motor
Solenoid
150
Blk
(W1)
963 Brn (W1)
544 Yel (W1)
Y7
Deck
Drive
Solenoid
960 Gry (W1)
528 Yel (W1)
Y8
Right
Motor
Solenoid
963 Brn (W1)
966 Gry (W1)
110 Blk(W1)
220 Red (W1)
540 Yel (W1)
222
Red
(W1)
501
Yel
(W1)
F4
Lights
Fuse
500
Yel
(W1)
Optional Lights
(Early Models)
K4
Lights
Relay
30
85
87a
87
86
S16
Lights
Switch
Off
On
550
Yel/
Wht
(W1)
190
Gry
(W1)
X54
A
450
Yel
(W2)
451 Yel (W2)
452 Yel (W2)
E3
Auxiliary
Headlight
E1
Left
Head-
light
E2
Right
Head-
light
102 Blk (W2)
100
Blk
(W2)
101 Blk (W2)
X54
B
135
Blk
(W1)
120
Blk
(W1)
110 Blk(W1)
SE9 - Mow Circuit
SE10 - Lights Circuit

MIF (MX14713)

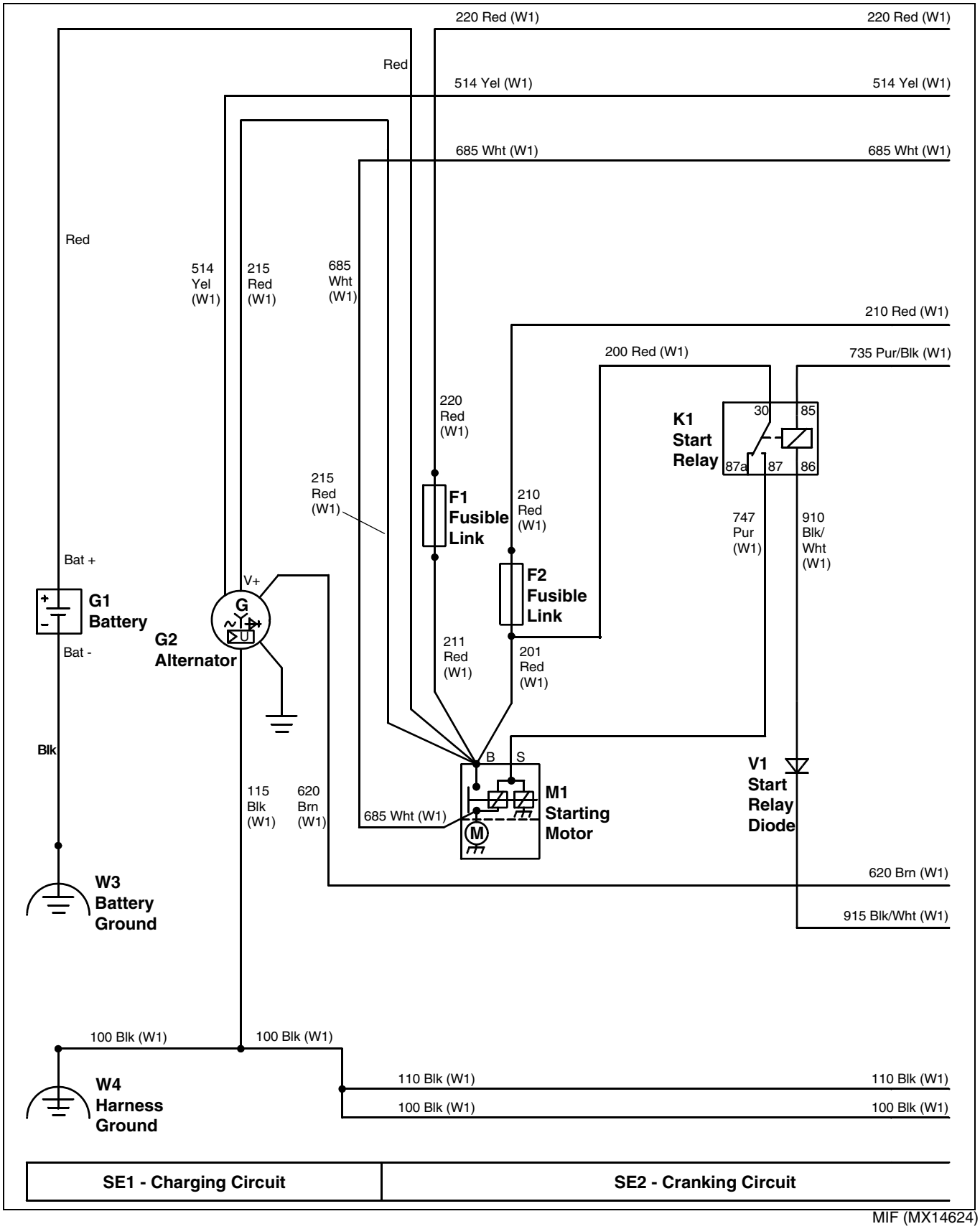
Optional Work Lights - Models 1600 and 1620 S.N. (020001-)



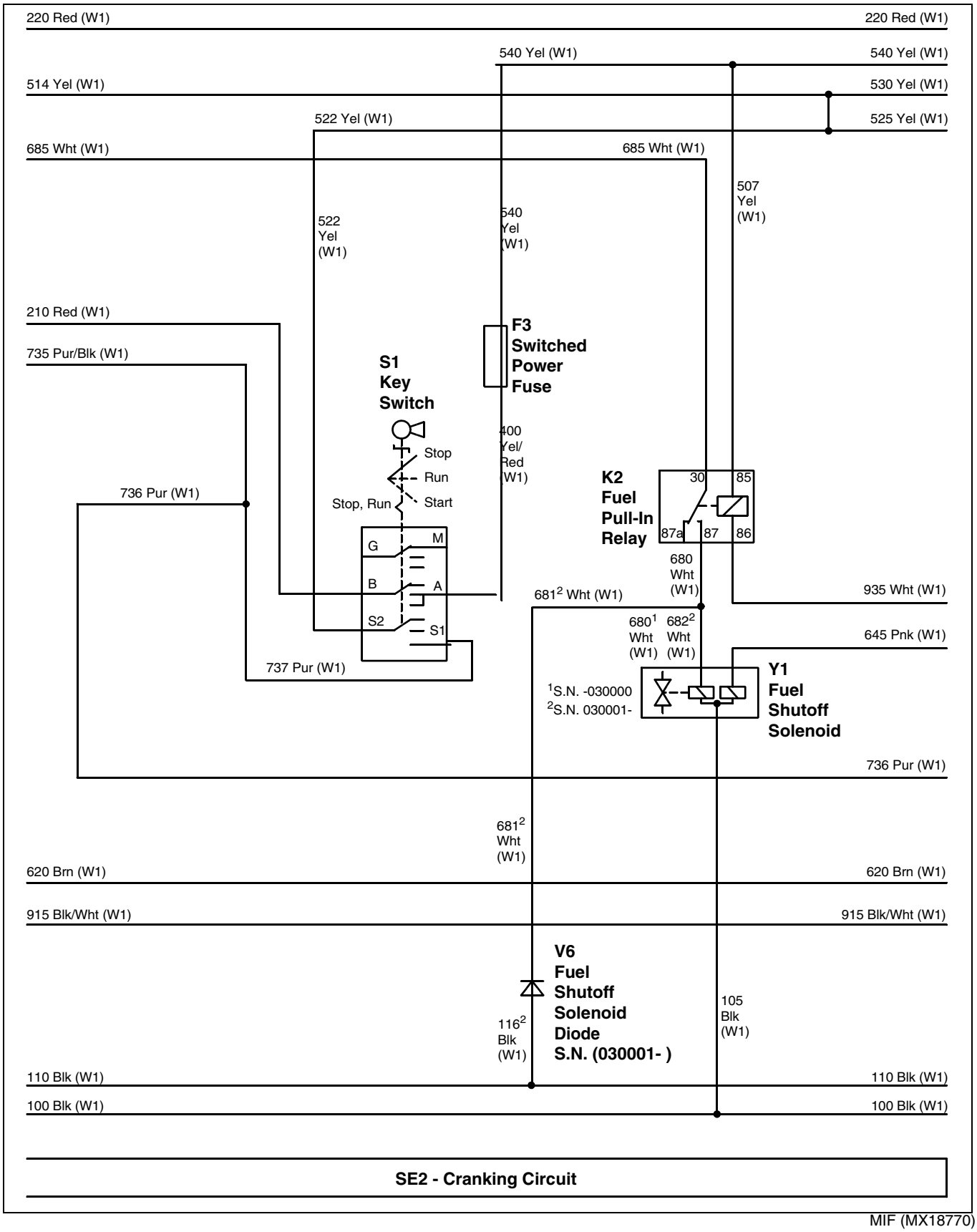
SE10 - Lights Circuit

MIF (MX14942)

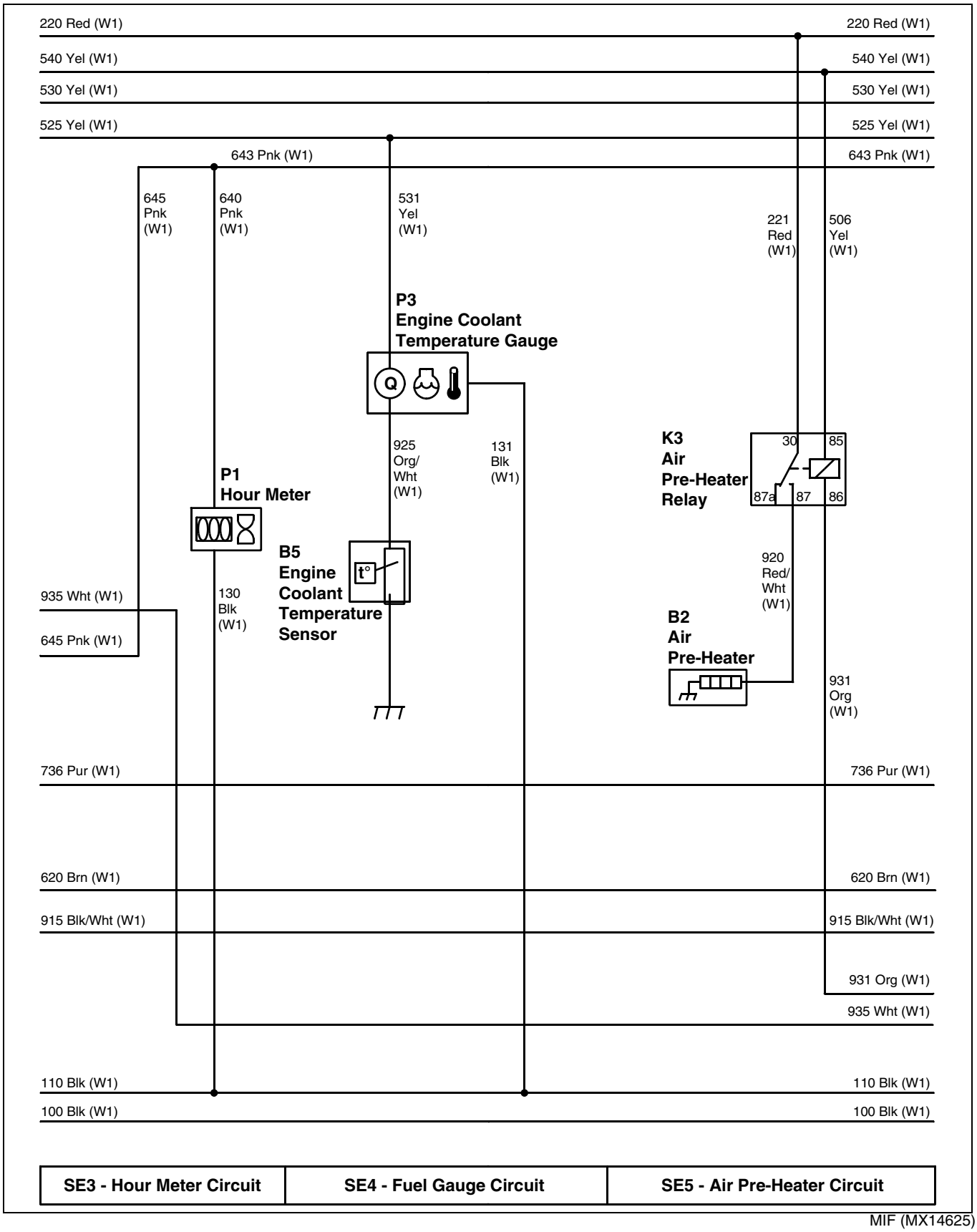
Main Schematic - Model 1600 Turbo



MIF (MX14624)

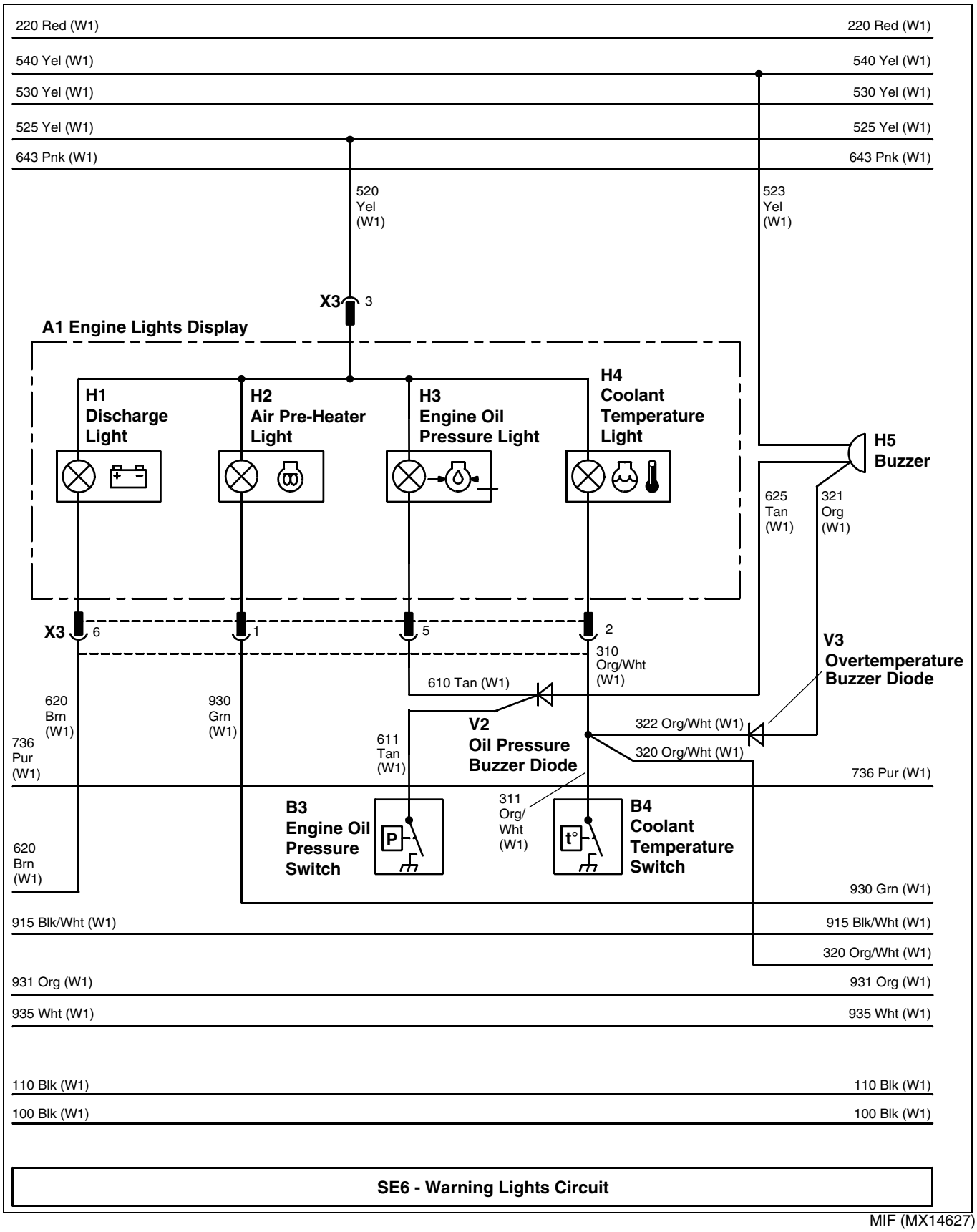

220 Red (W1)
220 Red (W1)
540 Yel (W1)
540 Yel (W1)
514 Yel (W1)
530 Yel (W1)
522 Yel (W1)
525 Yel (W1)
685 Wht (W1)
685 Wht (W1)
507 Yel (W1)
522 Yel (W1)
540 Yel (W1)
210 Red (W1)
735 Pur/Blk (W1)
F3 Switched Power Fuse
S1 Key Switch
400 Yel/ Red (W1)
Stop
Run
Start
Stop, Run
736 Pur (W1)
G
M
B
A
S2
S1
737 Pur (W1)
K2 Fuel Pull-In Relay
30
85
87a
87
86
680 Wht (W1)
681[2] Wht (W1)
935 Wht (W1)
680[1] Wht (W1)
682[2] Wht (W1)
645 Pnk (W1)
Y1 Fuel Shutoff Solenoid
[1]S.N. -030000
[2]S.N. 030001-
736 Pur (W1)
681[2] Wht (W1)
620 Brn (W1)
620 Brn (W1)
915 Blk/Wht (W1)
915 Blk/Wht (W1)
V6 Fuel Shutoff Solenoid Diode S.N. (030001-)
116[2] Blk (W1)
105 Blk (W1)
110 Blk (W1)
110 Blk (W1)
100 Blk (W1)
100 Blk (W1)
SE2 - Cranking Circuit

MIF (MX18770)



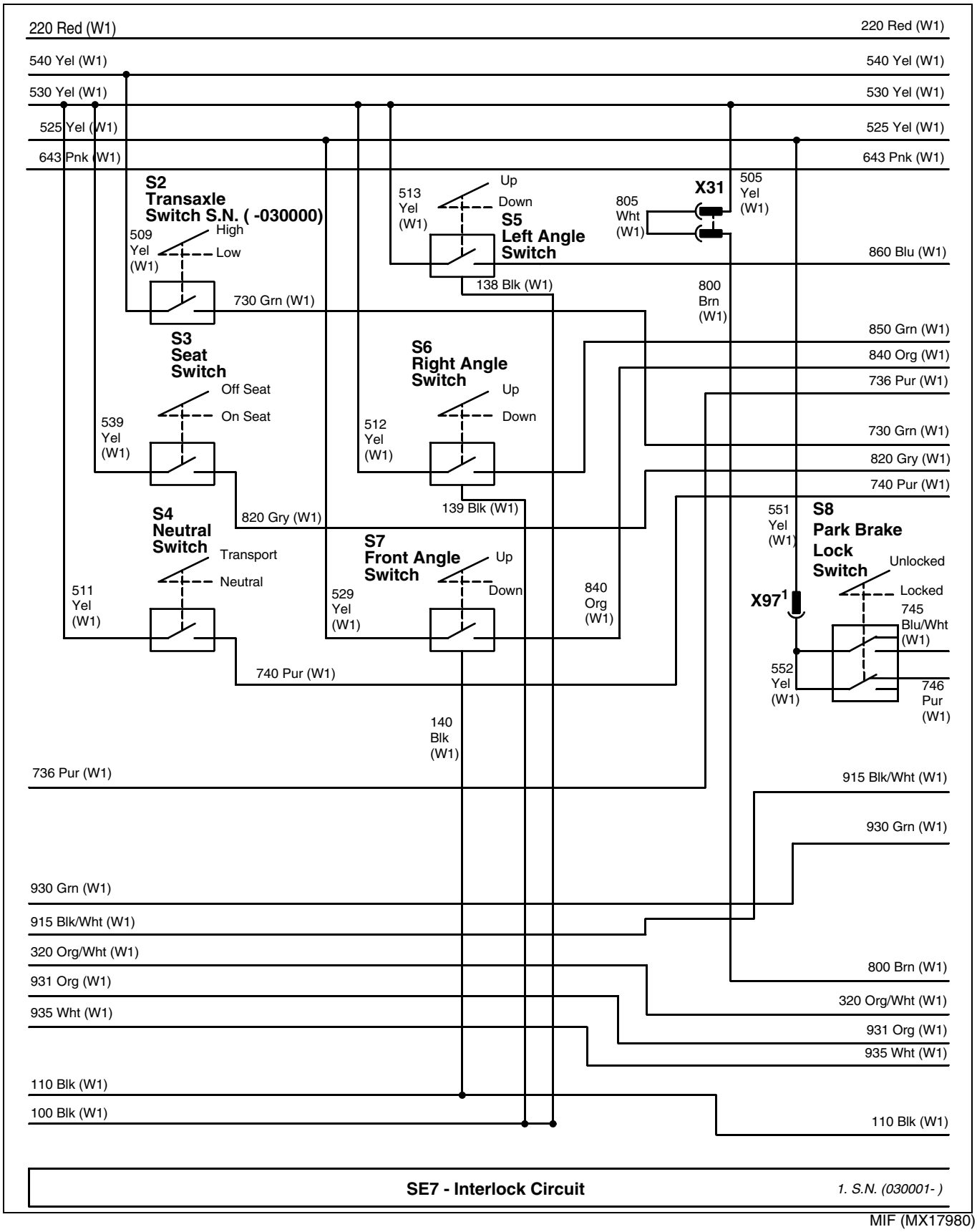
SE3 - Hour Meter Circuit	SE4 - Fuel Gauge Circuit	SE5 - Air Pre-Heater Circuit

MIF (MX14625)



SE6 - Warning Lights Circuit

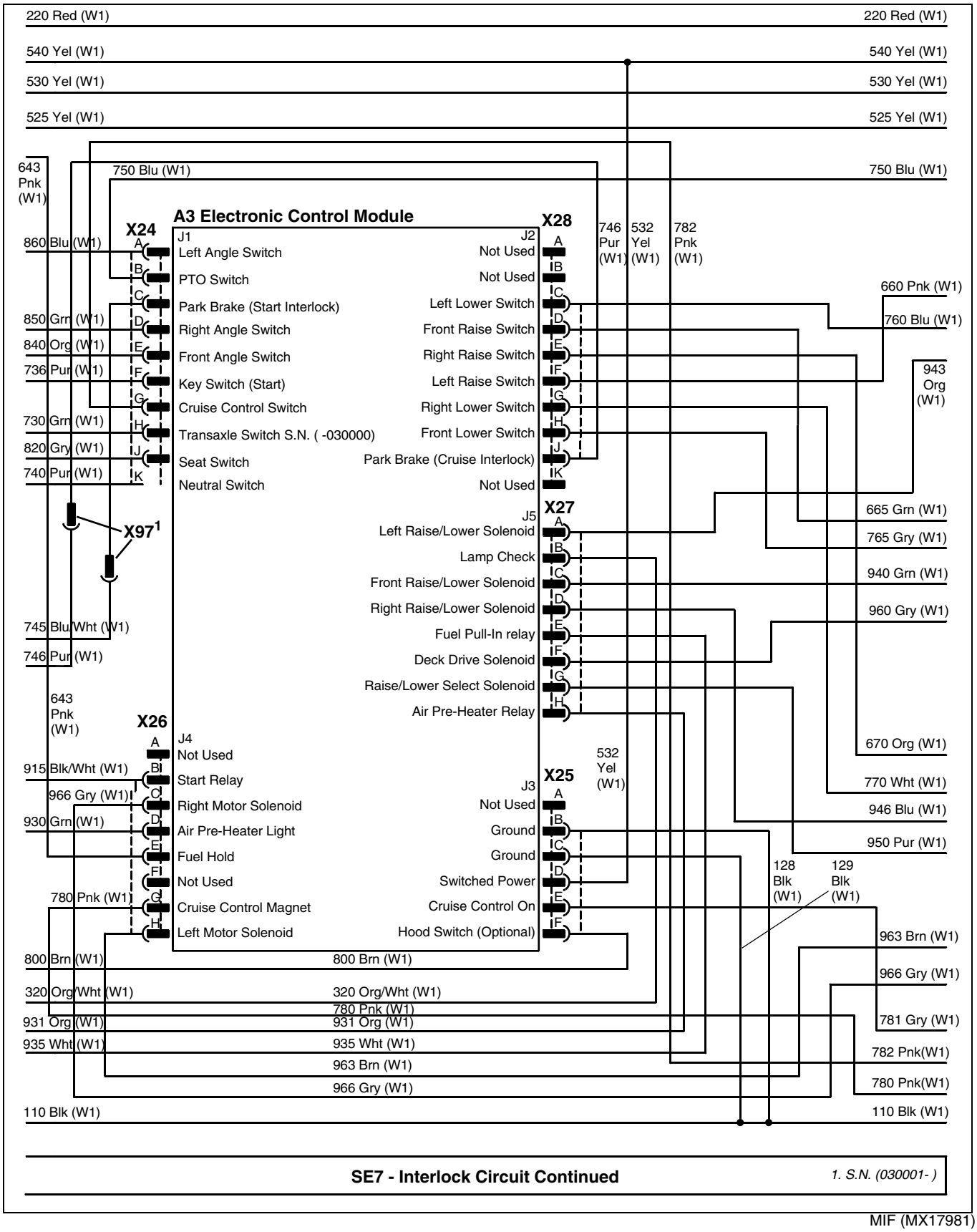
MIF (MX14627)



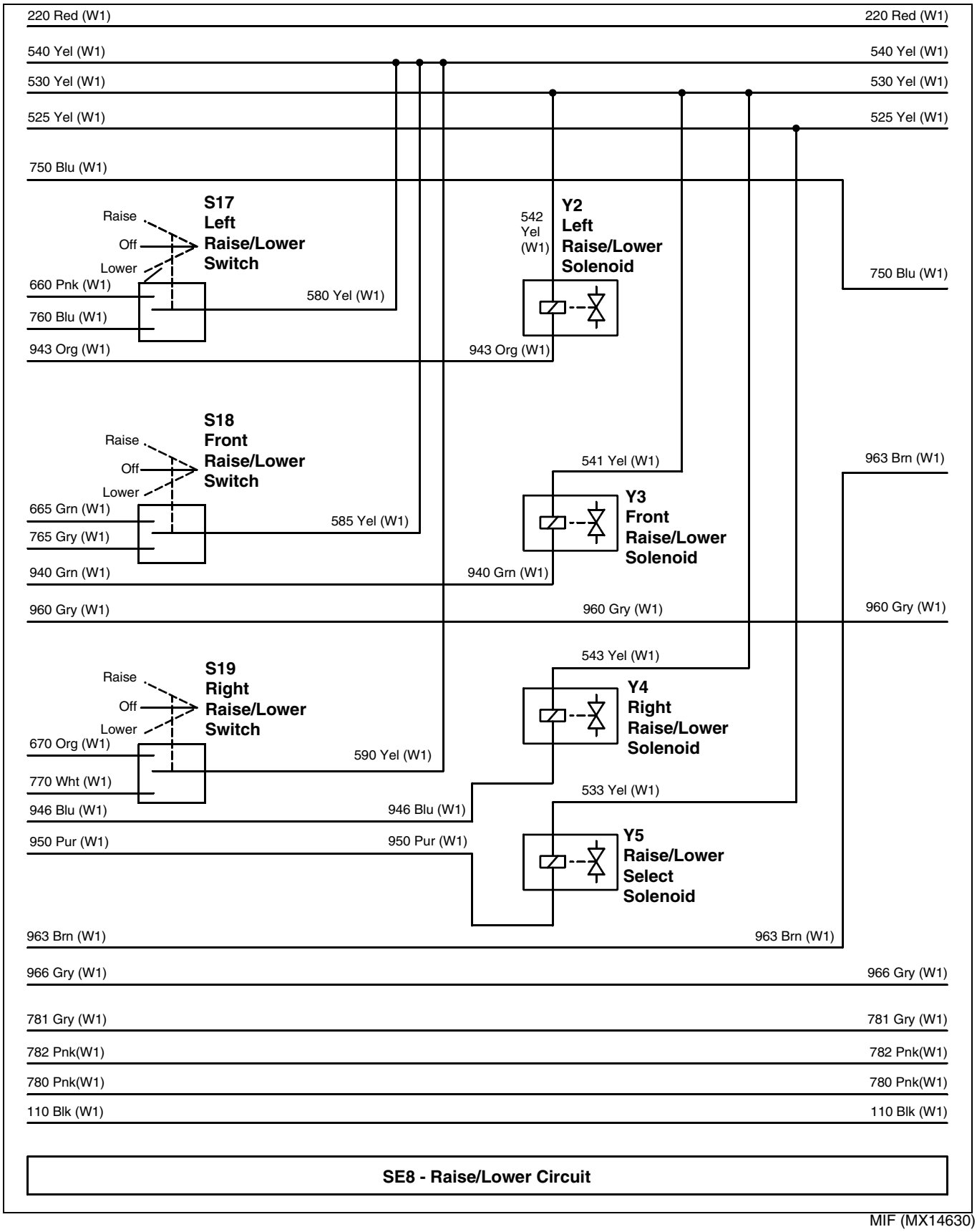
SE7 - Interlock Circuit

1. S.N. (030001-)

MIF (MX17980)

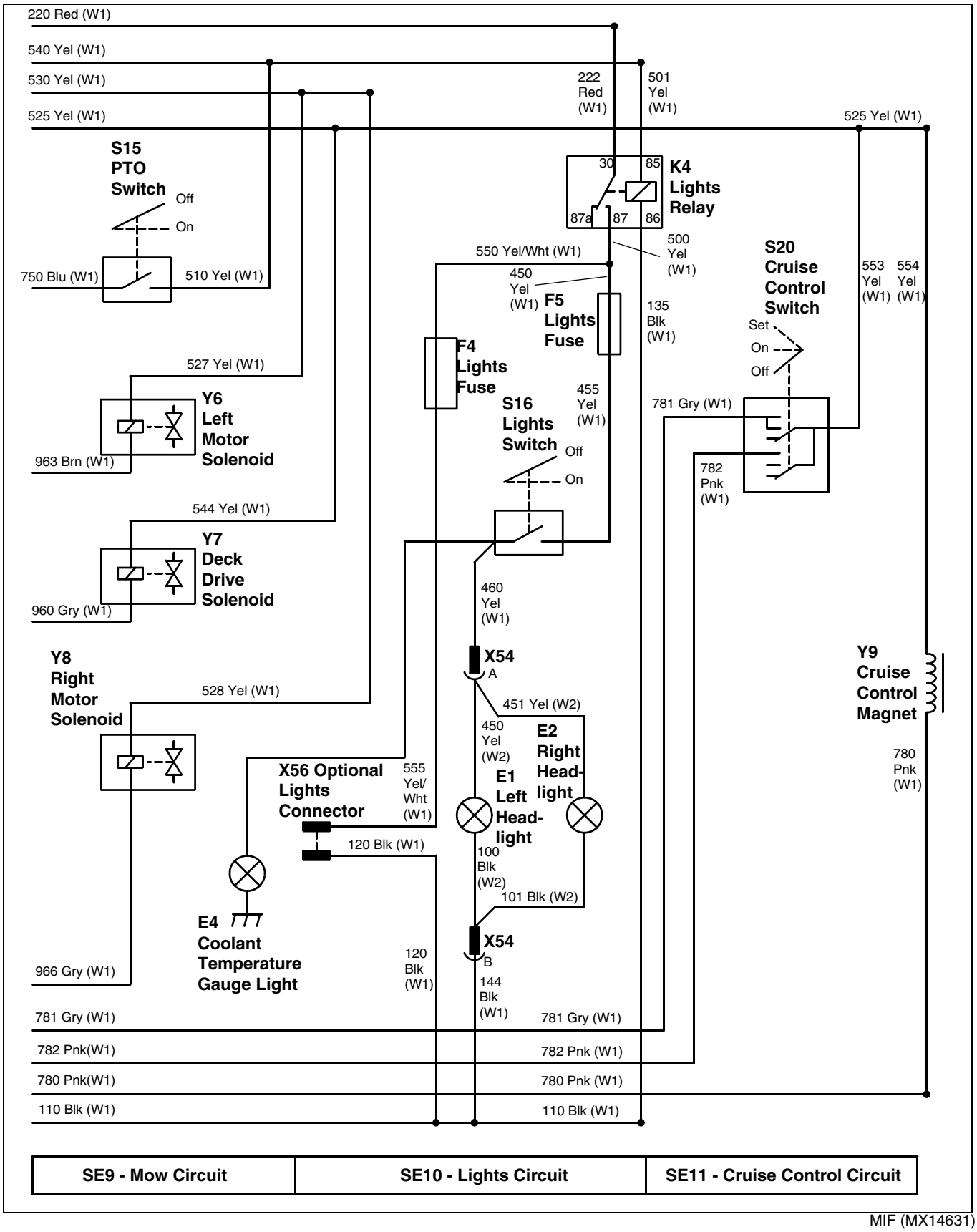

220 Red (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
643 Pnk (W1)
750 Blu (W1)
A3 Electronic Control Module
X24
J1
860 Blu (W1)
Left Angle Switch
PTO Switch
Park Brake (Start Interlock)
850 Grn (W1)
Right Angle Switch
840 Org (W1)
Front Angle Switch
736 Pur (W1)
Key Switch (Start)
Cruise Control Switch
730 Grn (W1)
Transaxle Switch S.N. (-030000)
820 Gry (W1)
Seat Switch
740 Pur (W1)
Neutral Switch
X97[1]
745 Blu/Wht (W1)
746 Pur (W1)
X28
J2
Not Used
Not Used
Left Lower Switch
Front Raise Switch
Right Raise Switch
Left Raise Switch
Right Lower Switch
Front Lower Switch
Park Brake (Cruise Interlock)
Not Used
746 Pur (W1)
532 Yel (W1)
782 Pnk (W1)
660 Pnk (W1)
760 Blu (W1)
943 Org (W1)
X27
J5
Left Raise/Lower Solenoid
Lamp Check
Front Raise/Lower Solenoid
Right Raise/Lower Solenoid
Fuel Pull-In relay
Deck Drive Solenoid
Raise/Lower Select Solenoid
Air Pre-Heater Relay
665 Grn (W1)
765 Gry (W1)
940 Grn (W1)
960 Gry (W1)
670 Org (W1)
643 Pnk (W1)
X26
J4
915 Blk/Wht (W1)
Not Used
Start Relay
966 Gry (W1)
Right Motor Solenoid
930 Grn (W1)
Air Pre-Heater Light
Fuel Hold
Not Used
780 Pnk (W1)
Cruise Control Magnet
Left Motor Solenoid
X25
J3
Not Used
Ground
Ground
Switched Power
Cruise Control On
Hood Switch (Optional)
532 Yel (W1)
770 Wht (W1)
946 Blu (W1)
950 Pur (W1)
128 Blk (W1)
129 Blk (W1)
963 Brn (W1)
966 Gry (W1)
781 Gry (W1)
782 Pnk(W1)
780 Pnk(W1)
800 Brn (W1)
320 Org/Wht (W1)
780 Pnk (W1)
931 Org (W1)
935 Wht (W1)
963 Brn (W1)
966 Gry (W1)
110 Blk (W1)
SE7 - Interlock Circuit Continued
1. S.N. (030001-)

MIF (MX17981)



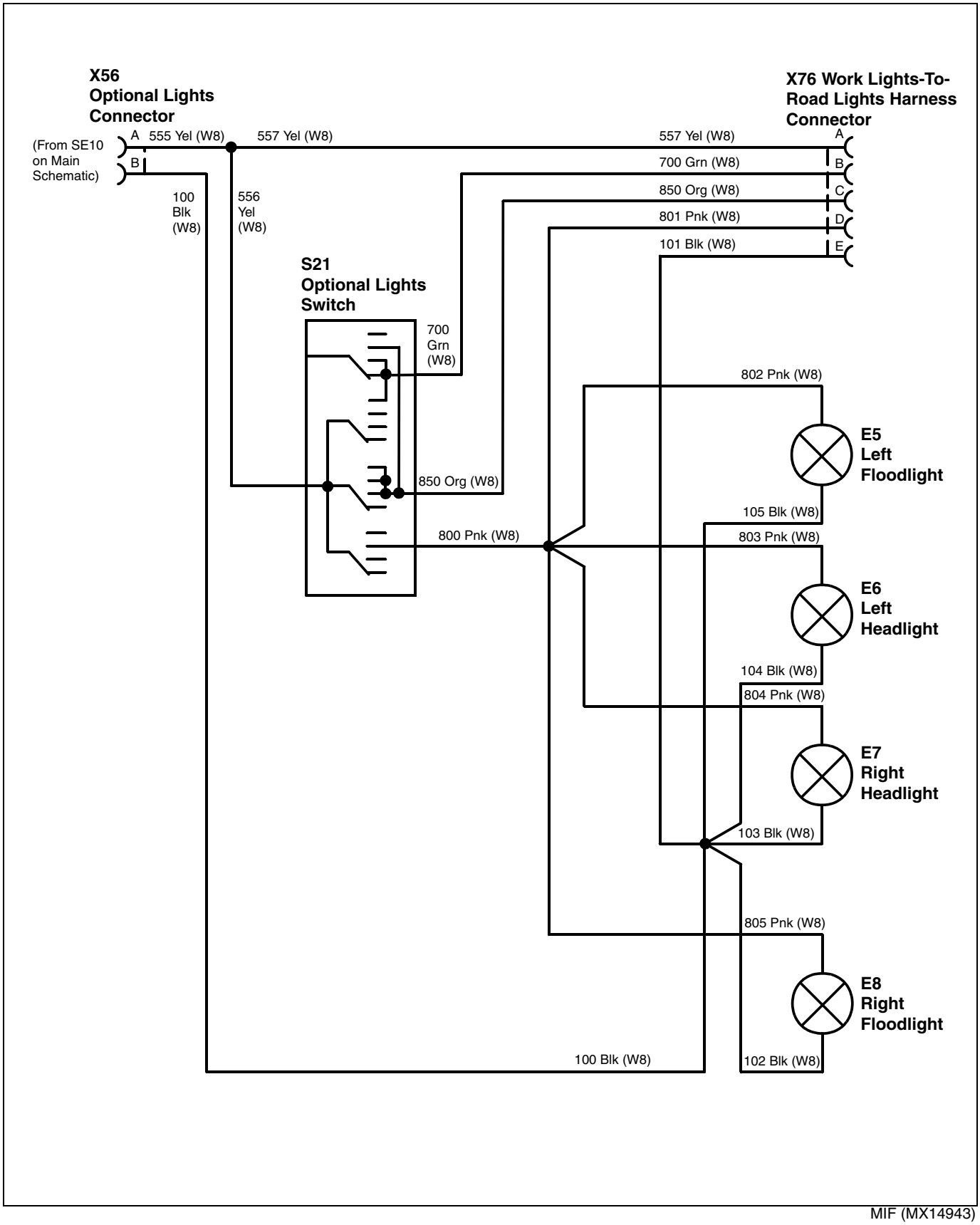
SE8 - Raise/Lower Circuit

MIF (MX14630)


220 Red (W1)
540 Yel (W1)
530 Yel (W1)
525 Yel (W1)
222 Red (W1)
501 Yel (W1)
525 Yel (W1)
S15 PTO Switch
Off
On
750 Blu (W1)
510 Yel (W1)
30
85
K4 Lights Relay
87a
87
86
500 Yel (W1)
550 Yel/Wht (W1)
450 Yel (W1)
F5 Lights Fuse
135 Blk (W1)
S20 Cruise Control Switch
Set
On
Off
553 Yel (W1)
554 Yel (W1)
F4 Lights Fuse
527 Yel (W1)
Y6 Left Motor Solenoid
963 Brn (W1)
455 Yel (W1)
S16 Lights Switch
Off
On
781 Gry (W1)
782 Pnk (W1)
544 Yel (W1)
Y7 Deck Drive Solenoid
960 Gry (W1)
460 Yel (W1)
X54
A
Y9 Cruise Control Magnet
780 Pnk (W1)
Y8 Right Motor Solenoid
528 Yel (W1)
451 Yel (W2)
450 Yel (W2)
E2 Right Head-light
E1 Left Head-light
X56 Optional Lights Connector
555 Yel/ Wht (W1)
120 Blk (W1)
100 Blk (W2)
101 Blk (W2)
E4 Coolant Temperature Gauge Light
X54
B
120 Blk (W1)
966 Gry (W1)
144 Blk (W1)
781 Gry (W1)
781 Gry (W1)
782 Pnk(W1)
782 Pnk (W1)
780 Pnk(W1)
780 Pnk (W1)
110 Blk (W1)
110 Blk (W1)
SE9 - Mow Circuit
SE10 - Lights Circuit
SE11 - Cruise Control Circuit

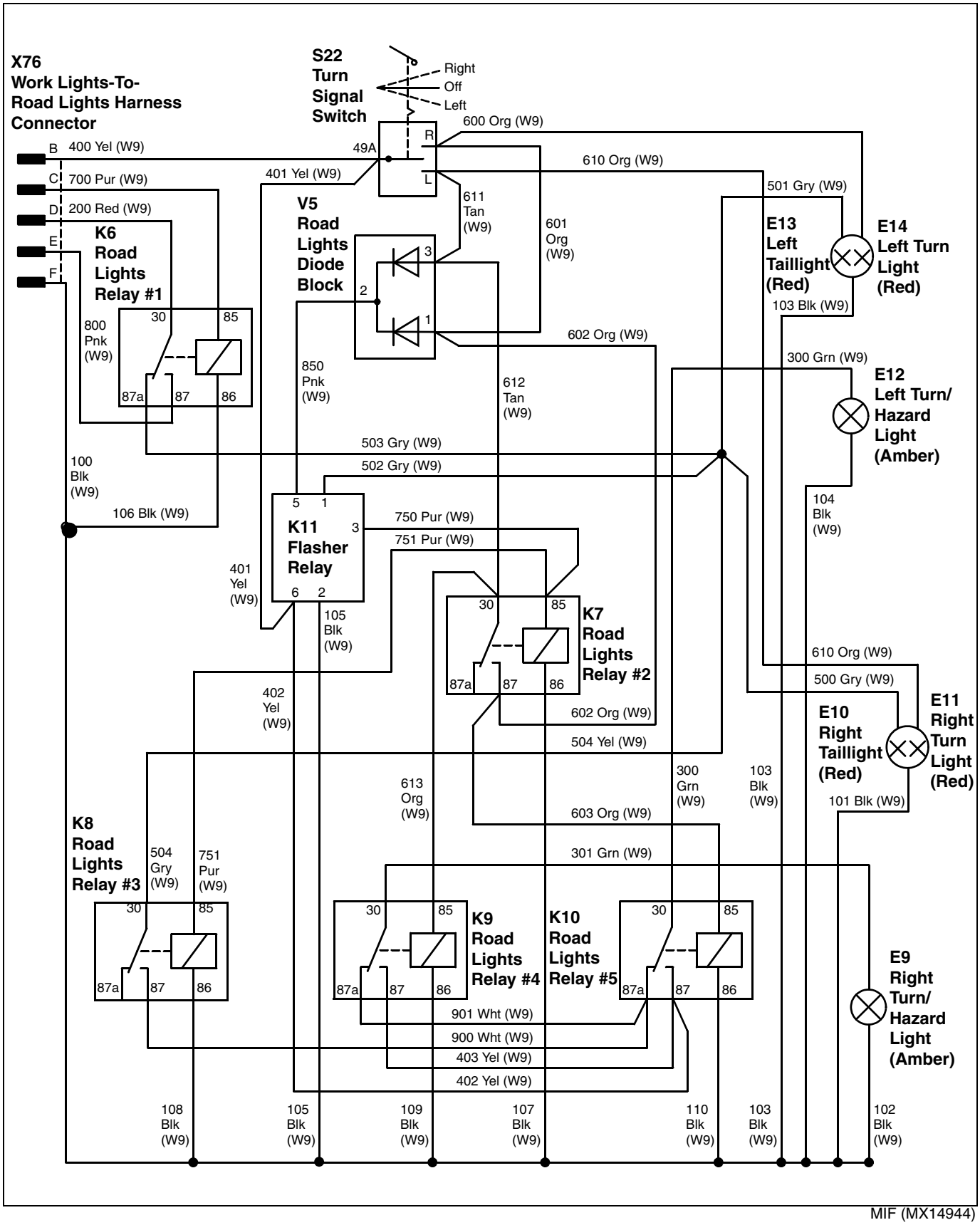
MIF (MX14631)

Optional Work Lights Schematic - Model 1600 Turbo



MIF (MX14943)

Optional Road Lights Schematic



MIF (MX14944)

Wire Code Table - Models 1600 and 1620

Circuit Number	Wire Size	Color	Termination Points
100	5.0	Blk	W1 Ground, Splice 9
105	5.0	Blk	X40, Splice 9
110	3.0	Blk	Splice 9, Splice 7
111	0.8	Blk	X45, Splice 9
115	5.0	Blk	X37, Splice 9
120	2.0	Blk	X54, Splice 7
128	0.8	Blk	X25, Splice 7
129	0.8	Blk	X25, Splice 7
130	0.8	Blk	X30, Splice 7
131	0.8	Blk	X2, Splice 7
135	0.8	Blk	X17, Splice 7
138	0.8	Blk	X42, Splice 9
139	0.8	Blk	X47, Splice 9
140	0.8	Blk	X53, Splice 7
150	0.8	Blk	(R1, Splice 7)[3, 4] (Not Used)[1, 2]
190	0.8	Gry	X7, X17
200	3.0	Red	(F2, Splice 1)[1, 2] (F2, X6)[3, 4]
201	1.0	Red, Fuse Link	X32, 200 Red
205	3.0	Red	(X8, Splice 1)[1] (Not Used)[2, 3, 4]
206	2.0	Red	(X6, Splice 1)[1, 2] (Not Used)[3, 4]
210	3.0	Red	X1, F2
211	2.0	Red, Fuse Link	X32, 220 Red
215	5.0	Red	X32, X33
220	5.0	Red	F1, Splice 4
221	5.0	Red	X9, Splice 4
222	5.0	Red	F4 (X20), Splice 4
310	0.8	Org/Wht	X3, Splice 6
311	0.8	Org/Wht	X35, Splice 6
320	0.8	Org/Wht	X27, Splice 6
321	0.8	Org	X19, X22
322	0.8	Org/Wht	X19, Splice 6
400	3.0	Yel/Red	X1, X21
500	2.0	Yel	X7, F4
501	0.8	Yel	X7, Splice 2
505	0.8	Yel	X31, Splice 8
506	0.8	Yel	X9, Splice 2
507	0.8	Yel	X8, Splice 2
509	0.8	Yel	X29, Splice 2
510	0.8	Yel	X23, Splice 2
511	0.8	Yel	X48, Splice 8
512	0.8	Yel	X47, Splice 8
513	0.8	Yel	X42, Splice 8
514	0.8	Yel	X34, Splice 8
520	0.8	Yel	X3, Splice 3
521	0.8	Yel	X4, Splice 3
522	0.8	Yel	X1, Splice 3
523	0.8	Yel	X22, Splice 2
525	1.0	Yel	Splice 3, Splice 8
526	0.8	Yel	X5, Splice 3
527	0.8	Yel	X44, Splice 8
528	0.8	Yel	X43, Splice 8
529	0.8	Yel	X53, Splice 3
530	2.0	Yel	525 Yel, Splice 2
531	0.8	Yel	X2, Splice 3
532	0.8	Yel	X25, Splice 2
533	0.8	Yel	X52, Splice 3
539	0.8	Yel	X49, Splice 8
540	1.0	Yel	F3, Splice 2
541	0.8	Yel	X50, Splice 8

Circuit Number	Wire Size	Color	Termination Points
542	0.8	Yel	X50, Splice 8
543	0.8	Yel	X50, Splice 8
544	0.8	Yel	X51, Splice 3
550	2.0	Yel/Wht	X7, X54
560	0.8	Yel	(X14, Splice 2)[1,2] (X60, Splice 2)[3, 4]
565	0.8	Yel	(X15, Splice 2)[1, 2]
570	0.8	Yel	(X16, Splice 2)[1, 2]
580	0.8	Red[1, 2] Yel[3, 4]	(X13, Splice 2)[1, 2] (X61, Splice 2)[3, 4]
585	0.8	Red[1, 2] Yel[3, 4]	(X12, Splice 2)[1, 2] (X62, Splice 2)[3, 4]
590	0.8	Red[1, 2] Yel[3, 4]	(X11, Splice 2)[1, 2] (X63, Splice 2)[3, 4]
610	0.8	Tan	X3, X18
611	0.8	Tan	X18, X39
612	0.8	Blk	(X8, V4)[2] (Not Used)[1, 3, 4]
620	0.8	Brn	X3, X34
625	0.8	Tan	X18, X22
640	0.8	Pnk	X30, Splice 5
643	0.8	Pnk	(X26, Splice 5)[1, 3] (X58, Splice 5)[2, 4]
645	0.8	Pnk	X40, Splice 5
660	0.8	Blu[1,2] Pnk[3,4]	(X14, X28)[1, 2] (X28, X61)[3, 4]
665	0.8	Gry[1, 2] Grn[3, 4]	(X15, X28)[1, 2] (X28, X62)[3, 4]
670	0.8	Wht[1] Wht[2] Org[3, 4]	(X16, X28)[1] (X28, X59)[2] (X28, X63)[3, 4]
680	3.0	Wht	X8, X40
685	3.0	Wht	X8, X67

Circuit Number	Wire Size	Color	Termination Points
730	0.8	Grn	X24, X29
735	0.8	Pur/Blk	X1, X6
736	0.8	Pur	X6, X24
740	0.8	Pur	X24, X48
745	0.8	Blu/Wht	X5, X24
747	2.0	Pur	X6, X38
750	0.8	Blu	X23, X24
751	0.8	Blu	(Not Used)[1, 2] (R1, 750 Blu)[3, 4]
755	0.8	Wht	X4, X26
757	0.8	Blu	X4, X26
759	0.8	Pur	X4, X26
760	0.8	Blu	(X13, X28)[1, 2] (X28, X61)[3, 4]
765	0.8	Gry	(X12, X28)[1, 2] (X28, X62)[3, 4]
770	0.8	Wht	(X11, X28)[1, 2] (X28, X63)[3, 4]
800	0.8	Brn	X25, X31
805	0.8	Wht	X31, X31
820	0.8	Gry	X24, X49
840	0.8	Org	X24, X53
850	0.8	Grn	X24, X47
860	0.8	Blu	X24, X42
900	0.8	Blk/Wht	X2, X46
910	0.8	Blk/Wht	X6, X10
915	0.8	Blk/Wht	X10, X26
920	5.0	Red/Wht	X9, X36
930	0.8	Grn	X3, X26
931	0.8	Org	X9, X27
935	0.8	Wht	(X8, X27)[1, 3, 4] (Not Used)[2]

Circuit Number	Wire Size	Color	Termination Points
940	0.8	Grn	X27, X50
943	0.8	Org	X27, X50
946	0.8	Blu	X27, X50
950	0.8	Pur	X27, X52
960	0.8	Gry	X27, X51
963	0.8	Brn	X26, X44
966	0.8	Gry	X26, X43

[1]S.N. (010001-020000) without MPTC10114 Kit installed

[2]S.N. (010001-020000) with MPTC10114 Kit installed

[3]S.N. (020001-) without MPTC10114 Kit installed

[4]S.N. (020001-) with MPTC10114 Kit installed

Wire Code Table - Model 1600 Turbo

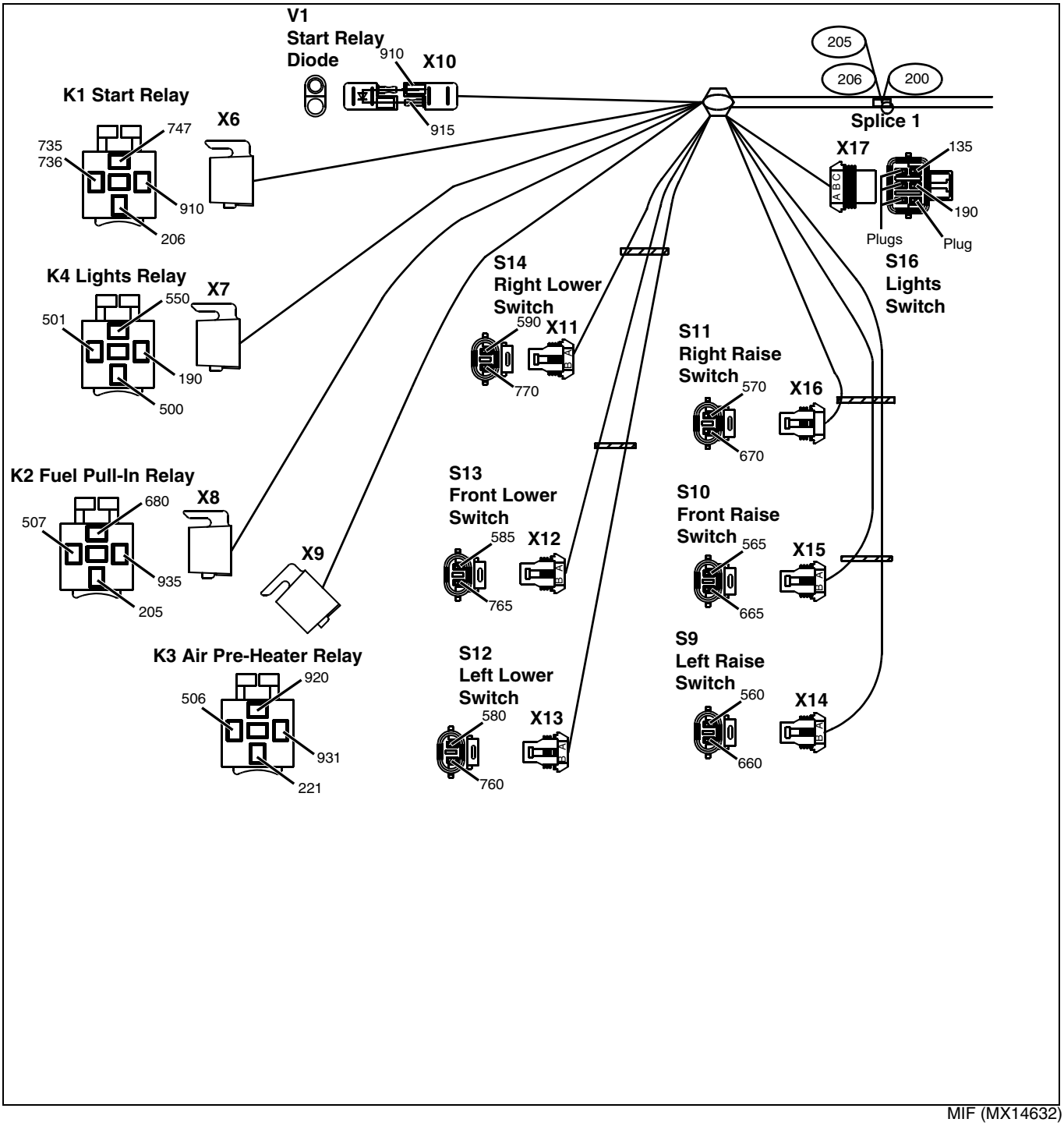
Circuit Number	Wire Size	Color	Termination Points
100	5.0	Blk	X41 (W1 Ground), Splice 11
105	5.0	Blk	X40, Splice 11
110	3.0	Blk	Splice 11, Splice 8
115	5.0	Blk	X37, Splice 11
116	0.8	Blk	X196, Splice 11 S.N. (030001-)
120	3.0	Blk	X54, Splice 8
128	0.8	Blk	X25, Splice 8
129	0.8	Blk	X25, Splice 8
130	0.8	Blk	X30, Splice 8
131	0.8	Blk	X2, Splice 8
135	0.8	Blk	X17, Splice 8
138	0.8	Blk	X42, Splice 11
139	0.8	Blk	X47, Splice 11
140	0.8	Blk	X53, Splice 8
144	1.0	Blk	X54, Splice 8
200	3.0	Red	F2, X6
201	1.0	Red, Fuse Link	X32, 200 Red
210	3.0	Red	X1, F2
211	2.0	Red, Fuse Link	X32, 220 Red
215	5.0	Red	X32, X33
220	5.0	Red	F1, Splice 6
221	5.0	Red	X9, Splice 6
222	5.0	Red	X7, Splice 6
310	0.8	Org/Wht	X3, Splice 5
311	0.8	Org/Wht	X35, Splice 5
320	0.8	Org/Wht	X27, Splice 5
321	0.8	Org	X19, X22
322	0.8	Org/Wht	X19, Splice 5

Circuit Number	Wire Size	Color	Termination Points
400	3.0	Yel/Red	X1, X21
450	5.0	Yel	X75, Splice 1
455	1.0	Yel	X17, X75
460	1.0	Yel	X17, X54
465	0.8	Yel	X17, X72
500	2.0	Yel	X7, Splice 1
501	0.8	Yel	X7, Splice 3
505	0.8	Yel	X31, Splice 9
506	0.8	Yel	X9, Splice 3
507	0.8	Yel	X8, Splice 3
509	0.8	Yel	X29, Splice 3 S.N. (-030000)
510	0.8	Yel	X23, Splice 3
511	0.8	Yel	X48, Splice 9
512	0.8	Yel	X47, Splice 9
513	0.8	Yel	X42, Splice 9
514	0.8	Yel	X34, Splice 9
520	0.8	Yel	X3, Splice 2
522	0.8	Yel	X1, Splice 2
523	0.8	Yel	X22, Splice 3
525	1.0	Yel	Splice 2, Splice 9
527	0.8	Yel	X44, Splice 9
528	0.8	Yel	X43, Splice 9
529	0.8	Yel	X53, Splice 2
530	2.0	Yel	Splice 9, Splice 3
531	0.8	Yel	X2, Splice 2
532	0.8	Yel	X25, Splice 3
533	0.8	Yel	X52, Splice 2
539	0.8	Yel	X49, Splice 9
540	1.0	Yel	F3, Splice 3
541	0.8	Yel	X50, Splice 9
542	0.8	Yel	X50, Splice 9
543	0.8	Yel	X50, Splice 9
544	0.8	Yel	X51, Splice 2
550	5.0	Yel/Wht	X20, Splice 1
551	0.8	Yel	X5[a], Splice 2
552	0.8	Yel	X5[a], 551 Yel
553	0.8	Yel	X4, Splice 2
554	0.8	Yel	X71, Splice 2
556	0.8	Yel/Wht	X20, X56
560	0.8	Yel	X60, Splice 3
580	0.8	Red	X61, Splice 3
585	0.8	Red	X62, Splice 3
590	0.8	Red	X63, Splice 3
610	0.8	Tan	X3, X18
611	0.8	Tan	X18, X39
620	0.8	Brn	X3, X34
625	0.8	Tan	X18, X22
640	0.8	Pnk	X30, Splice 7
643	0.8	Pnk	X26, Splice 7
645	0.8	Pnk	X40, Splice 7
660	0.8	Pnk	X28, X61
665	0.8	Grn	X28, X62
670	0.8	Org	X28, X63
680	3.0	Wht	X8, X40 S.N. (-030000) X8, Splice 10 S.N. (030001-)
681	0.8	Wht	X196, Splice 10 S.N. (030001-)
682	3.0	Wht	X40, Splice 10 S.N. (030001-)
685	3.0	Wht	X8, X67
730	0.8	Grn	X24, X29 S.N. (-030000)
735	0.8	Pur/Blk	X6, Splice 4
736	0.8	Pur	X24, Splice 4

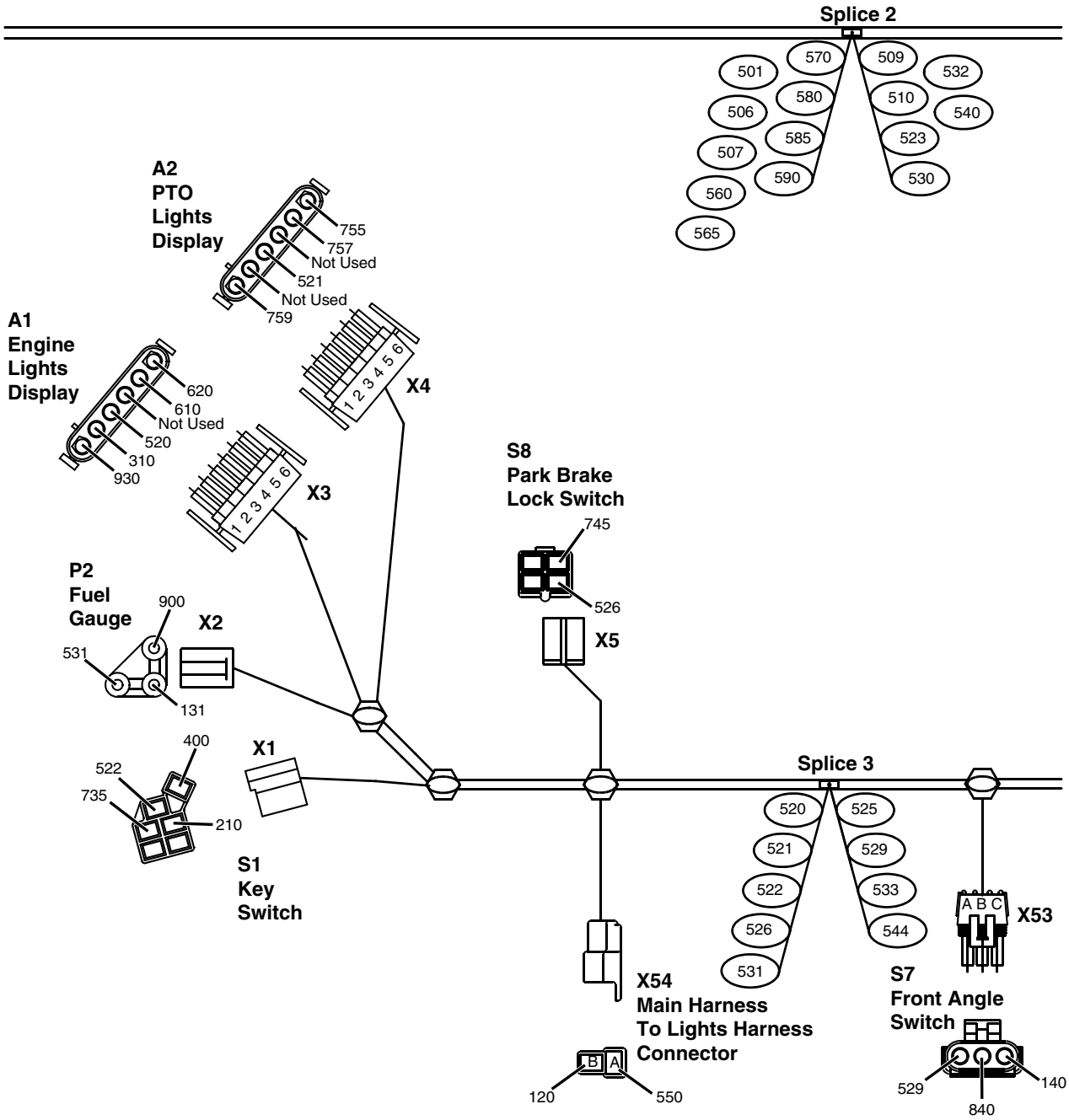
Circuit Number	Wire Size	Color	Termination Points
737	0.8	Pur	X1, Splice 4
740	0.8	Pur	X24, X48
745	0.8	Blu/Wht	X5[a], X24
746	0.8	Pur	X5[a], X28
747	2.0	Pur	X6, X38
750	0.8	Blu	X23, X24
760	0.8	Blu	X28, X61
765	0.8	Gry	X28, X62
770	0.8	Wht	X28, X63
780	0.8	Pnk	X26, X73
781	0.8	Gry	X25, X74
782	0.8	Pnk	X24, X74
800	0.8	Brn	X25, X31
805	0.8	Wht	X31, X31
820	0.8	Gry	X24, X49
840	0.8	Org	X24, X53
850	0.8	Grn	X24, X47
860	0.8	Blu	X24, X42
910	0.8	Blk/Wht	X6, X10
915	0.8	Blk/Wht	X10, X26
920	5.0	Red/Wht	X9, X36
925	0.8	Org/Wht	X70, X71
930	0.8	Grn	X3, X26
931	0.8	Org	X9, X27
935	0.8	Wht	X8, X27
940	0.8	Grn	X27, X50
943	0.8	Org	X27, X50
946	0.8	Blu	X27, X50
950	0.8	Pur	X27, X52
960	0.8	Gry	X27, X51
963	0.8	Brn	X26, X44
966	0.8	Gry	X26, X43

a. Models S.N. (030001-) incorporate a jumper harness (W10) between the main harness (W1) and the park brake lock switch (S8).

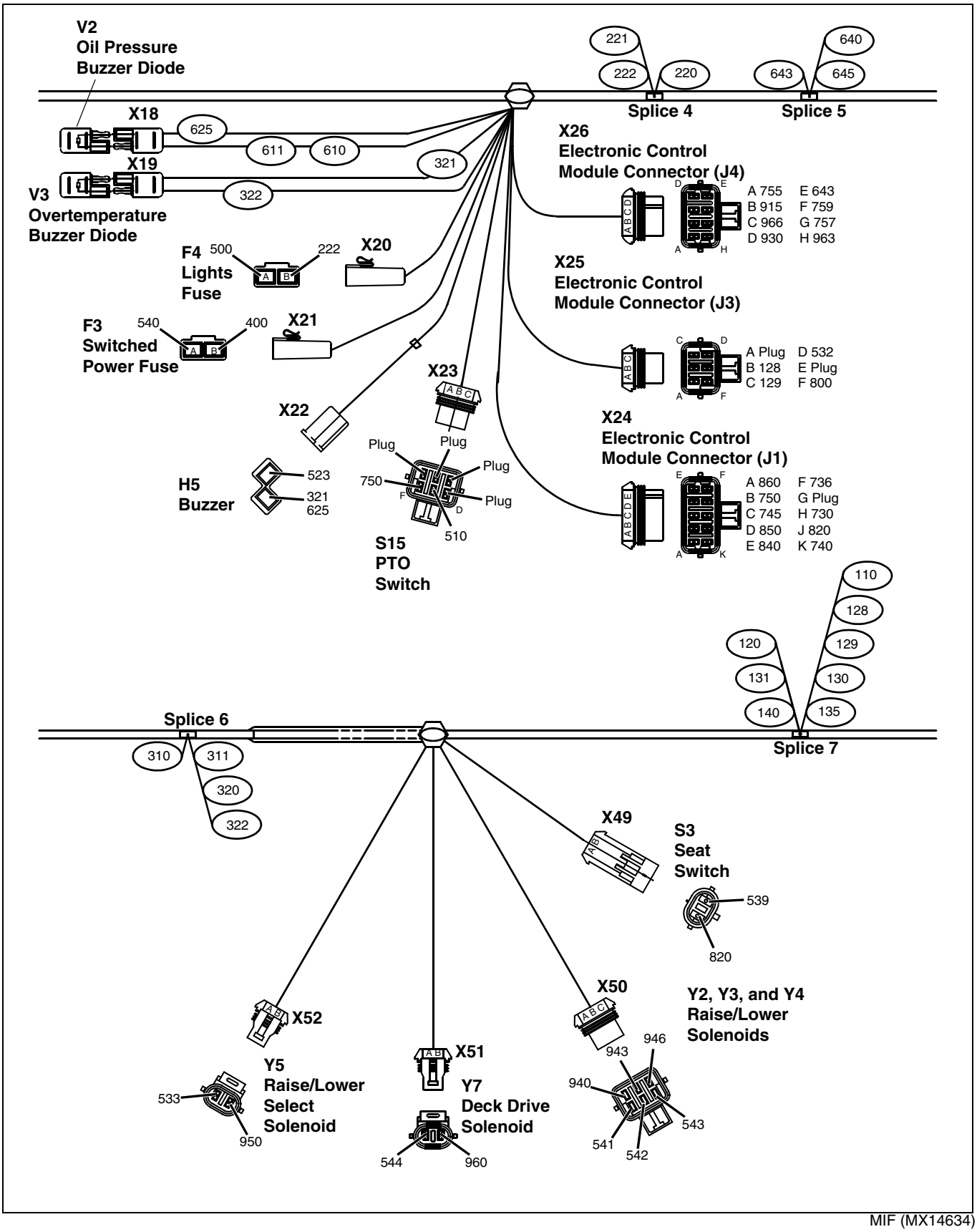
Main Wiring Harness (W1) - Models 1600 and 1620 S.N. (010000-020000)



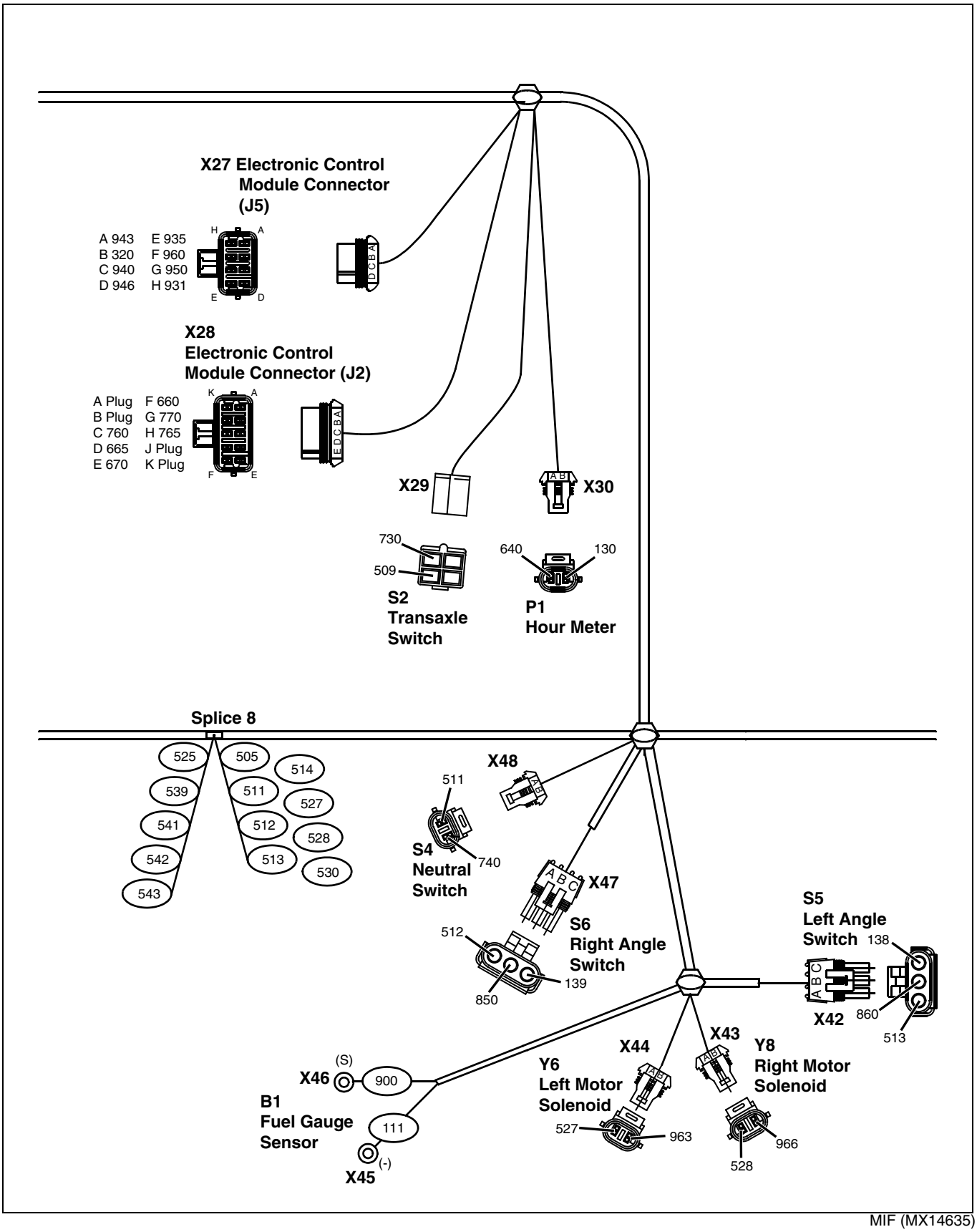
MIF (MX14632)


Splice 2
570
509
532
501
580
510
540
506
585
523
507
590
530
560
565
A2
PTO
Lights
Display
755
757
Not Used
521
Not Used
759
A1
Engine
Lights
Display
620
610
Not Used
520
310
930
X4
X3
1 2 3 4 5 6
S8
Park Brake
Lock Switch
745
526
X5
P2
Fuel
Gauge
900
X2
531
131
400
X1
522
735
210
S1
Key
Switch
Splice 3
520
525
521
529
522
533
526
544
531
A B C
X53
X54
Main Harness
To Lights Harness
Connector
B A
120
550
S7
Front Angle
Switch
529
140
840

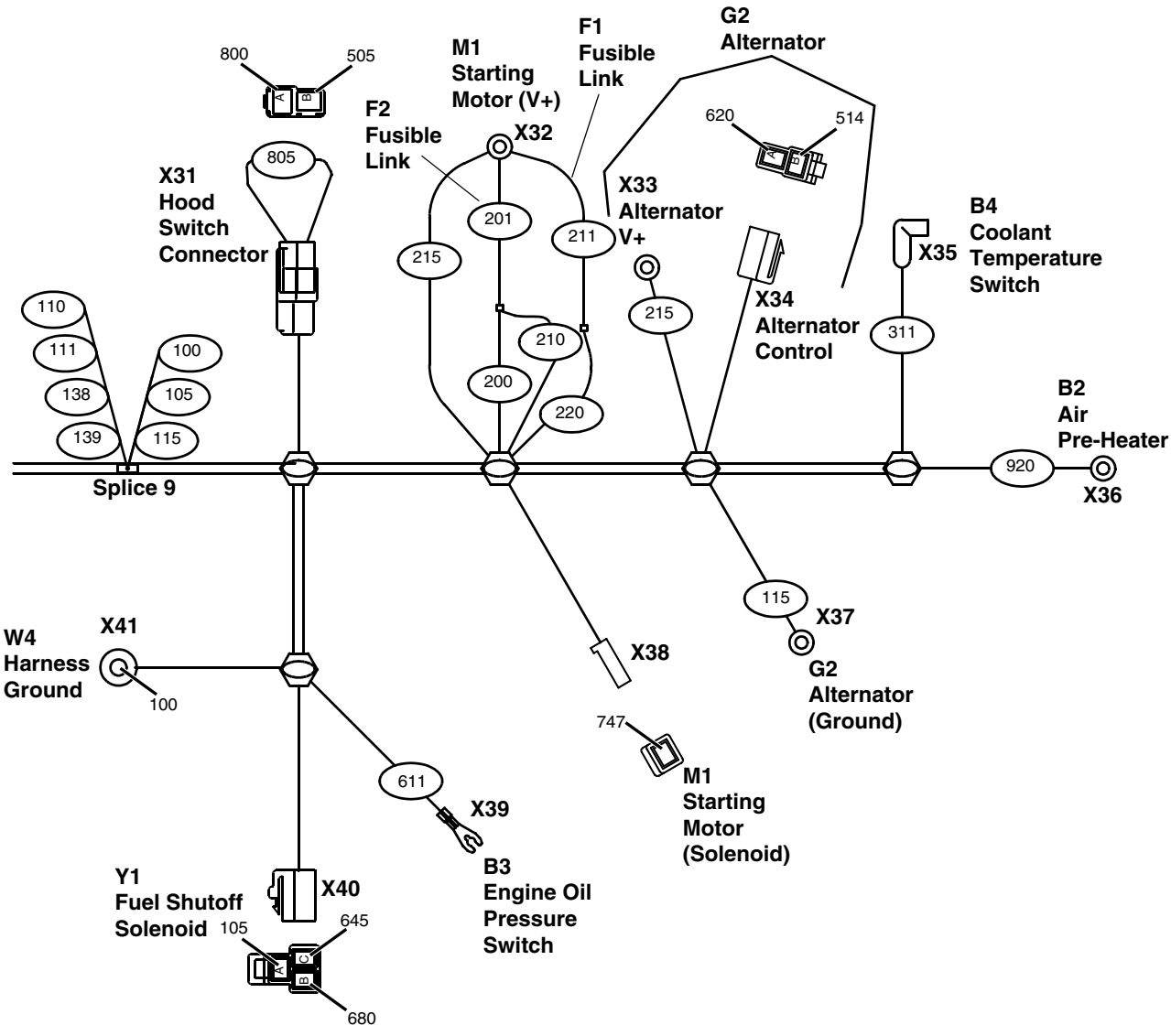
MIF (MX14633)


V2
Oil Pressure
Buzzer Diode
221
222
220
640
643
645
Splice 4
Splice 5
X18
625
611
610
321
X19
322
V3
Overtemperature
Buzzer Diode
X26
Electronic Control
Module Connector (J4)
A 755 E 643
B 915 F 759
C 966 G 757
D 930 H 963
F4
Lights
Fuse
500
222
X20
X25
Electronic Control
Module Connector (J3)
A Plug D 532
B 128 E Plug
C 129 F 800
F3
Switched
Power Fuse
540
400
X21
X23
X22
X24
Electronic Control
Module Connector (J1)
A 860 F 736
B 750 G Plug
C 745 H 730
D 850 J 820
E 840 K 740
Plug
Plug
Plug
750
Plug
510
H5
Buzzer
523
321
625
S15
PTO
Switch
110
128
120
129
131
130
140
135
Splice 6
Splice 7
310
311
320
322
X49
S3
Seat
Switch
539
820
X50
Y2, Y3, and Y4
Raise/Lower
Solenoids
X52
X51
946
943
940
543
541
542
Y5
Raise/Lower
Select
Solenoid
533
950
Y7
Deck Drive
Solenoid
544
960

MIF (MX14634)

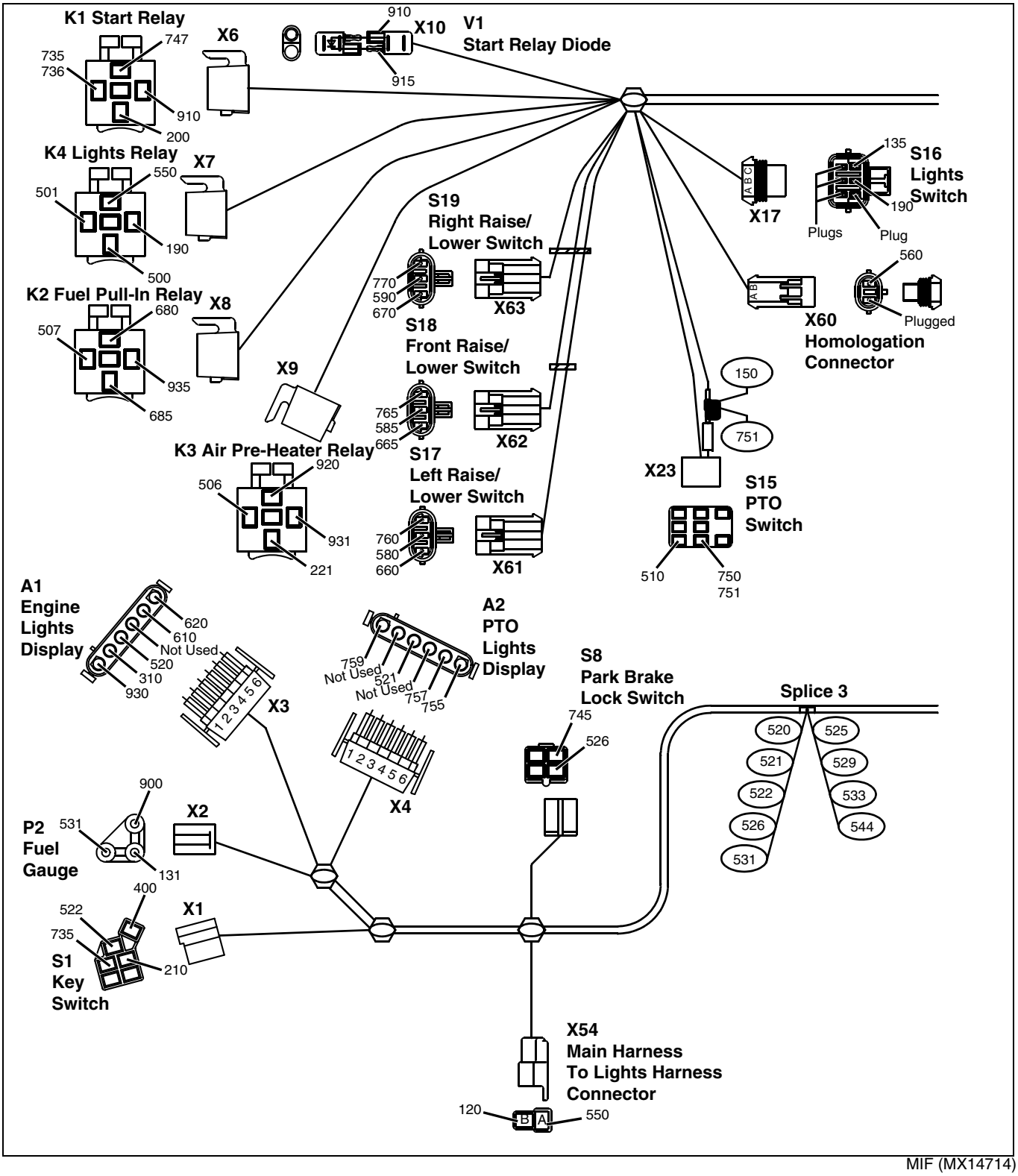

X27 Electronic Control Module Connector (J5)
A 943 E 935
B 320 F 960
C 940 G 950
D 946 H 931
X28 Electronic Control Module Connector (J2)
A Plug F 660
B Plug G 770
C 760 H 765
D 665 J Plug
E 670 K Plug
X29
X30
730
509
S2 Transaxle Switch
640
130
P1 Hour Meter
Splice 8
525
505
514
539
511
527
541
512
528
542
513
530
543
X48
511
S4 Neutral Switch
740
X47
S6 Right Angle Switch
512
139
850
S5 Left Angle Switch
138
X42
860
513
X43
X44
Y6 Left Motor Solenoid
Y8 Right Motor Solenoid
527
963
966
528
(S)
X46
900
B1 Fuel Gauge Sensor
111
(-)
X45

MIF (MX14635)

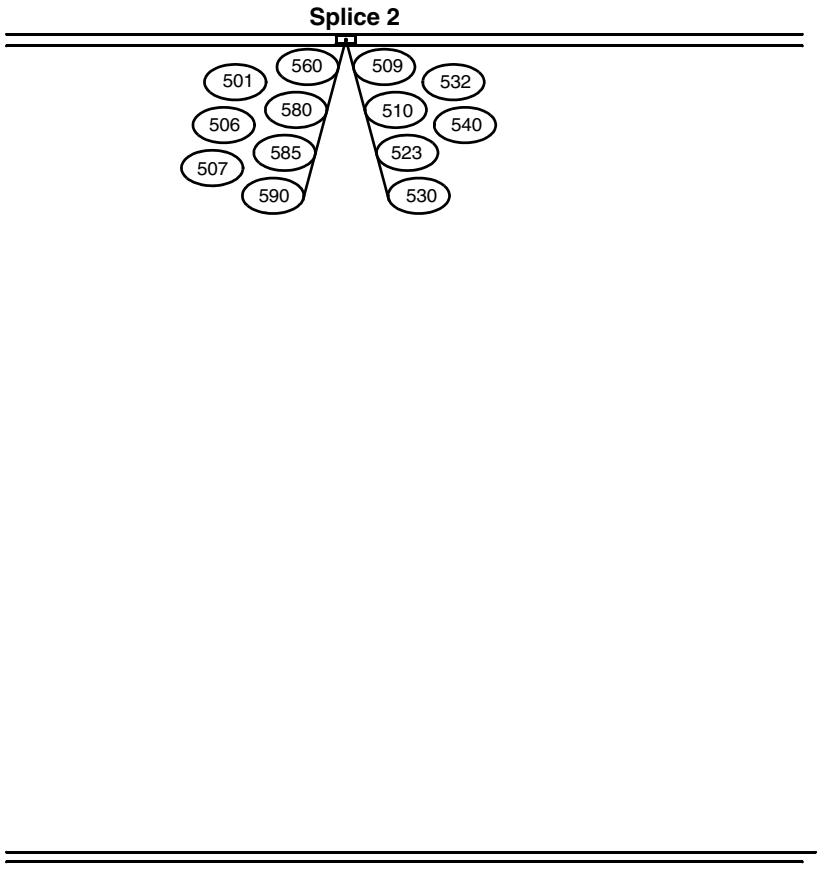

800
505
M1
Starting
Motor (V+)
F1
Fusible
Link
G2
Alternator
620
514
F2
Fusible
Link
X32
805
X31
Hood
Switch
Connector
201
211
215
X33
Alternator
V+
215
X34
Alternator
Control
X35
B4
Coolant
Temperature
Switch
311
110
111
138
139
100
105
115
210
200
220
Splice 9
920
B2
Air
Pre-Heater
X36
115
X37
G2
Alternator
(Ground)
W4
Harness
Ground
X41
100
X38
747
M1
Starting
Motor
(Solenoid)
611
X39
B3
Engine Oil
Pressure
Switch
Y1
Fuel Shutoff
Solenoid
X40
105
645
680

MIF (MX14636)

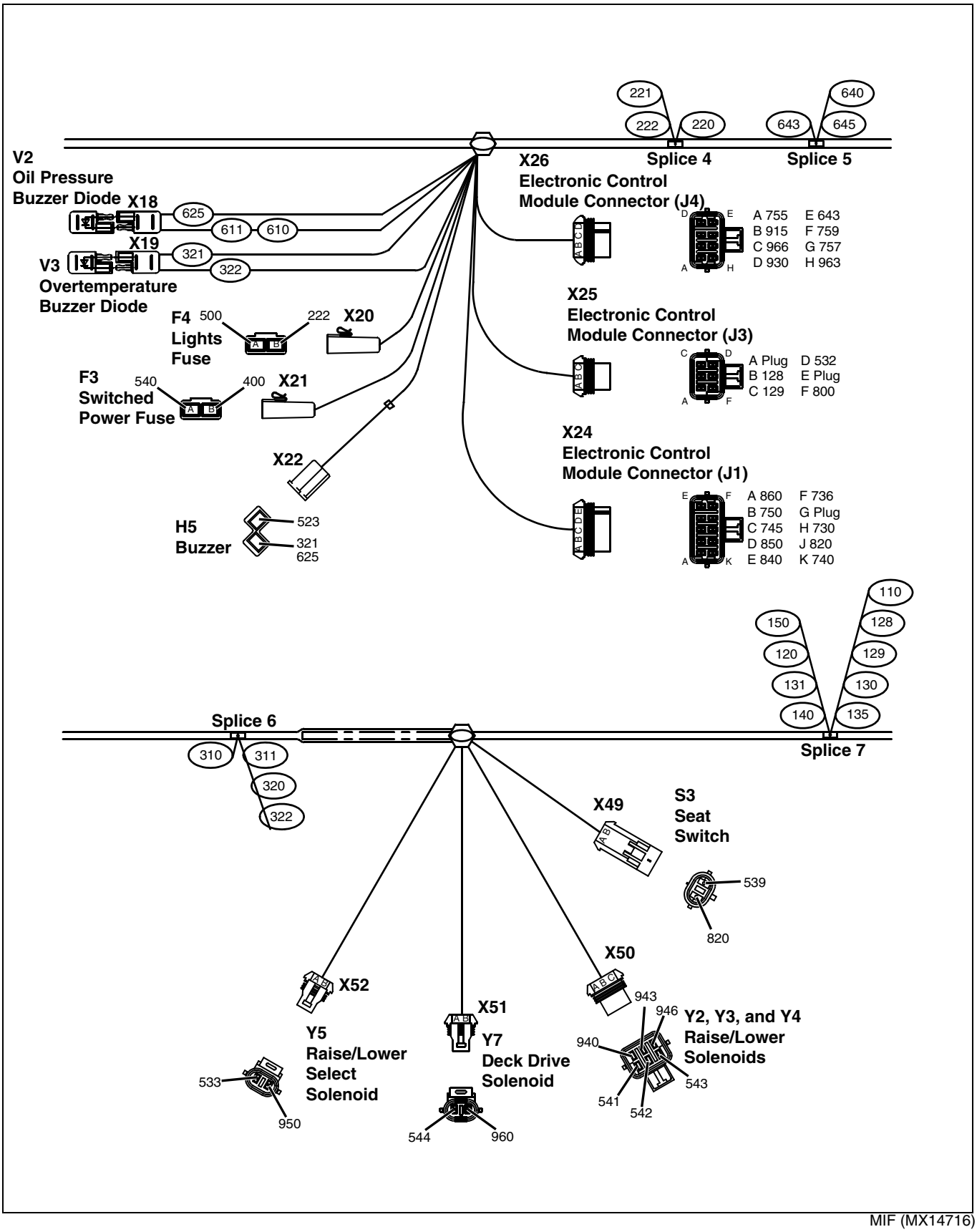
Main Wiring Harness (W1) - Models 1600 and 1620 S.N. (020001-)



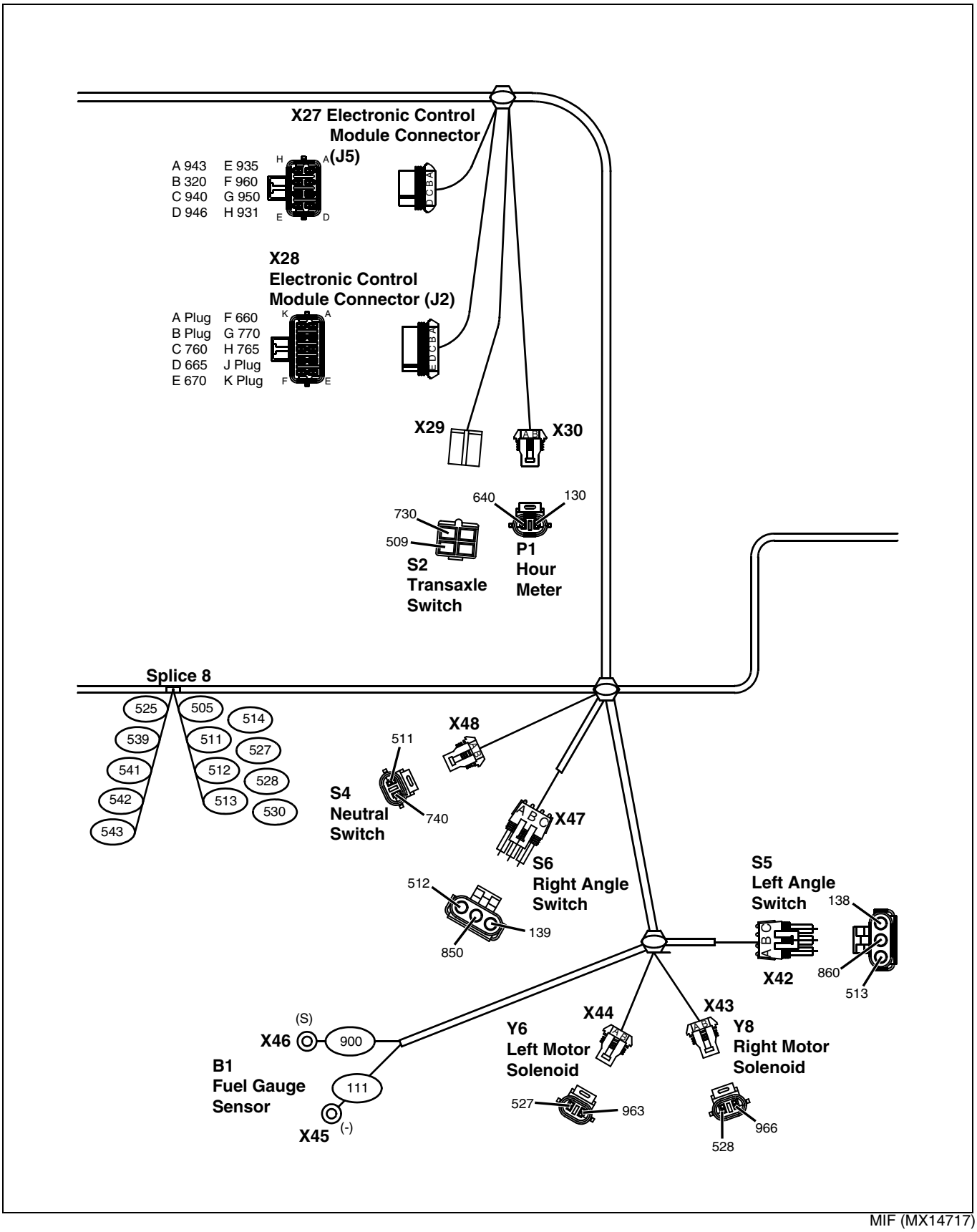
MIF (MX14714)



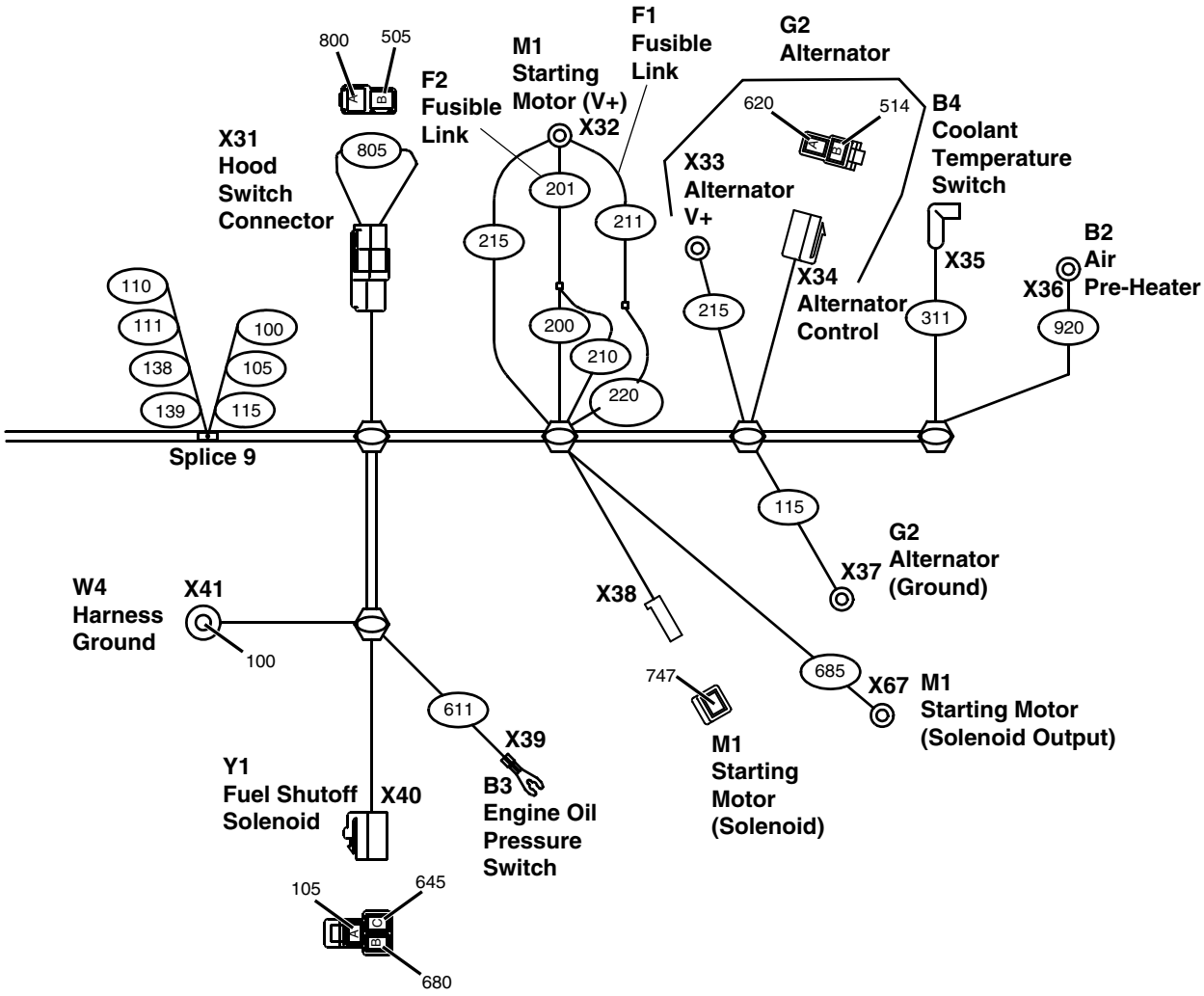
MIF (MX14715)


221
222
220
640
643
645
Splice 4
Splice 5
V2
Oil Pressure
Buzzer Diode
X18
625
611
610
X19
321
322
V3
Overtemperature
Buzzer Diode
X26
Electronic Control
Module Connector (J4)
A 755 E 643
B 915 F 759
C 966 G 757
D 930 H 963
X25
Electronic Control
Module Connector (J3)
A Plug D 532
B 128 E Plug
C 129 F 800
F4
Lights
Fuse
500
222
X20
F3
Switched
Power Fuse
540
400
X21
X24
Electronic Control
Module Connector (J1)
A 860 F 736
B 750 G Plug
C 745 H 730
D 850 J 820
E 840 K 740
X22
H5
Buzzer
523
321
625
110
150
128
120
129
131
130
140
135
Splice 6
Splice 7
310
311
320
322
X49
S3
Seat
Switch
539
820
X50
X52
X51
943
946
Y2, Y3, and Y4
Raise/Lower
Solenoids
940
543
541
542
Y5
Raise/Lower
Select
Solenoid
Y7
Deck Drive
Solenoid
533
950
544
960

MIF (MX14716)

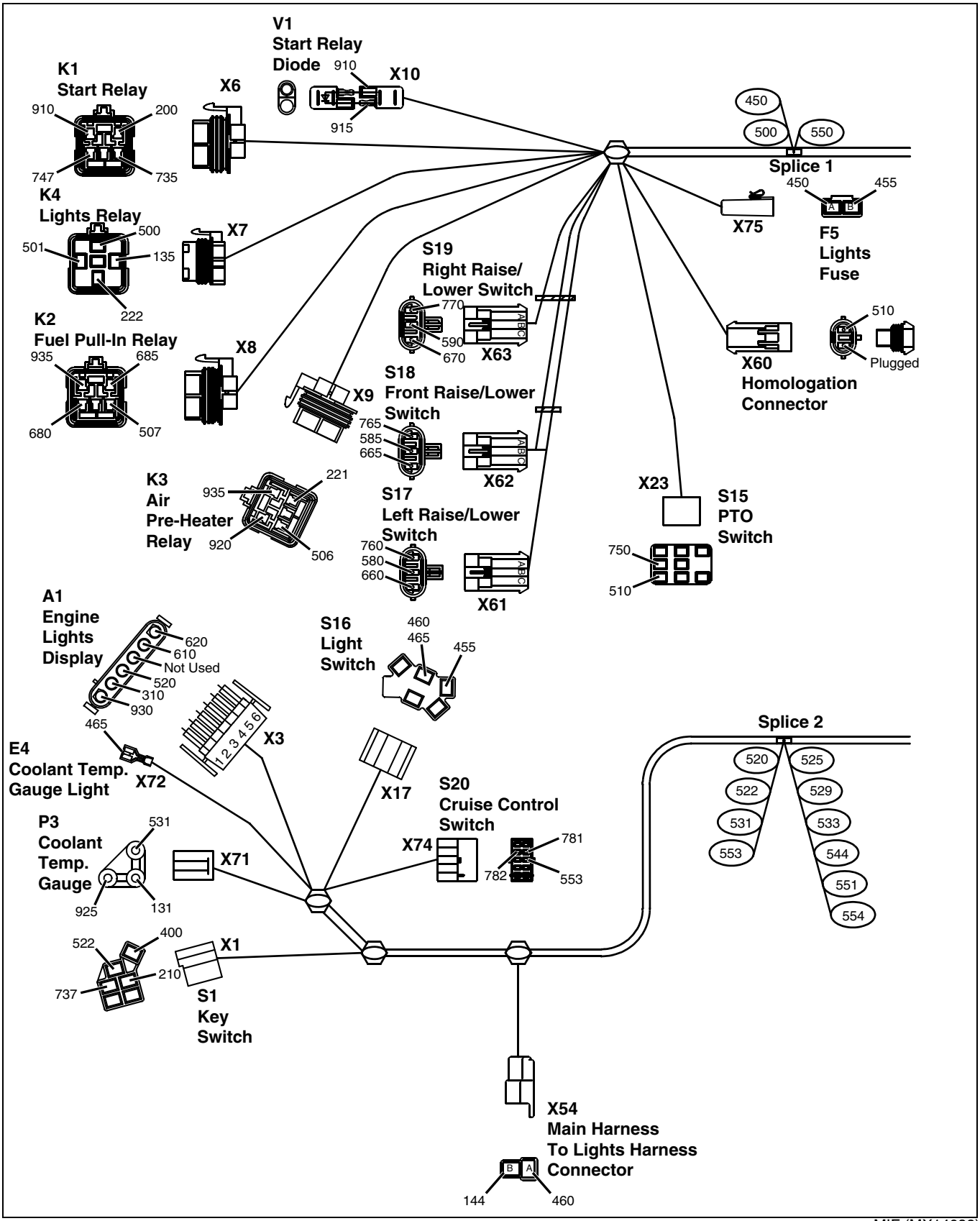

X27 Electronic Control Module Connector (J5)
A 943 E 935
B 320 F 960
C 940 G 950
D 946 H 931
X28 Electronic Control Module Connector (J2)
A Plug F 660
B Plug G 770
C 760 H 765
D 665 J Plug
E 670 K Plug
X29
X30
640
130
730
509
S2 Transaxle Switch
P1 Hour Meter
Splice 8
525
505
514
539
511
527
541
512
528
542
513
530
543
X48
511
S4 Neutral Switch
740
X47
S6 Right Angle Switch
512
139
850
S5 Left Angle Switch
138
860
513
X42
X46
(S)
900
B1 Fuel Gauge Sensor
111
X45
(-)
X44
Y6 Left Motor Solenoid
527
963
X43
Y8 Right Motor Solenoid
966
528

MIF (MX14717)

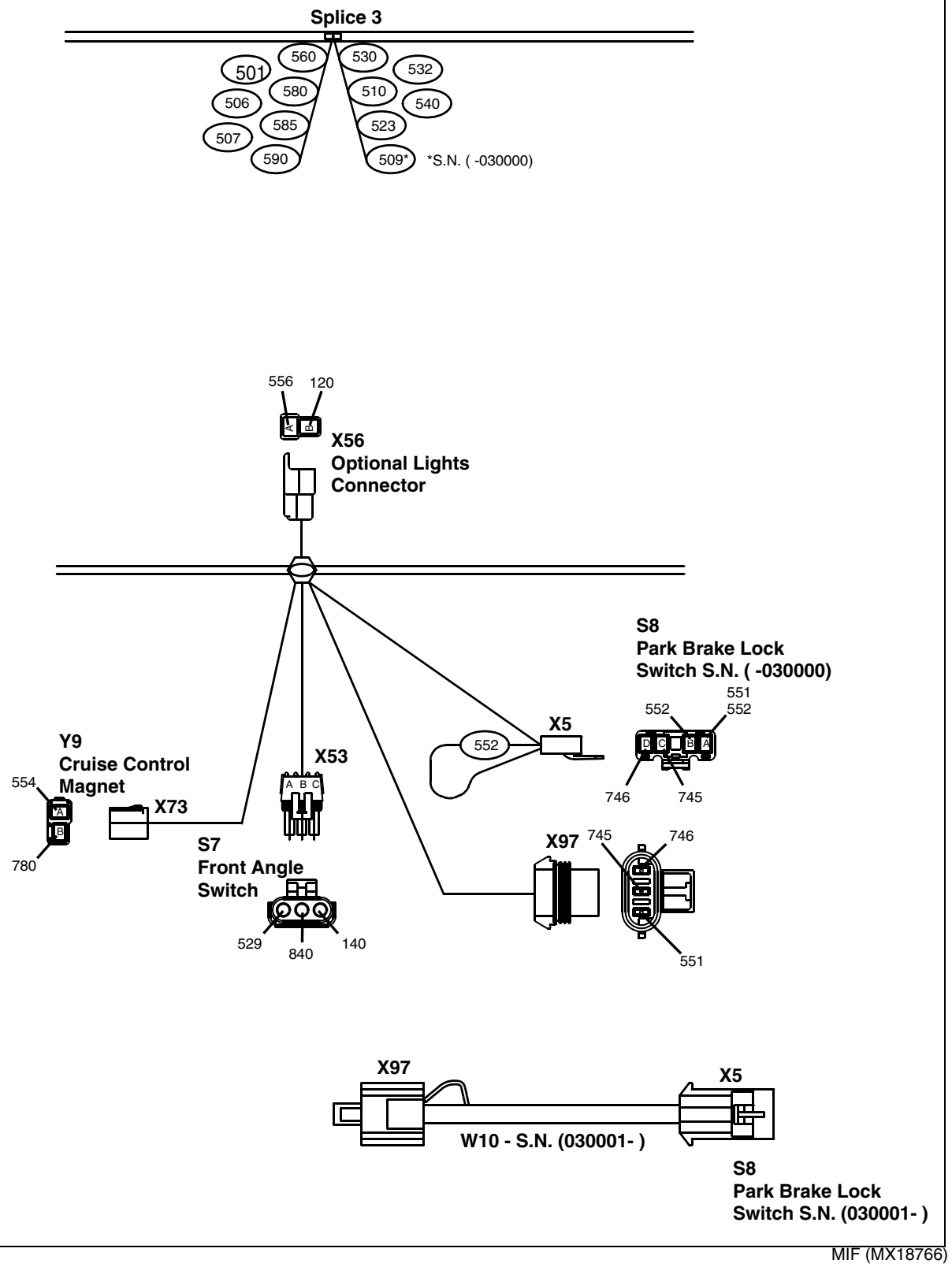

800
505
F2
Fusible
Link
M1
Starting
Motor (V+)
X32
F1
Fusible
Link
G2
Alternator
620
514
B4
Coolant
Temperature
Switch
X31
Hood
Switch
Connector
805
201
211
215
X33
Alternator
V+
X34
Alternator
Control
X35
B2
Air
Pre-Heater
X36
110
111
138
139
100
105
115
200
210
220
215
311
920
Splice 9
115
G2
Alternator
(Ground)
X37
W4
Harness
Ground
X41
100
X38
747
685
X67
M1
Starting Motor
(Solenoid Output)
611
X39
B3
Engine Oil
Pressure
Switch
M1
Starting
Motor
(Solenoid)
Y1
Fuel Shutoff
Solenoid
X40
105
645
680

MIF (MX14718)

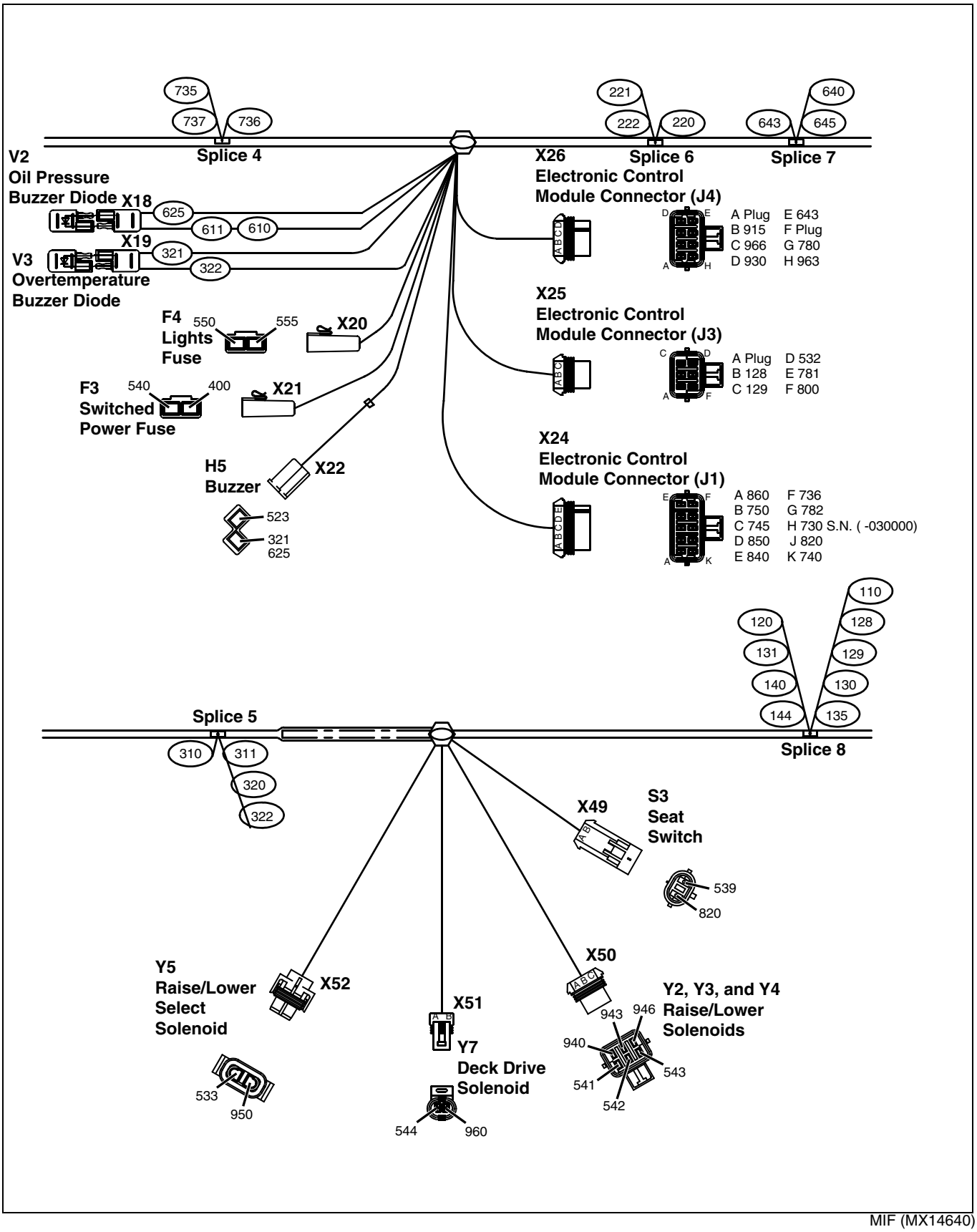
Main Wiring Harness (W1) - Model 1600 Turbo



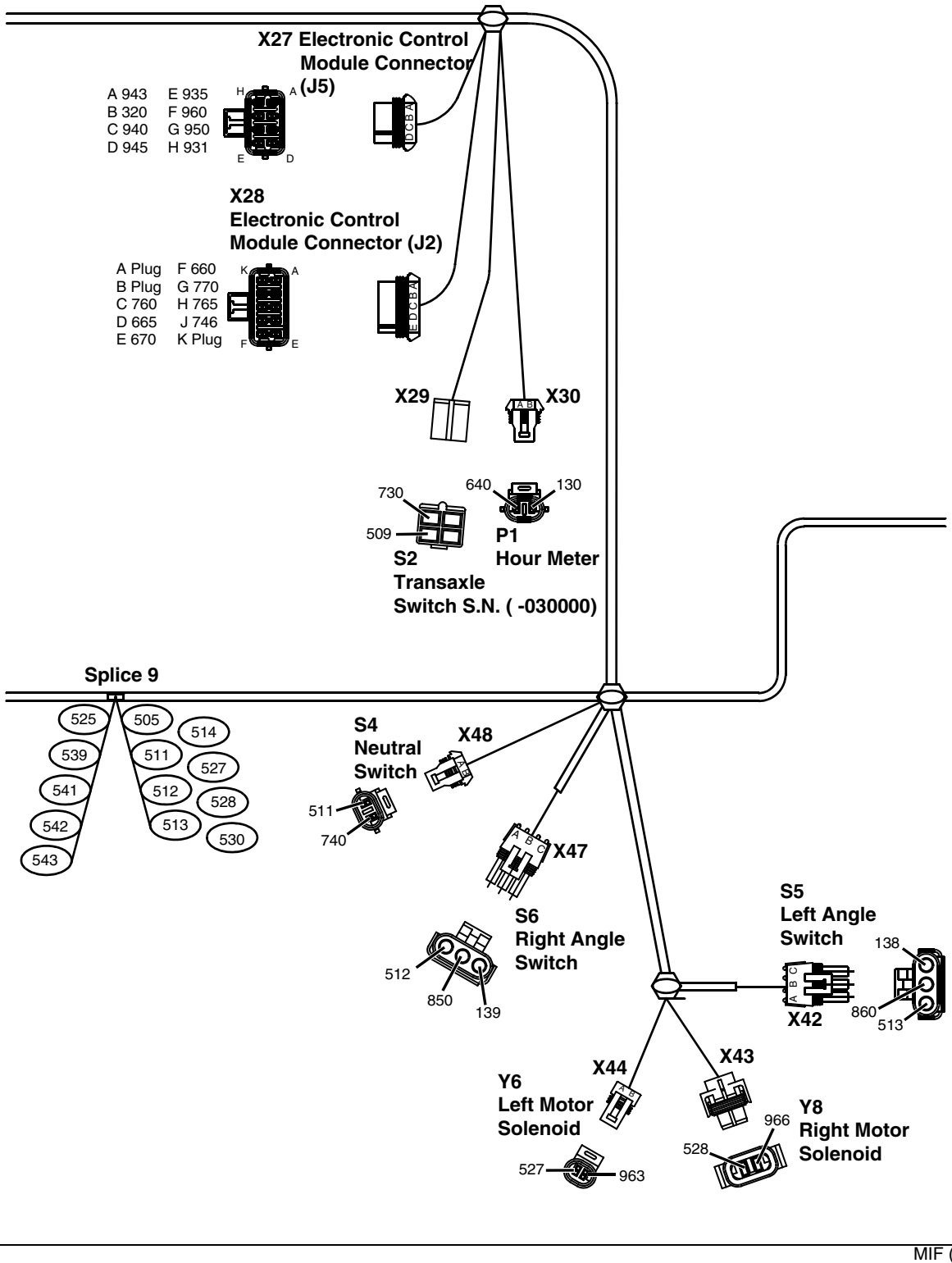
MIF (MX14638)


Splice 3
501
560
530
532
580
510
540
506
585
523
507
590
509*
*S.N. (-030000)
556
120
X56
Optional Lights
Connector
S8
Park Brake Lock
Switch S.N. (-030000)
551
552
552
X5
552
D C B A
746
745
Y9
Cruise Control
Magnet
554
A
B
780
X73
X53
A B C
S7
Front Angle
Switch
529
840
140
X97
745
746
551
X97
X5
W10 - S.N. (030001-)
S8
Park Brake Lock
Switch S.N. (030001-)

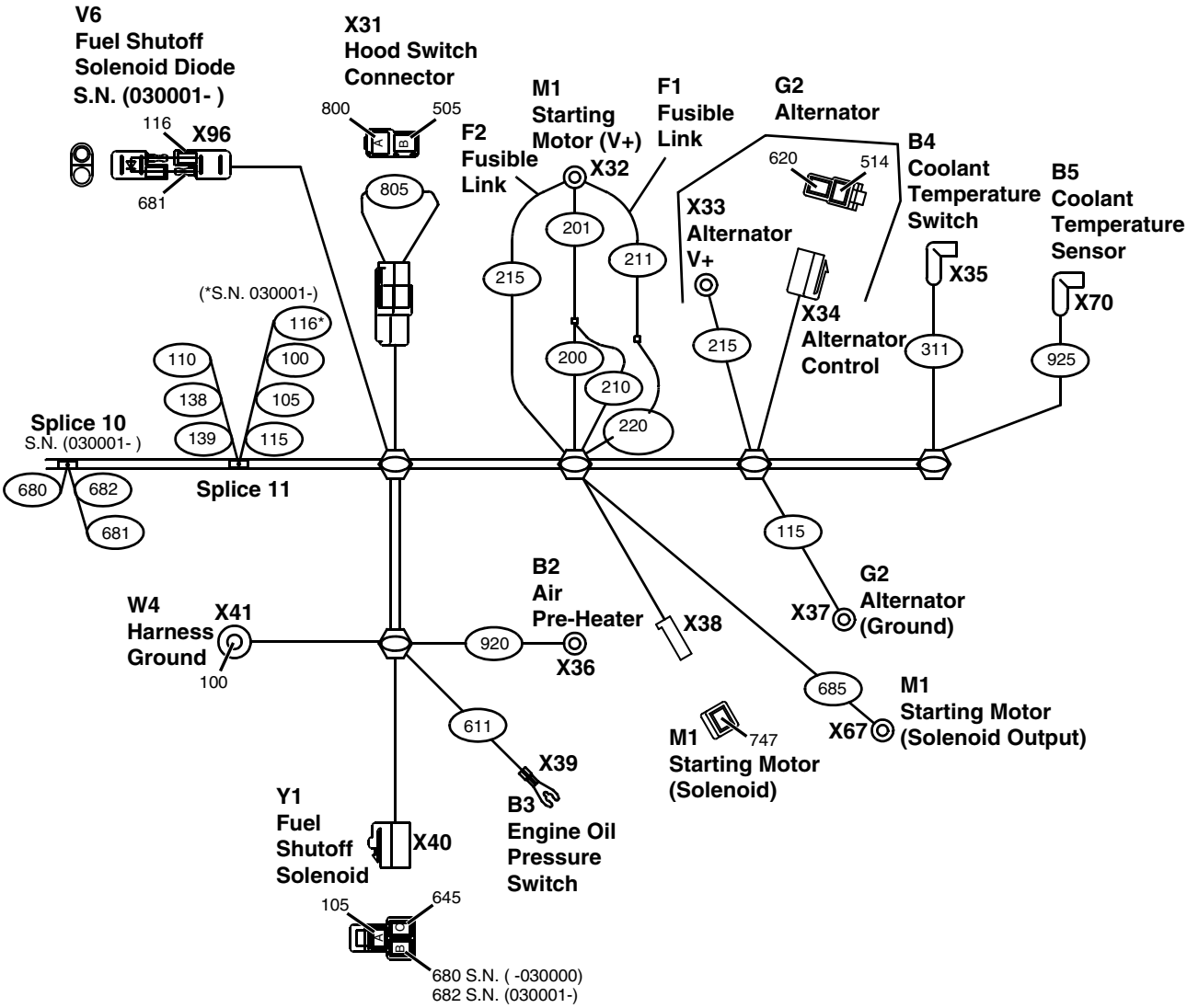
MIF (MX18766)


735
737
736
Splice 4
221
222
220
Splice 6
640
643
645
Splice 7
V2
Oil Pressure
Buzzer Diode
X18
625
611
610
X19
V3
Overtemperature
Buzzer Diode
321
322
X26
Electronic Control
Module Connector (J4)
A Plug E 643
B 915 F Plug
C 966 G 780
D 930 H 963
X25
Electronic Control
Module Connector (J3)
A Plug D 532
B 128 E 781
C 129 F 800
F4
Lights
Fuse
550
555
X20
F3
Switched
Power Fuse
540
400
X21
H5
Buzzer
X22
523
321
625
X24
Electronic Control
Module Connector (J1)
A 860 F 736
B 750 G 782
C 745 H 730 S.N. (-030000)
D 850 J 820
E 840 K 740
110
120
128
131
129
140
130
144
135
Splice 8
Splice 5
310
311
320
322
X49
S3
Seat
Switch
539
820
Y5
Raise/Lower
Select
Solenoid
X52
533
950
X51
Y7
Deck Drive
Solenoid
544
960
X50
Y2, Y3, and Y4
Raise/Lower
Solenoids
943
946
940
543
541
542

MIF (MX14640)

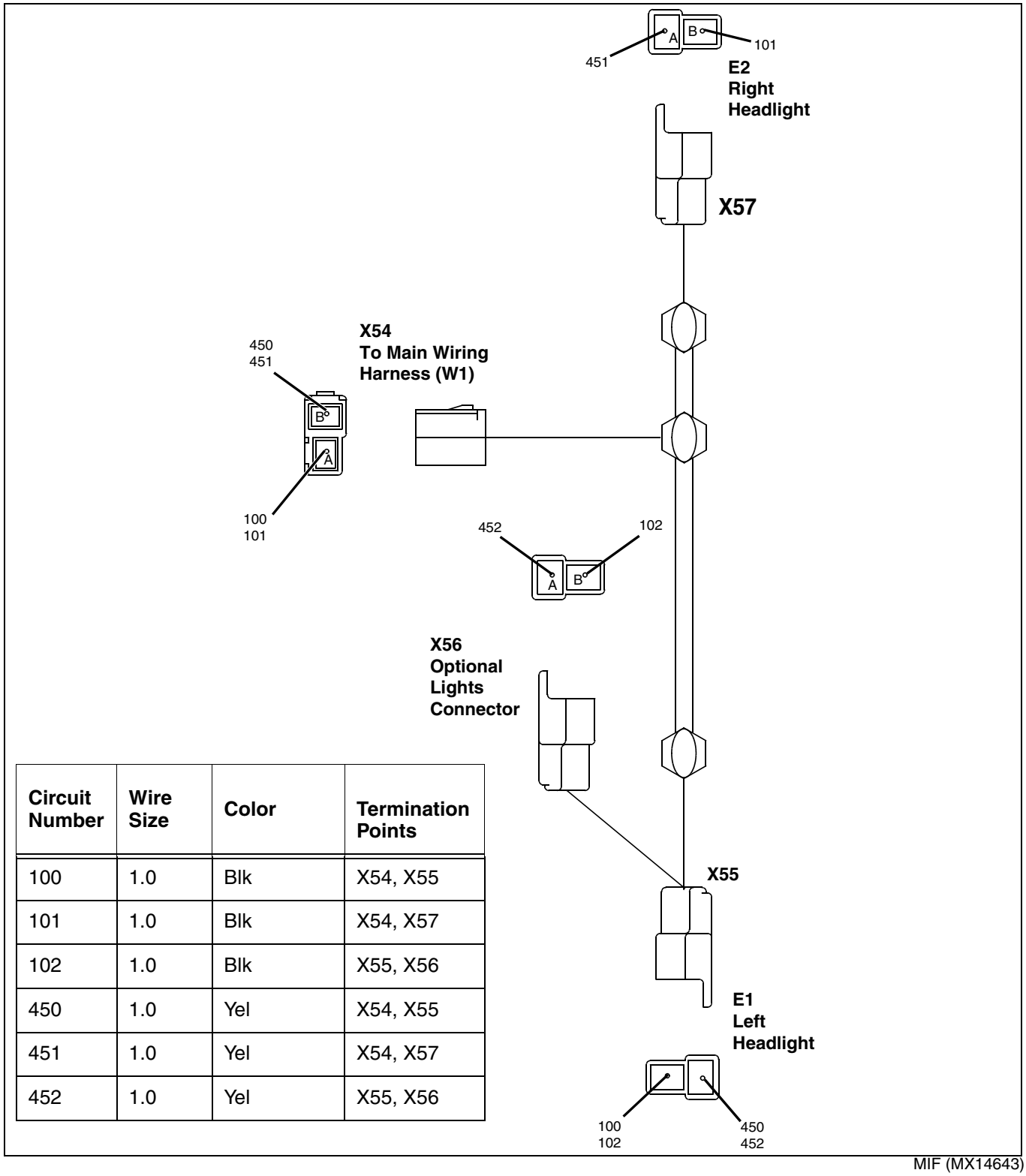

X27 Electronic Control Module Connector (J5)
A 943 E 935
B 320 F 960
C 940 G 950
D 945 H 931
X28 Electronic Control Module Connector (J2)
A Plug F 660
B Plug G 770
C 760 H 765
D 665 J 746
E 670 K Plug
X29
X30
730
509
640
130
S2 Transaxle Switch S.N. (-030000)
P1 Hour Meter
Splice 9
525
539
541
542
543
505
511
512
513
514
527
528
530
S4 Neutral Switch
X48
511
740
X47
S6 Right Angle Switch
512
850
139
S5 Left Angle Switch
138
860
513
X42
X44
X43
Y6 Left Motor Solenoid
527
963
966
528
Y8 Right Motor Solenoid

MIF (MX14641)


V6
Fuel Shutoff
Solenoid Diode
S.N. (030001-)
116
X96
681
X31
Hood Switch
Connector
800
505
805
F2
Fusible
Link
M1
Starting
Motor (V+)
X32
F1
Fusible
Link
G2
Alternator
620
514
B4
Coolant
Temperature
Switch
B5
Coolant
Temperature
Sensor
X35
X70
X33
Alternator
V+
X34
Alternator
Control
201
211
215
215
200
210
220
311
925
(*S.N. 030001-)
116*
100
105
115
110
138
139
Splice 10
S.N. (030001-)
Splice 11
680
682
681
115
B2
Air
Pre-Heater
X38
G2
Alternator
(Ground)
X37
W4
Harness
Ground
X41
100
920
X36
685
M1
Starting Motor
(Solenoid Output)
X67
M1
Starting Motor
(Solenoid)
747
611
X39
B3
Engine Oil
Pressure
Switch
Y1
Fuel
Shutoff
Solenoid
X40
105
645
680 S.N. (-030000)
682 S.N. (030001-)

MIF (MX18769)

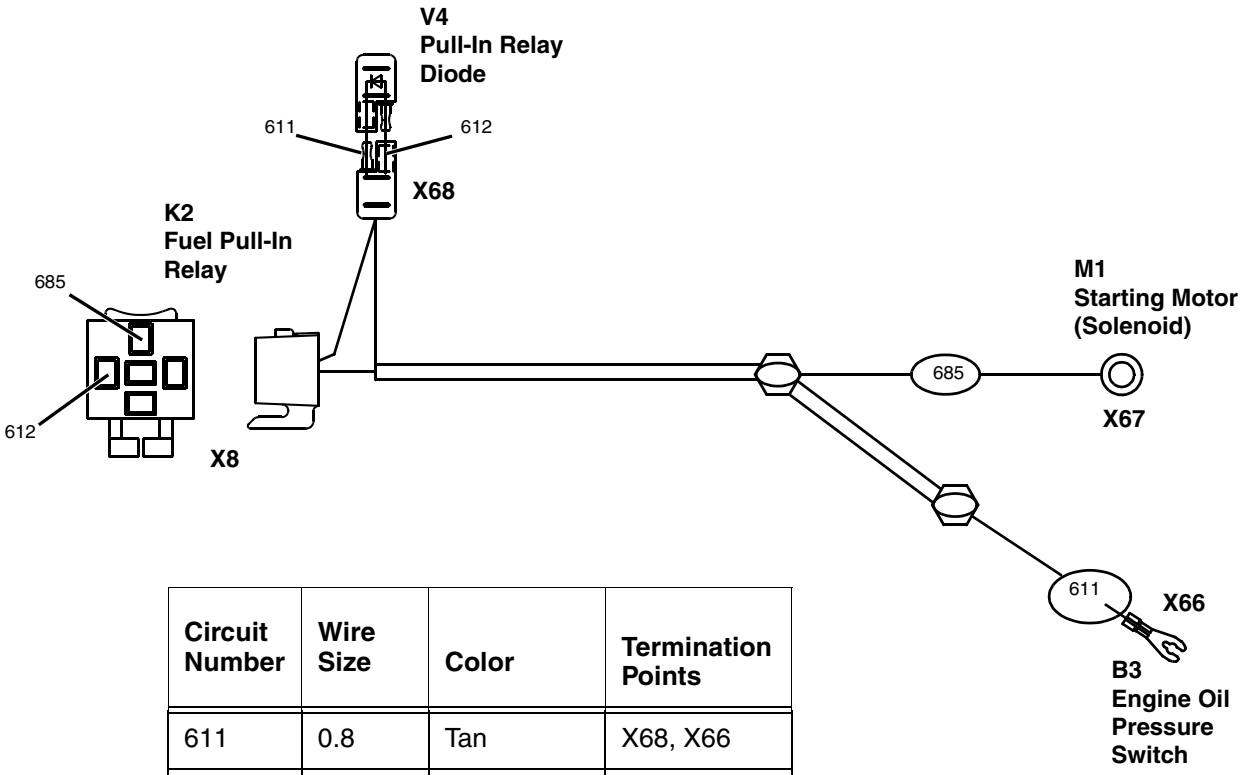
Lights Wiring Harness (W2) - Models 1600 and 1620



Circuit Number	Wire Size	Color	Termination Points
100	1.0	Blk	X54, X55
101	1.0	Blk	X54, X57
102	1.0	Blk	X55, X56
450	1.0	Yel	X54, X55
451	1.0	Yel	X54, X57
452	1.0	Yel	X55, X56

MIF (MX14643)

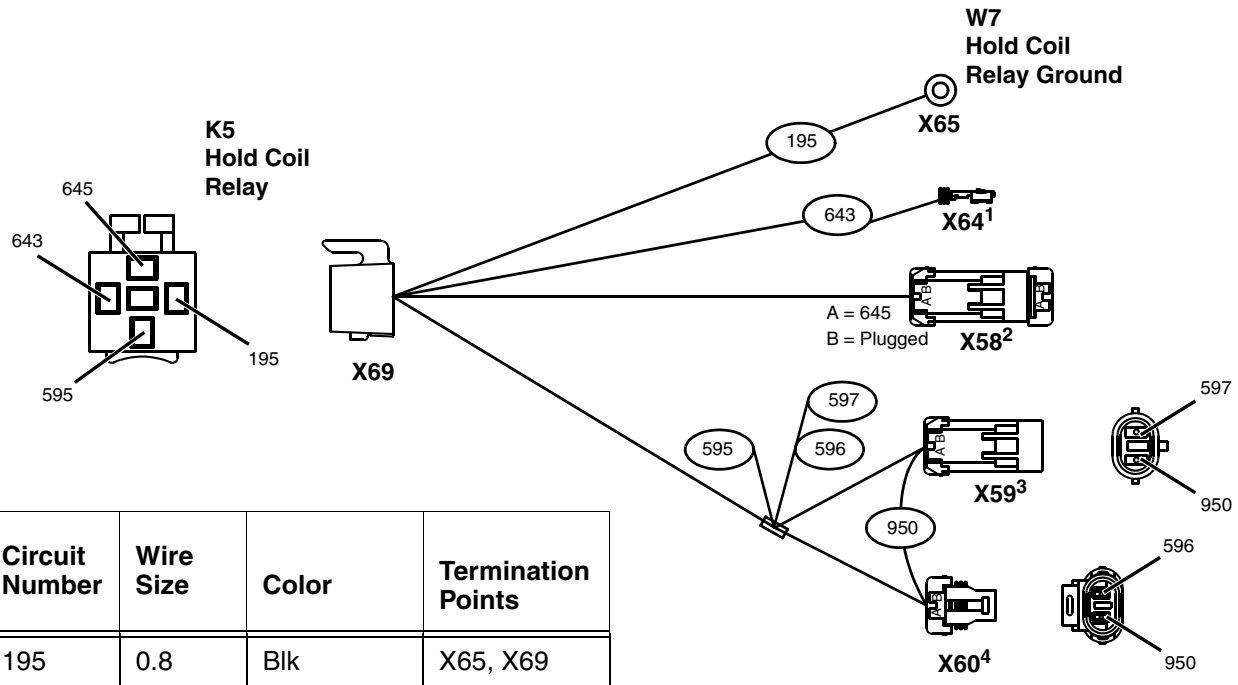
Pull-In Relay Coil Wiring Harness (W5) - Models 1600 and 1620 S.N. (010001-020000) (Installed in MPTC10114)



Circuit Number	Wire Size	Color	Termination Points
611	0.8	Tan	X68, X66
612	0.8	Blk	X8, X68
685	3.0	Wht	X8, X67

MIF

Hold Coil Relay Harness (W6) - Models 1600 and 1620 S.N. (010001-020000) and (020001-) (Installed in MPTC10114)



Circuit Number	Wire Size	Color	Termination Points
195	0.8	Blk	X65, X69
595	0.8	Yel	X69, 596 Yel
596	0.8	Yel	X60, 595 Yel
597	0.8	Yel	X59, 595 Yel
643	0.8	Pnk	X64, X69
645	0.8	Pnk	X58, X69
950	0.8	Wht	X59, X60

[1]This terminal is inserted in electronic control module connector X26.
[2]S.N. (010000-020000) Pink wire No. 643 (W1) is removed from electronic control module connector X26 and inserted into female half of this connector. S.N. (020001-) The male half of this connector is connected to homologation connector X58 on main wiring harness (W1).
[3]S.N. (010000-020000) This connector is connected to right lift switch (S11). S.N. (020001-) This connector is connected to X60.
[4]S.N. (010000-020000) This connector is connected to right lift switch connector (X16). S.N. (020001-) This connector is connected to X59.

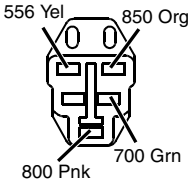
MIF

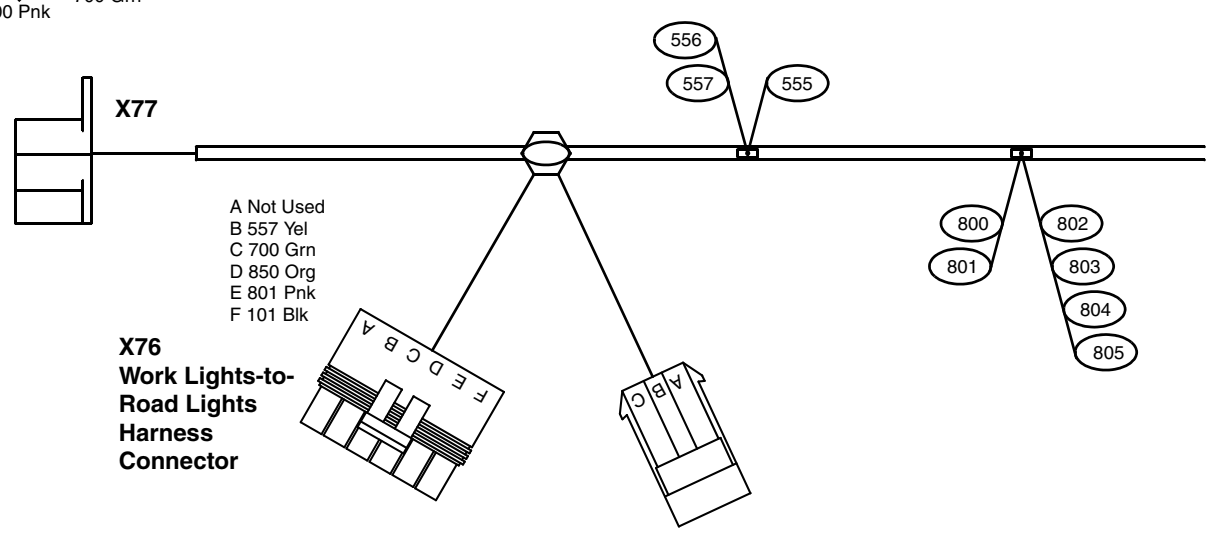
Optional Work Lights Harness (W8) - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo

Circuit Number	Wire Size	Color	Termination Points
100	3.0	Blk	X56, 101 Blk
101	3.0	Blk	X76, 100 Blk
102	1.0	Blk	E8, 100 Blk
103	1.0	Blk	E7, 100 Blk
104	1.0	Blk	E6, 100 Blk
105	1.0	Blk	E5, 100 Blk

Circuit Number	Wire Size	Color	Termination Points
110	1.0	Blk	X17, X17
555	3.0	Yel	X56, 556 Yel
556	3.0	Yel	S21, 555 Yel
557	3.0	Yel	X76, 555 Yel
700	2.0	Grn	S21, X76
800	2.0	Pnk	S21, 801 Pnk

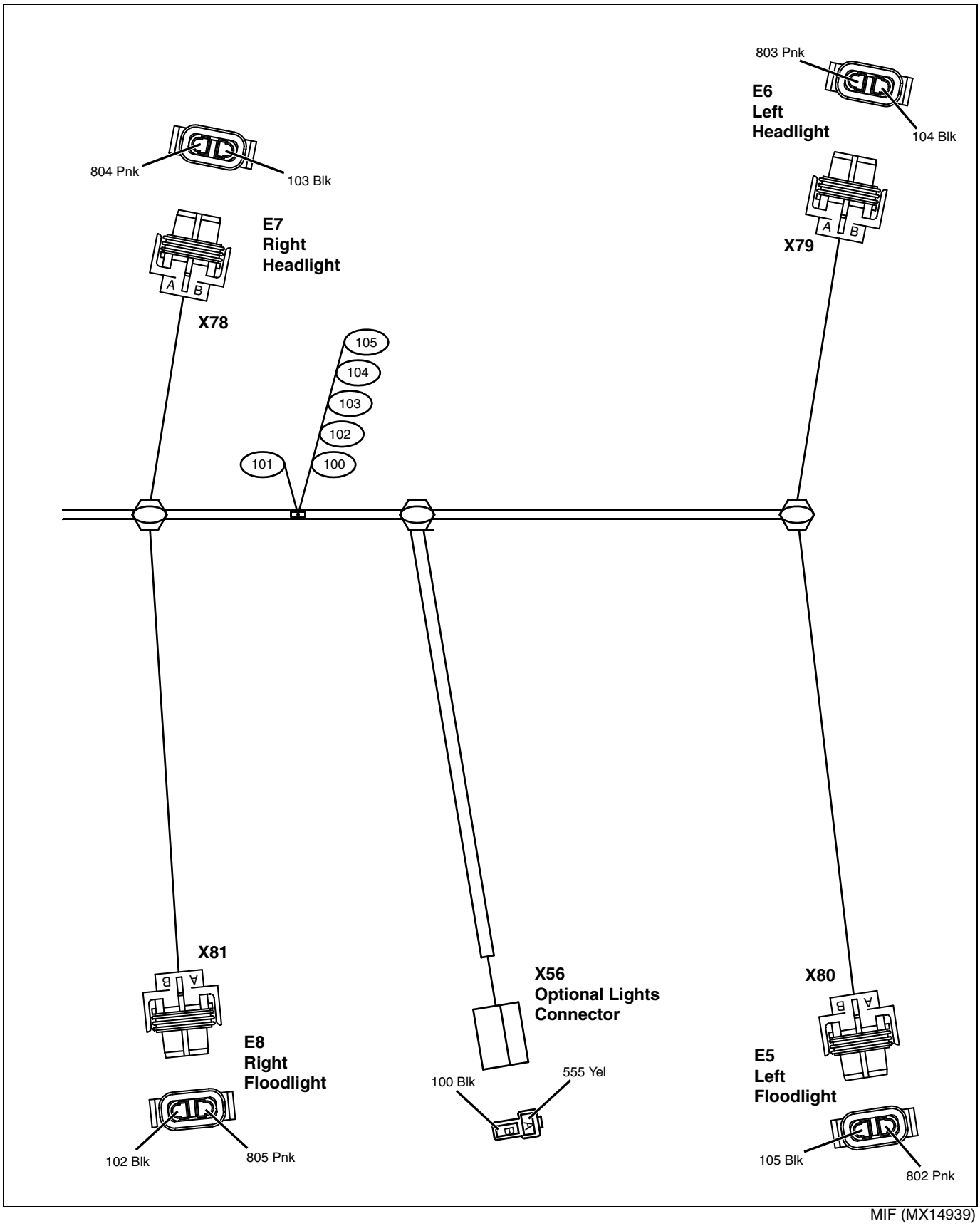
S21 Optional Lights Switch





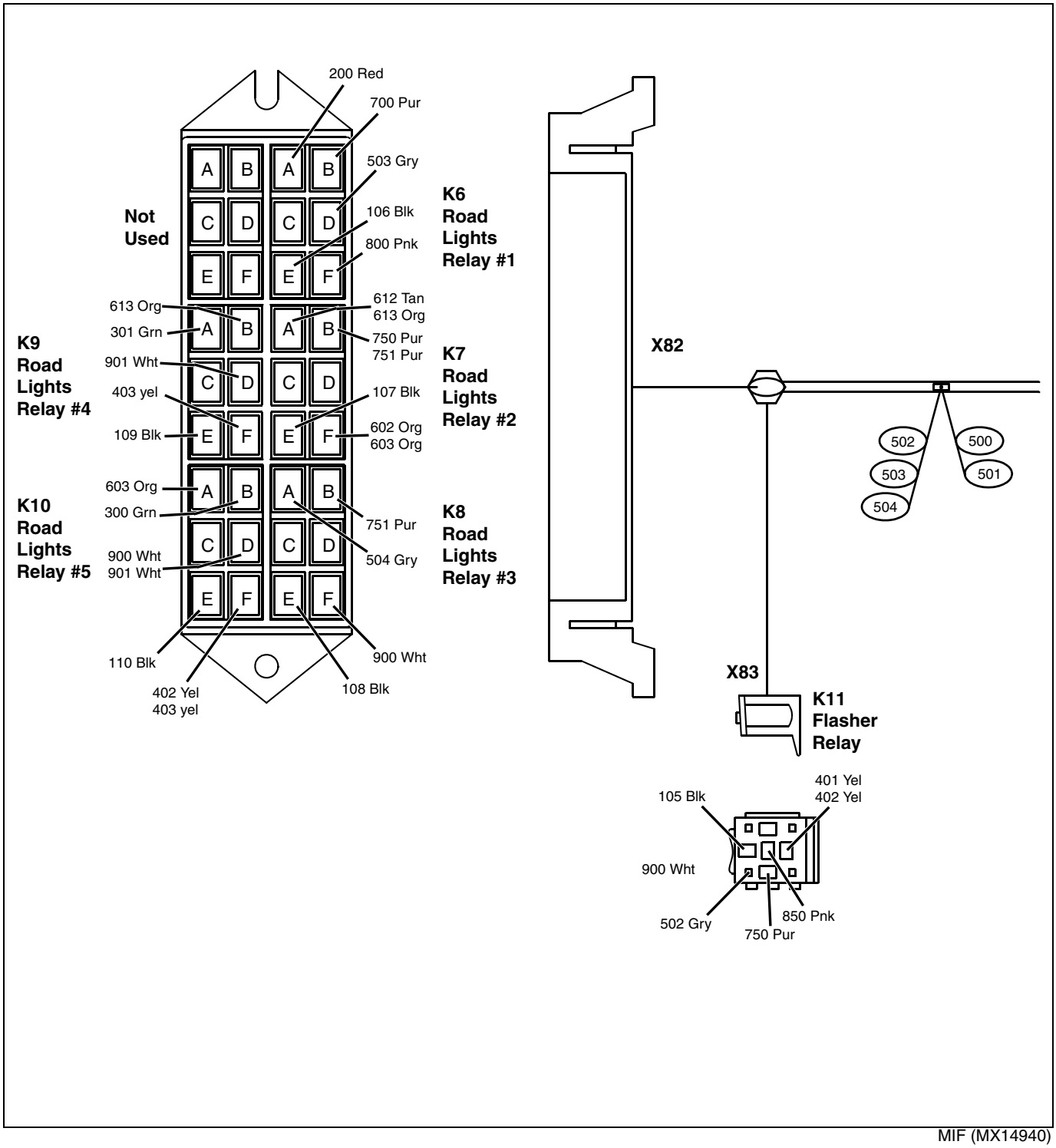
Circuit Number	Wire Size	Color	Termination Points
801	2.0	Pnk	X76, 800 Pnk
802	1.0	Pnk	E5, 800 Pnk
803	1.0	Pnk	E6, 800 Pnk
804	1.0	Pnk	E7, 800 Pnk
805	1.0	Pnk	E8, 800 Pnk
850	2.0	Org	S21, X76

MIF (MX14938)

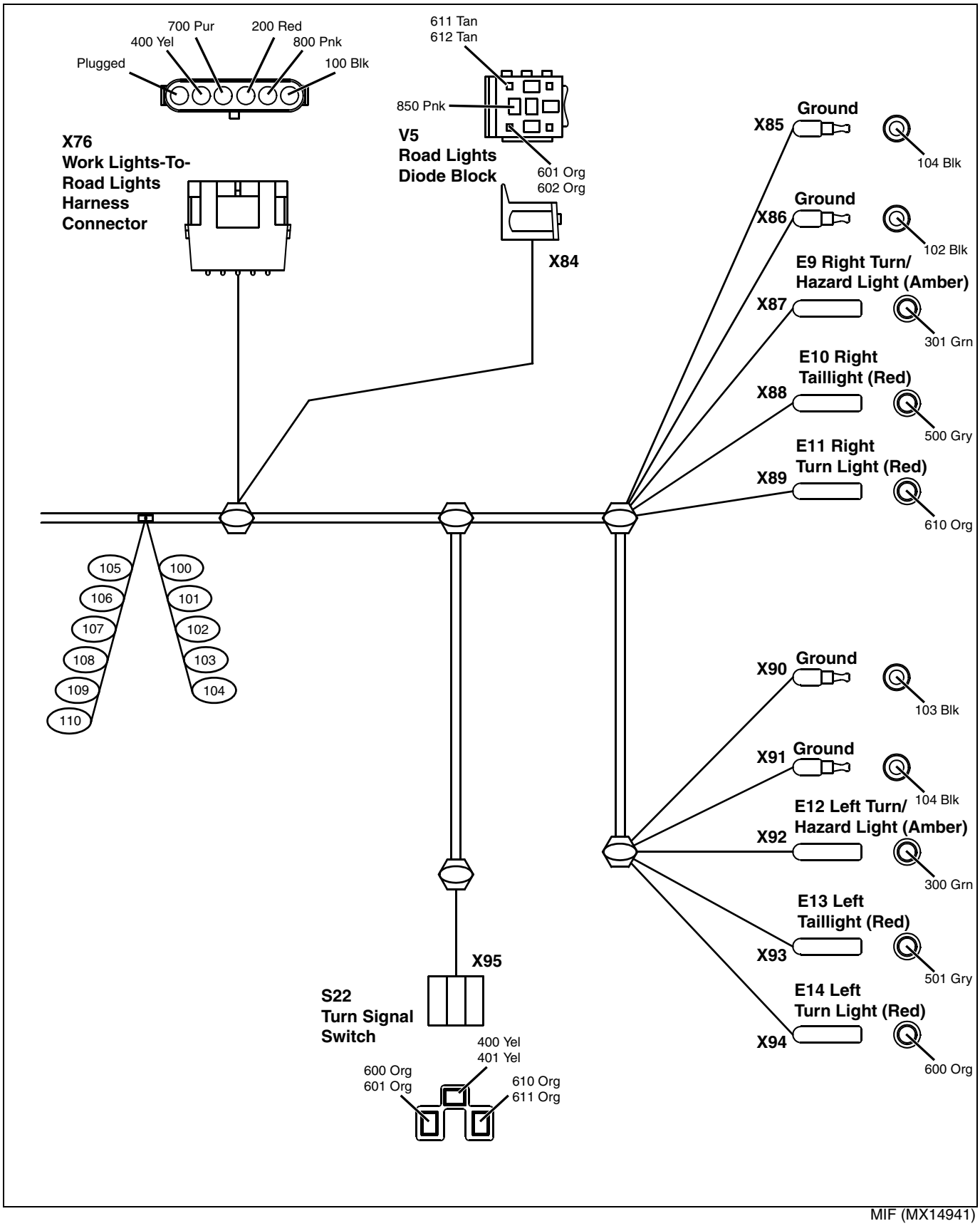

803 Pnk
E6
Left
Headlight
104 Blk
804 Pnk
103 Blk
E7
Right
Headlight
X78
X79
105
104
103
102
101
100
X81
E8
Right
Floodlight
X56
Optional Lights
Connector
X80
E5
Left
Floodlight
100 Blk
555 Yel
102 Blk
805 Pnk
105 Blk
802 Pnk

MIF (MX14939)

Optional Road Lights Wiring Harness (W9) - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo



MIF (MX14940)


700 Pur
200 Red
400 Yel
800 Pnk
Plugged
100 Blk
X76
Work Lights-To-
Road Lights
Harness
Connector
611 Tan
612 Tan
850 Pnk
V5
Road Lights
Diode Block
601 Org
602 Org
X84
X85
Ground
104 Blk
X86
Ground
102 Blk
E9 Right Turn/
Hazard Light (Amber)
X87
301 Grn
E10 Right
Taillight (Red)
X88
500 Gry
E11 Right
Turn Light (Red)
X89
610 Org
105
106
107
108
109
110
100
101
102
103
104
X90
Ground
103 Blk
X91
Ground
104 Blk
E12 Left Turn/
Hazard Light (Amber)
X92
300 Grn
E13 Left
Taillight (Red)
X93
501 Gry
E14 Left
Turn Light (Red)
X94
600 Org
X95
S22
Turn Signal
Switch
400 Yel
401 Yel
600 Org
601 Org
610 Org
611 Org

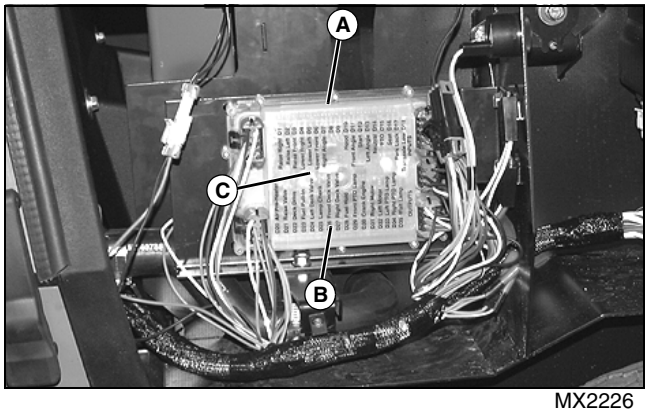
MIF (MX14941)

Optional Road Lights Wiring Harness (W9) - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo Wire Code Table

Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	X76, 101 Blk
101	0.8	Blk	X85, 100 Blk
102	0.8	Blk	X86, 100 Blk
103	0.8	Blk	X90, 100 Blk
104	0.8	Blk	X91, 100 Blk
105	0.8	Blk	K11, 100 Blk
106	0.8	Blk	K6, 100 Blk
107	0.8	Blk	K7, 100 Blk
108	0.8	Blk	K8, 100 Blk
109	0.8	Blk	K9, 100 Blk
110	0.8	Blk	K10, 100 Blk
200	0.8	Red	K6, X76
300	0.8	Grn	K10, E12
301	0.8	Grn	K9, E9
400	2.0	Yel	S22, X76
401	0.8	Yel	K11, S22
402	0.8	Yel	K11, K10
403	0.8	Yel	K9, K10
500	0.8	Gry	E10, 501 Gry
501	0.8	Gry	E13, 500 Gry
502	0.8	Gry	K11, 500 Gry
503	0.8	Gry	K6, 500 Gry
504	0.8	Gry	K8, 500 Gry
600	0.8	Org	E14, S22
601	0.8	Org	S22, V5
602	0.8	Org	K7, V5
603	0.8	Org	K7, K10
610	0.8	Org	E11, S22
611	0.8	Tan	S22, V5
612	0.8	Tan	K7, V5
613	0.8	Org	K7, K9
700	0.8	Pur	K6, X76
750	0.8	Pur	K7, K11
751	0.8	Pur	K7, K8
800	0.8	Pnk	K6, X76
850	0.8	Pnk	K11, V5
900	0.8	Wht	K8, K10
901	0.8	Wht	K9, K10

Circuit Operation and Diagnosis

Electronic Control Module Operation



MX2226

Picture Note: Models 1600/1620 S.N. (-020000) Shown

The 1600 Wide Area Mower is equipped with an electronic control module. The module controls and monitors all safety interlock functions and the engine air pre-heater function.

The electronic control module features input LEDs (A), output LEDs (B), and status LED (C) to aid in electrical circuit diagnosis.

The input LEDs will light whenever a function switch has been activated. This will indicate that the input circuit is functioning properly.

The output LEDs, when lit, indicate that the control module circuitry for that particular function is operating properly.

If all circuits are OK, the status LED will flash at a steady rate called the “heartbeat”. Because if this, the status LED is also known as the “heartbeat” LED. The heartbeat pattern is 130 milliseconds ON and 830 milliseconds OFF.

If the control module detects a harness malfunction, the status LED will flash a specific pattern to indicate one of several diagnostic codes. The flash pattern is 280 milliseconds ON and 280 milliseconds OFF for a given digit. There is a 1-second OFF delay between digits and a 2-second OFF delay before the code is repeated.

- For diagnostic codes caused by the operator, See “Safety Interlock Diagnostic Codes” on page 209.
- For diagnostic codes most likely caused by a system malfunction on an input circuit, See “Electronic Control Module Input Circuits Diagnostic Codes” on page 209.
- For diagnostic codes caused by a system malfunction on an output circuit, See “Electronic Control Module Output Circuits Diagnostic Codes” on page 210.

Safety Interlock Diagnostic Codes

The Sit On Seat (SOS) diagnostic feature alerts the operator when an attempt is made to start the machine when one or more safety interlock switches are not in the correct position for starting.

The following diagnostic codes are displayed by the flashing of the status LED on the electronic control module and the pre-heat wait lamp on the instrument cluster.

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

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

- **Code 1-2** (One pulse followed by a short pause followed by two pulses.) Indicates that the park brake switch is not activated and/or the seat switch is not activated (operator not on seat) during an attempted start.
- **Code 1-3** (One pulse followed by a short pause followed by three pulses.) Indicates that the PTO switch is in the ON position during an attempted start.
- **Code 2-1** (Models 1600/1620 with early controllers only) (Two pulses followed by a short pause followed by one pulse.) Indicates that the FORWARD/REVERSE pedals are not in the NEUTRAL position during an attempted start.
- **Code 2-3** (Two pulses followed by a short pause followed by three pulses.) Indicates that the hood switch is not activated (European machines) or jumper wire is missing from hood switch connector (North American machines).

Electronic Control Module Input Circuits Diagnostic Codes

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

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

- **3-1** (Three pulses followed by a short pause followed by one pulse.) Indicates an over-voltage condition (voltage input to control box over 18 volts). This could also be caused by attempting to jump start the machine with a 24-volt power source.

NOTE: When the following diagnostic codes are displayed, no output LEDs will be lit.

Circuits connected to the output connector of the control module operate by switching the ground side of the circuit.

- **Code 3-2** (Three pulses followed by a short pause followed by two pulses.) Indicates a wiring harness failure. Proceed to See “Electronic Control Module Checks” on page 213.

- **Code 3-3** (Three pulses followed by a short pause followed by three pulses.) Indicates an output short to positive 12 volts on one or more of the following circuits (see individual circuit diagnosis for diagnostic procedures):
  - Mower Deck Raise/Lower Circuit
  - Crank Engine Circuit
  - Discharge Light (Charging) Circuit
  - Air Pre-Heater Circuit
  - Mow Valve Circuit
- **Code 3-4** (Three pulses followed by a short pause followed by four pulses.) Indicates the fuel hold output shorted to ground or wired to pull-in coil.
- **Code 3-5** (Three pulses followed by a short pause followed by five pulses.) Indicates control module missing ground connection.

NOTE: On Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed, moving the key switch from STOP to START too quickly, can result in code 3-8 being displayed.

If the codes cannot be cleared, report the code to Deere service.

- **Code 3-6** (Three pulses followed by a short pause followed by six pulses.) Indicates control module is missing supply voltage.
- **Code 3-7** (Three pulses followed by a short pause followed by seven pulses.) Indicates control module has an internal over-temperature condition.

Electronic Control Module Output Circuits Diagnostic Codes

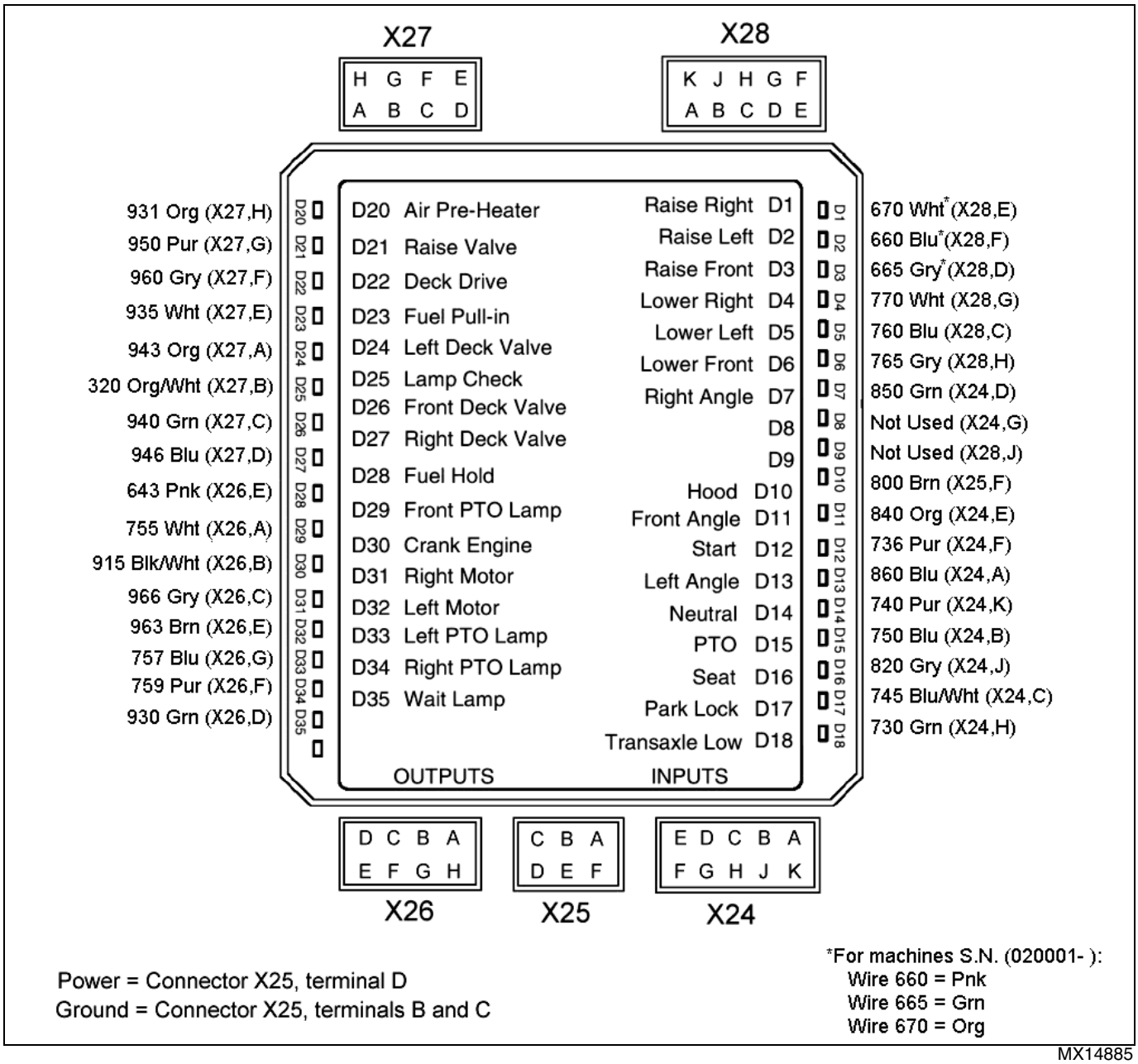
- **Code 4-1** (Models 1600/1620 with early controllers only) (Four pulses followed by a short pause followed by one pulse.) Indicates a malfunctioning front PTO lamp circuit.
- **Code 4-2** (Four pulses followed by a short pause followed by two pulses.) Indicates a malfunctioning start relay circuit.
- **Code 4-3** (Four pulses followed by a short pause followed by three pulses.) Indicates a malfunctioning right motor solenoid circuit.
- **Code 4-4** (Four pulses followed by a short pause followed by four pulses.) Indicates a malfunctioning air pre-heater lamp circuit.
- **Code 4-5** (Four pulses followed by a short pause followed by five pulses.) Indicates a malfunctioning fuel hold circuit.
- **Code 4-6** (Models 1600/1620 with early controllers only) (Four pulses followed by a short pause followed by six pulses.) Indicates a malfunctioning right PTO lamp circuit.
- **Code 4-7** (Four pulses followed by a short pause followed by seven pulses.) Models 1600/1620 with early controllers: Indicates a malfunctioning left PTO lamp circuit. Model 1600 Turbo: Indicates a malfunctioning cruise control magnet circuit.
- **Code 4-8** (Four pulses followed by a short pause followed by eight pulses.) Indicates a malfunctioning left motor solenoid circuit.
- **Code 5-1** (Five pulses followed by a short pause followed by one pulse.) Indicates a malfunctioning left raise/lower solenoid circuit.
- **Code 5-2** (Five pulses followed by a short pause followed by two pulses.) Indicates a malfunctioning lamp test circuit.
- **Code 5-3** (Five pulses followed by a short pause followed by three pulses.) Indicates a malfunctioning front raise/lower solenoid circuit.
- **Code 5-4** (Five pulses followed by a short pause followed by four pulses.) Indicates a malfunctioning right raise/lower solenoid circuit.
- **Code 5-5** (Five pulses followed by a short pause followed by five pulses.) Indicates a malfunctioning fuel pull-in relay circuit.
- **Code 5-6** (Five pulses followed by a short pause followed by six pulses.) Indicates a malfunctioning deck drive solenoid circuit.
- **Code 5-7** (Five pulses followed by a short pause followed by seven pulses.) Indicates a malfunctioning raise/lower select solenoid circuit.
- **Code 5-8** (Five pulses followed by a short pause followed by eight pulses.) Indicates a malfunctioning air pre-heater relay circuit.

Engine Air Pre-Heater Function

The electronic control module incorporates an internal thermistor to monitor ambient air temperature. When the key switch is moved to the START position, the control module turns on the air pre-heater to aid engine starting.

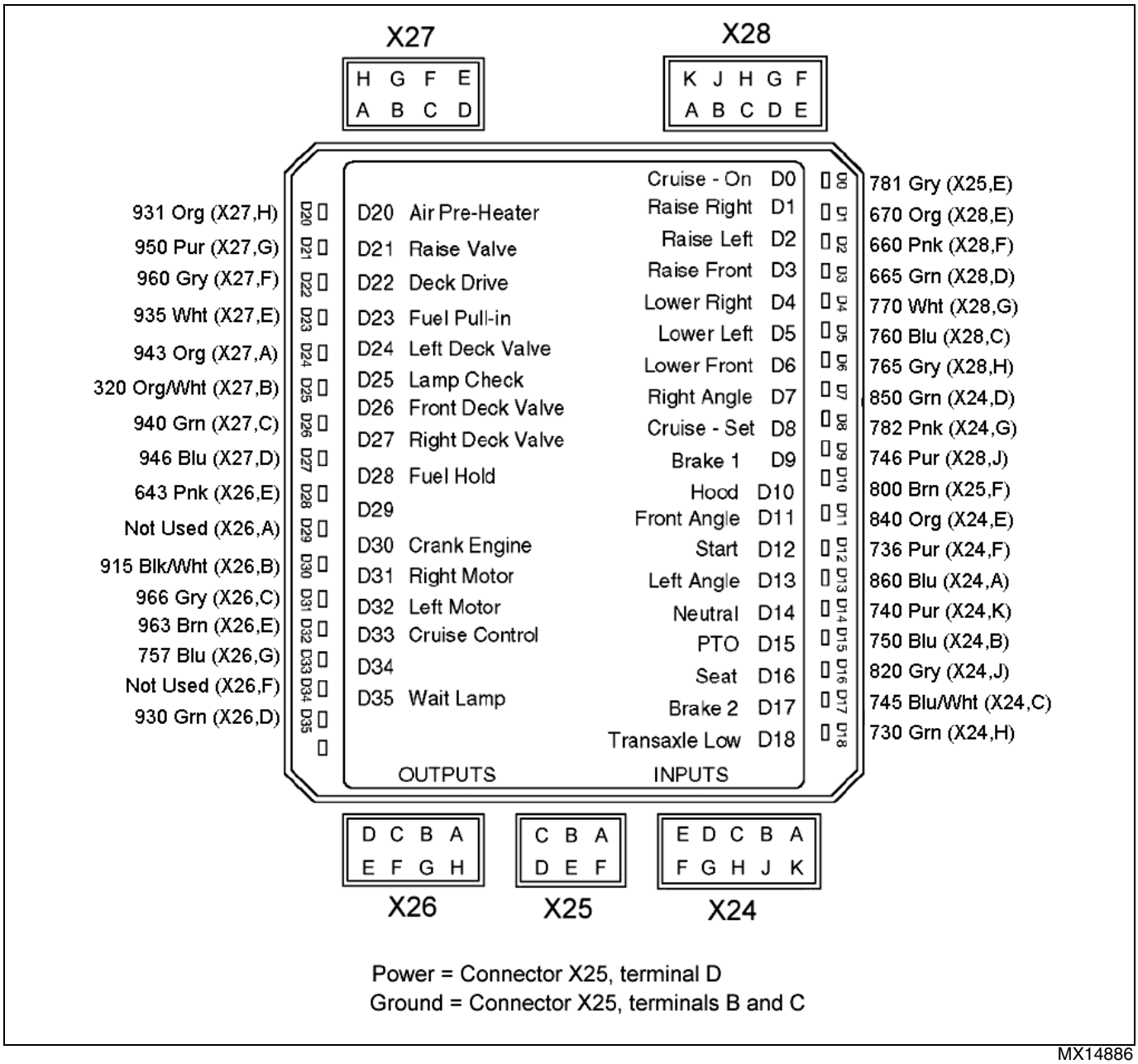
After the air pre-heater has reached the correct operating temperature, the pre-heat wait lamp will go off and the control module will enable the start circuit. The control module will keep the air pre-heater active for up to 45 seconds to help minimize white smoke during the first few seconds of operation. The amount of time that the air pre-heater stays on will vary with the ambient air temperature.

Electronic Control Module Input and Output Identification - Models 1600 and 1620



MX14885

Electronic Control Module Input and Output Identification - Model 1600 Turbo



MX14886

Electronic Control Module Circuits Diagnosis

Diagnostics of the electronic control module and its common circuits is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

The multi-step process is as follows:

1. See “Electronic Control Module Checks” on page 213.
2. See “Electronic Control Module Input LEDs and Common Circuits Checks” on page 214.
3. See “Electronic Control Module Circuit Tests” on page 217.

NOTE: It is important that all steps be performed in the sequence shown.

Electronic Control Module Checks

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

Conditions

- Machine parked on a level surface.
- Cutting units lowered to the ground.

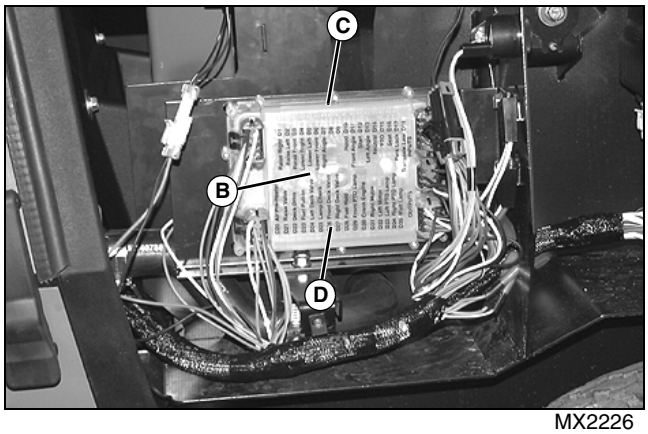
Procedure



MX2225

Picture Note: Models 1600/1620 S.N. (-020000) Shown

1. Remove access panel (A).
2. Turn key switch to RUN position.



MX2226

Picture Note: Models 1600/1620 S.N. (-020000) Shown

3. Check the status LED (B), input LEDs (C), and output LEDs (D).

Normal

- Status LED (B) flashing in a regular, even rate (about once per second).
- Input LED(s) (C) corresponding to activated switch(es) lit.

NOTE: It is normal for the output LEDs to flicker. This is a function of the self-diagnostic feature.

- Output LED(s) (D) corresponding to active component(s) lit.

Not Normal

- If the status LED and input/output LEDs are not lit, check main fuse (F3). If fuse is good, check current supply to the control module.

NOTE: For description of the service codes, See "Electronic Control Module Operation" on page 209.

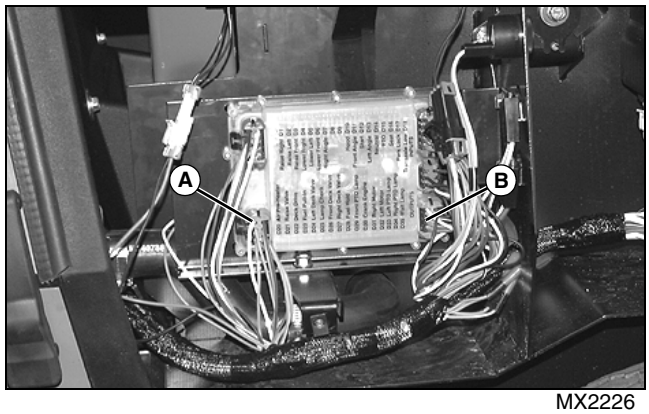
- The status LED may flash one of the following diagnostic codes:

SOS	Inputs	Outputs	
1-2	3-1	4-1[a]	5-1
1-3	3-2	4-2	5-2
2-1[a]	3-3	4-3	5-3
2-3	3-4	4-4	5-4
	3-5	4-5	5-5
	3-6	4-6[a]	5-6
	3-7	4-7	5-7
	3-8	4-8	5-8

a. Not used on Model 1600 Turbo or Models 1600/1620 with early controllers.

Control Module Check

1. Turn key switch to STOP position.



MX2226

Picture Note: Models 1600/1620 S.N. (-020000) Shown

2. Disconnect output connectors X27 (A) and X26 (B).

3. Turn key switch to RUN position.

Normal

- Status LED is flashing at a regular, even rate. This indicates the control module is operating properly and the problem is most likely in the wiring harness.

Not Normal

- If the status LED flashes code 3-2, replace the control module.

Electronic Control Module Input LEDs and Common Circuits Checks

NOTE: Models 1600/1620 S.N. (-020000) use individual raise and lower switches that are controlled by a lever.

Inputs consist of the following switches:

- Key Switch
- Hood Switch (European Only)
- Park Brake Lock Switch
- Seat Switch
- Neutral Switch
- Transaxle Low Range Switch[1]
- PTO Switch
- Right Raise/Lower Switch
- Left Raise/Lower Switch
- Front Raise/Lower Switch
- Right Angle Proximity Switch
- Left Angle Proximity Switch
- Front Angle Proximity Switch

Conditions

- Park brake engaged (LOCKED).
- Key switch in RUN position.
- Mower decks lowered to the ground.

Procedure

NOTE: When checking the input/output LEDs, use the numbers printed directly on the circuit board to identify the LEDs. DO NOT use the label on the control module, as it may not align with the LEDs.

Key Switch Input

1. Disable the starting motor by disconnecting the start relay diode (V1).

2. Move key switch to START position and back to RUN position.

3. Observe the start input LED (D12). The LED must be ON when the key switch is in the START position, and OFF when the key switch is in the RUN position.

If the LED does not come ON when the key switch is in the START position, test key switch circuit. (See “Key Switch (S1) Start Circuit” on page 217.)

Hood Switch Input

NOTE: The hood switch is used on European machines only. North American machines will include the hood switch wiring connector in the harness, but will be bypassed with a jumper wire to provide a continuous hood switch input.

1. Turn key switch to RUN position.

2. Observe the hood input LED (D10). The LED must be ON with the hood closed, and OFF when the hood is open.

If the LED does not come ON, test hood switch circuit. (See “Hood Switch Circuit” on page 217.)

Seat Switch Input

1. Turn key switch to RUN position.

2. Push down on the lower cushion of the seat to engage the seat switch.

3. Observe the seat input LED (D16). The LED must be ON when the seat switch is engaged (operator on seat).

4. Release pressure from the seat cushion to disengage the seat switch.

5. Observe the seat input LED (D16). The LED must be OFF when the seat switch is disengaged (operator off seat).

If the light does not come ON, test seat switch circuit. (See “Seat Switch Circuit Test” on page 219.)

Park Brake Lock Switch Input

1. Turn key switch to RUN position.

2. Depress the park brake pedal and observe the park brake lock input LED (D17). The LED must be ON when the park brake pedal is depressed (brake switch plunger released).

For Model 1600 Turbo, also observe brake 1 LED (D9). The LED must be OFF when the park brake pedal is depressed (brake switch plunger released).

3. Release the park brake pedal and observe the park brake lock input LED (D17). The LED must be OFF when the park brake pedal is released (brake switch plunger depressed).

1. For Models 1600/1620 and 1600 Turbo S.N. (-030000)

For Model 1600 Turbo, also observe brake 1 LED (D9). LED must be ON when the park brake pedal is released (brake switch plunger depressed).

4. If LED(s) (D17 and D9) do not come ON or go OFF as described in steps 2 and 3, first check brake switch adjustment. (See “Park Brake Lock Switch Test and Adjustment - Models 1600 and 1620” on page 618 or See “Park Brake Lock Switch Test and Adjustment - Model 1600 Turbo” on page 619.) If LED(s) do not come ON after adjustment, test brake switch circuit. (See “Park Brake Lock Switch Circuit Test - Models 1600/1620” on page 220 or See “Park Brake Lock Switch Circuit Test - Model 1600 Turbo” on page 221.)

Neutral Switch Input

1. Turn key switch to RUN position.

2. Move the forward/reverse travel pedals to the neutral position and observe the neutral input LED (D14). The LED must be ON when the forward/reverse travel pedals are in the NEUTRAL position (neutral switch engaged).

3. Depress either the forward or reverse pedal and observe the neutral input LED (D14). The LED must be OFF when either travel pedal is depressed (neutral switch is disengaged).

4. If LED (D14) does not come ON or go OFF as described in steps 2 and 3, first check transmission neutral adjustment. If LED does not come ON after adjustment, test neutral switch circuit. (See “Neutral Switch Circuit Test” on page 222.)

Transaxle Low Range Switch Input[1]

1. Turn key switch to RUN position.

2. Move the transaxle high/low range lever to the HIGH position and observe the transaxle low input LED (D18). The LED must be OFF.

3. Move the transaxle high/low range lever to the LOW position and observe the transaxle low input LED (D18). The LED must be ON.

4. If LED (D18) does not come ON or go OFF as described in steps 2 and 3, first check the high/low range switch adjustment. If LED does not come ON after adjustment, test high/low range switch circuit. (See “Transaxle Switch Circuit - Models 1600/1620 and 1600 Turbo S.N. (-030000)” on page 223.)

PTO Switch Input

1. Turn key switch to RUN position.

2. Move the PTO switch to the ON position and observe the PTO input LED (D15). The LED must be ON when the PTO switch is in the ON position.

3. Move the PTO switch to the OFF position and observe the PTO input LED (D15). The LED must be OFF when the PTO switch is in the OFF position.

4. If the LED (D15) does not come ON and go OFF as described in steps 2 and 3, test PTO switch circuit. (See “PTO Switch Circuit Test” on page 224.)

Right Mower Deck Raise/Lower Switch Inputs

1. Turn key switch to RUN position.

2. Move the right mower deck raise/lower control switch (or lever) to the RAISE position and observe the raise right input LED (D1). The LED must be ON when the raise/lower control switch (or lever) is in the RAISE position.

3. Move the right mower deck raise/lower control switch (or lever) to the LOWER position and observe the lower right input LED (D4). The LED must be ON when the raise/lower control switch (or lever) is in the LOWER position.

4. Release the control switch (or lever). The control switch (or lever) should return to the NEUTRAL position and both input LEDs (D1 and D4) must be OFF.

5. **On Models 1600 S.N. (-020000):** If LEDs (D1 and D4) do not come ON and go OFF as described in steps 2-4:

- Inspect and repair the raise/lower lever assembly as needed.
- Test right mower deck raise switch and circuit. (See “Mower Deck Raise Switch Circuit Test - Models 1600/1620 S.N. (-020000)” on page 225.)
- Test right mower deck lower switch and circuit. (See “Mower Deck Lower Switch Circuit Test - Models 1600/1620 S.N. (-020000)” on page 226.)

6. **On Models 1600 S.N. (020000-) and Model 1600 Turbo:** If LEDs (D1 and D4) do not come ON and go OFF as described in steps 2-4, test the right mower deck raise/lower switch and circuit. (See “Mower Deck Raise/Lower Switch Circuit Test - Models 1600/1620 S.N. (020001-) and Model 1600 Turbo” on page 227.)

Left Mower Deck Raise/Lower Switch Inputs

1. Turn key switch to RUN position.

2. Move the left mower deck raise/lower control switch (or lever) to the RAISE position and observe the raise left input LED (D2). The LED must be ON when the raise/lower control switch (or lever) is in the RAISE position.

3. Move the left mower deck raise/lower control switch (or lever) to the LOWER position and observe the lower left input LED (D5). The LED must be ON when the raise/lower control switch (or lever) is in the LOWER position.

4. Release the control switch (or lever). The control switch (or lever) should return to the NEUTRAL position and both input LEDs (D2 and D5) must be OFF.

1. For Models 1600/1620 and 1600 Turbo S.N. (-030000)

5. **On Models 1600 S.N. (-020000):** If LEDs (D2 and D5) do not come ON and go OFF as described in steps 2-4:

- Inspect and repair raise/lower lever assembly as needed.
- Test left mower deck raise switch and circuit. (See "Mower Deck Raise Switch Circuit Test - Models 1600/ 1620 S.N. (-020000)" on page 225.)
- Test left mower deck lower switch and circuit. (See "Mower Deck Lower Switch Circuit Test - Models 1600/ 1620 S.N. (-020000)" on page 226.)

6. **On Models 1600 S.N. (020001-) and Model 1600 Turbo:** If LEDs (D2 and D5) do not come ON and go OFF as described in steps 2-4, test the left mower deck raise/ lower switch and circuit. (See "Mower Deck Raise/Lower Switch Circuit Test - Models 1600/1620 S.N. (020001-) and Model 1600 Turbo" on page 227.)

Front Mower Deck Raise/Lower Switch Inputs

1. Turn key switch to RUN position.

2. Move the front mower deck raise/lower control switch (or lever) to the RAISE position and observe the raise front input LED (D3). The LED must be ON when the raise/lower control switch (or lever) is in the RAISE position.

3. Move the front mower deck raise/lower control switch (or lever) to the LOWER position and observe the lower front input LED (D6). The LED must be ON when the raise/lower control switch (or lever) is in the LOWER position.

4. Release the control switch (or lever). The control switch (or lever) should return to the NEUTRAL position and both input LEDs (D3 and D6) must be OFF.

5. **On Models 1600/1620 S.N. (-020000):** If LEDs (D3 and D6) do not come ON and go OFF as described in steps 2-4:

- Inspect and repair the raise/lower lever assembly as needed.
- Test front mower deck raise switch and circuit. (See "Mower Deck Raise Switch Circuit Test - Models 1600/ 1620 S.N. (-020000)" on page 225.)
- Test front mower deck lower switch and circuit. (See "Mower Deck Lower Switch Circuit Test - Models 1600/ 1620 S.N. (-020000)" on page 226.)

6. **On Models 1600/1620 S.N. (020001-) and Model 1600 Turbo:** If LEDs (D3 and D6) do not come ON and go OFF as described in steps 2-4, test the front mower deck raise/ lower switch and circuit. (See "Mower Deck Raise/Lower Switch Circuit Test - Models 1600/1620 S.N. (020001-) and Model 1600 Turbo" on page 227.)

Right Mower Deck Angle (Proximity) Switch Inputs

1. Turn key switch to RUN position.

2. Observe the right angle input LED (D7). The LED must be ON whenever the right mower deck is in the lowered position (proximity switch activated by the mower deck linkage).

3. Start the machine.

4. Move the right mower deck raise/lower control switch (or lever) to the RAISE position and observe the right angle input LED (D7). The LED must be OFF when the right mower deck is in the raised position.

5. If LED (D7) does not come ON or go OFF as described in steps 2 and 4, test angle (proximity) switch circuit. (See "Mower Deck Angle (Proximity) Switch Circuit Test" on page 228.)

Left Mower Deck Angle (Proximity) Switch Inputs

1. Turn key switch to RUN position.

2. Observe the left angle input LED (D13). The LED must be ON whenever the left mower deck is in the lowered position (proximity switch activated by the mower deck linkage).

3. Start the machine.

4. Move the left mower deck raise/lower control switch (or lever) to the RAISE position and observe the left angle input LED (D13). The LED must be OFF when the left mower deck is in the raised position.

5. If LED (D13) does not come ON or go OFF as described in steps 2 and 4, test angle (proximity) switch circuit. (See "Mower Deck Angle (Proximity) Switch Circuit Test" on page 228.)

Front Mower Deck Angle (Proximity) Switch Inputs

1. Turn key switch to RUN position.

2. Observe the front angle input LED (D11). The LED must be ON whenever the front mower deck is in the lowered position (proximity switch activated by the mower deck linkage).

3. Start the machine.

4. Move the front mower deck raise/lower control switch (or lever) to the RAISE position and observe the front angle input LED (D11). The LED must be OFF when the front mower deck is in the raised position.

5. If LED (D11) does not come ON or go OFF as described in steps 2 and 4, test angle (proximity) switch circuit. (See "Mower Deck Angle (Proximity) Switch Circuit Test" on page 228.)

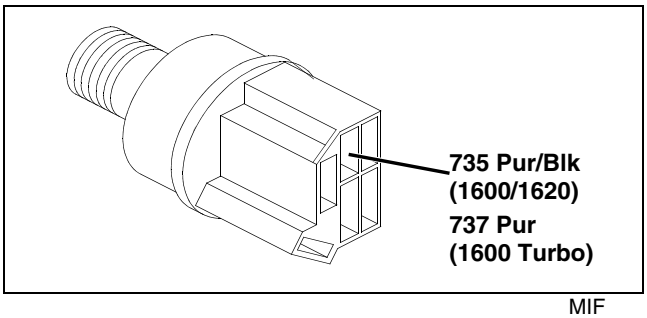
Electronic Control Module Circuit Tests

Test Conditions:

- Machine parked on a level surface.
- Remove Start Relay Diode (V1) to prevent engine from cranking.
- Key switch in START position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

Key Switch (S1) Start Circuit

System: Key Switch (S1) Start Circuit



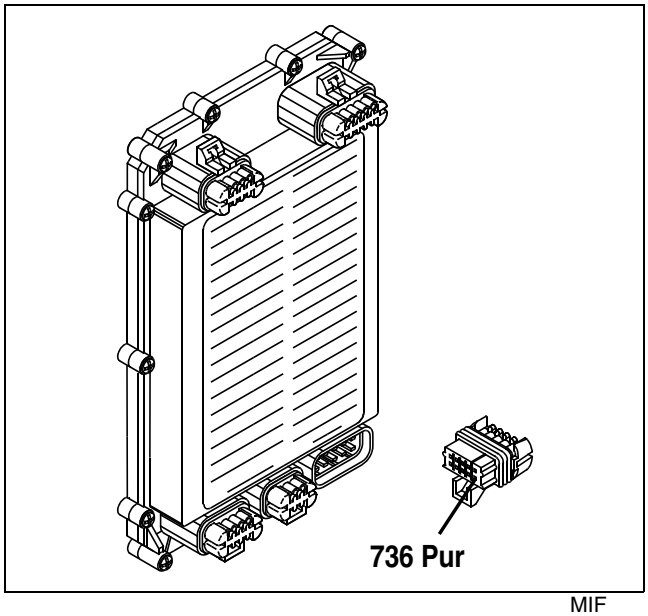
MIF

(1) Key switch (S1) - Terminal S1, Wire 735 or 737 Purple/Black. Is battery voltage present?

Yes - Go To Step (2)

No - Test key switch. (See “Key Switch Test” on page 364.)

System: Key Switch (S1) Start Circuit



MIF

(2) Electronic control module (A3) connector X24 disconnected.
Electronic control module (A3) - Connector (X24) - Terminal F, Wire 736 Purple/Black. Is battery voltage present?

No - Models 1600/1620: Test wires 736 purple, 735 purple/black, and connections.

No - Model 1600 Turbo: Test wires 736 and 737 purple and connections.

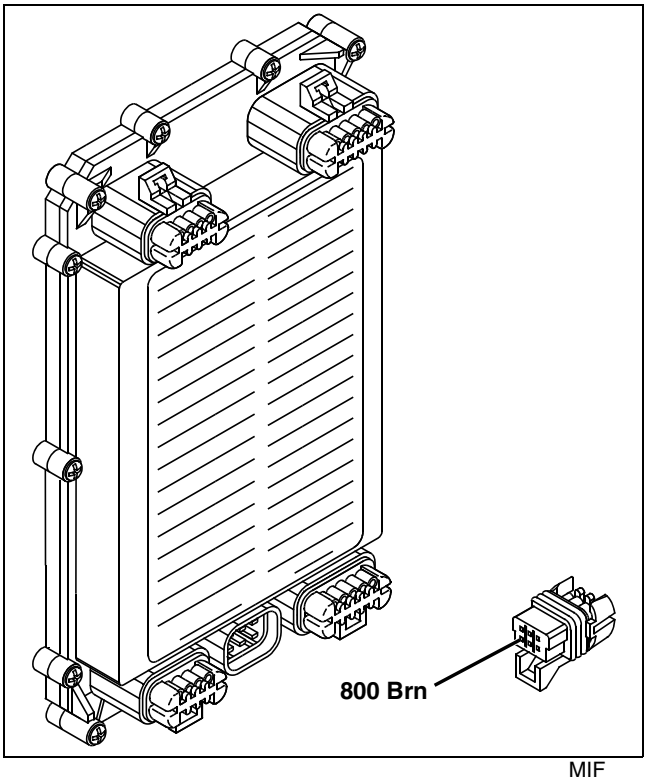
Hood Switch Circuit

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Hood closed (European machines only).
- Electronic control module connector X25 disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

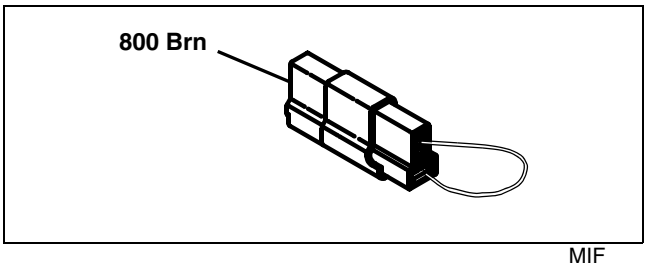
System: Hood Switch Circuit



MIF

(1) Electronic Control Module (A3) - Connector X25 - Terminal F, Wire 800 Brown. Is battery voltage present?

No - Go To Step (2)



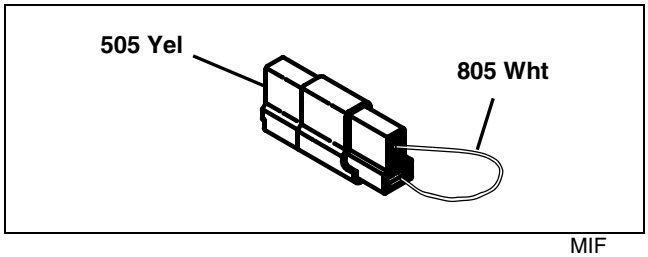
MIF

(2) Hood Switch Connector (X31) - Terminal A, Wire 800 Brown. Is battery voltage present?

Yes - Test wire 800 brown and connections.

No - Go To Step (3)

System: Hood Switch Circuit



MIF

(3) Hood Switch Connector (X31) - Terminal B, Wire 505 Yellow. Is battery voltage present?

Yes - Check switch (European machines only). (See “Hood Switch Test” on page 372.)

Yes - Test wire 805 white (North American machines only).

No - Test wire 505 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

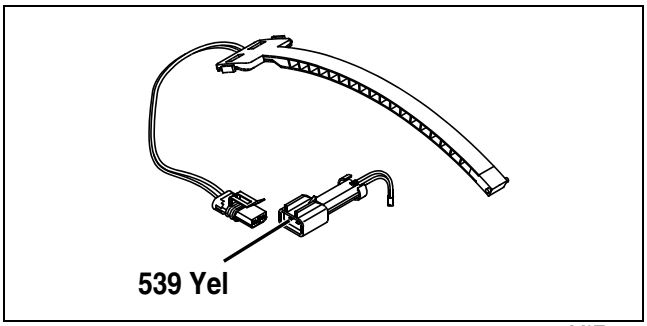
Seat Switch Circuit Test

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Seat switch connector X49 disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Seat Switch Circuit



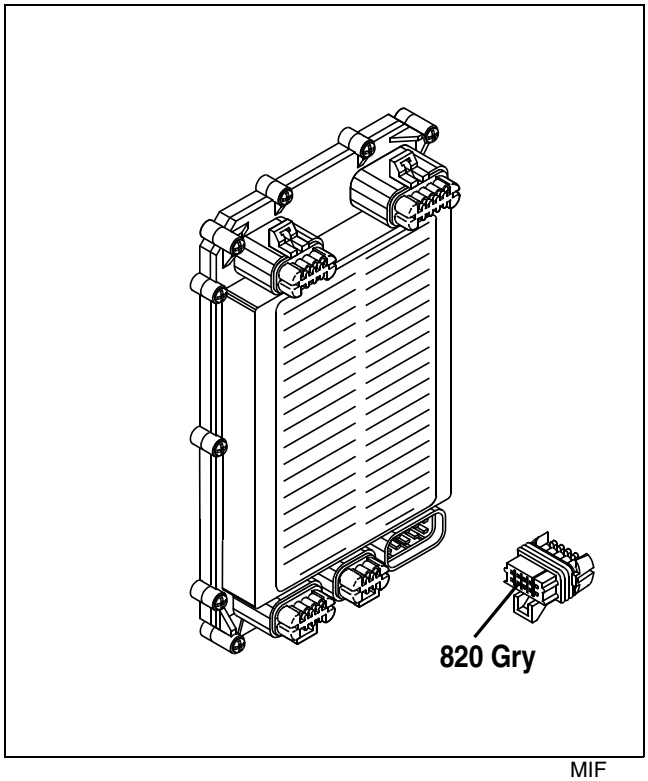
MIF

(1) Seat Switch (S3) - Terminal B, Wire 539 Yellow. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 539 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Seat Switch Circuit



MIF

**(2) Seat switch connector X49 connected.
Seat switch engaged (operator on seat).
Key switch in RUN position.
Electronic control module connector X24 disconnected.
Electronic Control Module (A3) - Connector X24 - Terminal J, Wire 820 Gray. Is battery voltage present?**

No - Test wire 820 gray and connections. Test seat switch. (See “Seat Switch Test” on page 365.)

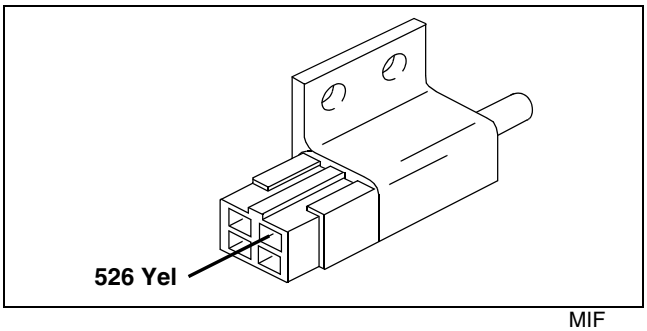
Park Brake Lock Switch Circuit Test - Models 1600/1620

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Park brake switch connector X5 connected.
- Park brake engaged.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Park Brake Lock Switch Circuit - Models 1600/1620

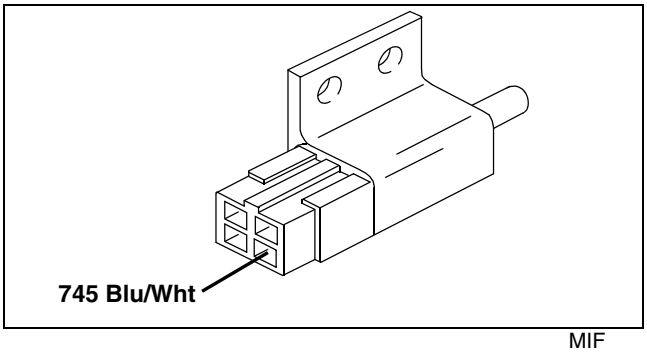


MIF

(1) Park Brake Lock Switch (S8) - Wire 526 Yellow. Is battery voltage present?

Yes - Go To Step (2)

No - Test wire 526 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



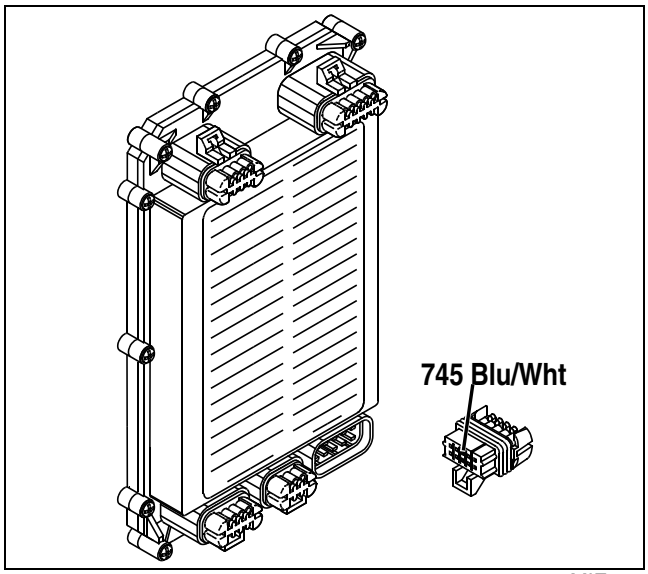
MIF

(2) Park Brake Lock Switch (S8) - Wire 745 Blue/White. Is battery voltage present?

Yes - Go To Step (3)

No - Test switch. (See “Park Brake Lock Switch Test - Models 1600 and 1620” on page 364.)

System: Park Brake Lock Switch Circuit - Models 1600/1620



MIF

(3) Electronic control module (A3) connector X24 disconnected.
Electronic Control Module (A3) - Connector X24 - Terminal C, Wire 745 Blue/White. Is battery voltage present?

No - Test wire 745 blue/white and connections.

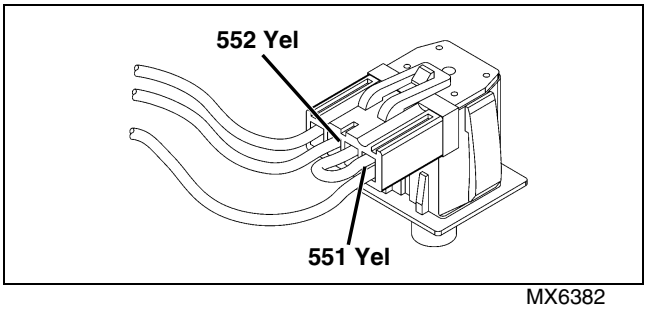
Park Brake Lock Switch Circuit Test - Model 1600 Turbo

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Park brake switch connector X5 connected.
- Park brake released.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Park Brake Lock Switch Circuit[a] - Model 1600 Turbo

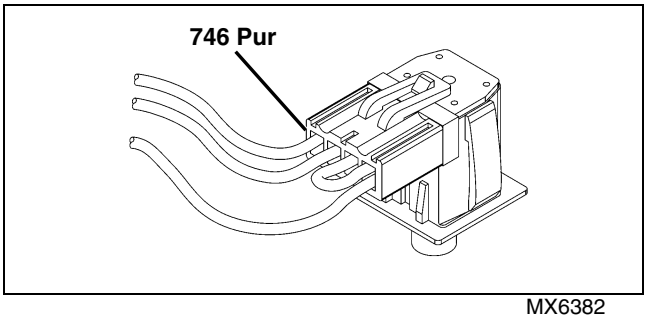


MX6382

(1) Park Brake Lock Switch (S8) - Wires 551 and 552 Yellow. Is battery voltage present?

Yes - Go To Step (2)

No - Test wires 551 and 552 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



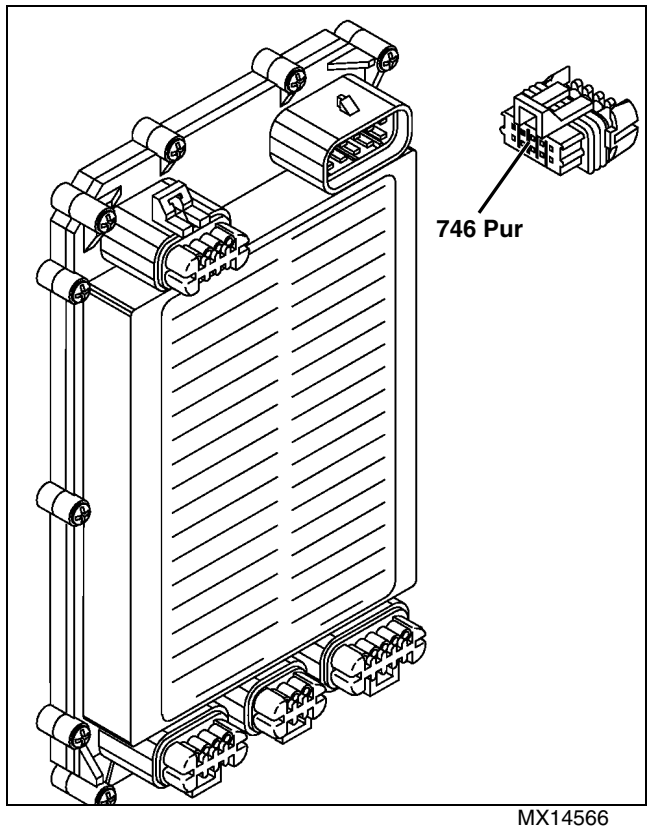
MX6382

(2) Park Brake Lock Switch (S8) - Wire 746 Purple. Is battery voltage present?

Yes - Go To Step (3)

No - Test switch. (See “Park Brake Lock Switch Test - Model 1600 Turbo” on page 365.)

System: Park Brake Lock Switch Circuit[a] - Model 1600 Turbo

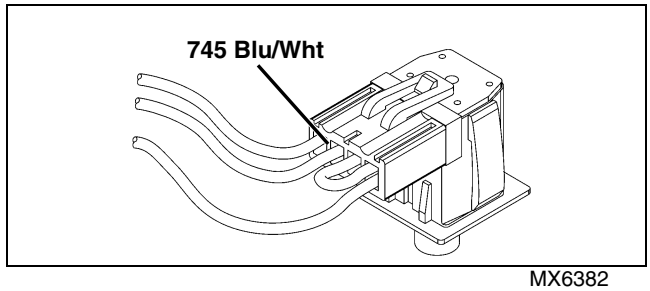


MX14566

(3) Electronic control module connector X28 disconnected.
Electronic Control Module (A3) - Connector X28 - Terminal J, Wire 746 Purple. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 746 purple and connections.



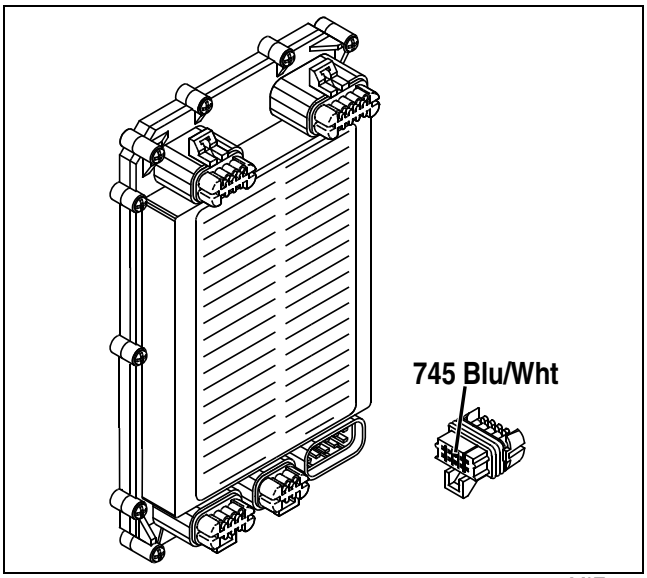
MX6382

(4) Park brake engaged.
Park Brake Lock Switch (S8) - Wire 745 Blue/White. Is battery voltage present?

Yes - Go To Step (5)

No - Test switch. (See “Park Brake Lock Switch Test - Model 1600 Turbo” on page 365.)

System: Park Brake Lock Switch Circuit[a] - Model 1600 Turbo



MIF

(5) Electronic Control Module (A3) - Connector X24 - Terminal C, Wire 745 Blue/White. Is battery voltage present?

No - Test wire 745 blue/white and connections.

a. Models S.N. (030001-) incorporate a jumper harness (W10) between the main harness (W1) and the park brake lock switch (S8).

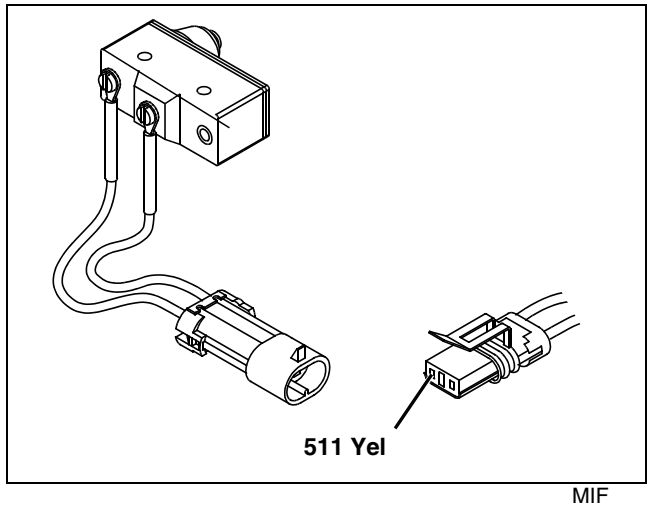
Neutral Switch Circuit Test

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Neutral switch connector X48 disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Neutral Switch Circuit

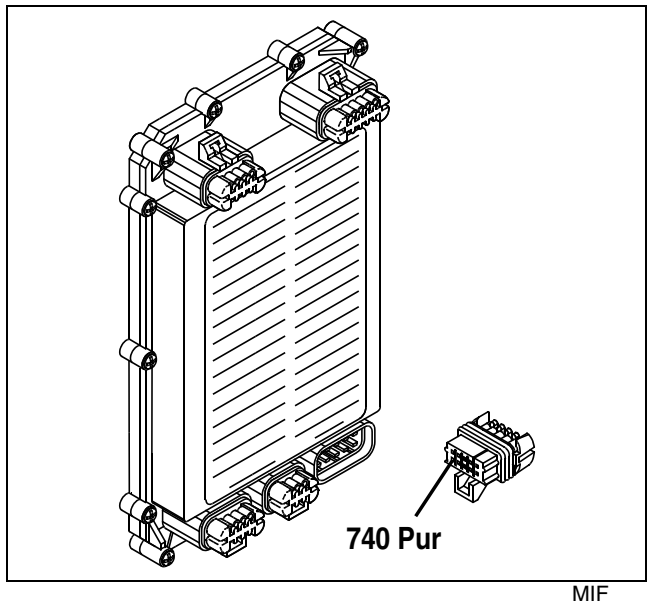


MIF

(1) Neutral Switch (S4) - Terminal A, Wire 511 Yellow. Is battery voltage present?

Yes - Go To Step (2)

No - Test wire 511 yellow and connections.



MIF

(2) Neutral switch connector X48 connected. Neutral switch engaged (forward/reverse pedals in NEUTRAL position).
Electronic control module connector X24 disconnected.
Electronic Control Module (A3) - Connector X24 - Terminal K, Wire 740 Purple. Is battery voltage present?

No - Test wire 740 purple and connections. Test switch. (See “Neutral Switch Test” on page 366.)

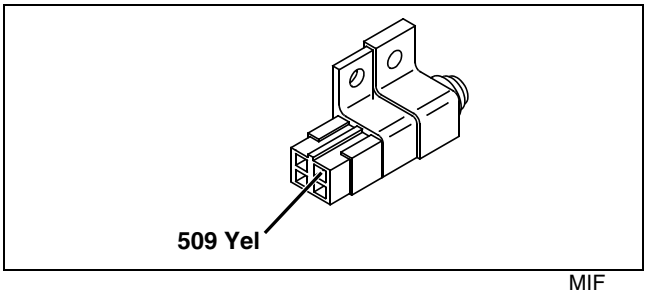
Transaxle Switch Circuit - Models 1600/1620 and 1600 Turbo S.N. (-030000)

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Transaxle switch connector X29 disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Transaxle Switch Circuit - Models 1600/1620 and 1600 Turbo S.N. (-030000)



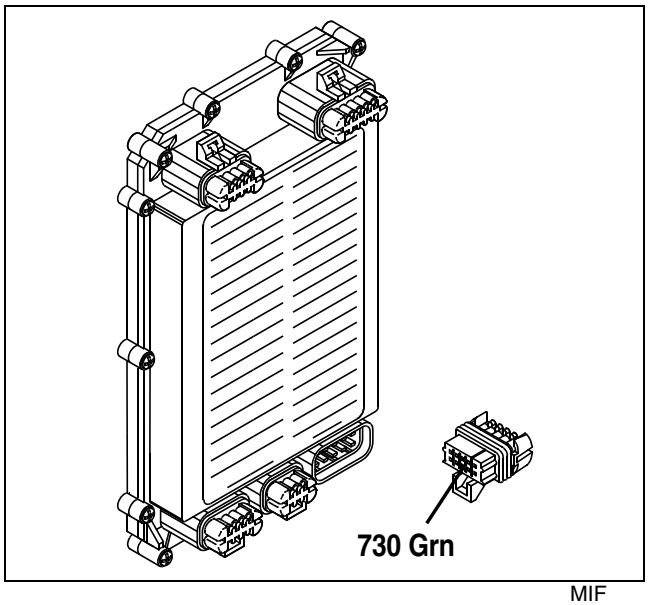
MIF

(1) Transaxle Switch (S2) - Wire 509 Yellow. Is battery voltage present?

Yes - Go To Step (2)

No - Test wire 509 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Transaxle Switch Circuit - Models 1600/1620 and 1600 Turbo S.N. (-030000)



MIF

(2) Transaxle switch connector X29 connected. Transaxle switch engaged (lever in LOW position).
Electronic control module connector X24 disconnected.
Electronic Control Module (A3) - Connector X24 - Terminal H, Wire 730 Green. Is battery voltage present?

No - Test wire 730 green and connections. Test switch. (See “Transaxle Switch Test” on page 367.)

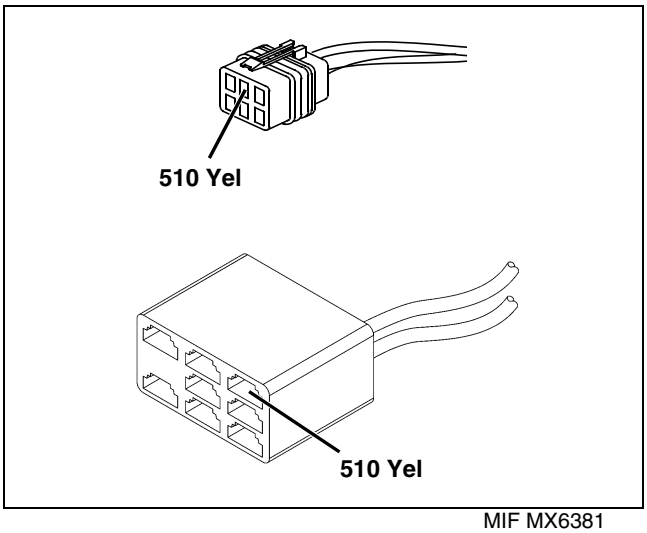
PTO Switch Circuit Test

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- PTO switch connector X23 disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: PTO Switch Circuit



MIF MX6381

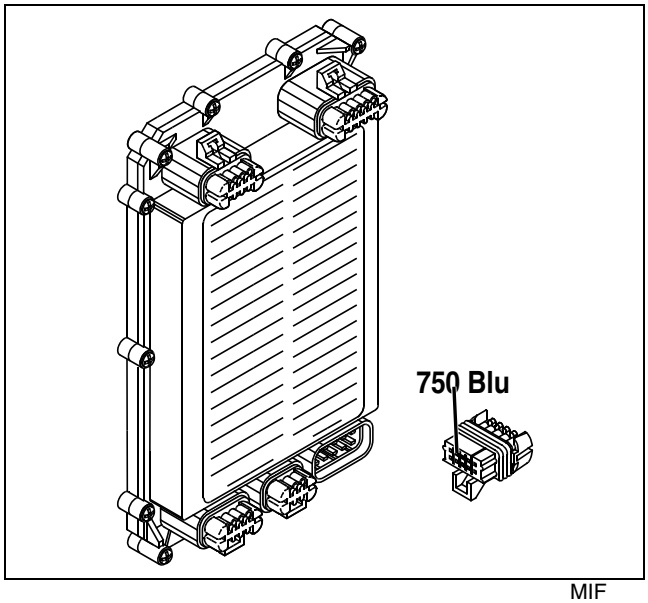
Picture Note:
UPPER: Models 1600/1620 S.N. (-020000)
LOWER: Models 1600/1620 S.N. (020001-) and Model 1600 Turbo

(1) PTO Switch (S15) - Wire 510 Yellow. Is battery voltage present?

Yes - Go To Step (2)

No - Test wire 510 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: PTO Switch Circuit



MIF

(2) PTO switch connector X23 connected.
PTO switch engaged.
Electronic control module connector X24 disconnected.
Electronic Control Module (A3) - Connector X24 - Terminal B, Wire 750 Blue. Is battery voltage present?

No - Test wire 750 blue and connections. Test switch. (See “PTO Switch Test” on page 369.)

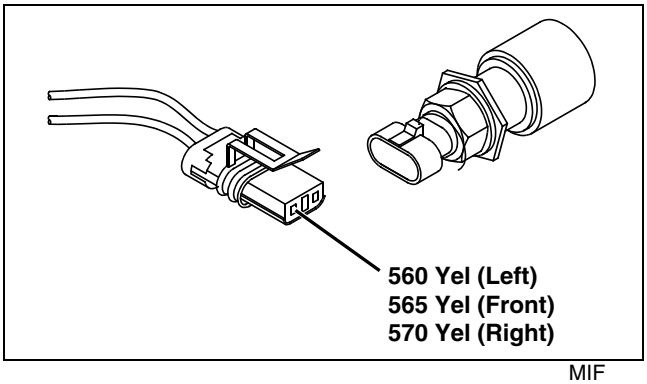
Mower Deck Raise Switch Circuit Test - Models 1600/ 1620 S.N. (-020000)

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Raise switches - connectors X16 (right), X15 (front), and X14 (left) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mower Deck Raise Switch Circuit - Models 1600/1620 S.N. (-020000)



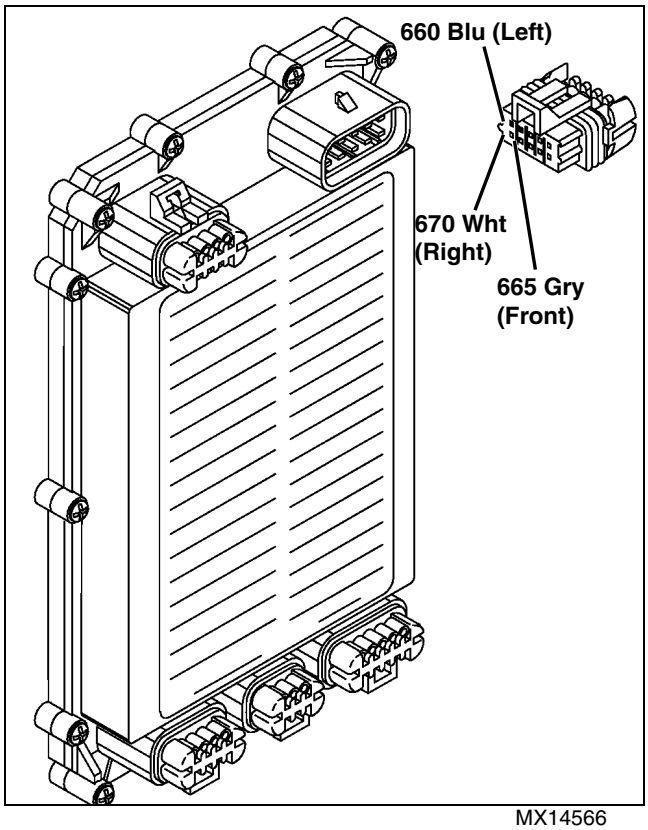
MIF

**(1) Left Raise Switch (S9) - Wire 560 Yellow.
Front Raise Switch (S10) - Wire 565 Yellow.
Right Raise Switch (S11) - Wire 570 Yellow.
Is battery voltage present?**

Yes - Go To Step (2)

No - Test wires 560 (S9), 565 (S10), and 570 (S11) yellow, and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Mower Deck Raise Switch Circuit - Models 1600/1620 S.N. (-020000)



MX14566

**(2) Raise switches - connectors X16 (right), X15 (front), and X14 (left) connected.
Raise switches engaged (control levers in RAISE position).
Electronic control module connector X28 disconnected.
Electronic Control Module (A3) - Connector X28.
Terminal D - Wire 665 Gray.
Terminal E - Wire 670 White.
Terminal F - Wire 660 Blue. Is battery voltage present?**

No - Test wire 670 white (terminal E). Test wire 665 gray (terminal D). Test wire 660 blue (terminal F).

No - Test switch(es). (See “Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)” on page 368.)

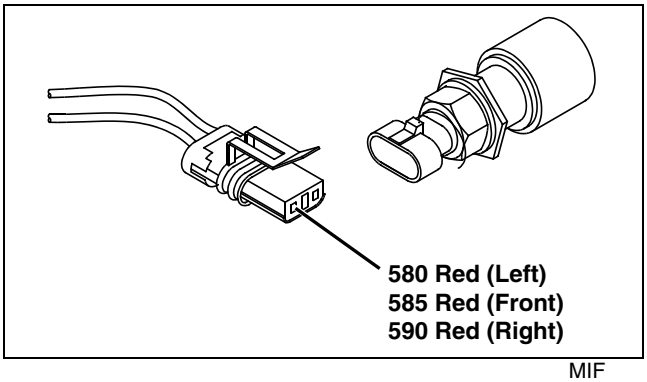
Mower Deck Lower Switch Circuit Test - Models 1600/ 1620 S.N. (-020000)

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Lower switches - connectors X11 (right), X12 (front), and X13 (left) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mower Deck Lower Switch Circuit - Models 1600/1620 S.N. (-020000)



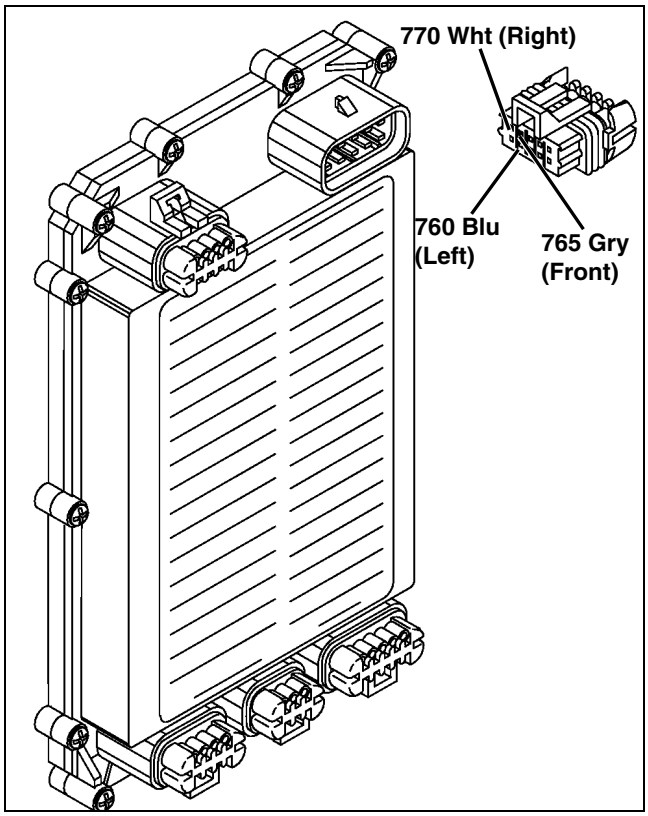
MIF

**(1) Left Lower Switch (S12) - Wire 580 Red.
Front Lower Switch (S13) - Wire 585 Red.
Right Lower Switch (S14) - Wire 590 Red.
Is battery voltage present?**

Yes - Go To Step (2)

No - Test wires 580 (S12), 585 (S13), and 590 (S14) red, and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Mower Deck Lower Switch Circuit - Models 1600/1620 S.N. (-020000)



MX14566

**(2) Lower switches - connectors X11 (right), X12 (front), and X13 (left) connected.
Lower switches engaged (control levers in LOWER position).
Electronic control module connector X28 disconnected.
Electronic Control Module (A3) - Connector X28.
Terminal C - Wire 760 Blue.
Terminal G - Wire 770 White.
Terminal H - Wire 765 Gray. Is battery voltage present?**

No - Test wire 770 white (terminal G). Test wire 765 gray (terminal H). Test wire 760 blue (terminal C).

No - Test switch(es). (See “Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)” on page 368.)

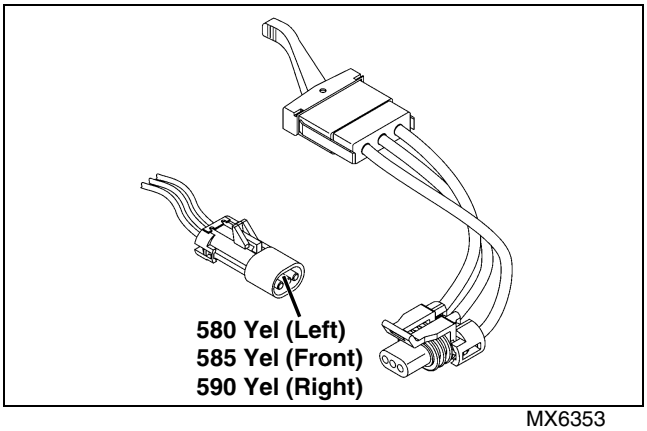
Mower Deck Raise/Lower Switch Circuit Test - Models 1600/1620 S.N. (020001-) and Model 1600 Turbo

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Raise/lower switches - connectors X61 (left), X62 (front), and X63 (right) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mower Deck Raise/Lower Switch Circuit - Models 1600/1620 S.N. (020001-) and Model 1600 Turbo



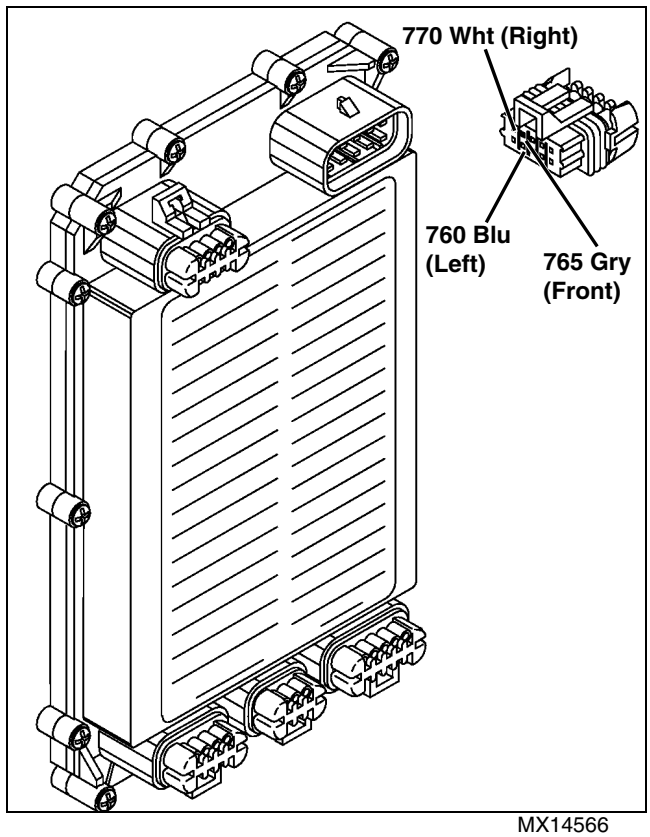
MX6353

(1) Left Raise/Lower Switch (S17) - Wire 580 Yellow.
Front Raise/Lower Switch (S18) - Wire 585 Yellow.
Right Raise/Lower Switch (S19) - Wire 590 Yellow. Is battery voltage present?

Yes - Go To Step (2)

No - Test wires 580 (S17), 585 (S18), and 590 (S19) yellow, and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Mower Deck Raise/Lower Switch Circuit - Models 1600/1620 S.N. (020001-) and Model 1600 Turbo



MX14566

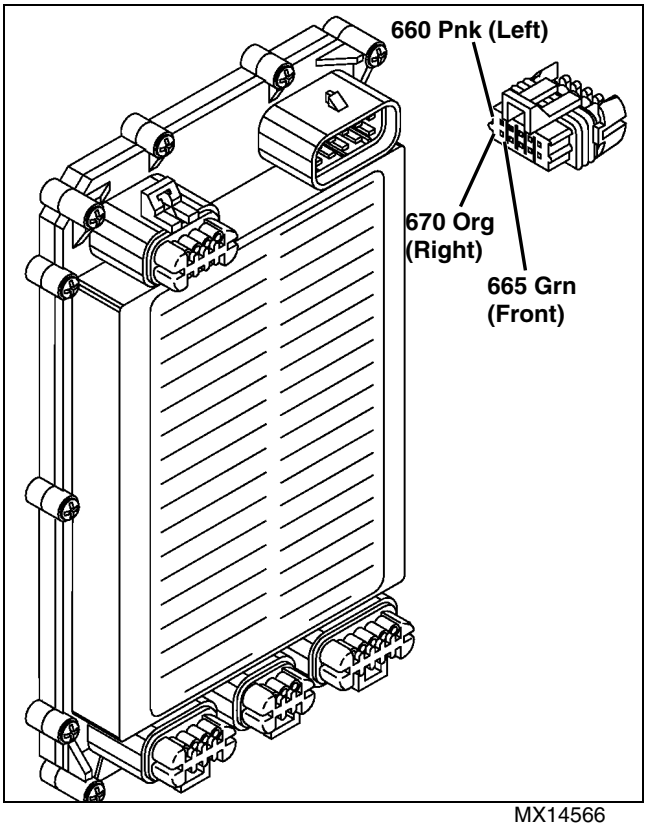
(2) Raise/lower switches - connectors X61 (left), X62 (front), and X63 (right) connected.
Raise/lower switches at the LOWER position.
Electronic control module connector X28 disconnected.
Electronic Control Module (A3) - Connector X28.
Terminal C - Wire 760 Blue.
Terminal G - Wire 770 White.
Terminal H - Wire 765 Gray. Is battery voltage present?

Yes - Go To Step (3)

No - Test wire 770 white (terminal G). Test wire 765 gray (terminal H). Test wire 760 blue (terminal C).

No - Test switch(es). (See “Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo” on page 368.)

System: Mower Deck Raise/Lower Switch Circuit - Models 1600/1620 S.N. (020001-) and Model 1600 Turbo



MX14566

(3) Raise/lower switches at the RAISE position. Electronic Control Module (A3) - Connector X28. Terminal D - Wire 665 Green. Terminal E - Wire 670 Orange. Terminal F - Wire 660 Pink. Is battery voltage present?

No - Test wire 670 orange (terminal E). Test wire 665 green (terminal D). Test wire 660 pink (terminal F).

No - Test switch(es). (See “Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo” on page 368.)

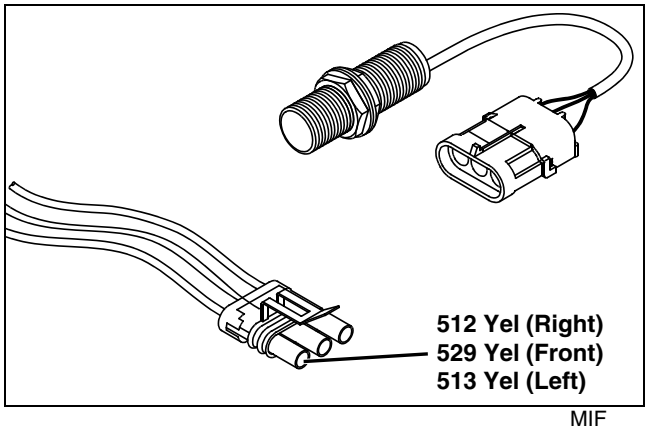
Mower Deck Angle (Proximity) Switch Circuit Test

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Deck angle switches - connectors X47 (right), X53 (front), and X42 (left) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mower Deck Angle (Proximity) Switch Circuit



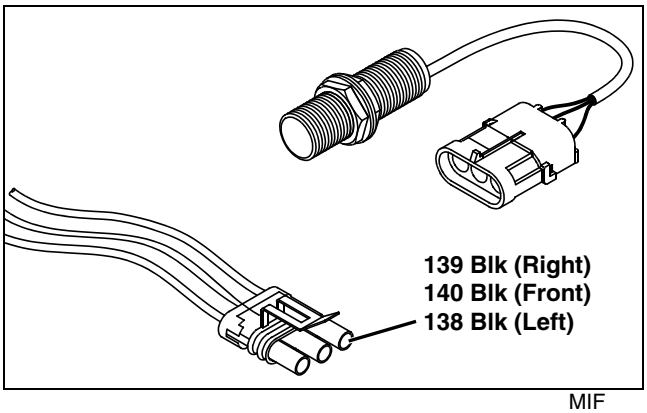
MIF

(1) Left Angle Switch (S5) - Wire 513 Yellow. Front Angle Switch (S7) - Wire 529 Yellow. Right Angle Switch (6) - Wire 512 Yellow. Is battery voltage present?

Yes - Go To Step (2)

No - Test wires 512 (S6), 513 (S5), and 529 (S7) yellow, and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Mower Deck Angle (Proximity) Switch Circuit



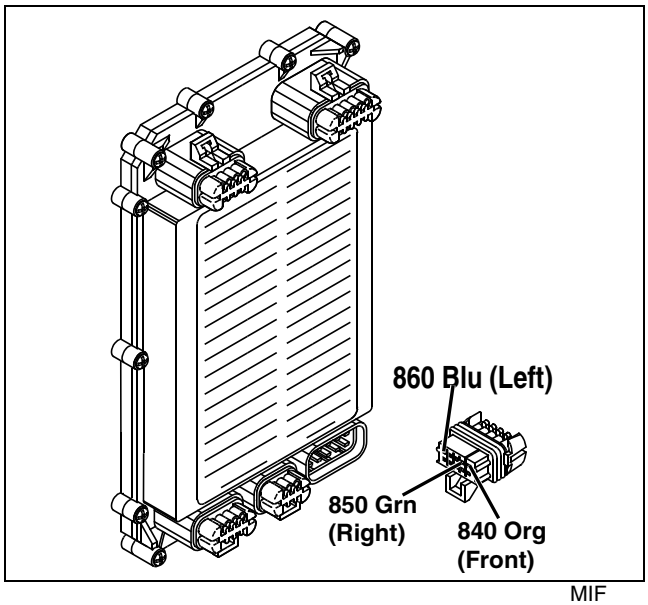
MIF

(2) Key switch in STOP position.
Left Angle Switch (S5) - Wire 138 Black.
Front Angle Switch (S7) - Wire 140 Black.
Right Angle Switch (6) - Wire 139 Black. Check ground circuit for resistance. Is there less than 0.1 ohms of resistance?

Yes - Go To Step (3)

No - Test wires 138 (S5), 139 (S6), 140 (S7), 110, and 100 black, and connections.

System: Mower Deck Angle (Proximity) Switch Circuit



MIF

(3) Deck angle switches - connectors X47 (right), X53 (front), and X42 (left) connected.
Deck angle switches engaged (decks lowered to ground).
Electronic control module connector X24 disconnected.
Electronic Control Module (A3) - Connector X24.
Terminal A- Wire 860 Blue.
Terminal D- Wire 850 Green.
Terminal E- Wire 840 Orange. Is battery voltage present?

No - Test wire 840 orange (terminal E). Test wire 850 green (terminal D). Test wire 860 blue (terminal A).

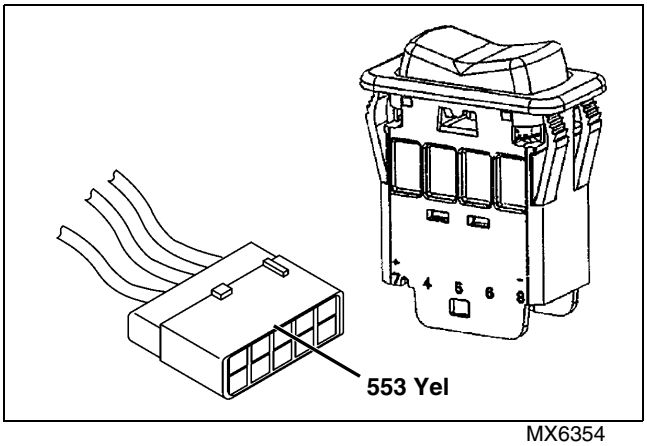
Cruise Control Circuit Test - Model 1600 Turbo

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Cruise control switch connector X74 disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Cruise Control Circuit - Model 1600 Turbo



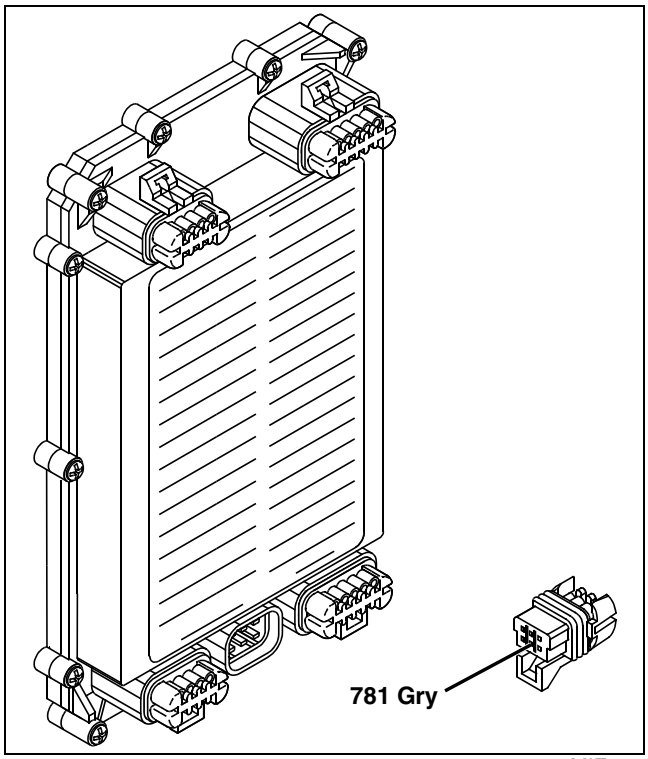
MX6354

(1) Cruise Control Switch (S20) - Terminal 5. Is battery voltage present?

Yes - Go To Step (2)

No - Test wire 553 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)

System: Cruise Control Circuit - Model 1600 Turbo



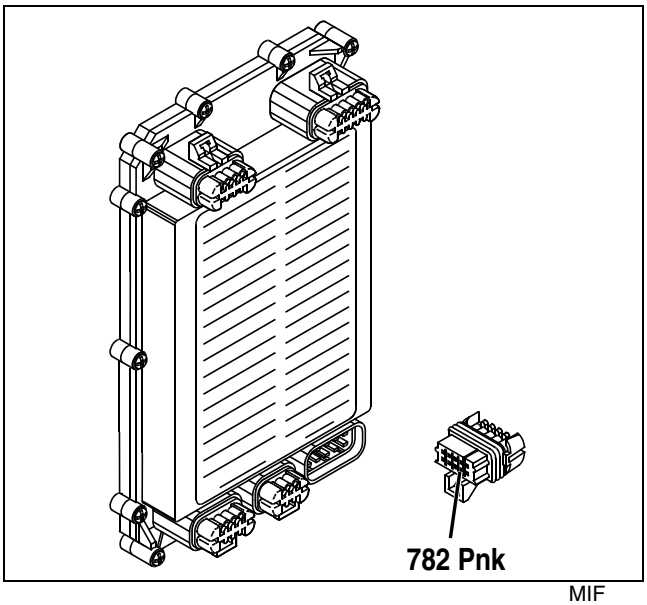
MIF

(2) Cruise control switch connector X74 connected.
Cruise control switch at the ON position.
Electronic control module connector X25 disconnected.
Electronic Control Module (A3) - Connector X25 - Terminal E, Wire 781 Gray. Is battery voltage present?

Yes - Go To Step (3)

No - Test wire 781 gray and connections. If wire and connections are good, test switch. (See "Cruise Control Switch Test - Model 1600 Turbo" on page 374.)

System: Cruise Control Circuit - Model 1600 Turbo



MIF

(3) Cruise control switch at the SET position. Electronic control module connector X24 disconnected.
Electronic Control Module (A3) - Connector X24 - Terminal G, Wire 782 Pink. Is battery voltage present?

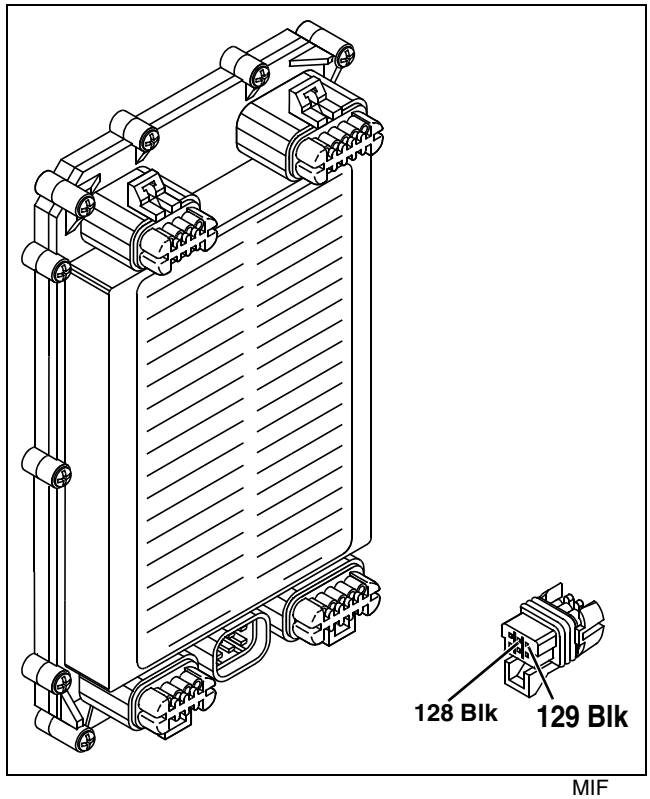
No - Test wire 782 pink and connections. If wire and connections are good, test switch. (See "Cruise Control Switch Test - Model 1600 Turbo" on page 374.)

Electronic Control Module Ground Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in OFF position.
- Electronic control module connector X25 disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Electronic Control Module Ground Circuit Test



MIF

(1) Electronic control module connector X25 disconnected.
Electronic Control Module (A3) - Connector X25.
Terminal B - Wire 128 Black.
Terminal C - Wire 129 Black.
Check ground circuit for resistance. Is there less than 0.1 ohms of resistance?

No - For Terminal B, test wires 128, 110, and 100 black, and connections. For Terminal C, test wires 129, 110, and 100 black, and connections

Power Circuit Operation - Unswitched Power

Function

Provides power to the primary circuit whenever the battery is connected.

Operating Conditions

- Key switch in STOP position.

Theory of Operation

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

- Battery (G1) positive (+) terminal.
- Battery terminal of starting motor (M1) solenoid.
- Battery terminal of key switch (S1).
- Battery terminal of alternator (G2).
- Terminal 30 of start relay (K1).
- Terminal 30 of fuel pull-in relay (K2) [S.N. (-020000) without MPTC10114 kit].
- Terminal 30 of air pre-heater relay (K3).
- Lights fuse (F4) (Models 1600/1620).
- Terminal 30 of lights relay (K4)[1].

The positive (+) battery cable connects the battery to the starting motor battery terminal B. This connection is used as a tie point for the rest of the electrical system.

NOTE: The battery cables and the starting motor connections must be in good condition for the electrical system to work properly.

The ground cable connections are equally as important as the positive (+) cable. The starting motor depends on these cables and connections to carry the high current necessary for operation.

For Models 1600/1620, the connection from starting motor (M1) to lights fuse (F4) and air pre-heater relay (K3) is protected by the fusible link (F1).

For Model 1600 Turbo, the connection from starting motor (M1) to lights relay (K4) and air pre-heater relay (K3) is protected by fusible link (F1).

The connection from starting motor (M1) to key switch (S1) and start relay (K1) is protected by fusible link (F2). Fusible links are short lengths of wire designed to protect the main wiring harness and will fail if current load is excessive or if a short circuit occurs.

1. Models 1600/1620: lights relay (K4) is optional.

Power Circuit Operation - Switched Power

Function

Provides power to components by means of a key switch.

Operating Conditions

- Key switch in RUN position.

Theory of Operation

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

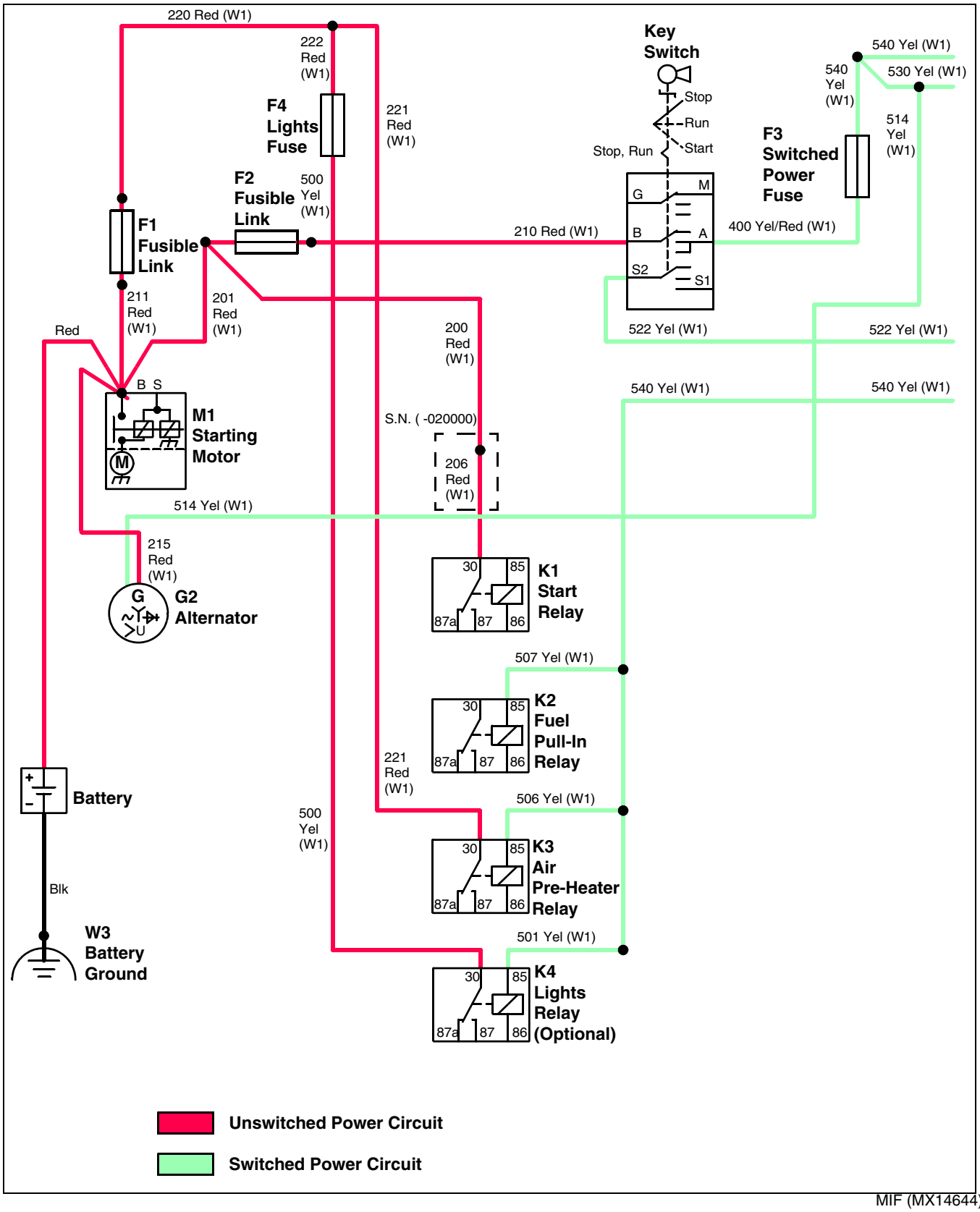
- Terminals A and S2 on key switch (S1).
- Yellow wire at engine lights display (A1).
- For Models 1600/1620, yellow wire on PTO lights display (A2) and fuel gauge (P2).
- For Model 1600 Turbo, yellow wire on coolant temperature gauge (P3), cruise control switch (S20), and cruise control magnet (Y9).
- Terminal D on connector (X25) of electronic control module (A3).
- Terminal 85 of fuel pull-in relay (K2), and air pre-heater relay (K3) and lights relay (K4)[2].
- Yellow wire on seat switch (S3), transaxle switch (S2)[3], neutral switch (S4), left angle switch (S5), right angle switch (S6), front angle switch (S7), park brake lock switch (S8), PTO switch (S15), alternator (G2), buzzer (H5), and optional hood switch connector (X31).
- Yellow wire on left raise/lower solenoid (Y2), front raise/lower solenoid (Y3), right raise/lower solenoid (Y4), raise/lower select solenoid (Y5), left motor solenoid (Y6), deck drive solenoid (Y7), and right motor solenoid (Y8).
- For Models 1600/1620 S.N. (-020000), yellow wire on right raise switch (S11), left raise switch (S9), and front raise switch (S10).
- For Models 1600/1620 S.N. (-020000), red wire on left lower switch (S12), front lower switch (S13), and right lower switch (S14).
- For Models 1600/1620 S.N. (020001-) and 1600 Turbo, yellow wire on left raise/lower switch (S17), front raise/lower switch (S18), and right raise/lower switch (S19).

2. Models 1600/1620: lights relay (K4) is optional.

3. Models 1600/1620 and 1600 Turbo S.N. (-030000)

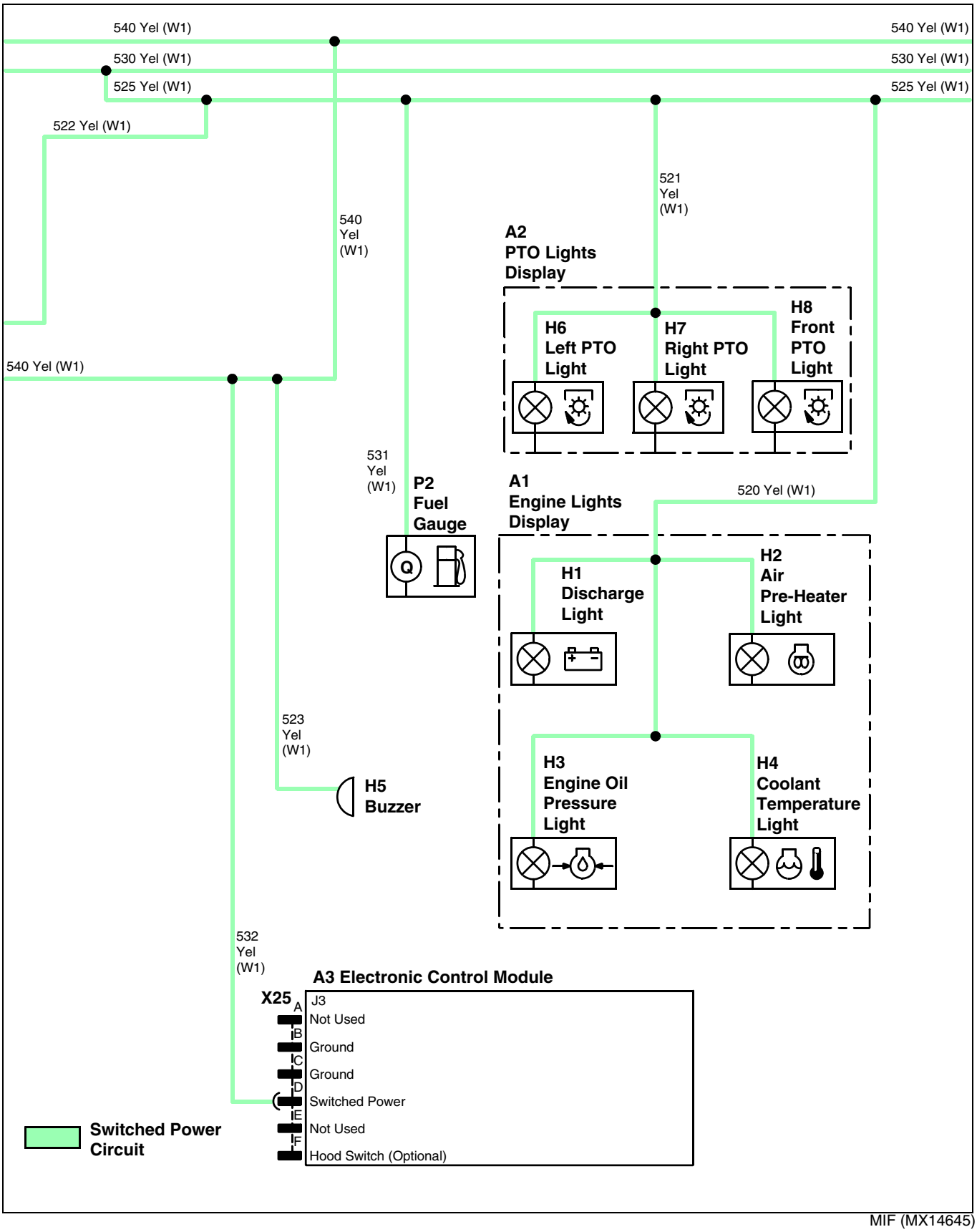
Power Circuit Schematics

Models 1600/1620 (Sheet 1 of 4)



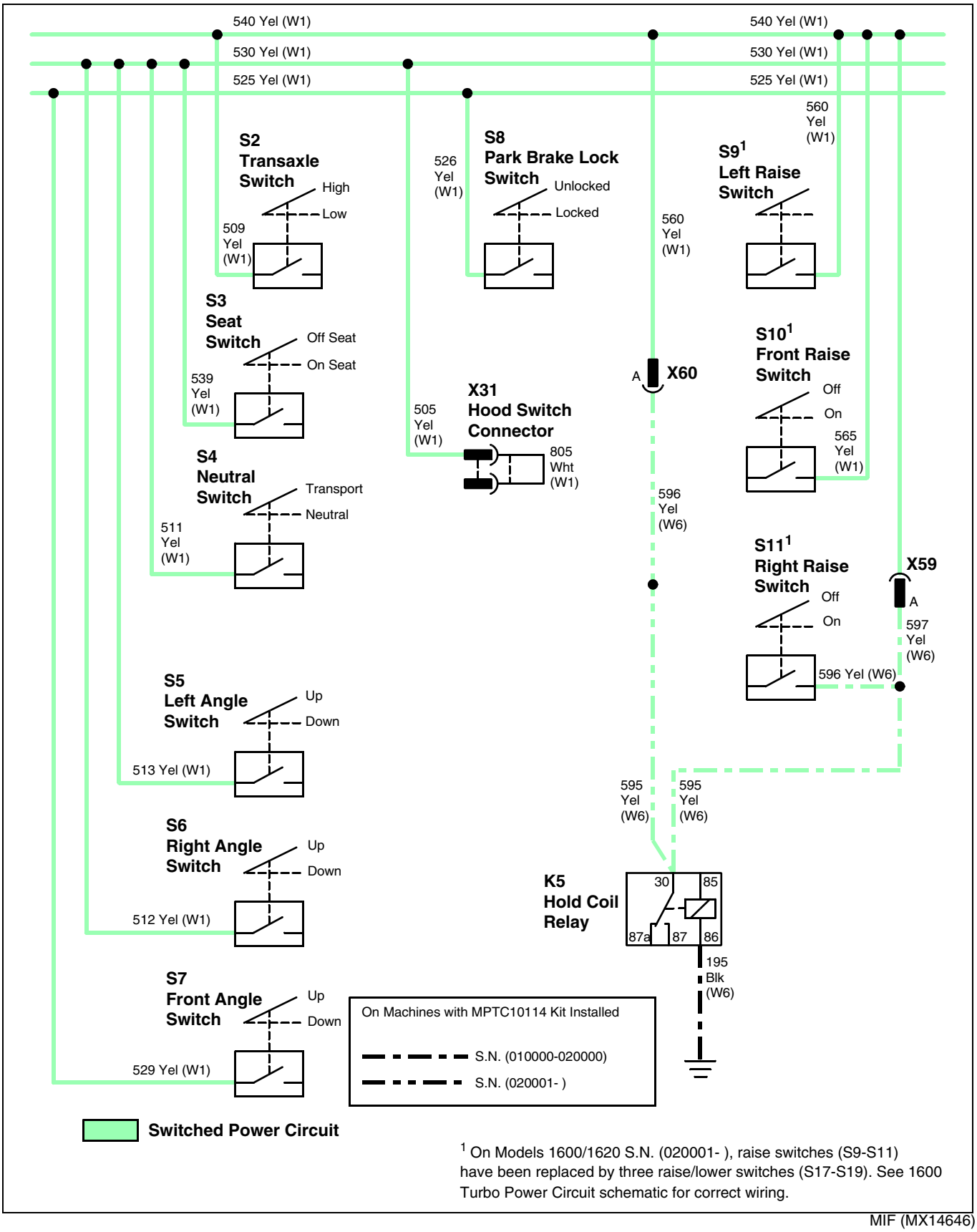
MIF (MX14644)

Models 1600/1620 (Sheet 2 of 4)



MIF (MX14645)

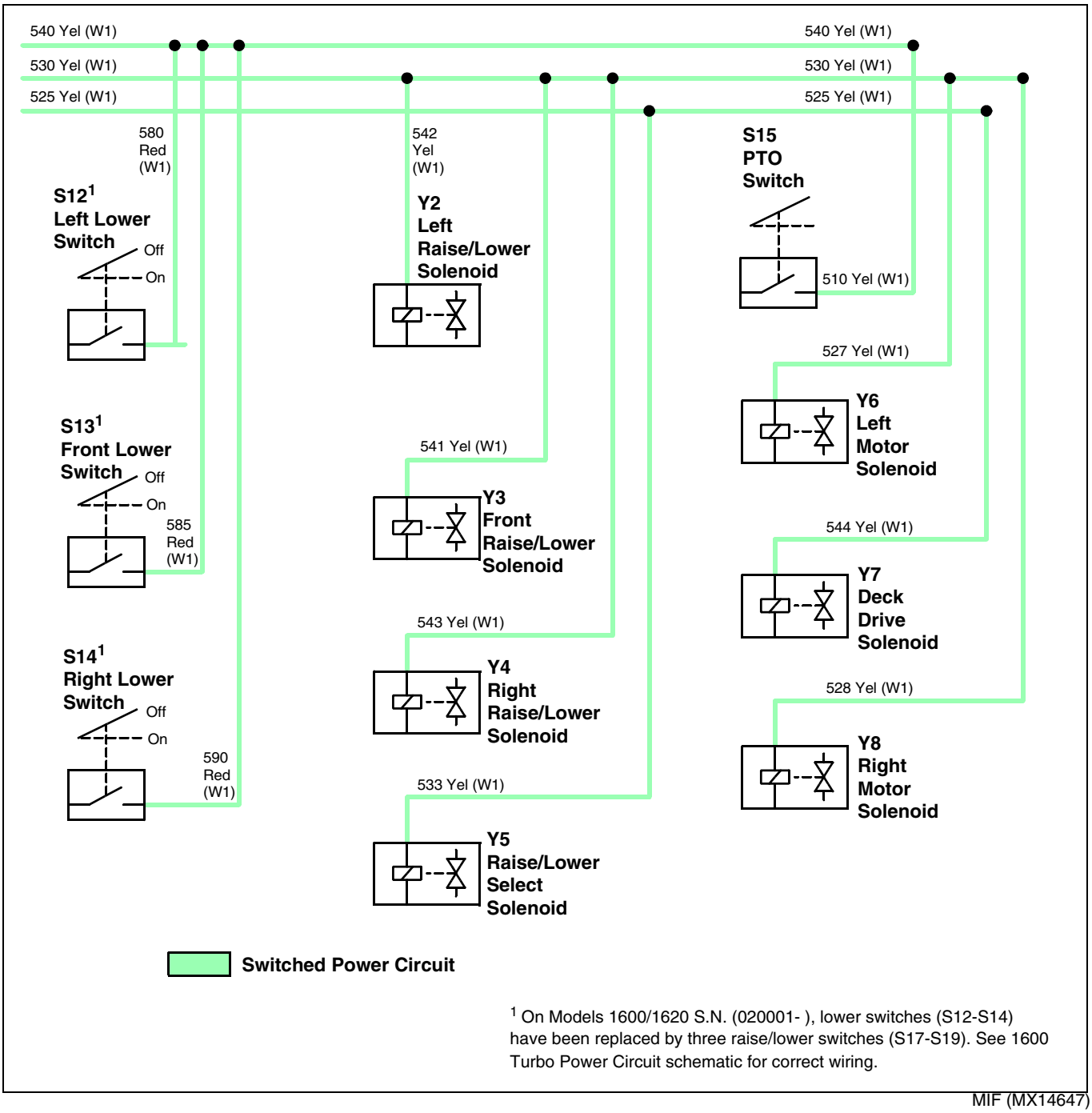
Models 1600/1620 (Sheet 3 of 4)



[1] On Models 1600/1620 S.N. (020001-), raise switches (S9-S11) have been replaced by three raise/lower switches (S17-S19). See 1600 Turbo Power Circuit schematic for correct wiring.

MIF (MX14646)

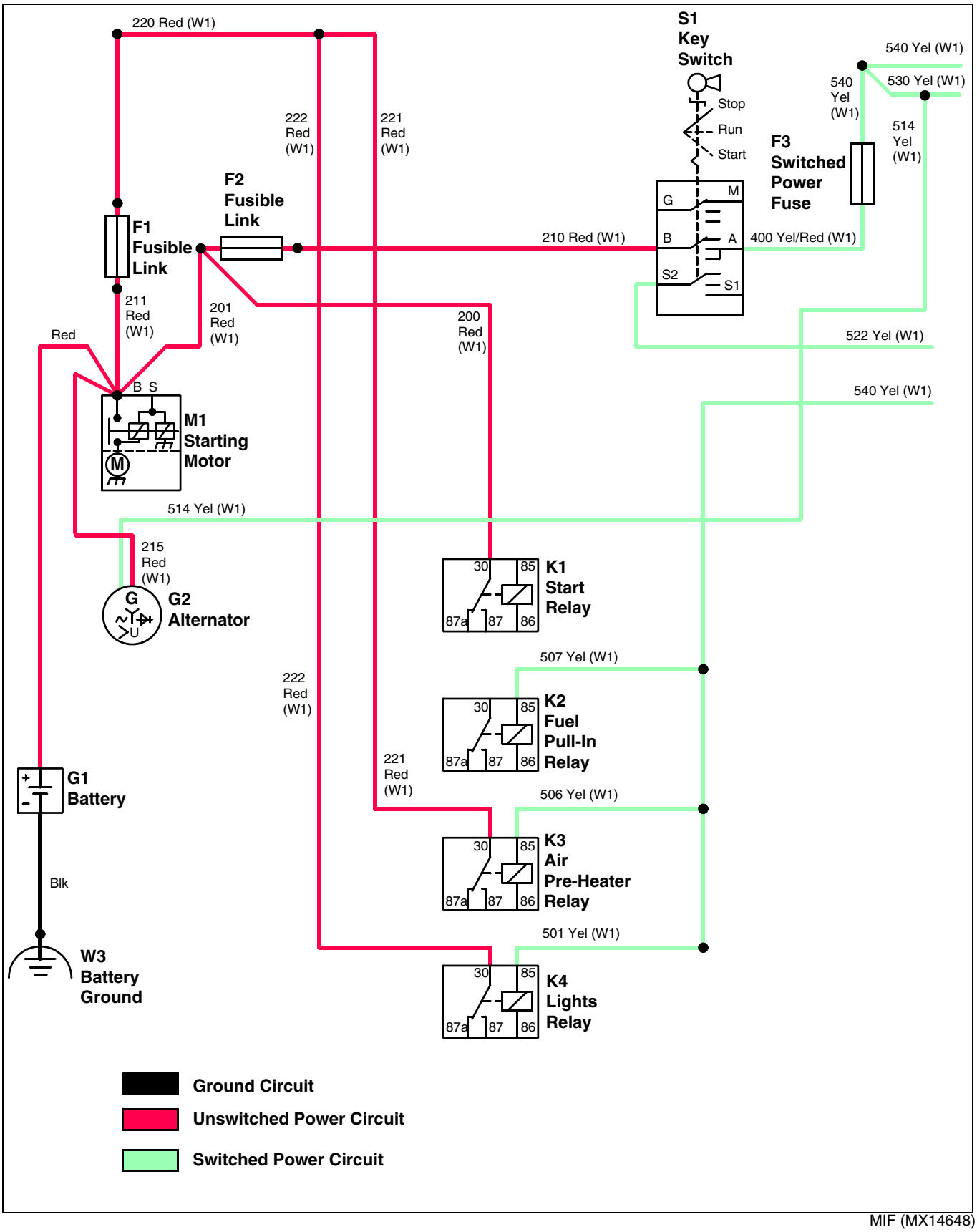
Models 1600/1620 (Sheet 4 of 4)



[1] On Models 1600/1620 S.N. (020001-), lower switches (S12-S14) have been replaced by three raise/lower switches (S17-S19). See 1600 Turbo Power Circuit schematic for correct wiring.

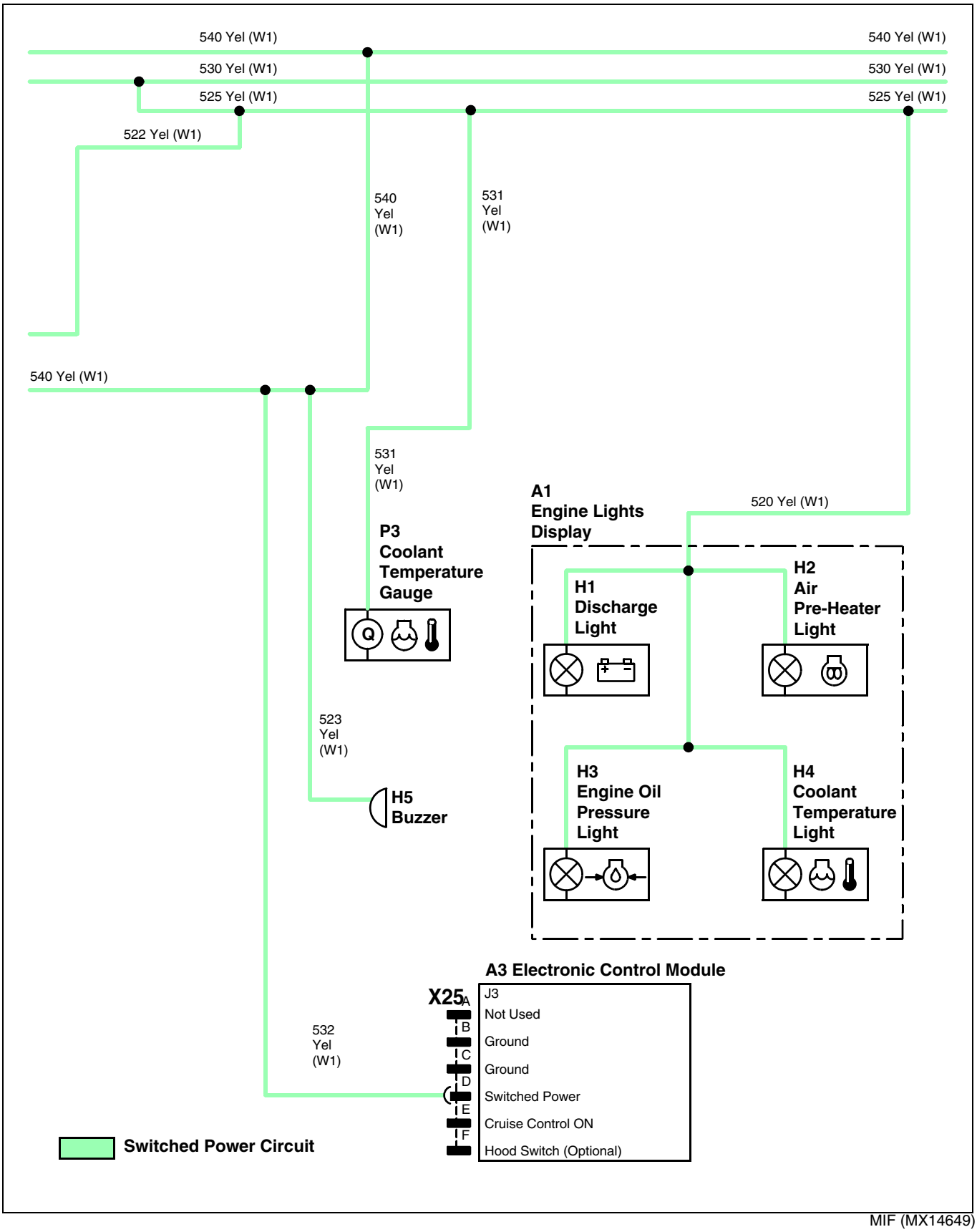
MIF (MX14647)

Model 1600 Turbo (Sheet 1 of 4)



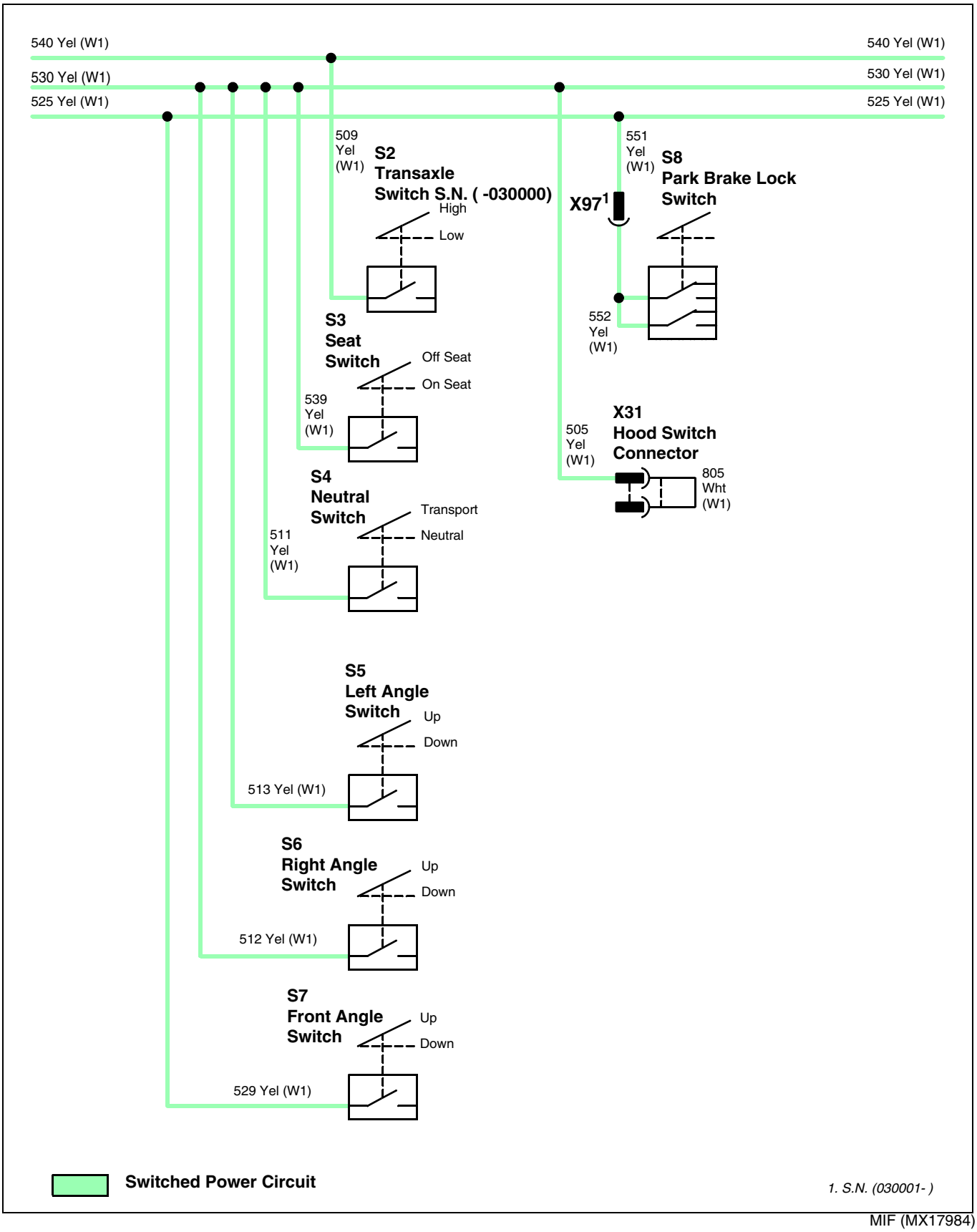
MIF (MX14648)

Model 1600 Turbo (Sheet 2 of 4)



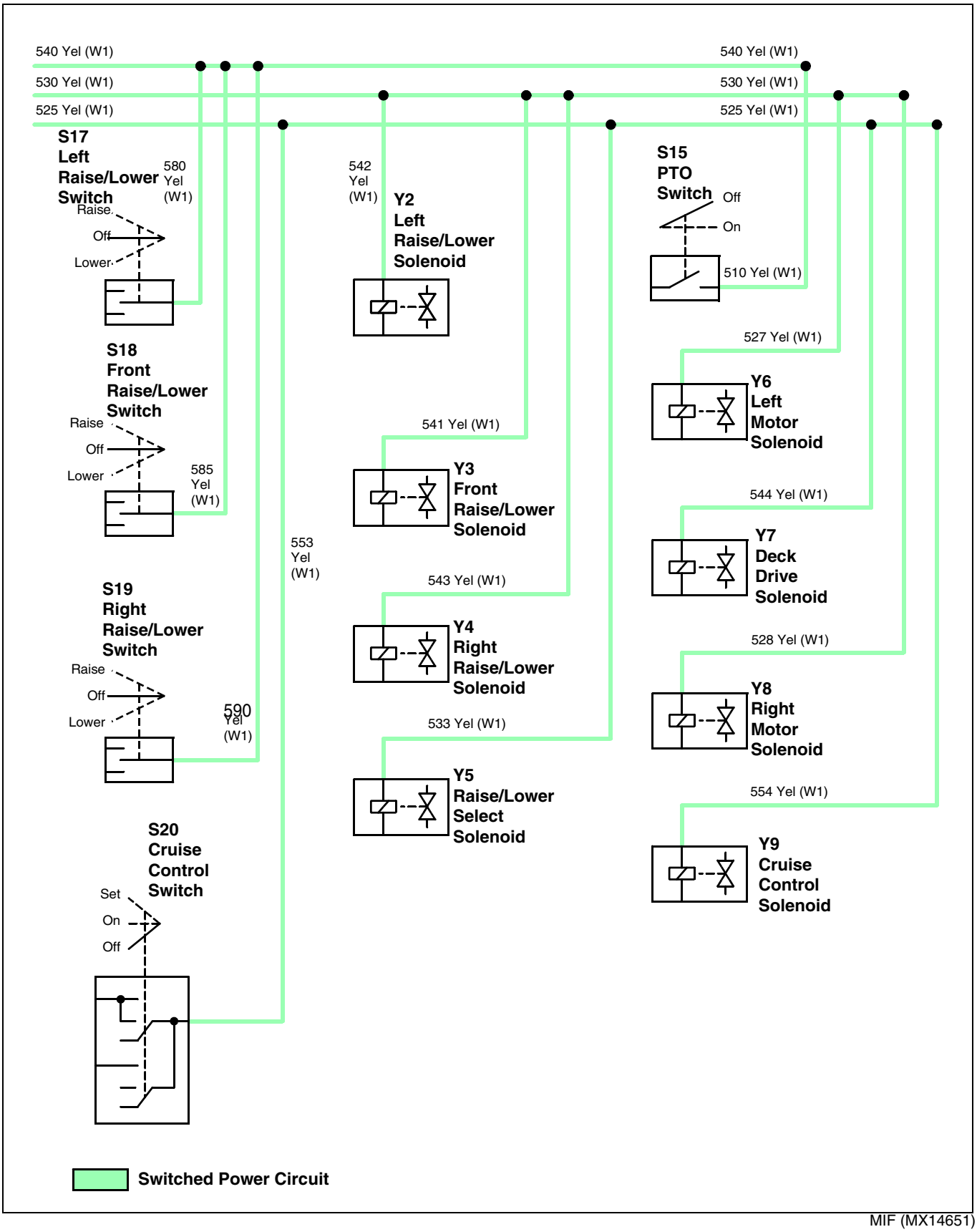
MIF (MX14649)

Model 1600 Turbo (Sheet 3 of 4)



MIF (MX17984)

Model 1600 Turbo (Sheet 4 of 4)



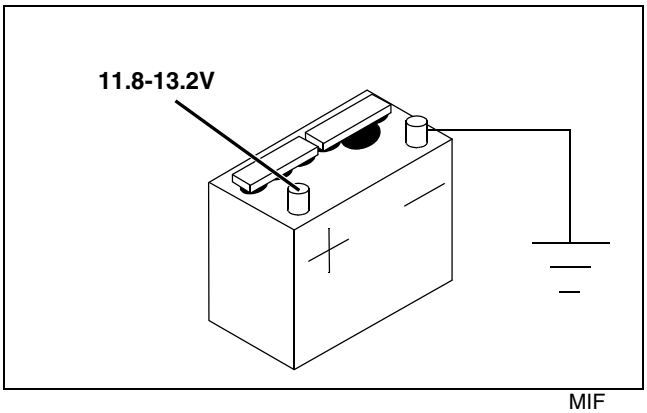
MIF (MX14651)

Unswitched Power Circuit Diagnosis

Test Conditions:

- Machine parked on a level surface.
- Key switch in OFF position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Unswitched Power Circuit Diagnosis

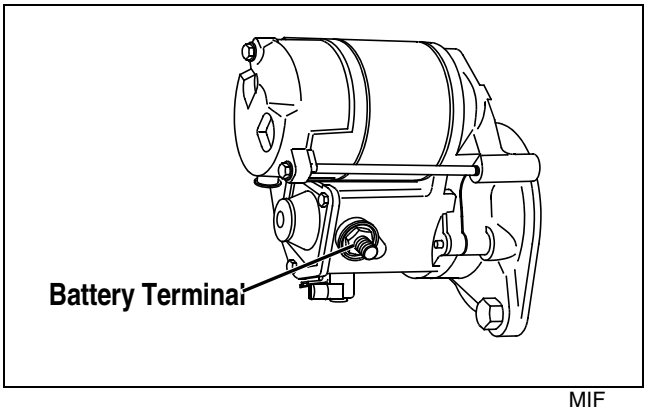


MIF

(1) Battery Positive (+) Post. Measure voltage. Is voltage in the range 11.8-13.2V?

Yes - Go To Step (2)

No - Check battery condition. (See “Battery Test” on page 358.)



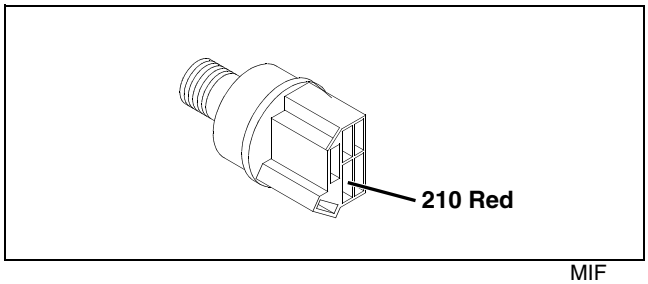
MIF

(2) Starting Motor Solenoid - Battery Terminal. Is battery voltage present?

Yes - Go To Step (3)

No - Check battery positive (+) cable and clamps. Clean and tighten connections.

System: Unswitched Power Circuit Diagnosis

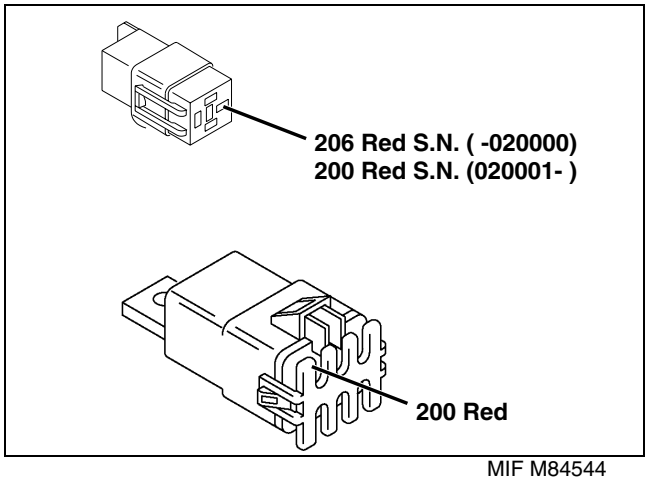


MIF

(3) Key Switch (S1) - Terminal B. Is battery voltage present?

Yes - Go To Step (4)

No - Test wires 201 (fusible link F2) and 210 red, and connections.



MIF M84544

Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

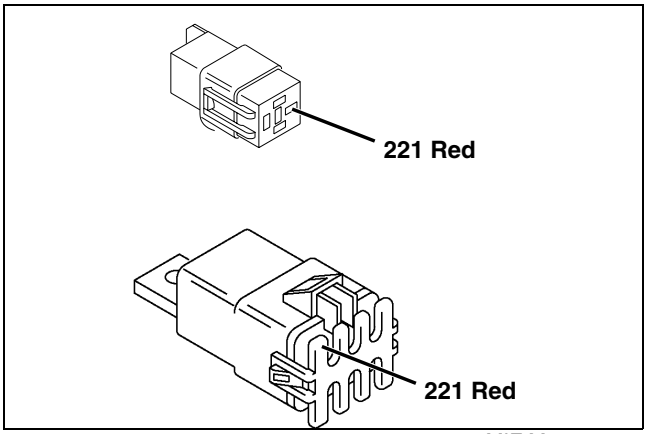
(4) Start Relay (K1) - Terminal 30. Is battery voltage present?

Yes - Go To Step (5)

No - Models 1600/1620 S.N. (-020000): Test wires 201 (fusible link F2), 200, and 206 red, and connections.

No - Models 1600/1620 S.N. (020001-) and 1600 Turbo: Test wires 201 (fusible link F2), 200 red, and connections.

System: Unswitched Power Circuit Diagnosis



MIF M84544

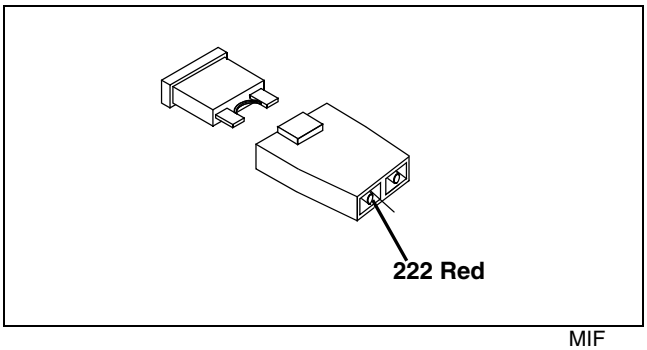
Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(5) Air Pre-Heater Relay (K3) - Terminal 30. Is battery voltage present?

Yes - Models 1600/1620: Go To Step (6).

Yes - Model 1600 Turbo: Go To Step (7).

No - Test wires 211 (fusible link F1), 220, and 221 red, and connections.



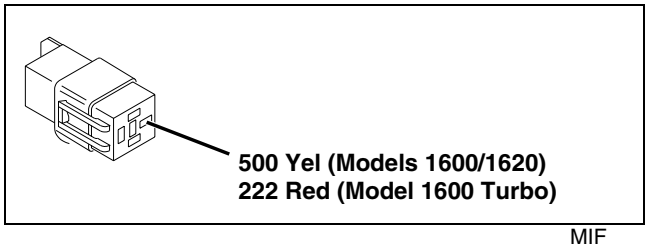
MIF

(6) Lights Fuse (F4) - Terminal B, Wire 222 Red. Is battery voltage present?

Yes - Go To Step (7)

No - Test wires 222, 220, and 211 (fusible link F1) red and connections.

System: Unswitched Power Circuit Diagnosis



MIF

(7) Lights Relay (K4)[a] - Terminal 30. Is battery voltage present?

Yes - See “Switched Power Circuit Diagnosis” on page 242.

No - Models 1600/1620: Test lights fuse (F4), and wire 500 yellow, and connections.

No - Model 1600 Turbo: Test wires 211 (fusible link F1), 220, and 222 red, and connections.

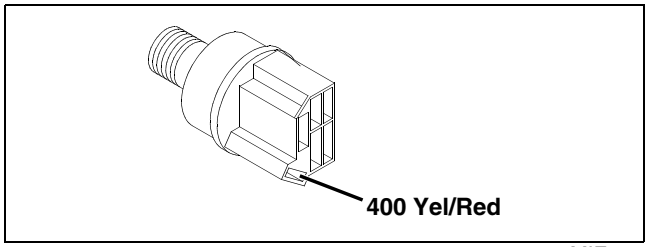
a. Models 1600/1620: lights relay (K4) is optional.

Switched Power Circuit Diagnosis

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Switched Power Circuit



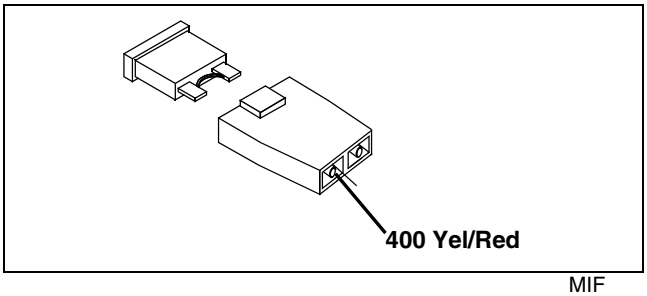
MIF

(1) Key Switch (S1) - Terminal A, Wire 400 Yellow/Red. Is battery voltage present?

Yes - Go To Step (2)

No - Test key switch. (See “Key Switch Test” on page 364.)

System: Switched Power Circuit

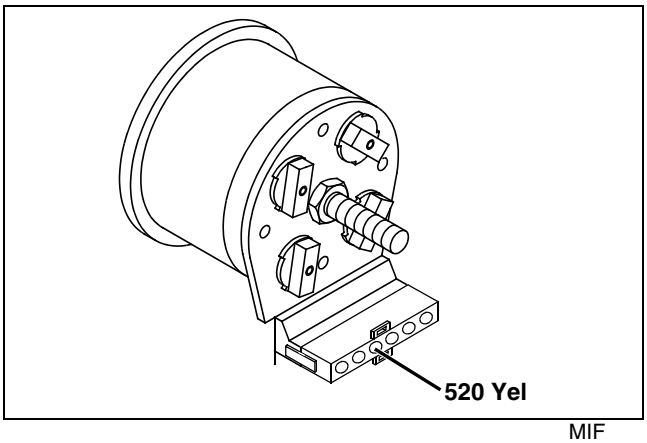


MIF

(2) Switched Power Fuse (F3) - Wire 400 Yellow/ Red. Is battery voltage present?

Yes - Go To Step (3)

No - Test wire 400 yellow/red and connections.



MIF

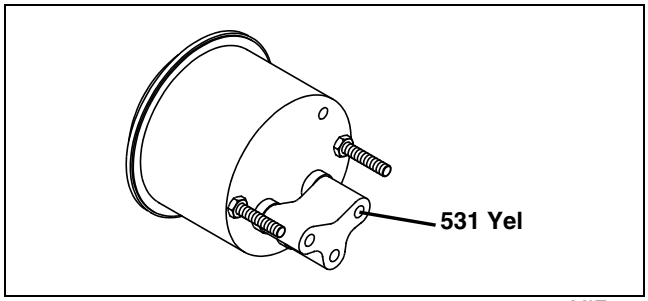
(3) Engine Lights Display (A1) - Wire 520 Yellow. Is battery voltage present?

Yes - Models 1600/1620: Go To Step (4).

Yes - Model 1600 Turbo: Go To Step (5).

No - Test wires 520, 525, 530, and 540 yellow, and connections.

System: Switched Power Circuit

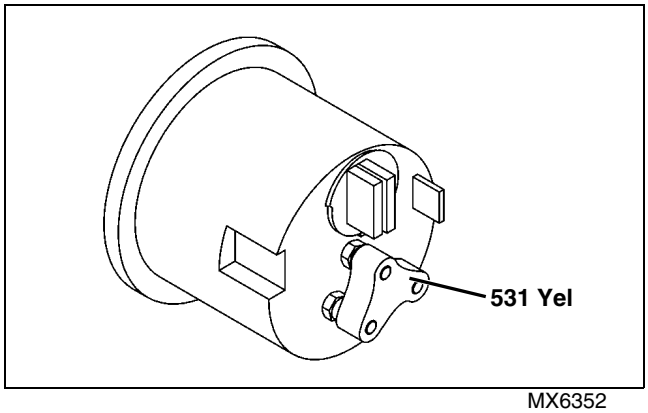


MIF

(4) Fuel Gauge (P2) - Wire 531 Yellow (Models 1600/1620). Is battery voltage present?

Yes - Go To Step (6)

No - Test wires 531, 525, 530, and 540 yellow, and connections.



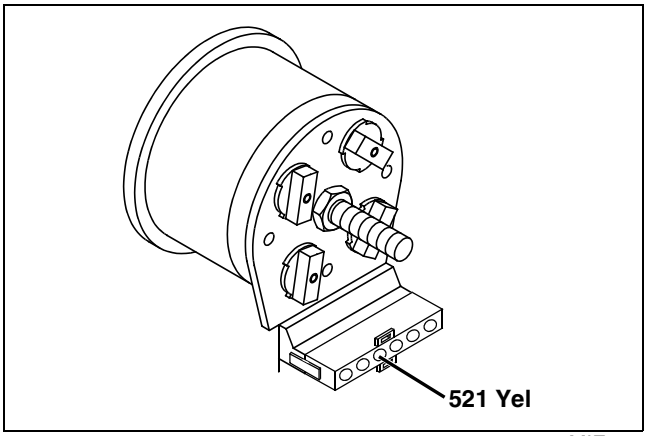
MX6352

(5) Coolant Temperature Gauge (P3) - Wire 531 Yellow (Model 1600 Turbo). Is battery voltage present?

Yes - Go To Step (7)

No - Test wires 531, 525, 530,and 540 yellow, and connections.

System: Switched Power Circuit

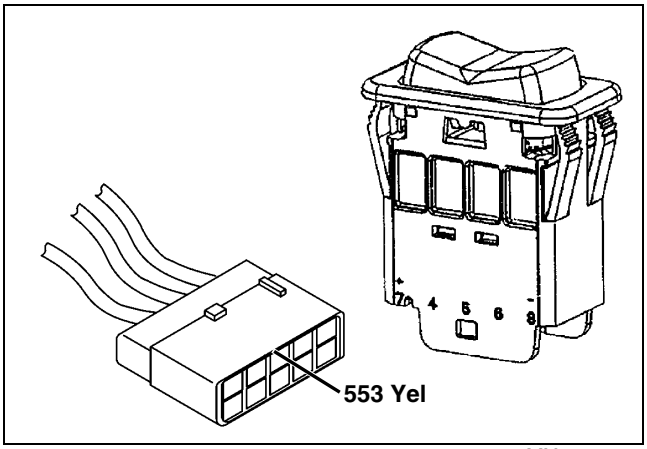


MIF

(6) PTO Lights Display (A2) - Wire 521 Yellow (Models 1600/1620). Is battery voltage present?

Yes - Go To Step (8)

No - Test wires 521, 525, 530, and 540 yellow, and connections.



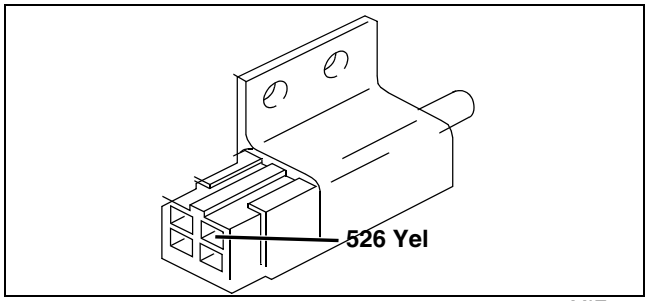
MX6354

(7) Cruise Control Switch (S20) - Wire 553 Yellow (Model 1600 Turbo). Is battery voltage present?

Yes - Go To Step (9)

No - Test wires 553, 525, 530, and 540 yellow, and connections.

System: Switched Power Circuit

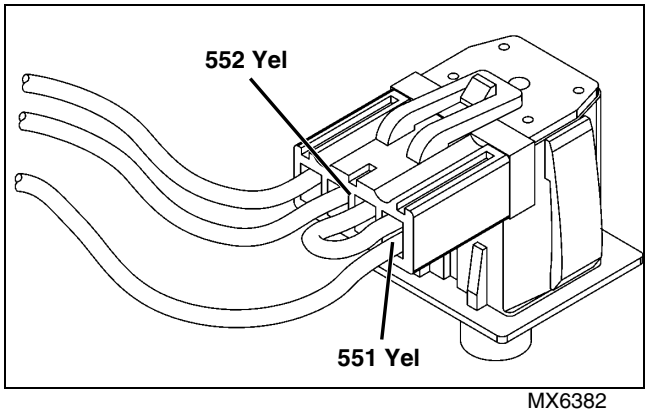


MIF

(8) Park Brake Lock Switch (S8) - Wire 526 Yellow (Models 1600/1620). Is battery voltage present?

Yes - Go To Step (10)

No - Test wires 526, 525, 530, and 540 yellow, and connections.



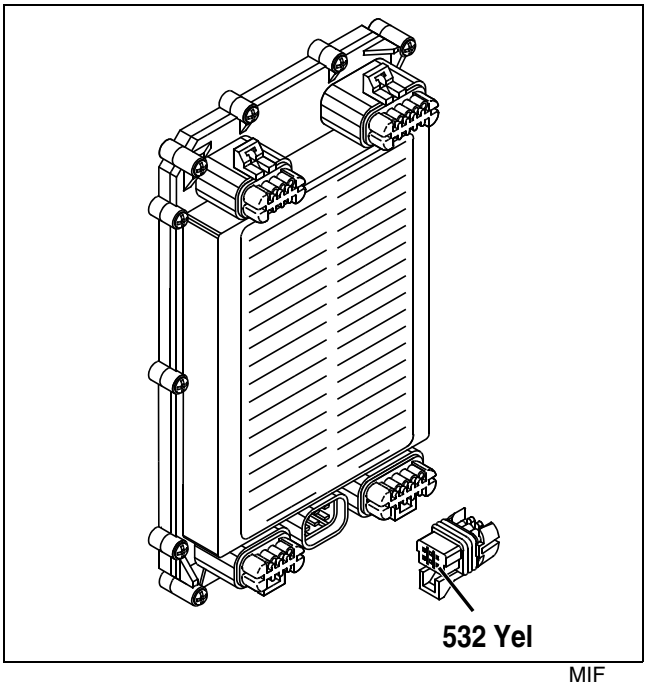
MX6382

(9) Park Brake Lock Switch (S8)[a] - Wires 551 and 552 Yellow (Model 1600 Turbo). Is battery voltage present?

Yes - Go To Step (10)

No - Test wires 551, 552, 525, 530, and 540 yellow, and connections.

System: Switched Power Circuit

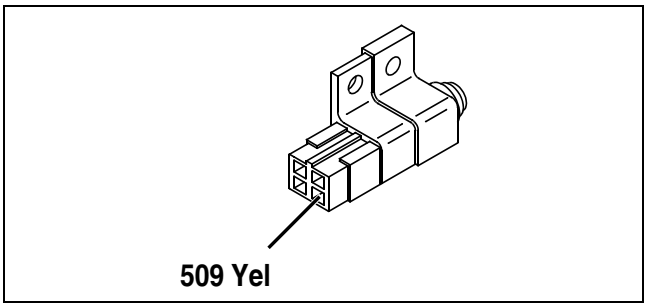


MIF

(10) Electronic Control Model (A3) - Connector X25, Terminal D, Wire 532 Yellow. Is battery voltage present?

Yes - Go To Step (11)

No - Test wires 532 and 540 yellow, and connections.



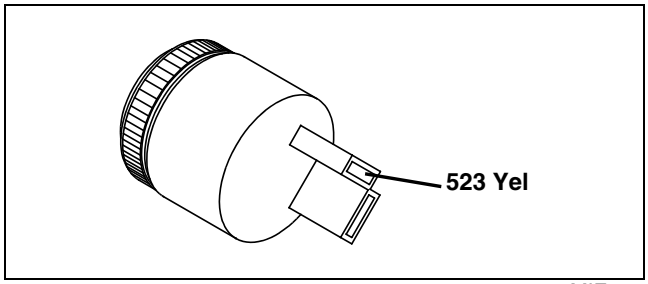
MIF

(11) Transaxle Switch (S2)[b] - Wire 509 Yellow. Is battery voltage present?

Yes - Go To Step (12)

No - Test wires 509 and 540 yellow, and connections.

System: Switched Power Circuit

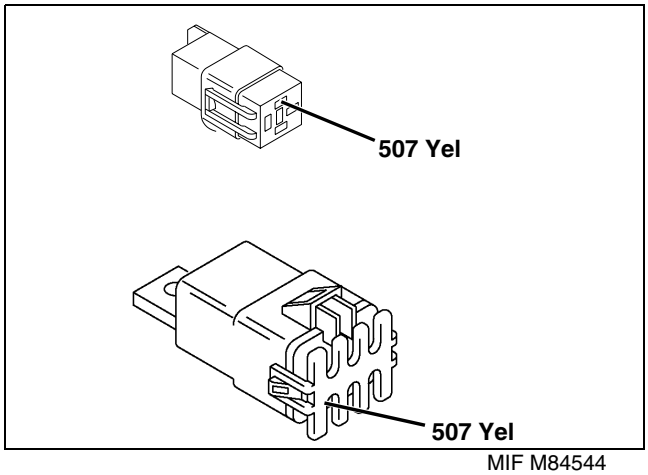


MIF

(12) Buzzer (H5) - Wire 523 Yellow. Is battery voltage present?

Yes - Go To Step (13)

No - Test wires 523 and 540 yellow, and connections.



MIF M84544

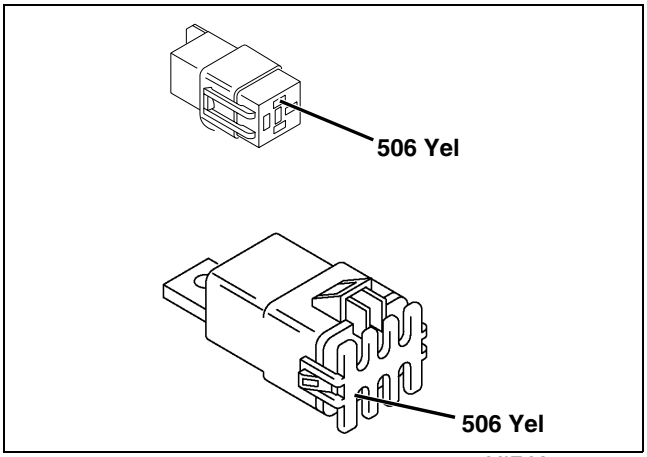
Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(13) Pull-In Relay (K2) - Terminal 85, Wire 507 Yellow. Is battery voltage present?

Yes - Go To Step (14)

No - Test wires 507 and 540 yellow, and connections.

System: Switched Power Circuit



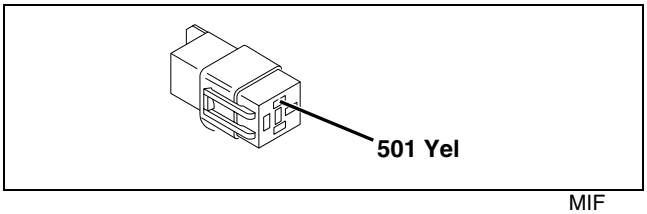
MIF M84544

Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(14) Air Pre-Heater Relay (K3) - Terminal 85, Wire 506 Yellow. Is battery voltage present?

Yes - Go To Step (15)

No - Test wires 506 and 540 yellow, and connections.



MIF

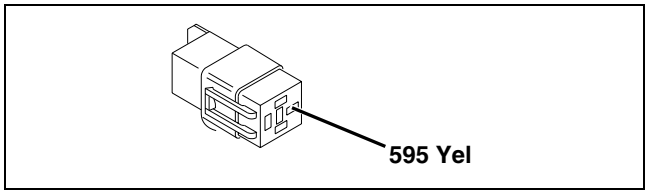
(15) Lights Relay (K4)[c] - Terminal 85. Is battery voltage present?

Yes - Models 1600/1620: Go To Step (16).

Yes - Model 1600 Turbo: Go To Step (17).

No - Test wires 501 and 540 yellow, and connections.

System: Switched Power Circuit



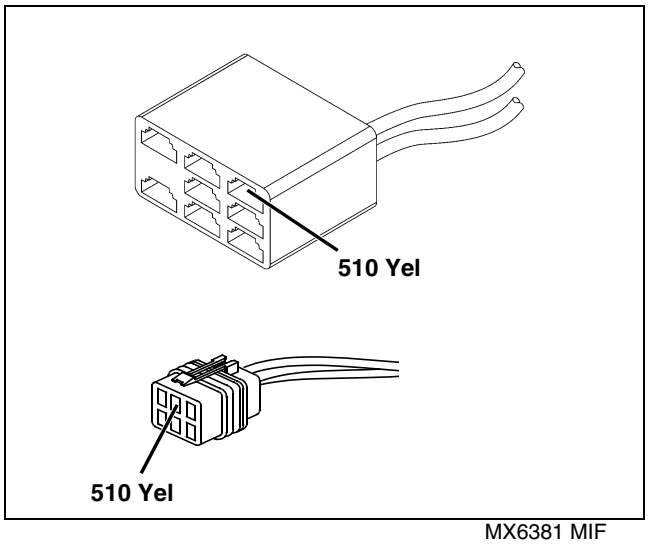
MIF

(16) Hold Coil Relay (K5)[d] - Terminal 30, Wire 595 Yellow. Is battery voltage present?

Yes - Go To Step (17)

No - Models 1600/1620 S.N. (010000-020000): Test wires 595, 597, and 540 yellow, and connections.

No - Models 1600/1620 S.N. (020001-): Test wires 595, 596, and 540 yellow, and connections.



MX6381 MIF

Picture Note:
UPPER: Models 1600/1620 S.N. (020001-) and Model 1600 Turbo
LOWER: 1600/1620 S.N. (-020000)

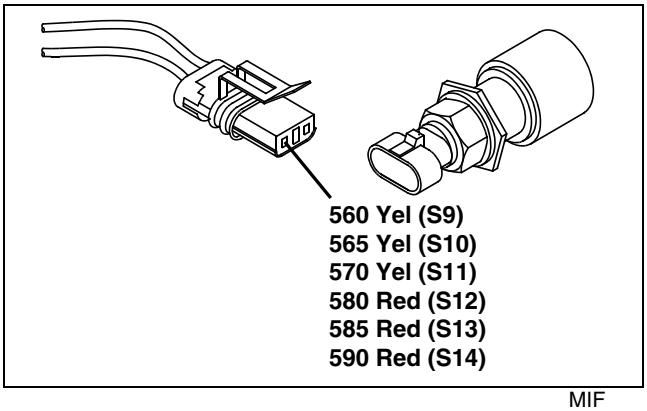
(17) PTO Switch (S15) - Wire 510 Yellow. Is battery voltage present?

Yes - Models 1600/1620 S.N. (-020000): Go To Step (18).

Yes - Models 1600/1620 S.N. (020001-) and Model 1600 Turbo: Go To Step (19).

No - Test wires 510 and 540 yellow, and connections.

System: Switched Power Circuit

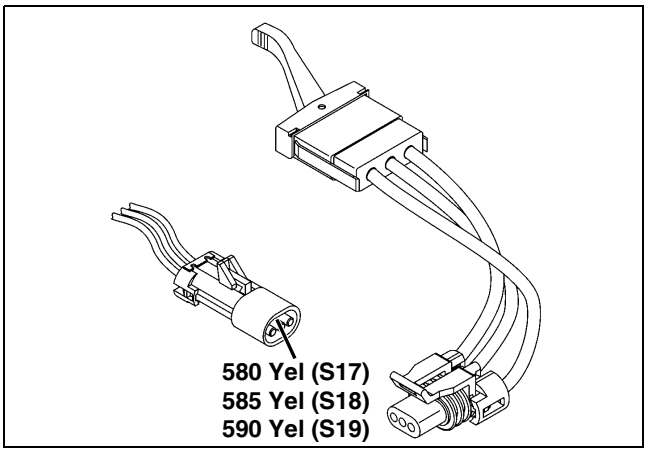


MIF

(18) Raise/Lower Switches (S9-S14) - Terminal A (Models 1600/1620 S.N. (-020000). Is battery voltage present?

Yes - Go To Step (20)

No - Test wires 560 (S9), 565 (S10), 570 (S11), and 540 yellow, and connections. Test wires 580 (S12), 585 (S13), 590 (S14), and 540 red, and connections.



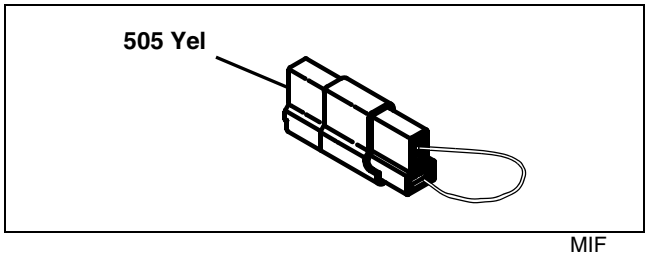
MX6353

(19) Raise/Lower Switches (S17-S19) - Terminal B (Models 1600/1620 S.N. (020001-) and 1600 Turbo). Is battery voltage present?

Yes - Go To Step (20)

No - Test wires 580 (S17), 585 (S18), 590 (S19), and 540 yellow, and connections.

System: Switched Power Circuit

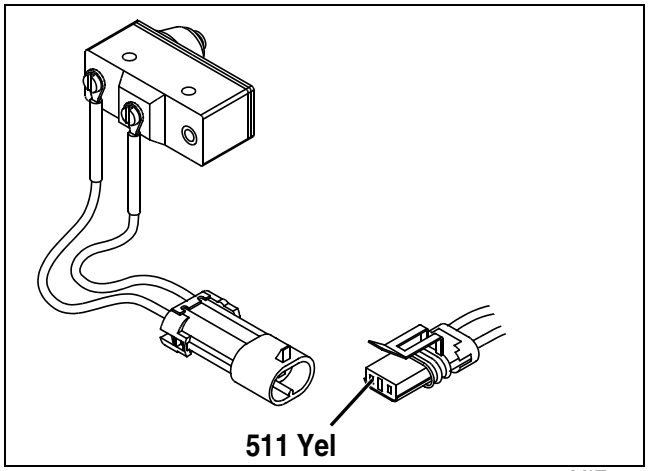


MIF

(20) Hood Switch Connector (X31) - Wire 505 Yellow. Is battery voltage present?

Yes - Go To Step (21)

No - Test wires 505, 530, and 540 yellow, and connections.

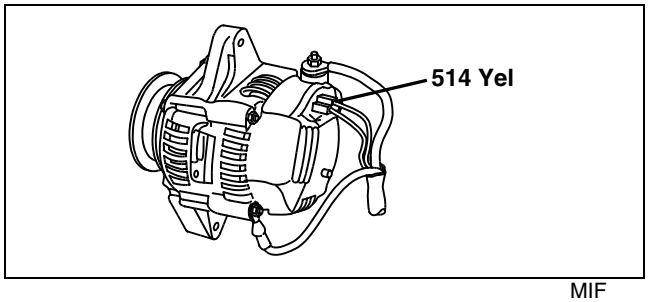


MIF

(21) Neutral Switch (S4) - Wire 511 Yellow. Is battery voltage present?

Yes - Go To Step (22)

No - Test wires 511, 530, and 540 yellow, and connections.



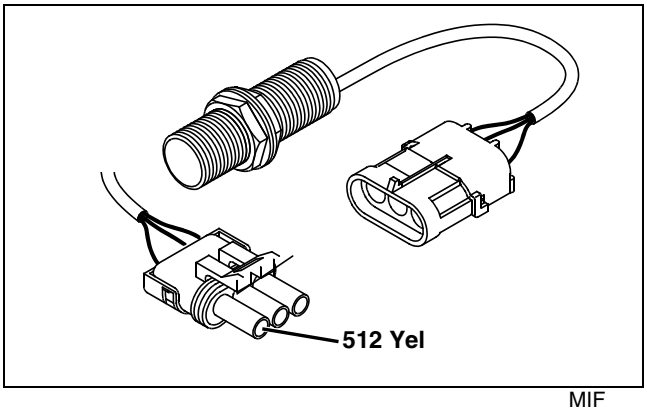
MIF

(22) Alternator (G2) - Wire 514 Yellow. Is battery voltage present?

Yes - Go To Step (23)

No - Test wires 514, 530, and 540 yellow, and connections.

System: Switched Power Circuit

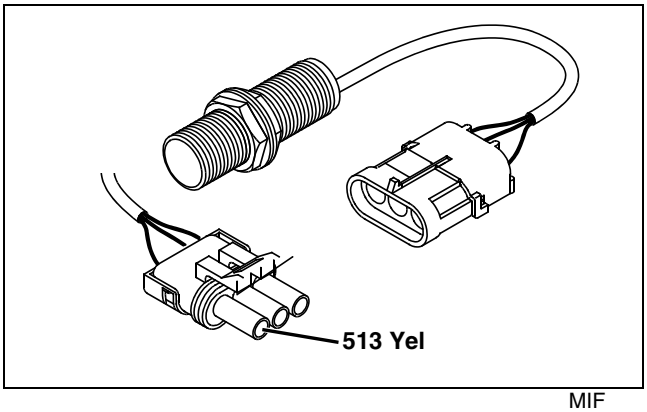


MIF

(23) Right Angle Switch (S6) - Terminal A, Wire 512 Yellow. Is battery voltage present?

Yes - Go To Step (24)

No - Test wires 512, 530, and 540 yellow, and connections.



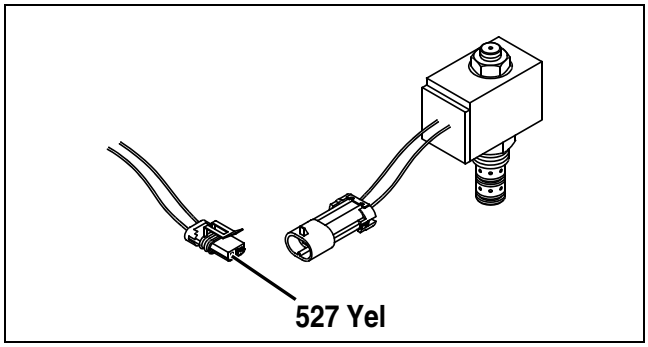
MIF

(24) Left Angle Switch (S5) - Terminal A, Wire 513 Yellow. Is battery voltage present?

Yes - Go To Step (25)

No - Test wires 513, 530, and 540 yellow, and connections.

System: Switched Power Circuit

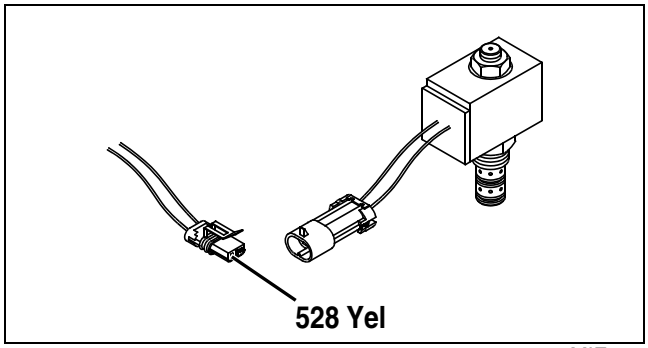


MIF

(25) Left Motor Solenoid (Y6) - Terminal A, Wire 527 Yellow. Is battery voltage present?

Yes - Go To Step (26)

No - Test wires 527, 530, and 540 yellow, and connections.



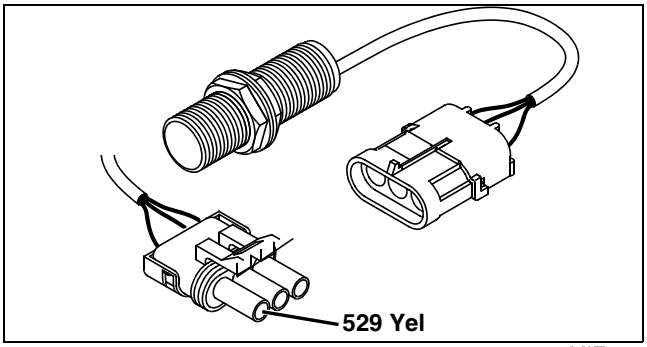
MIF

(26) Right Motor Solenoid (Y8) - Terminal A, Wire 528 Yellow. Is battery voltage present?

Yes - Go To Step (27)

No - Test wires 528, 530, and 540 yellow, and connections.

System: Switched Power Circuit

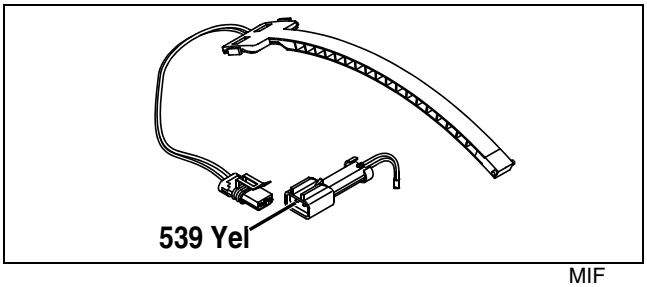


MIF

(27) Front Angle Switch (S7) - Terminal A, Wire 529 Yellow. Is battery voltage present?

Yes - Go To Step (28)

No - Test wires 529, 525, 530, and 540 yellow, and connections.

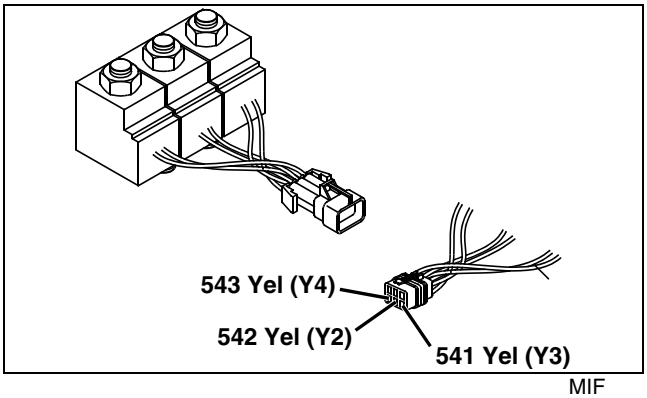


MIF

(28) Seat Switch (S3) - Terminal B, Wire 539 Yellow. Is battery voltage present?

Yes - Go To Step (29)

No - Test wires 539, 530, and 540 yellow, and connections.



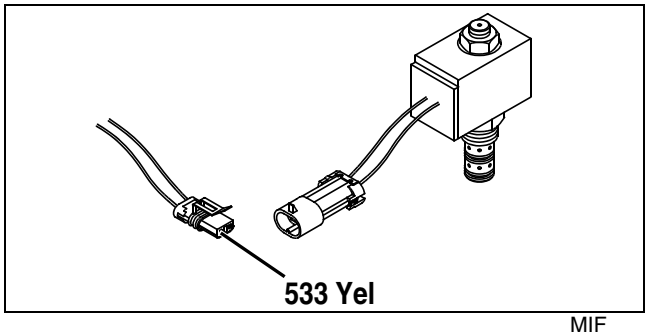
MIF

(29) Raise/Lower Solenoids (Y2-Y4) - Wires 542, 541, and 543 Yellow. Is battery voltage present?

Yes - Go To Step (30)

No - Test wires 542 (Y2), 541 (Y3), 543 (Y4), 530, and 540 yellow, and connections.

System: Switched Power Circuit

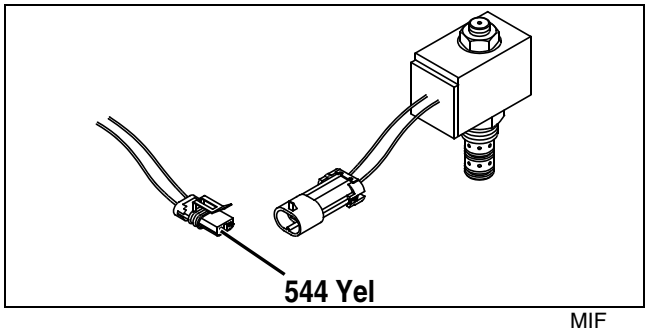


MIF

(30) Raise/Lower Select Solenoid (Y5)[e] - Terminal A, Wire 533 Yellow. Is battery voltage present?

Yes - Go To Step (31)

No - Test wires 533, 525, 530, and 540 yellow, and connections.



MIF

(31) Deck Drive Solenoid (Y7)[f] - Terminal A, Wire 544 Yellow. Is battery voltage present?

No - Test wires 544, 525, 530, and 540 yellow, and connections.

a. Models S.N. (030001-) incorporate a jumper harness (W10) between the main harness (W1) and the park brake lock switch (S8).

b. Models 1600/1620 and 1600 Turbo S.N. (-030000)

c. Models 1600/1620: lights relay (K4) is optional.

d. Hold coil relay is part of MPTC10114 Light Kit.

e. Models 1600/1620 shown. Model 1600 Turbo does not use pigtail.

f. Models 1600/1620 shown. Model 1600 Turbo does not use pigtail.

Cranking Circuit Operation

Function

Provides power to the starting motor (M1) to crank the engine and energize the fuel shutoff solenoid (Y1).

Operating Conditions

To crank the engine, the following conditions must be met:

- Key switch in start position.
- Operator ON seat or park brake locked.
- Machine in NEUTRAL.
- Hood switch connector:
  - Hood closed (European machines).
  - Jumper wire in place (North American machines).
- PTO switch in OFF position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the cranking circuit with a fusible link (F2) and 15-amp switched power fuse (F3).

Unswitched power from the battery (G1) positive (+) terminal is available at the following components:

- Key switch (S1), terminal B (wires 201 and 210 red).
- Start relay (K1), terminal 30 (wires 201, 200, and 206 red).

Moving key switch (S1) to the START position allows power to be present at all the components as when in the RUN position and is also present at the following locations:

- Terminal S1 of key switch (S1)
- Terminal 85 of start relay (K1)
- Terminal F of electronic control module connector (X24)

For engine to crank, all of the following conditions must be met:

1. **Key switch, START position -** When key switch is in the START position, current flows from key switch terminal A to switched power fuse (F3) (wire 400 yellow/red) and then to the following:

   a. Key switch terminal S2 (wires 540, 530, 525, and 522 yellow).

   b. Seat switch (S3) (wires 540, 530 and 539 yellow).

   c. Park brake lock switch (S8) (wires 540, 530, 525 and 526[1] yellow).

   d. Neutral switch (S4) (wires 540, 530, and 511 yellow).

   e. Hood switch connector (X31) (wires 540, 530, and 505 yellow).

   f. PTO switch (S15) (wires 540 and 510 yellow.

   g. Control module connector (X25), terminal D (wires 540 and 532 yellow).

   h. Fuel pull-in relay (K2) (wires 540 and 507 yellow).

From key switch terminal S1, current flows to start relay (K1), terminal 85 (wire 735[2] purple/black), and then to electronic control module connector (X24), terminal F (wire 736 purple).

2. **Operator ON seat -** When the operator is ON the seat, switch (S3) is closed, allowing current to flow to control module connector (X24), terminal J (wire 820 gray). When this condition exists, the electronic control module knows that the operator is ON the seat.

When the operator is OFF the seat, switch (S3) is open, thus preventing current flow to control module connector (X24), terminal J. When this condition exists, the electronic control module knows that the operator is OFF the seat.

- OR -

Park brake, LOCKED - When the park brake is engaged (LOCKED), the normally open contacts of switch (S8) are closed, allowing current to flow to control module connector (X24), terminal C (wire 745 blue/white). When this condition exists, the electronic control module knows that the park brake is engaged.

When the park brake is disengaged (UNLOCKED), the normally open contacts of switch (S8) are open, thus preventing current to flow to control module connector (X24), terminal C. When this condition exists, the electronic control module knows that the park brake is disengaged.

3. **Neutral switch, NEUTRAL position -** When the machine is in NEUTRAL, neutral switch (S4) is closed and current flows to control module connector (X24), terminal K (wire 740 purple). When this condition exists, the electronic control module knows that the machine is in NEUTRAL.

When the machine is in TRANSPORT mode, neutral switch (S4) is open, thus preventing current flow to control module connector (X24), terminal K. When this condition exists, the electronic control module knows that the machine is in TRANSPORT mode.

4. **PTO switch in OFF position -** When the PTO switch (S15) is in the OFF position, no current flows to control module connector (X24), terminal B. When this condition exists, the electronic control module knows that the PTO is OFF.

1. Model 1600 Turbo: Wire 551 yellow replaces wire 526. A jumper wire 552 yellow has been added.

2. Model 1600 Turbo uses wire 737 purple in addition to wire 735 purple/black.

When the PTO switch is in the ON position, current flows to control module connector (X24), terminal B (wire 750 blue). When this condition exists, the electronic control module knows that the PTO is ON.

5. **Hood switch (European) or connector with jumper wire (North American) -** When hood is closed (European) or switch connector (X31) with jumper (wire 805 white) (North American) is properly connected, current is allowed to flow to control module connector (X25), terminal F (wire 800 brown). When this condition exists, the electronic control module knows that hood is closed (European machines) or the hood switch connector with jumper wire is properly connected (North American machines).

When the jumper wire 805 is not installed (North American machines), hood is open (European machines), or the hood switch disconnected, current is prevented from flowing to control module connector (X25), terminal F. When this condition exists, the electronic control module knows that the hood switch connector circuit is open (North American machines) or hood is open (European machines).

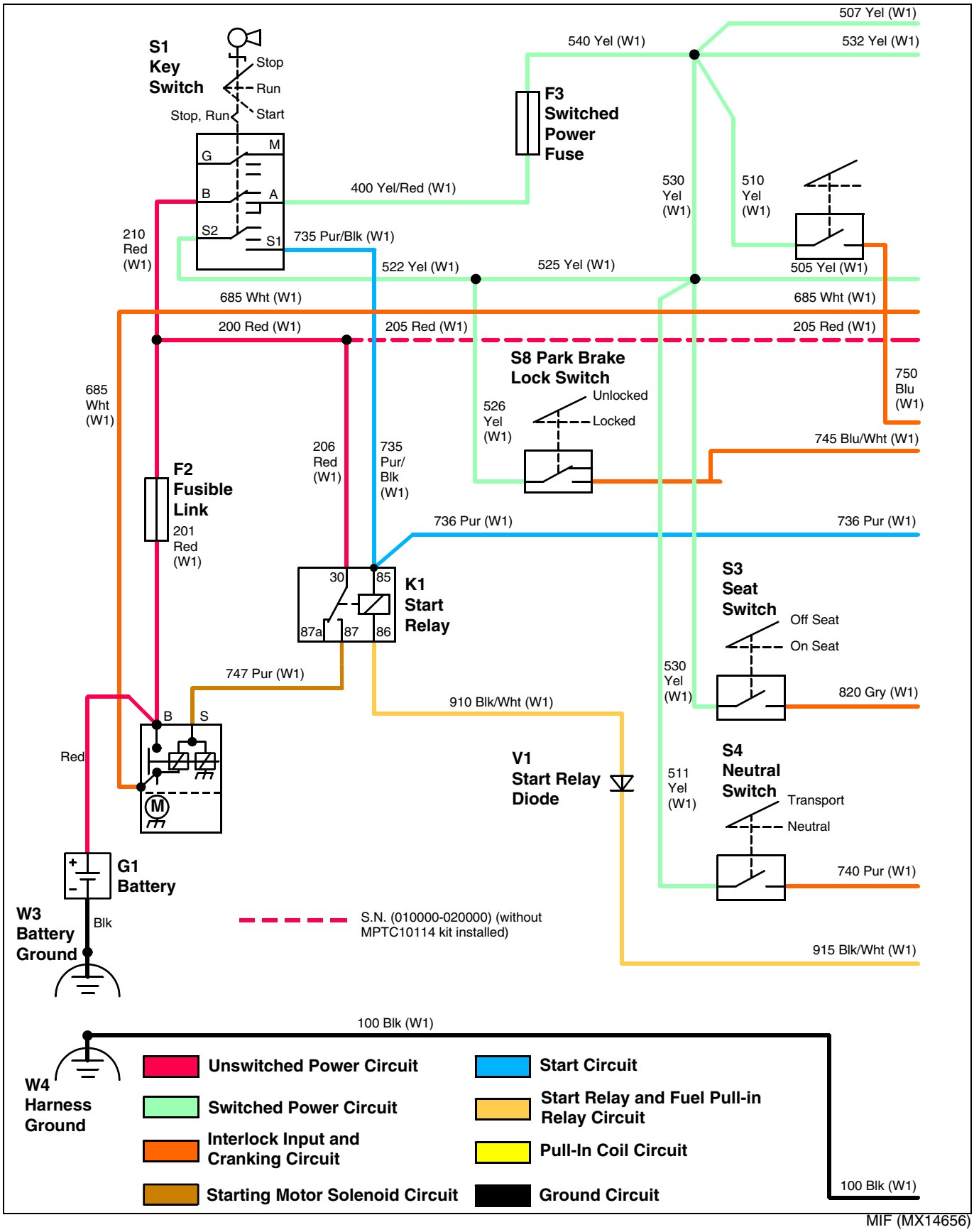
Cranking interlock circuit inputs: seat switch (S3), neutral switch (S4), park brake lock switch (S8), PTO switch (S15) and hood switch connector (X31), are used by the control module to determine whether or not to crank the engine. Power present at control module connector (X24), terminal F indicates that the operator wants to crank the engine. The operating conditions must be verified by the control module or it will NOT allow the engine to crank. When the control module receives inputs, indicating all operating conditions are met, the control module provides ground to start relay (K1), terminal 86 (wire 910 black/white), energizing the relay. With the start relay energized, current from the unswitched power circuit flows to the solenoid of starting motor (M1) (wire 747 purple), engaging the starting motor.

During this time the control module provides a ground path at connector X27, terminal E (wire 935 white[1]) for the coil of fuel pull-in relay (K2), energizing the relay. During the time the starting motor is engaged, current will flow from the starting motor (M1) to fuel pull-in relay (K2), terminal 30 (wire 685 white). The current flows across the relay contacts to the pull-in coil of fuel shutoff solenoid (Y1), energizing the coil. The energized coil causes the solenoid armature to move the fuel shutoff linkage to the ON position, allowing the engine to start.

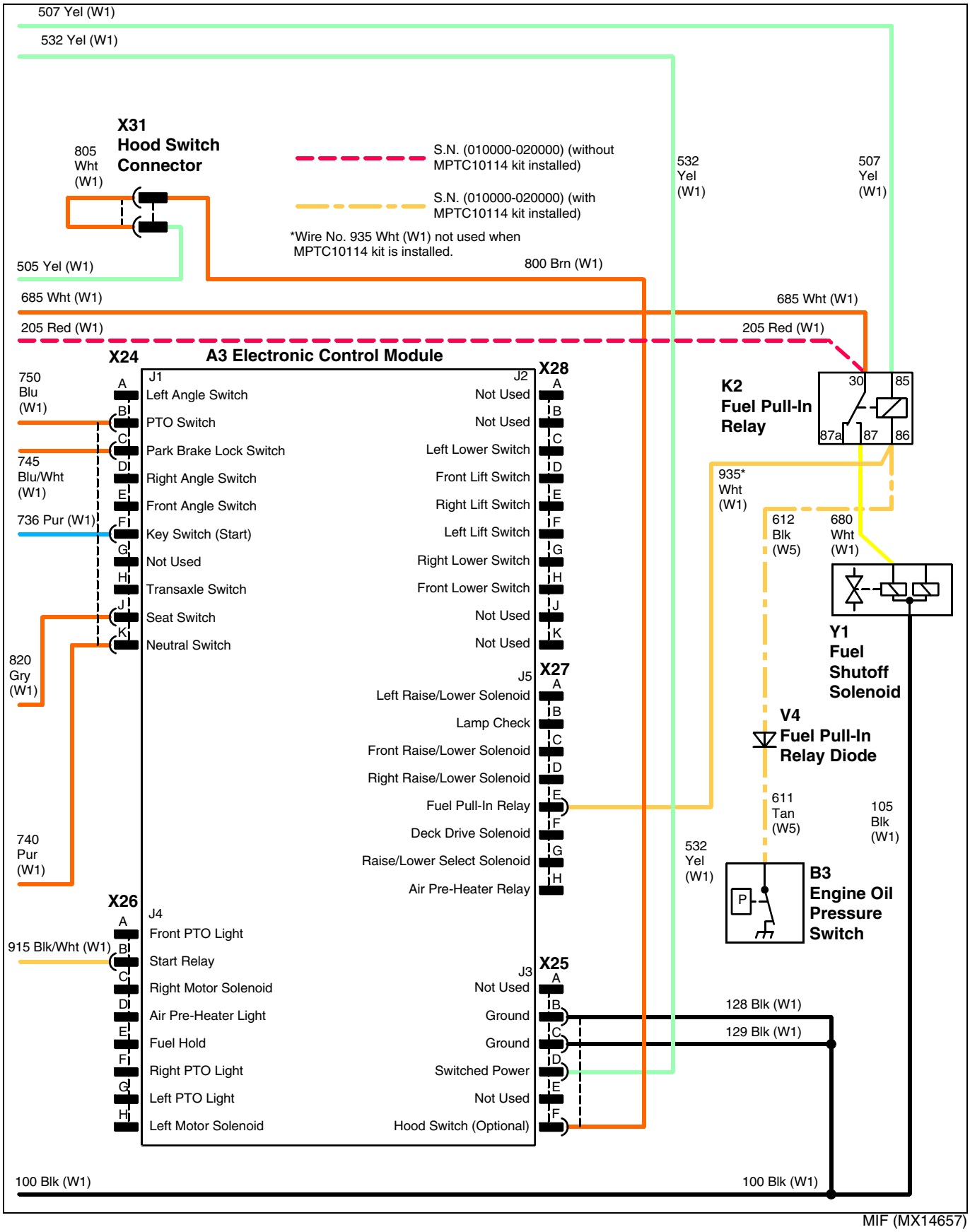
1. For Models 1600/1620 S.N. (010000-020000) with MPTC10114 kit installed, wire 935 white is disconnected from terminal 86 of relay (K2). The ground path for the relay is provided by engine oil pressure switch (B3) using wire 612 black (W5).

Cranking Circuit Schematics

Models 1600 and 1620

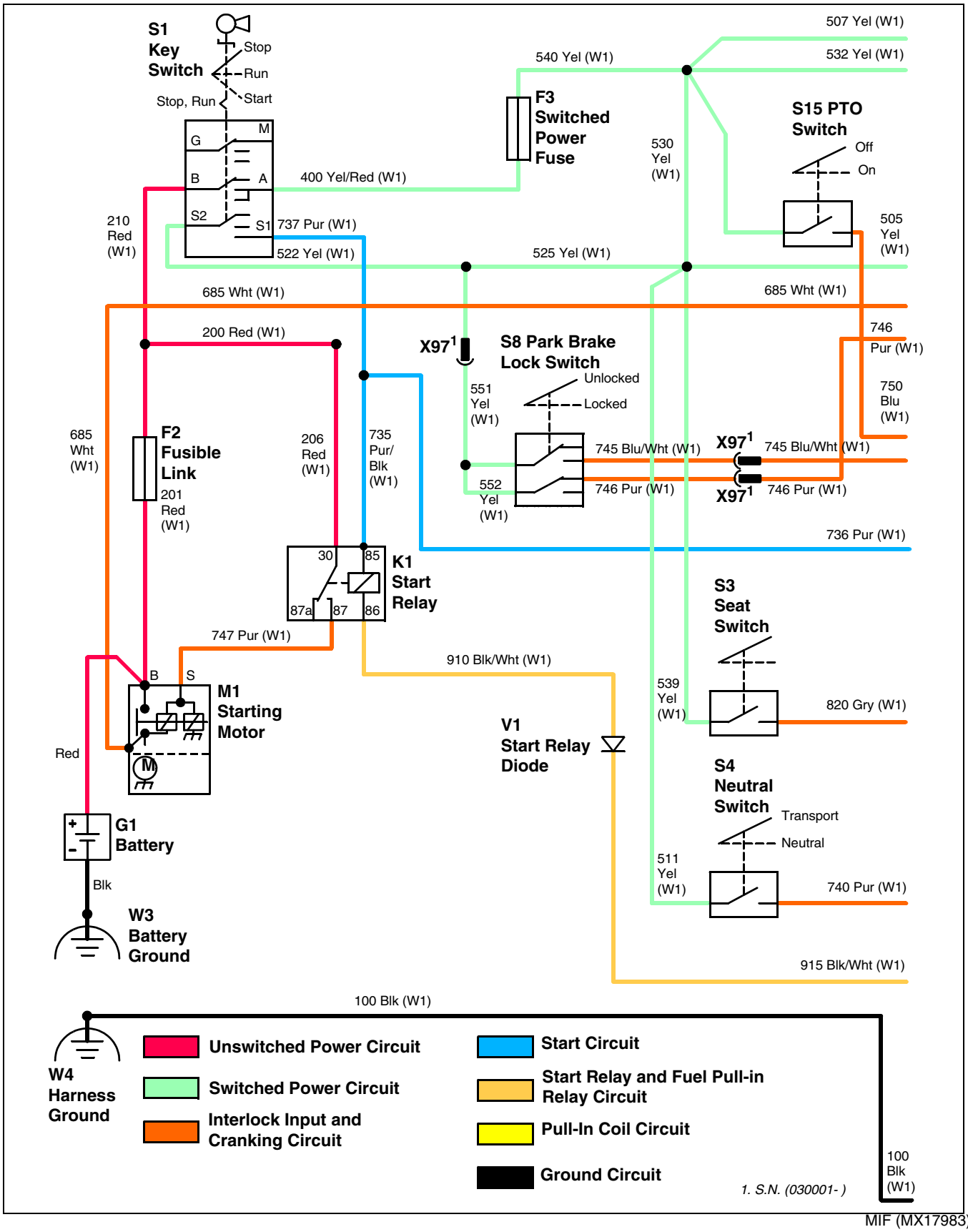


MIF (MX14656)

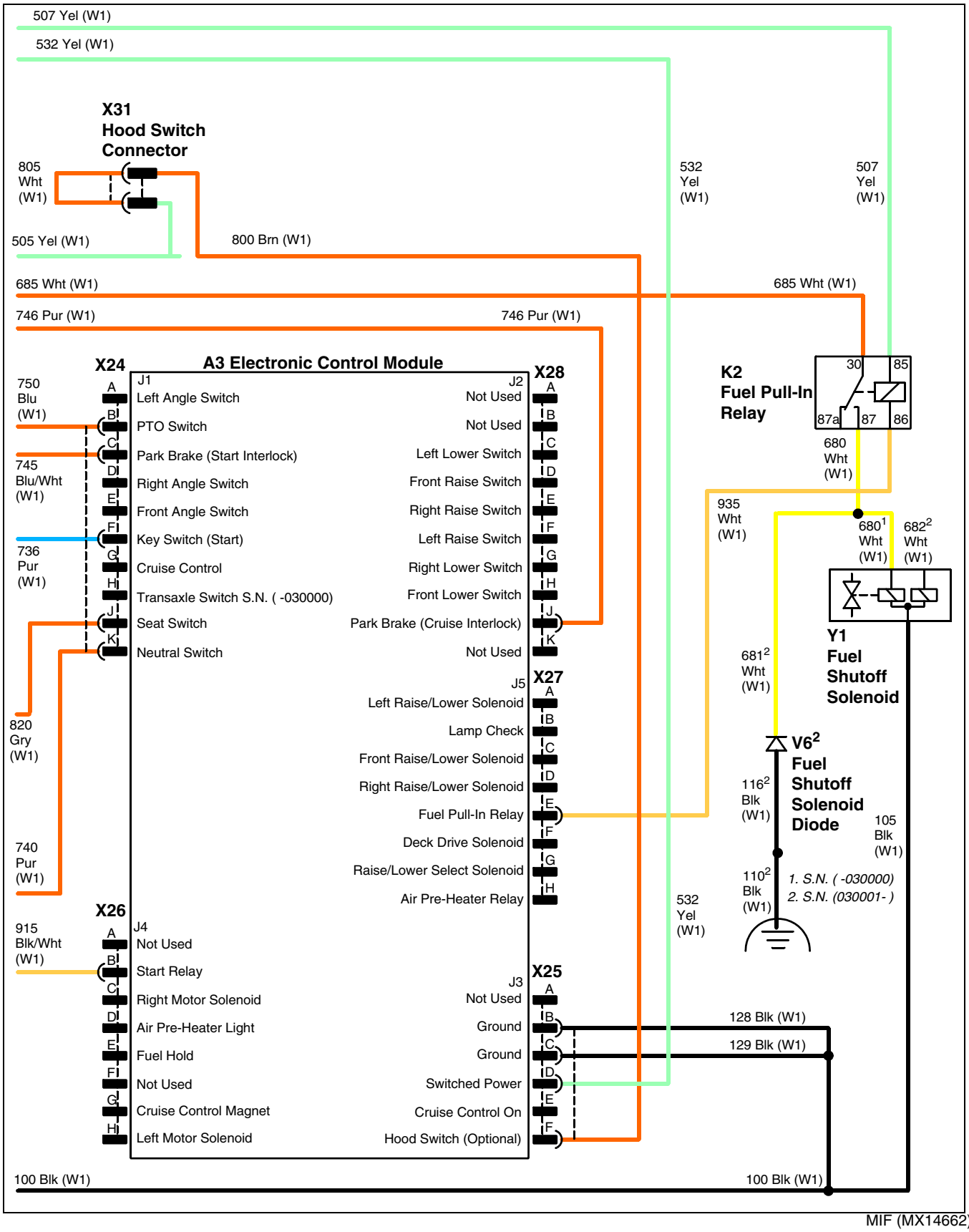

507 Yel (W1)
532 Yel (W1)
X31
Hood Switch
Connector
805
Wht
(W1)
S.N. (010000-020000) (without MPTC10114 kit installed)
S.N. (010000-020000) (with MPTC10114 kit installed)
*Wire No. 935 Wht (W1) not used when MPTC10114 kit is installed.
532
Yel
(W1)
507
Yel
(W1)
505 Yel (W1)
800 Brn (W1)
685 Wht (W1)
685 Wht (W1)
205 Red (W1)
205 Red (W1)
X24
A3 Electronic Control Module
J1
Left Angle Switch
PTO Switch
Park Brake Lock Switch
Right Angle Switch
Front Angle Switch
Key Switch (Start)
Not Used
Transaxle Switch
Seat Switch
Neutral Switch
750
Blu
(W1)
745
Blu/Wht
(W1)
736 Pur (W1)
820
Gry
(W1)
740
Pur
(W1)
J2
X28
Not Used
Not Used
Left Lower Switch
Front Lift Switch
Right Lift Switch
Left Lift Switch
Right Lower Switch
Front Lower Switch
Not Used
Not Used
J5
X27
Left Raise/Lower Solenoid
Lamp Check
Front Raise/Lower Solenoid
Right Raise/Lower Solenoid
Fuel Pull-In Relay
Deck Drive Solenoid
Raise/Lower Select Solenoid
Air Pre-Heater Relay
X26
J4
Front PTO Light
Start Relay
Right Motor Solenoid
Air Pre-Heater Light
Fuel Hold
Right PTO Light
Left PTO Light
Left Motor Solenoid
915 Blk/Wht (W1)
J3
X25
Not Used
Ground
Ground
Switched Power
Not Used
Hood Switch (Optional)
128 Blk (W1)
129 Blk (W1)
K2
Fuel Pull-In
Relay
30
85
87a
87
86
935*
Wht
(W1)
612
Blk
(W5)
680
Wht
(W1)
Y1
Fuel
Shutoff
Solenoid
V4
Fuel Pull-In
Relay Diode
611
Tan
(W5)
105
Blk
(W1)
532
Yel
(W1)
P
B3
Engine Oil
Pressure
Switch
100 Blk (W1)
100 Blk (W1)

MIF (MX14657)

Model 1600 Turbo



MIF (MX17983)


507 Yel (W1)
532 Yel (W1)
X31
Hood Switch
Connector
805
Wht
(W1)
505 Yel (W1)
800 Brn (W1)
532
Yel
(W1)
507
Yel
(W1)
685 Wht (W1)
685 Wht (W1)
746 Pur (W1)
746 Pur (W1)
A3 Electronic Control Module
X24
J1
Left Angle Switch
PTO Switch
Park Brake (Start Interlock)
Right Angle Switch
Front Angle Switch
Key Switch (Start)
Cruise Control
Transaxle Switch S.N. (-030000)
Seat Switch
Neutral Switch
750
Blu
(W1)
745
Blu/Wht
(W1)
736
Pur
(W1)
820
Gry
(W1)
740
Pur
(W1)
X28
J2
Not Used
Not Used
Left Lower Switch
Front Raise Switch
Right Raise Switch
Left Raise Switch
Right Lower Switch
Front Lower Switch
Park Brake (Cruise Interlock)
Not Used
X27
J5
Left Raise/Lower Solenoid
Lamp Check
Front Raise/Lower Solenoid
Right Raise/Lower Solenoid
Fuel Pull-In Relay
Deck Drive Solenoid
Raise/Lower Select Solenoid
Air Pre-Heater Relay
X26
J4
Not Used
Start Relay
Right Motor Solenoid
Air Pre-Heater Light
Fuel Hold
Not Used
Cruise Control Magnet
Left Motor Solenoid
915
Blk/Wht
(W1)
X25
J3
Not Used
Ground
Ground
Switched Power
Cruise Control On
Hood Switch (Optional)
128 Blk (W1)
129 Blk (W1)
100 Blk (W1)
100 Blk (W1)
K2
Fuel Pull-In
Relay
30
85
87a
87
86
680
Wht
(W1)
935
Wht
(W1)
680[1]
Wht
(W1)
682[2]
Wht
(W1)
Y1
Fuel
Shutoff
Solenoid
681[2]
Wht
(W1)
V6[2]
Fuel
Shutoff
Solenoid
Diode
116[2]
Blk
(W1)
105
Blk
(W1)
110[2]
Blk
(W1)
1. S.N. (-030000)
2. S.N. (030001-)
532
Yel
(W1)

MIF (MX14662)

Cranking Circuit Diagnosis

Diagnostics of circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

The multi-step process is as follows:

1. Electronic Control Module Checks. (See “Electronic Control Module Checks” on page 256.)

2. Cranking Circuit Tests (See “Cranking Circuits Tests” on page 258.)

NOTE: It is important that all steps be performed in sequence shown.

Electronic Control Module Checks

Conditions

- Machine parked on a level surface.
- Cutting units lowered to the ground.

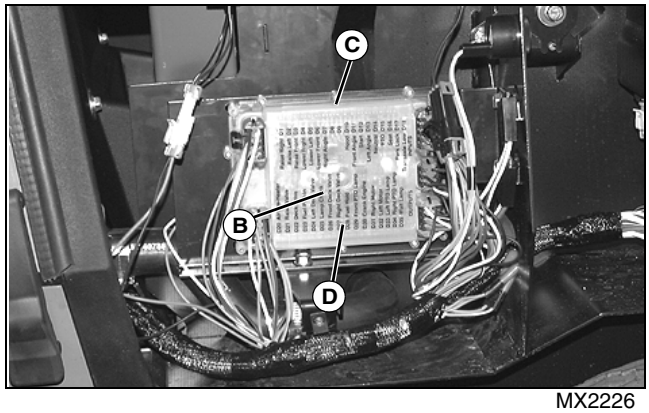
Procedure



MX2225

Picture Note: Models 1600/1620 S.N. (-020000) Shown

1. Remove access panel (A).
2. Turn key switch to the RUN position.



MX2226

Picture Note: Models 1600/1620 S.N. (-020000) Shown

3. Check the status LED (B), input LEDs (C), and output LEDs (D).

NORMAL:

- Status LED (B) flashing in a regular, even rate. (about one per second).

NOT NORMAL:

- If the status LED and input/output LEDs are not lit, check switched power fuse (F3). If fuse is good, check current supply to the control module. (See “Switched Power Circuit Diagnosis” on page 242.)

4. Turn key switch to the START position.

NORMAL:

- The engine must crank and start.

NOT NORMAL:

NOTE: For a complete list of diagnostic codes, See "Electronic Control Module Checks" on page 213.

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

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

For Models 1600/1620, moving the key switch from STOP to START too quickly may cause a failure to start and code 3-8 (internal error) to be displayed.

- Engine does not crank and the air pre-heater light begins to flash one of the following codes:

  CODE 1-2

  Indicates that the park brake switch and/or seat switch is not activated during an attempted start.

  For park brake lock switch, engage and lock park brake, then repeat procedure. If the code continues to flash after the brake has been engaged and locked, perform "Park Brake Lock Switch" Input check. (See "Electronic Control Module Input LEDs and Common Circuits Checks" on page 214

  For seat switch, activate seat switch by sitting on seat, then repeat procedure. If the code continues to flash after the seat switch has been activated, perform "Seat Switch Input" check. (See "Electronic Control Module Input LEDs and Common Circuits Checks" on page 214.)

  CODE 1-3

  Indicates that the PTO switch is in the ON position during an attempted start.

  If the code continues to flash after the PTO switch has been moved to the OFF position, perform Seat Switch Input check. (See "Electronic Control Module Input LEDs and Common Circuits Checks" on page 214.)

  CODE 2-1

  Indicates that the forward/reverse pedals are not in the NEUTRAL position. Make sure that forward/reverse pedals are in NEUTRAL position and repeat check procedure.

  If the code continues to flash after the forward/reverse pedals are in NEUTRAL position, perform "Neutral Switch Input" check. (See "Electronic Control Module Input LEDs and Common Circuits Checks" on page 214.)

  CODE 2-3

  Indicates that the hood is not closed (European machines), hood switch connector is not properly connected, or the jumper wire is missing (North American machines). Make sure the hood is closed, hood switch connector is properly connected, or the jumper wire is in place.

  If the code continues to flash even when the hood is closed or it is confirmed that the jumper wire is in place, perform Hood Switch Input check. (See "Electronic Control Module Input LEDs and Common Circuits Checks" on page 214.)

- If engine does not crank and no code is flashing, perform the following procedures in the sequence shown:

  KEY SWITCH INPUT

  See "Electronic Control Module Input LEDs and Common Circuits Checks" on page 214.

  KEY SWITCH START CIRCUIT TEST

  See "Key Switch (S1) Start Circuit" on page 217.

  START RELAY CIRCUIT TEST

  See "Start Relay Circuit Test" on page 258.

- Engine cranks, but does not start or run, check run circuit. (See "Run Circuit Diagnosis" on page 273.)

Cranking Circuits Tests

Start Relay Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Park brake engaged (LOCKED).
- PTO switch in OFF position.
- Forward/reverse pedals in NEUTRAL position.
- Hood closed (European machines).
- Hood switch connector with jumper wire properly connected (North American machines).
- Key switch cycled between RUN and START positions.

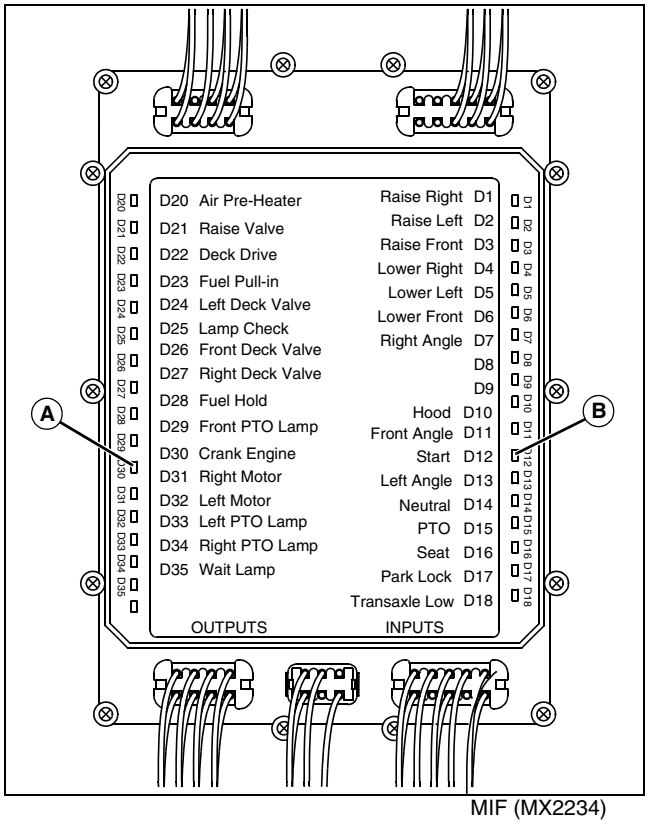
System: Start Relay Circuit

(1) Start Relay (K1) Check. Does start relay (K1) click when key switch is cycled between RUN and START positions?

Yes - Go To Step (9)

No - Go To Step (2)

System: Start Relay Circuit



MIF (MX2234)

Picture Note: Electronic Control Module for Models 1600/1620 Shown

(2) Key switch in START position.
Crank Engine Output LED D30.
Start Input LED D12.
Electronic Control Module (A3) Input/Output LED Check.
Is input LED D12 (B) ON?
Is output LED D30 (A) ON?

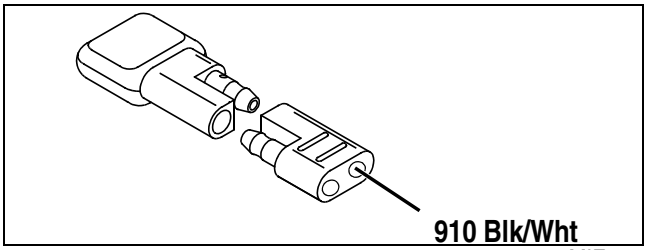
Yes - Go To Step (3)

No - If input LED D12 is not ON, Go To Step (7).

No - If output LED D30 is ON, Go To Step (3).

No - If output LED D30 is not ON, all interlock inputs are valid, and no diagnostic code occurs, replace electronic control module.

System: Start Relay Circuit

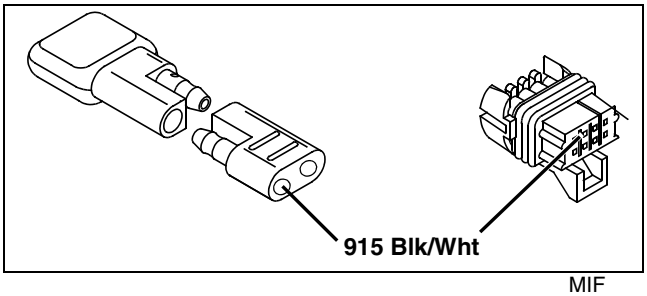


MIF

(3) Key switch in START position.
Start relay diode (V1) disconnected.
Meter negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
Start Relay Diode (V1) - Wire 910 Black/White. Is battery voltage present?

Yes - Test start relay diode (V1). (See "Diode Test" on page 373.) If diode is good, Go To Step (4).

No - Go To Step (5)



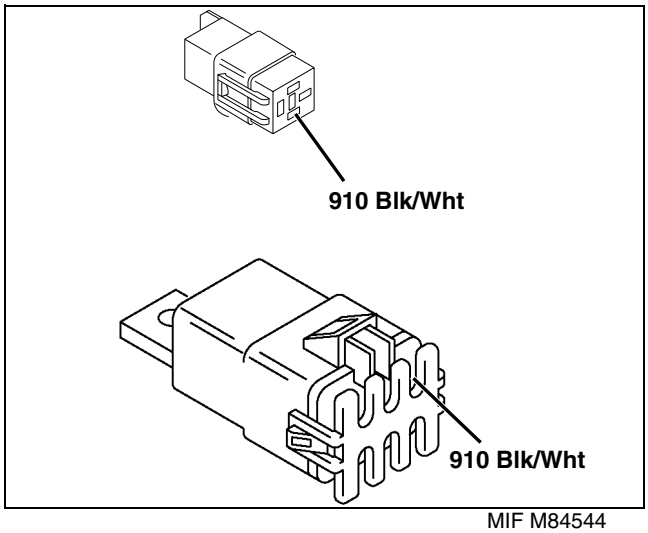
MIF

(4) Key switch in OFF position.
Electronic control module connector X26 disconnected.
Start Relay Diode (V1) disconnected.
Start Relay Diode (V1) - Wire 915 Black/White and Electronic Control Module Connector X26, Terminal B. Check resistance of wire 915. Is there less than 0.1 ohm of resistance?

Yes - Go To Step (9)

No - Replace harness.

System: Start Relay Circuit



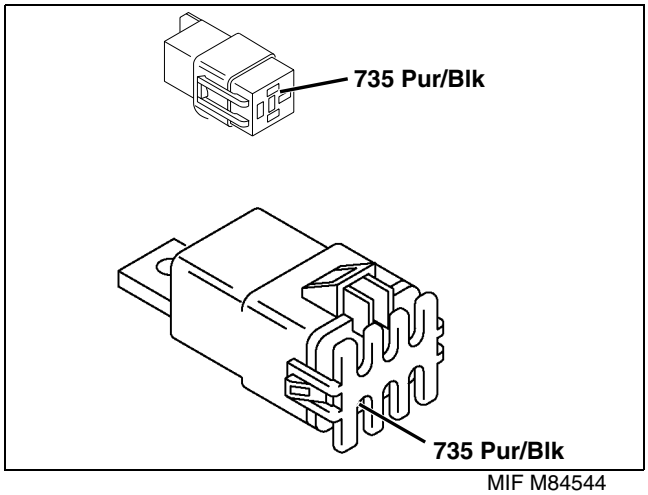
MIF M84544

Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(5) Key switch in START position.
Start Relay Diode (V1) disconnected.
Start Relay (K1) - Terminal 86, Wire 910 Black/White. Is battery voltage present?

Yes - Test wire 910 black/white and connections.

No - Go To Step (6)



MIF M84544

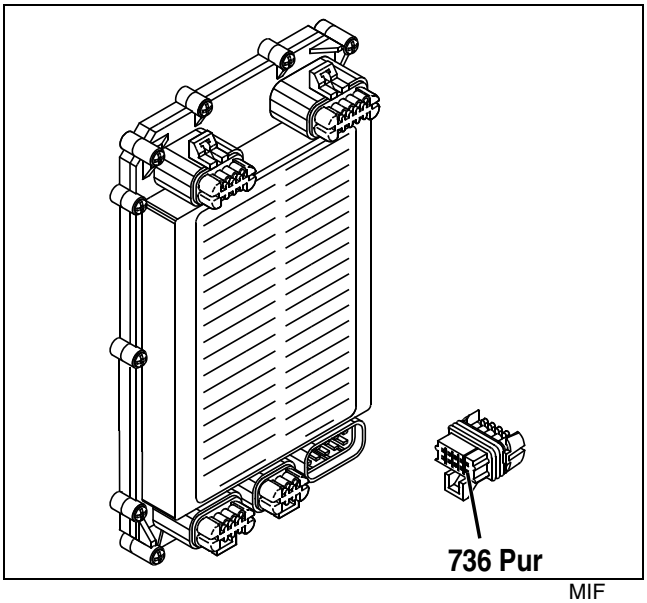
Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(6) Start Relay (K1) - Terminal 85, Wire 735 Purple/Black. Is battery voltage present?

Yes - Test start relay (K1). (See "Relay Test" on page 363.)

No - Go To Step (8)

System: Start Relay Circuit



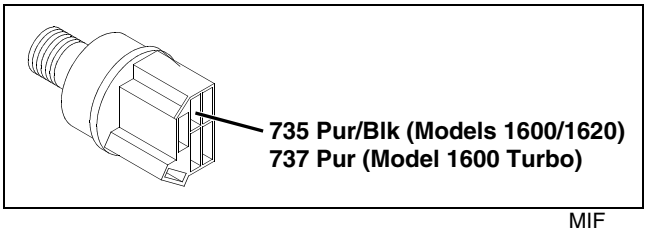
MIF

(7) NOTE: Continued from step (2) of this test. Electronic Control Module Connector X24 disconnected.
Electronic Control Module (A3) - Connector X24 - Terminal F, Wire 736 Purple. Is battery voltage present?

Yes - Go To Step (9)

No - Models 1600/1620: Test wire 736 purple and connections.

No - Model 1600 Turbo: Go To Step (8).



MIF

(8) Key Switch (S1) - Terminal S1. Is battery voltage present?

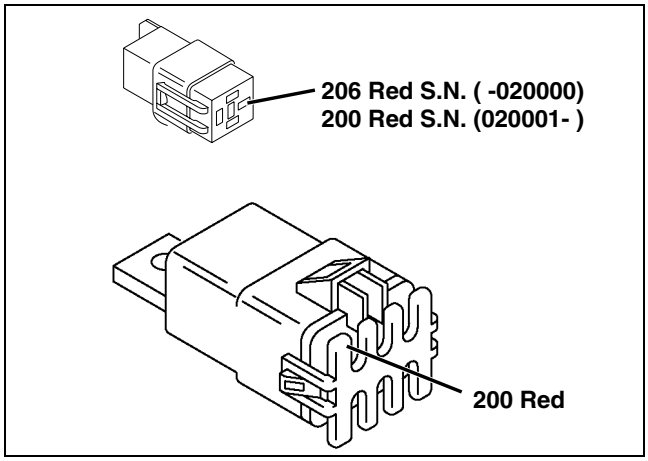
Yes - Model 1600/1620: Test wires 735 purple/black, 736 purple, and connections.

Yes - Model 1600 Turbo: Test wires 735 purple/black, 736 purple, 737 purple, and connections.

No - Test switched power circuit. (See “Switched Power Circuit Diagnosis” on page 242.)

No - Test key switch. (See “Key Switch Test” on page 364.)

System: Start Relay Circuit



MIF M84544

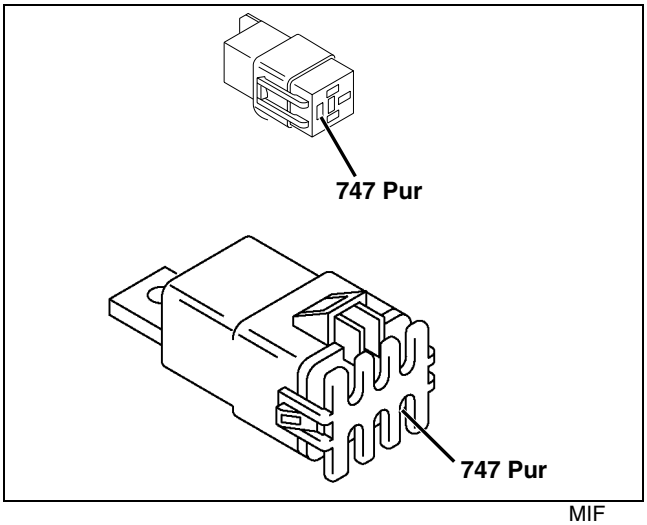
Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(9) Start Relay (K1) - Terminal 30, Wire 200 or 206 Red. Is battery voltage present?

Yes - Go To Step (10)

No - Test unswitched power circuit. (See “Unswitched Power Circuit Diagnosis” on page 241.)

System: Start Relay Circuit



MIF

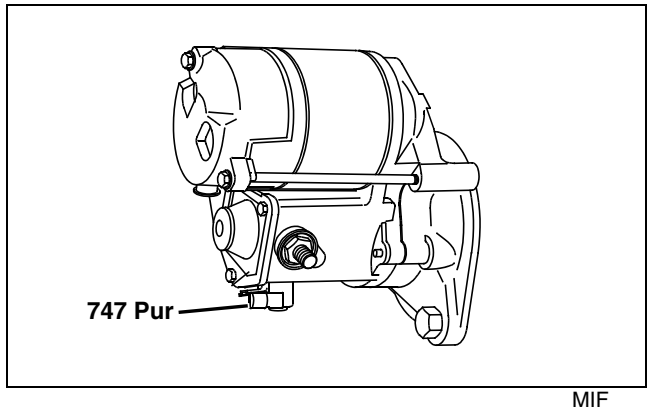
Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(10) Key switch in START position.
Start Relay Diode (V1) disconnected with jumper wire connecting wire 910 black/white at connector X10 to ground.
Start Relay (K1) - Terminal 87, Wire 747 Purple. Is battery voltage present?

Yes - Go To Step (11)

No - Test relay. (See “Relay Test” on page 363.)

System: Start Relay Circuit



MIF

(11) Key switch in START position.
Start Relay Diode (V1) disconnected with jumper wire connecting wire 910 black/white at connector X10 to ground.
Starting Motor (M1) - Terminal S, Wire 747 Purple. Is battery voltage present?

Yes - Test starting motor. (See “Starting Motor Solenoid Test” on page 362 and See “Starting Motor Loaded Amperage Draw Test” on page 362.)

No - Test wire 747 purple and connections.

Fuel Pull-In Relay Circuit Test

NOTE: Make sure switched power fuse (F3) is good before performing this test.

When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.

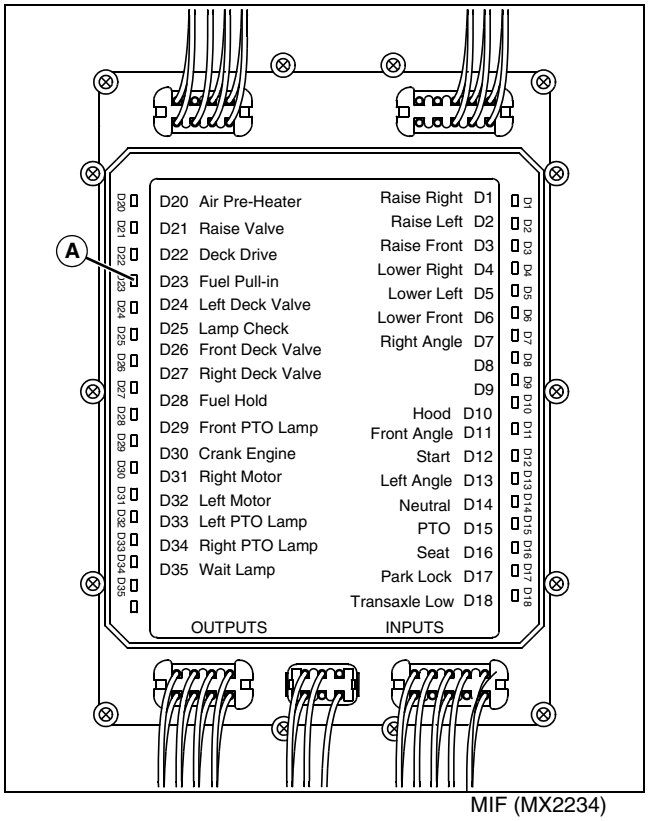
Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Machine parked on a level surface.
- Park brake engaged (LOCKED).
- PTO switch in OFF position.
- Forward/reverse pedals in NEUTRAL position.
- Hood closed (European machines).
- Hood switch connector with jumper wire properly connected (North American machines).
- Start Relay Diode (V1) disconnected.
- Key switch in START position.

NOTE: For Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed, See "Fuel Pull-In Relay Circuit Test" on page 262.

System: Fuel Pull-In Relay Circuit



MIF (MX2234)

Picture Note: Electronic Control Module for Models 1600/1620 Shown

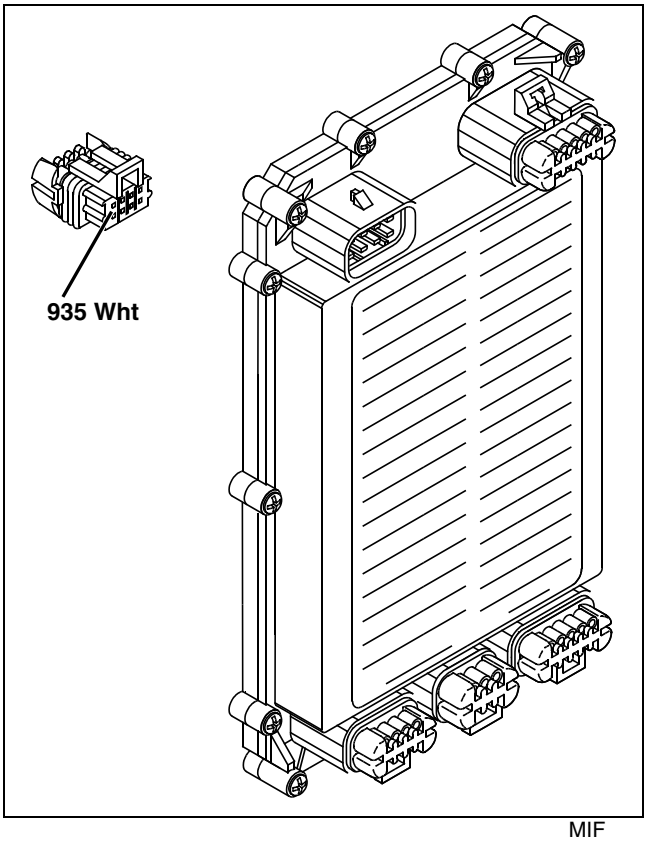
A - Fuel Pull-In Output LED D23

(1) Electronic Control Module (A3) - Fuel Pull-In Output LED D23. Does LED D23 (A) come ON for approximately one second, then go OFF?

Yes - Go To Step (2)

No - Verify interlock (SOS) inputs to the electronic control module. (See "Electronic Control Module Input LEDs and Common Circuits Checks" on page 214.) If all interlock inputs are valid, replace electronic control module.

System: Fuel Pull-In Relay Circuit



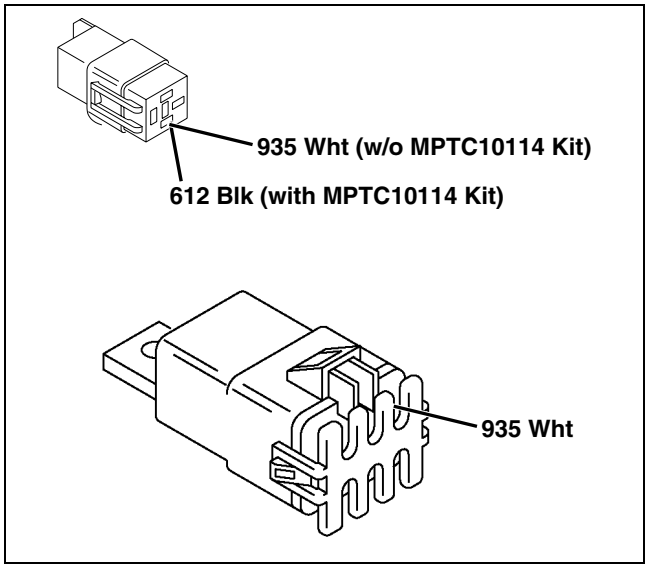
MIF

(2) Electronic control module connector X27 disconnected.
Key switch in RUN position.
Electronic Control Module (A3) - Connector X27-Terminal E, Wire 935 White. Is battery voltage present?

Yes - Go To Step (5)

No - Go To Step (3)

System: Fuel Pull-In Relay Circuit



MIF M84544

Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

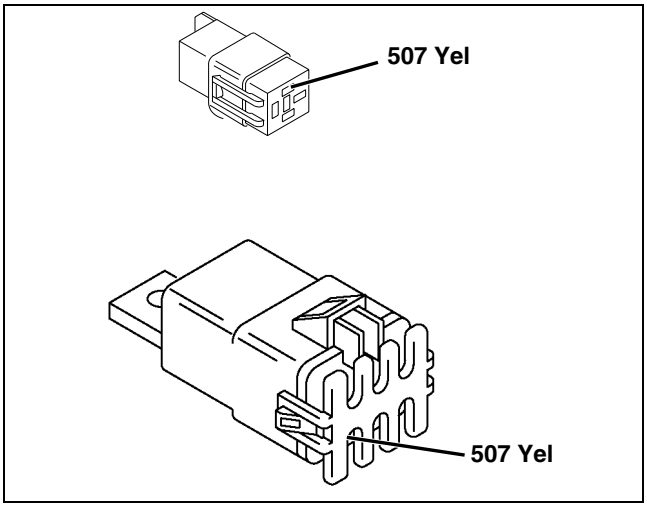
(3) Electronic control module connector X27 disconnected.
Key switch in RUN position.
Fuel Pull-In Relay (K2) - Terminal 86, Wire 935 White or 612 Black. Is battery voltage present?

Yes - All machines except Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Test wire 935 white and connections.

Yes - Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Go To Step (6).

No - Go To Step (4)

System: Fuel Pull-In Relay Circuit



MIF M84544

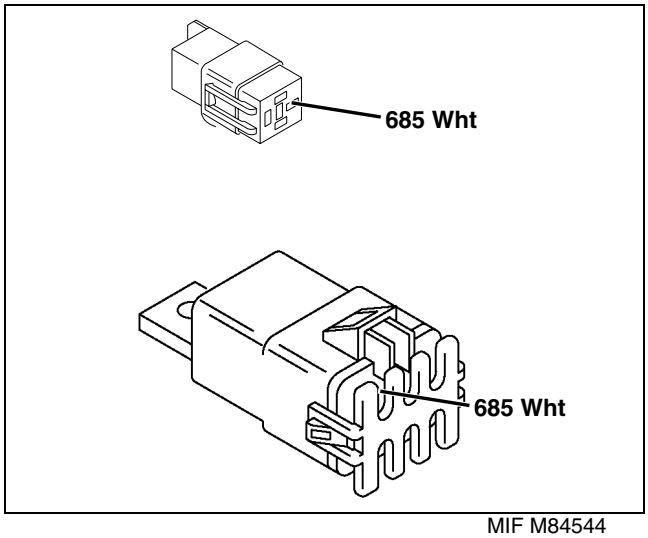
Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(4) Fuel Pull-In Relay (K2) - Terminal 85, Wire 507 Yellow. Is battery voltage present?

Yes - Test fuel pull-in relay (K2). (See “Relay Test” on page 363.)

No - Test switched power circuit. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Fuel Pull-In Relay Circuit



MIF M84544

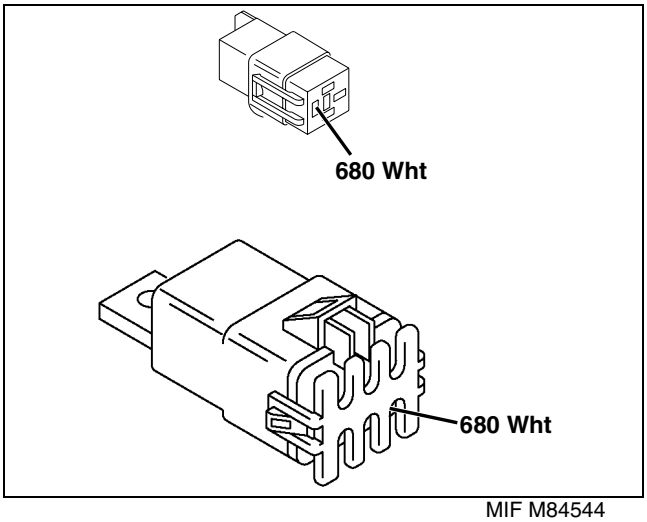
Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(5) NOTE: Continued from step (2) of this test.
Fuel shutoff solenoid disconnected.
Start Relay Diode (V1) installed.
Key switch in START position (engine cranking).
Fuel Pull-In Relay (K2) - Terminal 30, Wire 685 White. Is battery voltage present?

Yes - Go To Step (6)

No - Test wire 685 white and connections. If OK, test unswitched power circuit. (See “Unswitched Power Circuit Diagnosis” on page 241.)

System: Fuel Pull-In Relay Circuit



MIF M84544

Picture Note:
UPPER: Models 1600/1620
LOWER: Model 1600 Turbo

(6) Fuel shutoff solenoid disconnected.
Start Relay Diode (V1) installed.
Key switch in START position (engine cranking).
All machines except Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Electronic control module connector X27 disconnected with jumper wire connecting terminal E (harness side) to ground.
Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Fuel pull-in relay diode (V4) disconnected with a jumper wire connecting wire 612 black at connector X68 to ground.
Fuel Pull-In Relay (K2) - Terminal 87, Wire 680 White. Is battery voltage present?

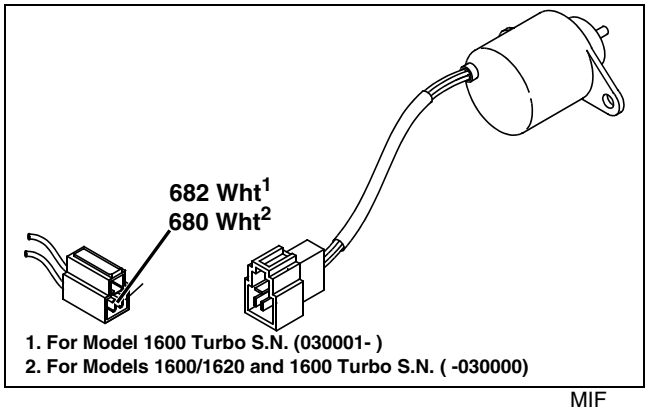
Yes - All machines except models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Go To Step (7).

Yes - Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Test fuel pull-in relay diode (V4), wire 611 tan, and engine oil pressure switch (B3). If these items are good: Go To Step (7).

No - All machines except models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Test relay. (See “Relay Test” on page 363.)

No - Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Test wire 612 black and connections. If wire is good, test relay. (See “Relay Test” on page 363.)

System: Fuel Pull-In Relay Circuit



MIF

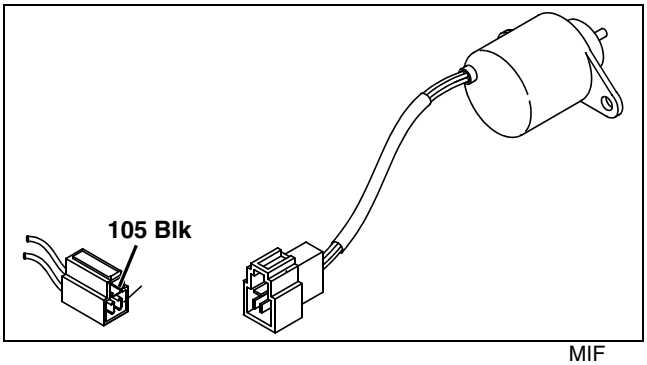
(7) Fuel shutoff solenoid disconnected.
Start Relay Diode (V1) installed.
Key switch in START position (engine cranking).
All machines except Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Electronic control module connector X27 disconnected with jumper wire connecting terminal E (harness side) to ground.
Models 1600/1620 S.N. (-020000) with MPTC10114 kit installed: Fuel pull-in relay diode (V4) disconnected with a jumper wire connecting wire 612 black at connector X68 to ground.
Fuel Shutoff Solenoid (Y1) - Terminal B. Is battery voltage present?

Yes - Go To Step (8)

No - Model 1600 Turbo S.N. (-030000): Test wire 680 white and connections.

No - Model 1600 Turbo S.N. (030001-): Test wires 682 and 680 white and connections.

System: Fuel Pull-In Relay Circuit



MIF

(8) Key switch in OFF position.
Fuel shutoff solenoid disconnected.
Fuel Shutoff Solenoid (Y1) - Terminal A. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?

Yes - Test fuel shutoff solenoid (Y1). (See “Fuel Shutoff Solenoid Test” on page 371.)

Yes - Model 1600 Turbo S.N. (030001-): Test fuel shutoff solenoid diode (V6).

No - Test wires 105 black, 100 black, and connections.

Run Circuit Operation - Operator ON Seat

NOTE: The run circuit consists of the following sub circuits:

- ***Fuel shutoff solenoid hold-in coil circuit***
- ***Hour meter circuit***

Function

To allow the engine (and hour meter) to operate when the operator is ON the seat.

Operating Conditions

- Key switch in RUN position (engine running).
- Operator ON seat.
- PTO switch in OFF position whenever park brake is engaged.
- Hood closed (European machines).
- Hood switch connector with jumper wire properly connected (North American machines).

Theory of Operation

POWER CIRCUITS

The power circuit provides current to key switch (S1) and protects the run circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to fusible link (F2) and then to key switch (S1), terminal B (wires 201 and 210 red).

When the key switch is in the RUN position, current flows from key switch terminal A to switched power fuse (F3) (wire 400 yellow/red) and then to the following:

1. Seat switch (S3) (wires 540, 530 and 539 yellow).
2. PTO switch (S15) (wires 540 and 510 yellow).
3. Park brake lock switch (S8) (wires 540, 530, and 526 yellow).
4. Hood switch connector (X31) (wires 540, 530, and 505 yellow).
5. Electronic control module connector (X25), terminal D (wires 540 and 532 yellow). This supplies power to the control module.

FUEL SHUTOFF SOLENOID HOLD-IN COIL AND HOUR METER CIRCUITS

Models 1600/1620 without MPTC10114 kit installed and 1600 Turbo: After the machine starts, the control module continues to supply current to the hold-in coil of fuel shutoff solenoid (Y1) (wires 643 and 645 pink) to keep the solenoid energized. Current also flows to the hour meter (P1) (wires 643 and 640 pink), energizing the hour meter.

Models 1600/1620 S.N. (010000-020000) with MPTC10114 kit installed: Current flows to hold coil relay (K5) (wires 570 [W1], 597 [W6], and 595 [W6] yellow.) When the key switch is in the RUN position, the control module supplies current to the hold coil relay (K2) (wire 643 [W5] pink) to energize it. With the relay energized, current flows to the hold coil of fuel shutoff solenoid (Y1) (wires 645 [W6], 643 [W1], and 645 [W1] pink) to keep the solenoid energized. Current also flows to the hour meter (P1) (wires 643 and 640 pink), energizing the hour meter.

Models 1600/1620 S.N. (020001-020148) with MPTC10114 kit installed: Current flows to hold coil relay (K5) (wires 560 [W1], 506 [W6], and 595 [W6] yellow). When the key switch is in the RUN position, the control module supplies current to the hold coil relay (K2) (wire 643 [W5] pink) to energize it. With the relay energized, current flows to the hold coil of fuel shut-off solenoid (Y1) (wires 645 [W6], 643 [W1], and 645 [W1] pink) to keep the solenoid energized. Current also flows to the hour meter (P1) (wires 643 and 640 pink), energizing the hour meter.

All Models: With current to the hold-in coil, the fuel shutoff solenoid remains energized and fuel continues to flow to the engine. The control module will keep the fuel shutoff solenoid hold-in coil and hour meter energized only when all of the following conditions are met:

NOTE: The control module has a built-in delay so that if the operator bounces on the seat the engine will continue to run.

1. **Operator ON seat** - With the operator ON the seat, the seat switch (S3) is closed and current flows to control module connector (X24), terminal J (wire 820 gray).

2. **Hood closed (European) or hood switch connector with jumper wire (North American) properly connected** - With hood closed or hood switch connector (X31) with jumper wire (wire 805 white) properly connected, current flows to control module connector (X25), terminal F (wire 800 brown).

NOTE: Whenever the park brake is engaged, the PTO must also be OFF for the engine to run.

3. **Park brake UNLOCKED** - When the park brake is in the UNLOCKED (released) position, switch (S8) is open and no current flows to control module connector (X24), terminal C (wire 745 blue/white), indicating that the park brake is released.

-OR-

PTO switch OFF - With the PTO switch (S15) OFF, no current flows from the PTO switch to control module connector (X24), terminal B (wire 750 blue), indicating that the PTO is off.

Run Circuit Operation - Operator OFF Seat

Function

To allow the engine (and hour meter) to run when the operator is OFF the seat.

Operating Conditions

- Key switch in RUN position (engine running).
- Operator OFF seat.
- Park brake engaged (LOCKED).
- PTO switch in OFF position.
- Hood closed (European machines)
- Hood switch connector with jumper wire properly connected (North American machines).

Theory of Operation

POWER CIRCUITS

The power circuit provides current to key switch (S1) and protects the run circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to fusible link (F2) and then to key switch (S1), terminal B (wires 201 and 210 red).

When the key switch is in the RUN position, current flows from key switch terminal A to switched power fuse (F3) (wire 400 yellow/red) and then to the following:

1. Seat switch (S3) (wires 540, 530, and 539 yellow).

2. PTO switch (S15) (wires 540 and 510 yellow).

3. Park brake lock switch (S8) (wires 540, 530, and 526 yellow).

4. Hood switch connector (X31) (wires 540, 530, and 505 yellow).

5. Electronic control module connector (X25), terminal D (wires 540 and 532 yellow). This supplies power to the control module.

FUEL SHUTOFF SOLENOID HOLD-IN COIL AND HOUR METER CIRCUITS

Models 1600/1620 without MPTC10114 kit installed and 1600 Turbo: After the machine starts, the control module continues to supply current to the hold-in coil of fuel shutoff solenoid (Y1) (wires 643 and 645 pink) to keep the solenoid energized. Current also flows to the hour meter (P1) (wires 643 and 640 pink), energizing the hour meter.

Models 1600/1620 S.N. (010000-020000) with MPTC10114 kit installed: Current flows to hold coil relay (K5) (wires 570 [W1], 597 [W6], and 595 [W6] yellow.) When the key switch is in the RUN position, the control module supplies current to the hold coil relay (K2) (wire 643 [W5] pink) to energize it. With the relay energized, current flows to the hold coil of fuel shutoff solenoid (Y1) (wires 645 [W6], 643 [W1], and 645 [W1] pink) to keep the solenoid energized. Current also flows to the hour meter (P1) (wires 643 and 640 pink), energizing the hour meter.

Models 1600/1620 S.N. (020001-020148) with MPTC10114 kit installed: Current flows to hold coil relay (K5) (wires 560 [W1], 506 [W6], and 595 [W6] yellow). When the key switch is in the RUN position, the control module supplies current to the hold coil relay (K2) (wire 643 [W5] pink) to energize it. With the relay energized, current flows to the hold coil of fuel shut-off solenoid (Y1) (wires 645 [W6], 643 [W1], and 645 [W1] pink) to keep the solenoid energized. Current also flows to the hour meter (P1) (wires 643 and 640 pink), energizing the hour meter.

All Models: With current to the hold-in coil, the fuel shutoff solenoid remains energized and fuel continues to flow to the engine. The control module will keep the fuel shutoff solenoid hold-in coil and hour meter energized only when all of the following conditions are met:

NOTE: The control module has a built-in delay so that if the operator bounces on the seat the engine will continue to run.

1. **Operator OFF seat** - With the operator off the seat, the seat switch is open and no current flows to control module connector (X24), terminal J (wire 820 gray).

NOTE: Whenever the park brake is engaged, the PTO must also be OFF for the engine to run.

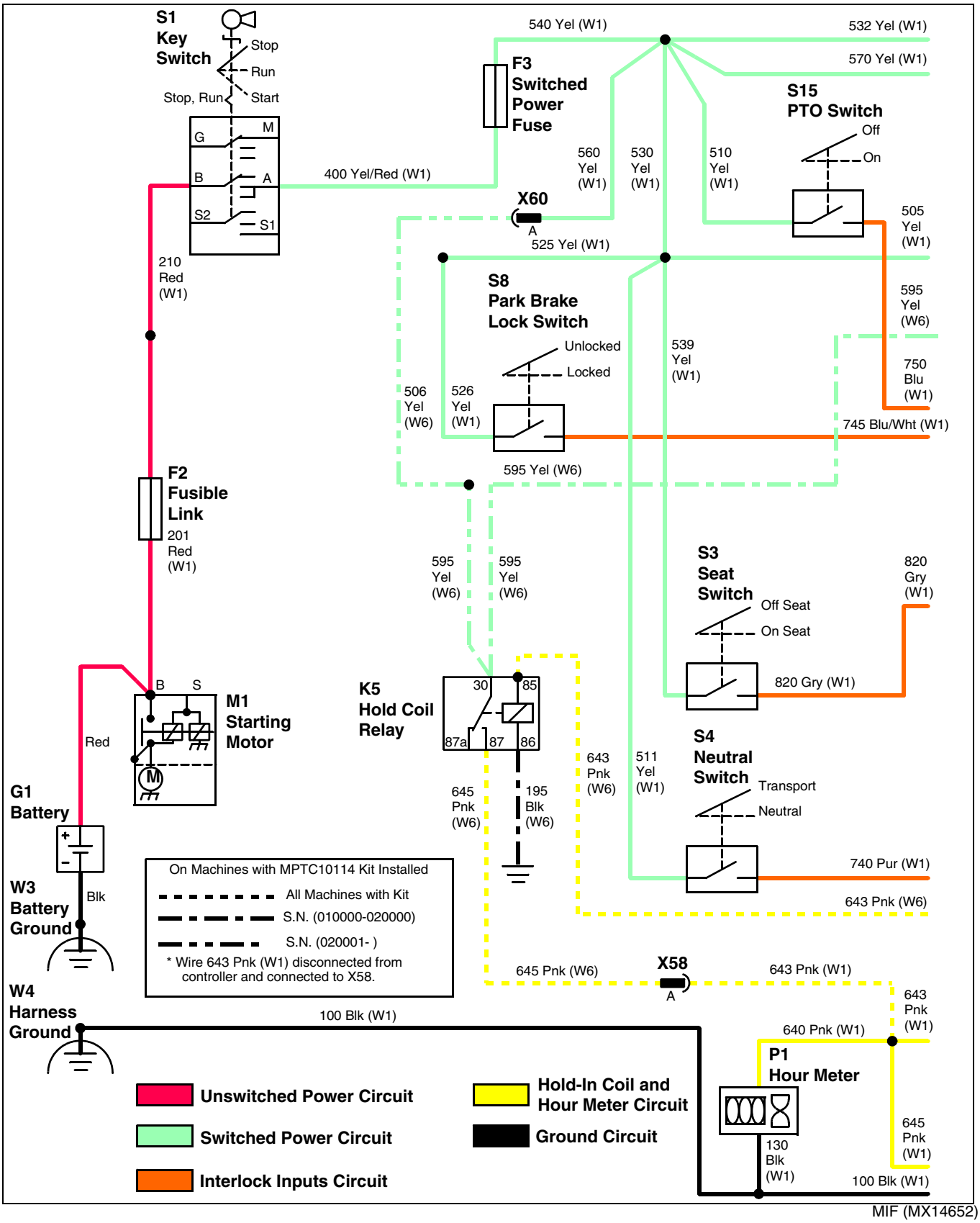
2. **Park brake LOCKED** - With the park brake LOCKED (engaged), park brake lock switch (S8) is closed, allowing current to flow to control module connector (X24), terminal B (wire 745 blue/white). Although the operator is OFF the seat, the control module keeps the hold-in coil energized because the park brake lock switch is closed.

3. **PTO switch OFF** - With the PTO switch (S15) OFF, no current flows from the PTO switch to control module connector (X24), terminal B (wire 750 blue), indicating that the PTO is off.

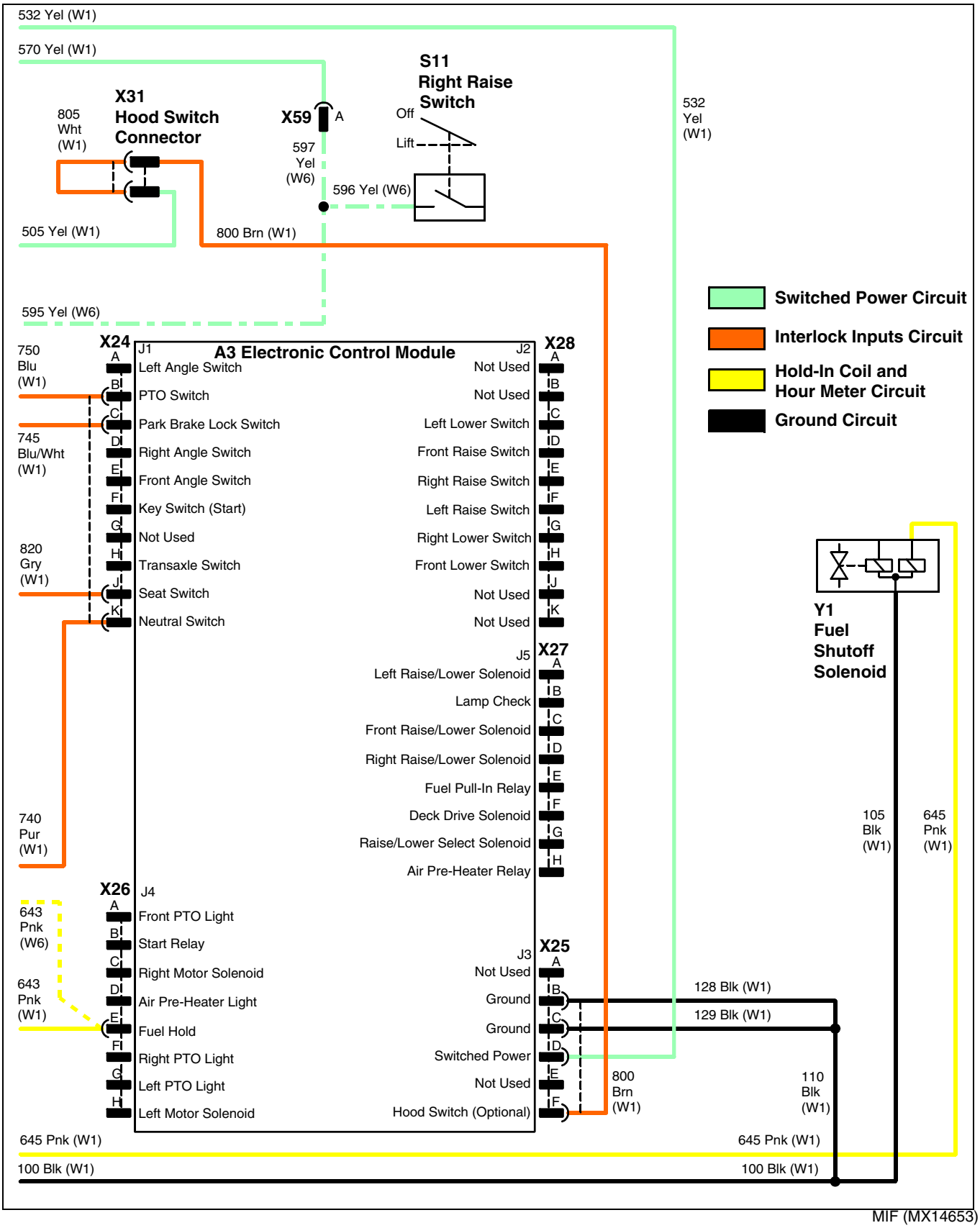
4. **Hood closed (European) or hood switch connector with jumper wire (North American) properly connected** - With hood closed or hood switch connector (X31) with jumper wire (wire 805 white) properly connected, current flows to control module connector (X25), terminal F (wire 800 brown).

Run Circuit Schematics

Models 1600/1620

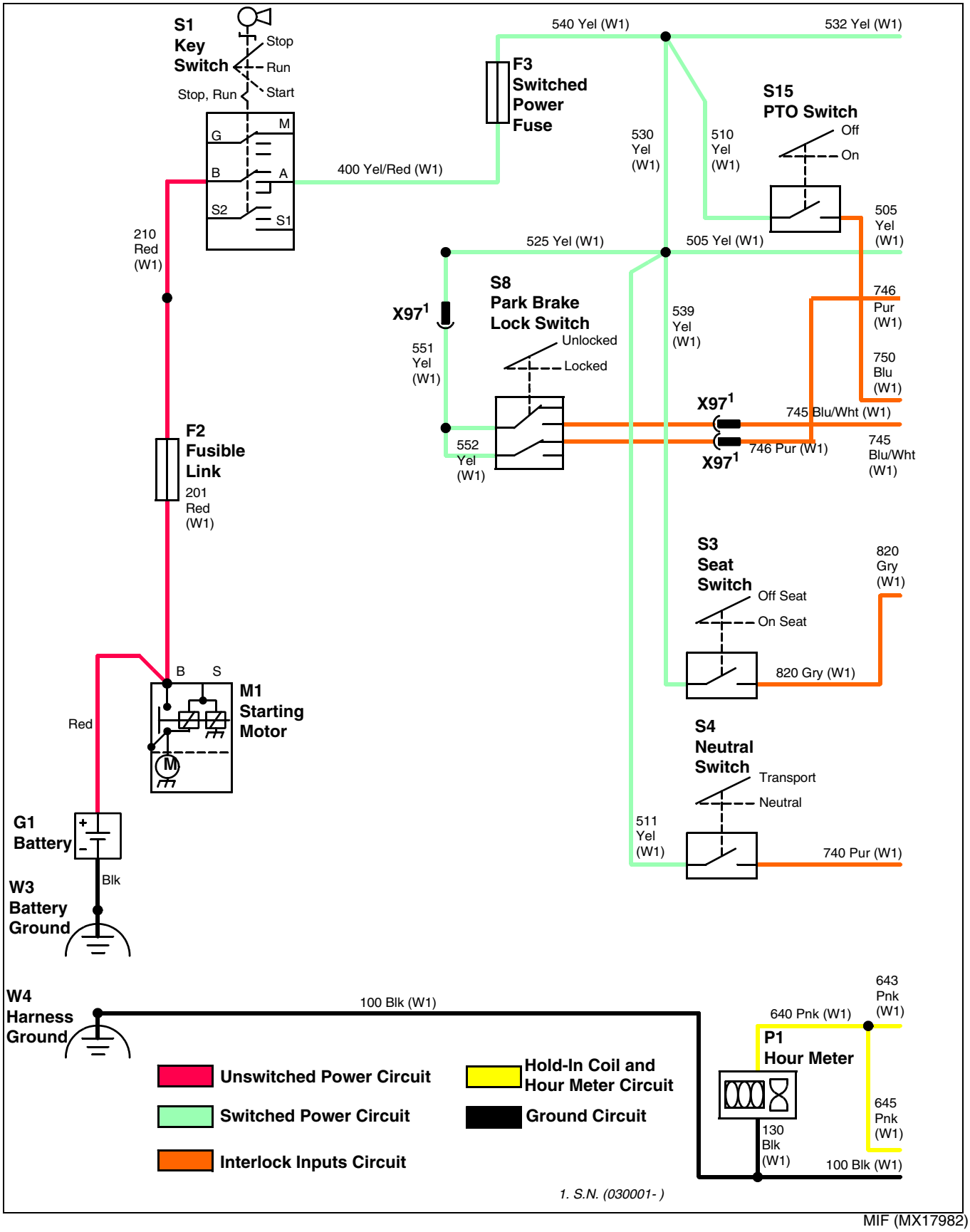


MIF (MX14652)

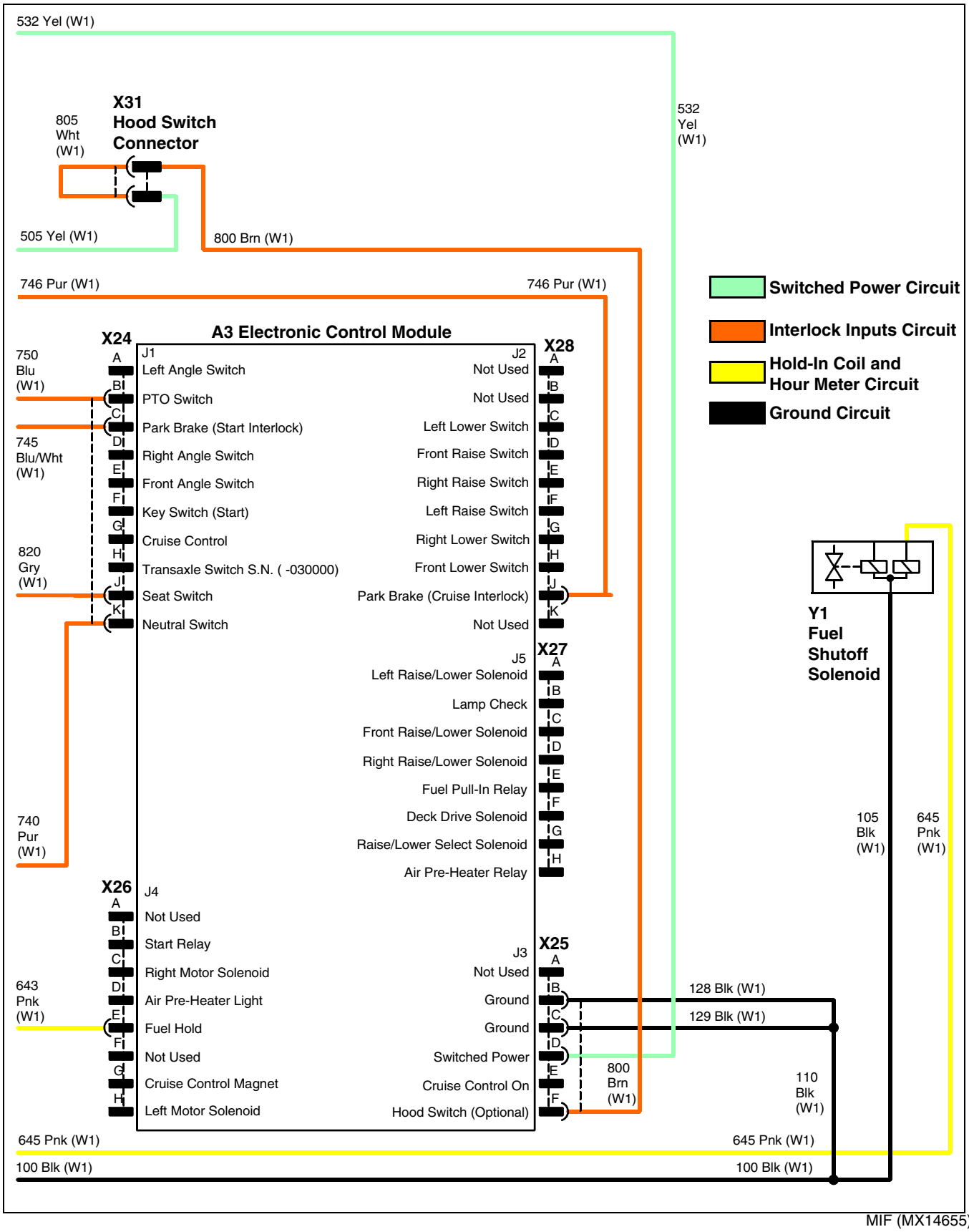

532 Yel (W1)
570 Yel (W1)
S11
Right Raise
Switch
X31
Hood Switch
Connector
805
Wht
(W1)
X59
A
Off
Lift
597
Yel
(W6)
596 Yel (W6)
532
Yel
(W1)
505 Yel (W1)
800 Brn (W1)
595 Yel (W6)
Switched Power Circuit
Interlock Inputs Circuit
Hold-In Coil and
Hour Meter Circuit
Ground Circuit
X24
J1
A3 Electronic Control Module
J2
X28
750
Blu
(W1)
Left Angle Switch
PTO Switch
Park Brake Lock Switch
Right Angle Switch
Front Angle Switch
Key Switch (Start)
Not Used
Transaxle Switch
Seat Switch
Neutral Switch
Not Used
Not Used
Left Lower Switch
Front Raise Switch
Right Raise Switch
Left Raise Switch
Right Lower Switch
Front Lower Switch
Not Used
Not Used
745
Blu/Wht
(W1)
820
Gry
(W1)
740
Pur
(W1)
J5
X27
Left Raise/Lower Solenoid
Lamp Check
Front Raise/Lower Solenoid
Right Raise/Lower Solenoid
Fuel Pull-In Relay
Deck Drive Solenoid
Raise/Lower Select Solenoid
Air Pre-Heater Relay
Y1
Fuel
Shutoff
Solenoid
105
Blk
(W1)
645
Pnk
(W1)
X26
J4
Front PTO Light
Start Relay
Right Motor Solenoid
Air Pre-Heater Light
Fuel Hold
Right PTO Light
Left PTO Light
Left Motor Solenoid
643
Pnk
(W6)
643
Pnk
(W1)
J3
X25
Not Used
Ground
Ground
Switched Power
Not Used
Hood Switch (Optional)
128 Blk (W1)
129 Blk (W1)
800
Brn
(W1)
110
Blk
(W1)
645 Pnk (W1)
645 Pnk (W1)
100 Blk (W1)
100 Blk (W1)

MIF (MX14653)

Model 1600 Turbo



MIF (MX17982)


532 Yel (W1)
X31
Hood Switch
Connector
805
Wht
(W1)
532
Yel
(W1)
505 Yel (W1)
800 Brn (W1)
746 Pur (W1)
746 Pur (W1)
Switched Power Circuit
Interlock Inputs Circuit
Hold-In Coil and
Hour Meter Circuit
Ground Circuit
A3 Electronic Control Module
X24
J1
750
Blu
(W1)
745
Blu/Wht
(W1)
820
Gry
(W1)
740
Pur
(W1)
A Left Angle Switch
B PTO Switch
C Park Brake (Start Interlock)
D Right Angle Switch
E Front Angle Switch
F Key Switch (Start)
G Cruise Control
H Transaxle Switch S.N. (-030000)
J Seat Switch
K Neutral Switch
X28
J2
A Not Used
B Not Used
C Left Lower Switch
D Front Raise Switch
E Right Raise Switch
F Left Raise Switch
G Right Lower Switch
H Front Lower Switch
J Park Brake (Cruise Interlock)
K Not Used
X27
J5
A Left Raise/Lower Solenoid
B Lamp Check
C Front Raise/Lower Solenoid
D Right Raise/Lower Solenoid
E Fuel Pull-In Relay
F Deck Drive Solenoid
G Raise/Lower Select Solenoid
H Air Pre-Heater Relay
Y1
Fuel
Shutoff
Solenoid
105
Blk
(W1)
645
Pnk
(W1)
X26
J4
643
Pnk
(W1)
A Not Used
B Start Relay
C Right Motor Solenoid
D Air Pre-Heater Light
E Fuel Hold
F Not Used
G Cruise Control Magnet
H Left Motor Solenoid
X25
J3
A Not Used
B Ground
C Ground
D Switched Power
E Cruise Control On
F Hood Switch (Optional)
128 Blk (W1)
129 Blk (W1)
800
Brn
(W1)
110
Blk
(W1)
645 Pnk (W1)
645 Pnk (W1)
100 Blk (W1)
100 Blk (W1)

MIF (MX14655)

Run Circuit Diagnosis

Diagnostics of circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

When diagnosing the run circuit, it is important to perform the following steps in the sequence shown:

1. Electronic Control Module Checks. (See “Electronic Control Module Checks” on page 213.)

2. Input LEDs and Circuits Checks. (See “Input LEDs and Circuits Checks” on page 273.)

3. Run Circuit and Hour Meter Circuit Tests. (See “Run Circuit Tests” on page 273 and See “Hour Meter Circuit Test” on page 276.)

Input LEDs and Circuits Checks

NOTE: The following common input circuit checks are necessary when diagnosing the run circuit. (See “Electronic Control Module Input LEDs and Common Circuits Checks” on page 214.)

- Seat Switch
- Park Brake Lock Switch
- PTO Switch
- Hood Switch

Run Circuit Tests

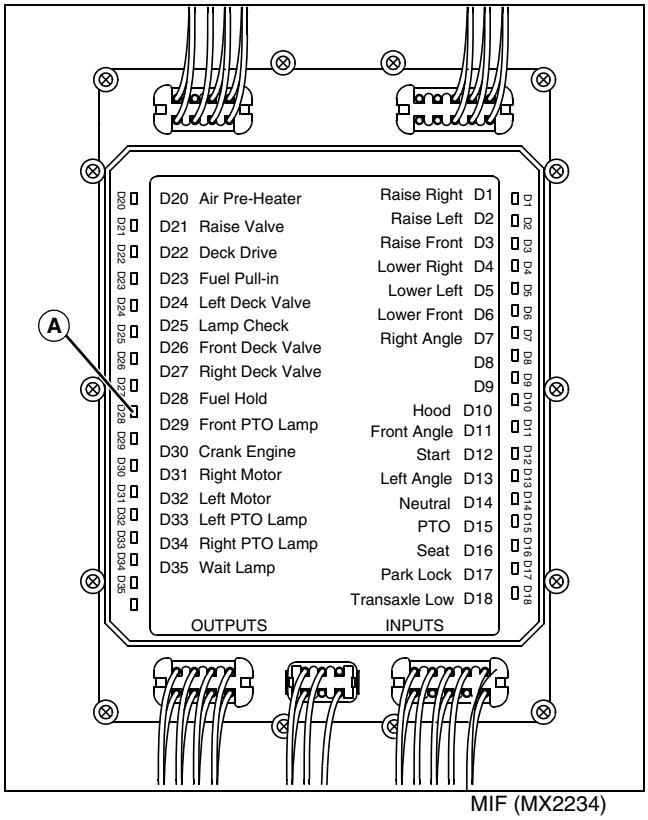
Fuel Hold Output LED Check

NOTE: Make sure switched power fuse (F3) is good before performing these tests.

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Park brake engaged (LOCKED) or operator on seat.
- PTO switch in OFF position.
- Hood closed (European machines).
- Hood switch connector with jumper wire properly connected (North American machines).

System: Fuel Hold Output LED Check



MIF (MX2234)

Picture Note: Electronic Control Module for Models 1600/1620 Shown; 1600 Turbo Is Similar

(1) Electronic Control Module (A3) - Fuel Hold Output LED D28. Is LED D28 (A) ON?

Yes - Test fuel hold circuit. (See “Fuel Hold Circuit Test” on page 274.)

Yes - Test hour meter circuit. (See “Hour Meter Circuit Test” on page 276.)

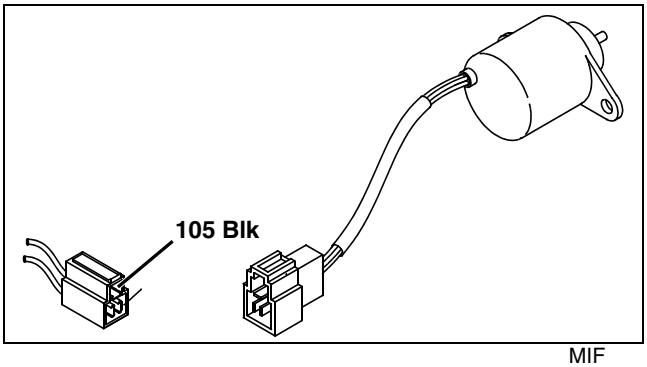
No - Verify interlock (SOS) inputs to the electronic control module. (See “Electronic Control Module Input LEDs and Common Circuits Checks” on page 214.) If all interlock inputs are valid and no diagnostic code occurs, replace electronic control module.

Fuel Hold Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in OFF position.
- Fuel shutoff solenoid disconnected.
- When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Fuel Hold Circuit Test



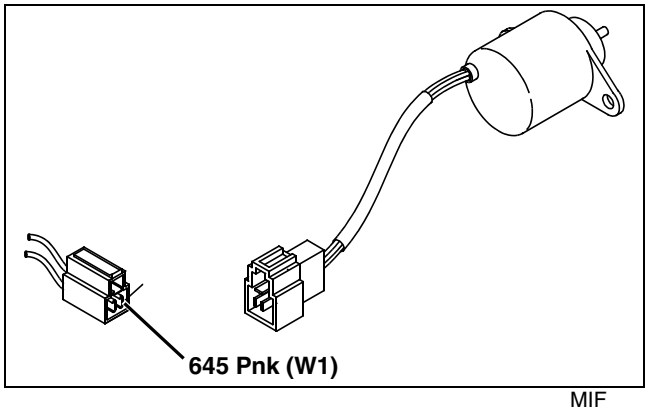
MIF

(1) Fuel Shutoff Solenoid (Y1) - Terminal A, Wire 105 Black. Check ground circuit for resistance. Is there less than 0.1 ohms of resistance?

Yes - Go To Step (2)

No - Test wires 105 black, 100 black, and connections.

System: Fuel Hold Circuit Test



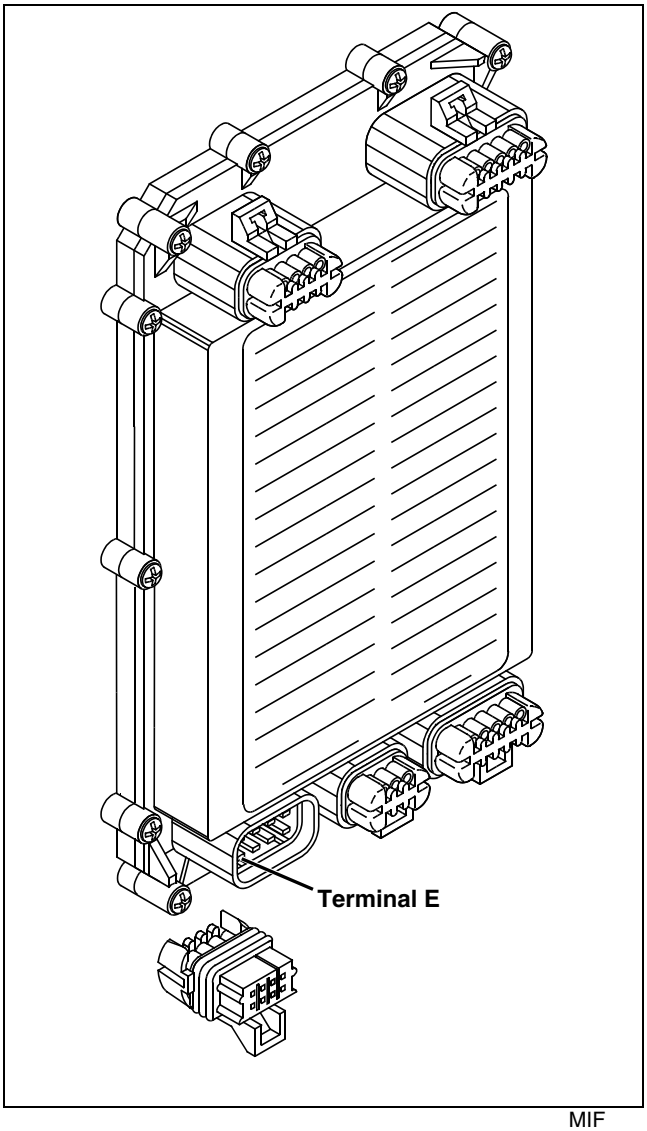
MIF

(2) Key switch in RUN position.
Fuel shutoff solenoid disconnected.
Park brake engaged (LOCKED) or operator on seat.
PTO switch in OFF position.
Hood closed (European machines).
Hood switch connector with jumper wire properly connected (North American machines).
Fuel Shutoff Solenoid (Y1) - Terminal C, Wire 645 Pink. Is battery voltage present?

Yes - Test fuel shutoff solenoid (Y1). (See “Fuel Shutoff Solenoid Test” on page 371.)

No - Go To Step (3)

System: Fuel Hold Circuit Test



MIF

(3) Electronic Control Module (A3.) - Connector X26, Terminal E. Is battery voltage present?

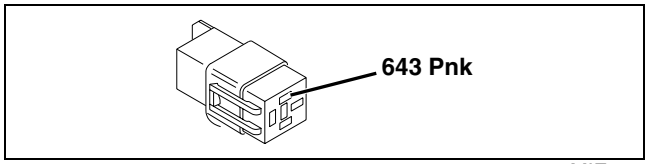
Yes - Test wires 643 (W1), 645 (W1) pink, and connections.

Yes - Models 1600/1620 S.N. (-020148) with MPTC10114 kit installed: If wires 643 (W1), 645 (W1) pink, and connections are good, Go To Step (4)

No - If output LED D28 is ON, replace electronic control module.

No - If output LED D28 is not ON and the appropriate inputs exist with no diagnostic codes occurring, replace electronic control module.

System: Fuel Hold Circuit Test

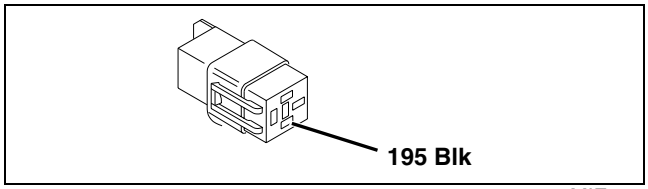


MIF

(4) Hold Coil Relay (K5) - Terminal 85, Wire 643 Pink. Is battery voltage present?

Yes - Go To Step (5)

No - Test wire 643 (W6) pink and connections.

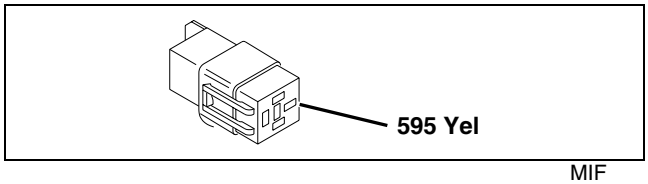


MIF

(5) Key switch in OFF position.
Hold Coil Relay (K5) -Terminal 86, Wire 195 Black. Check ground circuit for resistance. Is there less than 0.1 ohms of resistance?

Yes - Go To Step (6)

No - Test wires 195 (W6) black and connections.



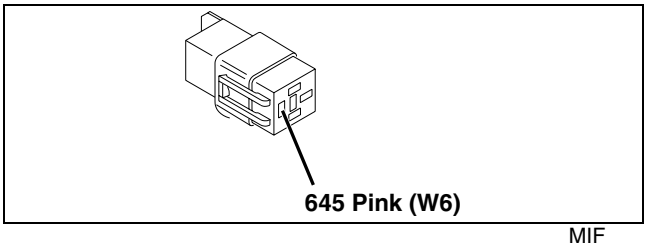
MIF

(6) Key switch in RUN position.
Hold Coil Relay (K5) - Terminal 30, Wire 595 Yellow. Is battery voltage present?

Yes - Go To Step (7)

No - Test wires 595 (W6), 596 (W6) yellow, and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Fuel Hold Circuit Test



MIF

(7) Key switch in RUN position.

(8) Connector X58 disconnected.
Hold Coil Relay (K5) - Terminal 87, Wire 654 Pink. Is battery voltage present?

Yes - Test wires 643 (W1), 645 (W6) pink, and connections.

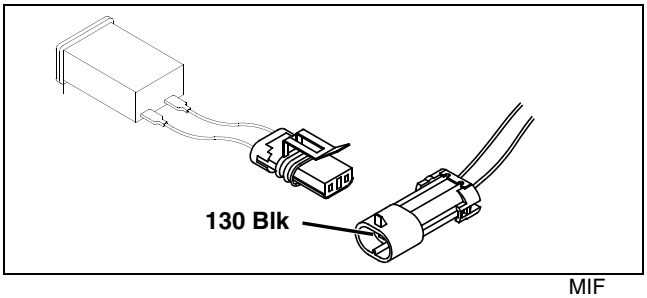
No - Test hold coil relay (K5). (See “Relay Test” on page 363.)

Hour Meter Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in OFF position.
- Hour meter disconnected.
- When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Hour Meter Circuit Test



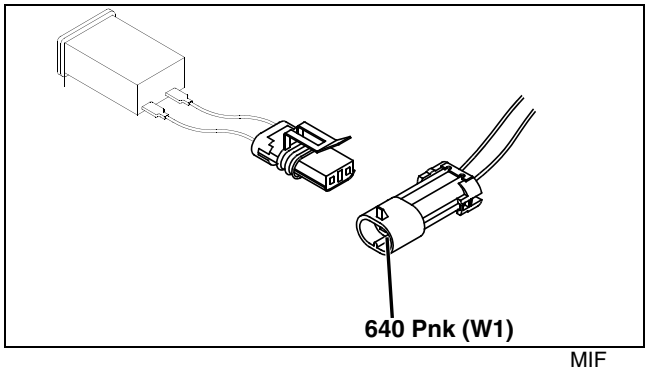
MIF

(1) Hour Meter (P1) - Terminal B, Wire 130 Black. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?

Yes - Go To Step (2)

No - Test wires 130 black, 100 black, and connections.

System: Hour Meter Circuit Test



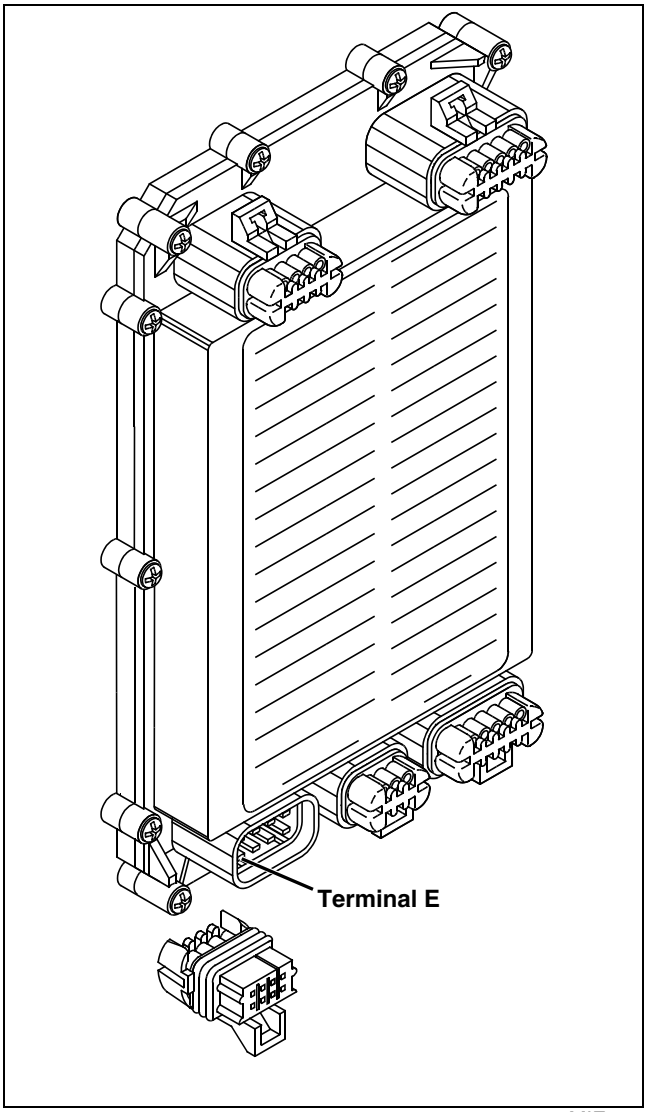
MIF

(2) Key switch in RUN position.
Hour meter disconnected.
Park brake engaged (LOCKED) or operator on seat.
PTO switch in OFF position.
Hood closed (European machines).
Hood switch connector with jumper wire properly connected (North American machines).
Hour Meter (P1) - Terminal A. Is battery voltage present?

Yes - Replace hour meter.

No - Go To Step (3)

System: Hour Meter Circuit Test



MIF

(3) Electronic Control Module (A3) - Connector X26, Terminal E. Is battery voltage present?

Yes - Test wires 640, 643 pink, and connections.

No - If output LED D28 is not ON and the appropriate inputs exist with no diagnostic codes occurring, replace electronic control module.

Charging Circuit Operation

Function

To maintain battery voltage between 12.2 and 14.7 volts.

Operating Conditions

- Key switch in RUN position.
- Engine running.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the cranking circuit with a fusible link (F2) and 15-amp switched power fuse (F3). Unswitched power flows from the battery (G1) positive (+) terminal to fusible link (F2) and then to key switch (S1), terminal B (red wires 201 [W1] and 210 [W1]).

When the key switch is in the RUN position, switched power flows from key switch terminal A to switched power fuse (F3) (400 yellow/red) and then to the following:

- Engine lights display (A1) (yellow wires 540 [W1], 530 [W1], 525 [W1], and 520 [W1]).
- Alternator (G2) (yellow wires 540 [W1], 530 [W1], and 514 [W1]).

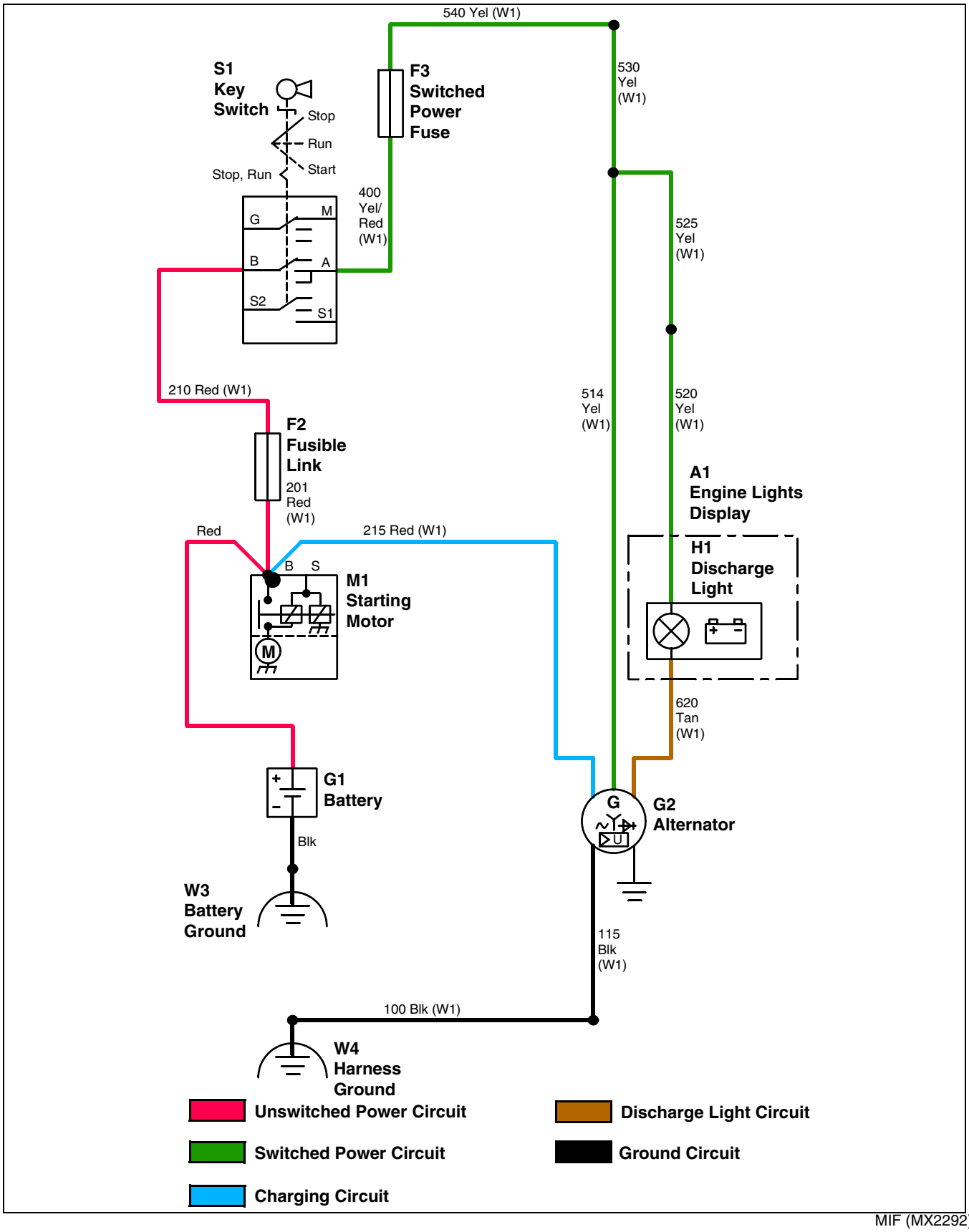
The alternator has an internal voltage regulator that monitors battery voltage and increases alternator output to maintain proper running voltage and battery charge. Alternator output is determined by the intensity of magnetism at the field coil. As the battery voltage fluctuates, the regulator adjusts the voltage to the field coil, which in turn, intensifies the magnetic field at the field coil to increase alternator output.

The alternator produces alternating current (AC) which is then rectified to direct current (DC) by an internal rectifier in the alternator.

Charging current flows from the alternator to the battery terminal on starting motor (M1) (wire 215 [W1] red) and then to the battery positive (+) terminal through the positive (+) battery cable (red).

When the alternator has no output or low output, discharge light (H1) is turned on by providing ground (wire 620 [W1] tan). The alternator provides the ground internally.

Ground for alternator (G2) is provided by black wires 115 (W1) and 100 (W1).


540 Yel (W1)
S1
Key
Switch
Stop
Run
Start
Stop, Run
F3
Switched
Power
Fuse
530
Yel
(W1)
400
Yel/
Red
(W1)
525
Yel
(W1)
G
M
B
A
S2
S1
210 Red (W1)
514
Yel
(W1)
520
Yel
(W1)
F2
Fusible
Link
201
Red
(W1)
A1
Engine Lights
Display
Red
215 Red (W1)
H1
Discharge
Light
B
S
M1
Starting
Motor
M
620
Tan
(W1)
G1
Battery
Blk
G
G2
Alternator
U
W3
Battery
Ground
115
Blk
(W1)
100 Blk (W1)
W4
Harness
Ground
Unswitched Power Circuit
Discharge Light Circuit
Switched Power Circuit
Ground Circuit
Charging Circuit

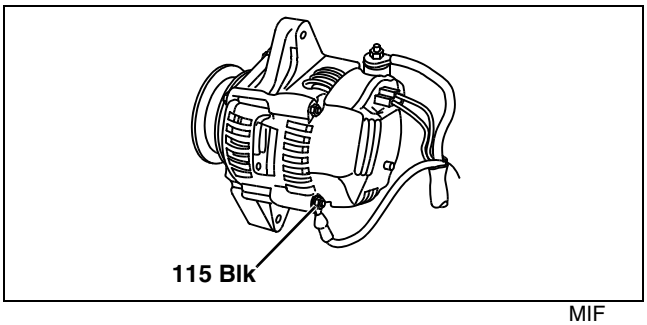
MIF (MX2292)

Charging Circuit Diagnosis

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in RUN position with engine OFF.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Charging Circuit Diagnosis

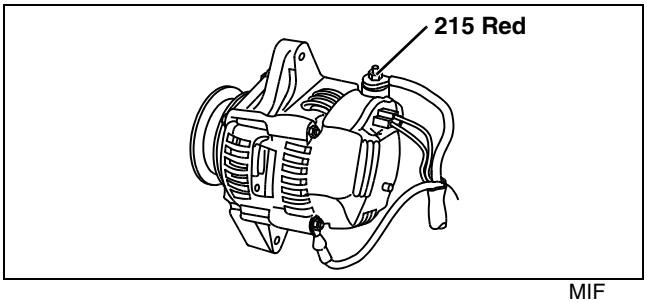


MIF

(1) Alternator (G2) - Wire 115 Black. Is there less than 0.1 ohm of resistance?

Yes - Go To Step (2)

No - Test wire 115 black and connections.



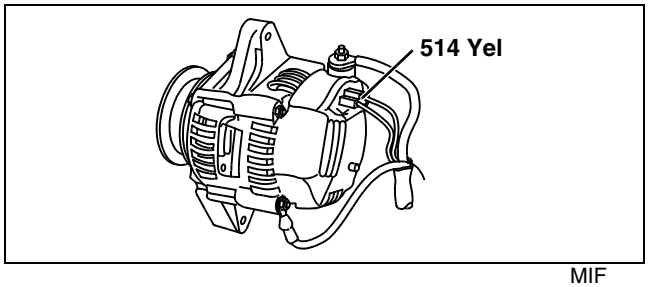
MIF

(2) Alternator (G2) - Wire 215 Red. Is battery voltage present?

Yes - Go To Step (3)

No - Check wire 215 red and connections. (See “Unswitched Power Circuit Diagnosis” on page 241.)

System: Charging Circuit Diagnosis

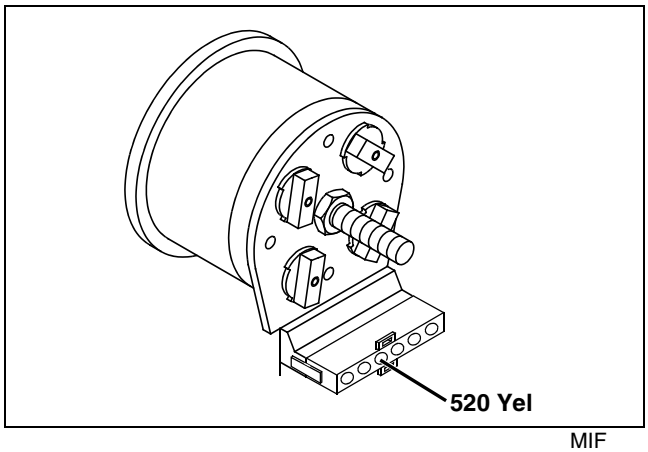


MIF

(3) Alternator connector (X34) disconnected. Alternator (G2) - Terminal B, Wire 514 Yellow. Is battery voltage present?

Yes - Go To Step (4)

No - Check wire 514 yellow, and connection. (See “Switched Power Circuit Diagnosis” on page 242.)



MIF

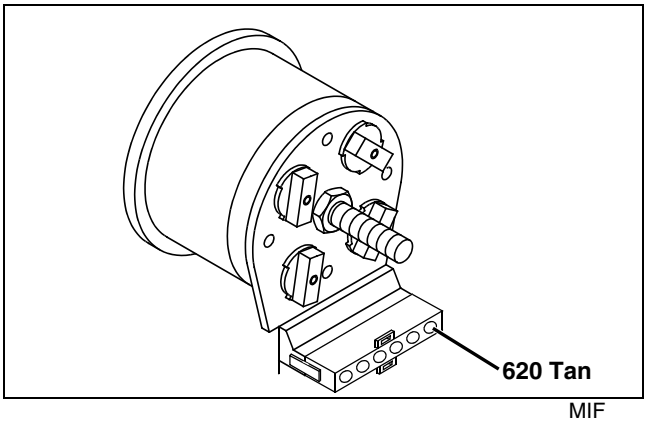
A - Alternator connector (X34) connected.

(4) Engine Lights Display (A1) - Terminal 3, Wire 520 Yellow. Is battery voltage present?

Yes - Go To Step (5)

No - Check wire 520 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Charging Circuit Diagnosis

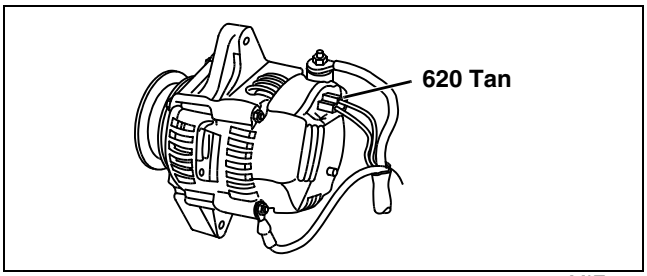


MIF

(5) Engine Lights Display (A1) - Terminal 6, Wire 620 Tan. Is battery voltage present?

Yes - Go To Step (6)

No - Check light bulbs in engine lights display (A1). If bulbs are good, replace engine lights display.



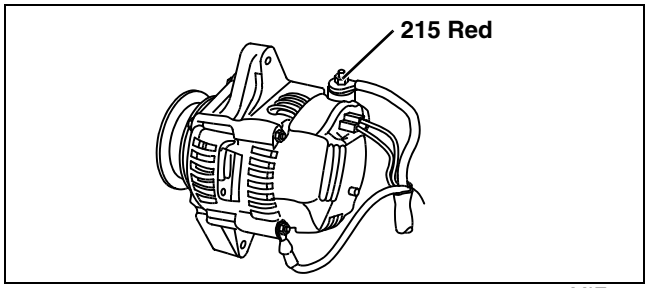
MIF

(6) Alternator connector (X34) disconnected. Alternator (G2) - Terminal A, Wire 620 Tan. Is battery voltage present at harness side of connector?

Yes - Go To Step (7)

No - Check wire 620 tan and connections.

System: Charging Circuit Diagnosis



MIF

(7) Disconnect fuel shutoff solenoid connector (X40).
Crank engine for 15 seconds to discharge battery.
Connect fuel shutoff solenoid connector (X40).
Start and run engine at fast idle.
Meter negative (-) lead on battery negative (-) terminal or chassis ground.
Alternator (G2) - Wire 215 Red. Measure voltage. Does voltage increase to 12.2-14.7 volts?

No - If voltage exceeds 14.7 volts, replace regulator. If voltage does not increase, test unregulated amperage to determine if alternator or regulator is defective. (See “Unregulated Amperage Test” on page 360.)

Mower Deck Lower Circuit Operation

Function

To lower the mower decks.

Operating Conditions

- Key switch in RUN position.
- Operator ON seat.

Theory of Operation

NOTE: The mower deck lower system is gravity assisted and does not require hydraulic oil pressure or the engine running to function.

The power circuit provides current to the key switch (S1) and protects the lower circuit with a fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch terminal B (wires 201 and 210 red).

When the key switch is in the RUN position, current flows from terminal A of the key switch, through wire 400 yellow/red, to switched power fuse (F3). From fuse (F3), current flows to the following:

- Through wires 540 and 532 yellow to the electronic control module connector (X25), terminal D.
- Models 1600/1620 S.N. (-020000): Through wires 540 and 530 yellow, then to switches:
  - Left lower switch (S12) (wire 580 red).
  - Front lower switch (S13) (wire 585 red).
  - Right lower switch (S14) (wire 590 red).
- Models 1600/1620 S.N. (020001-) and 1600 Turbo: Through wires 540 and 530 yellow, then to switches:
  - Left raise/lower switch (S17) (wire 580 yellow).
  - Front raise/lower switch (S18) (wire 585 yellow).
  - Right raise/lower switch (S19) (wire 590 yellow).

NOTE: Solenoids (Y2, Y3 and Y4) are used to raise AND lower the decks. This is accomplished by energizing or de-energizing the raise/lower select solenoid (Y5). When the raise/lower select solenoid is energized, the raise function is selected. When de-energized, the lower function is selected. This function is controlled by the electronic control module.

- Through wires 540 and 530 yellow, to solenoids:
  - Left raise/lower solenoid (Y2) (wire 542 yellow).
  - Front raise/lower solenoid (Y3) (wire 541 yellow).
  - Right raise/lower solenoid (Y4) (wire 543 yellow).
  - Through wires 540, 530, 525, and 533 yellow, to the raise/lower select solenoid (Y5).

When any of the raise/lower control levers are moved to the LOWER position, current flows to the electronic control module as follows:

- Models 1600/1620 S.N. (-020000):
  - Left raise switch (S12) - Connector X28, terminal F (wire 760 blue).
  - Front raise switch (S13) - Connector X28, terminal D (wire 765 gray).
  - Right raise switch (S14) - Connector X28, terminal E (wire 770 white).
- Models 1600/1620 S.N. (020001-) and 1600 Turbo:
  - Left raise/lower switch (S17) - Connector X28, terminal F (wire 760 blue).
  - Front raise/lower switch (S18) - Connector X28, terminal D (wire 765 gray).
  - Right raise/lower switch (S19) - Connector X28, terminal E (wire 770 white).

NOTE: A time delay feature, designed into the electronic control module, keeps the deck lower function engaged for a few seconds to ensure that the deck lowers completely to the ground.

When the electronic control module receives current from a lower switch, the control module supplies a ground path for the corresponding raise/lower solenoid (Y2, Y3 or Y4), energizing the solenoid. The control module will not provide a ground path to the raise/lower select solenoid (Y5), which prevents the solenoid from energizing, thus selecting the lower function. The grounds to the solenoids are supplied by the electronic control module as follows:

- Left raise/lower solenoid (Y2) - Connector X27, terminal A (wire 943 orange).
- Front raise/lower solenoid (Y3) - Connector X27, terminal C (wire 940 green).
- Right raise/lower solenoid (Y4) - Connector X27, terminal D (wire 946 blue).
- Raise/lower select solenoid (Y5) - No ground is supplied to this solenoid at this time.

Mower Deck Raise Circuit Operation

Function

To raise the mower decks.

Operating Conditions

- Key switch in RUN position.
- Operator ON seat.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the lower circuit with a fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch terminal B (wires 201 and 210 red).

When the key switch is in the RUN position, current flows from terminal A of the key switch, through wire 400 yellow/red, to switched power fuse (F3). From fuse (F3), current flows to the following:

- Through wires 540 and 532 yellow to the electronic control module connector (X25), terminal D.
- Models 1600/1620 S.N. (-020000): Through wires 540 and 530 yellow, then to switches:
  - Left raise switch (S9) (wire 560 yellow).
  - Front raise switch (S10) (wire 565 yellow).
  - Right raise switch (S11) (wire 570 yellow).
- Models 1600/1620 S.N. (020001-) and 1600 Turbo: Through wires 540 and 530 yellow, then to switches:
  - Left raise/lower switch (S17) (wire 580 yellow).
  - Front raise/lower switch (S18 (wire 585 yellow).
  - Right raise/lower switch (S19) (wire 590 yellow).

NOTE: Solenoids (Y2, Y3, and Y4) are used to raise AND lower the decks. This is accomplished by energizing or de-energizing the raise/lower select solenoid (Y5). When the raise/lower select solenoid is energized, the raise function is selected. When de-energized, the lower function is selected. This function is controlled by the electronic control module.

- Through wires 540 and 530 yellow, to solenoids:
  - Left raise/lower solenoid (Y2) (wire 542 yellow).
  - Front raise/lower solenoid (Y3) (wire 541 yellow).
  - Right raise/lower solenoid (Y4) (wire 543 yellow).
  - Through wires 540, 530, 525, and 533 yellow, to the raise/lower select solenoid (Y5).

When any of the raise/lower control levers are moved to the RAISE position, current flows to the electronic control module as follows:

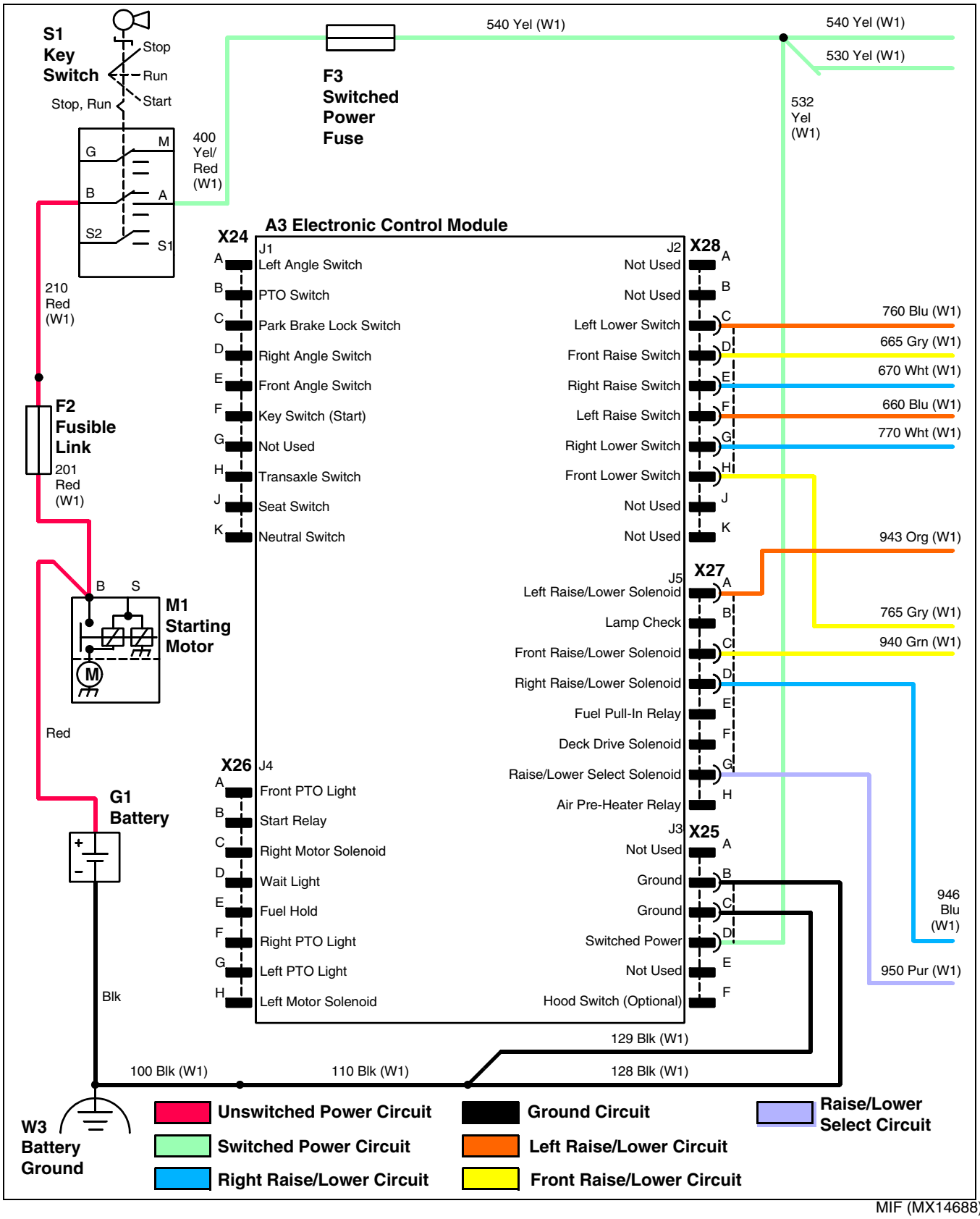
- Models 1600/1620 S.N. (-020000):
  - Left raise switch (S9) - Connector X28, terminal F (wire 660 blue).
  - Front raise switch (S10) - Connector X28, terminal D (wire 665 gray).
  - Right raise switch (S11) - Connector X28, terminal E (wire 670 white).
- Models 1600/1620 S.N. (020001-) and 1600 Turbo:
  - Left raise/lower switch (S17) - Connector X28, terminal F (wire 660 blue).
  - Front raise/lower switch (S18) - Connector X28, terminal D (wire 665 gray).
  - Right raise/lower switch (S19) - Connector X28, terminal E (wire 670 white).

When the electronic control module receives current from a raise switch, the control module supplies a ground path for the corresponding raise/lower solenoid (Y2, Y3, or Y4), energizing the solenoid. The control module also supplies a ground path to the raise/lower select solenoid (Y5), which energizes the solenoid, thus selecting the raise function. The ground path to the solenoids are supplied by the electronic control module as follows:

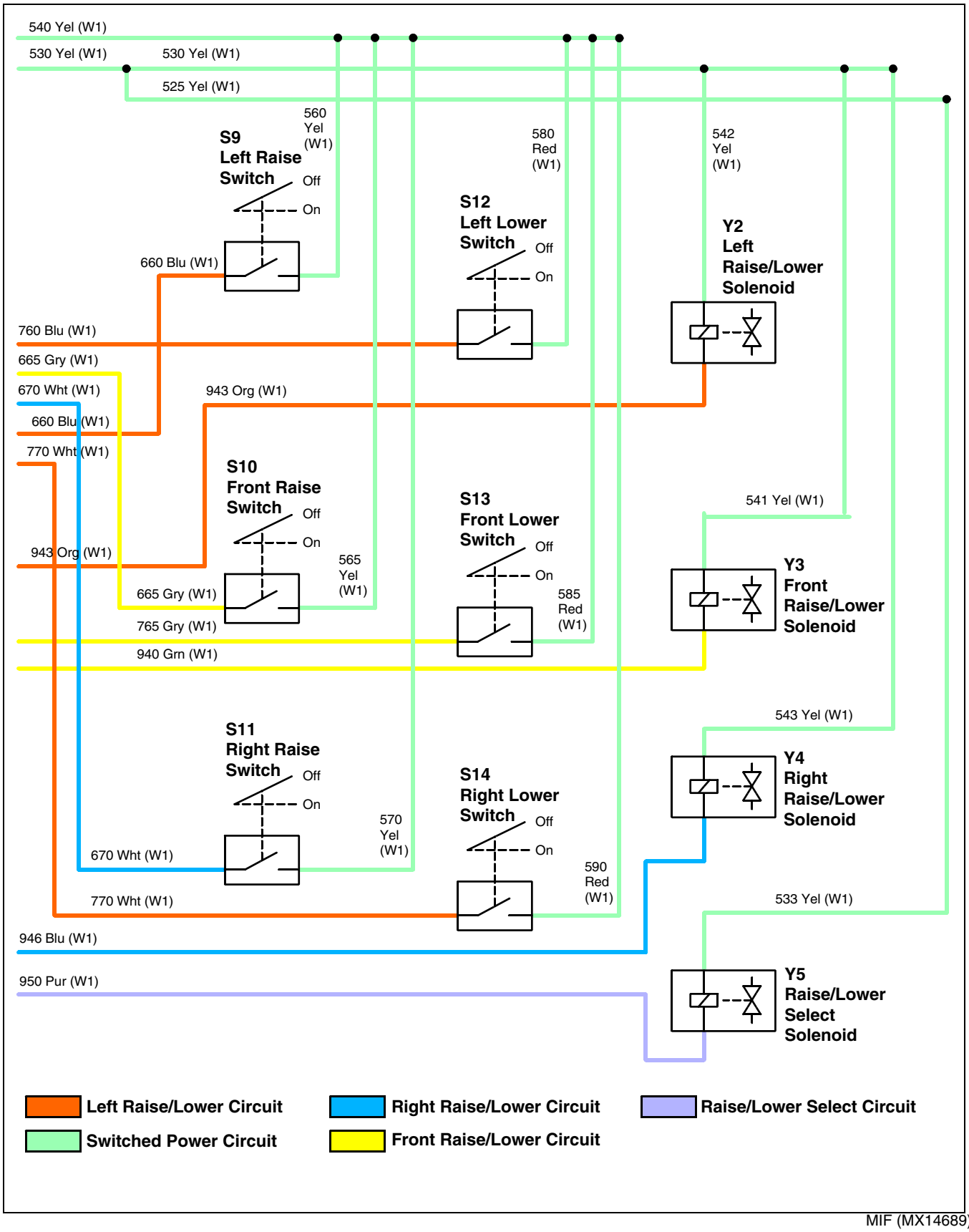
- Left raise/lower solenoid (Y2) - Connector X27, terminal A (wire 943 orange).
- Front raise/lower solenoid (Y3) - Connector X27, terminal C (wire 940 green).
- Right raise/lower solenoid (Y4) - Connector X27, terminal D (wire 946 blue).
- Raise/lower select solenoid (Y5) - Connector X27, terminal G (wire 950 purple).

Mower Deck Raise and Lower Circuit Schematics

Models 1600/1620 S.N. (-020000)

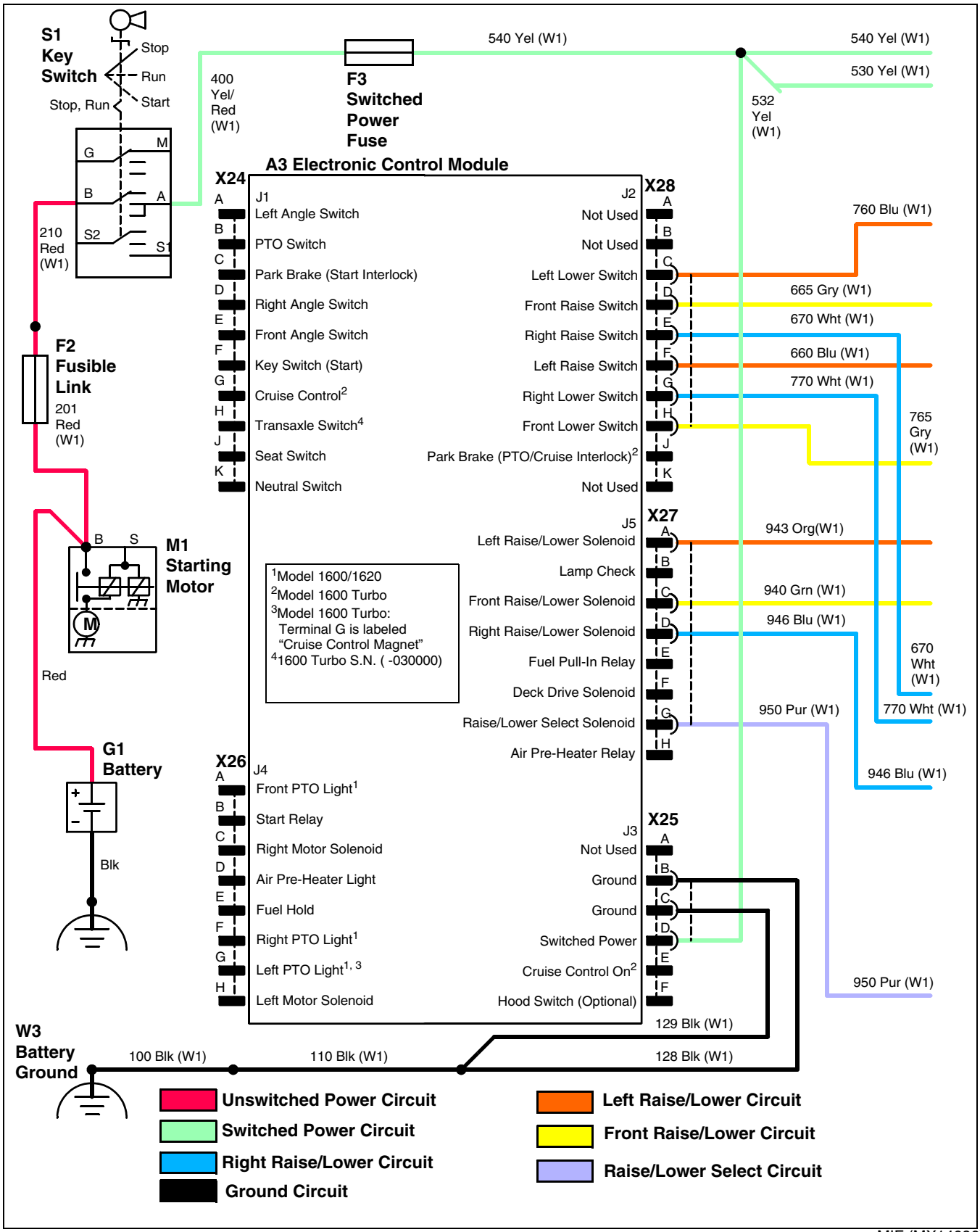


MIF (MX14688)

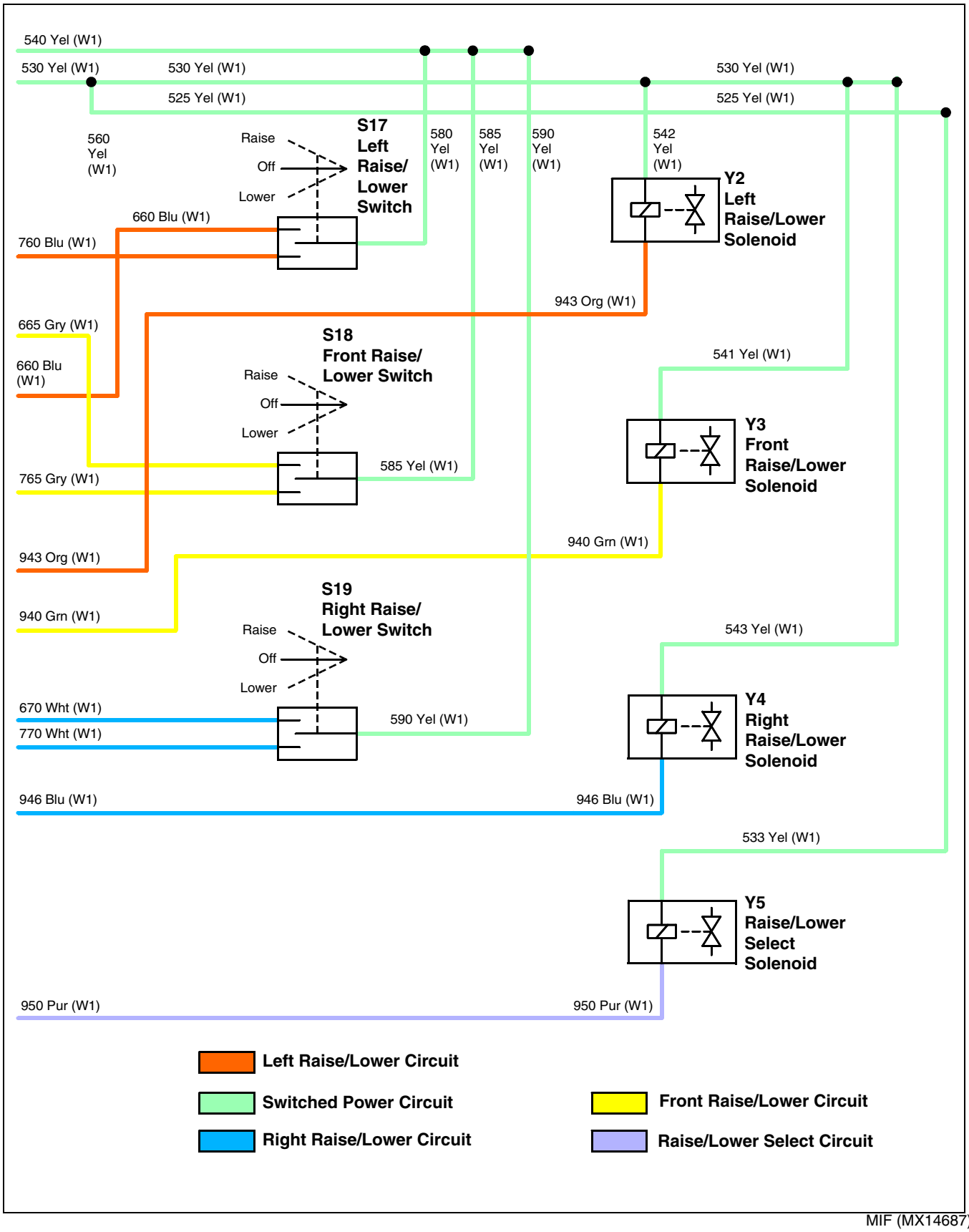

540 Yel (W1)
530 Yel (W1)
530 Yel (W1)
525 Yel (W1)
560 Yel (W1)
580 Red (W1)
542 Yel (W1)
S9 Left Raise Switch
Off
On
S12 Left Lower Switch
Off
On
Y2 Left Raise/Lower Solenoid
660 Blu (W1)
760 Blu (W1)
665 Gry (W1)
670 Wht (W1)
943 Org (W1)
660 Blu (W1)
770 Wht (W1)
S10 Front Raise Switch
Off
On
S13 Front Lower Switch
Off
On
541 Yel (W1)
943 Org (W1)
565 Yel (W1)
665 Gry (W1)
585 Red (W1)
765 Gry (W1)
940 Grn (W1)
Y3 Front Raise/Lower Solenoid
543 Yel (W1)
S11 Right Raise Switch
Off
On
S14 Right Lower Switch
Off
On
Y4 Right Raise/Lower Solenoid
570 Yel (W1)
670 Wht (W1)
590 Red (W1)
770 Wht (W1)
533 Yel (W1)
946 Blu (W1)
950 Pur (W1)
Y5 Raise/Lower Select Solenoid
Left Raise/Lower Circuit
Right Raise/Lower Circuit
Raise/Lower Select Circuit
Switched Power Circuit
Front Raise/Lower Circuit

MIF (MX14689)

Models 1600/1620 S.N. (020001-) and 1600 Turbo



MIF (MX14686)


540 Yel (W1)
530 Yel (W1)
530 Yel (W1)
530 Yel (W1)
525 Yel (W1)
525 Yel (W1)
560 Yel (W1)
Raise
Off
Lower
S17 Left Raise/ Lower Switch
580 Yel (W1)
585 Yel (W1)
590 Yel (W1)
542 Yel (W1)
Y2 Left Raise/Lower Solenoid
660 Blu (W1)
760 Blu (W1)
943 Org (W1)
665 Gry (W1)
660 Blu (W1)
S18 Front Raise/ Lower Switch
Raise
Off
Lower
541 Yel (W1)
Y3 Front Raise/Lower Solenoid
585 Yel (W1)
765 Gry (W1)
940 Grn (W1)
943 Org (W1)
940 Grn (W1)
S19 Right Raise/ Lower Switch
Raise
Off
Lower
543 Yel (W1)
Y4 Right Raise/Lower Solenoid
670 Wht (W1)
770 Wht (W1)
590 Yel (W1)
946 Blu (W1)
946 Blu (W1)
533 Yel (W1)
Y5 Raise/Lower Select Solenoid
950 Pur (W1)
950 Pur (W1)
Left Raise/Lower Circuit
Switched Power Circuit
Right Raise/Lower Circuit
Front Raise/Lower Circuit
Raise/Lower Select Circuit

MIF (MX14687)

Mower Deck Raise and Lower Circuits Diagnosis

Diagnostics of circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

When diagnosing the raise and lower circuits, it is important to perform the following steps in the sequence shown:

1. Electronic Control Module Checks (See “Electronic Control Module Checks” on page 213.)

2. Input LEDs and Circuits Checks (See “Input LEDs and Circuits Checks” on page 288.)

3. Raise and Lower Circuits Tests (See “Raise and Lower Circuits Tests” on page 288.)

Input LEDs and Circuits Checks

NOTE: The following common input circuit checks are necessary when diagnosing the mower deck raise/lower circuits. (See “Electronic Control Module Input LEDs and Common Circuits Checks” on page 214.)

- Seat Switch
- Left Raise/Lower Switch
- Front Raise/Lower Switch
- Right Raise/Lower Switch

Raise and Lower Circuits Tests

From the following list select which symptom best describes the machine's condition then go to the appropriate circuit test:

NOTE: Make sure switched power fuse (F3) is good before performing these checks/tests.

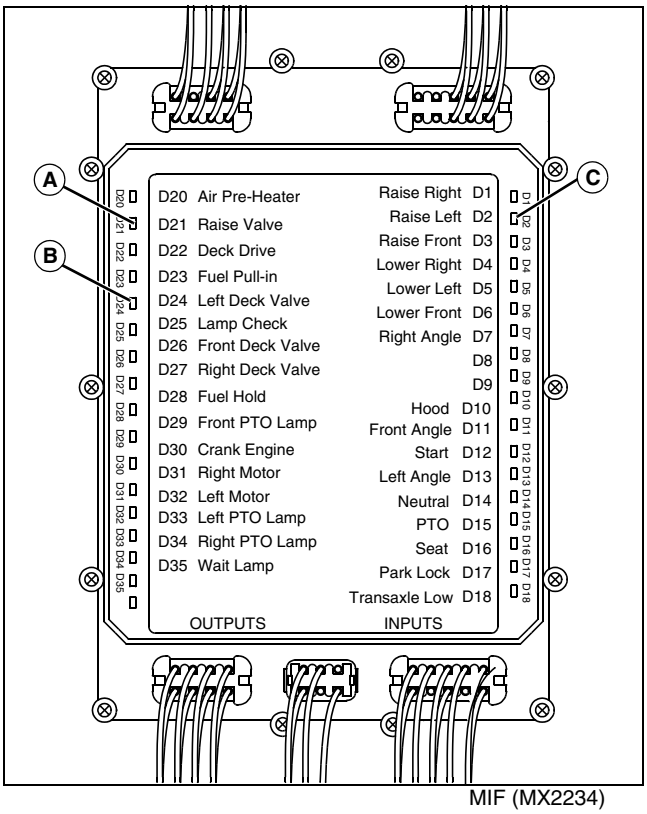
- If none of the mower decks rise when ALL the raise/lower control levers are moved to the RAISE position, go to See “Raise/Lower Select Solenoid Circuit Test” on page 304
- If left mower deck does not rise when the left raise/lower control lever is moved to the RAISE position, See “Left Deck Raise Circuit Test” on page 289.
- If left mower deck rises when the left raise/lower control lever is moved to the RAISE position, but does not lower when the control lever is moved to the LOWER position, See “Left Deck Lower Switch Circuit Test” on page 292.
- If front mower deck does not rise when the front raise/lower control lever is moved to the RAISE position, See “Front Deck Raise Circuit Test” on page 294.
- If front mower deck rises when the front raise/lower control lever is moved to the RAISE position, but does not lower when the control lever is moved to the LOWER position, See “Front Deck Lower Switch Circuit Test” on page 297.
- If right mower deck does not rise when the right raise/lower control lever is moved to the RAISE position, See “Right Deck Raise Circuit Test” on page 299.
- If right mower deck rises when the right raise/lower control lever is moved to the RAISE position, but does not lower when the control lever is moved to the LOWER position, See “Right Deck Lower Switch Circuit Test” on page 302.

Left Deck Raise Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Left raise/lower control lever in the RAISE position.

System: Left Deck Raise Circuit Test



MIF (MX2234)

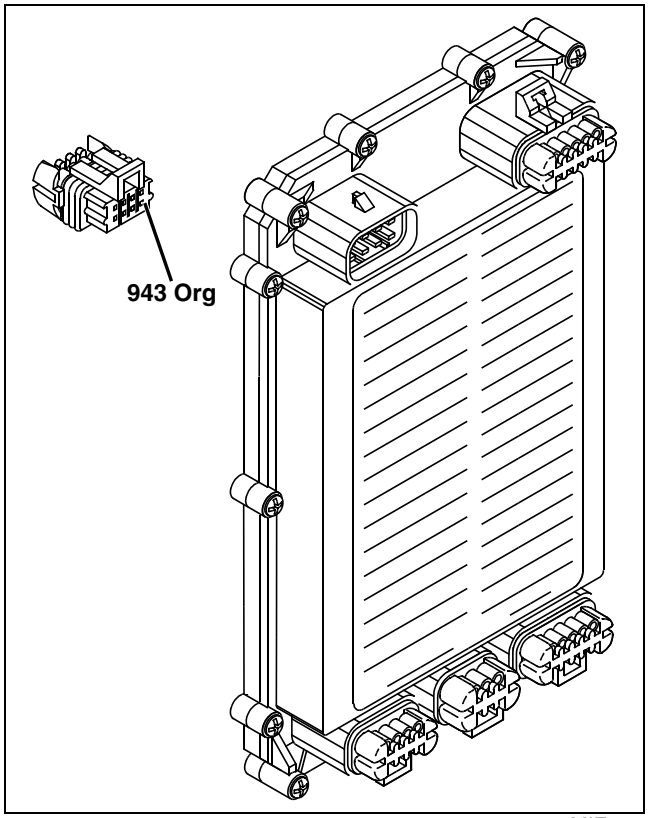
(1) Electronic Control Module (A3) - LEDs D2, D21, and D24.
Is input LED D2 (C) ON?
Is output LEDs D21 (A) and D24 (B) ON?

Yes - Go To Step (2)

No - If input LED D2 does not come on, Go To Step (5).

No - If input LED D2 comes on and the seat switch input is valid, but output LEDs D21 or D24 do not come on, check for an output diagnostic code. If no code is present, replace control module.

System: Left Deck Raise Circuit Test



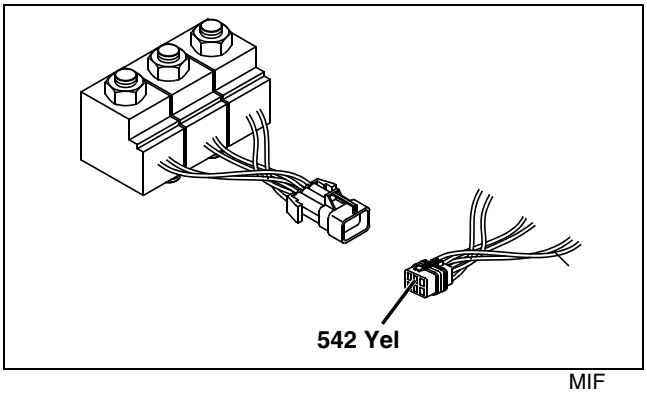
MIF

(2) Key switch in RUN position.
Electronic Control Module Connector X27 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
Electronic Control Module (A3) - Connector X27 - Terminal A, Wire 943 Orange. Is battery voltage present?

Yes - Test left raise/lower solenoid (Y2). (See “Raise and Lower Solenoid Coil Test” on page 371.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Go To Step (3)

System: Left Deck Raise Circuit Test

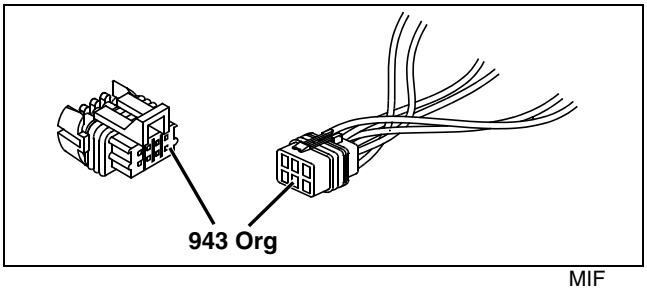


MIF

(3) Left Raise/Lower Solenoid (Y2) - Connector X50, Terminal E, Wire 542 Yellow. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 542 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



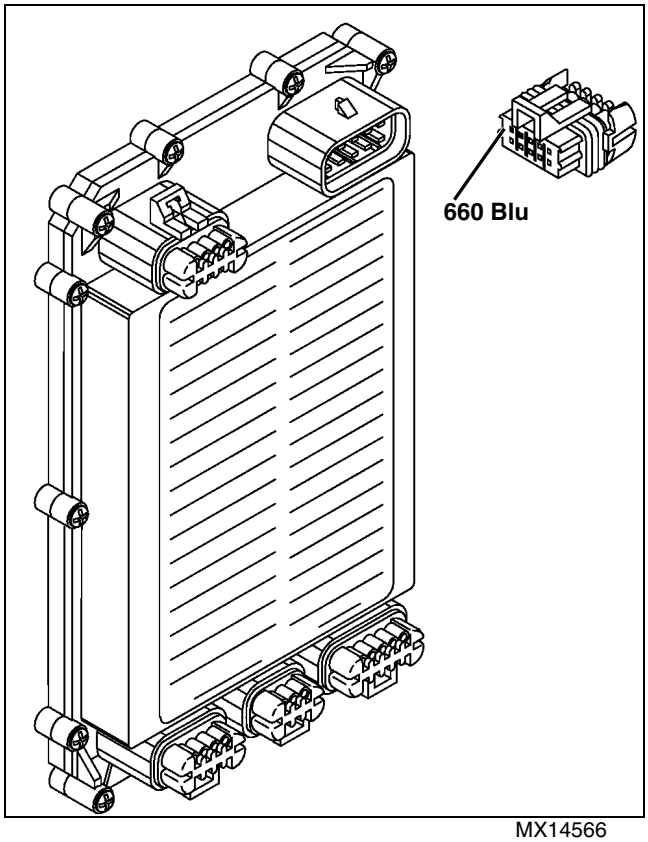
MIF

(4) Left Raise/Lower Solenoid (Y2) - Connector X50, Terminal B and ECM Connector X27, Terminal A. Is continuity indicated?

Yes - Test left raise/lower solenoid (Y2). (See "Raise and Lower Solenoid Coil Test" on page 371.) If solenoid is good, check solenoid valve. (See "Solenoid Valve Check" on page 534.)

No - Repair or replace wire 943 orange and connections.

System: Left Deck Raise Circuit Test



MX14566

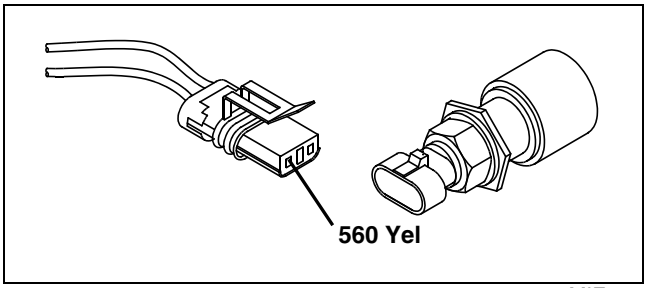
(5) Electronic Control Module Connector X28 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
NOTE: Continued from step (1) of this test.
Electronic Control Module (A3) - Connector X28 - Terminal F, Wire 660 Blue. Is battery voltage present?

Yes - Replace control module.

No - Models 1600/1620 S.N. (-020000): Go To Step (6).

No - Models 1600/1620 S.N. (020001-) and 1600 Turbo: Go To Step (8).

System: Left Deck Raise Circuit Test

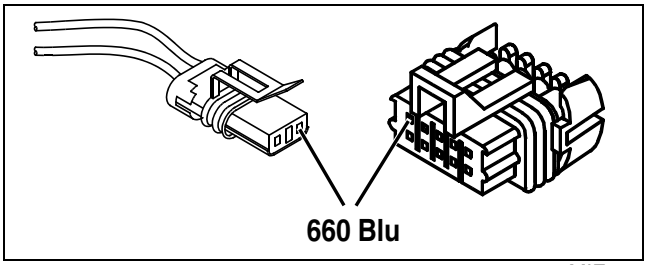


MIF

(6) Model 1600/1620 S.N. (-020000): Left Raise Switch (S9) - Terminal A, Wire 560 Yellow. Is battery voltage present?

Yes - Go To Step (7)

No - Test wire 560 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



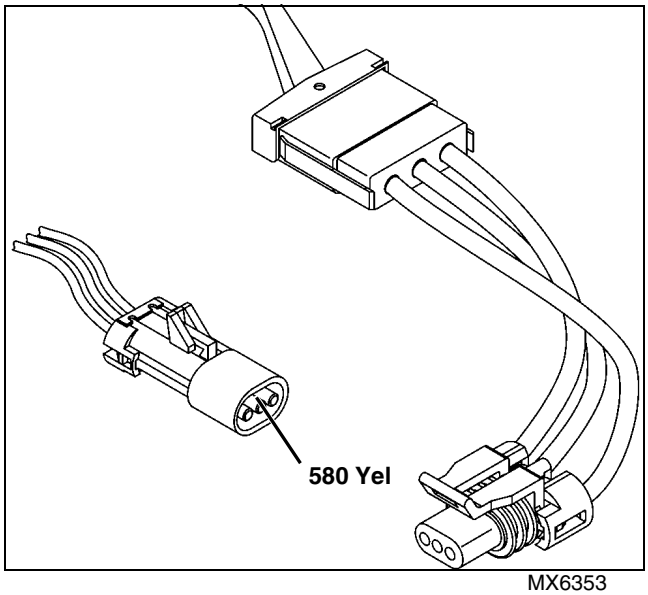
MIF

(7) Model 1600/1620 S.N. (-020000): Left Raise Switch (S9) - Terminal B and ECM Connector X28, Terminal F. Is continuity indicated?

Yes - Test left raise switch (S9). (See "Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)" on page 368

No - Repair or replace wire 660 blue and connections.

System: Left Deck Raise Circuit Test

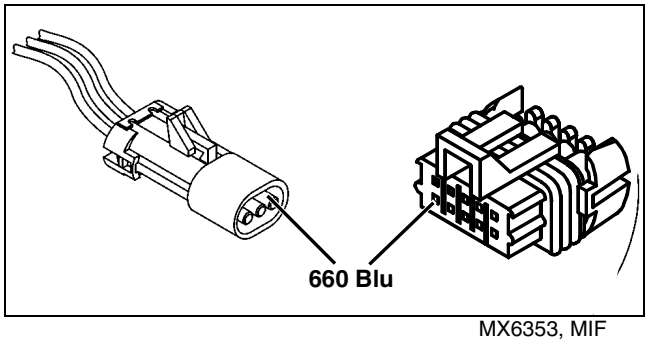


MX6353

(8) NOTE: Continued from step (5) of this test. Models 1600/1620 S.N. (020001-) and 1600 Turbo: Left Raise/Lower Switch (S17) - Terminal B, Wire 580 Yellow. Is battery voltage present?

Yes - Go To Step (9)

No - Test wire 580 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



MX6353, MIF

(9) Models 1600/1620 S.N. (020001-) and 1600 Turbo: Left Raise/Lower Switch (S17) - Terminal C and ECM Connector X28 - Terminal F. Is continuity indicated?

Yes - Test left raise/lower switch (S17). See "Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo" on page 368.)

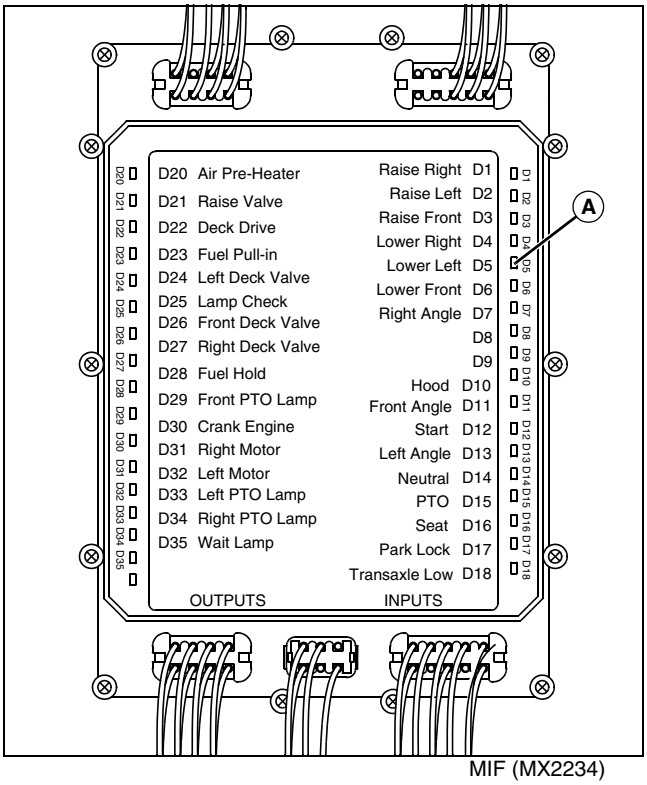
No - Repair or replace wire 660 blue and connections.

Left Deck Lower Switch Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Left raise/lower control lever in the LOWER position.

System: Left Deck Lower Switch Circuit Test



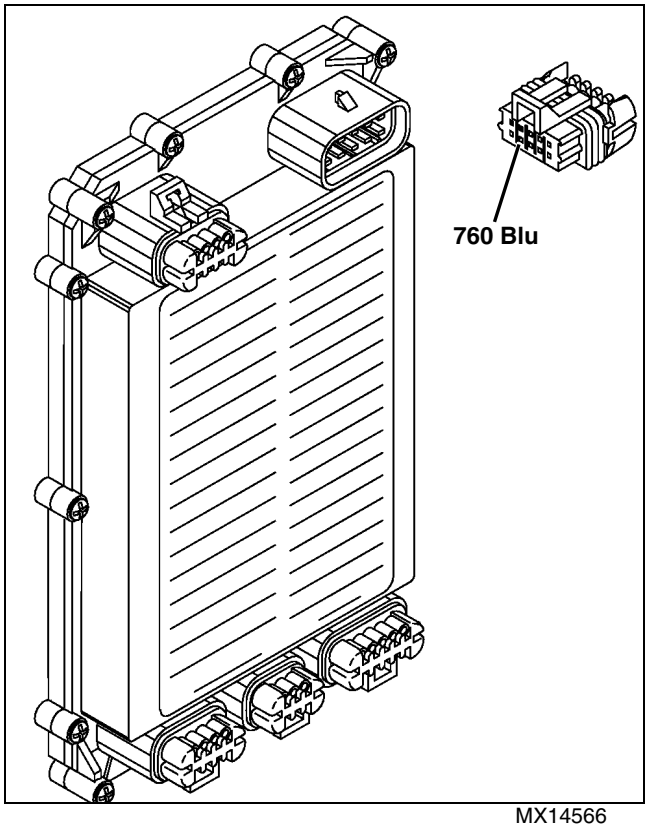
MIF (MX2234)

(1) Electronic Control Module (A3) - LED D5. Is input LED D5 (A) ON?

Yes - If input LED D5 comes on and the seat switch input is valid, but output LED D24 does not come on, check for an output diagnostic code. If no code is present, replace control module.

No - Go To Step (2)

System: Left Deck Lower Switch Circuit Test



MX14566

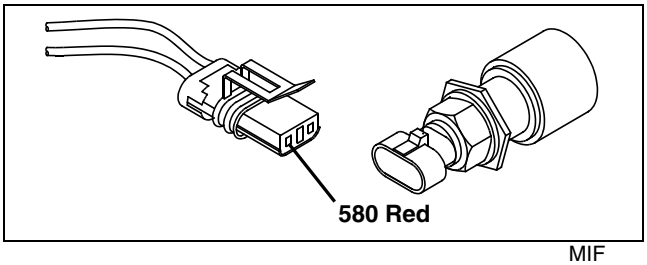
(2) Electronic Control Module Connector X28 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
Electronic Control Module (A3) - Connector X28 - Terminal C, Wire 760 Blue. Is battery voltage present?

Yes - Replace control module.

No - Models 1600/1620 S.N. (-020000): Go To Step (3).

No - Models 1600/1620 S.N. (020001-) and 1600 Turbo: Go To Step (5).

System: Left Deck Lower Switch Circuit Test

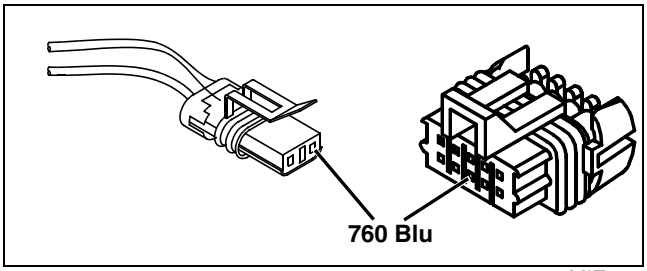


MIF

(3) Models 1600/1602 S.N. (-020000): Left Lower Switch (S12) - Terminal A, Wire 580 Red. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 580 red and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



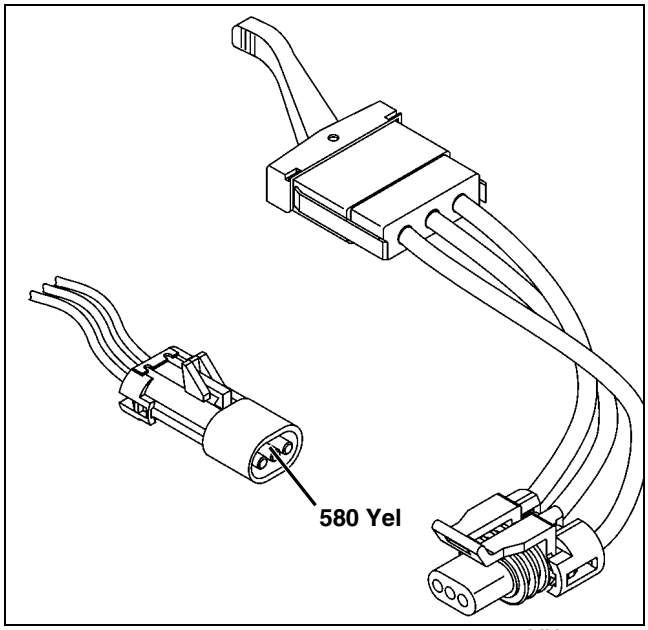
MIF

(4) Models 1600/1602 S.N. (-020000): Left Lower Switch (S12) - Terminal B and ECM Connector X28, Terminal C. Is continuity indicated?

Yes - Test left lower switch (S12). (See "Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)" on page 368.)

No - Repair or replace wire 760 blue and connections.

System: Left Deck Lower Switch Circuit Test

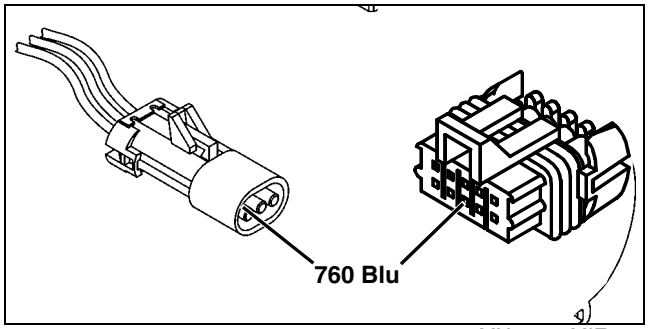


MX6353

(5) NOTE: Continued from step (2) of this test. Models 1600/1620 S.N. (020001-) and 1600 Turbo: Left Raise/Lower Switch (S17) - Terminal B, Wire 580 Yellow. Is battery voltage present?

Yes - Go To Step (6)

No - Test wire 580 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



MX6353, MIF

(6) Models 1600/1620 S.N. (020001-) and 1600 Turbo: Left Raise/Lower Switch (S17) - Terminal A and ECM Connector X28, Terminal C. Is continuity indicated?

Yes - Test left raise/lower switch (S17). See "Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo" on page 368.)

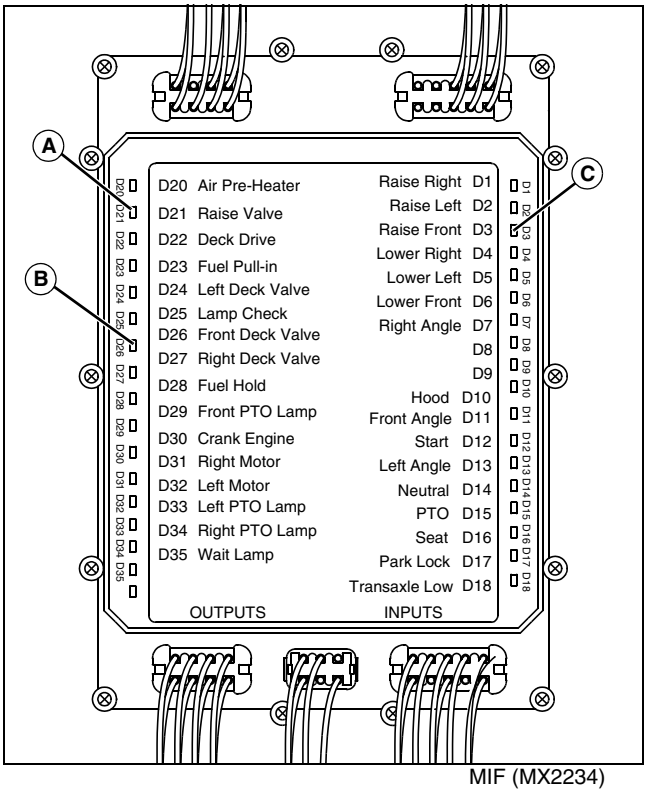
No - Repair or replace wire 760 blue and connections.

Front Deck Raise Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Front raise/lower control lever in the RAISE position.

System: Front Deck Raise Circuit Test



MIF (MX2234)

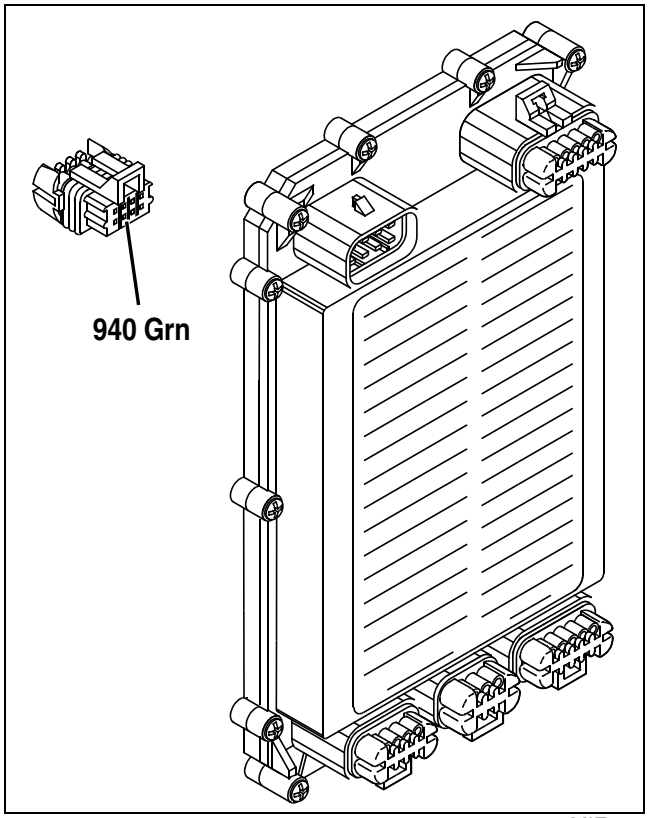
(1) Electronic Control Module (A3) - LEDs D3, D21, and D26.
Is output LEDs D21(A) and D26 (B) ON?
Is input LED D3 (C) ON?

Yes - Go To Step (2)

No - If input LED D3 does not come on: Go To Step (5).

No - If input LED D3 comes on and the seat switch input is valid, but output LEDs D21 or D26 do not come on, check for an output diagnostic code. If no code is present, replace control module.

System: Front Deck Raise Circuit Test



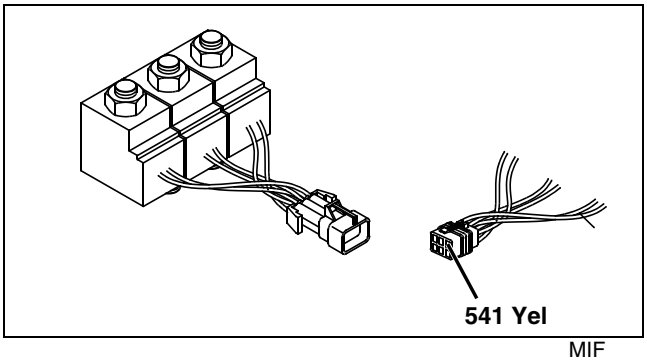
MIF

(2) Key switch in RUN position.
Electronic Control Module Connector X27 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
Electronic Control Module (A3) - Connector X27 - Terminal C, Wire 940 Green. Is battery voltage present?

Yes - Test front raise/lower solenoid (Y3). (See “Raise and Lower Solenoid Coil Test” on page 371.) (See “Solenoid Valve Check” on page 534.)

No - Go To Step (3)

System: Front Deck Raise Circuit Test

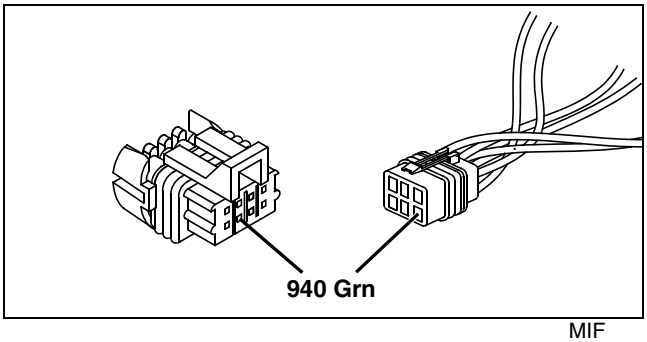


MIF

(3) Front Raise/Lower Solenoid (Y3) - Connector X50, Terminal F. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 541 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



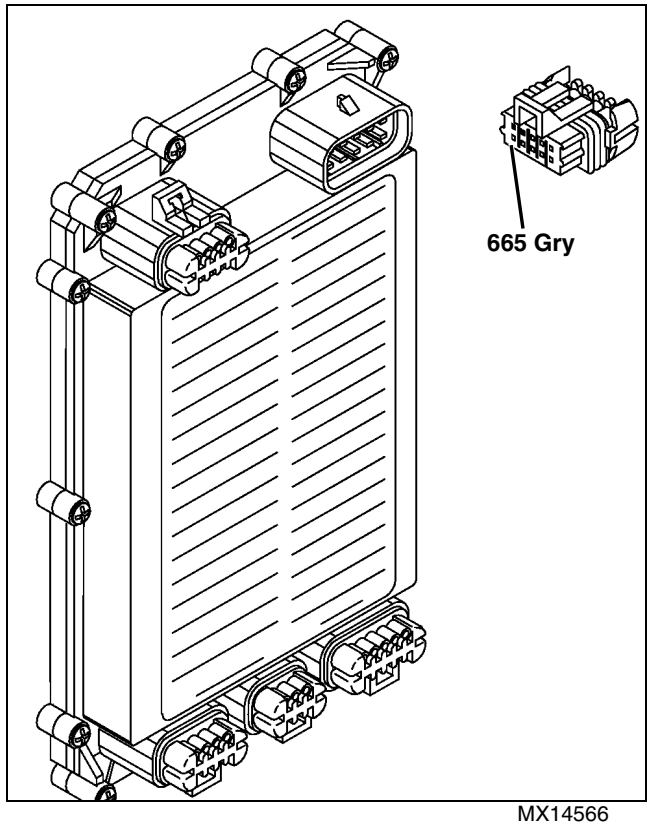
MIF

(4) Front Raise/Lower Solenoid (Y3) - Connector X50, Terminal A and ECM Connector X27, Terminal C. Is continuity indicated?

Yes - Test front raise/lower solenoid (Y3). (See "Raise and Lower Solenoid Coil Test" on page 371.) If solenoid is good, check solenoid valve. (See "Solenoid Valve Check" on page 534.)

No - Repair or replace wire 940 green and connections.

System: Front Deck Raise Circuit Test



MX14566

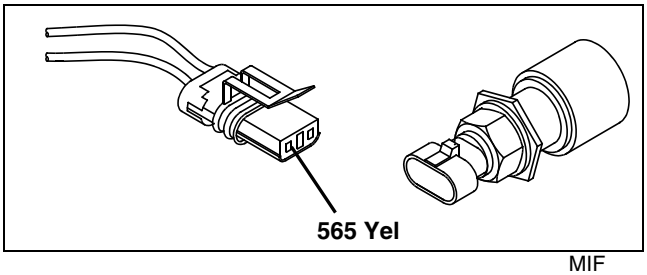
(5) NOTE: Continued from step (1) of this test. Electronic Control Module Connector X28 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
NOTE: Continued from step (1) of this test. Electronic Control Module (A3) - Connector X28 - Terminal D, Wire 665 Gray. Is battery voltage present?

Yes - Replace control module.

No - Models 1600/1620 S.N. (-020000): Go To Step (6).

No - Models 1600/1620 S.N. (020001-) and 1600 Turbo: Go To Step (8).

System: Front Deck Raise Circuit Test

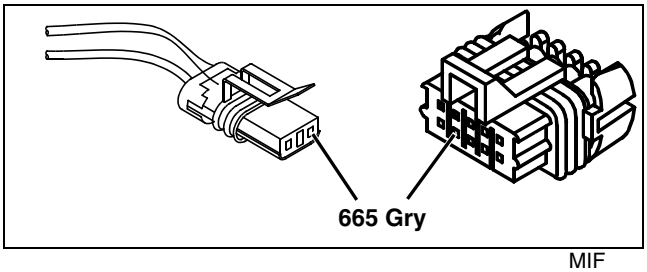


MIF

(6) Models 1600/1602 S.N. (-020000): Front Raise Switch (S10) - Terminal A, Wire 565 Yellow. Is battery voltage present?

Yes - Go To Step (6)

No - Test wire 565 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



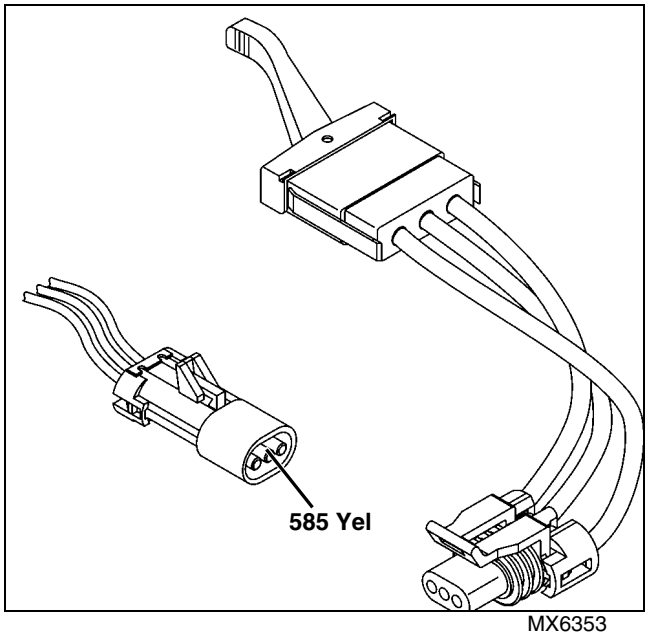
MIF

(7) Models 1600/1602 S.N. (-020000): Front Raise Switch (S10) - Terminal B and ECM Connector X28, Terminal D. Is continuity indicated?

Yes - Test front raise switch (S10). (See “Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)” on page 368.)

No - Repair or replace wire 665 gray and connections.

System: Front Deck Raise Circuit Test

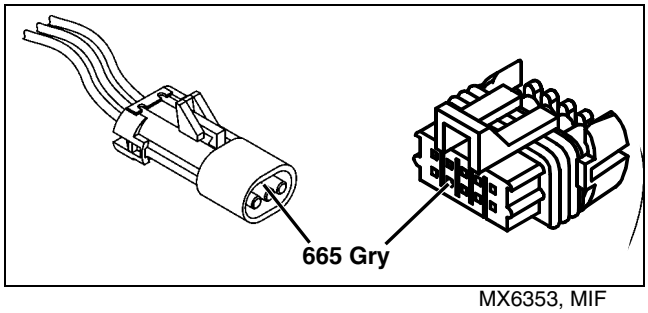


MX6353

(8) NOTE: Continued from step (5) of this test. Models 1600/1620 S.N. (020001-) and 1600 Turbo: Front Raise/Lower Switch (S18) - Terminal B. Is battery voltage present?

Yes - Go To Step (9)

No - Test wire 585 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



MX6353, MIF

(9) Models 1600/1620 S.N. (020001-) and 1600 Turbo: Front Raise/Lower Switch (S18) - Terminal C and ECM Connector X28, Terminal D. Is continuity indicated?

Yes - Test front raise switch (S18). (See “Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo” on page 368.)

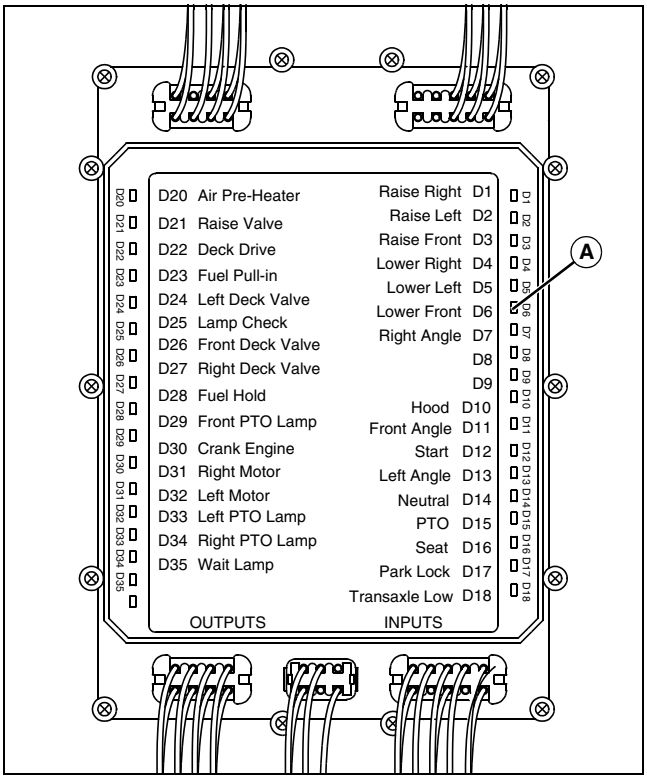
No - Repair or replace wire 665 gray and connections.

Front Deck Lower Switch Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Front raise/lower control lever in the LOWER position.

System: Front Deck Lower Switch Circuit Test



MIF (MX2234)

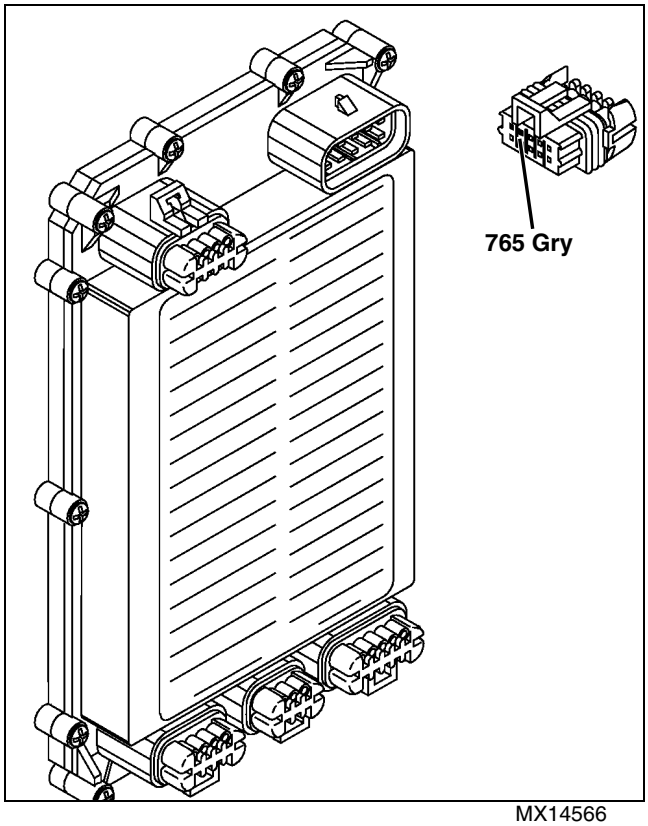
Picture Note: Electronic Control Module for Models 1600/1620 Shown; 1600 Turbo Is Similar

(1) Electronic Control Module (A3) - LED D6. Is input LED D6 (A) ON?

Yes - If input LED D6 comes on and the seat switch input is valid, but output LED D26 does not come on, check for an output diagnostic code. If no code is present, replace control module.

No - Go To Step (2)

System: Front Deck Lower Switch Circuit Test



MX14566

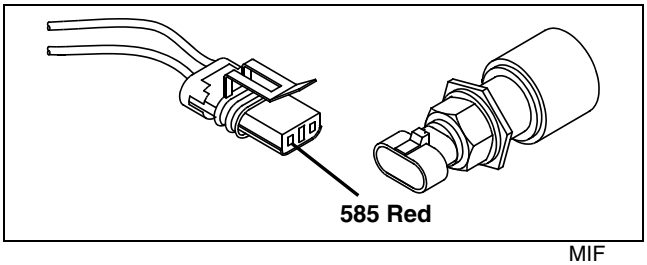
(2) Electronic Control Module Connector X28 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
Electronic Control Module (A3) - Connector X28 - Terminal H, Wire 765 Gray. Is battery voltage present?

Yes - Replace control module.

No - Models 1600/1620 S.N. (-020000): Go To Step (3).

No - Models 1600/1620 S.N. (020001-) and 1600 Turbo: Go To Step (5).

System: Front Deck Lower Switch Circuit Test

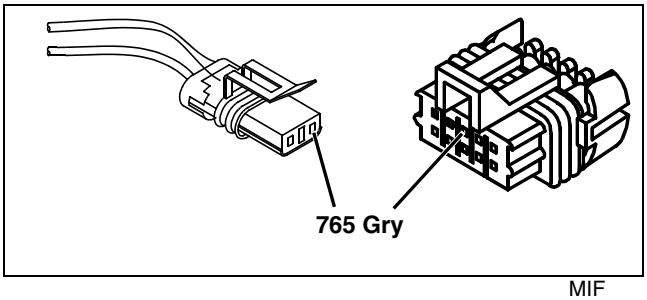


MIF

(3) Models 1600/1602 S.N. (-020000): Front Lower Switch (S13) - Terminal A, Wire 585 Red. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 585 red and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



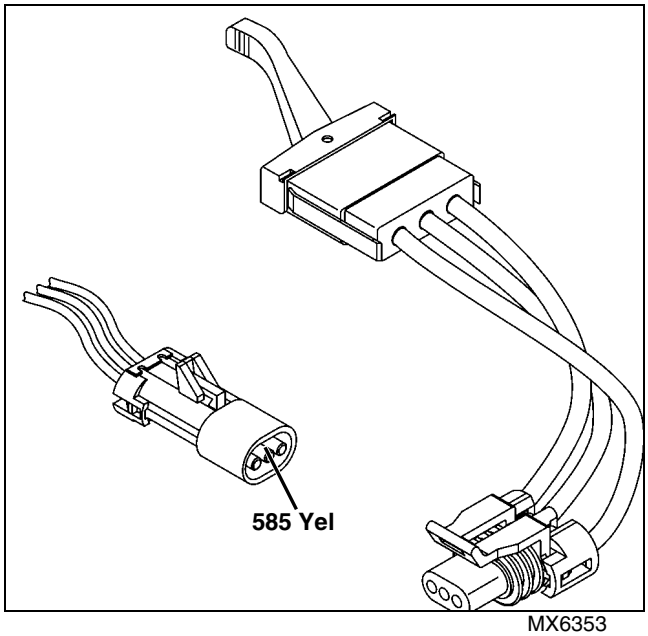
MIF

(4) Models 1600/1602 S.N. (-020000): Front Lower Switch (S13) - Terminal B and ECM Connector X28, Terminal H. Is continuity indicated?

Yes - Test front lower switch (S13). (See “Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)” on page 368.)

No - Repair or replace wire 765 gray and connections.

System: Front Deck Lower Switch Circuit Test

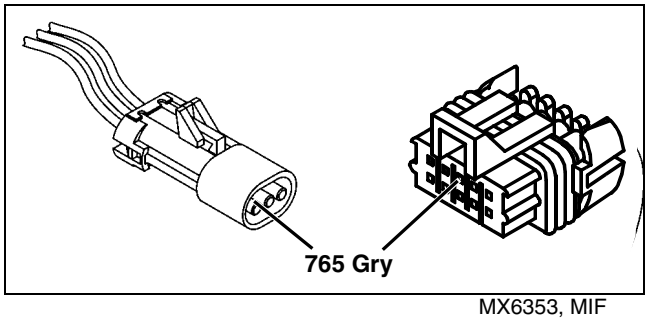


MX6353

(5) NOTE: Continued from step (2) of this test. Models 1600/1620 S.N. (020001-) and 1600 Turbo: Front Raise/Lower Switch (S18) - Terminal B, Wire 585 Yellow. Is battery voltage present?

Yes - Go To Step (6)

No - Test wire 585 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



MX6353, MIF

(6) Models 1600/1620 S.N. (020001-) and 1600 Turbo: Front Raise/Lower Switch (S18) - Terminal A and ECM Connector X28, Terminal H. Is continuity indicated?

Yes - Test front raise/lower switch. See “Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo” on page 368.)

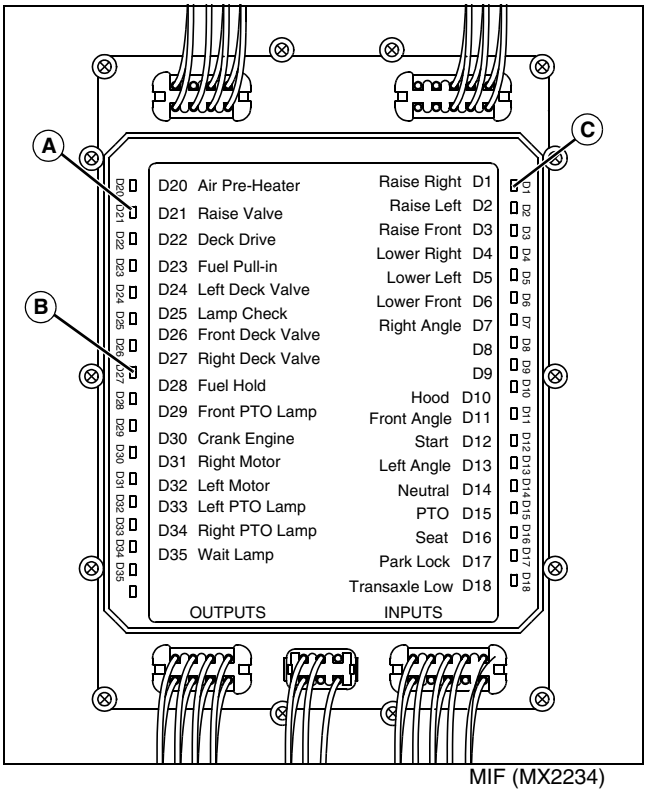
No - Repair or replace wire 765 gray and connections.

Right Deck Raise Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Right raise/lower control lever in the RAISE position.

System: Right Deck Raise Circuit Test



MIF (MX2234)

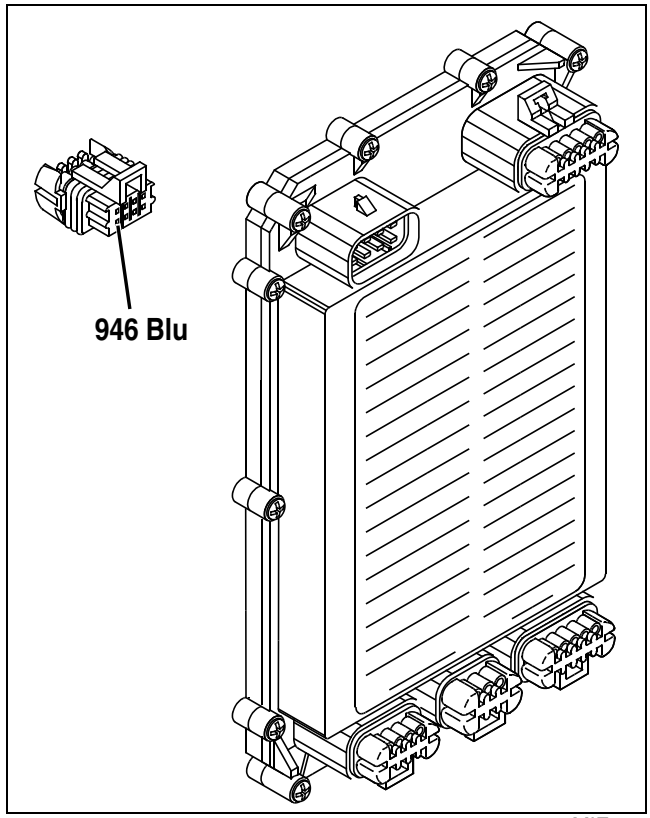
(1) Electronic Control Module (A3) - LEDs D1, D21, and D27. Is input LED D1 (C) ON? Is output LEDs D21(A) and D27 (B) ON?

Yes - Go To Step (2)

No - If input LED D1 does not come on: Go To Step (5).

No - If input LED D1 comes on and the seat switch input is valid, but output LEDs D21 or D27 do not come on, check for an output diagnostic code. If no code is present, replace control module.

System: Right Deck Raise Circuit Test



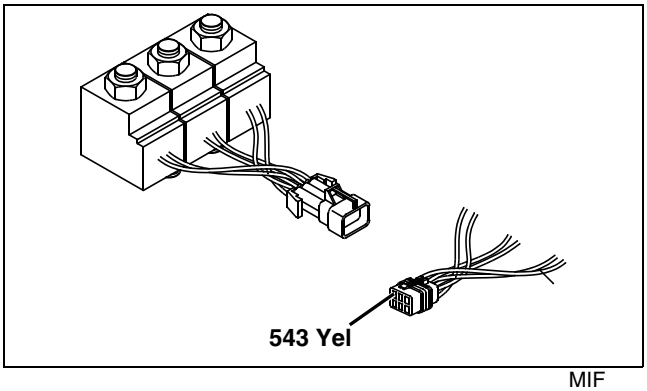
MIF

(2) Key switch in RUN position.
Electronic Control Module Connector X27 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
Electronic Control Module (A3) - Connector X27- Terminal D, Wire 946 Blue. Is battery voltage present?

Yes - Test right raise/lower solenoid (Y4). (See “Raise and Lower Solenoid Coil Test” on page 371.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Go To Step (3)

System: Right Deck Raise Circuit Test

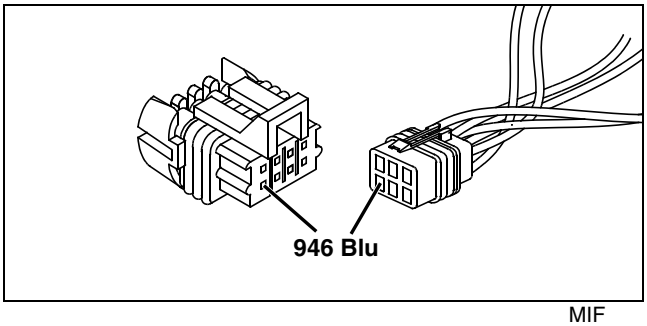


MIF

(3) Right Raise/Lower Solenoid (Y4) - Connector X50, Terminal D. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 543 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



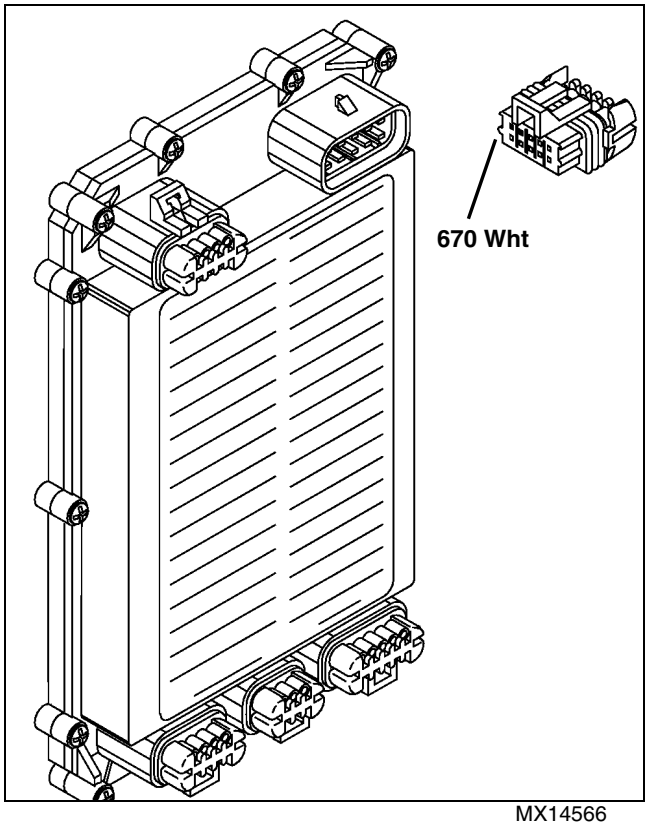
MIF

(4) Right Raise/Lower Solenoid (Y4) - Connector X50, Terminal C and ECM Connector X27, Terminal D. Is continuity indicated?

Yes - Test right raise/lower solenoid (Y4). (See "Raise and Lower Solenoid Coil Test" on page 371.)

No - Repair or replace wire 946 blue and connections.

System: Right Deck Raise Circuit Test



MX14566

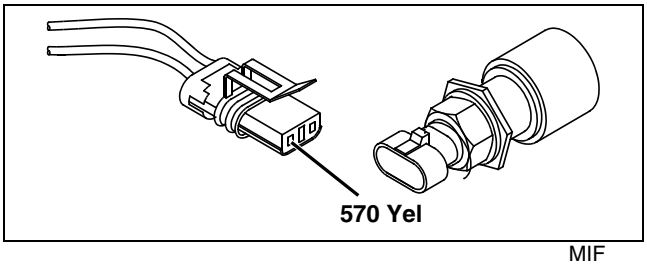
(5) NOTE: Continued from step (1) of this test. Electronic Control Module Connector X28 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing. Is battery voltage present?
NOTE: Continued from step (2) of this test. Electronic Control Module (A3) - Connector X28 - Terminal E, Wire 670 White. Is battery voltage present?

Yes - Replace control module.

No - Models 1600/1620 S.N. (-020000): Go To Step (6).

No - Models 1600/1620 S.N. (020001-) and 1600 Turbo: Go To Step (8).

System: Right Deck Raise Circuit Test

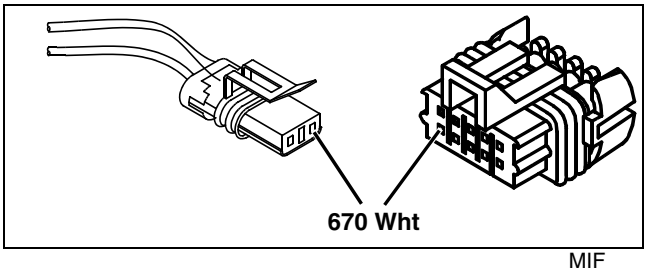


MIF

(6) Models 1600/1602 S.N. (-020000): Right Raise Switch (S11) - Terminal A, Wire 570 Yellow. Is battery voltage present?

Yes - Go To Step (7)

No - Test wire 570 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



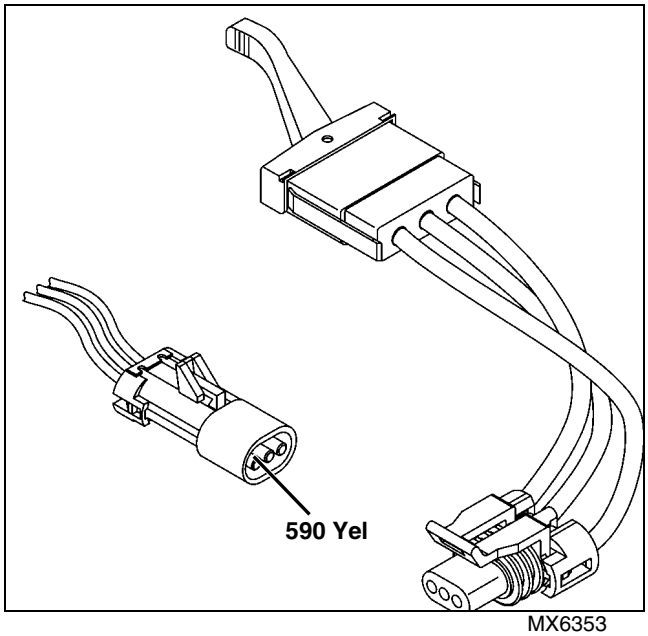
MIF

(7) Models 1600/1602 S.N. (-020000): Right Raise Switch (S11) - Terminal B and ECM Connector X28, Terminal E. Is continuity indicated?

Yes - Test right raise switch (S11). (See "Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)" on page 368.)

No - Repair or replace wire 670 white and connections.

System: Right Deck Raise Circuit Test

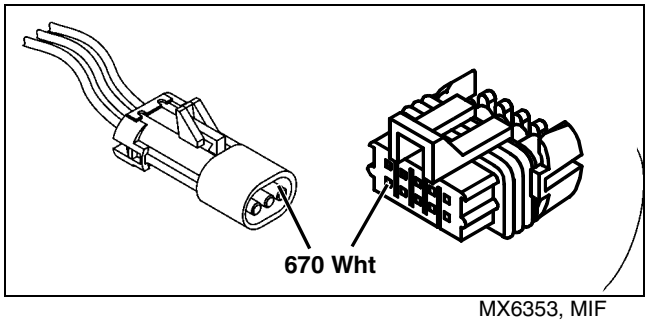


MX6353

(8) NOTE: Continued from step (5) of this test. Models 1600/1620 S.N. (020001-) and 1600 Turbo: Right Raise/Lower Switch (S19) - Terminal B, Wire 590 Yellow. Is battery voltage present?

Yes - Go To Step (9)

No - Test wire 590 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



MX6353, MIF

(9) Models 1600/1620 S.N. (020001-) and 1600 Turbo: Right Raise/Lower Switch (S19) - Terminal C and ECM Connector X28, Terminal E. Is continuity indicated?

Yes - Test right raise switch (S19). See "Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo" on page 368.)

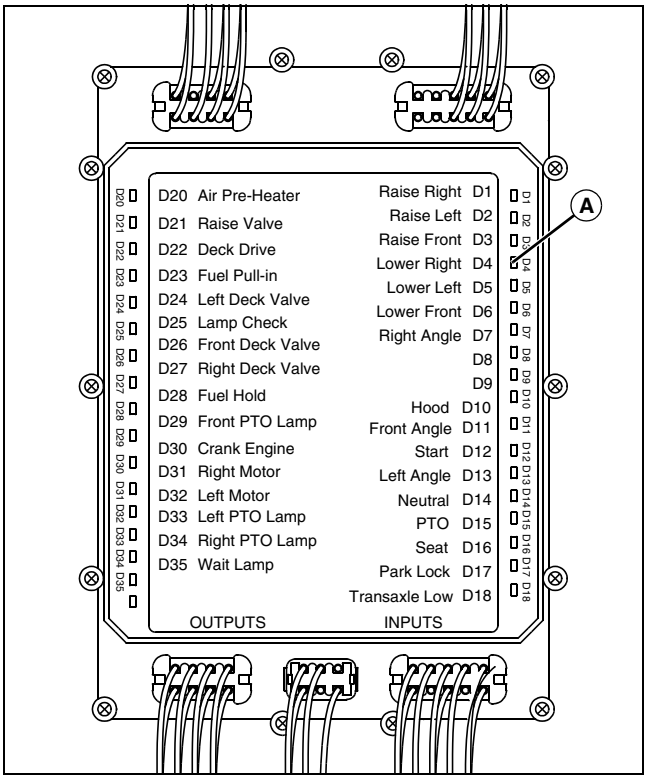
No - Repair or replace wire 670 white and connections.

Right Deck Lower Switch Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Right raise/lower control lever in the LOWER position.

System: Right Deck Lower Switch Circuit Test



MIF (MX2234)

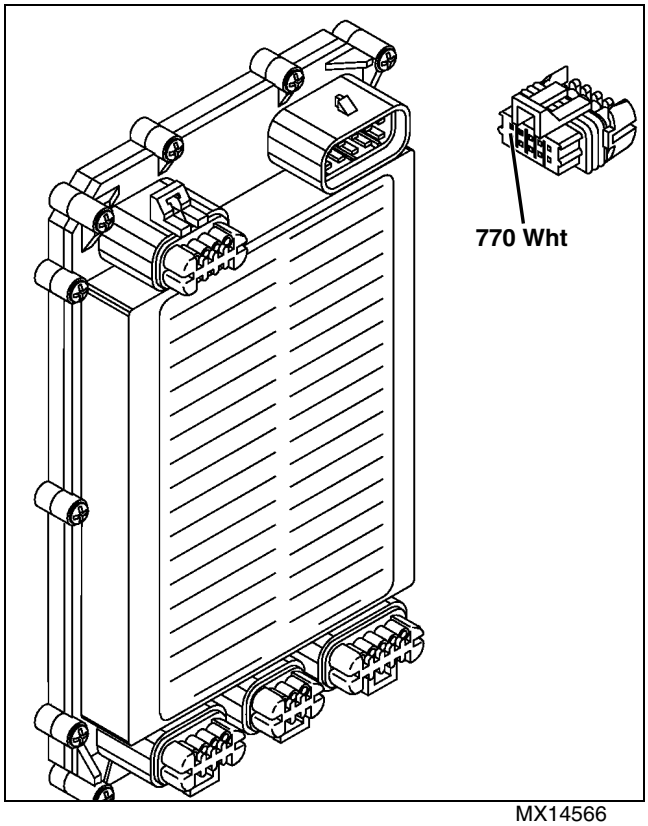
Picture Note: Electronic Control Module for Models 1600/1620 Shown; 1600 Turbo Is Similar

(1) Electronic Control Module (A3) - LED D4. Is input LED D4 (A) ON?

Yes - If input LED D4 comes on and the seat switch input is valid, but output LED D27 does not come on, check for an output diagnostic code. If no code is present, replace control module.

No - Go To Step (2)

System: Right Deck Lower Switch Circuit Test



MX14566

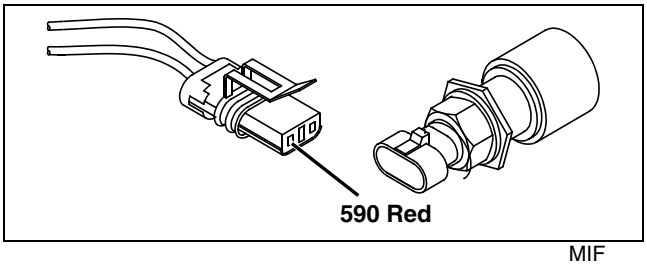
(2) Electronic Control Module Connector X28 disconnected.
When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when checking/testing.
Electronic Control Module (A3) - Connector X28 - Terminal G, Wire 770 White. Is battery voltage present?

Yes - Replace control module.

No - Models 1600/1620 S.N. (-020000): Go To Step (3)

No - Models 1600/1620 S.N. (020001-) and 1600 Turbo: Go To Step (5)

System: Right Deck Lower Switch Circuit Test

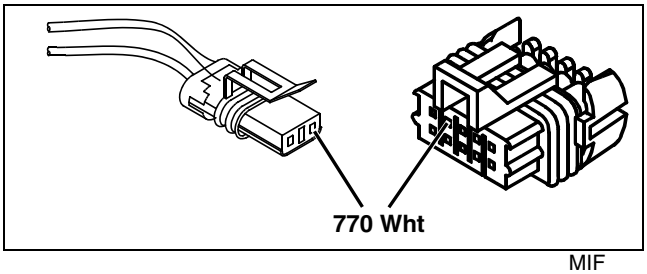


MIF

(3) Models 1600/1602 S.N. (-020000): Right Lower Switch (S14) - Terminal A, Wire 590 Red. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 590 red and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



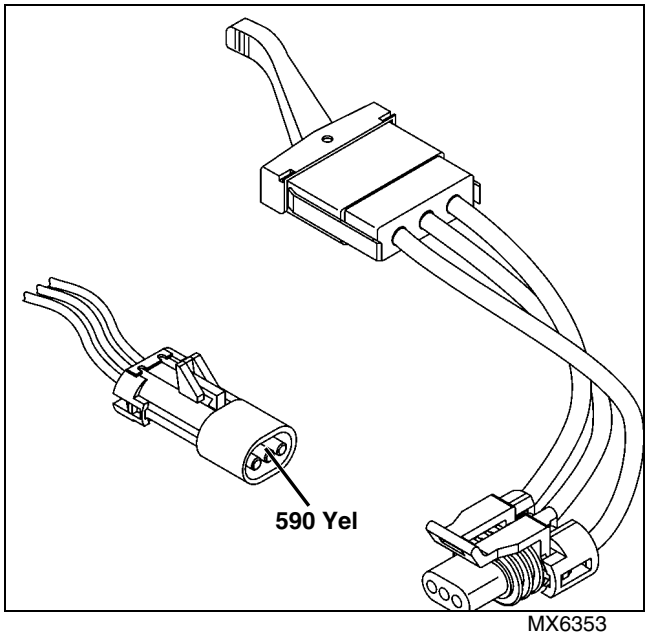
MIF

(4) Models 1600/1602 S.N. (-020000): Right Lower Switch (S14) - Terminal B and ECM Connector X28, Terminal G. Is continuity indicated?

Yes - Test right lower switch (S14). (See "Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)" on page 368.)

No - Repair or replace wire 770 white and connections.

System: Right Deck Lower Switch Circuit Test

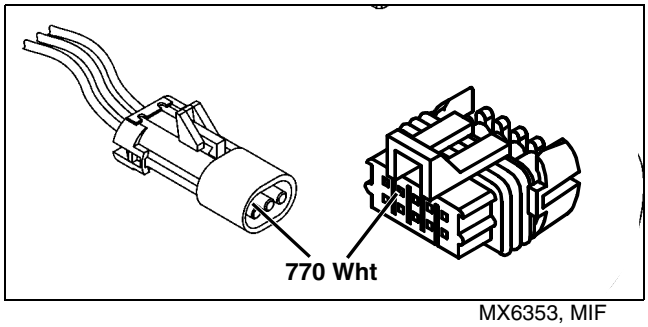


MX6353

(5) NOTE: Continued from step (2) of this test. Models 1600/1620 S.N. (020001-) and 1600 Turbo: Right Raise/Lower Switch (S19) - Terminal B, Wire 590 Red. Is battery voltage present?

Yes - Go To Step (6)

No - Test wire 590 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



MX6353, MIF

(6) Models 1600/1620 S.N. (020001-) and 1600 Turbo: Right Raise/Lower Switch (S19) - Terminal A and ECM Connector X28, Terminal G. Is continuity indicated?

Yes - Test right raise/lower switch (S19). (See "Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo" on page 368.)

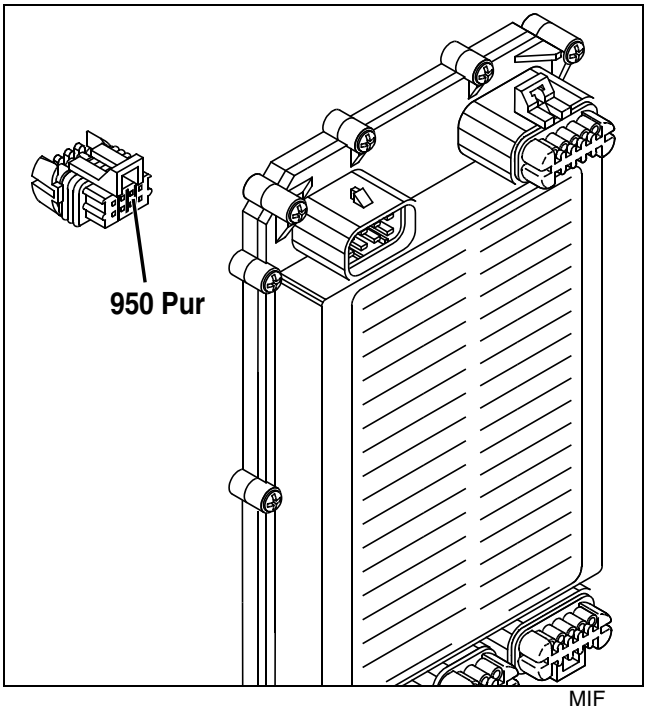
No - Repair or replace wire 770 white and connections.

Raise/Lower Select Solenoid Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Electronic Control Module Connector X27 disconnected.
- Any raise/lower control lever in the RAISE position.
- When checking voltage or resistance, connect the meter's negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Raise/Lower Select Solenoid Circuit Test



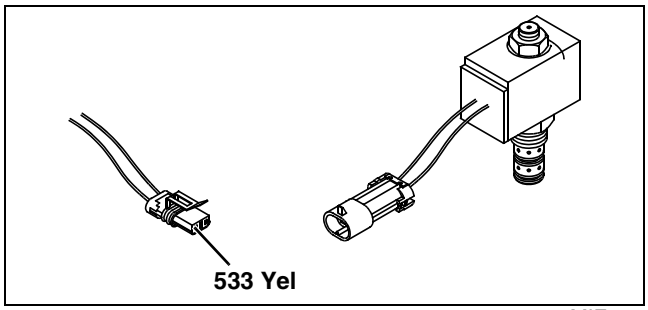
MIF

(1) Electronic Control Module (A3) - Connector X27 - Terminal G, Wire 950 Purple. Is battery voltage present?

Yes - Test raise/lower select solenoid (Y5). (See “Raise and Lower Solenoid Coil Test” on page 371.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Go To Step (2)

System: Raise/Lower Select Solenoid Circuit Test

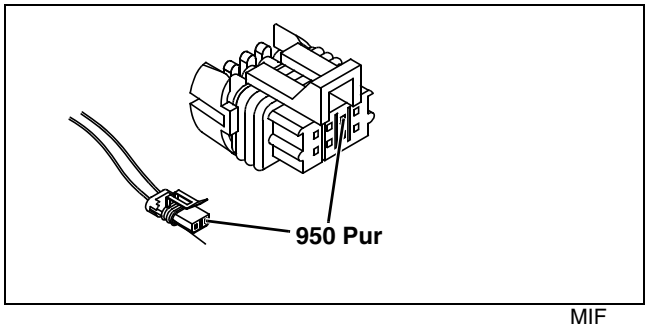


MIF

(2) Raise/Lower Select Solenoid (Y5) - Terminal A, Wire 533 Yellow. Is battery voltage present?

Yes - Go To Step (3)

No - Test wire 533 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



MIF

(3) Raise/Lower Select Solenoid (Y5) - Terminal B and ECM Connector X27, Terminal G. Is continuity indicated?

Yes - Test raise/lower select solenoid (Y5). (See “Raise and Lower Solenoid Coil Test” on page 371.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Repair or replace wire 950 purple and connections.

Mower Deck Mow Circuit Operation

Function

To engage the deck motors.

Operating Conditions

- Operator ON seat.
- Key switch in RUN position (engine running).
- Transaxle switch in LOW position[1, 2].
- PTO switch in ON position.
- Mower decks in fully lowered position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the lower circuit with a fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch terminal B wires (201 red and 210 red).

When the key switch is in the RUN position, current flows to key switch (S1) terminal A, then to switched power fuse (F3) (wire 400 yellow/red).

From switched power fuse (F3), current flows through wire 540 yellow to the following circuits:

- Electronic control module connector (X25), terminal D (wire 532 yellow).
- Transaxle switch (S2)[1, 2] (wire 509 yellow).
- PTO switch (S15) (wire 510 yellow).

From switched power fuse (F3), current flows through wires 540, and 530 yellow, then to the following circuits:

- Left angle switch (S5) (wire 513 yellow).
- Right angle switch (S6) (wire 512 yellow).
- Left motor solenoid (Y6) (wire 527 yellow).
- Right motor solenoid (Y8) (wire 528 yellow).

From switched power fuse (F3), current flows through wires 540, 530, and 525 yellow, then to the following circuits:

- Seat switch (S3) (wire 539 yellow).
- Front angle switch (S7) (wire 529 yellow).
- Deck drive solenoid (Y7) (wire 544 yellow).
- PTO lights display (A2)[1] (wire 521 yellow).
- Park brake lock switch (S8)[2] (wires 551 and 526 yellow).

For mow circuit to function, the following conditions must be met:

1. Engine running with park brake disengaged.
2. Seat switch (S3) - When switch is closed (wire 820 gray), current flows to electronic control module connector (X24), terminal J. When this condition exists, the control module knows the operator is on the seat.
3. Transaxle switch (S2)[1, 2] - When switch is closed (wire 730 green), current is flows to electronic control module connector (X24), terminal H. When this condition exists, the control module knows the transaxle is in the LOW position.
4. PTO switch (S15) - When switch is closed (wire 750 blue), current flows to electronic control module connector (X24), terminal B. When this condition exists the control module knows the operator has engaged the PTO.
5. Mower decks in the fully lowered position.
   - When the left mower deck is (457 mm [18 in.] or less from the ground), left angle switch (S5) (wire 750 blue) is closed, allowing current to flow to the electronic control module connector (X24), terminal A. Wires 138 and 100 black provide ground for proper operation of switch.
   - When the right mower deck is (457 mm [18 in.] or less from the ground), right angle switch (S6) (wire 850 green) is closed, allowing current to flow to the electronic control module connector (X24), terminal D. Wires 139 and 100 black provide ground for proper operation of switch.
   - When the front mower deck is (457 mm [18 in.] or less from the ground), front angle switch (S7) (wire 840 orange) is closed, allowing current to flow to the electronic control module connector (X24), terminal E. Wires 140, 110, and 100 black provide ground for proper operation of switch.

When the correct operating conditions are met, the control module will engage the deck motor and/or the appropriate side deck motors by grounding the appropriate solenoid(s) as follows:

- Deck drive solenoid (Y7) is grounded at connector (X27), terminal F (wire 960 gray). This will engage the front motor. The front deck motor must be operating for the left and right motors to operate.
- Left motor solenoid (Y6) is grounded at connector (X26), terminal H (wire 963 brown).
- Right motor solenoid (Y8) is grounded at connector (X26), terminal C (wire 966 gray).

1. For Model 1600/1620

2. For Model 1600 Turbo S.N. (-030000)

NOTE: When the front mower deck is raised to the point that it stops operating, all decks will stop. The front deck motor will not start again until the deck is lowered, all operating conditions are met, and the PTO switch is cycled from OFF to ON. However, if a side deck is raised and not the front deck, only the side deck motor will stop. The motor will start again automatically when the deck is lowered.

When a mower deck is raised to a certain point, depending on model series, current from the corresponding angle switch (S5, S6, and/or S7) is open, preventing current flow to control module. When this happens the control module will disengage the deck motor by removing ground from the appropriate solenoid(s), (Y6 - wire 963 brown), (Y7 - wire 960 gray), and (Y8 - wire 966 gray).

Models 1600/1620

When a deck motor is engaged, the control module will turn on the corresponding PTO light (H6 - wire 757 blue), (H7 - wire 759 purple), (H8 - wire 755 white) by grounding the appropriate wire.

When the front deck raise switch is activated, the front deck (and both side decks) will stop as soon as the switch is activated. However, if a side deck raise switch is activated, the deck must be raised 457 mm (18 in.) above the ground before only that deck motor will stop. The corresponding PTO light will flash on and off to indicate that the deck will start again automatically when the deck is lowered.

Model 1600 Turbo

Model 1600 Turbo S.N. (010000-030000): Deck motor engagement is affected as soon as a raise switch is activated, and the appropriate deck motor(s) stop.

Model 1600 Turbo S.N. (030001-): Any deck must be raised 457 mm (18 in.) above the ground before the appropriate deck motor(s) stop.

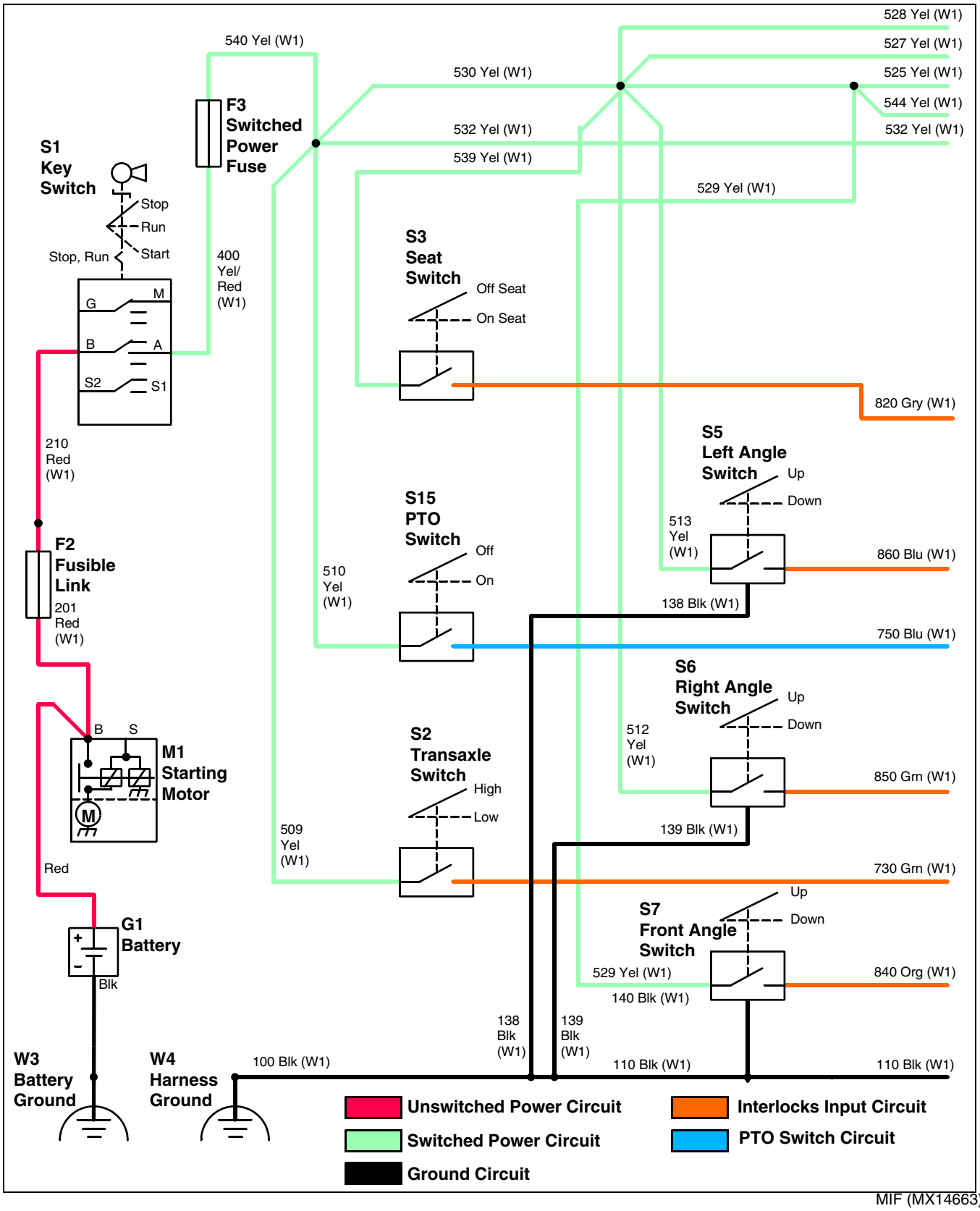
The park brake lock switch used on all Model 1600 Turbo machines is a multi-function switch. The switch activates two inputs to the control module with only one circuit active at a time.

When the park brake is engaged, the plunger of park brake lock switch (S8) is in the released position, current flows to electronic control module connector (X28), terminal J (wire 746 purple). When this happens, the electronic control module will disengage all deck motors.

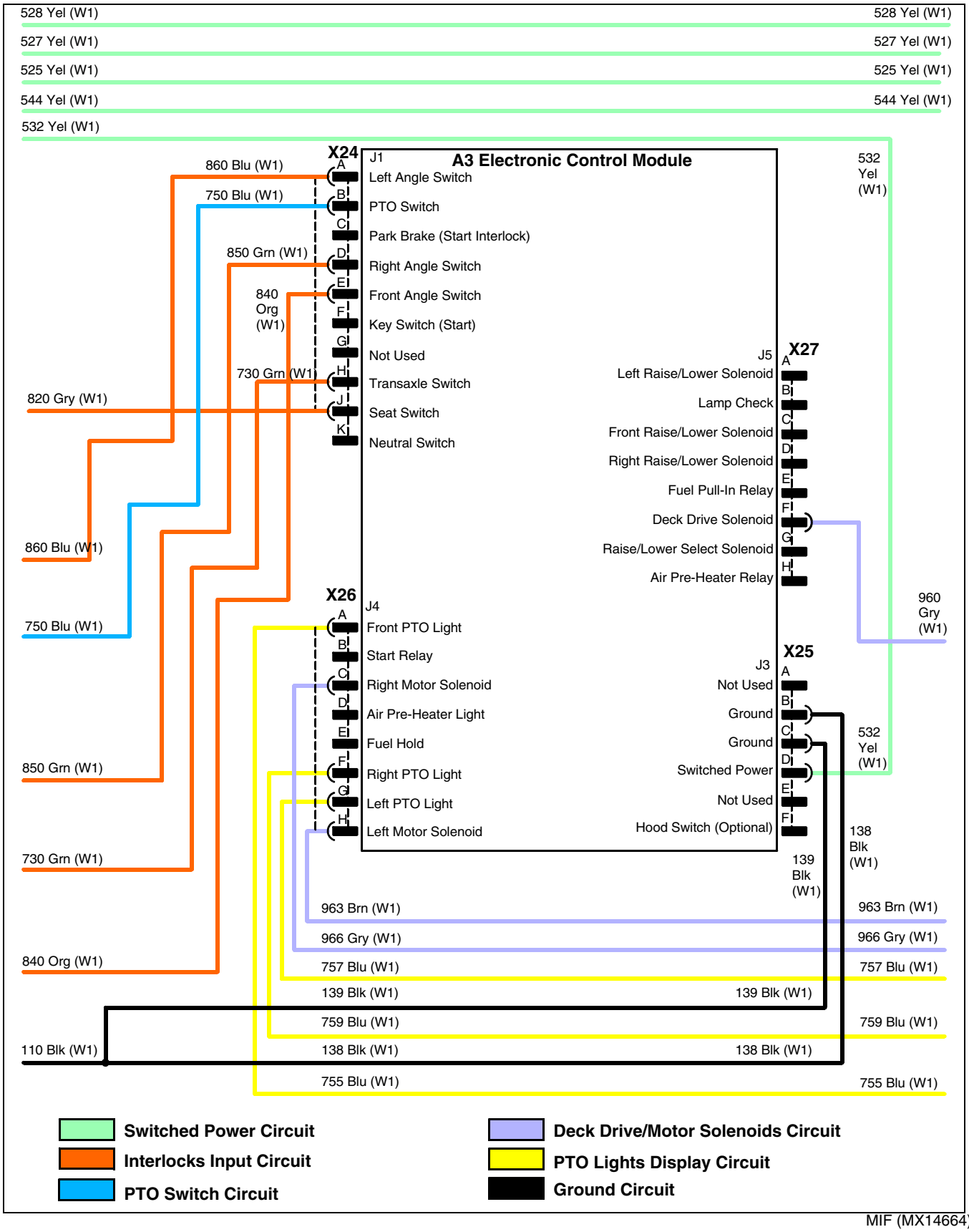
When the park brake is disengaged, the park brake lock switch (S8) plunger is in the depressed position, current flows to electronic control module connector (X24), terminal C (wire 745 blue/white). This input is used as an integral part of the start and run interlock systems.

Mower Deck Mow Circuit Schematics

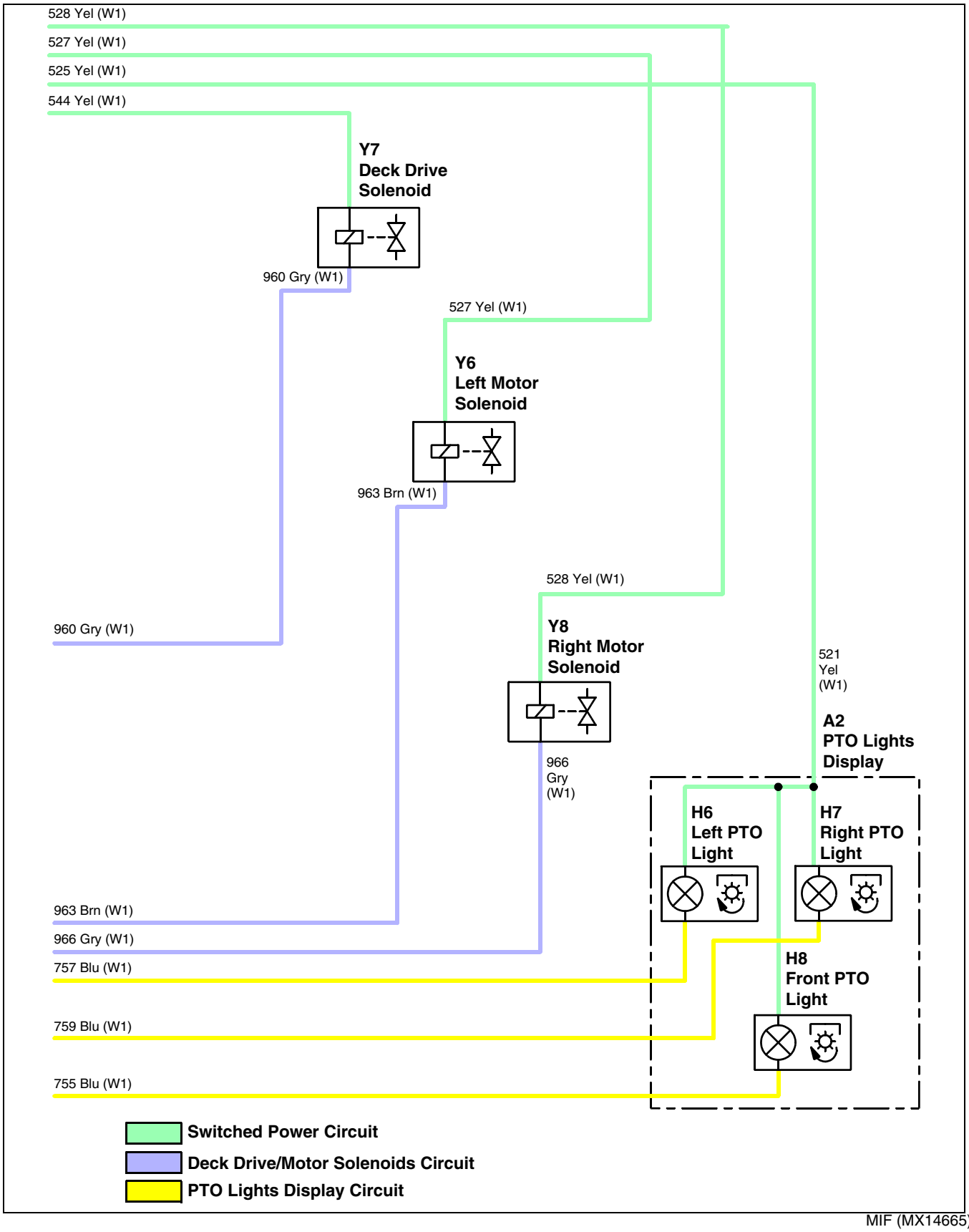
Models 1600/1620



MIF (MX14663)

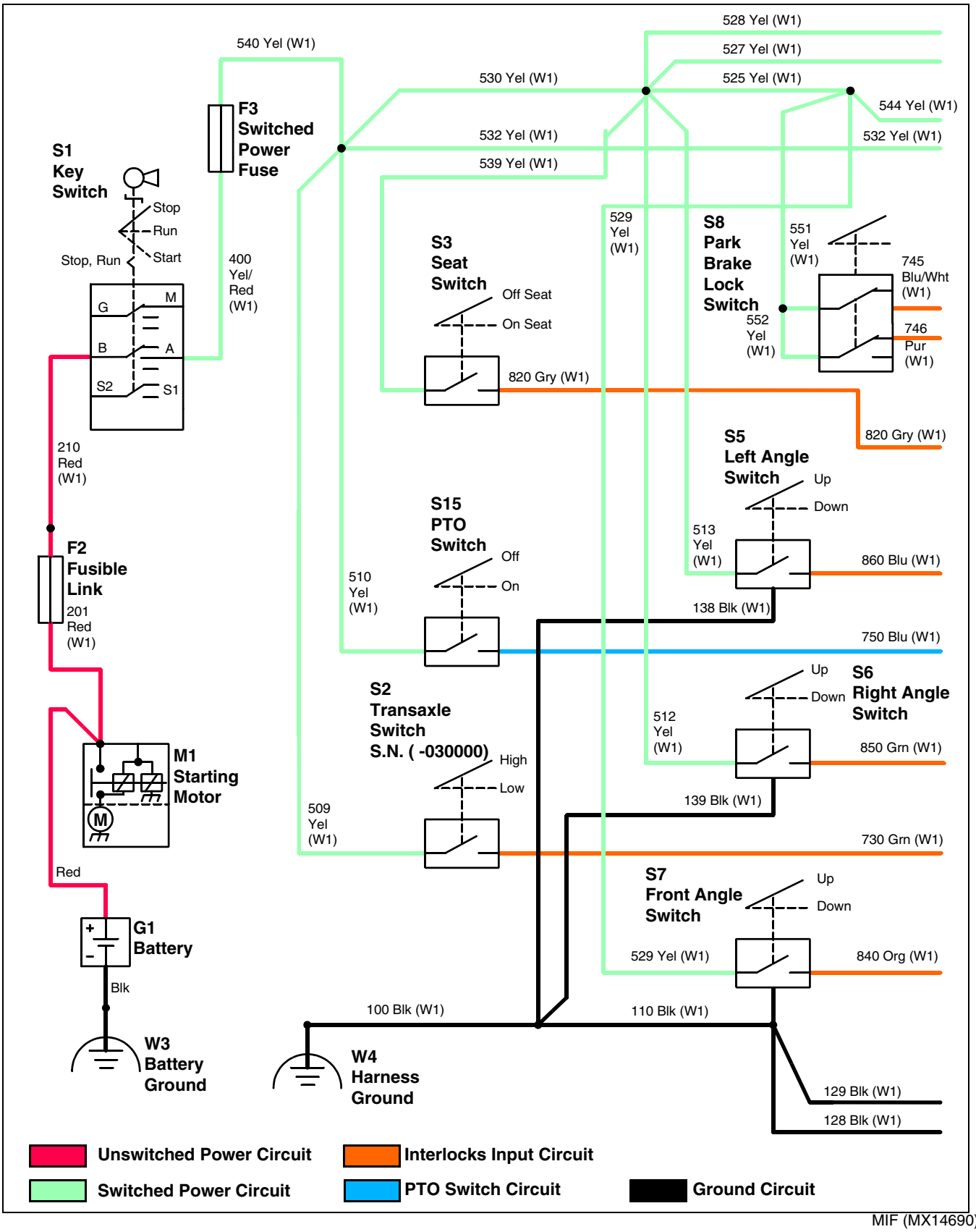

528 Yel (W1)
527 Yel (W1)
525 Yel (W1)
544 Yel (W1)
532 Yel (W1)
860 Blu (W1)
750 Blu (W1)
850 Grn (W1)
840 Org (W1)
730 Grn (W1)
820 Gry (W1)
860 Blu (W1)
750 Blu (W1)
850 Grn (W1)
730 Grn (W1)
840 Org (W1)
110 Blk (W1)
X24
J1
A3 Electronic Control Module
A Left Angle Switch
B PTO Switch
C Park Brake (Start Interlock)
D Right Angle Switch
E Front Angle Switch
F Key Switch (Start)
G Not Used
H Transaxle Switch
J Seat Switch
K Neutral Switch
X26
J4
A Front PTO Light
B Start Relay
C Right Motor Solenoid
D Air Pre-Heater Light
E Fuel Hold
F Right PTO Light
G Left PTO Light
H Left Motor Solenoid
X27
J5
A Left Raise/Lower Solenoid
B Lamp Check
C Front Raise/Lower Solenoid
D Right Raise/Lower Solenoid
E Fuel Pull-In Relay
F Deck Drive Solenoid
G Raise/Lower Select Solenoid
H Air Pre-Heater Relay
X25
J3
A Not Used
B Ground
C Ground
D Switched Power
E Not Used
F Hood Switch (Optional)
532 Yel (W1)
960 Gry (W1)
532 Yel (W1)
138 Blk (W1)
139 Blk (W1)
963 Brn (W1)
966 Gry (W1)
757 Blu (W1)
139 Blk (W1)
759 Blu (W1)
138 Blk (W1)
755 Blu (W1)
963 Brn (W1)
966 Gry (W1)
757 Blu (W1)
139 Blk (W1)
759 Blu (W1)
138 Blk (W1)
755 Blu (W1)
Switched Power Circuit
Interlocks Input Circuit
PTO Switch Circuit
Deck Drive/Motor Solenoids Circuit
PTO Lights Display Circuit
Ground Circuit

MIF (MX14664)

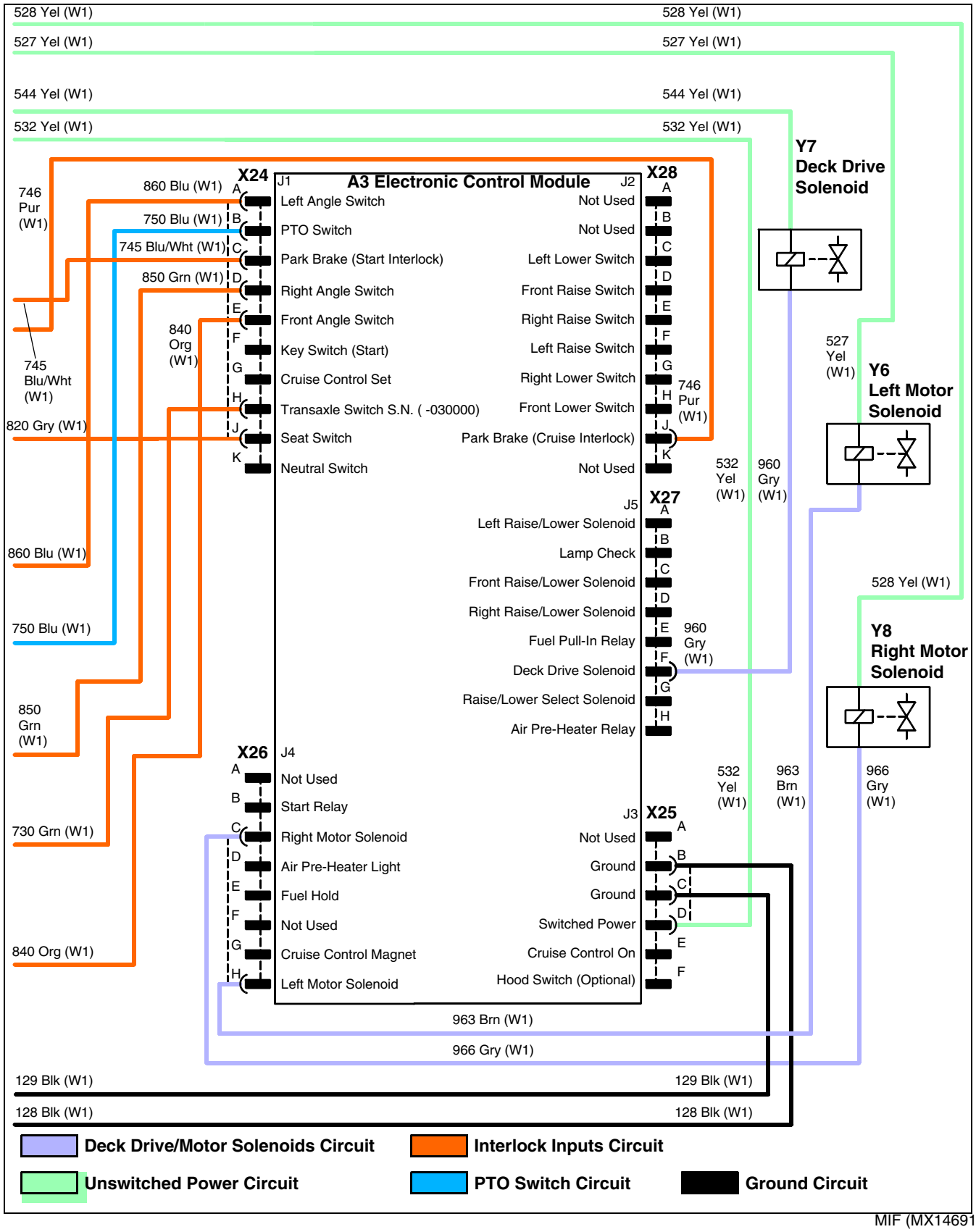

528 Yel (W1)
527 Yel (W1)
525 Yel (W1)
544 Yel (W1)
Y7
Deck Drive
Solenoid
960 Gry (W1)
527 Yel (W1)
Y6
Left Motor
Solenoid
963 Brn (W1)
528 Yel (W1)
960 Gry (W1)
Y8
Right Motor
Solenoid
521
Yel
(W1)
A2
PTO Lights
Display
966
Gry
(W1)
H6
Left PTO
Light
H7
Right PTO
Light
963 Brn (W1)
966 Gry (W1)
757 Blu (W1)
H8
Front PTO
Light
759 Blu (W1)
755 Blu (W1)
Switched Power Circuit
Deck Drive/Motor Solenoids Circuit
PTO Lights Display Circuit

MIF (MX14665)

Model 1600 Turbo



MIF (MX14690)


528 Yel (W1)
527 Yel (W1)
544 Yel (W1)
532 Yel (W1)
Y7
Deck Drive
Solenoid
X24
J1
A3 Electronic Control Module
J2
X28
860 Blu (W1)
750 Blu (W1)
745 Blu/Wht (W1)
850 Grn (W1)
840
Org
(W1)
746
Pur
(W1)
745
Blu/Wht
(W1)
820 Gry (W1)
Left Angle Switch
PTO Switch
Park Brake (Start Interlock)
Right Angle Switch
Front Angle Switch
Key Switch (Start)
Cruise Control Set
Transaxle Switch S.N. (-030000)
Seat Switch
Neutral Switch
Not Used
Not Used
Left Lower Switch
Front Raise Switch
Right Raise Switch
Left Raise Switch
Right Lower Switch
Front Lower Switch
Park Brake (Cruise Interlock)
Not Used
746
Pur
(W1)
527
Yel
(W1)
Y6
Left Motor
Solenoid
532
Yel
(W1)
960
Gry
(W1)
J5
X27
Left Raise/Lower Solenoid
Lamp Check
Front Raise/Lower Solenoid
Right Raise/Lower Solenoid
Fuel Pull-In Relay
Deck Drive Solenoid
Raise/Lower Select Solenoid
Air Pre-Heater Relay
860 Blu (W1)
750 Blu (W1)
850
Grn
(W1)
730 Grn (W1)
840 Org (W1)
528 Yel (W1)
Y8
Right Motor
Solenoid
960
Gry
(W1)
X26
J4
Not Used
Start Relay
Right Motor Solenoid
Air Pre-Heater Light
Fuel Hold
Not Used
Cruise Control Magnet
Left Motor Solenoid
J3
X25
Not Used
Ground
Ground
Switched Power
Cruise Control On
Hood Switch (Optional)
532
Yel
(W1)
963
Brn
(W1)
966
Gry
(W1)
963 Brn (W1)
966 Gry (W1)
129 Blk (W1)
128 Blk (W1)
Deck Drive/Motor Solenoids Circuit
Interlock Inputs Circuit
Unswitched Power Circuit
PTO Switch Circuit
Ground Circuit

MIF (MX14691)

Mower Deck Mow Circuit Diagnosis

Diagnostics of circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

When diagnosing the mow circuit, it is important to perform the following steps in the sequence shown:

1. Electronic Control Module Checks, (See “Electronic Control Module Checks” on page 213.)

2. Input LEDs and Circuits Checks, (See “Input LEDs Circuit and Checks” on page 312.)

3. Mow Circuit Tests, (See “Mow Circuit Tests” on page 312.)

Input LEDs Circuit and Checks

NOTE: The following common input circuit checks are necessary when diagnosing the mow circuit. (See “Electronic Control Module Input LEDs and Common Circuits Checks” on page 214.)

Perform the following input circuit checks:

- Seat Switch
- PTO Switch
- Transaxle Low Range Switch[1]
- Right Mower Deck Angle (Proximity) Switch
- Left Mower Deck Angle (Proximity) Switch
- Front Mower Deck Angle (Proximity) Switch

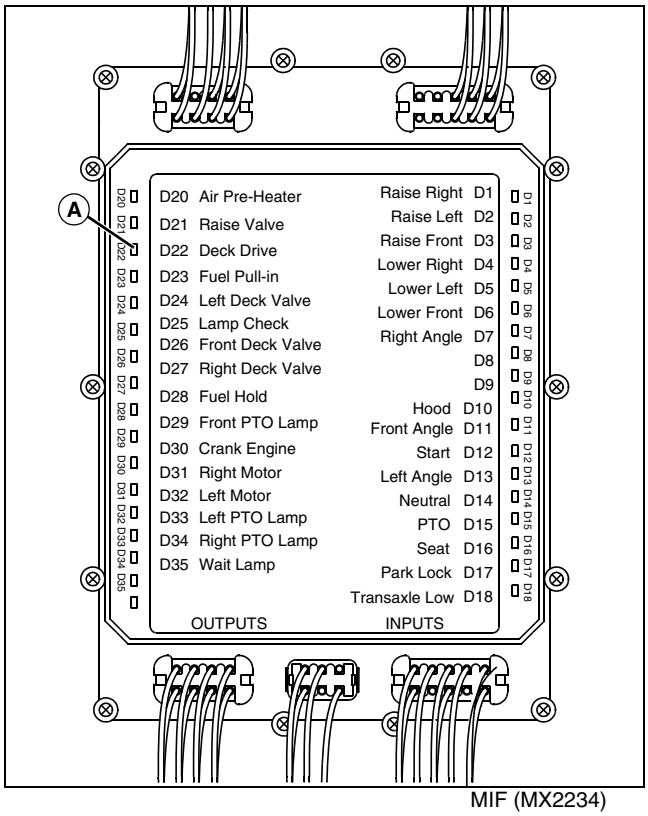
Mow Circuit Tests

Front Motor (Deck Drive) Solenoid Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Park brake disengaged (UNLOCKED).
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Machine in LOW range (transaxle switch[1] in LOW).
- PTO switch cycled from OFF to ON.

System: Front Motor (Deck Drive) Solenoid Circuit Test



MIF (MX2234)

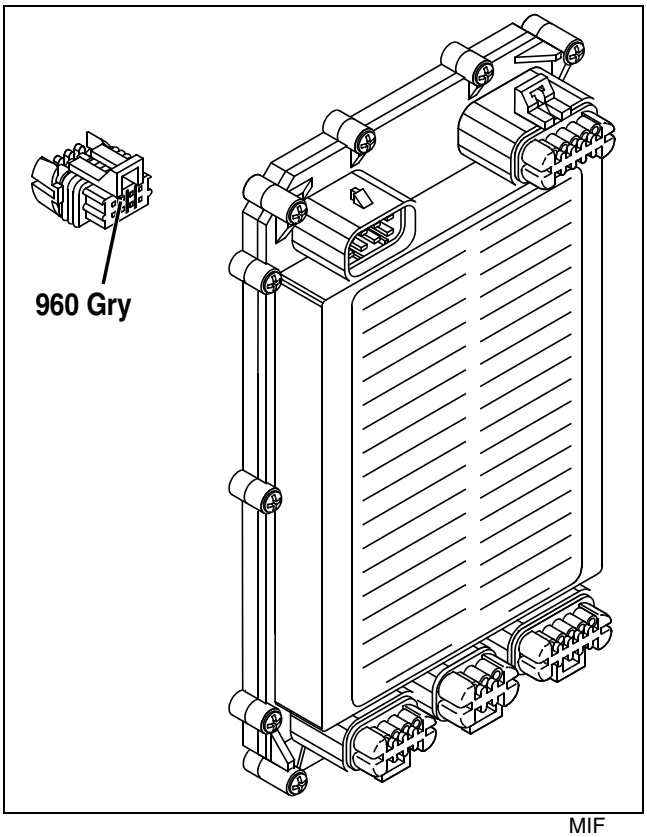
(1) Electronic Control Module (A3) - Deck Drive Output LED D22. Is deck drive LED D22 (A) ON?

Yes - Go To Step (2)

No - If the PTO and the appropriate interlock inputs are valid, but output LED D22 does not come on, check for an output diagnostic code. If no code is present, replace control module.

1. Models 1600/1620 and 1600 Turbo S.N. (-030000)

System: Front Motor (Deck Drive) Solenoid Circuit Test



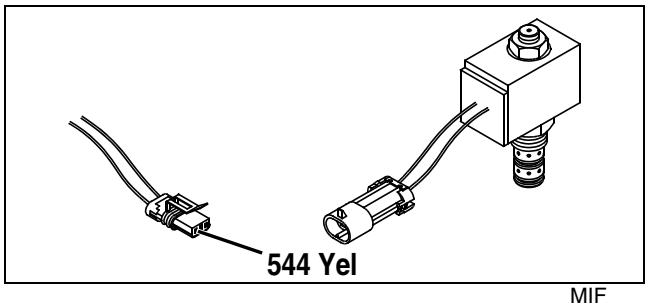
MIF

(2) Deck drive solenoid connector (X51) disconnected.
Meter negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when testing.
Electronic Control Module (A3) - Connector X27 - Terminal F, Wire 960 Gray. Is battery voltage present?

Yes - Test deck drive solenoid (Y7). (See “Deck Drive and Raise and Lower Select Solenoid Test” on page 370.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Go To Step (3)

System: Front Motor (Deck Drive) Solenoid Circuit Test

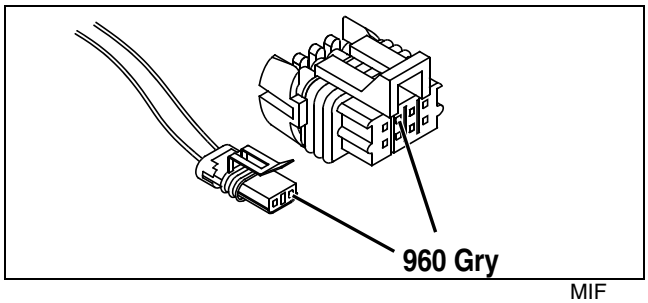


MIF

(3) Deck Drive Solenoid (Y7) - Terminal A, Wire 544 Yellow. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 544 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



MIF

(4) Deck Drive Solenoid (Y7) - Terminal B and ECM Connector X27, Terminal F. Is continuity indicated?

Yes - Test deck drive solenoid (Y7). (See “Deck Drive and Raise and Lower Select Solenoid Test” on page 370.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Repair or replace wire 960 gray and connections.

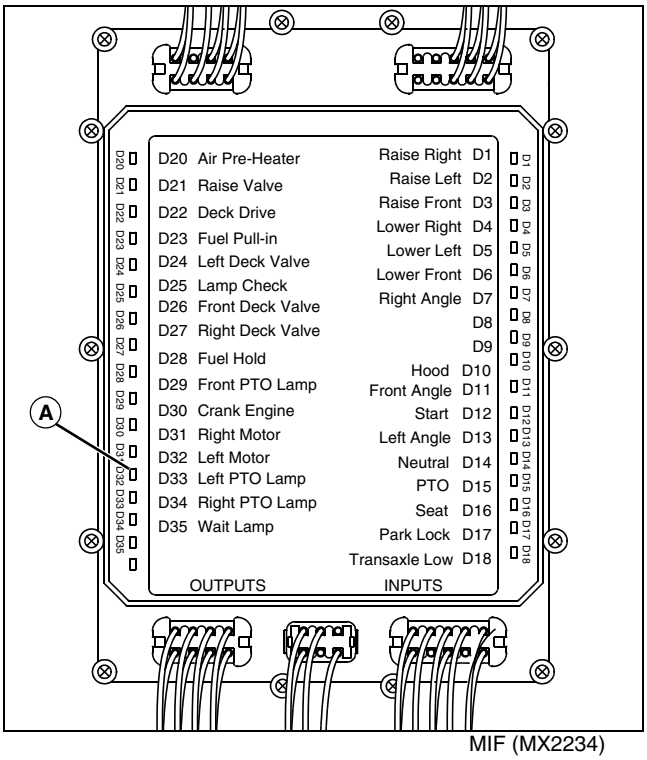
Left Motor Solenoid Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Park brake engaged (UNLOCKED).
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Machine in LOW range (transaxle switch[a] in LOW).
- PTO switch cycled from OFF to ON.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

a. Models 1600/1620 and 1600 Turbo S.N. (-030000)

System: Left Motor Solenoid Circuit Test



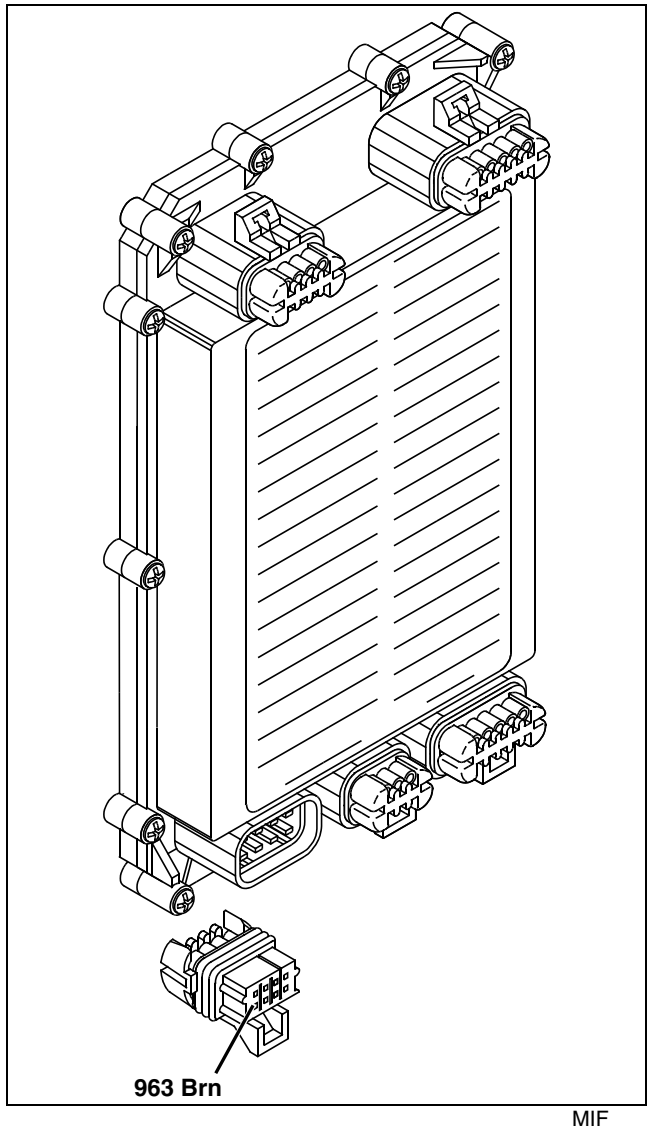
MIF (MX2234)

(1) Electronic Control Module (A3) - Left Motor Output LED D32. Is left motor LED D32 (A) ON?

Yes - Go To Step (2)

No - If the PTO and the appropriate interlock inputs are valid, but output LED D32 does not come on, check for an output diagnostic code. If no code is present, replace control module.

System: Left Motor Solenoid Circuit Test



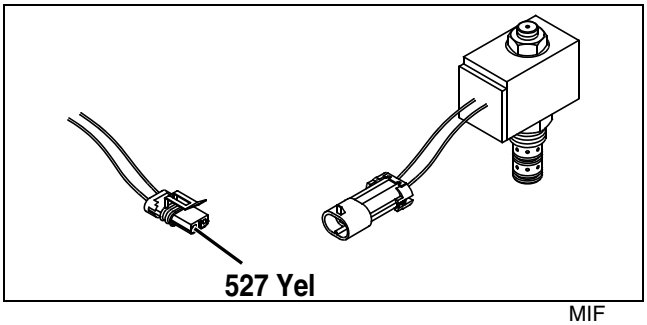
MIF

(2) Electronic Control Module (A3) - Connector X26 - Terminal H, Wire 963 Brown. Is battery voltage present?

Yes - Test left motor solenoid (Y6). (See “Deck Drive and Raise and Lower Select Solenoid Test” on page 370.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Go To Step (3)

System: Left Motor Solenoid Circuit Test

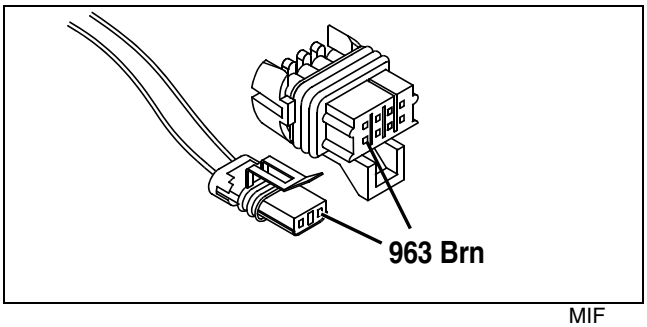


MIF

(3) Left Motor Solenoid (Y6) - Terminal A, Wire 527 Yellow. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 527 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)



MIF

(4) Left Motor Solenoid (Y6) - Terminal B and ECM Connector X26, Terminal H. Is continuity indicated?

Yes - Test left motor solenoid (Y6). (See "Deck Drive and Raise and Lower Select Solenoid Test" on page 370.) If solenoid is good, check solenoid valve. (See "Solenoid Valve Check" on page 534.)

No - Repair or replace wire 963 brown and connections.

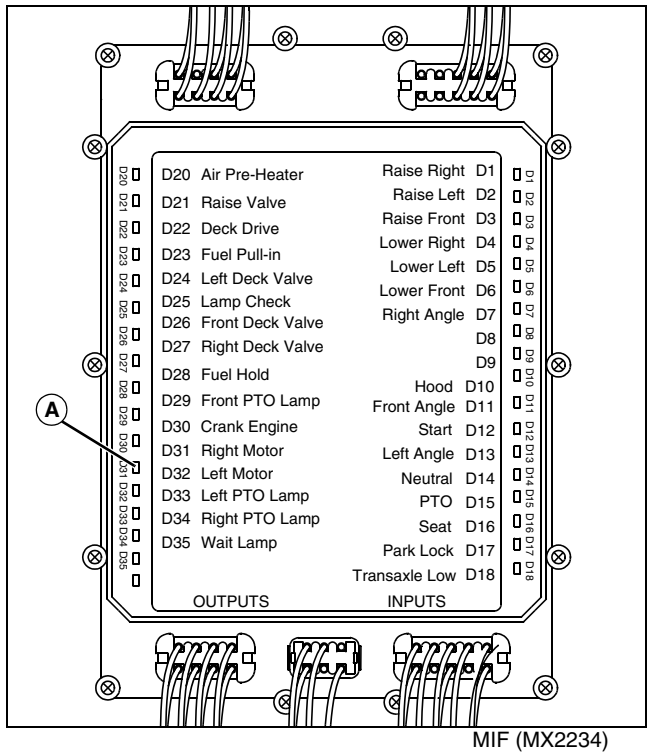
Right Motor Solenoid Circuit Test

Test Conditions:

- Machine parked safely. (See "Park Machine Safely" on page 3.)
- Operator ON seat.
- Park brake disengaged (UNLOCKED).
- Key switch in RUN position with engine OFF.
- Decks in the fully lowered position.
- Machine in LOW range (transaxle switch[a] in LOW).
- PTO switch cycled from OFF to ON.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

a. Models 1600/1620 and 1600 Turbo S.N. (-030000)

System: Right Motor Solenoid Circuit Test



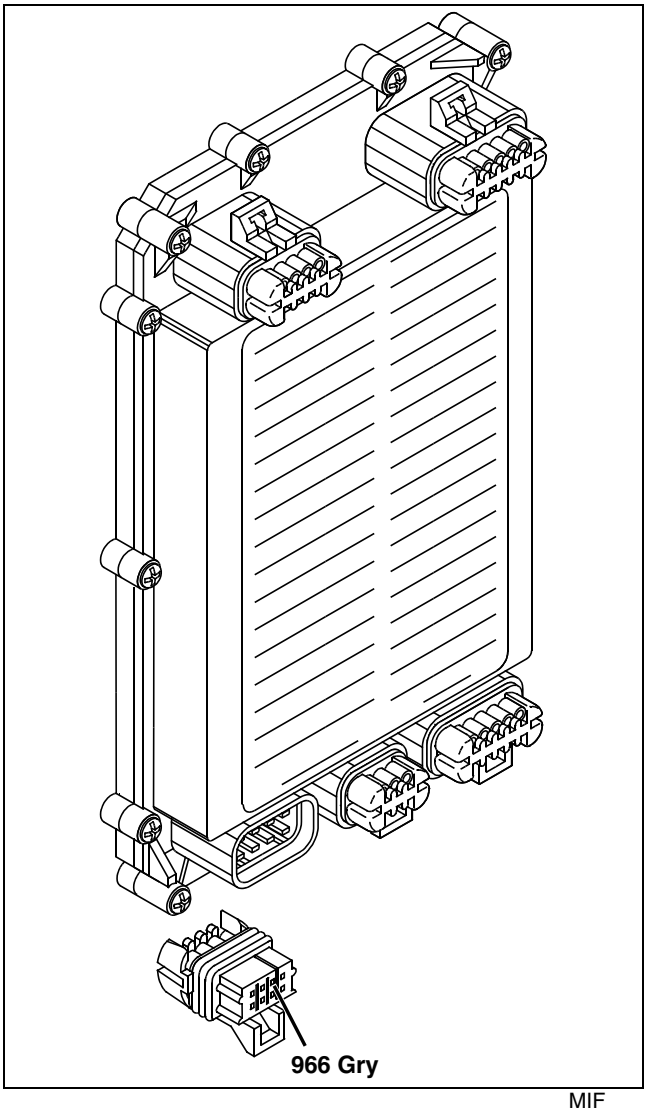
MIF (MX2234)

(1) Electronic Control Module (A3) - Right Motor Output LED D31. Is right motor LED D31 (A) ON?

Yes - Go To Step (2)

No - If the PTO and the appropriate interlock inputs are valid, but output LED D31 does not come on, check for an output diagnostic code. If no code is present, replace control module.

System: Right Motor Solenoid Circuit Test



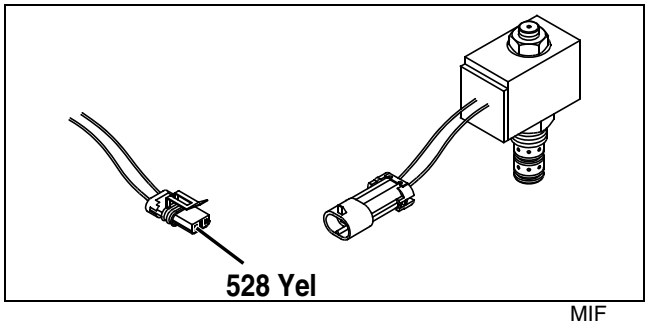
MIF

(2) Electronic Control Module (A3) - Connector X26 - Terminal C, Wire 966 Gray. Is battery voltage present?

Yes - Test right motor solenoid (Y8). (See “Deck Drive and Raise and Lower Select Solenoid Test” on page 370.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Go To Step (3)

System: Right Motor Solenoid Circuit Test

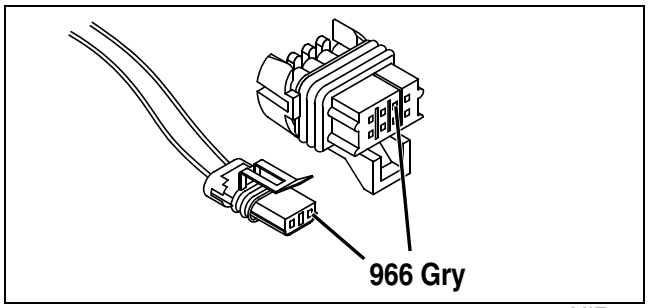


MIF

(3) Right Motor Solenoid (Y8) - Terminal A, Wire 528 Yellow. Is battery voltage present?

Yes - Go To Step (4)

No - Test wire 528 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



MIF

(4) Right Motor Solenoid (Y8) - Terminal B and ECM Connector X26, Terminal C. Is continuity indicated?

Yes - Test right motor solenoid (Y8). (See “Deck Drive and Raise and Lower Select Solenoid Test” on page 370.) If solenoid is good, check solenoid valve. (See “Solenoid Valve Check” on page 534.)

No - Repair or replace wire 966 gray and connections

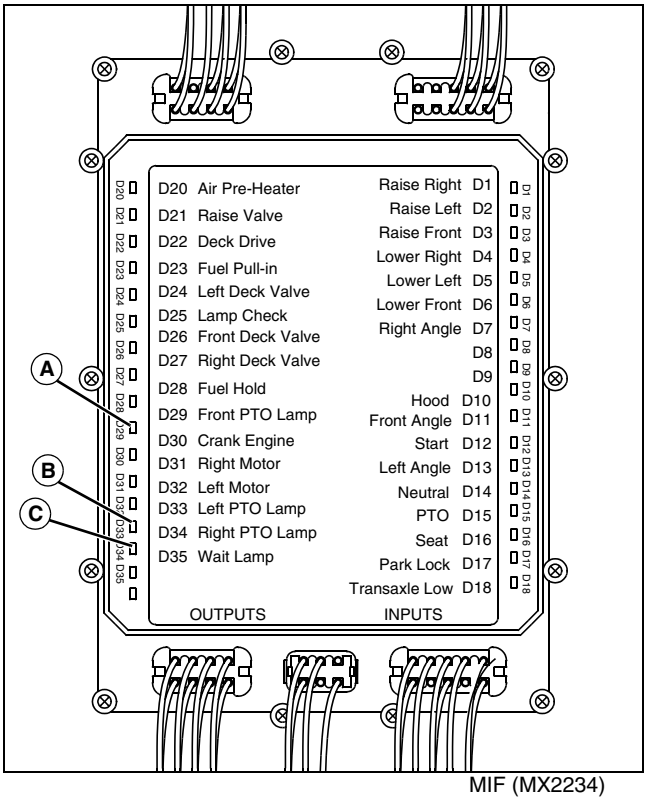
PTO Light Display Circuits Test - Models 1600/1620

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Park brake disengaged (UNLOCKED).
- Key switch in RUN position with engine OFF.
- All decks in the fully lowered position.
- Machine in LOW range (transaxle switch[a] in LOW).
- PTO switch cycled from OFF to ON.
- Electronic control module connector X26 disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

a. Models 1600/1620 and 1600 Turbo S.N. (-030000)

System: PTO Light Display Circuits Test - Models 1600/1620



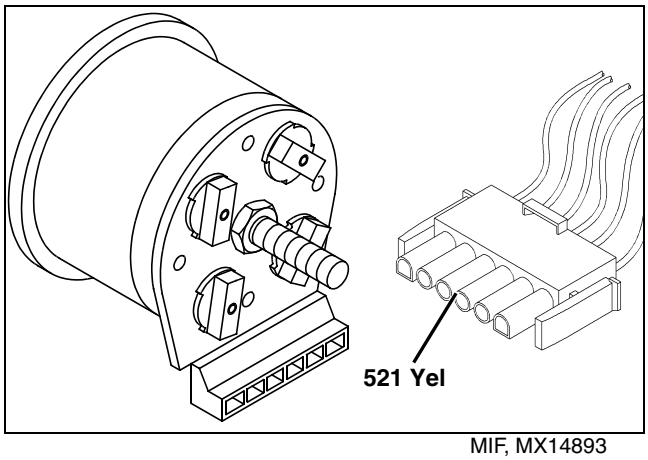
MIF (MX2234)

(1) Electronic Control Module - PTO Lamp Output LEDs, D29, D33, and D34. Is D29, D33, and D34 LEDs ON?

System: PTO Light Display Circuits Test - Models 1600/1620

Yes - Go To Step (2)

No - If the PTO and the appropriate interlock inputs are valid, but output LEDs D29, D33, or D34 do not come on, check for an output diagnostic code. If no code is present, replace control module.

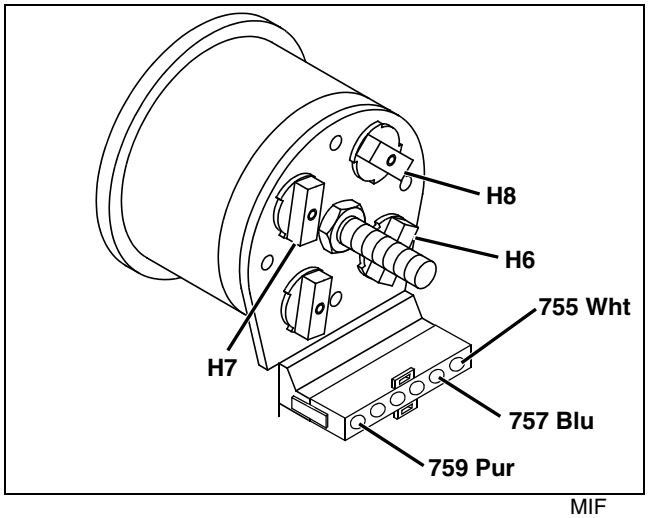


MIF, MX14893

(2) PTO Lights Display (A2) - Terminal 3, Wire 521 Yellow. Is battery voltage present?

Yes - Go To Step (3)

No - Test wire 521 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



MIF

(3) PTO Lights Display (A2) - Terminals 1, 5, and 6. Is battery voltage present?

Yes - Terminal 1 (wire 759 purple): Go To Step (4).

Yes - Terminal 5 (wire 757 blue): Go To Step (5).

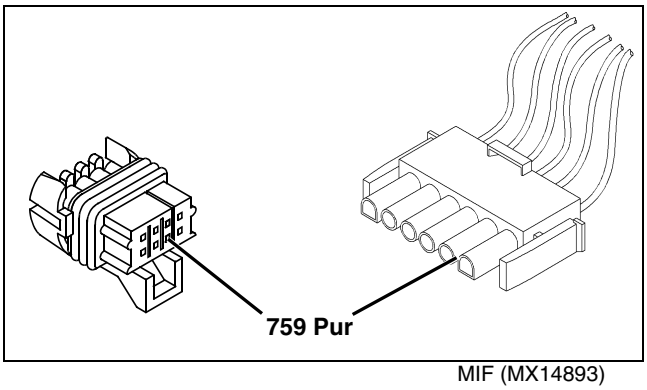
Yes - Terminal 6 (wire 755 white): Go To Step (6).

System: PTO Light Display Circuits Test - Models 1600/1620

No - Terminal 1 (wire 759 purple): Check right PTO light bulb H7. If bulb is good, replace PTO lights display.

No - Terminal 5 (wire 757 blue): Check left PTO light bulb H6. If bulb is good, replace PTO lights display.

No - Terminal 6 (wire 755 white): Check front PTO light bulb H8. If bulb is good, replace PTO lights display.

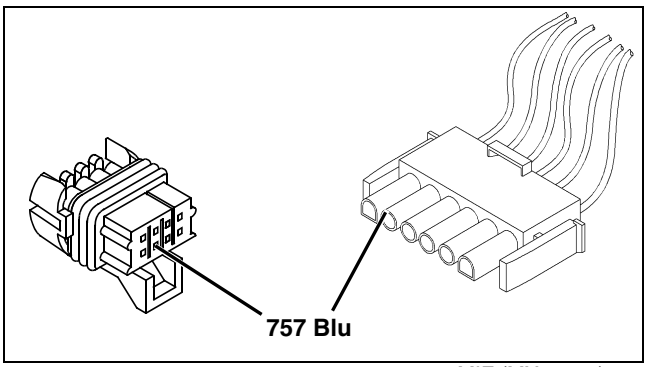


MIF (MX14893)

(4) PTO Lights Display (A2) - Terminal 1 and ECM (A3) - Connector X26, Terminal F. Is continuity indicated?

Yes - Replace Electronic Control Module (A3).

No - Repair or replace wire 759 purple and connections.



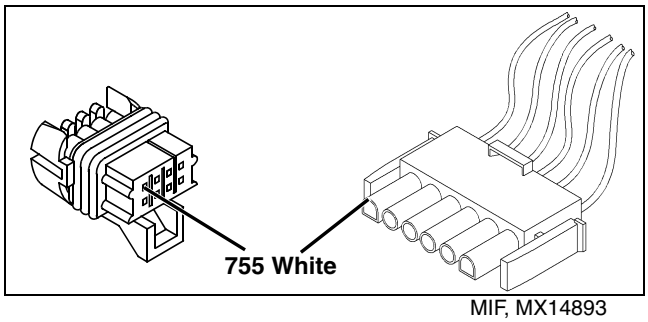
MIF (MX14893)

(5) PTO Lights Display (A2) - Terminal 5 and ECM (A3) - Connector X26, Terminal G. Is continuity indicated?

Yes - Replace Electronic Control Module (A3).

No - Repair or replace wire 757 blue and connections.

System: PTO Light Display Circuits Test - Models 1600/1620



MIF, MX14893

(6) PTO Lights Display (A2) - Terminal 6 and ECM (A3) - Connector X26, Terminal A. Is continuity indicated?

Yes - Replace Electronic Control Module (A3).

No - Repair or replace wire 755 white and connections.

Engine Oil Pressure Light Circuit Operation

Function

To warn the operator if the engine oil pressure drops below the safe operation level.

Operating Conditions

- Key switch in RUN position.
- Engine running.

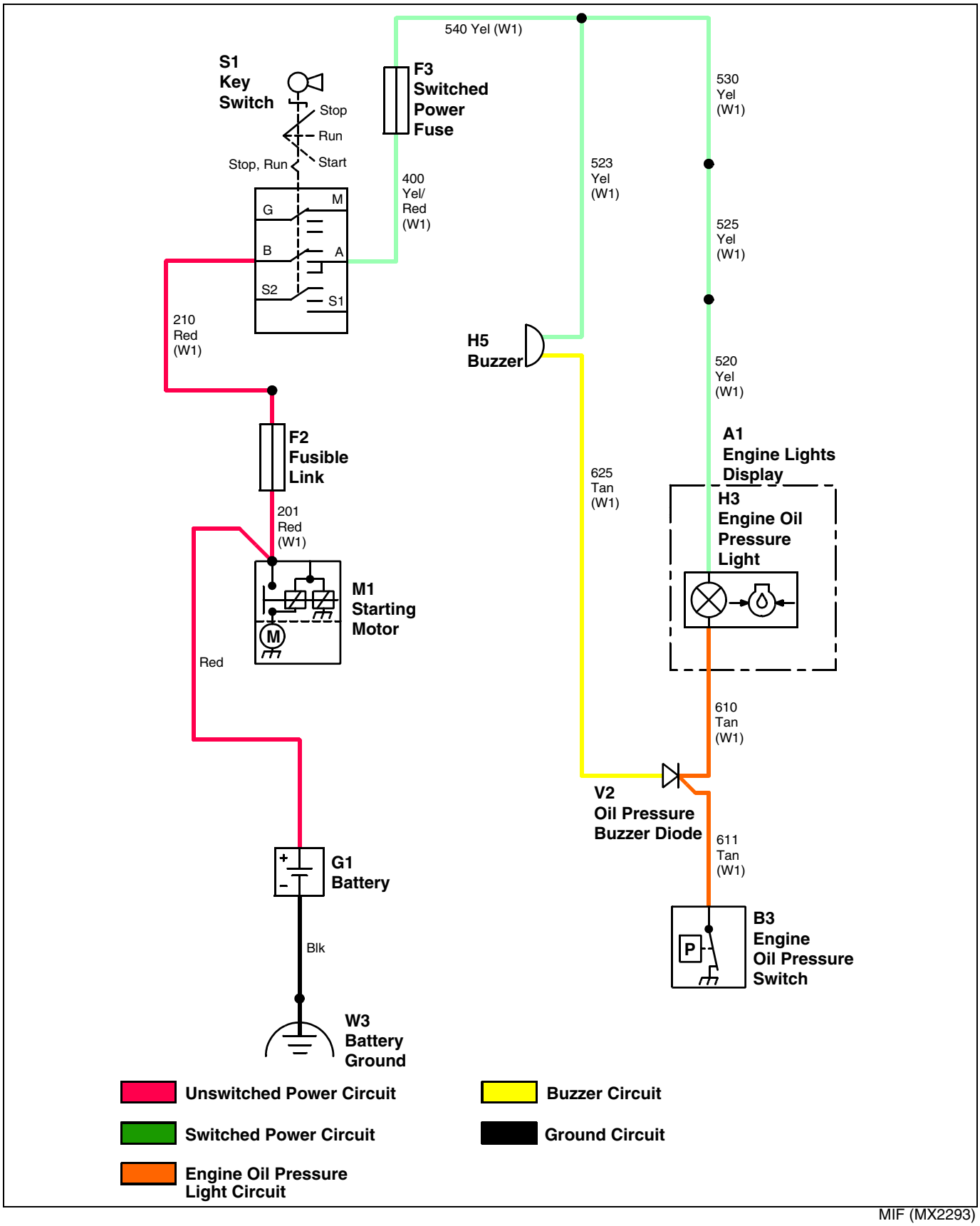
Theory of Operation

The power circuit provides current to key switch (S1) and protects the circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from battery (G1) positive (+) terminal to fusible link (F2) and then to key switch (S1), terminal B (red wires 201 [W1] and 210 [W1]).

When the key switch is in the RUN position, current flows from key switch terminal A to switched power fuse (F3) (yellow/red wire 400) and then to the following:

- Buzzer (H5) (yellow wires 540 [W1] and 523 [W1]).
- Engine lights display (A1) (yellow wires 540 [W1], 530 [W1], 525 [W1], and 520 [W1]).

When the engine oil pressure drops below the safe operating level, the engine oil pressure switch (B3) closes and completes the circuit to ground (tan wires 610 [W1] and 611 [W1]), causing the engine oil pressure light to come on. The engine oil pressure switch also completes the buzzer (H5) ground circuit (tan wires 625 [W1] and 611 [W1]), causing the buzzer to come on. Oil pressure buzzer diode (V2) is used to isolate the engine oil pressure light from other circuits that turn on the buzzer.


540 Yel (W1)
S1
Key
Switch
Stop
Run
Start
Stop, Run
F3
Switched
Power
Fuse
400
Yel/
Red
(W1)
530
Yel
(W1)
523
Yel
(W1)
525
Yel
(W1)
G
M
B
A
S2
S1
210
Red
(W1)
H5
Buzzer
520
Yel
(W1)
A1
Engine Lights
Display
F2
Fusible
Link
625
Tan
(W1)
H3
Engine Oil
Pressure
Light
201
Red
(W1)
M1
Starting
Motor
M
Red
610
Tan
(W1)
V2
Oil Pressure
Buzzer Diode
611
Tan
(W1)
G1
Battery
B3
Engine
Oil Pressure
Switch
P
Blk
W3
Battery
Ground
Unswitched Power Circuit
Buzzer Circuit
Switched Power Circuit
Ground Circuit
Engine Oil Pressure
Light Circuit

MIF (MX2293)

Engine Oil Pressure Light Circuit Diagnosis

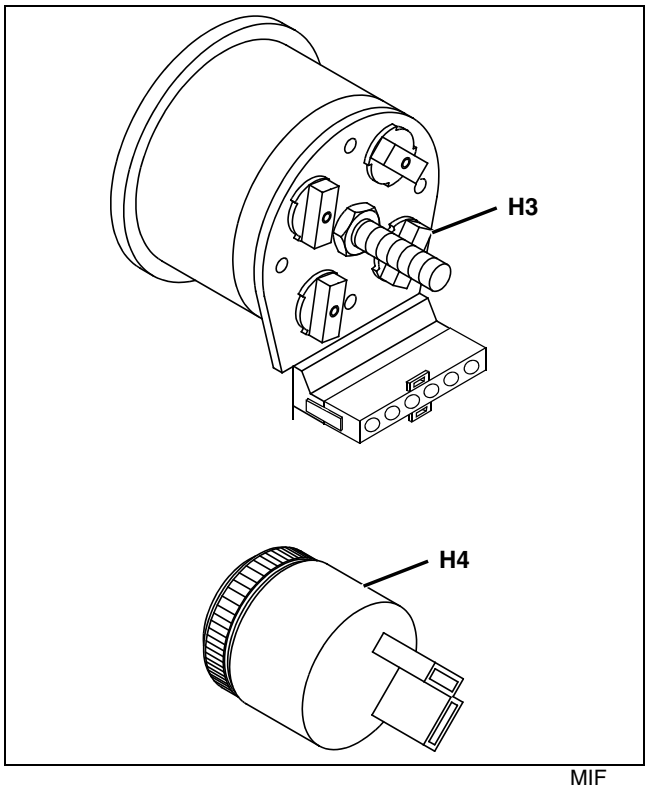
IMPORTANT: Avoid damage! During engine operation, if oil pressure light (H3) and buzzer (H5) are ON, STOP engine immediately and perform engine oil pressure test.

NOTE: Make sure fuse (F3) is good before performing this check.

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Engine overtemperature buzzer diode (V3) disconnected.
- Key switch in RUN position with engine running.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Engine Oil Pressure Light Circuit Diagnosis



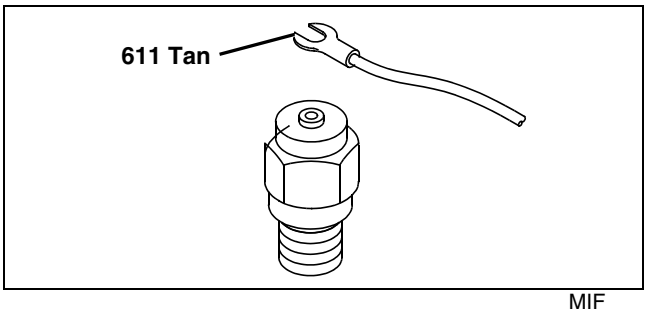
MIF

(1) Engine Oil Pressure Switch (B3) and Buzzer (H5). Are oil pressure light (H3) and buzzer (H5) both OFF?

Yes - Go To Step (2)

No - Check engine oil pressure. (See “Engine Oil Pressure Test” on page 46.) If engine oil pressure is good, replace engine oil pressure switch.

System: Engine Oil Pressure Light Circuit Diagnosis



MIF

(2) Key switch in RUN position with engine OFF. Engine oil pressure switch connector (X39) wire 611 tan disconnected.
Engine Oil Pressure Switch (B3) - Wire 611 Tan. Connect wire 611 tan to ground. Does oil pressure light come ON? Does buzzer (H5) emit sound?

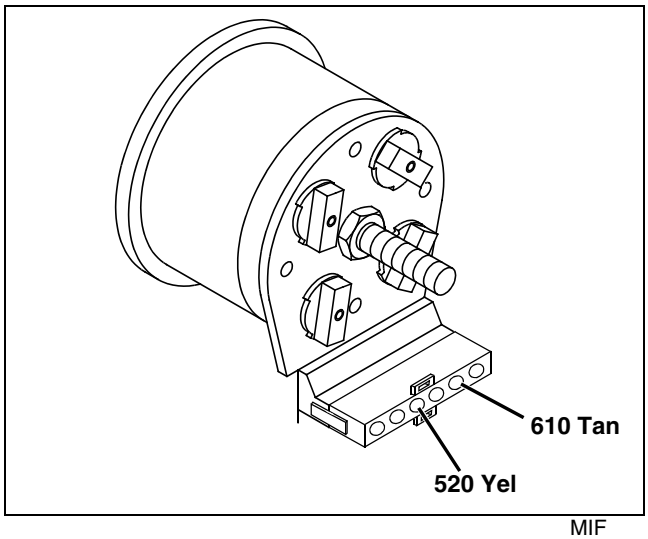
Yes - Test engine oil pressure switch. (See "Engine Oil Pressure Test" on page 46.)

No - If light is not ON and buzzer does not sound, test wire 611 tan, 610 tan and connections. If wire is good, test switched power to buzzer and engine lights display. (See "Switched Power Circuit Diagnosis" on page 242.)

No - If light is on but buzzer does not sound, Go To Step (4)

No - If buzzer sounds but oil light does not come on, Go To Step (3)

System: Engine Oil Pressure Light Circuit Diagnosis

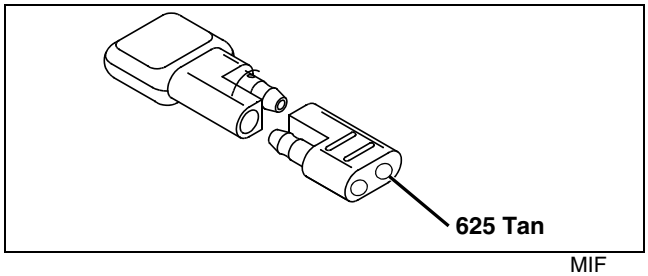


MIF

(3) Oil pressure buzzer diode (V2) removed. Engine Lights Display (A1) - Terminal 3 and Terminal 5. Is battery voltage present?

No - For Terminal 3: Test wire 520 yellow and connection. (See "Switched Power Circuit Diagnosis" on page 242.)

No - For Terminal 5: If voltage is present at terminal 3 but not at terminal 5, check light bulbs in engine lights display (A1). If bulbs are good, replace engine lights display.



MIF

(4) NOTE: Continued from step (2) of this test. Oil Pressure Buzzer Diode (V2) Connector - Wire 625 Tan. Is battery voltage present?

Yes - Test oil pressure buzzer diode (V2).

No - Check wire 625 tan and connections. If wires and connections check good, replace buzzer.

Engine Coolant Temperature Light Circuit Operation

Function

To warn the operator if the engine coolant temperature exceeds the safe operating level.

Operating Conditions

- Key switch in RUN position.
- Engine running.

Theory of Operation

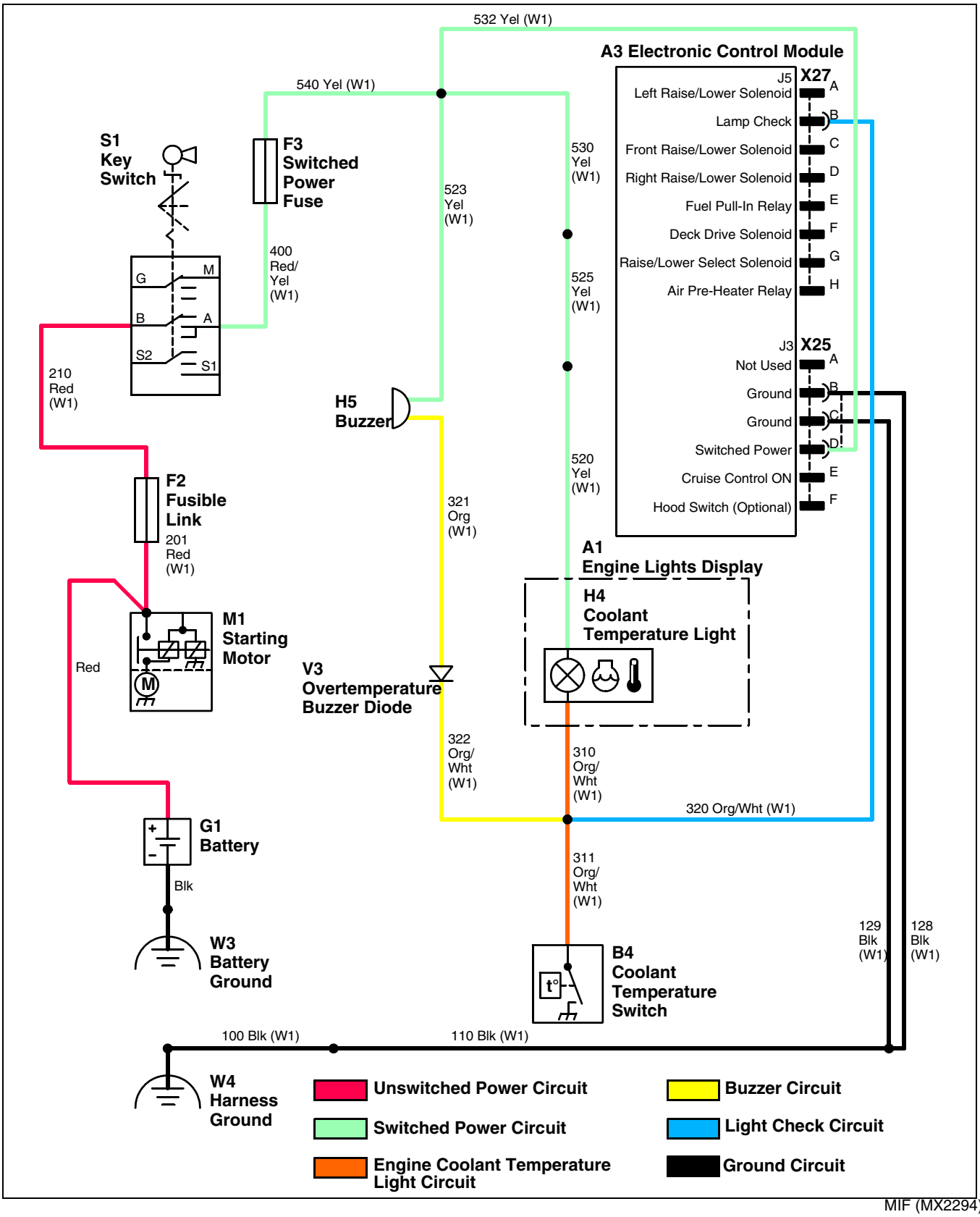
The power circuit provides current to key switch (S1) and protects the run circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to fusible link (F2) and then to key switch (S1), terminal B (wires 201 [W1] and 210 red [W1]).

When the key switch is in the RUN position, current flows from key switch terminal A to switched power fuse (F3) (wire 400 yellow/red) and then to the following:

- Buzzer (H5) (wires 540 [W1] and 523 yellow [W1]).
- Engine lights display (A1) (wires 540 [W1], 530 [W1], 525 [W1], and 520 yellow [W1]).

When the coolant temperature exceeds the safe operating level, the coolant temperature switch (B4) closes and completes the circuit to ground (wires 310 [W1] and 311 orange/white [W1]), causing the coolant temperature light to come on. The coolant temperature switch also completes the buzzer (H5) ground circuit (wires 311 [W1] and 322 orange/white [W1] and wire 321 orange [W1]), causing the buzzer to come on. Overtemperature buzzer diode (V3) is used to isolate the coolant temperature light from other circuits that turn on the buzzer.

When the key switch is moved from the OFF to the RUN position, the electronic control module grounds wire 320 orange/white (W1) for approximately 5 seconds. This completes the ground for the buzzer and coolant temperature light to turn them on. This serves as a way to check the operation of the buzzer and coolant temperature light.


532 Yel (W1)
A3 Electronic Control Module
J5 X27
Left Raise/Lower Solenoid A
Lamp Check B
Front Raise/Lower Solenoid C
Right Raise/Lower Solenoid D
Fuel Pull-In Relay E
Deck Drive Solenoid F
Raise/Lower Select Solenoid G
Air Pre-Heater Relay H
J3 X25
Not Used A
Ground B
Ground C
Switched Power D
Cruise Control ON E
Hood Switch (Optional) F
540 Yel (W1)
S1 Key Switch
F3 Switched Power Fuse
400 Red/ Yel (W1)
523 Yel (W1)
530 Yel (W1)
525 Yel (W1)
520 Yel (W1)
210 Red (W1)
H5 Buzzer
F2 Fusible Link
201 Red (W1)
321 Org (W1)
A1 Engine Lights Display
H4 Coolant Temperature Light
M1 Starting Motor
Red
V3 Overtemperature Buzzer Diode
322 Org/ Wht (W1)
310 Org/ Wht (W1)
320 Org/Wht (W1)
G1 Battery
Blk
311 Org/ Wht (W1)
129 Blk (W1)
128 Blk (W1)
W3 Battery Ground
B4 Coolant Temperature Switch
100 Blk (W1)
110 Blk (W1)
W4 Harness Ground
Unswitched Power Circuit
Switched Power Circuit
Engine Coolant Temperature Light Circuit
Buzzer Circuit
Light Check Circuit
Ground Circuit

MIF (MX2294)

Engine Coolant Temperature Light Circuit Diagnosis

Diagnostics of circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

1. Electronic Control Module Checks (See “Electronic Control Module Checks” on page 213.)

2. Engine Coolant Temperature Light Circuit Tests (See “Engine Coolant Temperature Light Circuit Tests” on page 325.)

Engine Coolant Temperature Light Circuit Tests

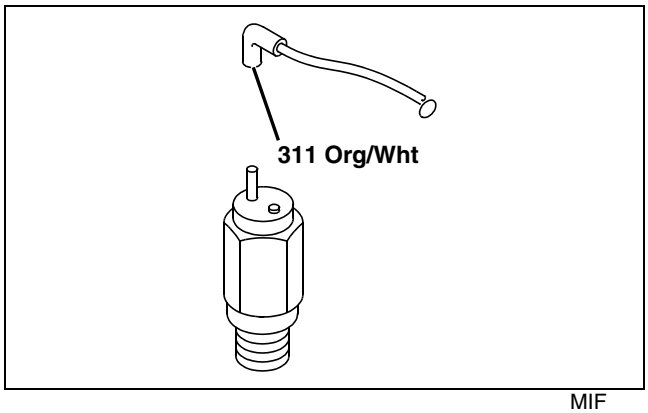
Engine Coolant Temperature Switch Circuit Test

NOTE: Make sure fuse (F3) is good before performing this test.

Test Conditions:

- Engine oil pressure switch connector (X39) (wire 611 tan) disconnected.
- Engine coolant temperature switch connector (X35) (wire 311 orange/white) disconnected and connected to ground using a jumper wire.
- Key switch in RUN position with engine OFF.
- Check connections for corrosion and looseness when testing.

System: Engine Coolant Temperature Switch Circuit Test



MIF

(1) Coolant Temperature Switch (B4) - Wire 311 Orange/White.
Does engine coolant temperature light come ON?
Does buzzer (H5) emit sound?

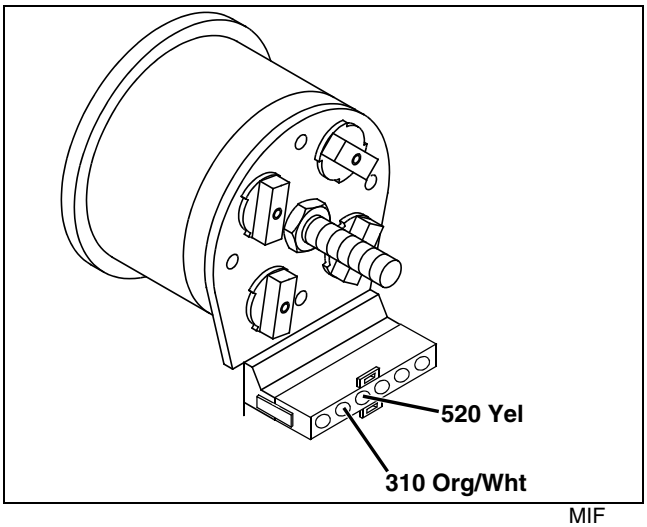
Yes - Test engine coolant temperature switch. (See “Coolant Temperature Switch Test” on page 374.)

No - If coolant temperature light is not ON and buzzer does not sound, test wire 311 orange/white and connections. If wire is good, test switched power to buzzer and engine lights display. (See “Switched Power Circuit Diagnosis” on page 242.)

No - If buzzer sounds but coolant temperature light does not come on, Go To Step (2).

No - If coolant temperature light is on but buzzer does not sound, Go To Step (3).

System: Engine Coolant Temperature Switch Circuit Test



MIF

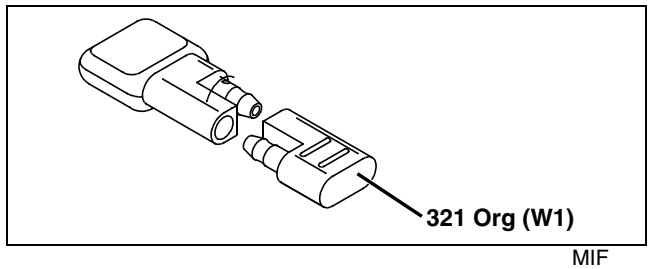
(2) Jumper wire removed from wire 311 orange. Overtemperature buzzer diode (V3) removed. Engine Lights Display (A1) connected. Engine Lights Display (A1) - Terminals 2 and 3. Is battery voltage present?

Yes - Test wire 310 orange/white and connections.

No - Terminal 3: Test wire 520 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

No - Terminal 2: If voltage is present at terminal 3 but not at terminal 2, check the coolant temperature light bulb in engine lights display (A1). If bulb is good, replace engine lights display.

System: Engine Coolant Temperature Switch Circuit Test



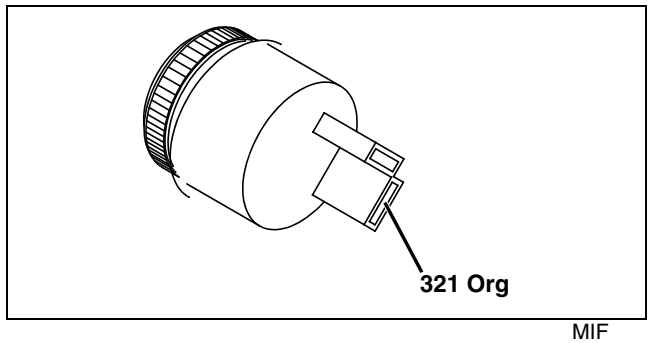
MIF

A - Overtemperature buzzer diode (V3) removed.

(3) NOTE: Continued from step (1) of this test. Overtemperature Buzzer Diode (V3) Connector - Wire 321 Orange. Is battery voltage present?

Yes - Test over temperature buzzer Diode (V3). If diode is good, test wire 322 orange/white and connections.

No - Go To Step (4)

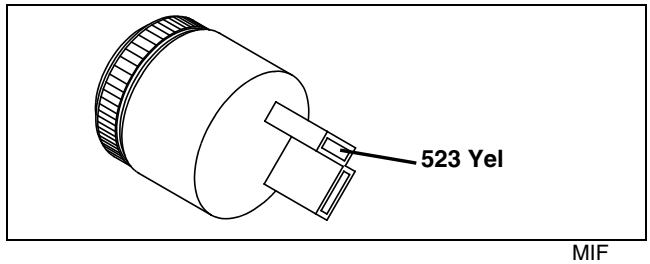


MIF

(4) Buzzer (H5) - Wire 321 Orange. Is battery voltage present?

Yes - Test wire 321 orange and connections.

No - Go To Step (5)



MIF

(5) Buzzer (H5) - Wire 523 Yellow. Is battery voltage present?

Yes - Replace buzzer.

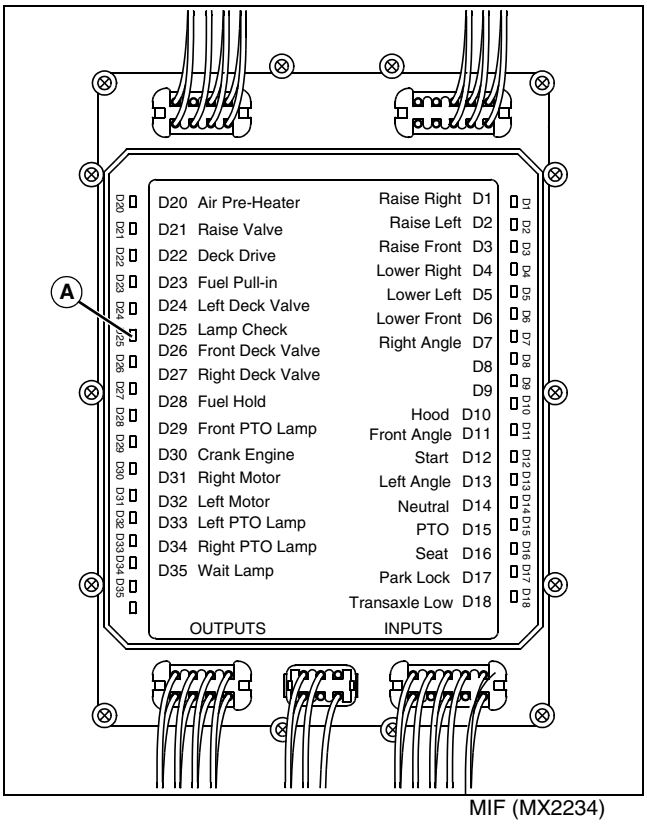
No - Test wire 523 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

Lamp Check Output Circuit Light Test

Test Conditions:

- Hood switch connector properly connected with jumper wire.
- Operator ON seat.
- Park brake engaged.
- PTO switch in OFF position.

System: Lamp Check Output Circuit Light Test



MIF (MX2234)

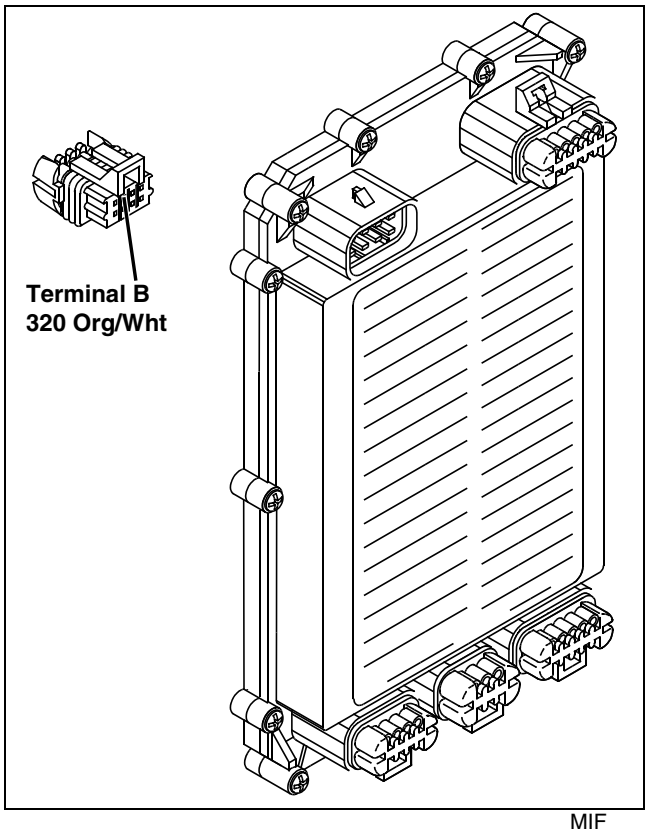
Picture Note: Electronic Control Module for Models 1600/1620 Shown; 1600 Turbo Is Similar

(1) Electronic Control Module - Lamp Check Output LED D25. Turn key switch to the RUN position.
Did LED D25 (A) come ON for a few seconds and then go OFF?

Yes - Go To Step (2)

No - Replace electronic control module.

System: Lamp Check Output Circuit Light Test



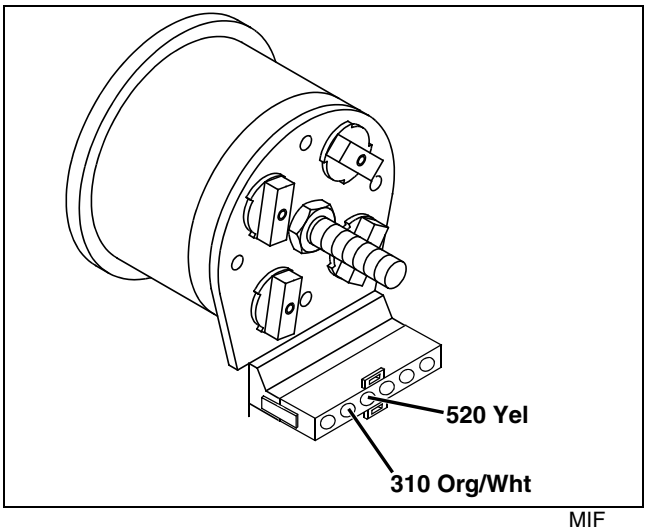
MIF

(2) Coolant temperature switch connector (X35) disconnected.
Electronic control module connector (X27) disconnected.
Overtemperature buzzer diode (V3) removed.
Electronic control module connector (X27) disconnected.
Key switch in RUN position with engine OFF.
Meter negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when testing.
Electronic Control Module (A3) - Terminal B. Is battery voltage present?

Yes - Go to step (3).

No - Test wire 320 orange/white and connections.

System: Lamp Check Output Circuit Light Test



MIF

(3) Engine Lights Display (A1) connected. Engine Lights Display (A1) - Terminals 2 and 3. Is battery voltage present?

Yes - Test wire 310 orange/white and connections.

No - Terminal 3: Test wire 520 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

No - Terminal 2: If voltage is present at terminal 3 but not at terminal 2, check the coolant temperature light bulb in engine lights display (A1). If bulb is good, replace engine lights display.

Engine Coolant Temperature Gauge Circuit Operation - Model 1600 Turbo

Function

To provide a visual indication of the engine coolant temperature.

Operating Conditions

- Key switch in RUN position.

Theory of Operation

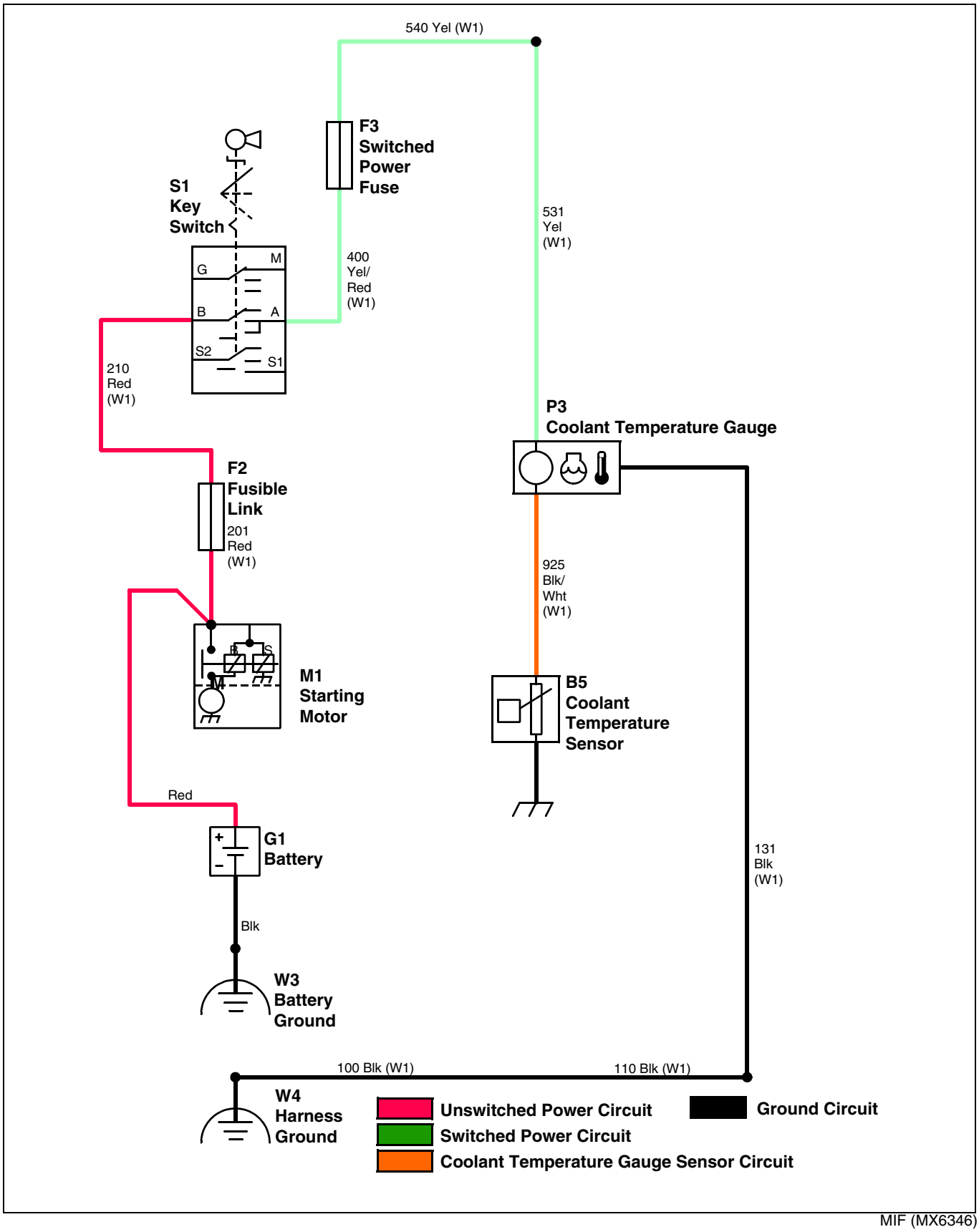
The power switch provides current to key switch (S1) and protects the circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to fusible link (F2), then to key switch terminal B (wires 201 red and 210 red).

When the key switch is in the RUN position, current flows from key switch terminal A to switched power fuse (F3) (wire 400 yellow/red), then to coolant temperature gauge (P3) (wire 531 yellow). Current flows from the coolant temperature gauge to the coolant temperature sensor (B5) (wire 925 orange/white). The coolant temperature gauge is grounded through wires 131, 110, and 100 black.

The engine coolant temperature sensor is a variable resistor that provides a signal to the coolant temperature gauge. When the temperature of the engine coolant increases, the resistance of the temperature sensor decreases. The resistance of the engine coolant temperature sensor will vary within specified range.

Specifications

Engine Coolant Temperature Sensor Resistance. . . . . .46-481 ohms


540 Yel (W1)
F3
Switched
Power
Fuse
S1
Key
Switch
G
M
B
A
S2
S1
400
Yel/
Red
(W1)
531
Yel
(W1)
210
Red
(W1)
P3
Coolant Temperature Gauge
F2
Fusible
Link
201
Red
(W1)
925
Blk/
Wht
(W1)
B
S
M
M1
Starting
Motor
B5
Coolant
Temperature
Sensor
Red
G1
Battery
131
Blk
(W1)
Blk
W3
Battery
Ground
100 Blk (W1)
110 Blk (W1)
W4
Harness
Ground
Unswitched Power Circuit
Switched Power Circuit
Coolant Temperature Gauge Sensor Circuit
Ground Circuit

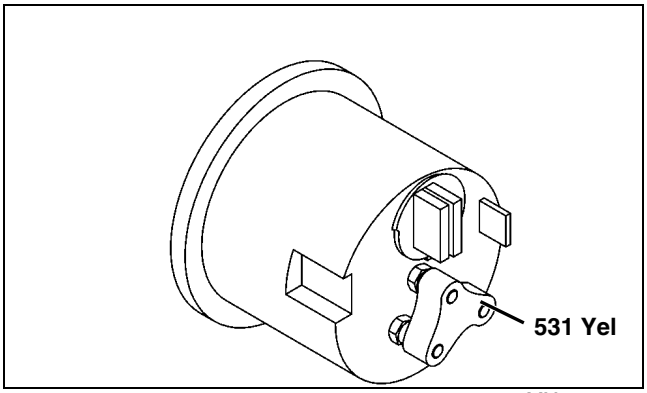
MIF (MX6346)

Engine Coolant Temperature Gauge Circuit Diagnosis

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in run position with engine OFF.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Engine Coolant Temperature Gauge Circuit Diagnosis

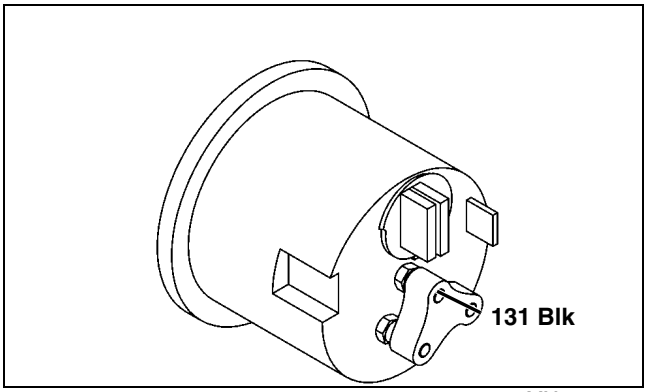


MX6352

(1) Engine Coolant Temperature Gauge (P3) - Wire 531 Yellow. Is battery voltage present?

Yes - Go To Step (2).

No - Test wire 531 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)



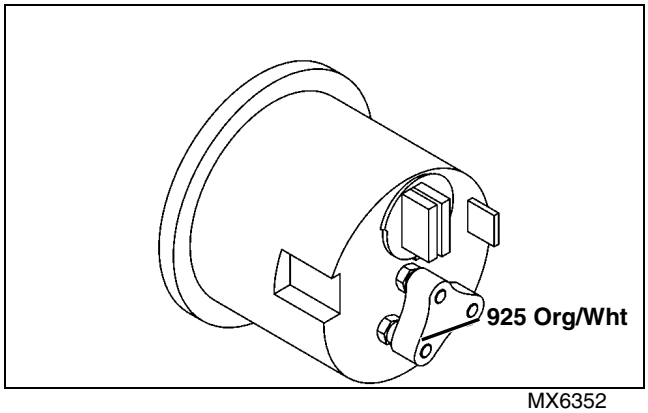
MX6352

(2) Key switch in STOP position. Engine Coolant Temperature Gauge (P3) - Wire 131 Black. Check ground circuit for resistance. Is there less than 0.1 ohms of resistance?

System: Engine Coolant Temperature Gauge Circuit Diagnosis

Yes - Go To Step (3).

No - Test wires 131, 110, and 100 black, and connections.



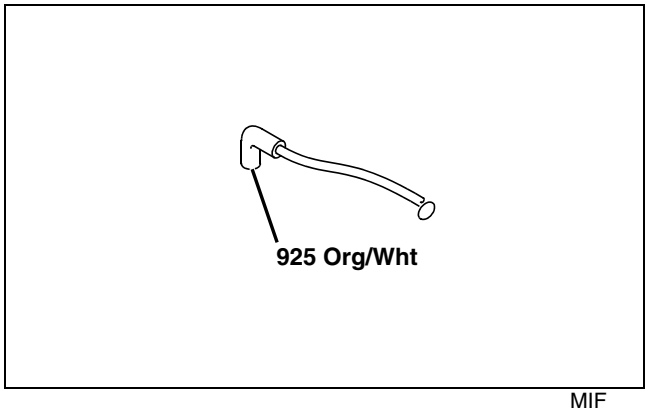
MX6352

A - Key switch in RUN position with engine OFF.

(3) Engine Coolant Temperature Gauge (P3) - Wire 925 Orange/White. Connect test point to ground. Does the engine coolant temperature gauge read 240°F?

Yes - Go To Step (4).

No - Replace engine coolant temperature gauge.



MIF

(4) Engine Coolant Temperature Sensor (B5) - Wire 925 Orange/White. Connect test point to ground. Does the engine coolant temperature gauge read 240°F?

Yes - See “Engine Coolant Temperature Sensor Test” on page 373.

No - Test wire 925 orange/white and connections.

Engine Air Pre-Heater Circuit Operation

Function

To preheat the air entering the engine air intake manifold to make starting easier during cold operating conditions.

Operating Conditions

- Key switch in RUN position.

Theory of Operation

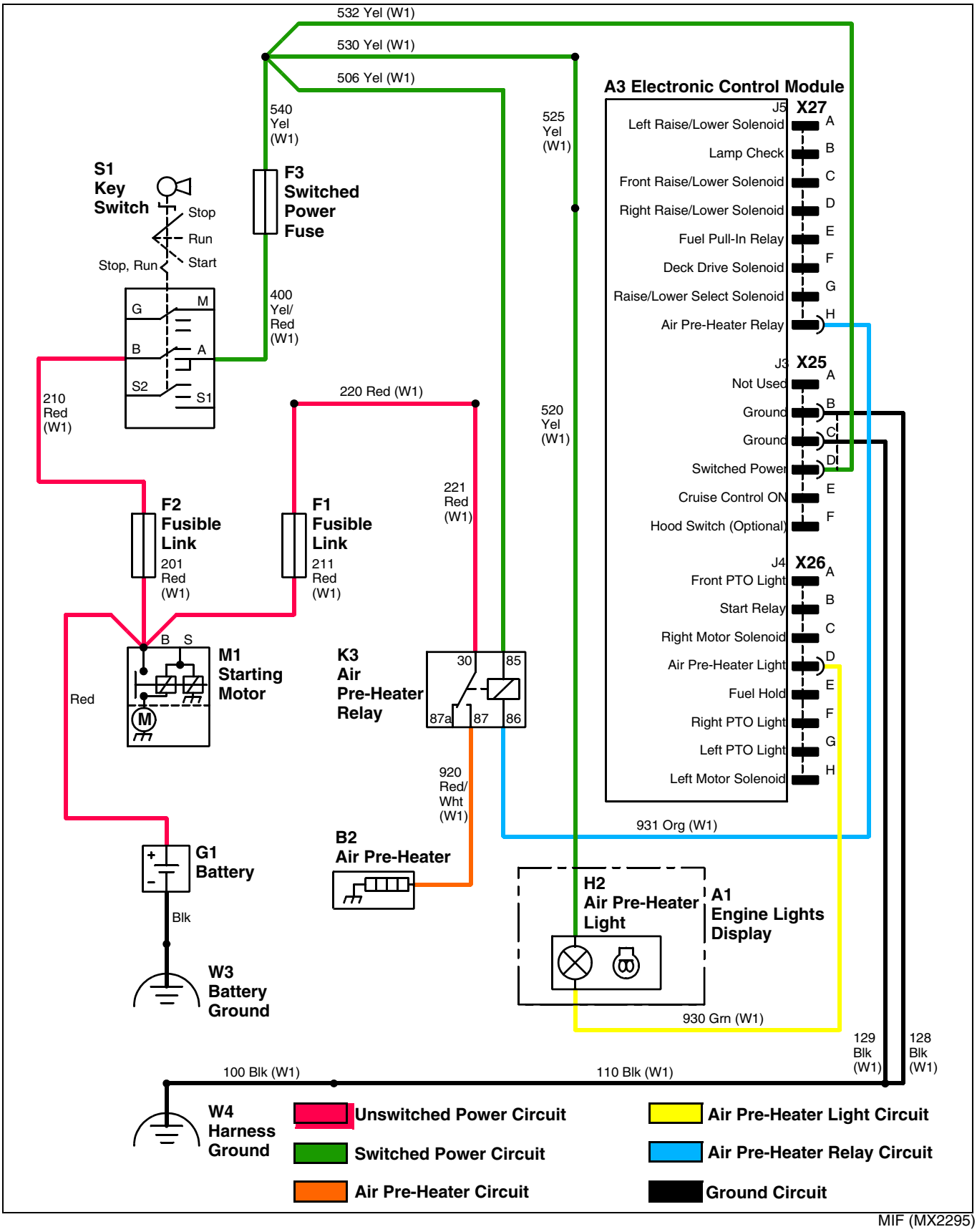
Unswitched power flows from the battery (G1) positive (+) terminal to fusible links (F1) (wire 211 red [W1]) and (F2) (wire 201 red [W1]). Current flows from fusible link (F1) to air pre-heater relay (K3) (wires 220 [W1] and 221 red [W1]). Current flows from fusible link (F2) to key switch (S1) (wire 210 red [W1]). Fusible links (F1 and F2) provide circuit protection.

When the key switch is in the RUN position, current flows from key switch terminal A to 15-amp switched power fuse (F3) (wire 400 yellow/red) to provide additional circuit protection. Current then flows from switched power fuse (F3) to the following:

- Electronic control module connector (X25), terminal D (wires 540 [W1] and 532 yellow [W1]).
- Engine lights display (A1) (wires 540 [W1], 530 [W1], and 520 yellow [W1]).
- Air pre-heater relay (K3) coil, terminal 86 (wires 540 [W1] and 506 yellow [W1]).

When the key switch is moved from the OFF position to the RUN position, the electronic control module energizes the air pre-heater relay (K3) by grounding the relay coil (wire 931 orange [W1]). With the relay energized, current flows to the air pre-heater (B2) (wire 920 red/white [W1]). The air pre-heater uses an internal ground to complete the circuit.

The air pre-heater light (H2) indicates the minimum time needed until the engine is ready to start and is turned on by the electronic control module by grounding the light (wire 930 green [W1]). The amount of time that air pre-heater is turned on depends on the ambient temperature. The air pre-heater remains on after the air pre-heater light turns off, to control “white smoke” during the first few seconds of running. The maximum on-time is 45 seconds, depending on ambient temperature.


532 Yel (W1)
530 Yel (W1)
506 Yel (W1)
540 Yel (W1)
525 Yel (W1)
A3 Electronic Control Module
J5 X27
Left Raise/Lower Solenoid A
Lamp Check B
Front Raise/Lower Solenoid C
Right Raise/Lower Solenoid D
Fuel Pull-In Relay E
Deck Drive Solenoid F
Raise/Lower Select Solenoid G
Air Pre-Heater Relay H
J3 X25
Not Used A
Ground B
Ground C
Switched Power D
Cruise Control ON E
Hood Switch (Optional) F
J4 X26
Front PTO Light A
Start Relay B
Right Motor Solenoid C
Air Pre-Heater Light D
Fuel Hold E
Right PTO Light F
Left PTO Light G
Left Motor Solenoid H
S1 Key Switch
Stop
Run
Start
Stop, Run
F3 Switched Power Fuse
400 Yel/ Red (W1)
210 Red (W1)
220 Red (W1)
520 Yel (W1)
221 Red (W1)
F2 Fusible Link
201 Red (W1)
F1 Fusible Link
211 Red (W1)
M1 Starting Motor
K3 Air Pre-Heater Relay
920 Red/ Wht (W1)
931 Org (W1)
B2 Air Pre-Heater
H2 Air Pre-Heater Light
A1 Engine Lights Display
930 Grn (W1)
G1 Battery
Blk
W3 Battery Ground
129 Blk (W1)
128 Blk (W1)
100 Blk (W1)
110 Blk (W1)
W4 Harness Ground
Unswitched Power Circuit
Switched Power Circuit
Air Pre-Heater Circuit
Air Pre-Heater Light Circuit
Air Pre-Heater Relay Circuit
Ground Circuit

MIF (MX2295)

Engine Air Pre-Heater Circuit Diagnosis

Diagnostics of circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

When diagnosing the air pre-heater circuit, it is important to perform an electronic control module check first. (See “Electronic Control Module Checks” on page 213.)

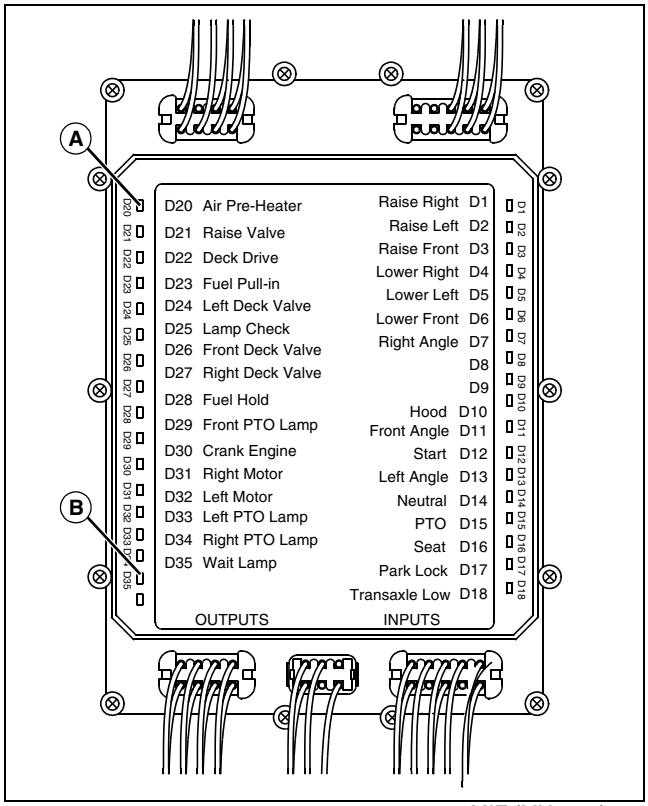
Air Pre-Heater Circuit Tests

Air Pre-Heater Output LEDs Check

Test Conditions:

- Hood switch connector properly connected with jumper wire.
- Operator ON seat.
- Park brake engaged.
- PTO switch in OFF position.
- Key Switch in STOP position.

System: Air Pre-Heater Output LEDs Check



MIF (MX2234)

Picture Note: Electronic Control Module for Models 1600/1620 Shown; 1600 Turbo Is Similar

(1) Electronic Control Module (A3) - Air Pre-Heater Output LEDs D20 and D35. Turn key switch to the RUN position.
Did LED D20 (A) and D35 (B) come ON for at least two seconds and then go OFF?

Yes - See “Air Pre-Heater (Wait) Lamp Circuit Test” on page 335.

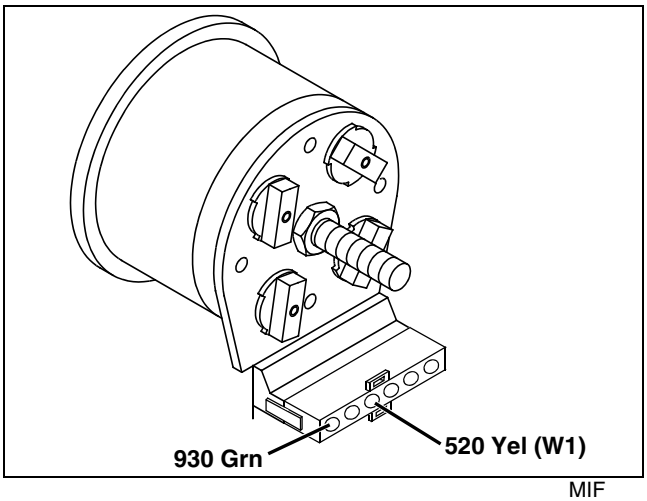
No - Replace electronic control module.

Air Pre-Heater (Wait) Lamp Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Electronic control module connector (X26) disconnected.
- Key switch in the RUN position with engine OFF.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Air Pre-Heater (Wait) Lamp Circuit Test



MIF

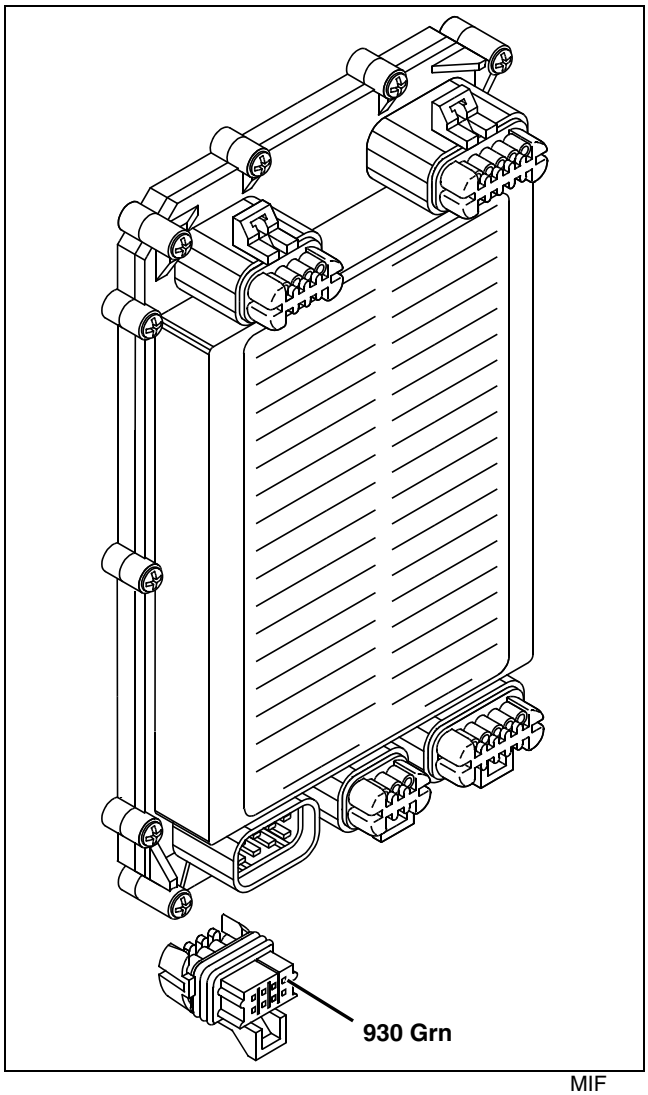
(1) Engine Lights Display (A1) - Terminals 1 and 3. Is battery voltage present?

Yes - Go To Step (2)

No - Terminal 3, Wire 520 Yellow: Test wire 520 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

No - Terminal 1, Wire 930 Green: If voltage is present at terminal 3 but not at terminal 1, check air pre-heater light bulb in engine lights display (A1). If bulb is good, replace engine lights display.

System: Air Pre-Heater (Wait) Lamp Circuit Test



MIF

(2) Electronic Control Module (A3) - Connector X26 - Terminal D, Wire 930 Green. Is battery voltage present?

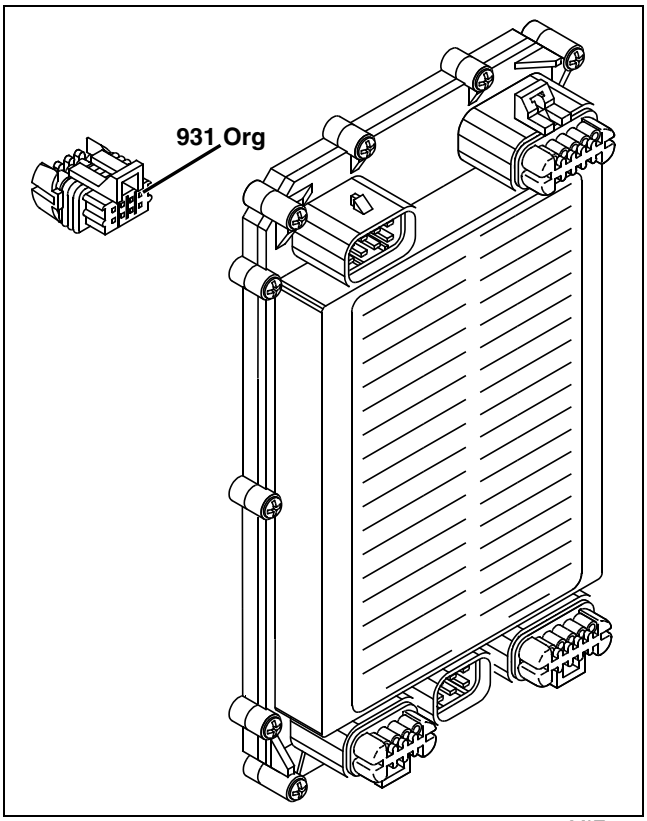
No - Test wire 930 green and connections.

Air Pre-Heater Relay Circuit Test

Test Conditions:

- Machine parked safely. (See "Park Machine Safely" on page 3.)
- Electronic control module connectors (X27) disconnected.
- Key switch in the RUN position with engine OFF.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Air Pre-Heater Relay Circuit Test



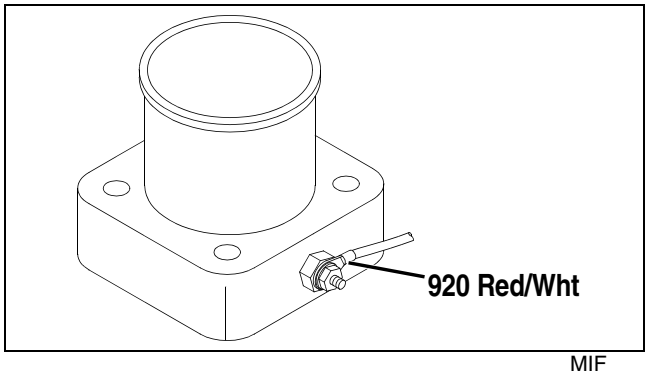
MIF

(1) Electronic Control Module (A3) - Connector X27 - Terminal H, Wire 931 Orange. Is battery voltage present?

Yes - Connect terminal H of connector (X27) to ground using a jumper wire, then Go To Step (2)

No - Go To Step (5)

System: Air Pre-Heater Relay Circuit Test

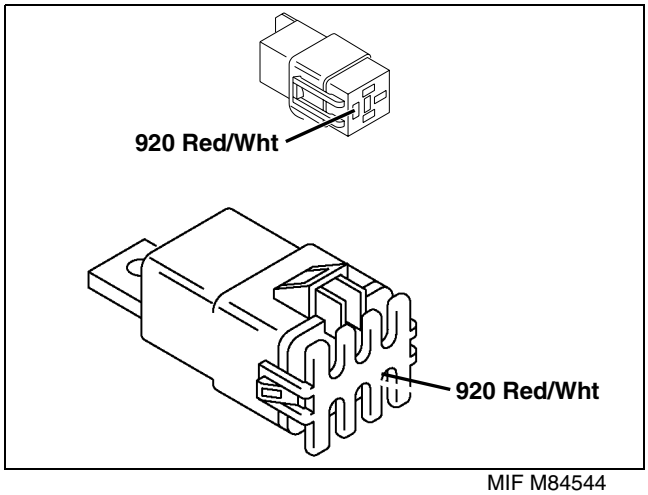


MIF

(2) Air Pre-Heater (B2) - Wire 920 Red/White. Is battery voltage present?

Yes - Test pre-heater element. (See "Air Pre-Heater Test" on page 363.)

No - Go To Step (3)



MIF M84544

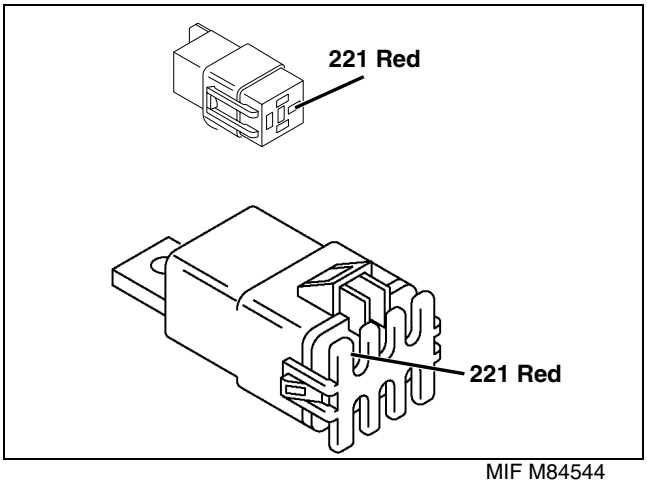
Picture Note:
UPPER: Model 1600/1620
LOWER: Model 1600 Turbo

(3) Air Pre-Heater Relay (K3) - Terminal 87, Wire 920 Red/White. Is battery voltage present?

Yes - Test wire 920 red/white and connections.

No - Go To Step (4)

System: Air Pre-Heater Relay Circuit Test



MIF M84544

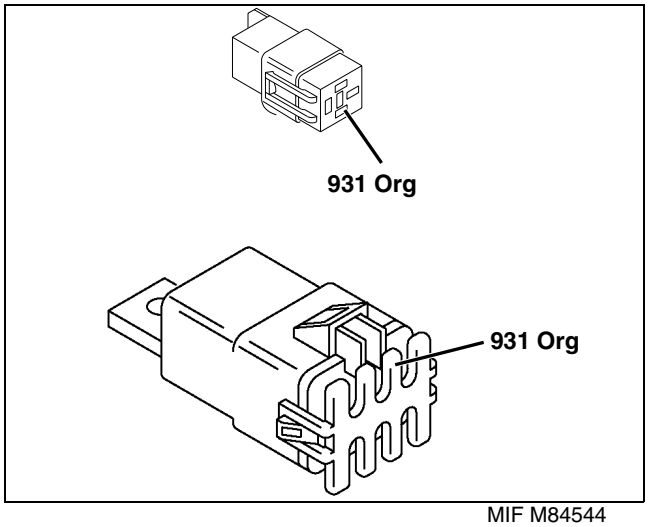
Picture Note:
UPPER: Model 1600/1620
LOWER: Model 1600 Turbo

(4) Air Pre-Heater Relay (K3) - Terminal 30, Wire 221 Red. Is battery voltage present?

Yes - Test air pre-heater relay (K3), (See "Relay Test" on page 363.)

No - Test wire 221 red and connections. (See "Unswitched Power Circuit Diagnosis" on page 241.)

System: Air Pre-Heater Relay Circuit Test



MIF M84544

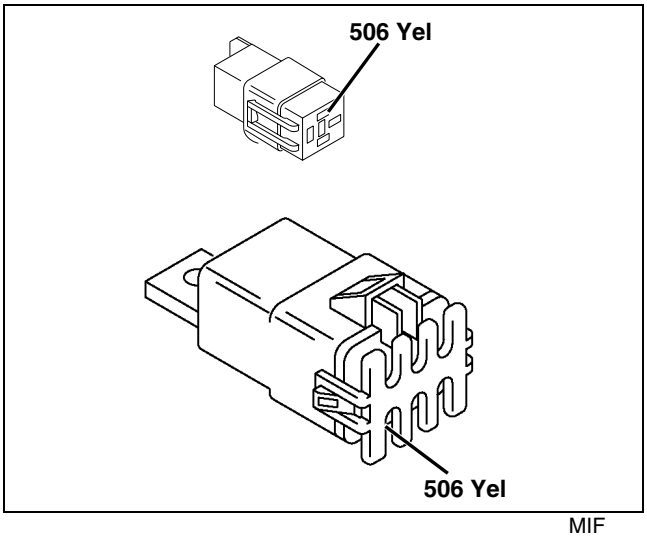
Picture Note:
UPPER: Model 1600/1620
LOWER: Model 1600 Turbo

(5) NOTE: Continued from step (1) of this test. Air Pre-Heater Relay (K3) - Terminal 86, Wire 931 Orange. Is battery voltage present?

Yes - Test wire 931 orange and connections.

No - Go To Step (6)

System: Air Pre-Heater Relay Circuit Test



MIF

Picture Note:
UPPER: Model 1600/1620
LOWER: Model 1600 Turbo

(6) Air Pre-Heater Relay (K3) - Terminal 85, Wire 506 Yellow. Is battery voltage present?

Yes - Test air pre-heater relay (K3). (See “Relay Test” on page 363.)

No - Test wire 506 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

Fuel Gauge Circuit Operation - Models 1600 and 1620

Function

To provide a visual indication of the amount of fuel in the fuel tank.

Operating Conditions

- Key switch in RUN position.

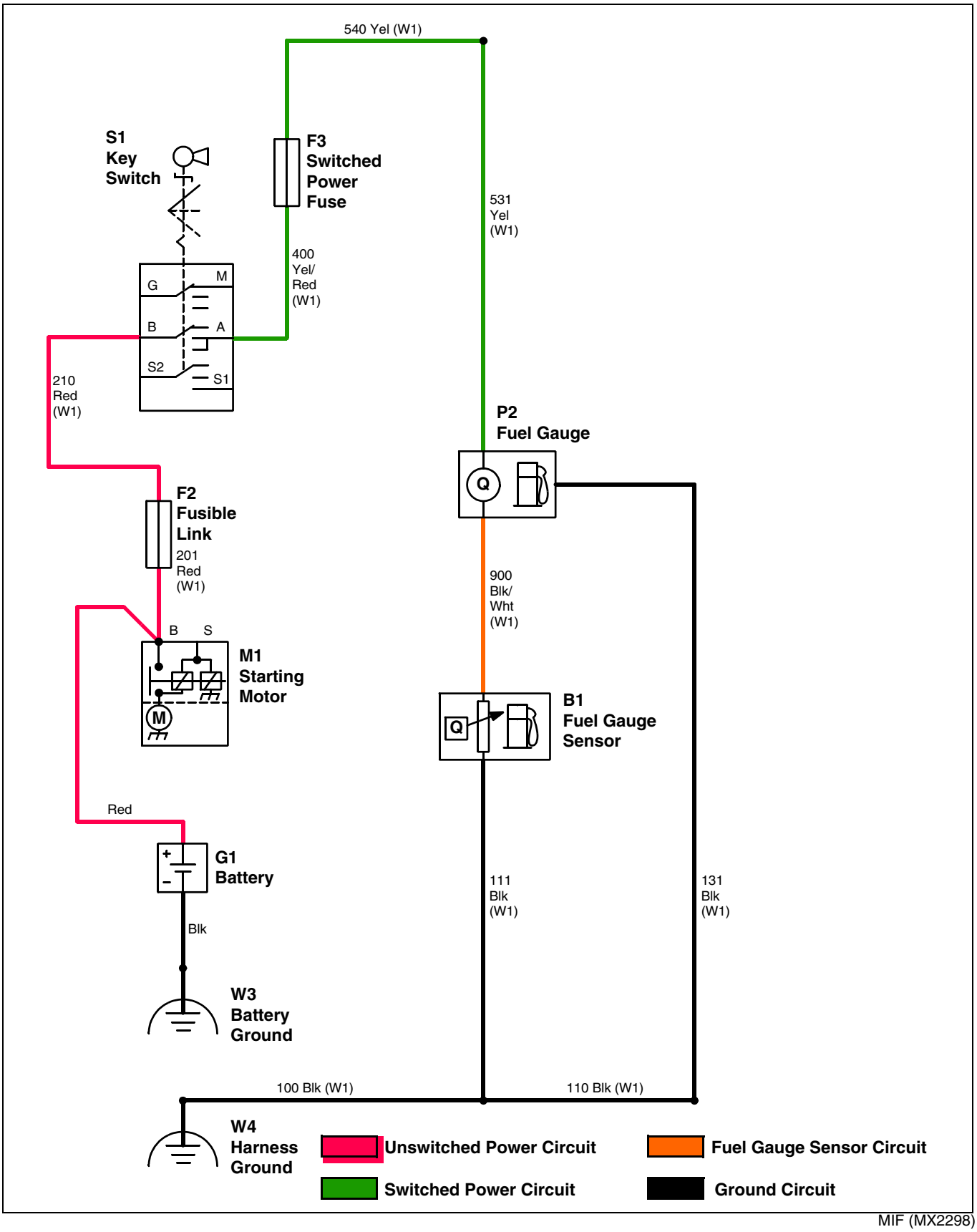
Theory of Operation

The power circuit provides current to key switch (S1) and protects the circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to fusible link (F2) and then to key switch (S1), terminal B (wires 201 [W1] and 210 [W1] red).

When the key switch is in the RUN position, current flows from key switch terminal A to switched power fuse (F3) (wire 400 yellow/red) and then to the fuel gauge (P2) (wire 531 yellow [W1]).

Current flows from the fuel gauge to the fuel gauge sensor (B1) (wire 900 black/white [W1]) and then to ground (wires 111 [W1] and 100 [W1] black). As the fuel in the tank varies, the resistance of the fuel gauge sensor varies and causes the current through the fuel gauge to vary and indicate the fuel level.

The fuel gauge requires ground (wires 131 [W1], 110 [W1], and 100 [W1] black).


540 Yel (W1)
S1
Key
Switch
F3
Switched
Power
Fuse
531
Yel
(W1)
400
Yel/
Red
(W1)
G
M
B
A
S2
S1
210
Red
(W1)
P2
Fuel Gauge
Q
F2
Fusible
Link
201
Red
(W1)
900
Blk/
Wht
(W1)
B
S
M1
Starting
Motor
M
Q
B1
Fuel Gauge
Sensor
Red
+
-
G1
Battery
111
Blk
(W1)
131
Blk
(W1)
Blk
W3
Battery
Ground
100 Blk (W1)
110 Blk (W1)
W4
Harness
Ground
Unswitched Power Circuit
Fuel Gauge Sensor Circuit
Switched Power Circuit
Ground Circuit

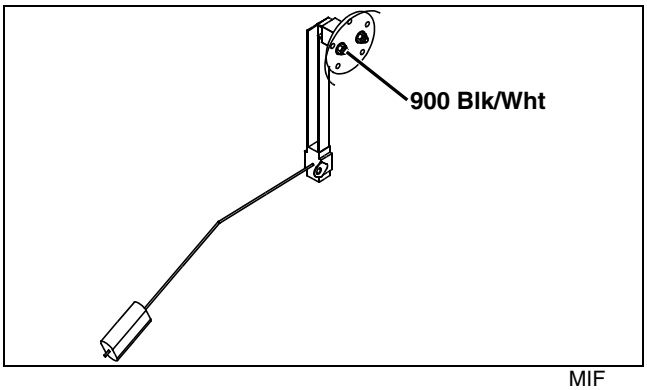
MIF (MX2298)

Fuel Gauge Circuit Diagnosis

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in RUN position with engine OFF.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Fuel Gauge Circuit Diagnosis

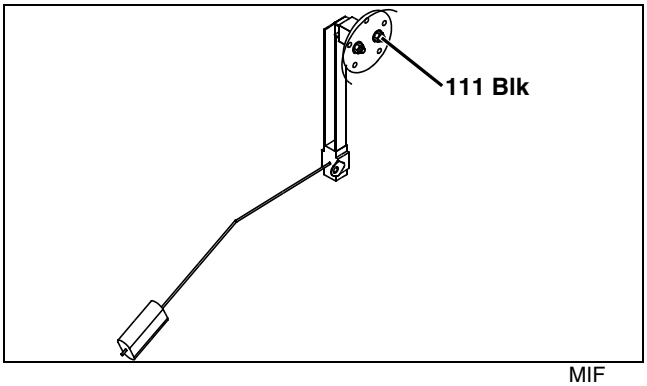


MIF

(1) Fuel Gauge Sensor (B1) - Wire 900 Black/White. Connect test point to ground. Does the fuel gauge read full?

Yes - Go To Step (2)

No - Go To Step (3)



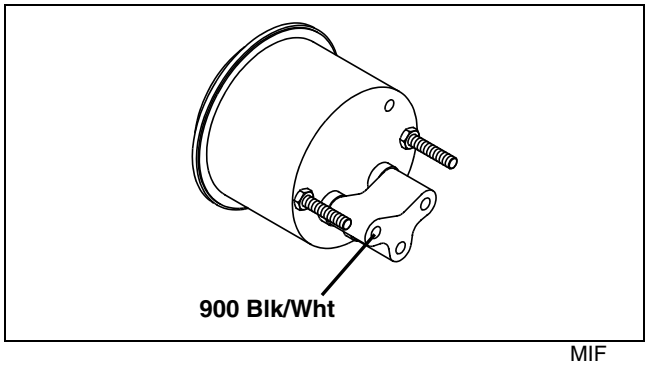
MIF

(2) Key switch in STOP position.
Fuel Gauge Sensor (B1) - Wire 111 Black. Check ground circuit for resistance. Is there less than 0.1 ohm resistance?

Yes - See “Fuel Gauge Sensor Test” on page 372.

No - Test wire 111 black and connections.

System: Fuel Gauge Circuit Diagnosis

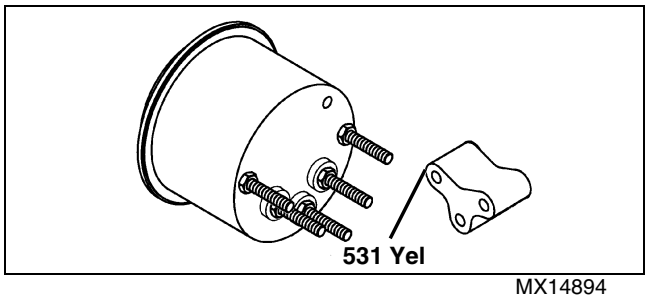


MIF

(3) Key switch in RUN position with engine OFF. Fuel Gauge (P2) connected.
Fuel Gauge (P2) - Wire 900 Black/White. Connect test point to ground. Does the fuel gauge read full?

Yes - Test wire 900 black/white and connections.

No - Go To Step (4)



MX14894

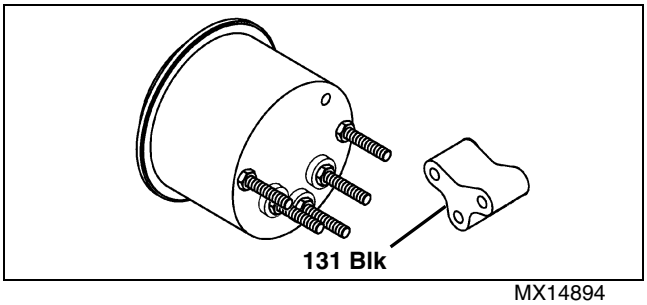
A - Fuel Gauge (P2) disconnected.

(4) Fuel Gauge (P2) - Wire 531 Yellow. Is battery voltage present?

Yes - Go To Step (5)

No - Test wire 531 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Fuel Gauge Circuit Diagnosis



MX14894

(5) Key switch in STOP position.
Fuel Gauge (P2) - Wire 131 Black. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?

Yes - Replace fuel gauge.

No - Test wires 131, 110, and 100 black and connections.

Hour Meter Circuit Operation

See “Fuel Hold Circuit Test” on page 274.

Hour Meter Circuit Diagnosis

See “Hour Meter Circuit Test” on page 276.

Lighting Circuit Operation

Function

To provide power to the headlights.

Operation Conditions

- Key switch in RUN position.
- Lights switch in ON position.

Theory of Operation - Models 1600/1620

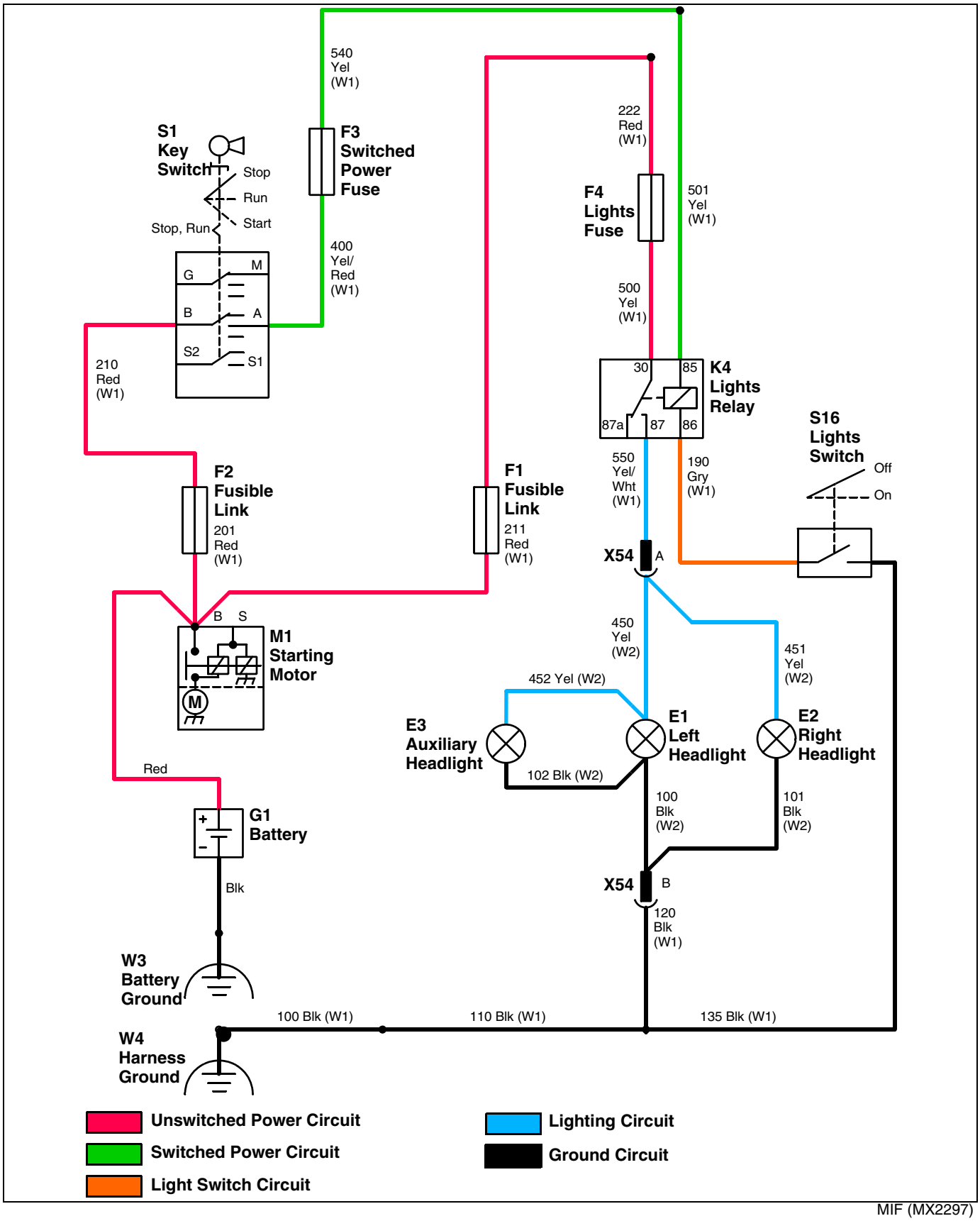
The power circuit provides current to key switch (S1) and protects the circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to fusible link (F2) and then to the key switch (S1), terminal B (wires 201 red and 210 red).

Unswitched power is also supplied to the lights relay (K4) from the battery and is protected by a fusible link (F1) and 20-amp lights fuse (F4). Current flows from the battery positive (+) terminal to starting motor (M1) (red battery cable). From the starting motor, current flows to the lights fuse (F4) (wires 211 red and 222 red) and then to terminal 30 of the lights relay (K4) (wire 500 yellow).

When the key switch is in the RUN position, current flows from the key switch, terminal A to switched power fuse (F3) (wire 400 yellow/red) and then to the lights relay (K4), terminal 85 (wires 540 yellow and 501 yellow).

When the lights switch is in the ON position, the coil of relay (K4) is connected to ground at terminal 86 (wire 190 gray) and (wires 135, 110, and 100 black) energizing the relay. When relay (K4) is energized, current flows across the relay contacts to the lights wiring harness connector (X54) (wire 550 yellow/white). From connector (X54), current flows to left headlight (E1) (wire 450 yellow [W2]) and to right headlight (E2) (wire 451 yellow [W2]), causing the headlights to come on. Current also flows to the auxiliary light connector (X57) (wire 452 yellow [W2]) to provide power for auxiliary lighting.

A ground circuit is provided to connector (X56) from the left headlight (E1) (wire 102 black [W2]). The ground path for headlights (E1 and E2) is provided by connector (X54) (wires 100 black [W2] and 101 black [W2]) to machine ground (wires 110 black and 100 black).


540
Yel
(W1)
S1
Key
Switch
Stop
Run
Start
Stop, Run
F3
Switched
Power
Fuse
400
Yel/
Red
(W1)
G
M
B
A
S2
S1
210
Red
(W1)
222
Red
(W1)
F4
Lights
Fuse
501
Yel
(W1)
500
Yel
(W1)
30
85
K4
Lights
Relay
87a
87
86
S16
Lights
Switch
Off
On
550
Yel/
Wht
(W1)
190
Gry
(W1)
F2
Fusible
Link
201
Red
(W1)
F1
Fusible
Link
211
Red
(W1)
X54
A
B
S
M1
Starting
Motor
M
450
Yel
(W2)
451
Yel
(W2)
452 Yel (W2)
E3
Auxiliary
Headlight
E1
Left
Headlight
E2
Right
Headlight
102 Blk (W2)
Red
100
Blk
(W2)
101
Blk
(W2)
G1
Battery
X54
B
Blk
120
Blk
(W1)
W3
Battery
Ground
100 Blk (W1)
110 Blk (W1)
135 Blk (W1)
W4
Harness
Ground
Unswitched Power Circuit
Switched Power Circuit
Light Switch Circuit
Lighting Circuit
Ground Circuit

MIF (MX2297)

Lighting Circuit Theory of Operation - Model 1600 Turbo

The power circuit provides current to key switch (S1) and protects the circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to fusible link (F2) and then to the key switch (S1), terminal B (wires 201 red and 210 red).

Unswitched power is also supplied to the lights relay (K4) from the battery and is protected by a fusible link (F1). Lights fuse (F4) provides protection for the headlight circuit. Auxiliary fuse (F5) protects the auxiliary light circuit. Current flows from the battery positive (+) terminal to starting motor (M1) (red battery cable). From the starting motor, current flows through fusible link (F1) (wires 211 and 222 red) to terminal 30 of relay (K4).

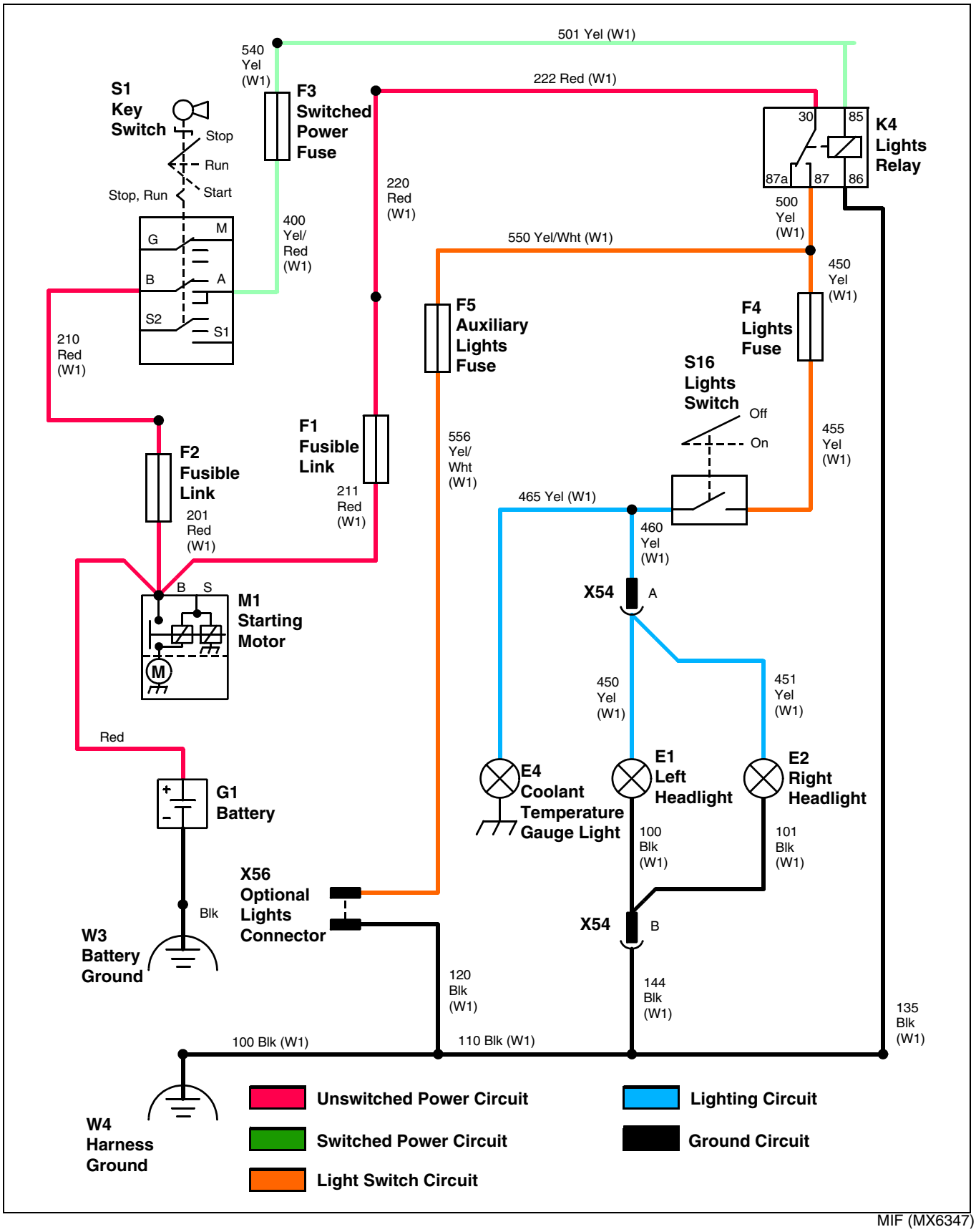
The coil of relay (K4) is connected to ground at terminal 86 (wires 135 black and 100 black). When the key switch is turned to the RUN position, current flows from key switch terminal A, through fuse (F3) (wire 400 yellow/red), then to relay (K4), terminal 85 (wires 540 and 501 yellow), energizing the relay.

With relay (K4) energized, power is available at lights switch (S16) (wires 500, 450, and 455 yellow) and to auxiliary light connector (X56) (wires 500 yellow, 550 yellow/white, and 556 yellow/white).

When switch (S16) is moved to the ON position, current flows to connector (X54) (wire 460 yellow). From connector (X54) current flows to left headlight (E1) (wire 450 yellow) and to right headlight (E2) (wire 451 yellow). Current also flows to coolant temperature gauge light (E4) (wire 465 yellow) to provide backlighting for the gauge.

The ground path for headlights (E1 and E2) is provided by connector (X54) (wires 100 and 101 black) to machine ground (wires 144, 110, and 100 black).

The ground path for auxiliary light connector (X56) to machine ground is through wires 120, 110, and 100 black.


501 Yel (W1)
540 Yel (W1)
222 Red (W1)
S1 Key Switch
Stop
Run
Start
Stop, Run
F3 Switched Power Fuse
30
85
87a
87
86
K4 Lights Relay
220 Red (W1)
500 Yel (W1)
400 Yel/ Red (W1)
G
M
B
A
S2
S1
550 Yel/Wht (W1)
450 Yel (W1)
F5 Auxiliary Lights Fuse
F4 Lights Fuse
S16 Lights Switch
Off
On
210 Red (W1)
F1 Fusible Link
556 Yel/ Wht (W1)
455 Yel (W1)
F2 Fusible Link
211 Red (W1)
201 Red (W1)
465 Yel (W1)
460 Yel (W1)
B
S
M1 Starting Motor
X54
A
450 Yel (W1)
451 Yel (W1)
Red
E4 Coolant Temperature Gauge Light
E1 Left Headlight
E2 Right Headlight
G1 Battery
100 Blk (W1)
101 Blk (W1)
X56 Optional Lights Connector
Blk
W3 Battery Ground
X54
B
120 Blk (W1)
144 Blk (W1)
135 Blk (W1)
100 Blk (W1)
110 Blk (W1)
W4 Harness Ground
Unswitched Power Circuit
Lighting Circuit
Switched Power Circuit
Ground Circuit
Light Switch Circuit

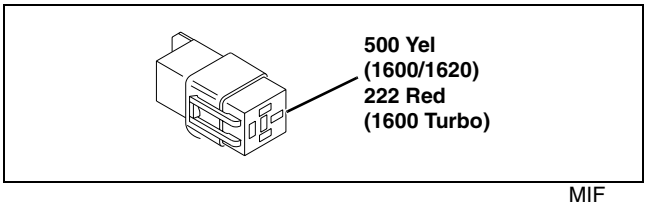
MIF (MX6347)

Lighting Circuit Diagnosis

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in RUN position with engine OFF.
- Light switch in OFF position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Lighting Circuit Diagnosis

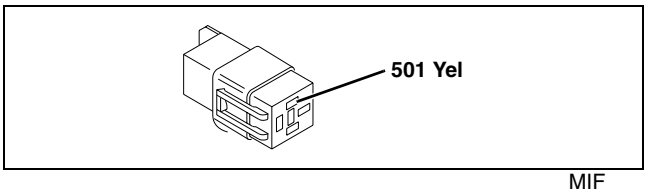


MIF

(1) Lights Relay (K4) - Terminal 30. Is battery voltage present?

Yes - Go To Step (2)

No - Models 1600/1620, test light fuse (F4), and wires 211 red (fusible link F1), 222 red, and 500 yellow. (See “Unswitched Power Circuit Diagnosis” on page 241.) Model 1600 Turbo, test wires 211 red (fusible link F1), 220 red, and 222 red. (See “Unswitched Power Circuit Diagnosis” on page 241.)



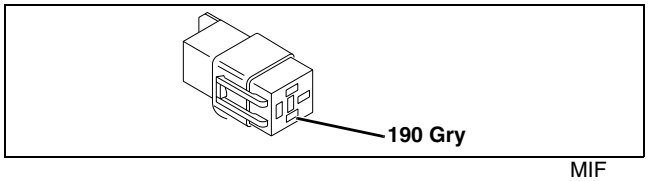
MIF

(2) Lights Relay (K4) - Terminal 85. Is battery voltage present?

Yes - Models 1600/1620, Go To Step (3). Model 1600 Turbo, Go To Step (4).

No - Test wire 501 yellow and connections. (See “Switched Power Circuit Diagnosis” on page 242.)

System: Lighting Circuit Diagnosis

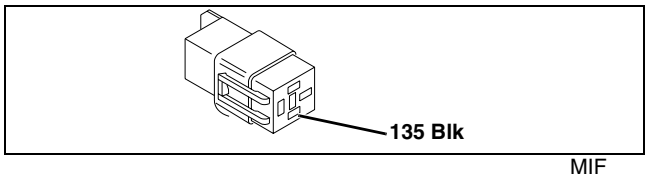


MIF

(3) Lights Relay (K4) - Terminal 86, Wire 190 Gray. Is battery voltage present?

Yes - Go To Step (5)

No - Test lights relay (K4). (See “Relay Test” on page 363.)

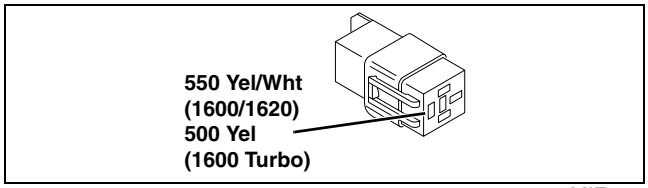


MIF

(4) Key switch in STOP position.
Lights Relay (K4) - Terminal 86, Wire 135 Black. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?

Yes - Go To Step (5)

No - Test wires 135, 110, and 100 black, and connections.



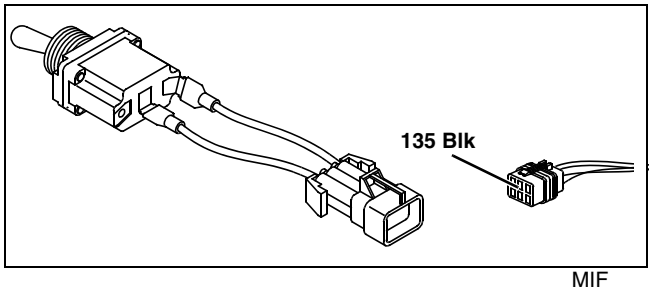
MIF

(5) Key switch in RUN position with engine OFF. Light switch in ON position (Models 1600/1620 only).
Lights Relay (K4) - Terminal 87, Wire 550 or 500 Yellow. Is battery voltage present?

Yes - Models 1600/1620, Go To Step (6). Model 1600 Turbo, Go To Step (7).

No - Test lights relay (K4). (See “Relay Test” on page 363.)

System: Lighting Circuit Diagnosis

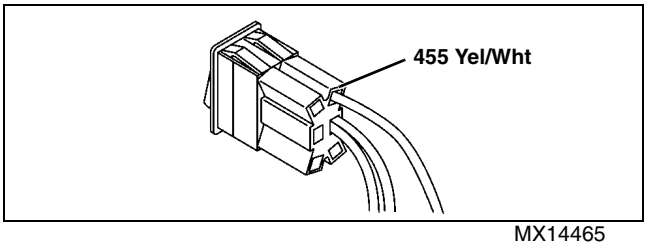


MIF

**(6) Headlight switch disconnected.
Key switch in STOP position.
Light Switch in OFF position.
Lights Switch (S16) - Wire 135 Black. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?**

Yes - Go To Step (9)

No - Test wires 135 and 110 black. Test headlight switch. (See “Headlight Switch Test” on page 369.)



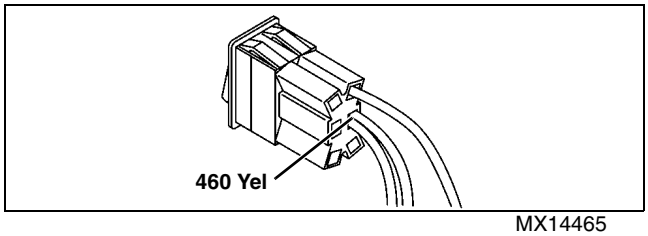
MX14465

**(7) Key switch in RUN position with engine OFF.
Lights Switch (S16) - Terminal A, Wire 455 Yellow/White. Is battery voltage present?**

Yes - Go To Step (8)

No - Test lights fuse (F4). Test wires 450 yellow and 455 yellow/white.

System: Lighting Circuit Diagnosis

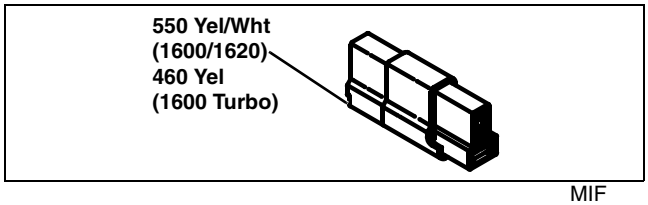


MX14465

**(8) Key switch in RUN position with engine OFF.
Light switch in ON position.
Lights Switch (S16) - Terminal C, Wire 460 Yellow. Is battery voltage present?**

Yes - Go To Step (9)

No - Test headlight switch. (See “Headlight Switch Test” on page 369.)

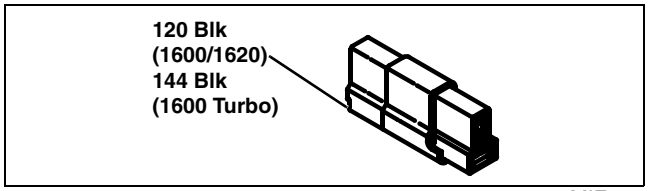


MIF

**(9) Key switch in RUN position with engine OFF.
Light switch in ON position.
Main Harness to Lights Harness Connector X54 - Terminal A, Wire 550 Yellow/White or 460 Yellow. Is battery voltage present?**

Yes - Go To Step (10)

No - Models 1600/1620, test wire 550 yellow/white and connector. Model 1600 Turbo, test wire 460 yellow and connector.



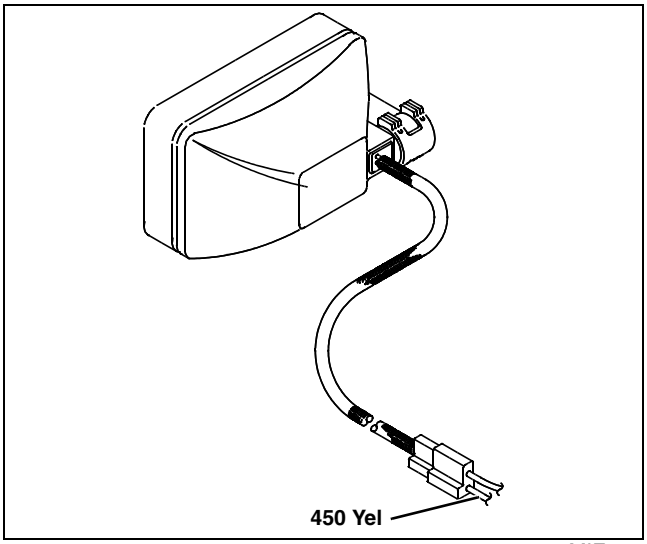
MIF

**(10) Key switch in STOP position.
Main Harness to Lights Harness Connector X54 - Terminal B, Wire 120 or 144 Black. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?**

Yes - Go To Step (11)

No - Models 1600/1620, test wires 120, 110, and 100 black, and connections. Model 1600 Turbo, test wires 144, 110, and 100 black, and connections.

System: Lighting Circuit Diagnosis

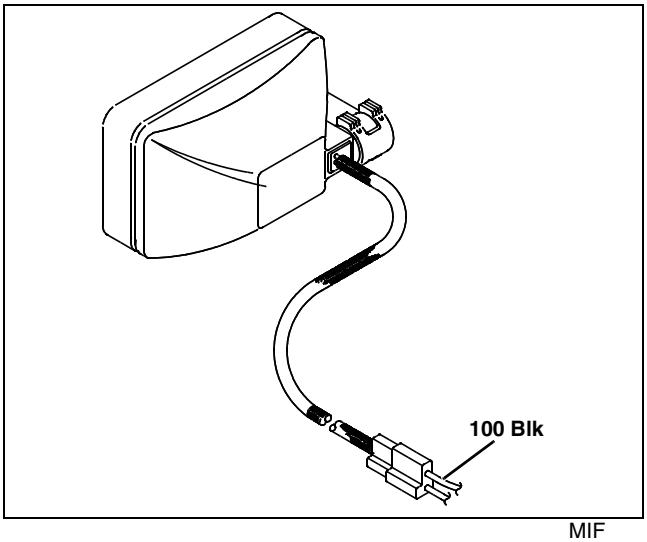


MIF

(11) Key switch in RUN position with engine OFF.
Light switch in ON position.
Left Headlight (E1) - Wire 450 Yellow. Is battery voltage present?

Yes - Go To Step (12)

No - Test wire 450 yellow and connections.



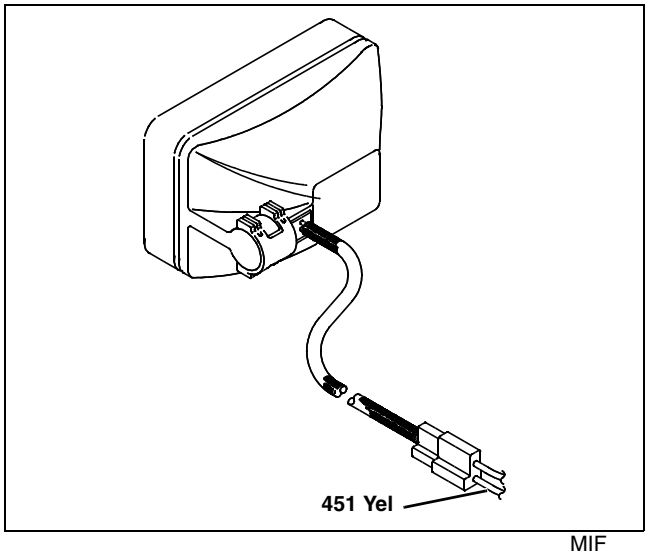
MIF

(12) Key switch in STOP position.
Left Headlight (E1) - Wire 100 Black. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?

Yes - Go To Step (13)

No - Test wire 100 black and connections.

System: Lighting Circuit Diagnosis

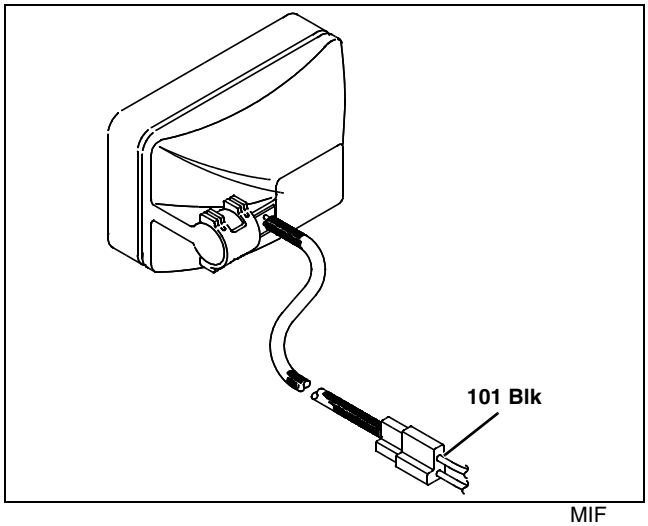


MIF

(13) Key switch in RUN position with engine OFF.
Light switch in ON position.
Right Headlight (E2) - Wire 451 Yellow. Is battery voltage present?

Yes - Go To Step (14)

No - Test yellow wire 451 and connections.



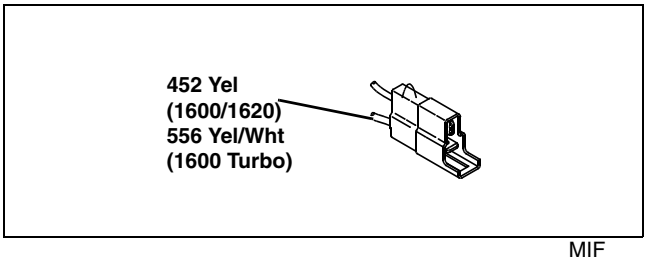
MIF

(14) Key switch in STOP position.
Right Headlight (E2) - Wire 101 Black. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?

Yes - Go To Step (15)

No - Test wire 101 black and connections.

System: Lighting Circuit Diagnosis

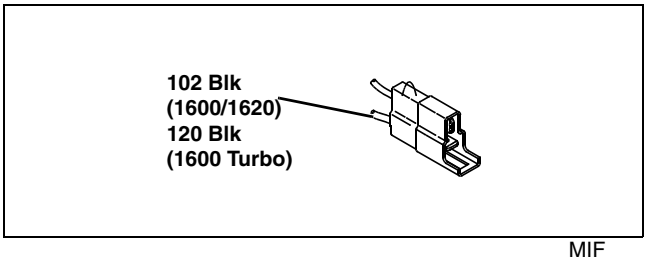


MIF

(15) Key switch in RUN position with engine OFF.
Light switch in ON position (Models 1600/1620 only).
Optional Lights Connector X56 - Terminal A, Wire 452 Yellow or 556 Yellow/White. Is battery voltage present?

Yes - Go To Step (16)

No - Models 1600/1620, test wire 452 yellow [W2] and connections. Model 1600 Turbo, test auxiliary lights fuse (F5). Test wires 556 yellow/white and 550 yellow/white.



MIF

A - Key switch in STOP position.

(16) Optional Lights Connector X56 - Terminal B. Check ground circuit for resistance. Is there less than 0.1 ohm of resistance?

No - Models 1600/1620, test wire 102 black and connections. Model 1600 Turbo, test wire 120 black and connections.

Cruise Control Circuit Operation - Model 1600 Turbo

Function

To provide a means of keeping the speed of the machine constant without the need of having the operator's foot on the forward hydrostatic control pedal.

The circuit controls an electromagnet that, when energized, holds the forward hydrostatic control pedal at the desired position.

Operating Conditions

- Key switch in RUN position.
- Operator on seat.
- Cruise control switch in the SET or ON position.
- Park brake disengaged (UNLOCKED).

Theory of Operation

NOTE: To engage the cruise control, the cruise control switch must be first moved to the SET position to latch the circuit.

The power circuit provides current to key switch (S1) and protects the circuit with fusible link (F2) and 15-amp switched power fuse (F3). Current flows from the battery (G1) positive (+) terminal to fusible link (F2) and then to the key switch (S1), terminal B (wires 201 red and 210 red).

When the key switch is in the RUN position, current flows from terminal A of the key switch, through wire 400 yellow/red, switched power fuse (F3), then to the following:

- Electronic control module (A3) connector X25, terminal D (wire 532 yellow).
- Cruise control switch (S20), terminal 5 (wire 553 yellow).
- Cruise control magnet (Y9) (wire 554 yellow).
- Park brake lock switch (S8) (wires 551 and 552 yellow).
- Seat switch (S3) (wire 539 yellow).

With the operator on the seat, current flows from the seat switch, through wire 820 gray to electronic control module connector (X24), terminal J.

With the park brake disengaged (UNLOCKED), current flows from the park brake lock switch, through wire 746 purple to terminal J of electronic control module connector (X28).

With the cruise control switch at the ON position, current flows through wire 781 gray to electronic control module connector (X25), terminal E.

With the cruise control switch at the momentary SET position, current flows through wire 781 gray to electronic control module connector (X25), terminal E. Current also flows through wire 782 pink to electronic control module connector (X24), terminal C.

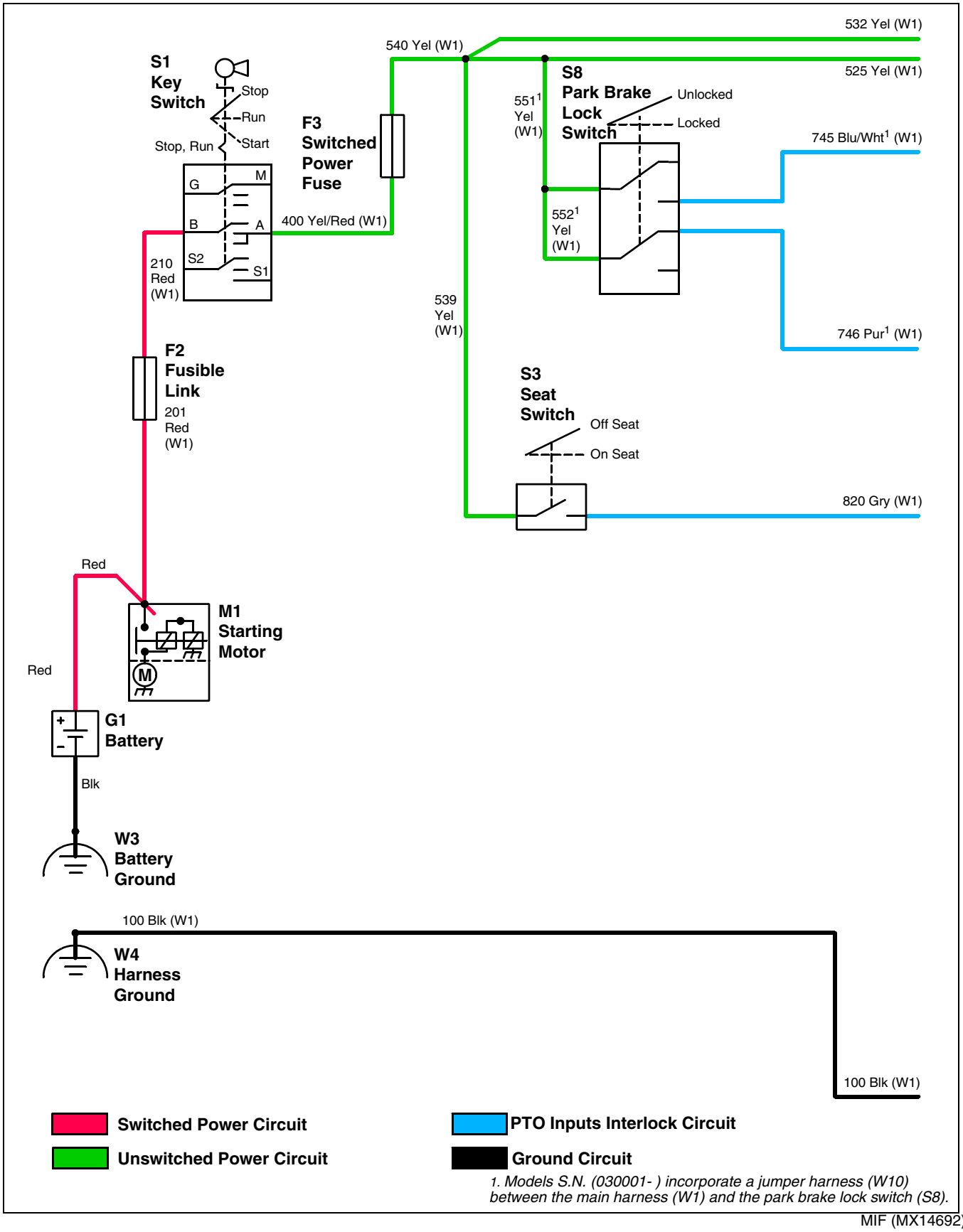
When the electronic control module receives the appropriate inputs, the control module will supply a ground path to cruise control electromagnet (Y9) (wire 780 pink), energizing the magnet.

When energized, the magnet pushes against the arm of the forward hydrostatic control pedal, thus holding the pedal at the desired position.

The cruise control will stay activated unless any of the following should occur:

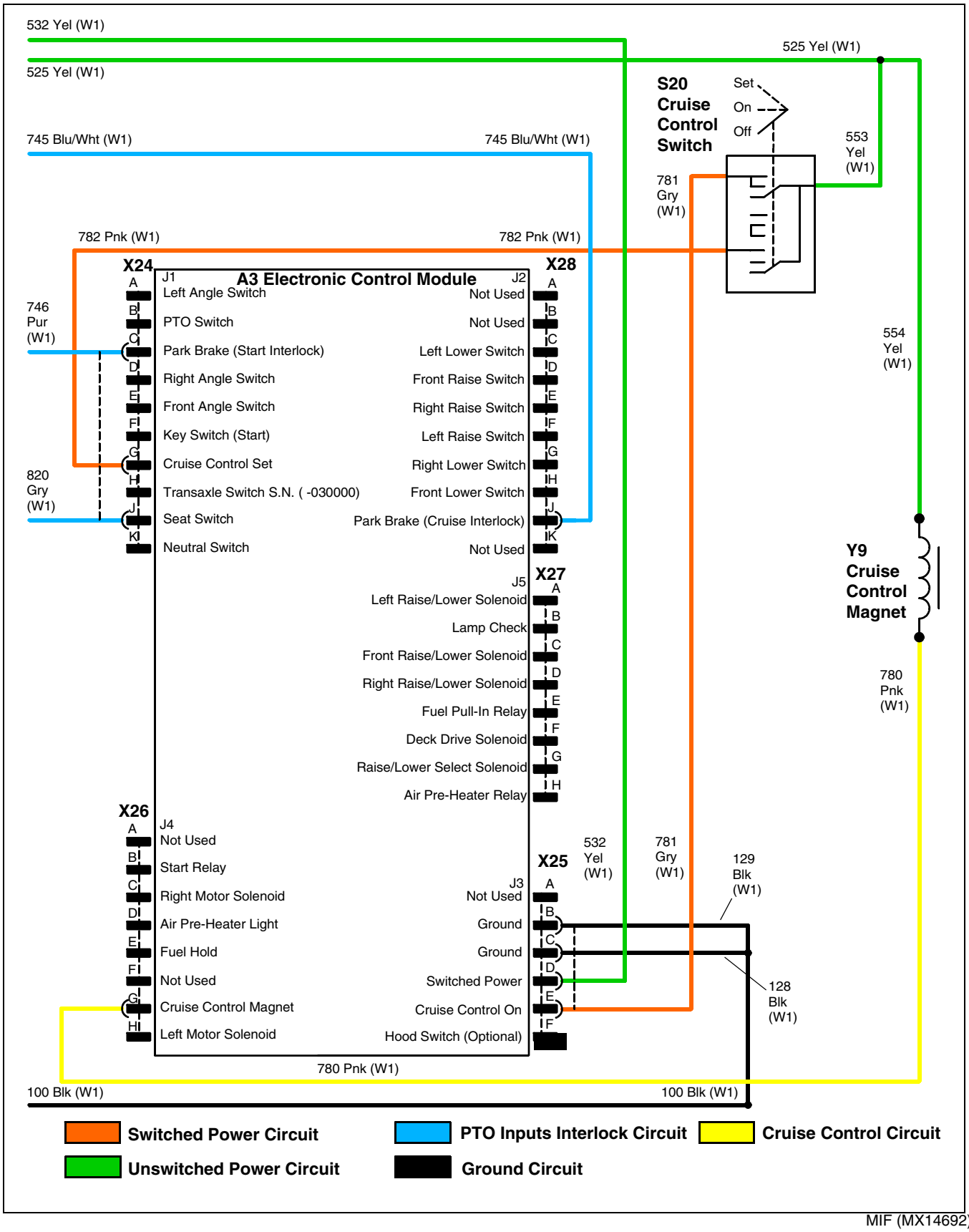
- Cruise control switch moved to the OFF position.
- Park brake is engaged [this stops current flow to terminal J of control module connector (X28)].
- Operator rises from the seat.
- Key switch turned to the OFF position.

Cruise Control Circuit Schematic - Model 1600 Turbo



1. Models S.N. (030001-) incorporate a jumper harness (W10) between the main harness (W1) and the park brake lock switch (S8).

MIF (MX14692)


532 Yel (W1)
525 Yel (W1)
525 Yel (W1)
745 Blu/Wht (W1)
745 Blu/Wht (W1)
782 Pnk (W1)
782 Pnk (W1)
S20 Cruise Control Switch
Set
On
Off
553 Yel (W1)
781 Gry (W1)
554 Yel (W1)
Y9 Cruise Control Magnet
780 Pnk (W1)
746 Pur (W1)
820 Gry (W1)
X24
X28
A3 Electronic Control Module
J1
J2
Left Angle Switch
PTO Switch
Park Brake (Start Interlock)
Right Angle Switch
Front Angle Switch
Key Switch (Start)
Cruise Control Set
Transaxle Switch S.N. (-030000)
Seat Switch
Neutral Switch
Not Used
Not Used
Left Lower Switch
Front Raise Switch
Right Raise Switch
Left Raise Switch
Right Lower Switch
Front Lower Switch
Park Brake (Cruise Interlock)
Not Used
X27
J5
Left Raise/Lower Solenoid
Lamp Check
Front Raise/Lower Solenoid
Right Raise/Lower Solenoid
Fuel Pull-In Relay
Deck Drive Solenoid
Raise/Lower Select Solenoid
Air Pre-Heater Relay
X26
J4
Not Used
Start Relay
Right Motor Solenoid
Air Pre-Heater Light
Fuel Hold
Not Used
Cruise Control Magnet
Left Motor Solenoid
X25
J3
Not Used
Ground
Ground
Switched Power
Cruise Control On
Hood Switch (Optional)
532 Yel (W1)
781 Gry (W1)
129 Blk (W1)
128 Blk (W1)
780 Pnk (W1)
100 Blk (W1)
100 Blk (W1)
Switched Power Circuit
PTO Inputs Interlock Circuit
Cruise Control Circuit
Unswitched Power Circuit
Ground Circuit

MIF (MX14692)

Cruise Control Circuit Diagnosis - Model 1600 Turbo

Diagnostics of circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

When diagnosing the cruise control circuit, it is important to perform the following steps in the sequence shown:

1. Electronic Control Module Checks. (See “Electronic Control Module Checks” on page 213.)

2. Input LEDs and Circuits Checks. (See “Input LEDs Circuits and Checks” on page 353.)

3. Cruise Control Circuit Tests. (See “Cruise Control Circuit Tests” on page 353.)

Input LEDs Circuits and Checks

NOTE: The following common input circuit checks are necessary when diagnosing the cruise control circuit. (See “Electronic Control Module Input LEDs and Common Circuits Checks” on page 214.)

Perform the following input circuit checks:

- Seat Switch
- Park Brake Lock Switch

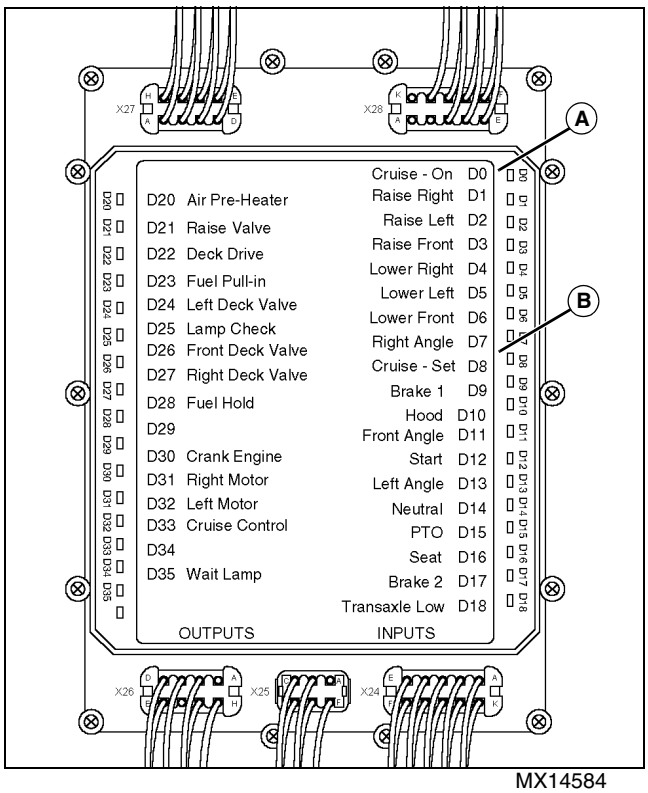
Cruise Control Circuit Tests

Cruise Control Switch Circuit Tests

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Park brake disengaged (UNLOCKED).
- Key switch in RUN position with engine OFF.
- Cruise control switch (S20) in the momentary SET position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Cruise Control Switch Circuit Tests



MX14584

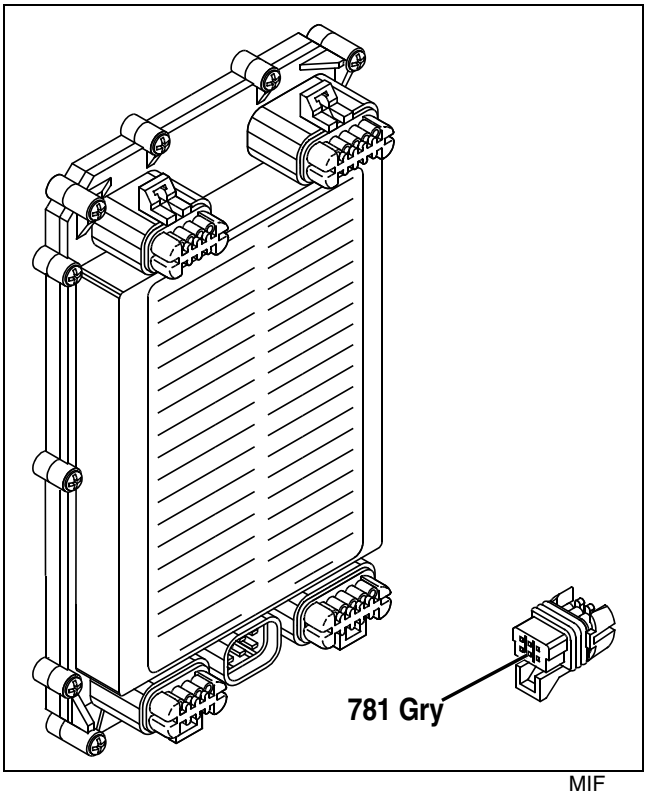
(1) Electronic Control Module (A3) - Cruise Control Switch ON Input LED D0 Cruise Control Switch SET Input LED D8. Is cruise control LED D0 (A) ON and SET LED D8 (B) ON?

Yes - See “Cruise Control Magnet Circuit Test” on page 355.

No - Cruise control ON LED D0: Go To Step (2).

No - Cruise control SET LED D8: Go To Step (3).

System: Cruise Control Switch Circuit Tests



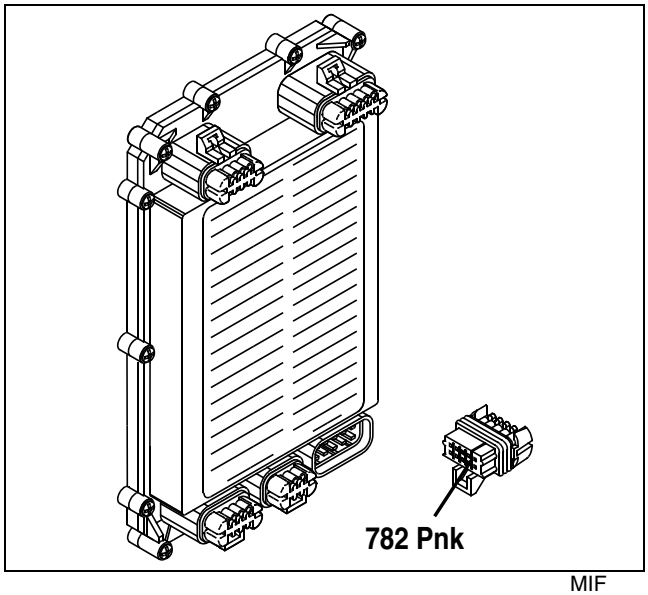
MIF

(2) Electronic Control Module Connector X25 disconnected.
Meter negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when testing.
Electronic Control Module (A3) - Connector X25 - Terminal E, Wire 781 Gray. Is battery voltage present?

Yes - Replace electronic control module.

No - Go To Step (4)

System: Cruise Control Switch Circuit Tests

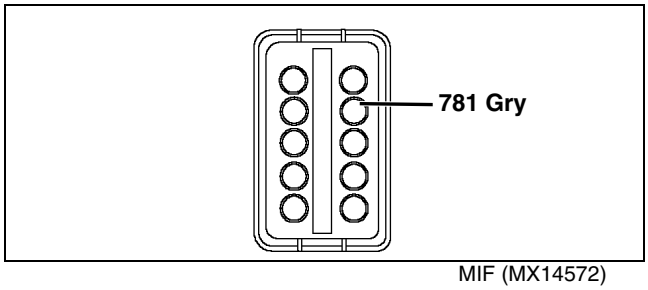


MIF

(3) Meter negative (-) lead on battery negative (-) terminal or chassis ground.
Electronic Control Module Connector X24 disconnected.
Check connections for corrosion and looseness when testing.
Electronic Control Module (A3) - Connector X24 - Terminal G, Wire 782 pink. Is battery voltage present?

Yes - Replace electronic control module.

No - Go To Step (5)



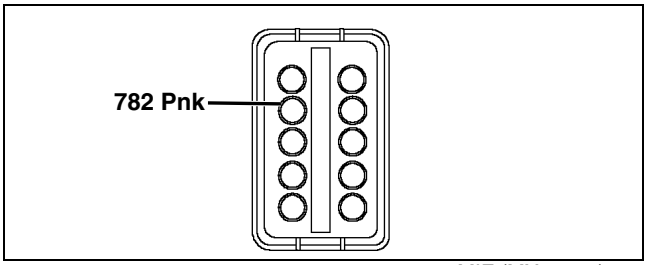
MIF (MX14572)

(4) Cruise Control Switch (S20) - Wire 781 Gray. Is battery voltage present?

Yes - Test wire 781 gray and connections.

No - Go To Step (6)

System: Cruise Control Switch Circuit Tests

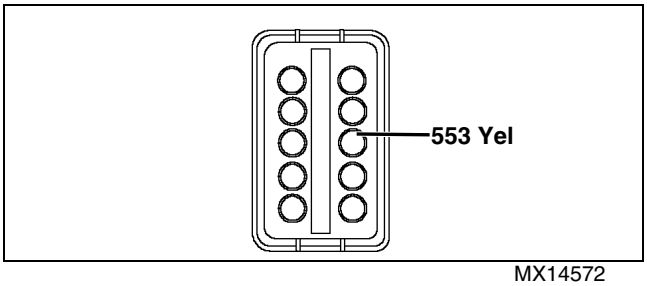


MIF (MX14572)

(5) Cruise Control Switch (S20) - Wire 782 Pink. Is battery voltage present?

Yes - Test wire 782 pink and connections.

No - Go To Step (6)



MX14572

(6) Cruise Control Switch (S20) - Wire 553 Yellow. Is battery voltage present?

Yes - Test cruise control switch. (See “Cruise Control Switch Test - Model 1600 Turbo” on page 374.)

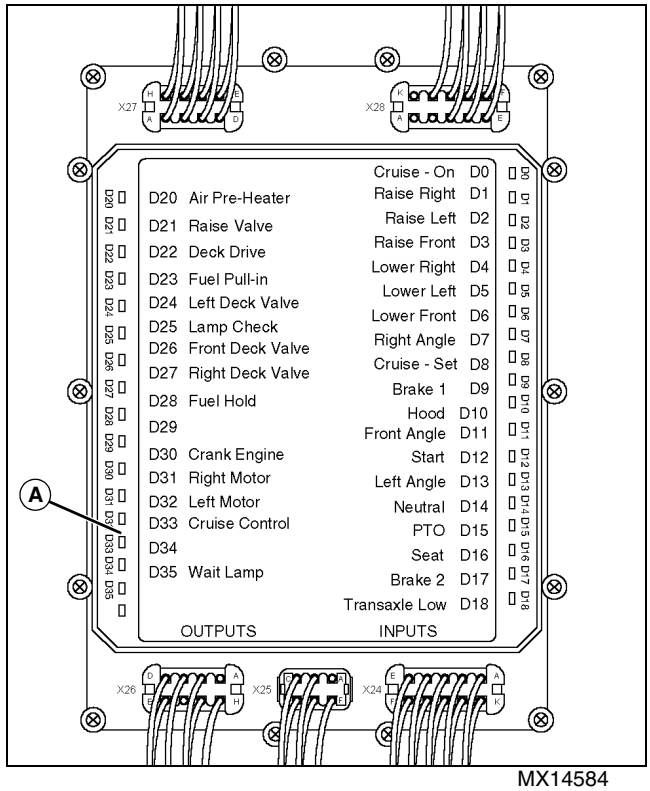
No - Test wire 553 yellow. (See “Switched Power Circuit Diagnosis” on page 242.)

Cruise Control Magnet Circuit Test

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Operator ON seat.
- Park brake disengaged (UNLOCKED).
- Key switch in RUN position with engine OFF.
- Cruise control switch (S20) in ON position. Push switch to momentary SET position, then release.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when testing.

System: Cruise Control Magnet Circuit Test



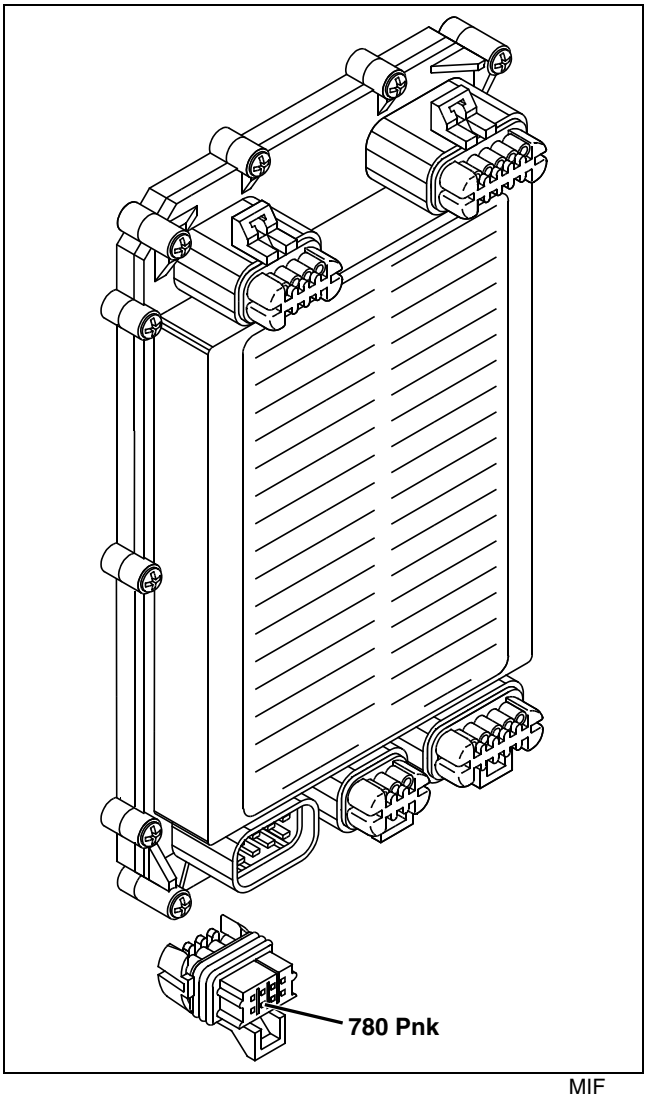
MX14584

(1) Electronic Control Module (A3) - Cruise Control Magnet Output LED D33. Is cruise control magnet output LED D33 (A) ON?

Yes - Go To Step (2)

No - Replace electronic control module.

System: Cruise Control Magnet Circuit Test



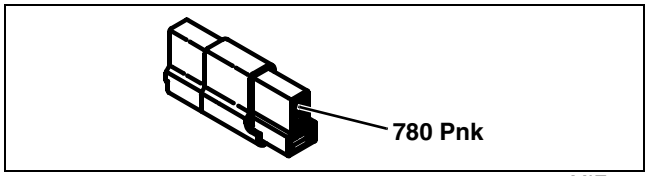
MIF

(2) Electronic Control Module Connector X26 disconnected.
Meter negative (-) lead on battery negative (-) terminal or chassis ground.
Check connections for corrosion and looseness when testing.
Electronic Control Module (A3) - Connector X26 - Terminal G, Wire 780 Pink. Is battery voltage present?

Yes - Test cruise control magnet (Y9). (See "Cruise Control Magnet Test - Model 1600 Turbo" on page 375.)

No - Go To Step (3)

System: Cruise Control Magnet Circuit Test

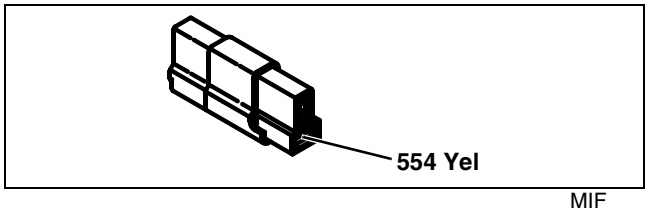


MIF

(3) Cruise Control Magnet (Y9) - Wire 780 Pink. Is battery voltage present?

Yes - Test wire 780 pink and connections.

No - Go To Step (4)



MIF

(4) Cruise Control Magnet (Y9) - Wire 554 Yellow. Is battery voltage present?

Yes - Test cruise control magnet (Y9). (See "Cruise Control Magnet Test - Model 1600 Turbo" on page 375.)

No - Test wire 554 yellow and connections. (See "Switched Power Circuit Diagnosis" on page 242.)

Tests and Adjustments

Ground Circuit Test

Reason

To check for open circuits, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

NOTE: The 1600 Wide Area Mower uses a "switched ground" system. Not all components are grounded directly to the battery. Most circuits/components are grounded through the control module; therefore, this test will not work for these circuits/components.

This test can be used to test the following components:

- ***Fuel Gauge Sender Unit***
- ***Headlights***
- ***Hour Meter***
- ***Light Switch***
- ***Fuel Solenoid***
- ***Temperature Gauge (1600 Turbo)***

Special or Required Tools

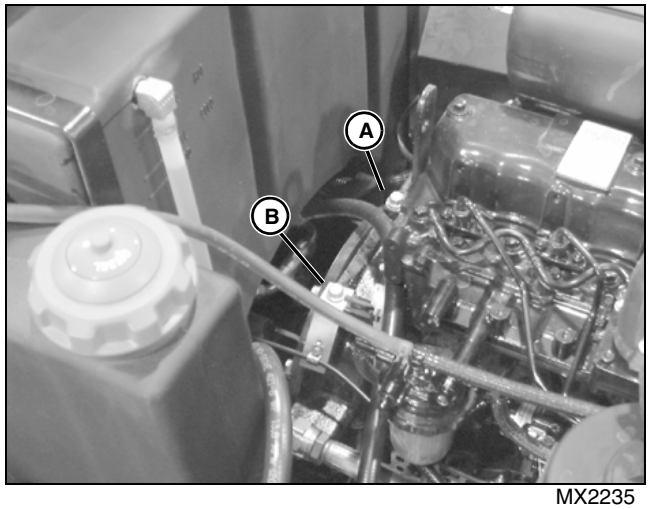
Tool Name	Tool No.	Tool Use
Ohmmeter or Voltmeter	NA	Used to test and measure continuity.

Procedure - Ohmmeter Method

1. Park machine safely. (See "Park Machine Safely" on page 3.)

2. Raise hood.

3. Connect ohmmeter negative (black) lead to negative (-) terminal of battery. Connect meter positive (red) lead to negative (-) terminal of battery and record reading.



MX2235

A - Battery Ground Connection

B - Harness Ground Connection

4. Connect ohmmeter red lead to ground terminal of circuit or component to be tested that is closest to the battery negative terminal. Resistance reading must be the same or very close to the battery negative terminal reading. Work backward from the battery on the ground side of the problem circuit until the resistance reading increases to above 0.1 ohm. The problem is between the last two test points. If a problem is indicated, disconnect the wiring harness connector to isolate the wire or component and check resistance again. Maximum allowable resistance in the circuit is 0.1 ohm. Check both sides of the connectors closely, as disconnecting and connecting may temporarily solve the problem.

Procedure - Voltmeter Method

NOTE: The voltmeter method checks ground connections under load.

1. Park machine safely. (See "Park Machine Safely" on page 3.)

2. Raise hood.

3. Connect voltmeter negative (black) lead to negative terminal of battery.

4. Connect voltmeter positive (red) lead to ground terminal of circuit or component to be tested. Be sure that component circuit is activated (key ON, switches CLOSED) so that voltage will be present at the component. Record voltage. Voltage must be greater than 0, but less than 1 volt. Some components will have a very small voltage reading on the ground side and still be operating correctly.

- If voltage is 0, the component is open.
- If voltage is greater than 1 volt, the ground circuit is bad. Check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

Battery Test

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

Avoid the hazard by:

- **Filling batteries in a well-ventilated area.**
- **Wearing eye protection and rubber gloves.**
- **Avoiding breathing fumes when electrolyte is added.**
- **Avoiding spilling or dripping electrolyte.**
- **Using proper jump start procedure.**

If you spill acid on yourself:

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

If acid is swallowed:

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

Reason

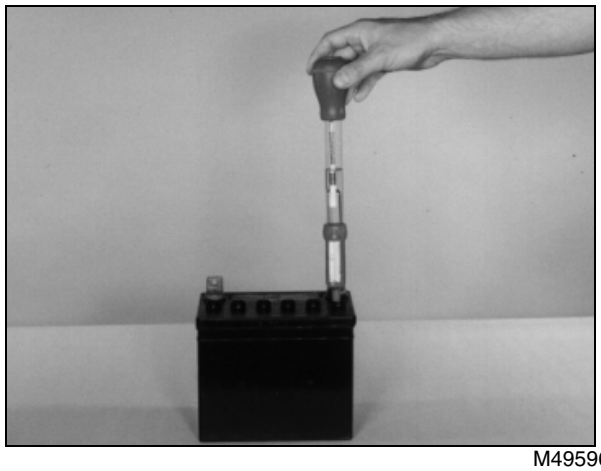
To check condition of battery and determine battery voltage.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hydrometer	NA	Used to measure specific gravity of battery electrolyte.
Voltmeter or Battery Tester	JT05685	Used to measure battery voltage.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.
3. Clean cable ends, battery terminals and top of battery.
4. Remove battery.
5. Inspect battery terminals and case for breakage or cracks.
6. Check electrolyte level in each battery cell. Add clean, distilled water as needed. If water is added, charge battery for 20 minutes at 10 amps.



M49596

7. Use a hydrometer to check specific gravity of each cell of battery. Specific gravity should be within specifications.
   - If all cells are less than 1.175, charge battery at 10-amp rate.
   - If all cells are less than 1.225 with less than 50-point variation, charge battery at 10-amp rate.
   - If all cells are more than 1.225 with less than 50-point variation, load test battery.
   - If more than 50- point variation between cells, replace battery.
8. Use a voltmeter or JT05685 Battery Tester to check battery voltage. Voltage should be 12.4 VDC minimum.
   - If battery voltage is less than 12.4 VDC, charge battery.
   - If battery voltage is more than 12.4 VDC, test specific gravity (see previous step).
9. Install battery.

Specifications

Battery

Specific Gravity (Min) 1.225

Maximum Variation of Specific Gravity between Cells . . . . . .50 points

Charge Battery

Reason

To increase battery charge after the battery has been discharged.

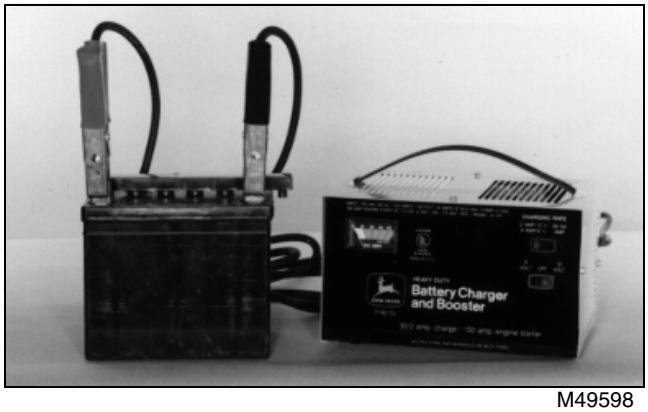
Special or Required Tools

Tool Name	Tool No.	Tool Use
Battery Charger (Variable Rate)	NA	To charge the battery.

Procedure

NOTE: Before charging battery, See "Battery Test" on page 358.

1. Park machine safely. (See "Park Machine Safely" on page 3.)
2. Raise hood.
3. Clean cable ends, battery terminals and top of battery.
4. Remove battery.



M49598

5. Connect variable rate charger to battery.
6. 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.
7. Check if battery is accepting 10-amp charge rate after 10 minutes at boost setting.
   - If battery WILL NOT accept 10-amp charge after 10 minutes at boost setting, replace battery.
8. Set charger at 15-25 amps.

IMPORTANT: Avoid damage! Decrease charge rate if battery gases or bubbles excessively or becomes too warm to touch.

9. Check specific gravity after 30 minutes (60 minutes for maintenance-free battery).
   - If MORE THAN 50-point variation between cells, replace battery.
   - If LESS THAN 50-point variation between cells, go to next step.

NOTE: If battery was discharged at slow or unknown rate, charge battery at 10-15 amps for 6-12 hours (4-8 hours for maintenance-free battery).

10. Continue to charge battery until specific gravity is within specifications.
11. Load test battery.
12. Install battery.

Specifications

Battery Specific Gravity after Charging 1.230-1.265

Battery Load Test

Reason

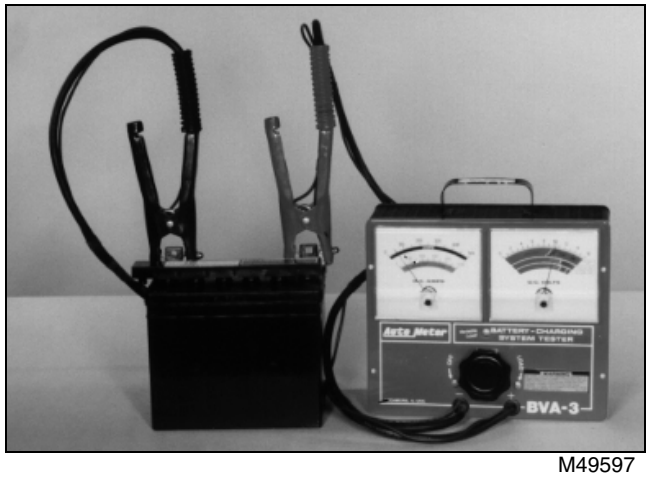
To check condition of battery under load.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Battery Tester	JT05685	To test battery under load.

Procedure

1. Park machine safely. (See "Park Machine Safely" on page 3.)
2. Raise hood.
3. Clean cable ends, battery terminals and top of battery.
4. Remove battery.



M49597

5. Turn load knob counterclockwise to OFF position.

6. Connect JT05685 Battery Tester positive (red) cable to battery positive (+) terminal.

7. Connect tester negative (black) cable to battery negative (-) terminal.

8. Turn load knob of tester clockwise (in) until amperage reading is equal to:

- cold cranking amperage rating of battery (use blue scale).

or

- three times ampere-hour rating (use black scale).

9. Hold for 15 seconds and turn load knob of tester counterclockwise (out) to OFF position.

10.Repeat steps 8 and 9 above and read condition of battery at DC volts scale.

Results

- If battery DOES NOT pass test and has NOT been charged, charge battery and retest.
- If battery DOES NOT pass test and HAS BEEN charged, replace battery.

Unregulated Amperage Test

Reason

To determine charging output of the alternator stator.

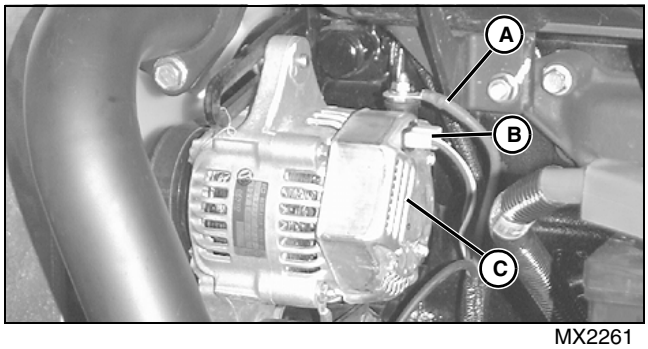
Special or Required Tools

Tool Name	Tool No.	Tool Use
Current Gun (with 60 Amp Capacity)	NA	Used to measure alternator output current.

Procedure

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

2. Raise hood.



MX2261

3. Put current gun over alternator red wire (A). Set current gun for DC current.

IMPORTANT: Avoid damage! Perform this test quickly to prevent damage to battery. DO NOT apply full load to battery for more than 10 seconds.

4. Start and run engine at FAST idle.

5. Insert a Phillips screwdriver through hole (C) in rear cover of alternator, to ground the regulator to the rear cover. Read unregulated amperage on current gun. Reading should be to specification.

Results

- If reading does not meet specifications, verify battery voltage at yellow wire at alternator regulator terminal (B) and verify good alternator. If voltage and ground are OK, replace the alternator.
- If reading meets specifications, replace the regulator.

Specifications

Models 1600/1620

Alternator Unregulated Output (Min) . . . . . 35 amps

Model 1600 Turbo

Alternator Unregulated Output (Min) . . . . . 55 amps

Regulated Voltage Output Test

Reason

To check the regulated voltage (charging) output of the alternator.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Voltmeter	NA	Used to measure alternator output voltage.

Procedure

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

2. Raise hood.

3. Remove surface charge from battery by cranking the engine for 15 seconds.

4. Set voltmeter for 25 to 50 DC volt scale.

5. Connect meter red lead to battery positive (+) terminal.

6. Connect meter black lead to battery negative (-) terminal.

7. Start and run engine at FAST idle.

8. Read meter several times during 5 minutes of running time. Voltage should remain within specifications.

Results

If the DC voltage goes above the maximum specification, replace the alternator.

Specifications

Regulated Output Voltage . . . . . .12.2-14.7 VDC

Start Circuit Check

Conditions

- PTO switch in OFF position.
- Forward/reverse pedals in NEUTRAL position.
- Park brake engaged or operator on seat.

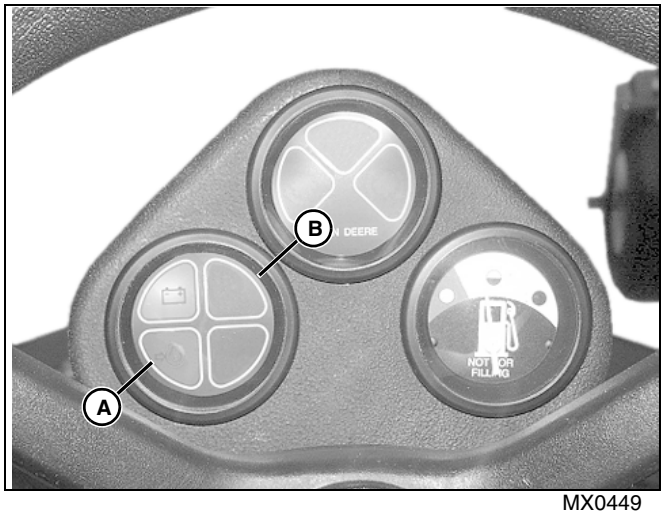
Procedure

1. Turn key switch to START position.

Normal

- The engine should crank and start.

If Not Normal



MX0449

- If the engine does not crank, hold the key switch in the START position. The oil pressure light (A) should remain lit and the pre-heat light (B) will begin to flash, indicating one of the following codes:

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

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

- **One pulse followed by a short pause, followed by two pulses (Code 1-2):** Indicates that the park brake switch is not activated and/or the seat switch is not activated (operator not on seat). Engage park brake and/or sit in seat and repeat check procedure.
- **One pulse followed by a short pause, followed by three pulses (Code 1-3):** Indicates that the PTO switch is activated. Move PTO switch to the OFF position and repeat check procedure.
- **Two pulses followed by a short pause, followed by one pulse (Code 2-1):** Indicates that the FORWARD/REVERSE pedals are not in the NEUTRAL position. Move the FORWARD/REVERSE pedals to NEUTRAL position and repeat check procedure.
- **Two pulses followed by a short pause, followed by three pulses (Code 2-3):** Indicates that the hood switch is not activated (European machines) or jumper wire is missing from hood switch connector (North American machines).
- If there is no response to the key switch and no codes indicated as described above, proceed to See “Electronic Control Module Checks” on page 213

Starting Motor Loaded Amperage Draw Test

Reason

To determine the amperage required to crank the engine and check the starting motor operation under load.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Current Clamp	JT02153	Used to measure starting motor current draw.
Voltmeter	NA	Used with current clamp to measure starting motor current draw.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.
3. Test system ground circuit connections.
4. Test battery.
5. Remove surface charge by placing a small load on the battery for 15 seconds.
6. Connect JT02153 Current Clamp around battery positive (+) cable.
7. Set voltmeter to DC amp scale.
8. Connect voltmeter to current clamp.

IMPORTANT: Avoid damage! Perform the following procedure within 15 seconds to prevent damage to electrical components.

9. Crank engine and read amperage on DC amp scale of voltmeter. Amperage draw should be to specifications.
10. Turn key switch to OFF position.

Results

- If amperage is above specifications, or rpm is low, check starter for binding or damage.
- If starter is good, check engine for internal binding or damage.

Specifications

Starting Motor Amperage Draw at 225 RPM (Max) . . . . . 180 amps

Starting Motor Solenoid Test

Reason

To determine if the starter solenoid or starting motor is defective.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.
3. Disconnect fuel shutoff solenoid wiring connector.



MX2339

4. Disconnect wire 747 purple (A) from starter solenoid.
5. Connect jumper wire to positive (+) battery terminal and briefly jump to starting motor tang.
   - Starting motor runs - Solenoid (and starting motor) is good. Test is complete.
   - Starting motor does not run - Go to next step.
6. Briefly connect jumper wire between large terminals of starter solenoid.
   - Starting motor runs - Replace solenoid.
   - Starting motor does not run - Check battery cables. If battery cables are good, replace starting motor.

Air Pre-Heater Test

Reason

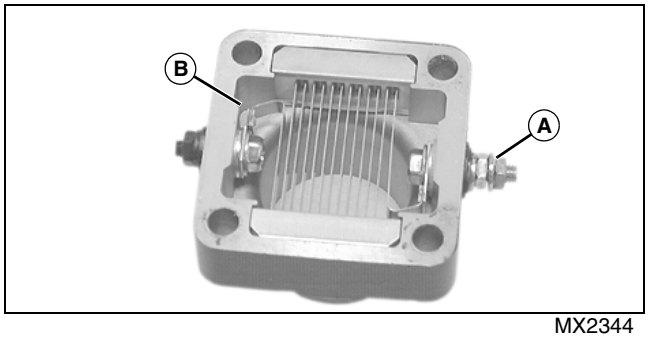
To test the condition of the engine air pre-heater.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter	NA	Used to measure the resistance of the air pre-heater element.

Procedure

1. Remove air pre-heater.



MX2344

2. Measure the resistance between terminal (A) and terminal (B). The reading should be to specifications.

Results

If the resistance of the air pre-heater element is high or completely open, replace the element.

Specifications

Air Pre-Heater Resistance (Max). . . . . 10 ohms

Relay Test

Reason

To check relay terminal continuity in the energized and de-energized conditions.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check relay continuity.

Procedure

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

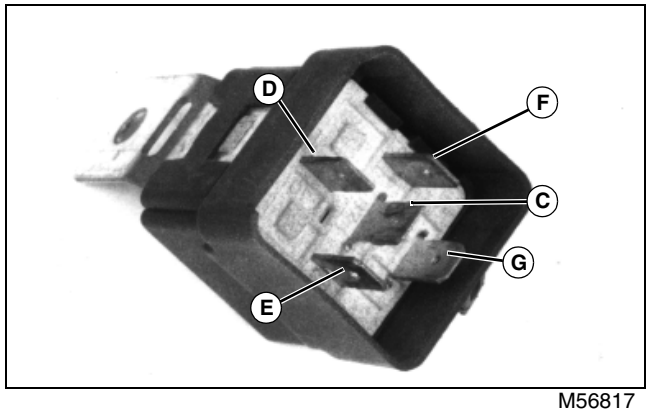


MX2225

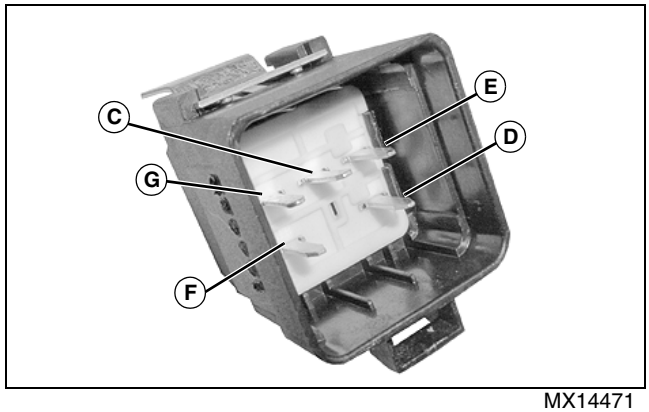
Picture Note: Models 1600/1620 S.N. (-20000) Shown

2. Remove access panel (A).
3. Remove relay.

NOTE: There are two types of relays used on the 1600 Wide Area Mower. Refer to the appropriate photograph for relay being tested.



M56817



MX14471

4. With relay de-energized:
   - Check continuity between terminals 87A (C) and 30 (D). There should be continuity.
   - Check continuity between terminals 30 (D) and 87 (G). There should NOT be continuity.

5. Energize relay by connecting a jumper wire from battery positive (+) to relay terminal 85 (E) and a jumper wire from relay terminal 86 (F) to ground (-).

6. With relay energized:

- Check continuity between terminals 30 (D) and 87 (G). There should be continuity.
- Check continuity between terminals 87A (C) and 30 (D). There should NOT be continuity.

Results

If continuity is not correct, replace relay.

Key Switch Test

Reason

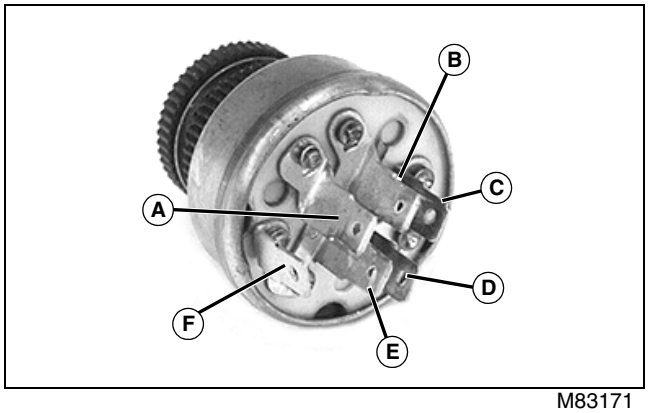
To verify key switch is operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check key switch continuity.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Move control levers to NEUTRAL position.
3. Turn key switch to OFF position.
4. Engage park brake.
5. Remove right-side control console cover.
6. Disconnect key switch connector.



M83171

7. Check key switch continuity in OFF, RUN, and START positions.

NOTE: DO NOT refer to markings if stamped on terminals. Identify by art keys ONLY. Terminal combinations other than those listed should not have continuity.

Key Switch Continuity

Switch Position	Terminal Continuity
OFF	C and D
RUN	E and F
START	E and F
	A and B

Results

If any continuity is not correct, replace the switch.

Park Brake Lock Switch Test - Models 1600 and 1620

Reason

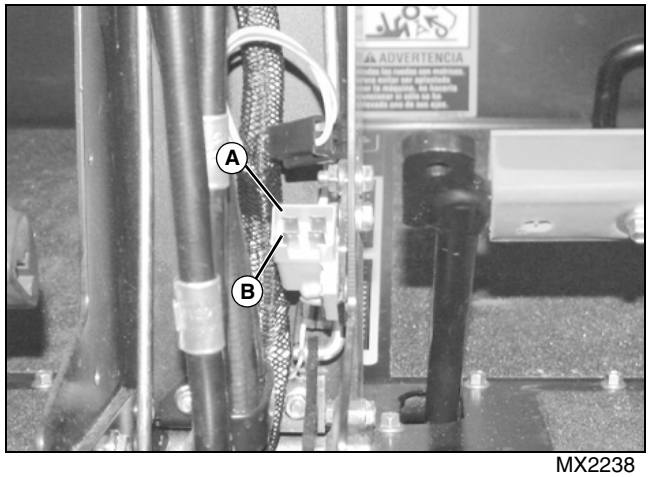
To verify brake switch is operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check park brake lock switch continuity.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Remove lower steering column cover.



MX2238

3. Park brake released.
4. Disconnect park brake lock switch connector.

5. Check continuity between terminals A and B. There should be NO continuity. There should be NO continuity between any other terminals.

6. Depress plunger.

7. Check continuity between terminals A and B. There should be no continuity.

Results

If continuity is not correct in either position, replace switch.

Park Brake Lock Switch Test - Model 1600 Turbo

Reason

To verify continuity between terminals when the switch is in the ON (depressed) and OFF (released) positions.

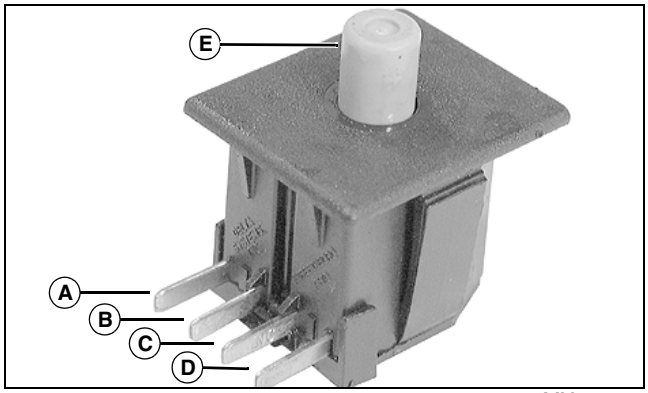
Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check park brake lock switch continuity.

Procedure

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

2. Remove park brake lock switch.



MX14461

3. With plunger (E) in the fully released position, check continuity between terminals (A and C), then between terminals (B and D).

- For terminals (A and C), there should be continuity.
- For terminals (B and D), there should be NO continuity.

4. Depress plunger (E) fully while checking continuity between terminals (A and C), then between terminals (B and D).

- For terminals (A and C), there should be NO continuity.
- For terminals (B and D), there should be continuity.

Results

If continuity is not correct in either position, replace switch.

Seat Switch Test

Reason

To verify continuity of seat switch when the operator is on the seat.

Special or Required Tools

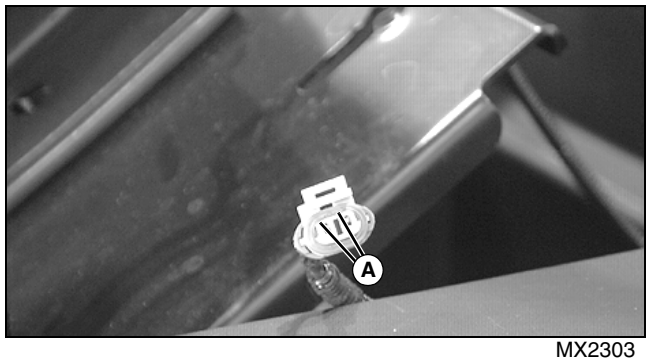
Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check seat switch continuity.

Procedure

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

2. Raise seat platform.

3. Disconnect seat switch connector.



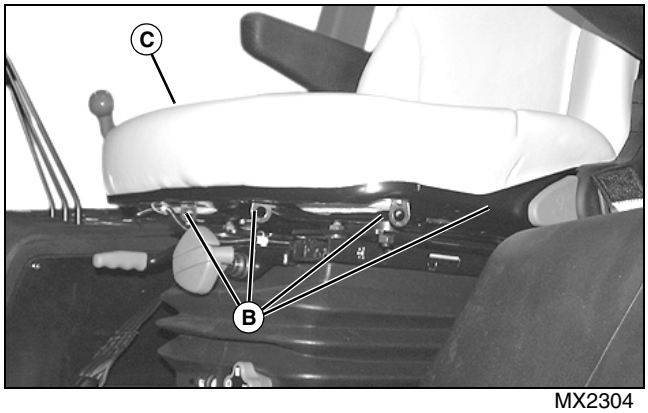
MX2303

4. Check continuity between connector terminals (A).

5. Depress the seat bottom to engage seat switch.

6. Check continuity between switch terminals (A).

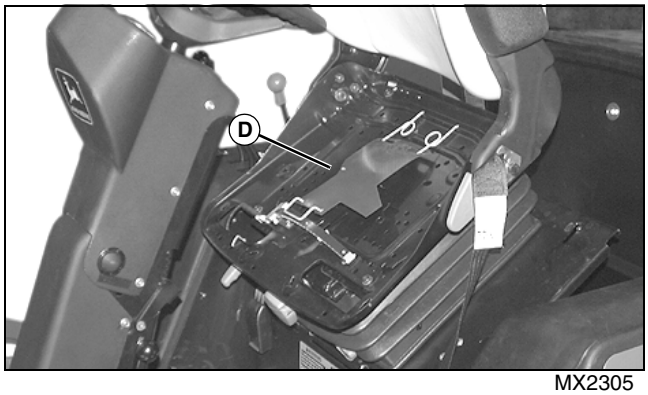
- If there is continuity, test is complete.
- If there is NO continuity, proceed to next step.



MX2304

7. Fold tabs (B) down and twist to align with slots in seat frame.

8. Remove seat cushion (C).



MX2305

9. Inspect the switch activator linkage (D). The linkage should be anchored at the rear of the frame and should move freely and activate the seat switch when pressure is applied.

- If the seat switch activator linkage is damaged or missing, repair or replace as needed.
- If the seat switch activator linkage is operating properly and there is NO continuity while activating the seat switch, replace seat switch.

Neutral Switch Test

Reason

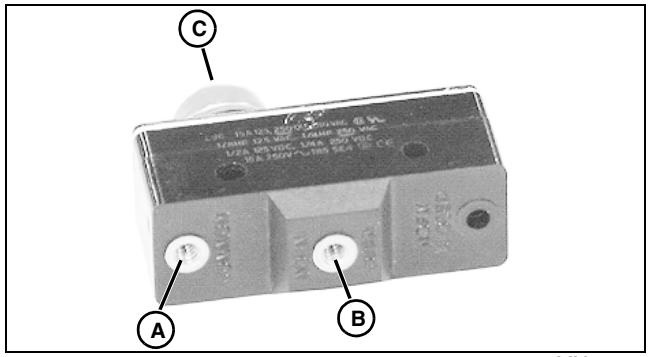
To verify continuity between the switch terminals when the forward/reverse pedals are placed in the neutral position.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter	NA	Used to check continuity of neutral switch.

Procedure

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



MX2444

2. Check continuity between switch terminals (A) and (B). There should be continuity.

3. Depress and hold the actuator (C).

4. Check continuity between switch terminals (A) and (B). There should be NO continuity.

Results

If continuity is not correct in either position, replace the switch.

Engine Oil Pressure Switch Test

Reason

To determine if the engine oil pressure switch is functioning properly to warn the operator if the oil pressure has dropped below safe operating pressure.

Other Material

Part No.	Part Name	Part Use
TY9375 (US) 592 (LOCTITE®) TY9480 (Canada)	Pipe Sealant with TEFLON®	Applied to threads of oil pressure switch before installation.

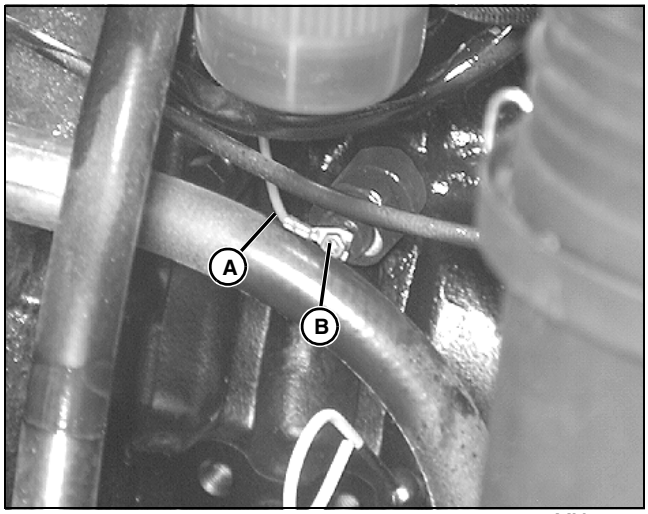
Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter	NA	Used to measure resistance between terminal and engine block.

Procedure

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

2. Raise hood.



MX2302

3. Disconnect wire (A) from oil pressure switch.

4. Connect black lead of ohmmeter to engine block and red lead of ohmmeter to terminal (B) of switch.

5. Set ohmmeter for 1x scale.

6. Measure resistance between terminal on oil pressure switch and engine block.

- There should be continuity between terminal and ground.

NOTE: Apply pipe sealant with TEFLON to threads of switch any time it is installed.

- If there is NO continuity between terminal and ground, replace the switch.

7. Start and run engine.

8. Measure resistance between terminal and engine block. There should be NO continuity.

- If the switch DOES have continuity to engine block (ground) with engine running, check oil pressure.

NOTE: Apply pipe sealant with TEFLON to threads of switch any time it is installed.

- If oil pressure is to specification, replace the oil pressure switch.

Transaxle Switch[1] Test

Reason

To verify the continuity between the switch terminals when the machine is placed in the low speed range.

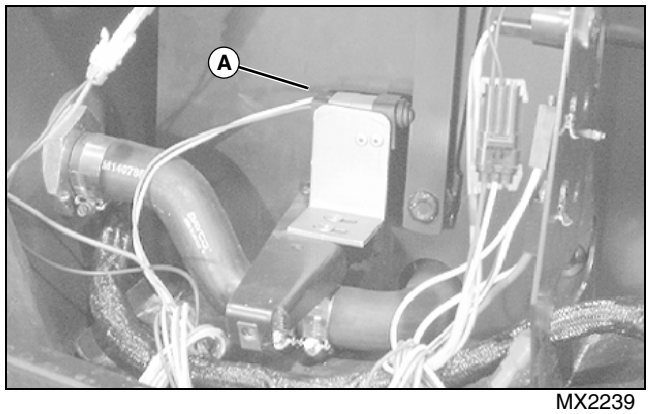
Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check continuity of transaxle switch

Procedure

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

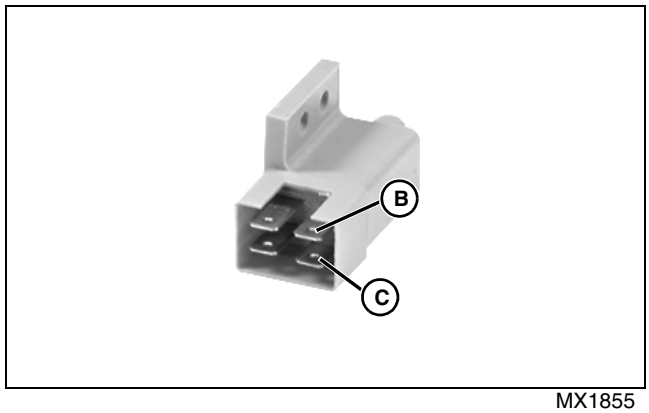
2. Remove the electronic control module.



MX2239

3. Disconnect the HIGH/LOW range switch connector (A).

4. Move HIGH/LOW range lever to HIGH position.



MX1855

5. Check continuity between switch terminals (B) and (C). There should be NO continuity.

6. Move HIGH/LOW range lever to LOW position.

7. Check continuity between switch terminals (B) and (C). There should be continuity.

Results

If continuity is not correct in either position, replace switch.

1. For Models 1600/1620 and 1600 Turbo S.N. (-030000)

Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (-020000)

Reason

To verify mower raise/lower switch continuity when the switch is in the ON (raise/lower) and OFF (released) positions.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check mower raise/lower switch continuity.

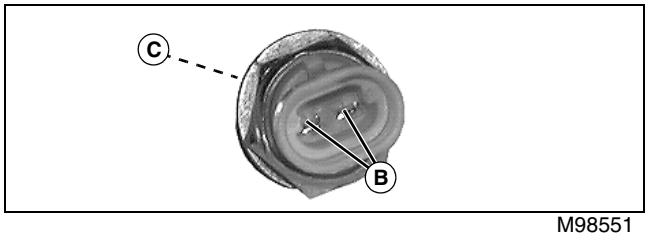
Procedure

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



MX2225

2. Remove access panel (A).
3. Disconnect the raise/lower switch connector.



M98551

4. Check continuity between switch terminals (B). There should be NO continuity.
5. Depress plunger (C).
6. Check continuity between switch terminals (B). There should be continuity.

Mower Raise and Lower Switch Test - Models 1600 and 1620 S.N. (020001-) and 1600 Turbo

Reason

To verify mower raise/lower switch continuity when the switch is in the ON (raise and lower) and OFF (released) positions.

Special or Required Tools

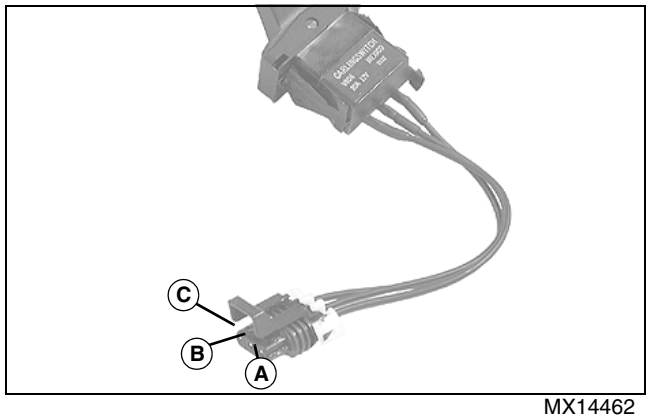
Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check mower raise/lower switch continuity.

Other Material

Part No.	Part Name	Part Use
495 (LOCTITE®)	Super Bonder	Used to bond the mower raise/lower switch to the control panel.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Remove mower raise/lower switch.



MX14462

3. Connect ohmmeter leads to connect terminals (A and B). There should be NO continuity.
4. With ohmmeter leads still connected to terminals (A and B), move raise/lower switch to the RAISE position. There should be continuity.
5. Connect ohmmeter leads to connector terminals (B and C). There should be NO continuity.
6. With ohmmeter leads still connected to terminals (B and C), move raise/lower switch to the LOWER position. There should be continuity.

Results

IMPORTANT: Avoid damage! When installing switch, LOCTITE Super Bonder 495 must be used.

If continuity is not correct in any switch position, replace switch.

PTO Switch Test

Reason

To verify PTO switch continuity when the switch is in the ON and OFF positions.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check PTO switch continuity.

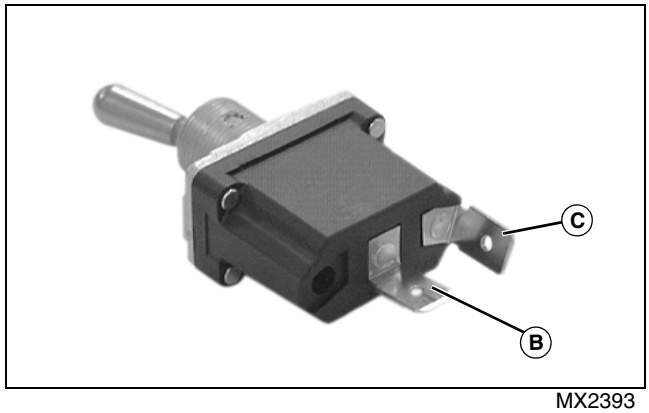
Procedure

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



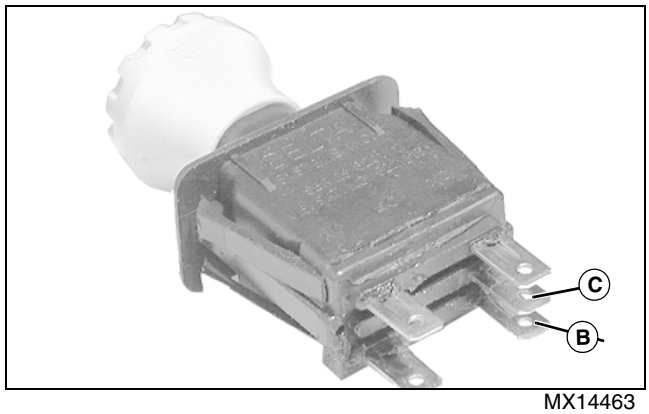
MX2225

2. Remove access panel (A).
3. Disconnect PTO switch connector.



MX2393

Picture Note: Models 1600 S.N. (020000-) and 1620 S.N. (020000-)



MX14463

Picture Note: Models 1600 S.N. (020000-), 1620 S.N. (020000-), and 1600 Turbo

4. Connect ohmmeter leads to switch terminals (B and C).
5. Move switch to ON position. There should be continuity.
6. Move switch to OFF position. There should be NO continuity.

Results

If continuity is not correct in either position, replace switch.

Headlight Switch Test

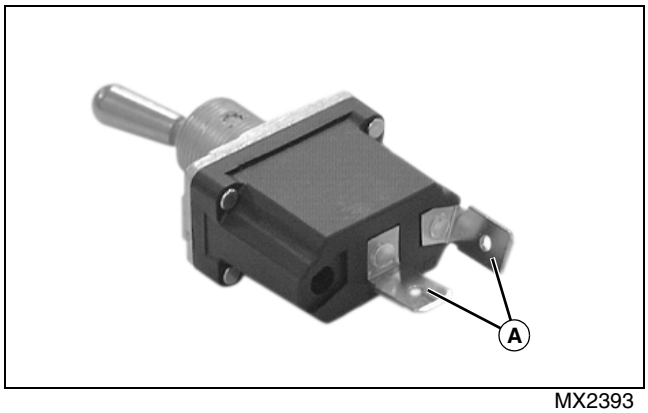
Reason

To verify PTO switch continuity when the switch is in the ON and OFF positions.

Special or Required Tools

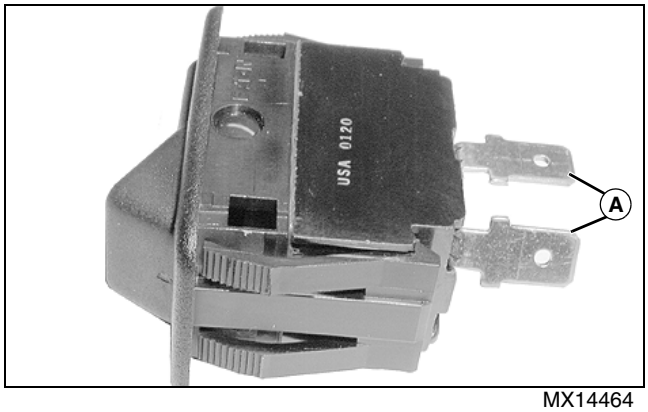
Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check headlight switch continuity.

Procedure



MX2393

Picture Note: Models 1600/1620



MX14464

Picture Note: Model 1600 Turbo

1. Connect ohmmeter leads to headlight switch terminals (A).
2. Move switch to ON position. There should be continuity.
3. Move switch to OFF position. There should be NO continuity.

Results

If continuity is not correct in either position, replace switch.

Deck Drive and Raise and Lower Select Solenoid Test

Reason

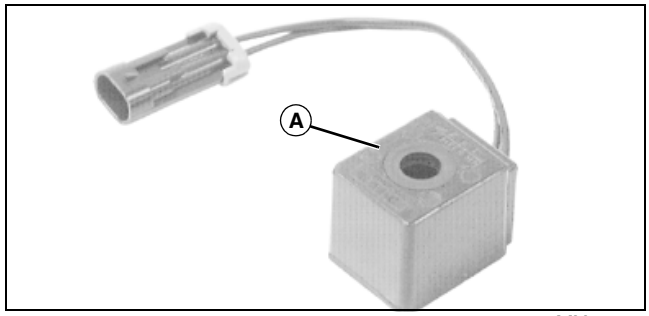
To verify mower deck drive and raise/lower select solenoid coils are operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check deck drive and raise/lower select solenoid coils continuity.

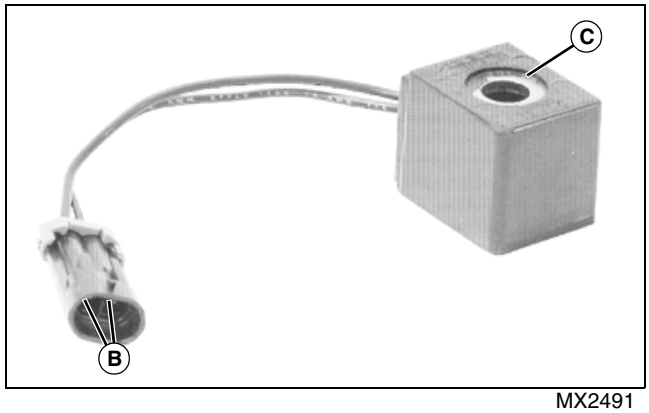
Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Disconnect solenoid wiring connector.
3. Remove solenoid coil from valve assembly.



MX2490

4. Remove the rubber isolation washer (A).



MX2491

5. Check continuity between terminals (B). There should be continuity.
6. Check continuity between terminals (B) and bare metal (C) on coil housing. There should be NO continuity.
7. Apply 12 volts DC to terminals (B) and insert a small screwdriver into the coil. A magnetic force should be noticed.

Results

If continuity is not correct or no magnetic force is noticed, replace the coil.

Raise and Lower Solenoid Coil Test

Reason

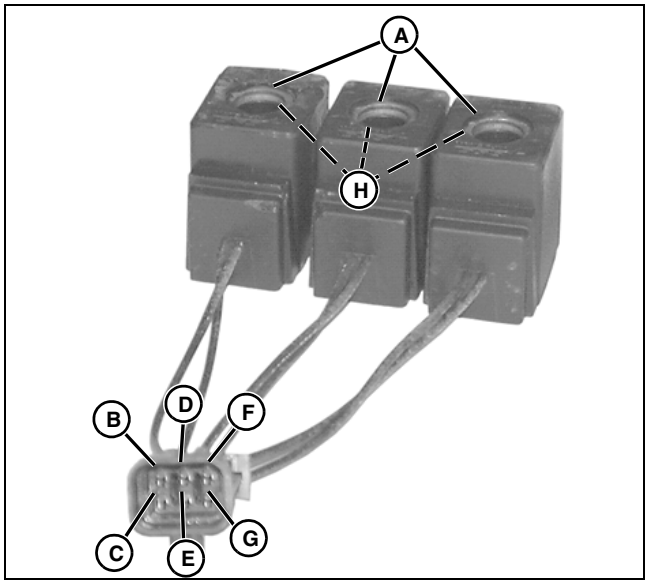
To verify the raise/lower solenoid coils are operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check deck drive and raise/lower select solenoid coils continuity.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Disconnect solenoid wiring connector.
3. Remove solenoid coils from the valve assembly.



MX2533

4. Remove the rubber isolation washers (A).
5. Check continuity between terminals (B and C), (D and E) and (F and G). There should be continuity between terminals.
6. Check continuity between terminals (B, C, D, E, F and G) and bare metal (below grommet) (H) on coil housing. There should be NO continuity between any terminal and the bare metal.
7. Apply 12 VDC to each pair of terminals (B and C), (D and E) and (F and G) and insert a small screwdriver into the coil. A magnetic force should be noticed.

Results

If continuity is not correct or no magnetic force is noticed, replace the coil.

Fuel Shutoff Solenoid Test

Reason

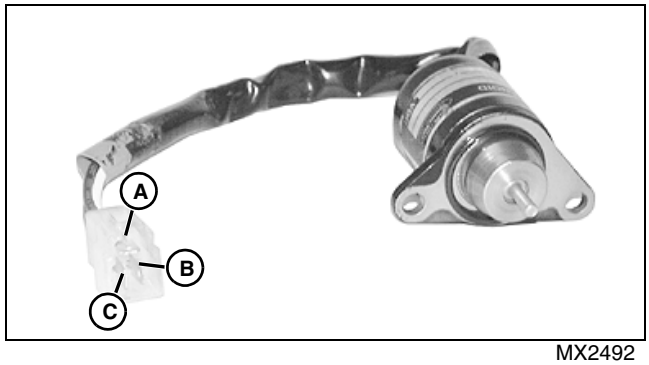
To verify the fuel shutoff solenoid is working properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter	NA	Used to measure shutoff solenoid coil resistance.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Move PTO switch to OFF position.
3. Move travel pedals to neutral position.
4. Engage park brake.
5. Move key switch to RUN position, a click should be heard as the solenoid engages.
   - If a click is heard, solenoid is good and test is complete.
   - If a click is NOT heard, go to next step.
6. Raise the cowling.
7. Disconnect the solenoid wiring connector.



MX2492

8. Check pull-in coil resistance, terminals (A) and (B). Resistance should be to specification.
9. Check hold coil resistance, terminals (B) and (C). Resistance should be to specifications.
10. Check resistance of both coils (combined), terminals (A) and (C). Resistance should be to specifications.

Results

- If resistance is not correct, replace fuel shutoff solenoid.
- If resistance is correct, check the fuel shutoff solenoid circuit.

Specifications

Fuel Shutoff Solenoid

Pull-In Coil Resistance (Approx).....0.4 ohms
Hold Coil Resistance (Approx) .....12.0 ohms
Coils Combined Resistance (Approx) .....12.4 ohms

Fuel Gauge Sensor Test

Reason

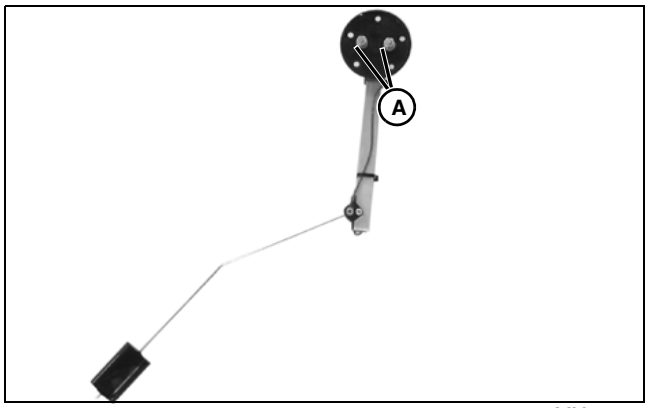
To verify the fuel gauge sensor is operating properly (changing resistance as the fuel level changes).

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter	NA	Used to measure the resistance of the fuel gauge sensor.

Procedure

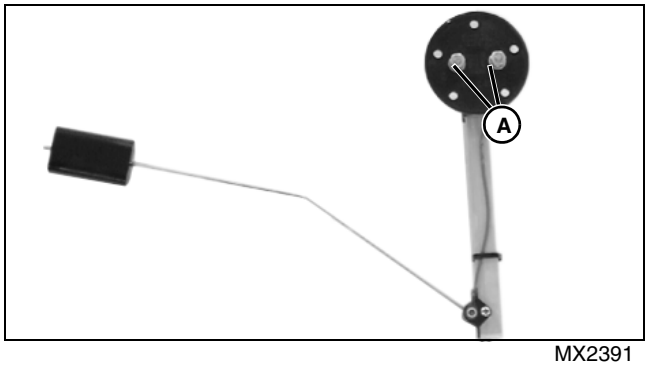
1. Remove the fuel gauge sensor.



MX2392

2. Connect the ohmmeter leads to sensor terminals (A).

3. Move the float to the bottom of travel (empty position). The resistance should be to specification.



MX2391

4. Move the float to the top of travel (full position). The resistance should be to specification.

Results

If the resistance does not match specifications, replace the sensor.

Specifications

Fuel Gauge Sensor Resistance

Empty (Approx) ..... 230 ohms
Full (Approx)..... 28 ohms

Hood Switch Test

NOTE: The hood switch is used on European machines only. North American machines will include the hood switch wiring connector in the harness but will be bypassed to provide a continuous hood switch input.

Reason

To verify hood switch continuity.

Special or Required Tools

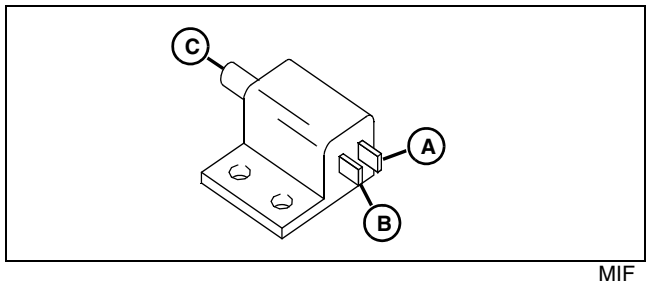
Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check continuity of hood switch.

Procedure

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

2. Raise hood.

3. Disconnect hood switch wiring connector.



MIF

4. Check continuity between switch terminals (A) and (B). There should be NO continuity.

5. Depress plunger (C).

6. Check continuity between switch terminals (A) and (B). There should be continuity.

Results

If continuity is not correct in either position, replace switch.

Diode Test

Reason

To verify that the diode has proper continuity.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Diode Tester, Ohmmeter, or Continuity Tester	NA	Used to check continuity of diodes.

Procedure

NOTE: Diode located within right-side control console.

1. Remove diode from connector.
2. Connect diode tester, ohmmeter or continuity tester lead to each lead of diode. Check for continuity.
3. Reverse test leads. Check for continuity.



E35624

Result

Diode must have a low resistance reading in one direction only. Replace defective diode.

Engine Coolant Temperature Sensor Test

Reason

To verify coolant temperature sensor is functioning properly.

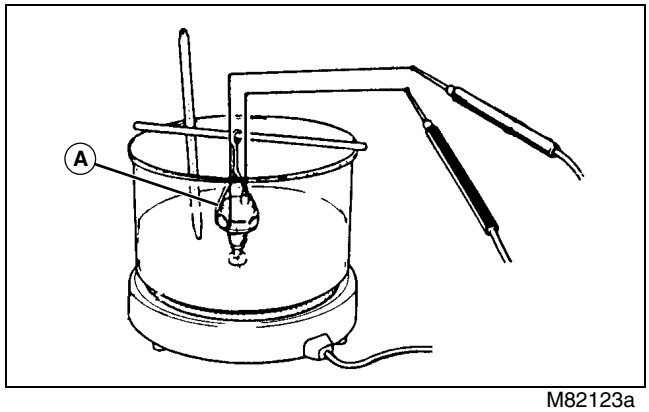
Special or Required Tools

Tool Name	Tool No.	Tool Use
Thermometer	NA	Used to measure temperature.
Glass Container	NA	Used to contain water.
Heating Unit	NA	Used to heat water/ coolant mixture.
Ohmmeter	NA	Used to test resistance.

Procedure

1. Machine parked safely. (See “Park Machine Safely” on page 3.)
2. Drain engine coolant and remove coolant temperature sensor.

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



M82123a

3. Place sensor (A) in water/coolant mixture.
4. Bring water/coolant mixture to specified temperatures while measuring resistance of sensor.
5. If resistance does not meet specifications, replace coolant temperature sensor.

Specifications

Engine Coolant Temperature Sensor

Resistance at 71°C (160°F) . . . . . 100 ohms
Resistance at 82°C (180°F) . . . . . 80 ohms
Resistance at 93°C (200°F) . . . . . 60 ohms
Resistance at 116°C (240°F) . . . . . 40 ohms

Coolant Temperature Switch Test

Reason

To determine the operating temperature of the switch.

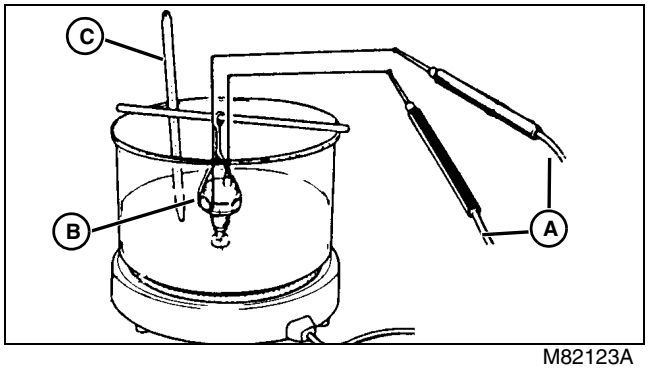
Special or Required Tools

Tool Name	Tool No.	Tool Use
Thermometer	NA	Used to measure water temperature.
Glass Container	NA	Used to contain water used in test.
Heating Unit	NA	Used to heat water.
Ohmmeter	NA	Used to measure continuity.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise hood.
3. Remove coolant temperature switch.

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



M82123A

4. Connect lead wires from ohmmeter probes (A) to switch terminal and body.
5. Suspend switch (B) and a thermometer (C) in a container of water/coolant mixture.
6. Heat and stir the water. Observe water/coolant mixture temperature when continuity occurs. Water/coolant mixture temperature should be to specification.

Results

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

Specifications

Coolant Temperature Switch
Operating Temperature . . . . . 107-113°C (225-235°F)

Cruise Control Switch Test - Model 1600 Turbo

Reason

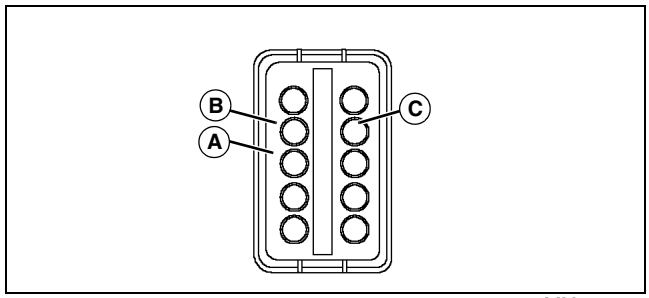
To verify the cruise control switch functions properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check continuity of cruise control switch.

Procedure

1. Park machine safely on a level surface. (See “Park Machine Safely” on page 3.)
2. Disengage PTO.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Remove cruise control switch.
6. Check switch terminals for continuity as shown in table.



MX14572

Cruise Control Switch Continuity	
Switch Position	Terminal Continuity
OFF	None
ON	A and B
SET (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 Magnet Test - Model 1600 Turbo

Reason

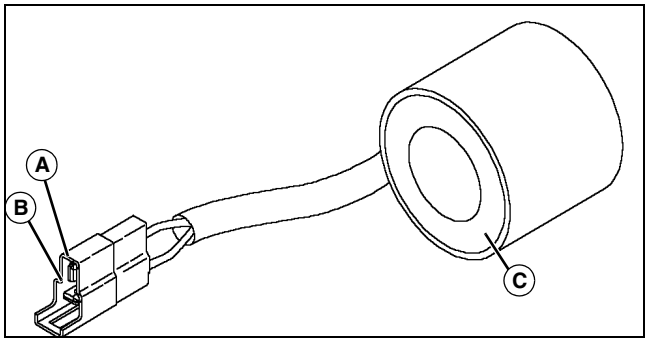
To check resistance of the cruise control magnet operation.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter	NA	Used to check resistance of cruise control magnet.

Procedure

1. Park machine safely on a level surface. (See “Park Machine Safely” on page 3.)
2. Disengage PTO.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Disconnect cruise control magnet connector from harness.
6. Using an ohmmeter, test for resistance between connector terminals A and B, then between terminals and magnet housing.



MX14573

Cruise Control Magnet Resistance	
A to B	20 ohms approximately
A to Magnet Housing (C)	No continuity
B to Magnet Housing (C)	No continuity

Results

If continuity exists between terminals and magnet housing or resistance is not to specification, replace the magnet.

Specifications

Cruise Control Magnet Resistance (Approx) . . 20 ohms

Repair

Battery Removal and Installation

Removal

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

Avoid the hazard by:

- **Filling batteries in a well-ventilated area.**
- **Wearing eye protection and rubber gloves.**
- **Avoiding breathing fumes when electrolyte is added.**
- **Avoiding spilling or dripping electrolyte.**
- **Using proper jump start procedure.**

If you spill acid on yourself:

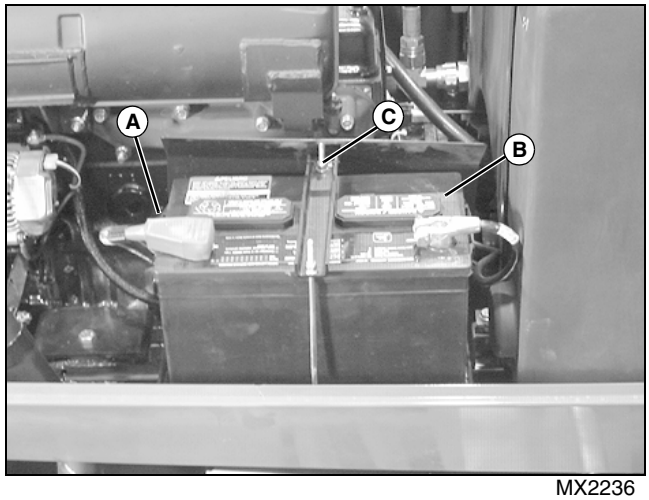
- **Flush your skin with water.**
- **Apply baking soda or lime to help neutralize the acid.**
- **Flush your eyes with water for 15-30 minutes. Get medical attention immediately.**

If acid is swallowed:

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

NOTE: Model 1600 shown. Models 1620 and 1600 Turbo are similar.

1. Raise hood.



MX2236

2. Disconnect battery cables (A and B), negative (-) cable (B) first.
3. Remove battery hold-down (C).
4. Remove battery.
5. **On Models 1600/1620:** If greater access to the starting motor and other engine components is required, remove battery splash guard.

Installation

Installation is done in the reverse order of removal.

- Clean battery if dirty.
- Inspect battery terminals and case for breakage or cracks. Replace if needed.
- Connect negative (-) cable last.

Cleaning

1. Remove battery from machine.

NOTE: Keep cleaning solution out of battery cells.

2. Clean battery, battery terminals, cable ends, bracket, and battery box with a solution of one part baking soda and four parts water.
3. Rinse all parts with clean water. Let dry thoroughly.
4. Apply petroleum jelly to battery terminals to prevent corrosion.

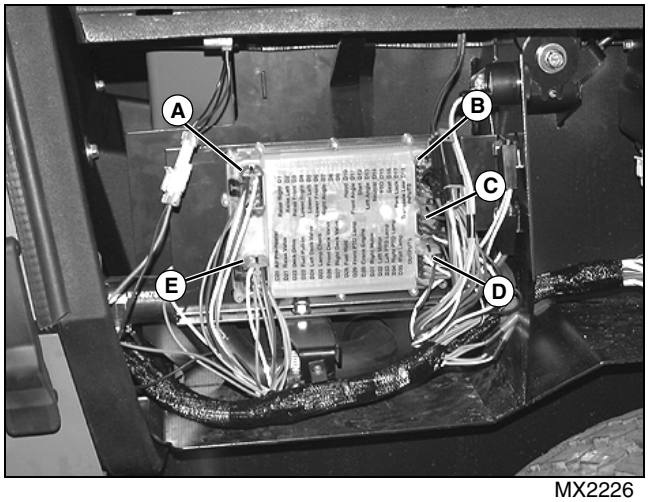
Electronic Control Module Removal and Installation

Removal

NOTE: Model 1600 shown. Models 1620 and 1600 Turbo are similar.

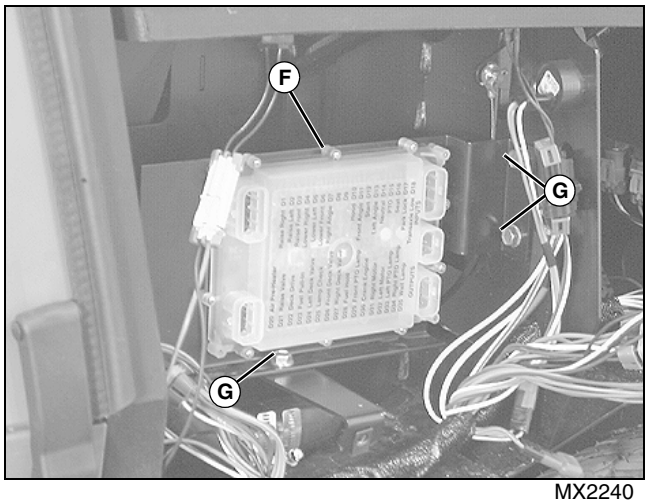
1. Remove right side access panel.

NOTE: Mark all connectors to ensure correct installation.



MX2226

2. Disconnect all wiring connectors (A-E).



MX2240

3. Remove three flange-head cap screws and nuts (G).
4. Remove electronic control module/bracket assembly (F).

Installation

Installation is done in the reverse order of removal.

HYDROSTATIC POWER TRAIN TABLE OF CONTENTS

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HYDROSTATIC POWER TRAIN TABLE OF CONTENTS

Specifications

Diagnostic Specifications

Charge Oil Pressure at Slow Idle	**1034 ± 103 kPa (150 ± 30 psi)**
Charge Oil Pressure at Fast Idle	**1379 ± 134 kPa (200 ± 50 psi)**
Rear Tire Air Pressure[2]	**138 kPa (20 psi)**
Rear Tire Air Pressure - 1600 Turbo S.N. (040001-)	**193 kPa (28 psi)**

Test and Adjustment Specifications

Traction Drive Oil Drain in 10 Seconds (Max)	**3.8 L (1.0 gal)**
Slow Idle Speed	**700 rpm**
MRWD Axle End Play	**0.127-1.016 mm (0.005-0.040 in.)**
MRWD Axle Pivot Pin Mounting Cap Screw Torque	**88 N•m (65 lb-ft)**

Repair Specifications

Pinion Nut Torque	**91 N•m (67 lb-ft)**
Differential Pinion Shaft Cap Screw Torque	**26 N•m (230 lb-in.)**
Rear Cover Assembly M8 x 50 Cap Screw Torque	**26 N•m (230 lb-in.)**
Rear Cover Assembly M10 x 50 Cap Screw Torque	**50 N•m (37 lb-ft)**
Rear Cover Assembly M12 x 80 Cap Screw Torque	**90 N•m (66 lb-ft)**
Ring Gear Cap Screw Torque	**26 N•m (230 lb-in.)**
Carrier Cap Screw Torque	**26 N•m (230 lb-in.)**
Ring Gear Backlash	**0.15-0.21 mm (0.006-0.008 in.)**
Differential Assembly M12 Cap Screw Torque	**90 N•m (66 lb-ft)**
Differential Assembly M10 Cap Screw Torque	**50 n•m (37 lb-ft)**
Seal Cover Cap Screw Torque	**26 N•m (230 lb-in.)**
Axle Shaft Housing M10 x 35 Cap Screw Torque	**51 N•m (38 lb-ft)**
Axle Shaft Housing M10 x 50 Cap Screw Torque	**51 N•m (38 lb-ft)**
Steering Cylinder Castle Nut Torque	**75 N•m (55 lb-ft)**
Steering Cylinder Cap Screw Torque	**88 N•m (65 lb-ft)**
Differential Housing Cap Screw Torque	**22 N•m (195 lb-in.)**
Differential Input Shaft Assembly Retaining Cap Screw Torque	**26 N•m (230 lb-in.)**
Differential Backlash	**0.17-0.23 mm (0.007-0.009 in.)**
Bearing Retainer Plate Cap Screw Torque	**26 N•m (230 lb-in.)**
Differential Input Housing Cap Screw Torque	**26 N•m (230 lb-in.)**
Differential Input Housing Cap Screw Final Torque	**52 N•m (38 lb-ft)**
Assembly Cover Cap Screw Torque	**52 N•m (38 lb-ft)**
Tie Rod Castle Nut Torque	**53 N•m (39 lb-ft)**

2. 1600 Turbo S.N. (-040000) see SIB 05-11-70-2

Tools and Materials

Required Tools

Special or Required Tools

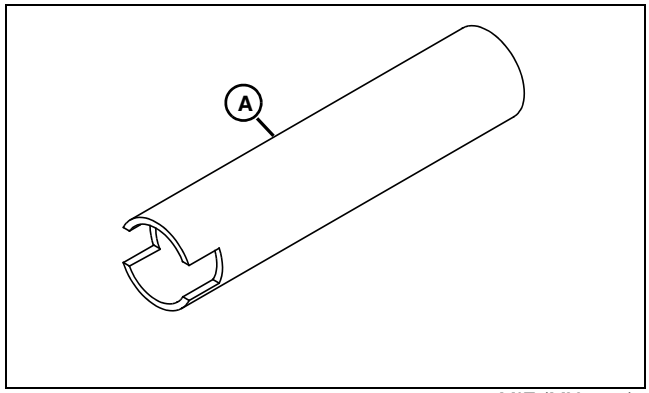
Tool Name	Tool No.	Tool Use
Hydraulic Test Hose with 13/16-16 (-8) F ORFS 90° Sw x 1-3/16-12 (-12) 90° Sw	JT03524	Used to drain oil.
13/16-16 (-8) M ORFS Plug	38H1147	Used to prevent hose leakage.
Knife-Edge Puller	NA	Used to remove axle oil seal, bearings, and inner race of pinion shaft.
Two-Jaw Puller	NA	Used to remove bearing and oil seal wear seal.
Bushing, Bearing, and Seal Driver Set	NA	Used to install bearing and differential assembly. Used to install axle housing seal. Used to remove spindle gear case needle bearing.
Pipe with Inside Diameter of 51 mm (2 in.)	NA	Used to install oil seal wear sleeve on axle shaft.
Pipe with Inside Diameter of 40 mm (1-9/16 in.)	NA	Used to install new inner bearing in axle shaft housing. Used to install oil seal wear sleeves in spindle gear case.
Wedge-Fork Driver	NA	Used to separate steering cylinder from mounting.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Internal Puller	NA	Used to remove top bearing from upper gear case.
Bearing Puller	NA	Used to remove bearing from spindle shaft and differential pinion shaft.

Fabricated Tools

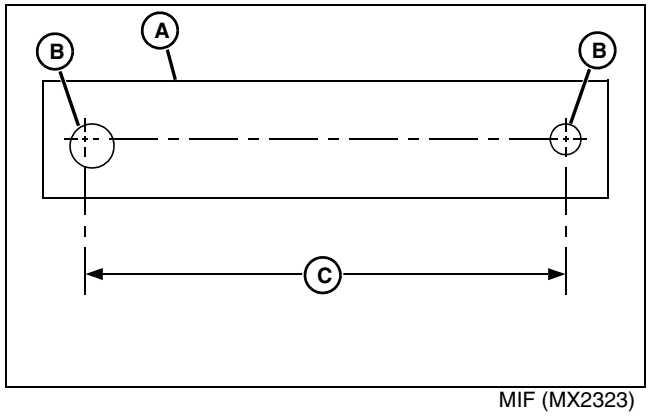
Spring Compression Tool



MIF (MX2637)

A pipe (A) is used to compress the spring to remove the snap ring on the transaxle differential lock shaft. The pipe inside diameter is 25 mm (1 in.). Make a 20 x 20 mm (3/4 x 3/4 in.) notch in the end of the pipe. The pipe length should be approximately 152 mm (6 in.).

Deflection Gauge Mounting Plate



MIF (MX2323)

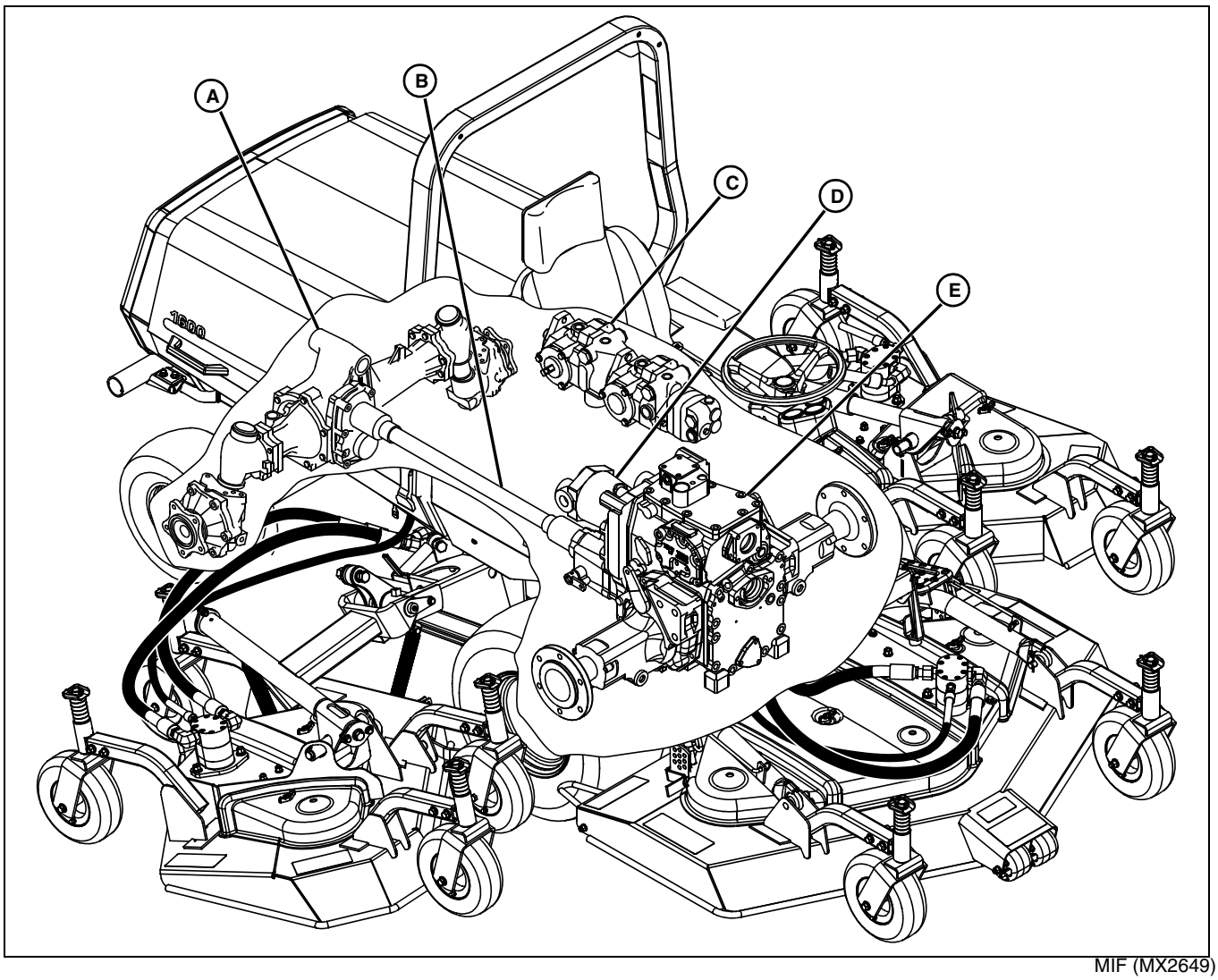
A steel plate (A) is mounted to the transaxle case, to attach a magnetic-based deflection indicator when checking the transaxle differential ring gear backlash. Drill two 13 mm (1/2 in.) holes (B) 213 mm (8-3/8 in.) (C) apart.

Other Materials

Other Material

Part No.	Part Name	Part Use
TY16285 (US) 7649 (LOCTITE®) CXTY16285 (Canada)	Cure Primer	Applied to threads of ring gear cap screws and differential housing cap screws before installation.
T43512 (US) 242 (LOCTITE) TY9473 (Canada)	Thread Lock and Sealer (Medium Strength)	Applied to threads of ring gear cap screws and differential cap screws before installation.

Component Location **Power Train Component Location**



MIF (MX2649)

A - Mechanical Rear Wheel Drive Axle
B - Drive Shaft
C - Traction Drive Pump
D - Traction Drive Motor
E - Transaxle Assembly

Theory of Operation

Power Train Operation

Function

To transmit power to the drive wheels and mechanical rear wheel drive axle.

Theory of Operation

The power train system consists of a transaxle assembly, driven by a hydraulic traction drive motor. Pressurized oil for the traction drive motor is provided by an engine-driven traction drive pump.

The transaxle includes dual speed range feature. This feature allows the operator to select the transport speed range that best fits the operation being performed. The mode of operation can be selected by a lever located on the operator's console.

Neutral (center) position: In this mode, the transmission is placed in neutral. The mower deck PTO cannot be engaged in this position.

Slow speed range position: The slow speed range is used for mowing or slow speed transport.

High speed range position: This range is used for high speed transport only. The mower deck PTO cannot be engaged in this position.

The differential can also be locked using a foot pedal on the operator's platform. This will provide greater traction in slippery conditions.

The machine also features a mechanically-driven rear wheel assist axle. The rear axle is driven from an auxiliary output shaft on the transaxle assembly.

The four-wheel drive (rear-wheel assist) system can be used in two modes; "on demand" or "full time." The mode of operation can be selected by a lever located on the operator's console.

"On demand" position: In this position, the rear wheels will engage whenever slip is detected, and will automatically disengage when not needed.

"Full time" position: In this position, the rear wheels will drive at all times.

Neutral

With the forward/reverse travel pedals in the neutral position, the spring in the cylinder block in the traction drive pump (M) forces the swash plate to a position that is parallel to the pump body. With the swash plate parallel to the pump body, the pistons do not reciprocate in the cylinder block, they merely rotate, and no oil is being drawn in or discharged from the pump. The machine is in a zero displacement position and the machine remains stationary.

Forward

Charge pressure oil (B) is supplied to the traction drive pump from the mower lift and steering systems (Q).

As the forward travel pedal is depressed, the swash plate in the traction drive pump (M) move from the neutral position (parallel to the pump body) to a forward angle position. Springs inside the cylinder bores force the pistons against the swash plate.

As the cylinder block rotates, the pistons follow the contour of the swash plate, moving outward, drawing oil into their bores. As the cylinder block continues to rotate, the pistons are forced into their bores, discharging oil under pressure.

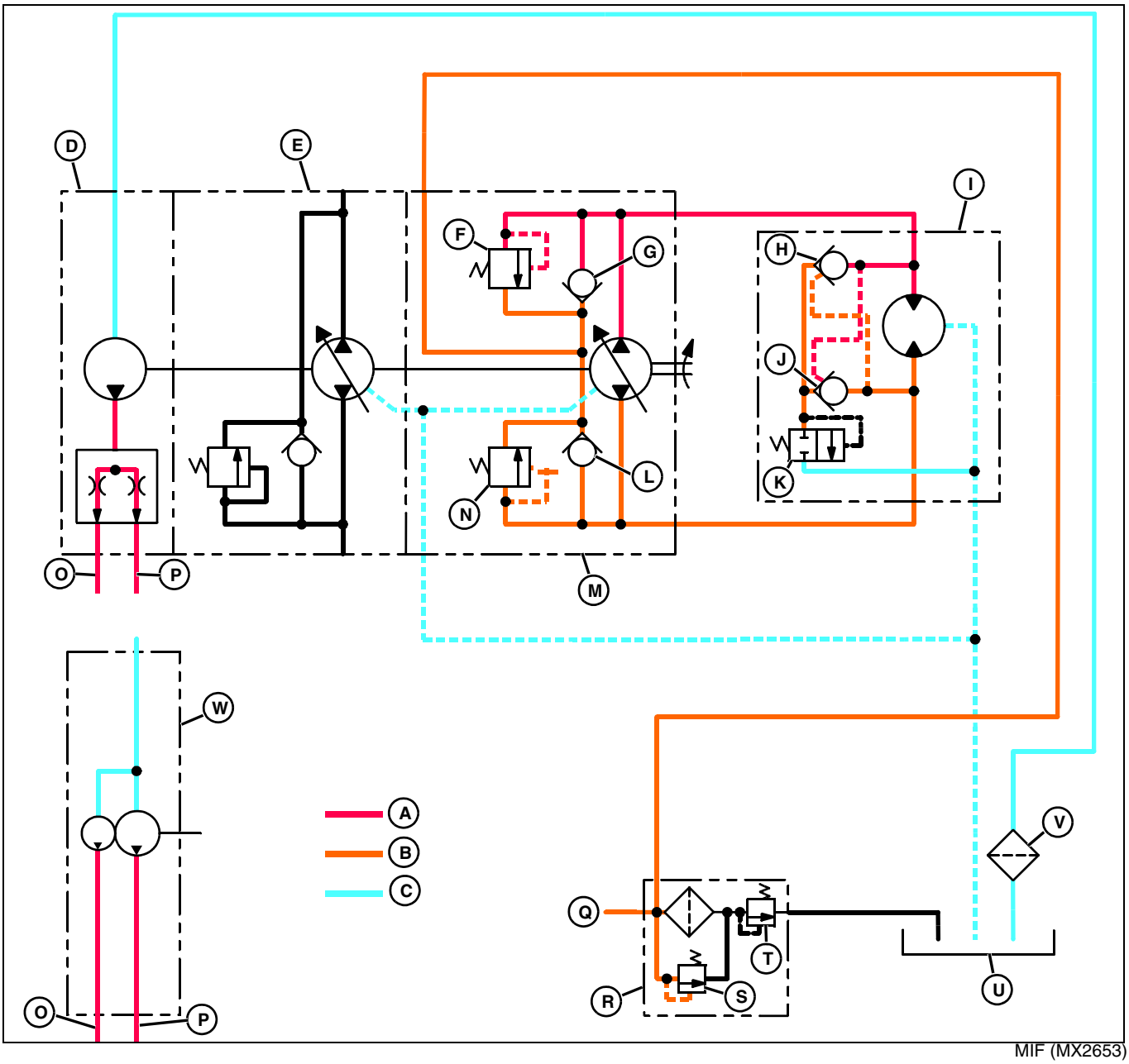
As pressure in the traction drive motor increases, the reverse check valve (J) is forced open, allowing oil to flow to the back pressure valve (K) causing it to open. Oil then exits the system through the back pressure valve (K), and the oil is then replaced with charge flow. The exchange of oil is done to improve cooling of the traction drive motor.

High pressure oil (C) from the traction pump is routed to the traction drive motor (I), driving the machine forward.

Reverse

Reverse operation is accomplished by reversing the angle applied to the traction drive pump swash plate, reversing the flow of high pressure oil to the traction drive wheel motor.

Oil Flow Schematic



MIF (MX2653)

A - High Pressure Oil
B - Charge Pressure Oil
C - Low Pressure/Return Oil
D - Model 1620 Steering/Lift Pump
E - Mower Deck Drive Pump
F - Traction Drive Pump Relief Valve (Forward)
G - Check Valve (Forward)
H - Traction Drive Motor Check Valve (Forward)
I - Traction Drive Motor
J - Traction Drive Motor Check Valve (Reverse)
K - Traction Drive Motor Back Pressure Valve
L - Check Valve (Reverse)
M - Traction Drive Pump
N - Traction Drive Pump Relief Valve (Reverse)
O - Oil Flow to Steering System
P - Oil Flow to Lift System
Q - Charge Pressure Oil from Lift and Deck Driver Systems
R - Oil Filter Assembly
S - Filter Bypass Relief Valve
T - Charge Pressure Relief Valve
U - Hydraulic Oil Reservoir
V - Filter Screen (in Reservoir)
W - Models 1600/1600 Turbo Steering/Lift Pump

Diagnostics

Machine Will Not Move When Travel Pedals Are Engaged

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Machine Will Not Move When Travel Pedals Are Engaged

(1) Speed Range Lever.
Is speed range lever in SLOW or FAST position?

Yes - Go To Step (2)

No - Move lever to either SLOW or FAST range position.

(2) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (3)

No - Reservoir is not properly filled - Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 390.)

(3) Hydraulic Hoses.
Check hoses between traction drive pump and traction drive motor.
Do hoses have any sharp bends or restrictions?
Are hoses improperly routed?

Yes - Hoses have sharp bends or restrictions. Replace hose(s) with hose of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions.

No - Go To Step (4)

(4) Transmission (Pedal) Control Linkage.
Is linkage connected properly and not damaged or binding?

Yes - Go To Step (5)

No - Repair or replace transmission linkage.

Symptom: Machine Will Not Move When Travel Pedals Are Engaged

(5) Traction Drive Pump Control Linkage.
Is traction drive pump control linkage adjusted properly?
Is linkage connected properly and not damaged?

Yes - Go To Step (6)

No - Adjust traction drive pump control linkage.

No - Repair or replace traction drive pump control linkage.

(6) Engine-to-Hydrostatic Pump Coupler.
Are coupler components damaged?

Yes - Repair or replace coupler.

No - Go To Step (7)

(7) Traction Drive Motor.
Is traction drive motor operating properly with no internal leakage or damage?
Is the pinion gear in place and not damaged?

Yes - Go To Step (8)

No - Traction drive motor is not operating properly, has internal leakage or damage. Repair or replace traction drive motor.

No - Pinion gear is not in place or is damaged. Replace pinion gear.

(8) Traction Drive Pump.
Is traction drive pump operating properly with no internal leakage or damage?

Yes - Go To Step (9)

No - Repair or replace traction drive pump.

(9) Transaxle Assembly.
Is transaxle operating properly with no internal damage?

Yes - Go To Step (10)

No - Repair or replace transaxle assembly.

(10) Park brake engaged.
Engine running at FAST idle.
Perform System Charge Relief Valve Pressure Test. (See “System Charge Relief Valve Pressure Test” on page 521.)
Is charge pressure to specification at slow and fast idle?

No - Check mower drive and lift systems. Repair as needed.

Specifications

Charge Oil Pressure
at Slow Idle . . . . . 1034 ± 103 kPa (150 ± 30 psi)
Charge Oil Pressure
at Fast Idle. . . . . 1379 ± 134 kPa (200 ± 50 psi)

Drive System Does Not Operate Smoothly

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Drive System Does Not Operate Smoothly

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 390.)

(2) Transaxle Oil Reservoir.
Is reservoir filled to correct level with clean oil of correct specifications?

Yes - Go To Step (3)

No - Fill transaxle reservoir to proper level with oil meeting specifications.

(3) Hydraulic Hoses.
Do hoses have any sharp bends or restrictions?
Are hoses improperly routed?

Yes - Hoses have sharp bends or restrictions. Replace hose(s) with hose of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions

No - Go To Step (4)

Symptom: Drive System Does Not Operate Smoothly

(4) Brakes.
Are brakes applied?
Are brakes binding or damaged?

Yes - Hoses have sharp bends or restrictions. Replace hose(s) with hose of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions

No - Go To Step (5)

(5) Traction Drive Motor.
Is traction drive motor operating properly with no internal leakage or damage?
Is the pinion gear in place and not damaged?

Yes - Go To Step (6)

No - Traction drive motor is not operating properly, has internal leakage or damage. Repair or replace traction drive motor.

No - Pinion gear is not in place or is damaged. Replace pinion gear.

(6) Traction Drive Pump.
Is traction drive pump operating properly with no internal leakage or damage?

Yes - Go To Step (7)

No - Repair or replace traction drive pump.

(7) Transaxle Assembly.
Is transaxle operating properly with no internal damage?

Yes - Go To Step (8)

No - Repair or replace transaxle assembly.

(8) Park brake engaged.
Engine running at FAST idle.
Perform System Charge Relief Valve Pressure Test. (See “System Charge Relief Valve Pressure Test” on page 521.)
Oil Filter Assembly.
Is charge pressure to specification at slow and fast idle?

No - Check mower drive and lift systems. Repair as needed.

Specifications

Charge Oil Pressure
at Slow Idle . . . . . 1034 ± 103 kPa (150 ± 30 psi)
Charge Oil Pressure
at Fast Idle . . . . . 1379 ± 134 kPa (200 ± 50 psi)

Machine Will Not Reach Maximum Speed or Accelerates Slowly

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Machine Will Not Reach Maximum Speed/Accelerates Slowly

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 390.)

(2)
Hydraulic Hoses.
Do hoses have any sharp bends or restrictions?
Are hoses improperly routed?

Yes - Hoses have sharp bends or restrictions. Replace hose(s) with hose of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions.

No - Go To Step (3)

(3) Brakes.
Are brakes applied?
Are brakes binding or damaged?

Yes - Brakes are applied. Release brakes.

Yes - Brakes are binding or damaged. Repair brakes.

No - Go To Step (4)

(4) Traction Drive Pump Control Linkage.
Is traction drive pump control linkage adjusted properly, allowing full motion of pump control arm?

Yes - Go To Step (5)

No - Adjust traction drive pump control linkage.

Symptom: Machine Will Not Reach Maximum Speed/Accelerates Slowly

(5) Transmission (Pedal) Control Linkage.
Is linkage properly connected and not damaged nor binding?

Yes - Go To Step (6)

No - Repair or replace transmission linkage.

(6) Traction Drive Motor.
Is traction drive motor operating properly with no internal leakage or damage?
Is the pinion gear in place and not damaged?

Yes - Go To Step (7)

No - Traction drive motor is not operating properly, has internal leakage or damage. Repair or replace traction drive motor.

(7) Traction Drive Pump.
Is traction drive pump operating properly with no internal leakage or damage?

Yes - Go To Step (8)

No - Repair or replace traction drive pump.

(8) Transaxle Assembly.
Is transaxle operating properly with no internal damage?

Yes - Go To Step (9)

No - Repair or replace transaxle assembly.

(9) Park brake engaged.
Engine running at FAST idle.
Perform System Charge Relief Valve Pressure Test. (See “System Charge Relief Valve Pressure Test” on page 521.)
Oil Filter Assembly.
Is charge pressure to specification at slow and fast idle?

No - Check mower drive and lift systems. Repair as needed.

Specifications

Charge Oil Pressure
at Slow Idle . . . . . 1034 ± 103 kPa (150 ± 30 psi)
Charge Oil Pressure
at Fast Idle . . . . . 1379 ± 134 kPa (200 ± 50 psi)

Machine Moves When Travel Pedals Are in Neutral Position

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Machine Moves When Travel Pedals Are in Neutral Position

(1) Traction Drive Pump Control Linkage.
Is traction drive pump control linkage adjusted properly, allowing full motion of pump control arm?
Does linkage move freely without binding and is not damaged?
Is linkage return spring connected properly, not missing?

Yes - Go To Step (2)

No - Adjust traction drive pump control linkage.

No - Repair or replace pump control linkage.

No - Connect or replace linkage return spring.

(2) Travel Pedals.
Are pedals binding?
Does shaft need lubrication?

Yes - Pedals are binding. Repair pedals.

Yes - Shaft needs lubrication. Lubricate shaft as needed.

Rear Wheels Do Not Drive

NOTE: This condition may be caused by systems other than brakes. Check the hydraulic system if the following procedure does not correct the problem.

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Rear Wheels Do Not Drive

(1) Four Wheel Drive Lever Linkage.
Is linkage connected, working properly and not damaged?

Yes - Go To Step (2)

No - Repair four wheel drive lever linkage.

Symptom: Rear Wheels Do Not Drive

(2) MRWD Drive Shaft.
Is shaft missing or damaged?

Yes - Repair or replace as needed.

No - Go To Step (3)

(3) Transaxle Assembly.
Is transaxle operating properly with no internal damage?

Yes - Go To Step (4)

No - Repair or replace transaxle assembly.

(4) MRWD Rear Axle Assembly.
Is MRWD rear axle assembly operating properly with no internal damage?

Yes - Check hydraulic system.

No - Repair or replace rear axle assembly.

Hydraulic Oil Foams

Test Conditions:

- Key switch in STOP position.
- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Hydraulic Oil Foams

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

(2) Hydraulic Pressure Hoses.
Check pressure hoses.
Do hoses have sharp bends or restrictions?
Are connections leaking?

Yes - Hoses have sharp bends and/or restrictions. Replace hose(s).

Yes - Connections are leaking. Tighten connections and/or replace hoses.

No - Go To Step (3)

Symptom: Hydraulic Oil Foams

(3) Hydraulic Suction Hoses.
Check suction hoses.
Are hoses cracked, cut, or badly scuffed?

(4) Are hose connections loose or leaking?

Yes - Hoses are cracked, cut, or badly scuffed. Replace hoses as needed with hoses of proper size.

Yes - Hose connections loose or leaking. Tighten connections and/or replace O-rings as needed.

Machine Pulls to One Side

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Park brake released.

Symptom: Machine Pulls to One Side

(1) Drive Wheels/Tires.
Are tires inflated to correct pressure?

Yes - Go To Step (2)

No - Inflate rear tires to specification.

(2) Brakes.
Are brakes damaged or binding?

Yes - Repair brakes.

Specifications

Rear Tire Air Pressure . . . . . 138 kPa (20 psi)
Rear Tire Air Pressure -
1600 Turbo S.N. (040001-) . . . . . 193 kPa (28 psi)

Travel Is Slow in One Direction

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Park brake released.

Symptom: Travel Is Slow in One Direction

(1) Traction Drive Pump.
Are high-pressure relief valves operating properly?

No - Swap relief valve if the problem follows the valve. Replace faulty valve.

Tests and Adjustments

Traction Drive Motor Case Drain Test

NOTE: Two people are recommended to perform this test.

Reason

To determine if there is excessive wear or leakage in the traction drive motor.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hydraulic Test Hose with 13/16-16 (-8) F ORFS 90° Sw x 1-3/16-12 (-12) 90° Sw	JT03524	Used to drain oil.
13/16-16 (-8) M ORFS Plug	38H1147	Used to prevent hose leakage.

Procedure

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

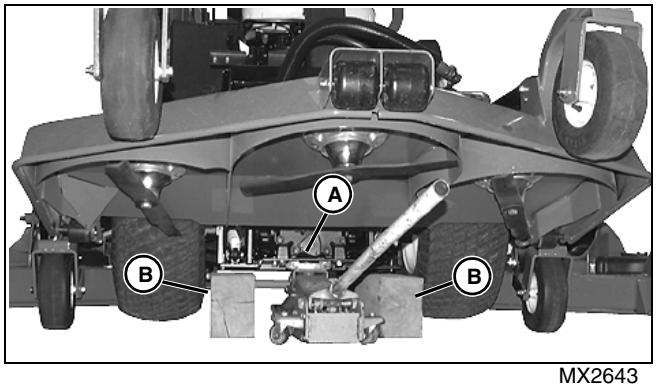
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

Always try to work in a well-ventilated area.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Remove MRWD drive shaft. (See “MRWD Drive Shaft Removal and Installation” on page 446.)
3. Lower side mower decks completely to the ground.
4. Rotate front mower deck for service.
5. Raise front mower deck completely.
6. Block rear wheels.

IMPORTANT: Avoid damage! Use caution when placing blocks under the subframe to avoid pinching or crushing the lift cylinder hydraulic hose.

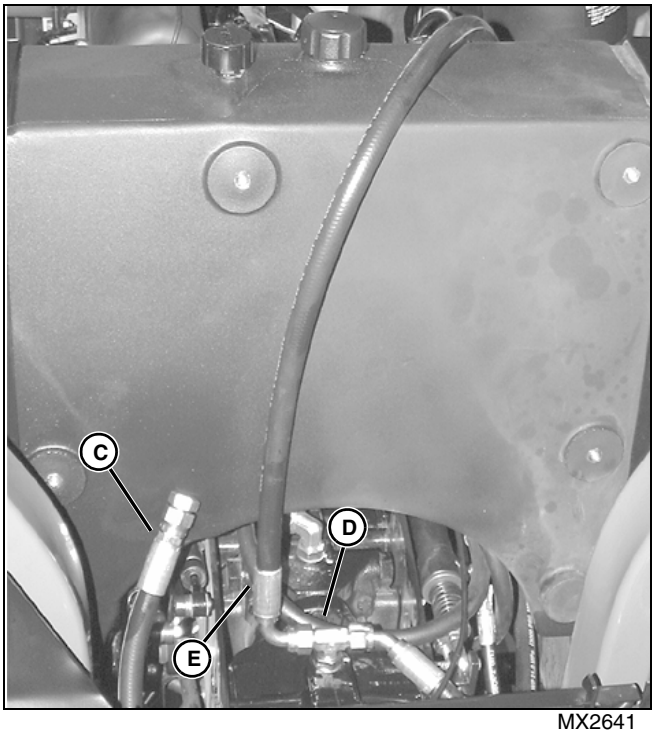


MX2643

7. Using a safe lifting device, jack up the front of the machine under the front lift arm support plate (A) so both front wheels are above the ground.
8. Install blocking material (B) under the front lift arm support plates and lower machine onto blocks. Make sure the front wheels can turn freely.
9. Remove bulkhead. (See “Bulkhead Removal and Installation” on page 665.)
10. Check the hydraulic oil reservoir and fill as necessary.
11. Bring the hydraulic oil to operating temperature and stop engine.

IMPORTANT: Avoid damage! Clean the area around the hoses before disconnecting.

NOTE: Work quickly when disconnecting hoses and connecting the test fittings, as oil will begin to drain from the system. It is helpful to have a second person to assist.



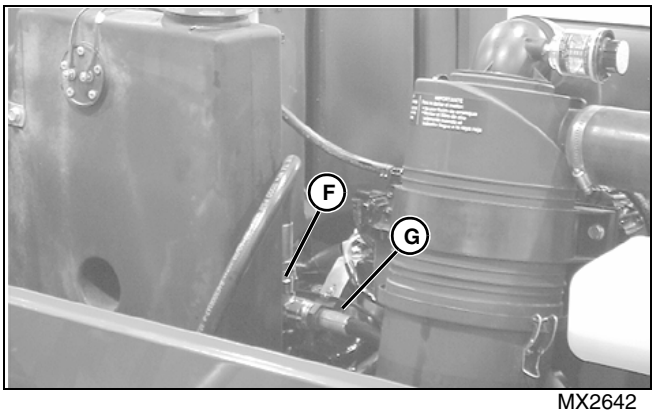
MX2641

12.Disconnect hose (C) from tee (D) on traction drive pump and plug hose with 38H1147 Plug.

13.Connect one end of Hydraulic Test Hose JT03524 (E) to tee.

IMPORTANT: Avoid damage! Clean the area around the hoses before disconnecting.

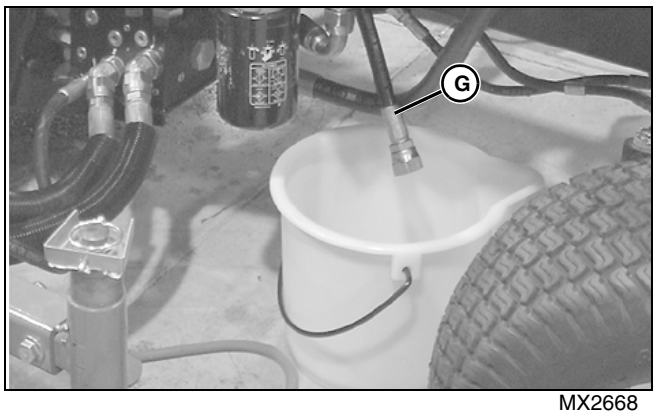
NOTE: Work quickly when disconnecting hoses and connecting the test fittings, as oil will begin to drain from the system. It is helpful to have a second person to assist.



MX2642

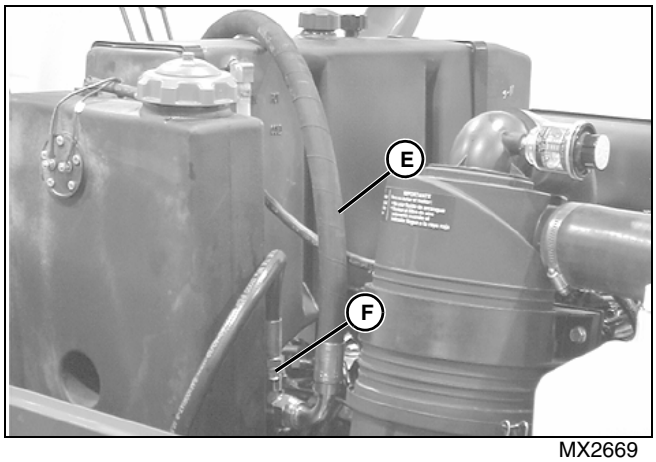
14.**On Models 1600/1620:** Disconnect hose (G, case drain hose from traction drive motor) from tee (F) on hydraulic reservoir.

15.**On Model 1600 Turbo:** Disconnect case drain hose (G) from bottom leg of tee (F) on hydraulic reservoir.



MX2668

16.Direct the free end of hose (G) from the traction drive motor into a clean graduated container that can hold at least 7.6 L (2 gal).



MX2669

17.Connect the free end of hydraulic test hose (E) to end of tee (F).

18.Operate engine at fast idle.

19.While pressing on the brake, press the forward travel pedal for ten seconds.

20.Record the amount of oil that has drained from the traction drive motor into the graduated container.

IMPORTANT: Avoid damage! Check the level of the hydraulic oil in the reservoir each time before repeating this test. Use clean oil to replace oil used during the test.

21.Replace the hydraulic reservoir oil used during the test and repeat steps 17-20 two more times.

22.Add the three measurements and divide by three to obtain the average amount of case drain oil and record the average amount.

Results

- The amount of oil that drains from the traction drive motor should be to specification.

• If the amount is more than specified, repair or replace traction drive motor.

Specifications

Traction Drive Oil Drain in 10 Seconds (Max) 3.8 L (1.0 gal)

Transmission Neutral Check and Adjustment

Reason

To ensure that the machine does not move when the forward/reverse travel pedals are in the NEUTRAL position while the engine is running.

Check Procedure

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

2. Release park brake.

3. Raise wing (side) mower decks and engage transport locks.

4. Move PTO switch to OFF position.

5. Use a safe lifting device to raise the front of the machine high enough to raise the front tires off the ground. Place blocks or jackstands under machine frame.

IMPORTANT: Avoid damage! DO NOT lift or support the rear of the machine by the rear bumper, as it is not designed to support the weight of the machine.

6. Use a safe lifting device to raise the rear of the machine high enough to raise the rear tires off the ground. Place blocks or jackstands under machine frame.

7. Sit in the seat and start engine at SLOW idle.

8. Observe the front tires for forward or rearward rotation.

9. Cycle the forward and reverse travel pedals and allow them to return to the centered (neutral) position.

10. Observe the front tires for forward or rearward rotation.

11. Stop engine.

Results

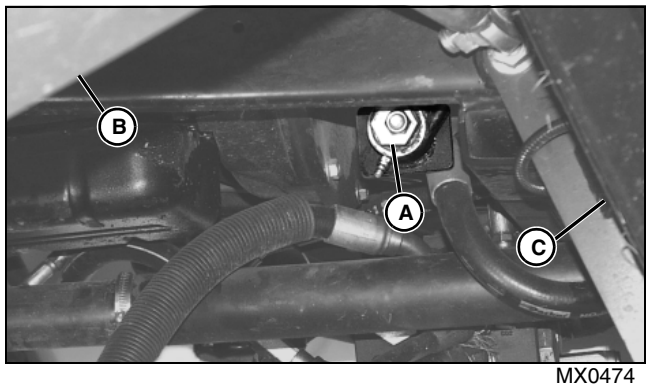
If tire rotation is noticed after the forward/reverse travel pedals have returned to the NEUTRAL position, perform adjustment procedure.

Adjustment Procedure

CAUTION: Avoid injury! DO NOT raise or lower decks, engage four-wheel drive or differential lock, or engage PTO switch during adjustment.

Keep people clear of the machine while it is running.

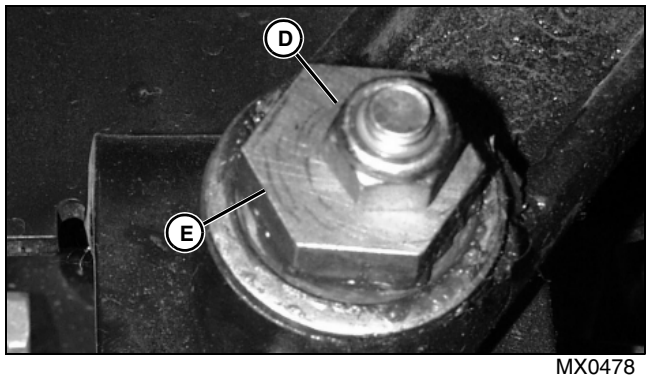
Always jack all four wheels off the ground. Four-wheel drive will automatically engage when the front wheels are off the ground and will push the machine off the jackstands if tires make contact with the ground.



MX0474

1. Locate the neutral adjuster cam (A) on the right side of the machine, under right mower deck (B), behind subframe (C).

2. Sit in the seat and run engine at SLOW idle.



MX0478

3. Loosen lock nut (D).

4. Rotate cam (E) until the front drive tires do not rotate.

5. Tighten lock nut.

6. Repeat check procedure to verify adjustment. Repeat adjustment procedure as needed.

Specifications

Slow Idle Speed . . . . . .700 rpm

Transaxle Low Range Switch Check and Adjustment (S.N. -030000)

Reason

To ensure the low range switch is engaged when the machine is placed in LOW range.

Check Procedure

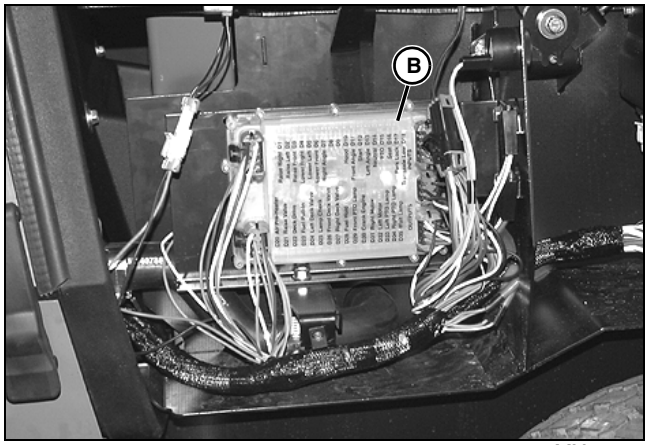
1. Park machine safely. (See “Park Machine Safely” on page 3.)



MX2225

2. Remove access panel (A).
3. Move HIGH/LOW range lever to LOW position.
4. Move key switch to RUN position.

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



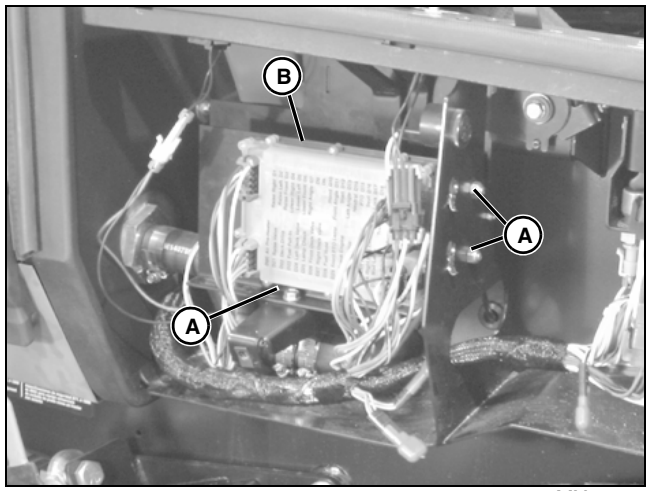
MX2226

5. Observe the TRANSAXLE LOW input light (D18) (B) on the electronic control module. The light should be ON.

Results

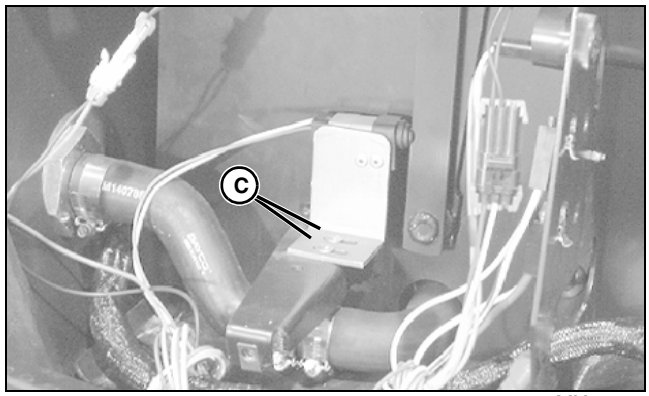
If the light is not on, perform adjustment procedure.

Adjustment Procedure



MX2245

1. Remove three flange-head cap screws and nuts (A).
2. Move the electronic control module (B) aside.



MX2239

3. Loosen the carriage bolts and nuts (C).
4. Move the bracket and switch toward the lever until the TRANSAXLE LOW input light (D18) is lit.

If the input light does not come on, test the transaxle low range switch input circuit.

5. Tighten round-head bolts and nuts.

MRWD Axle End Play Check and Adjustment

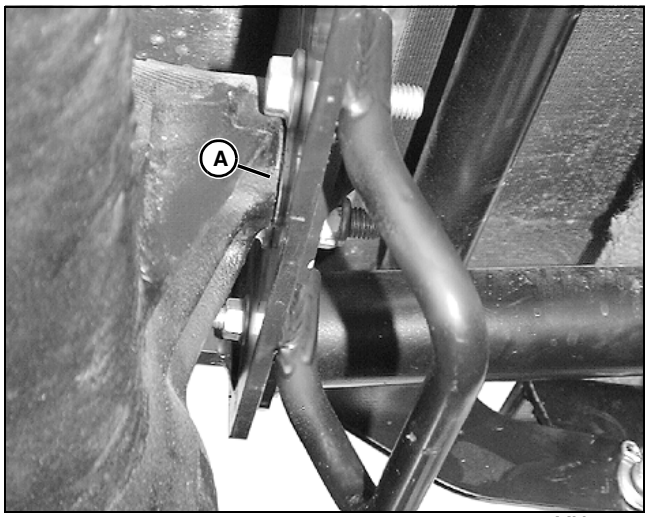
Reason

To ensure that the axle pivots freely without excessive end play.

Check Procedure

IMPORTANT: Avoid damage! DO NOT lift or support the rear of the machine by the rear bumper, as it is not designed to support the weight of the machine.

1. Use a safe lifting device to raise the machine high enough to allow the axle to pivot freely. Place blocks or jackstands under machine frame.



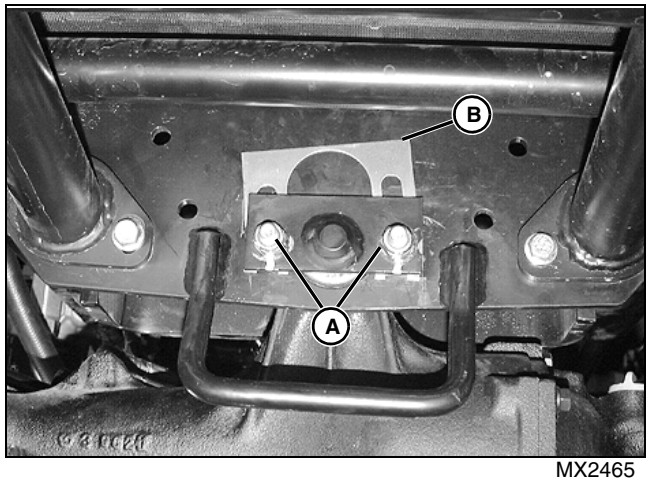
MX2464

2. Using a feeler gauge, measure the gap (A) between the rear edge of axle housing and the front edge of frame bushing. The end play should be to specification.

Results

If gap is not within specifications, perform adjustment procedure.

Adjustment Procedure



MX2465

1. Loosen two cap screws and nuts (A).
2. Remove or add shims (B) between the pivot pin flange and frame until the gap is within specifications.
3. Tighten cap screws and nuts (A) to specification.
4. Recheck gap. Repeat procedure as needed.

Specifications

MRWD Axle End Play. 0.127-1.016 mm (0.005-0.040 in.)
MRWD Axle Pivot Pin Mounting
Cap Screw Torque . . . . . 88 N•m (65 lb-ft)

Repair

Traction Drive Motor Removal and Installation

Removal

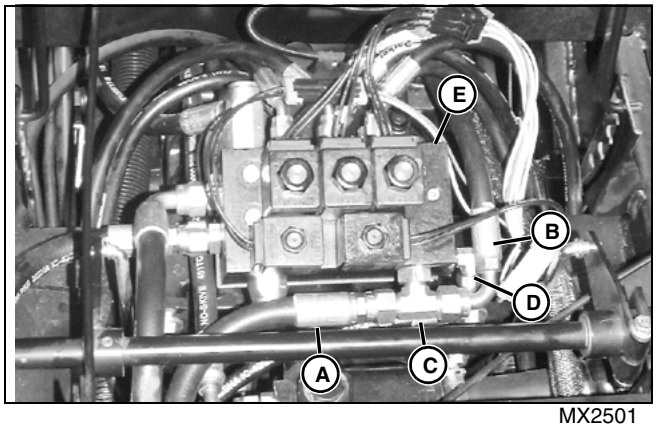
CAUTION: Avoid injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Remove seat and platform.
3. Disconnect negative (-) cable at battery.
4. Remove MRWD drive shaft. (See “MRWD Drive Shaft Removal and Installation” on page 446.)

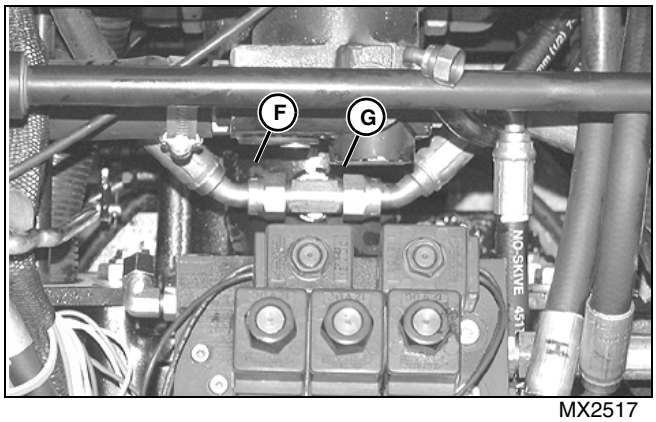
NOTE: Mark all hydraulic hoses and connection points before removing to ensure correct installation.

Close all open hoses and fittings using caps and plugs.



MX2501

5. Disconnect hydraulic hoses (A and B), tee fitting (C), and hydraulic hose (D) from deck lift control valve (E).

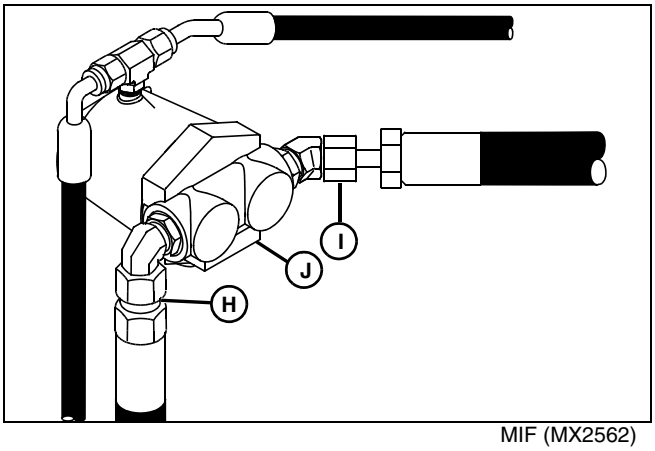


MX2517

6. Disconnect hydraulic hoses (F and G) from tee fitting on traction drive motor.

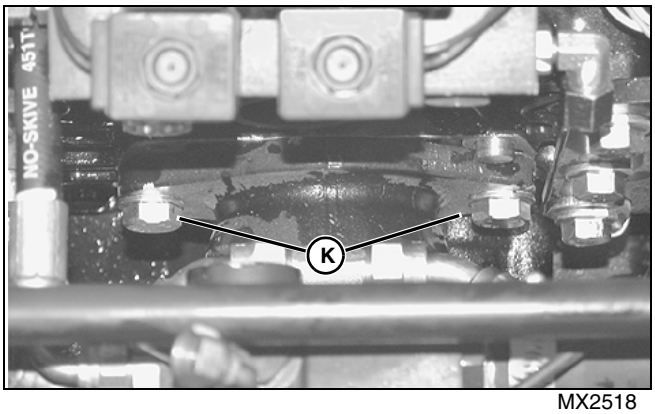
IMPORTANT: Avoid damage! DO NOT lift or support the rear of the machine by the rear bumper, as it is not designed to support the weight of the machine.

7. Using a safe lifting device, lift the rear of the machine. Place blocks or jackstands under machine frame.



MIF (MX2562)

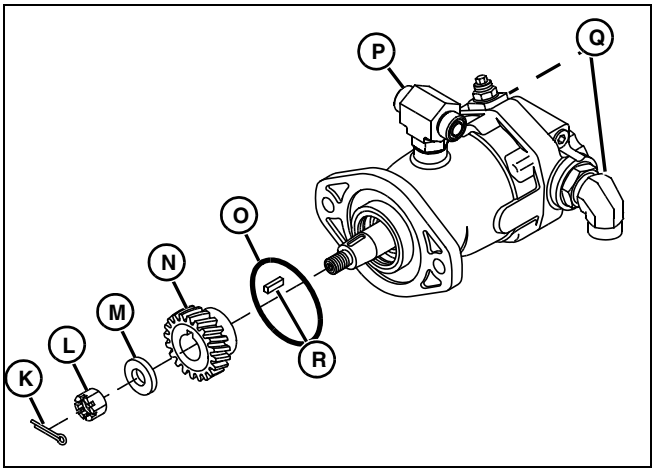
8. Disconnect hydraulic hoses (H and I) from traction drive motor (J)



MX2518

9. Remove cap screws and washers (K) from mounting flange.

10. Remove traction drive motor.



MIF (MX2671)

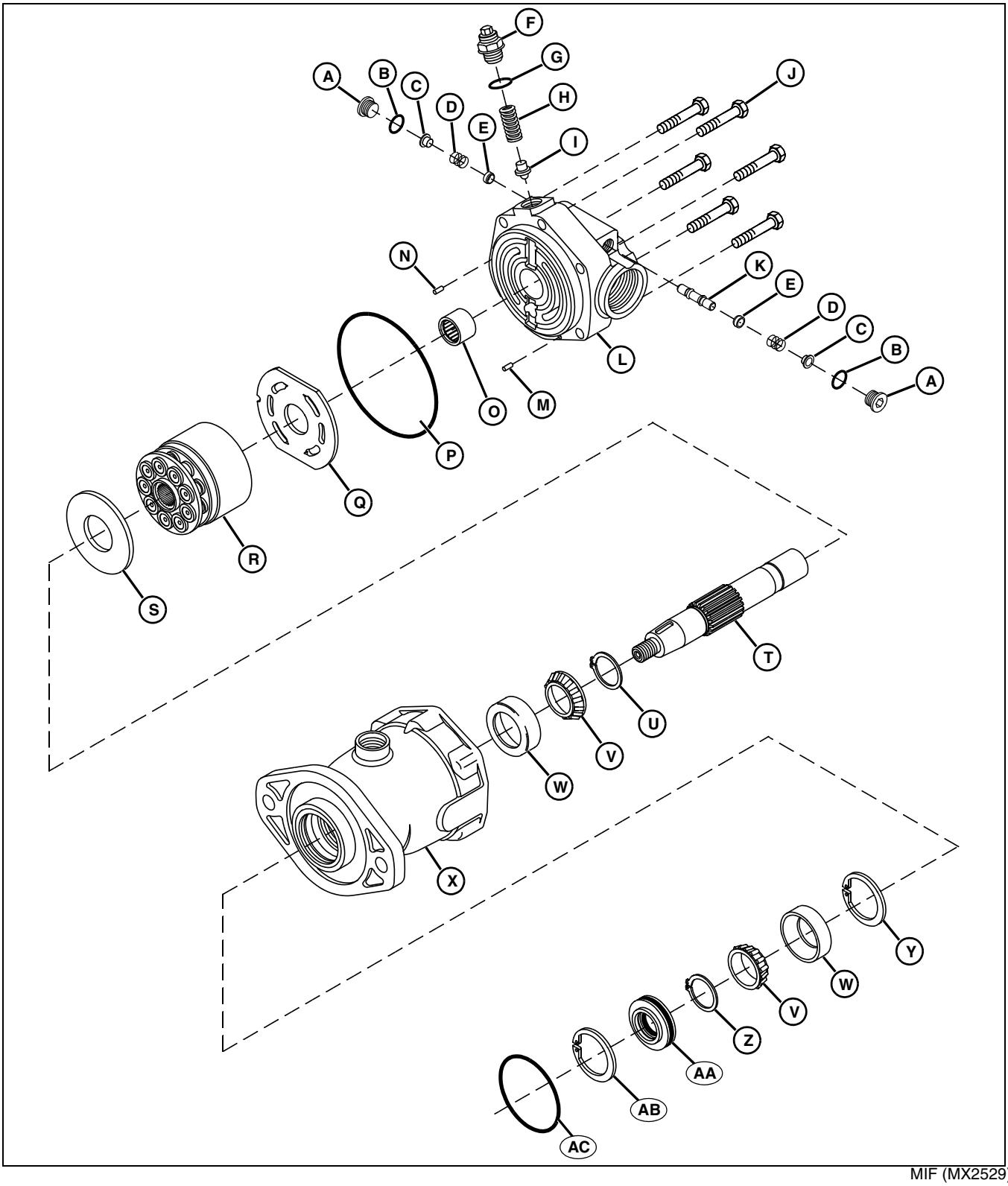
11. If the motor is to be repaired or replaced, remove (K-R).

Installation

Installation is done in the reverse order of removal.

- Make sure O-ring (O) is properly seated on motor flange before installation.
- Fill hydraulic reservoir to correct level.
- Bleed air from hydraulic system.

Traction Drive Motor Disassembly and Inspection and Assembly



MIF (MX2529)

A - Plug (2 used)
B - O-Ring (2 used)
C - Cap (2 used)
D - Spring (2 used)
E - Cap (2 used)
F - Plug

G - O-Ring
H - Spring
I - Poppet
J - Cap Screw (6 used)
K - Relief Shuttle
L - Back Plate Assembly
M - Alignment Pin
N - Alignment Pin
O - Needle Bearing
P - O-Ring
Q - Valve Plate
R - Rotating Group
S - Camplate Insert
T - Drive Shaft
U - Retaining Ring
V - Bearing Cone (2 used)
W - Bearing Cup (2 used)
X - Housing
Y - Retaining Ring
Z - Retaining Ring
AA- Seal Carrier Assembly
AB- Retaining Ring
AC- O-Ring

IMPORTANT: Avoid damage! Use caution when cleaning machined surfaces. DO NOT pry components apart. If resistance is noticed, tap lightly on the input shaft using a plastic hammer.

1. Thoroughly clean the outside of the motor before disassembly.

IMPORTANT: Avoid damage! Excessive clamping pressure will distort motor housing.

2. Place motor in a soft-jaw vise, using just enough pressure to prevent the motor from turning while removing cap screws.

3. Drain excess hydraulic oil from motor.

4. Remove six cap screws (J).

5. Remove back plate assembly (L).

6. Remove alignment pins (M and N), and O-ring (P).

7. Remove plugs (A), caps (C and E), and springs (D).

8. Remove relief shuttle (K).

9. Remove plug (F), spring (H), and poppet (I).

10. Remove needle bearing (O).

11. Remove valve plate (Q).

12. Remove rotating group (R) from drive shaft (T).

13. Remove camplate insert (S) from housing (X).

14. Remove retaining ring (AB).

15. Remove seal carrier assembly (AA).

16. Remove retaining ring (Z).

NOTE: Use a soft mallet or block of wood to prevent damage to shaft.

17. Remove shaft (T).

18. Remove bearing cone (V).

19. Remove retaining ring (U).

20. Remove bearing cone (V).

21. Remove bearing cups (W) from motor case.

22. Remove retaining ring (Y).

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

23. Clean all parts with solvent and blow dry using compressed air.

24. Inspect all parts for wear or damage. Replace entire motor if any parts other than seals and O-rings are worn or damaged.

Assembly

Assembly is done in the reverse order of disassembly.

IMPORTANT: Avoid damage! Always use new O-rings and seals. Damaged or used parts will leak.

NOTE: Apply hydraulic oil to all internal parts and seals of prior to assembly.

Use a soft mallet of block of wood when installing shaft seal (P) to prevent damage during installation.

- Install camplate insert (S) with markings facing away from rotating group assembly (R).
- Install valve plate (Q) with copper-colored side facing toward rotating group (R).

Transaxle Removal and Installation

Removal

1. Remove front mower deck.

2. Place wedge blocks in front and behind both rear wheels.

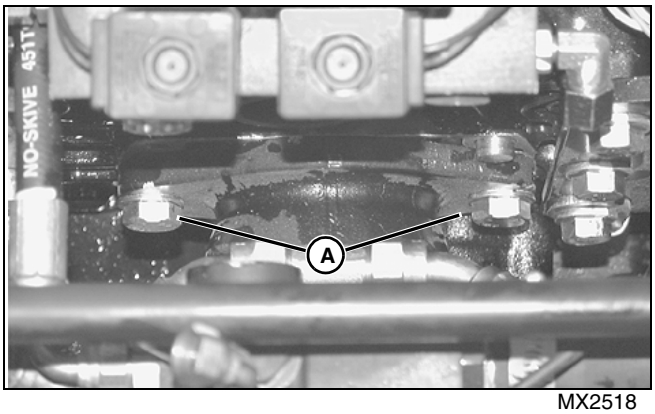
3. Remove front mower deck motor/plate assembly.

4. Remove wing (side) mower decks.

5. Lift wing (side) mower deck lift arms, and engage transport locks.

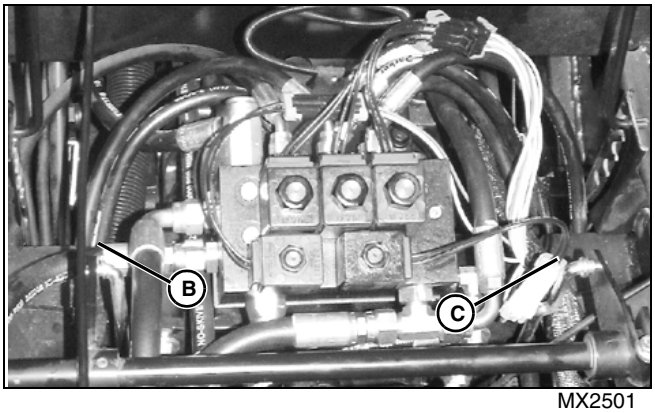
6. Remove MRWD drive shaft.

7. Remove seat platform assembly.



MX2518

8. Remove two cap screws and washers (A) from traction drive motor mounting flange.

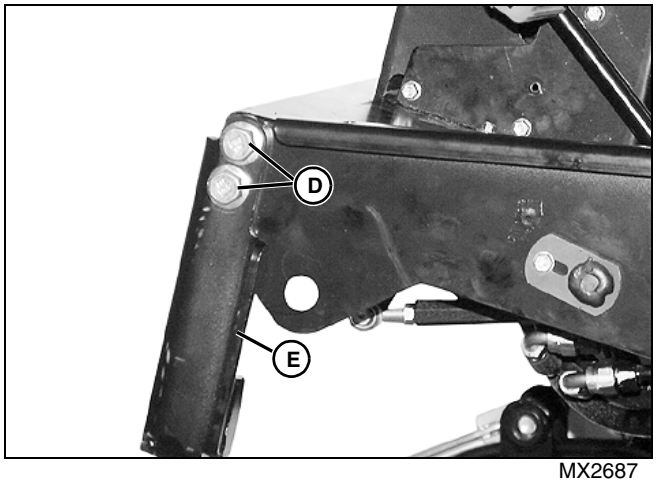


MX2501

9. Disconnect speed range selector linkage (B).

10.Disconnect four wheel assist linkage (C) from lever and remove linkage rod from transaxle.

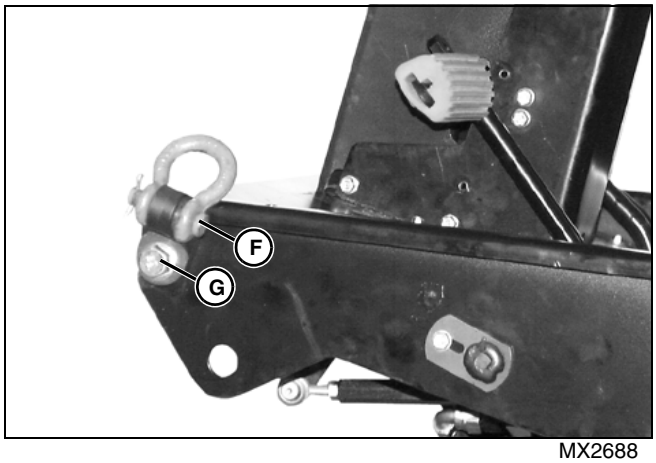
11.Remove mower deck lift control valve.



MX2687

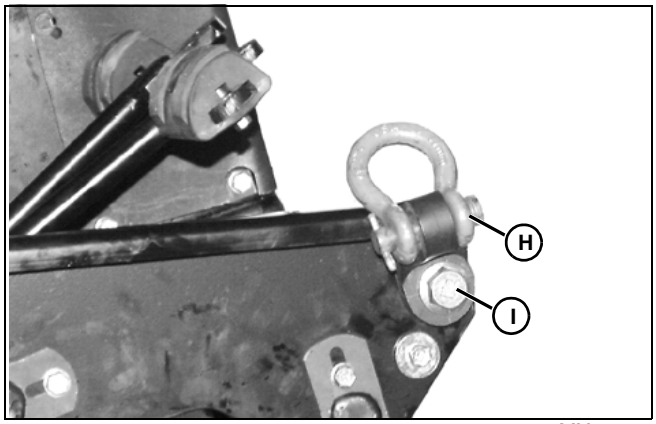
12.Remove two cap screws (D).

13.Remove front mower deck stop bracket (E).



MX2688

14.Install lifting eye bracket (F) to the lower mounting hole on left side of machine using one of the cap screws (G) removed from mower deck stop bracket.



MX2689

15.Install lifting eye bracket (H) to the lower mounting hole on the right side of machine using one of the cap screws (I) removed from mower deck stop bracket.

IMPORTANT: Avoid damage! DO NOT place a lifting device directly under the transaxle case. The transaxle case could be damaged if used to support the machine.

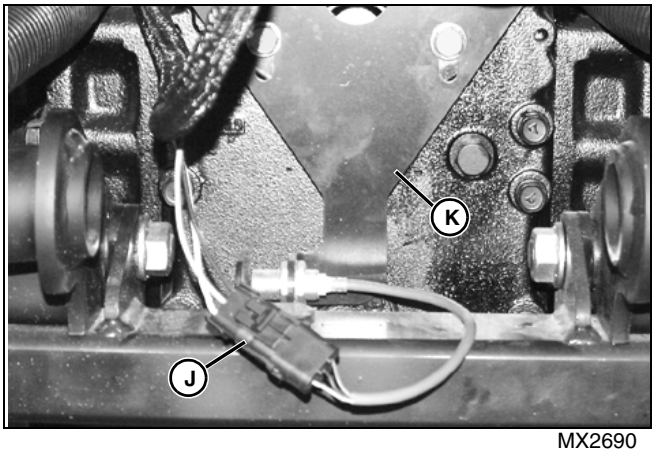
16.Using an overhead hoist, lift the front of the machine.

17.Remove front wheels.

IMPORTANT: Avoid damage! The wheeled platform used to support the transaxle must be strong enough to support several hundred pounds. DO NOT place the full weight of the machine onto the platform. Lower the machine only enough to rest the transaxle onto the platform.

18.Place a wheeled platform under the transaxle.

19.Lower the machine until the transaxle is resting on the platform.

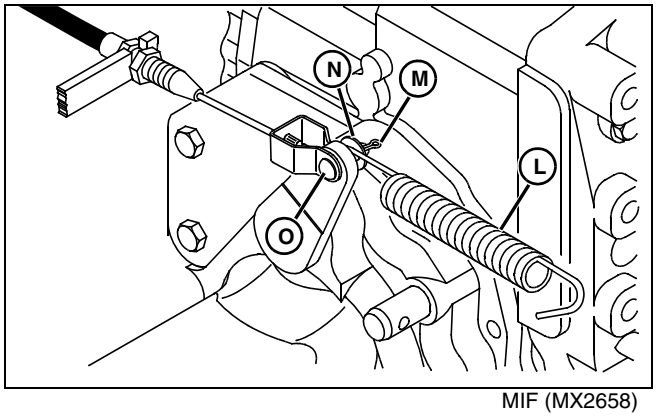


MX2690

20.Disconnect the front mower deck angle (proximity) switch wiring connector (J).

21.Cut tie-wraps securing hydraulic hoses to the angle (proximity) switch bracket (K) under machine.

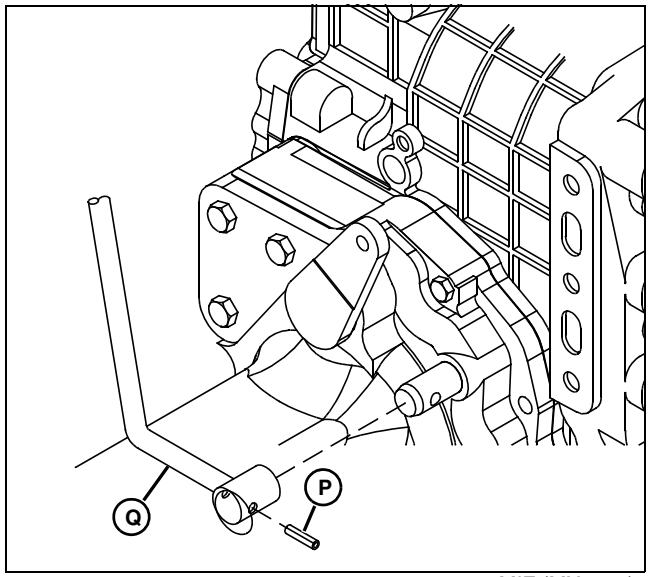
NOTE: Model 1600 Turbo uses solid linkage to brake arm.



MIF (MX2658)

22.Remove brake return spring (L) from both sides of machine.

23.Remove cotter pin (M), washer (N), and anchor pin (O) from brake arm (both sides of machine).

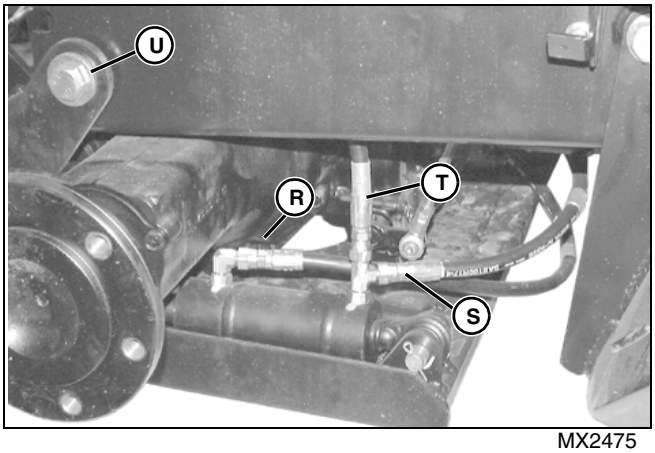


MIF (MX2702)

24.Drive spring pin (P) out using a punch.

25.Remove differential lock lever (Q).

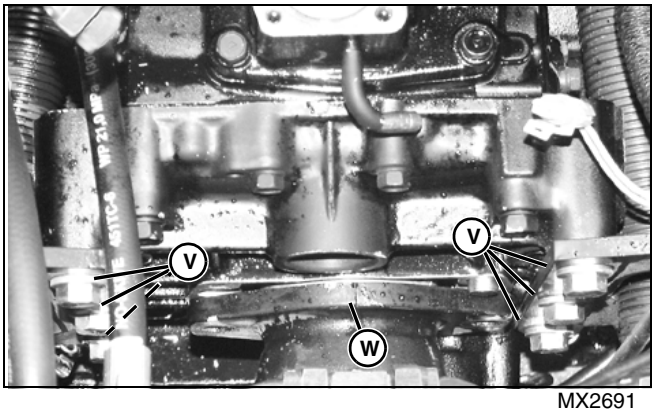
NOTE: Mark all hydraulic hoses and connection points before removing to ensure correct installation. It is critical to route hoses in the same manner in which they were installed from the factory.



MX2475

26.Disconnect and plug hydraulic hoses (R-T) from front lift cylinders (both sides of machine).

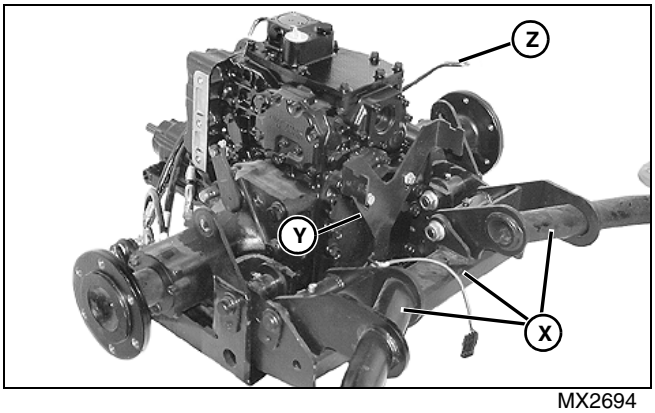
27.Remove cap screw and washer (U) (both sides of machine).



MX2691

28.Remove six cap screws and washers (V) and separate traction drive motor (W) from transaxle.

29.Lift the front of the machine high enough to clear the transaxle and slide transaxle from under machine on wheeled platform.



MX2694

30.If the transaxle is to be repaired or replaced, remove the following:

- Front lift arms and support bracket assembly (X).
- Mower deck angle (proximity) switch and bracket assembly (Y).
- Range selector linkage rod (Z).

Installation

Installation is done in the reverse order of removal.

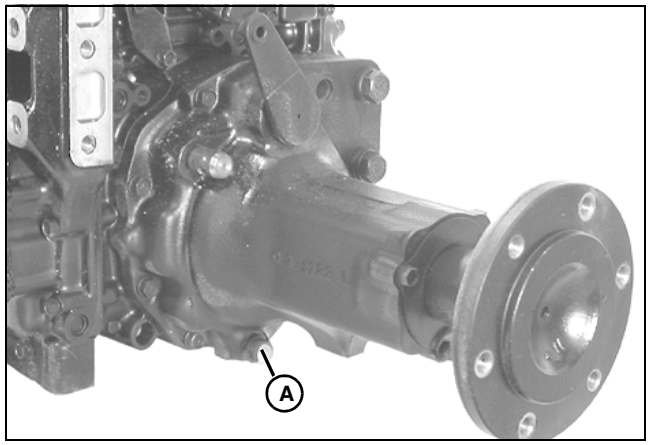
IMPORTANT: Avoid damage! Use care when installing transaxle assembly so as not to pinch hydraulic hoses.

- Fill hydraulic reservoir to correct level with oil meeting specifications.
- Check all connections for leaks. Repair as needed.
- Bleed air from hydraulic system.

Transaxle Disassembly and Inspection

Special or Required Tools

Tool Name	Tool No.	Tool Use
Knife-Edge Puller	NA	Used to remove axle oil seal, bearings, and inner race of pinion shaft.
Two-Jaw Puller	NA	Used to remove bearing and oil seal wear seal.



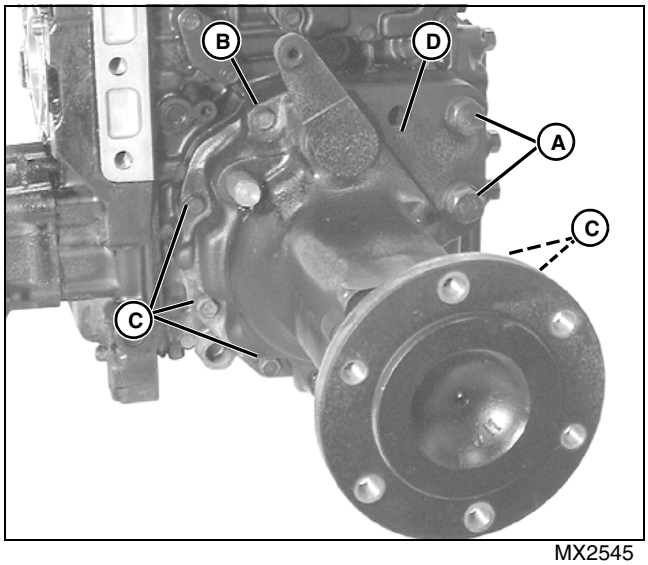
MX2544

NOTE: Transaxle oil capacity is approximately 13.3 L (3.5 gal).

Remove drain plug (A) and drain and drain oil into a properly marked container.

Axle Shaft Housings

NOTE: This disassembly procedure is for the right axle shaft housing. The procedure for the left side is similar, but some parts are not interchangeable, left to right. DO NOT mix right and left side parts.

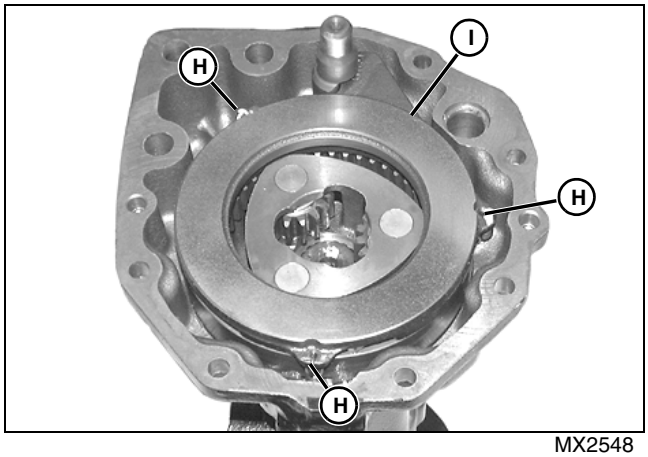


MX2545

1. Remove two large cap screws, flat washers and lock washers (A).
2. Remove M10 x 50 cap screw (B).
3. Remove five M10 x 35 cap screws (C).
4. Remove axle shaft housing (D) and gasket.

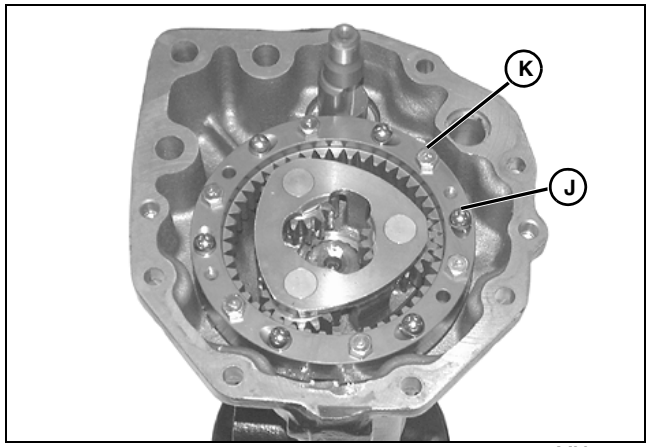
NOTE: The brake disks, separator disks, and drive pinion shaft may remain with the transaxle housing when the axle shaft housing is removed.

5. Remove brake separator disks (E) and brake disks (F).
6. Remove drive pinion shaft (G).



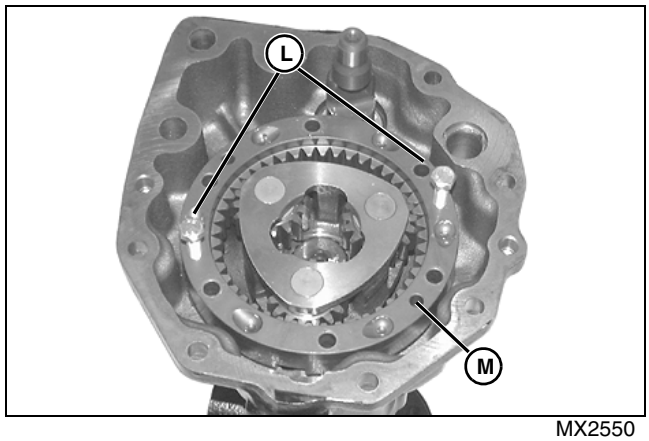
MX2548

7. Remove three springs (H).
8. Remove actuator plate (I).



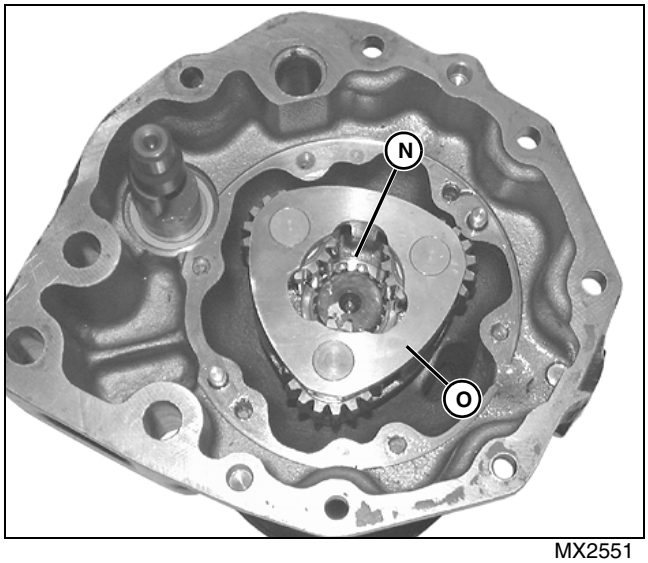
MX2549

9. Remove six steel balls (J).
10. Remove six cap screws (K).



MX2550

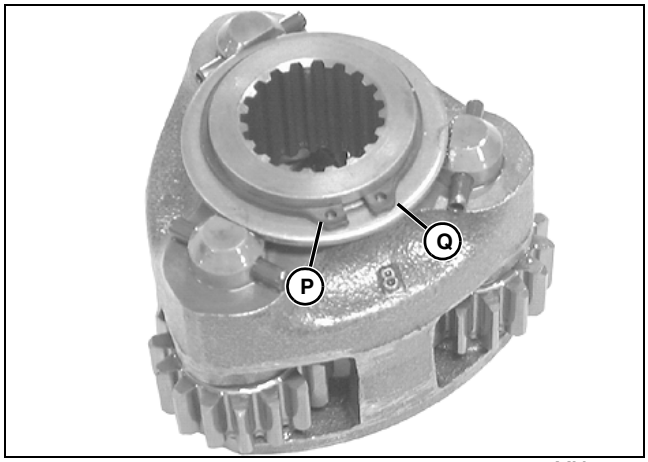
11. Install two M8 x 50 (minimum thread length) cap screws (L) in threaded holes in ring gear 180° apart.
12. Turn the cap screws in evenly to pull the ring gear off the alignment pins.
13. Remove ring gear (M).



MX2551

14.Remove snap ring (N).

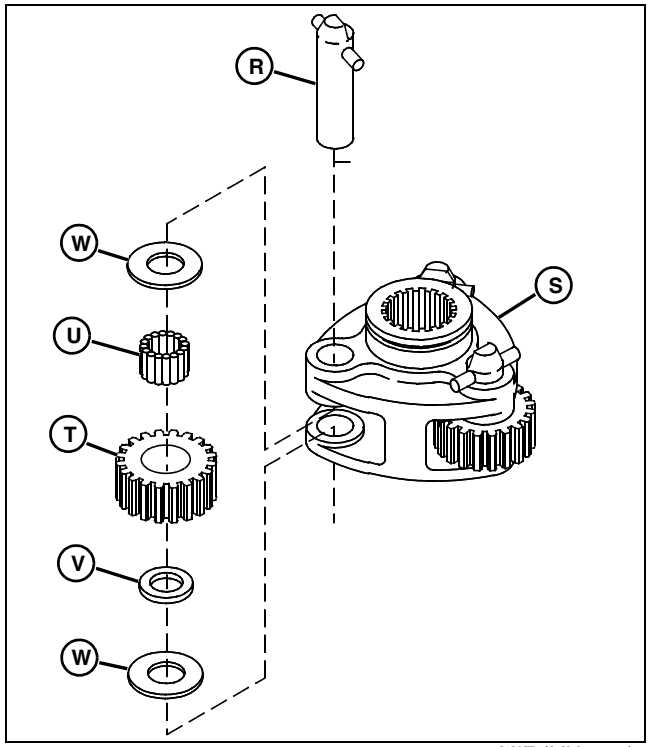
15.Remove planetary gear assembly (O).



MX2554

16.Remove snap ring (P) and washer (Q).

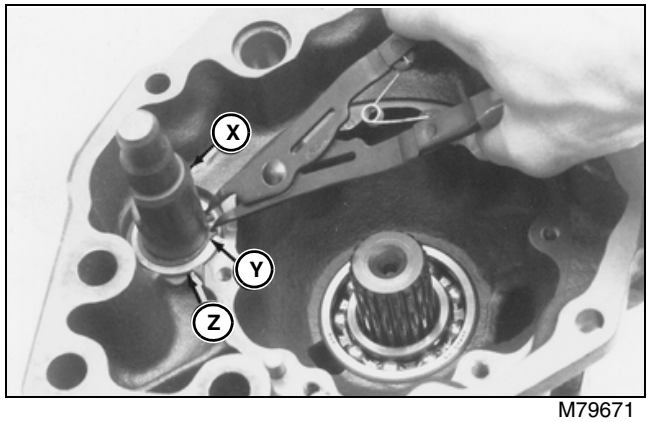
NOTE: Use caution when removing pinion gears, so as not to lose the 22 needle bearings in each gear. Bearings are loose inside the gear.



MIF (MX2555)

17.Remove three pinion shafts (R) from housing assembly (S).

18.Remove pinion gear (T) and needle bearings (U), and washers (V and W).



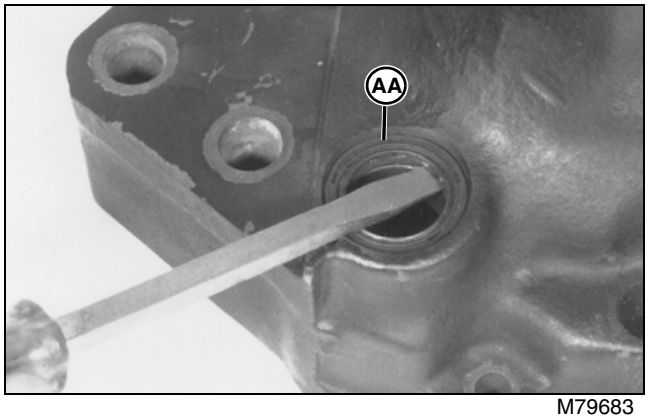
M79671

19.Remove snap ring (Y).

20.Remove brake camshaft (X).

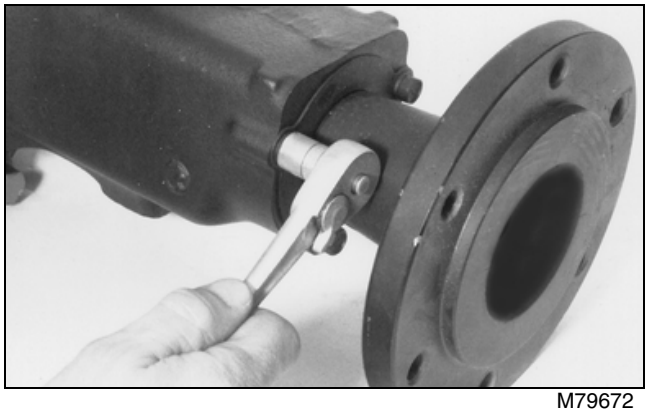
21.Remove flat washer (Z).

22.Turn the final drive over and allow it to rest on the mounting flange.



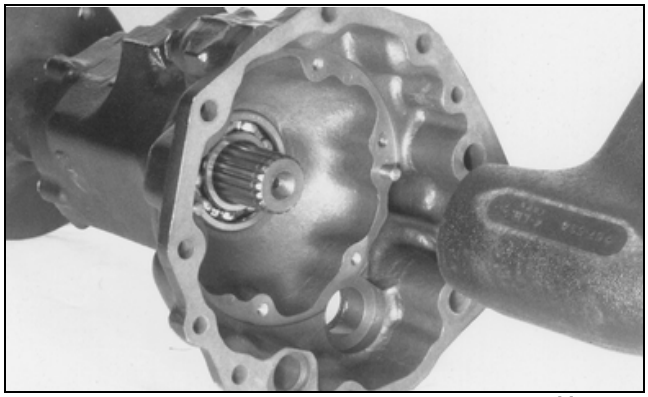
M79683

23.Remove the brake camshaft oil seal (AA).



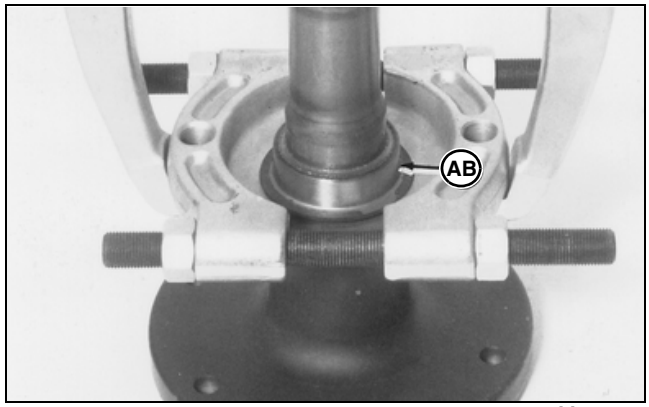
M79672

24.Remove three cap screws.



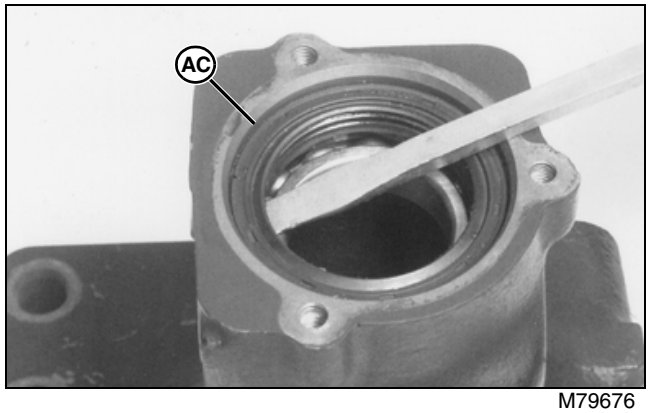
M79673

25.Drive the axle out of the housing using a soft-faced hammer.



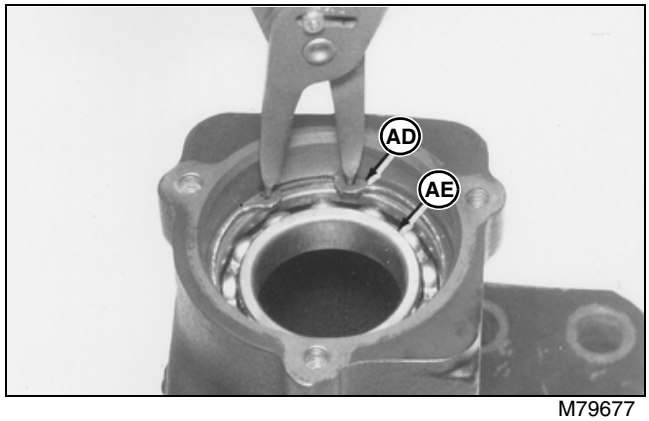
M79674

26.Remove the oil seal (AB) from the axle using a knife-edge puller.



M79676

27.Remove oil seal (AC) from axle housing.

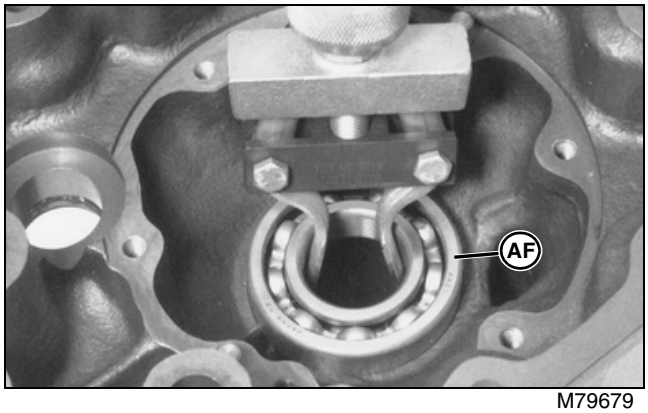


M79677

28.Inspect outer bearing (AE) for wear, damage or rough movement. Remove the bearing only if replacement is required.

29.Remove snap ring (AD).

30.Remove outer bearing.



M79679

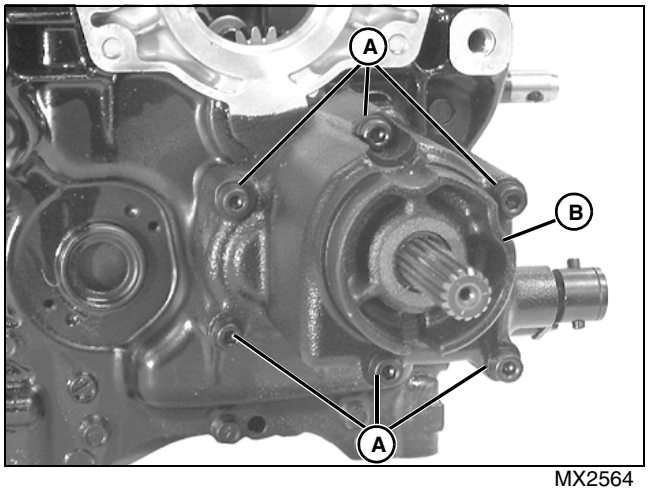
31.Inspect inner bearing (AF) for wear, damage or rough movement. Remove the bearing only if replacement is required.

32.Remove inner bearing, using a puller if needed.

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

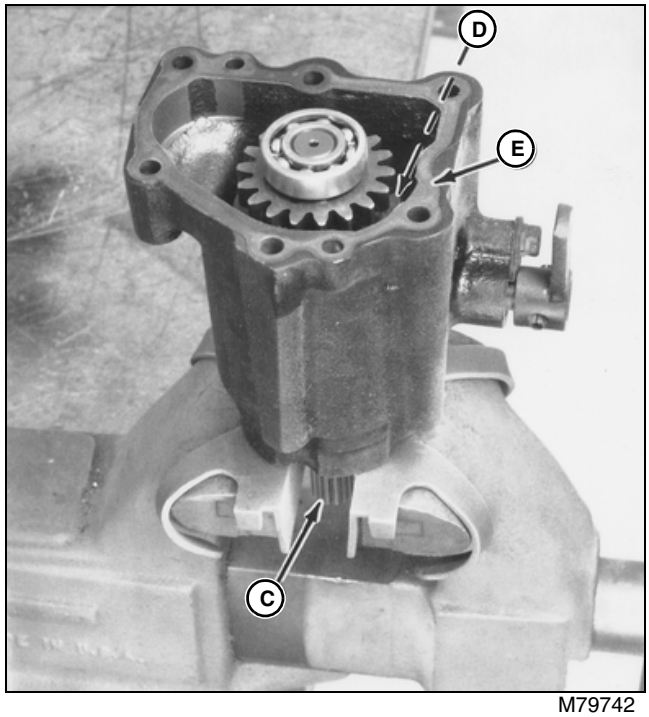
MRWD Gear Case

NOTE: The MRWD output shaft seal and shaft assembly can be repaired without disassembling the entire transaxle.



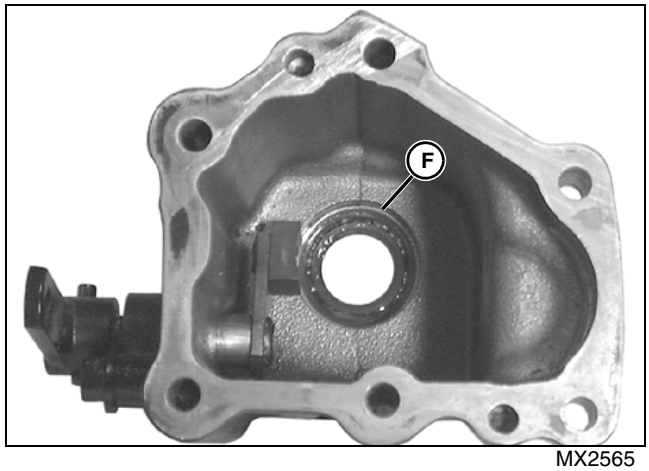
MX2564

1. Remove six socket-head cap screws and washers (A).
2. Remove MRWD gear case assembly (B).



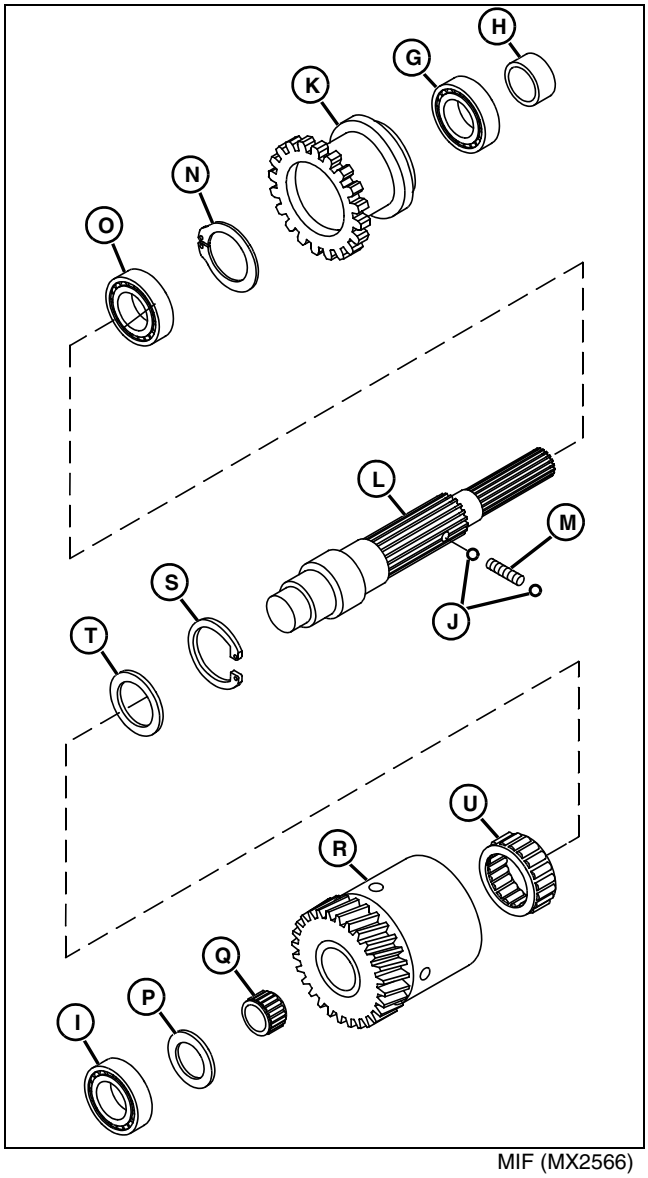
M79742

3. Place assembly on top of a soft-jaw vise, so that the splined shaft (C) is between the jaws, but not clamped.
4. Remove shaft assembly from housing by clearing shifting collar from shifting finger (D).
5. Remove gasket (E) and thoroughly remove any gasket residue from mating surface.



MX2565

6. Remove seal (F).



MIF (MX2566)

7. Remove bearing (G) and oil seal wear seal (H) using a two-jaw puller.

8. Remove bearing (I) using a knife-edge puller.

NOTE: Detent balls are spring loaded in the shaft. DO NOT lose them when removing the shift collar.

9. Wrap a shop cloth around the shaft assembly, and then slowly slide the shift collar (K) off the shaft (L).

10. Remove detent balls (J) and spring (M).

11. Remove snap ring (N).

12. Remove bearing (O).

13. Remove washer (P) and needle bearing (Q).

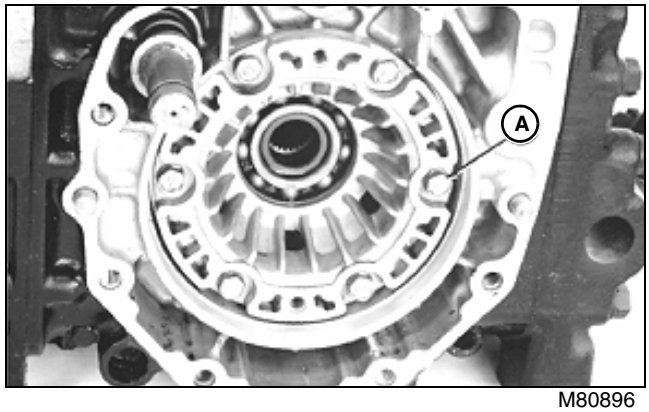
14. Remove clutch housing (R).

15. Remove snap ring (S) and over running clutch bearing (T).

16. Remove clutch sprag bearing (U).

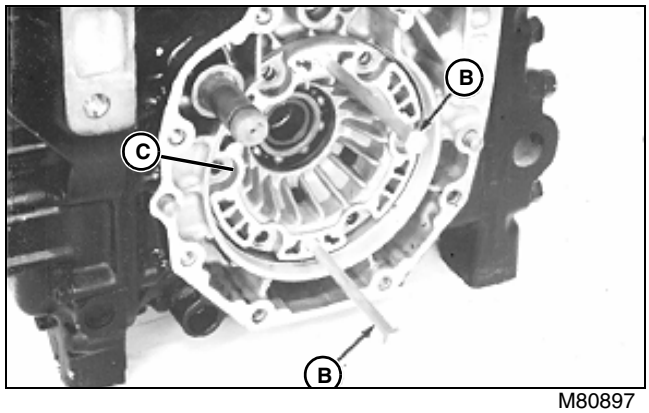
17. Inspect all parts for wear or damage. Replace parts as needed.

Differential Assembly



M80896

1. Remove six cap screws and washers (A) from right-side differential carrier.



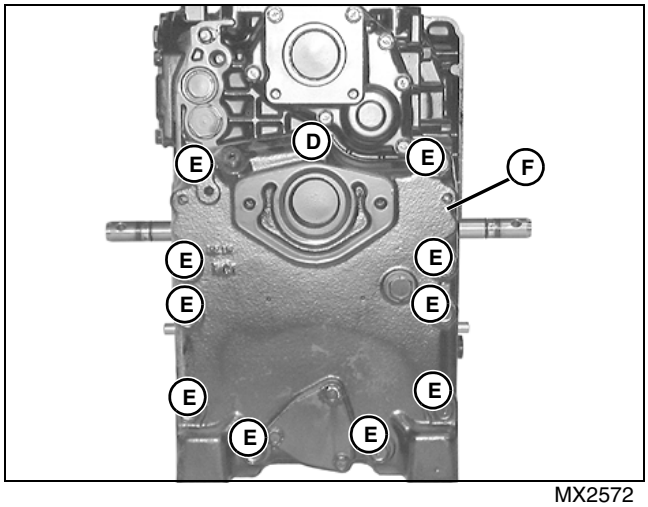
M80897

2. Install two 8 mm cap screws (B) into threaded holes.

3. Turn the cap screws in evenly to pull the differential carrier from the housing.

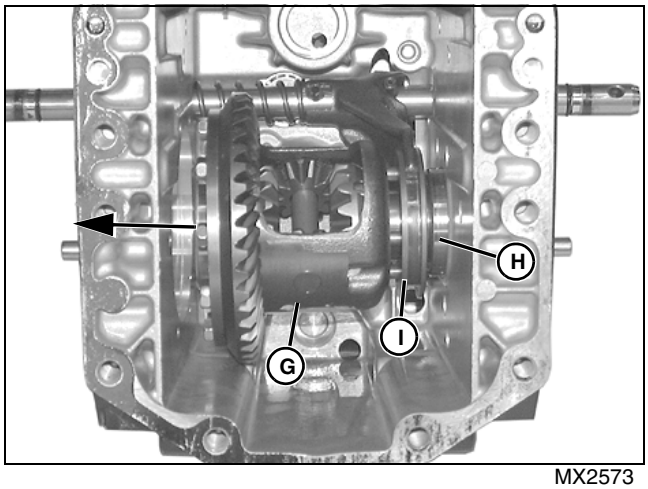
NOTE: Note the number of shims when removing the differential carrier.

4. Remove the differential carrier (C) and shims.



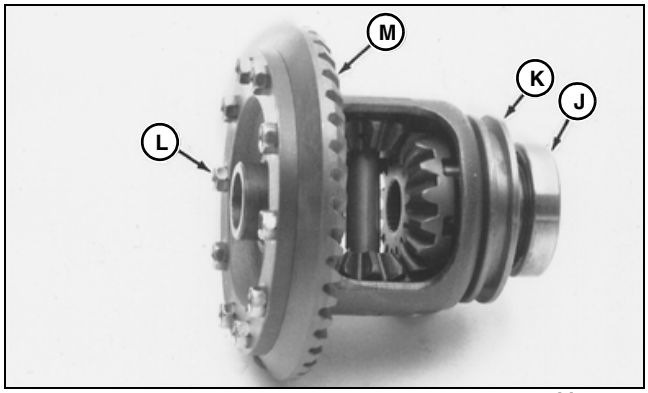
MX2572

5. Remove M10 cap screw (D).
6. Remove ten M12 cap screws (E).
7. Remove front cover (F).



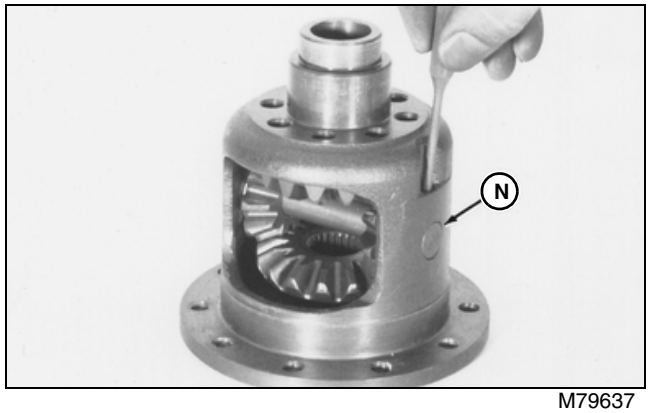
MX2573

8. Slide the differential assembly (G) to the left until the bearing (H) clears the housing, and the shift collar (I) clears the shift fork. Remove the differential assembly.



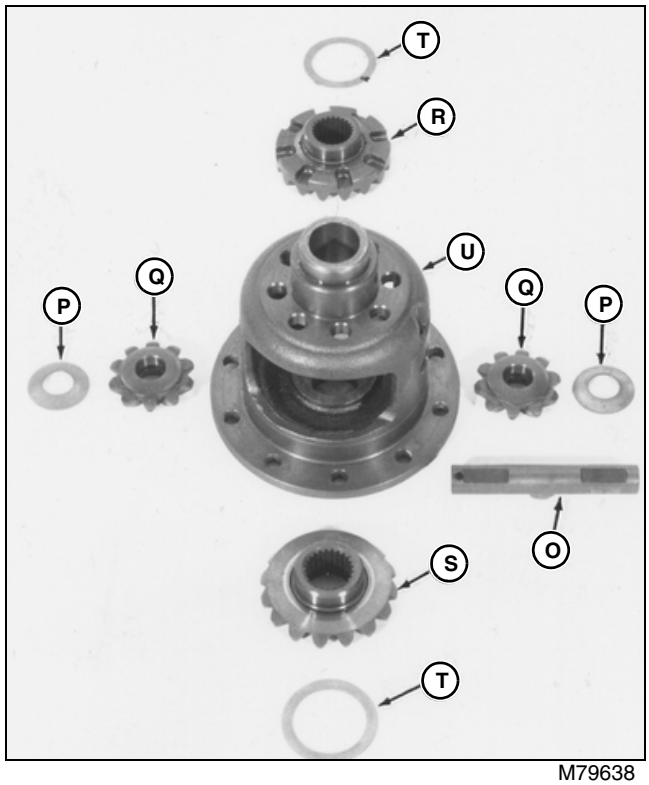
M79636

9. Using a knife-edge puller, remove bearing (J).
10. Remove shift collar (K).
11. Remove ten cap screws (L).
12. Remove ring gear (M).



M79637

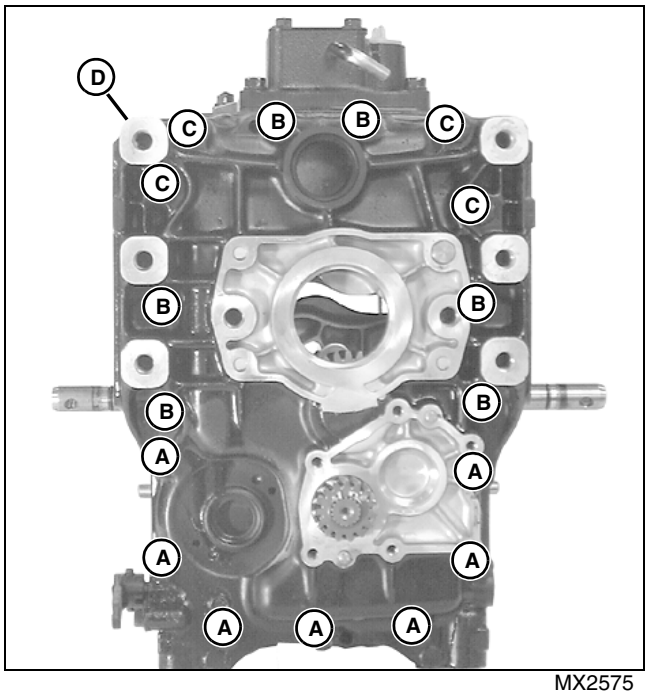
13. Using a punch, drive the spring pin (N) from the pinion cross shaft.



M79638

14. Remove the pinion cross shaft (O), bevel washers (P), pinion gears (Q), right side gear (R), left side gear (S), and flat thrust washers (T) from differential housing (U).
15. Inspect all parts for wear or damage. Replace parts as needed.

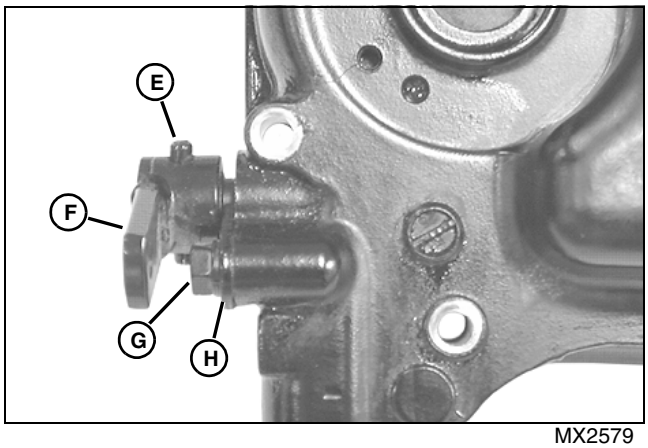
Rear Cover Assembly



MX2575

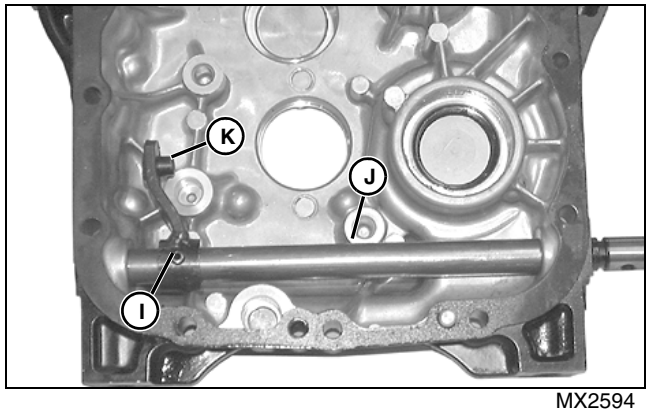
1. Remove seven M8 x 50 cap screws (A).
2. Remove six M10 x 50 cap screws (B).
3. Remove four M12 x 80 cap screws (C).
4. Remove rear cover (D).

NOTE: The high/low range levers and shaft do not have to be removed unless parts or O-ring require replacement. If not required, proceed to idler and pinion shaft assemblies.



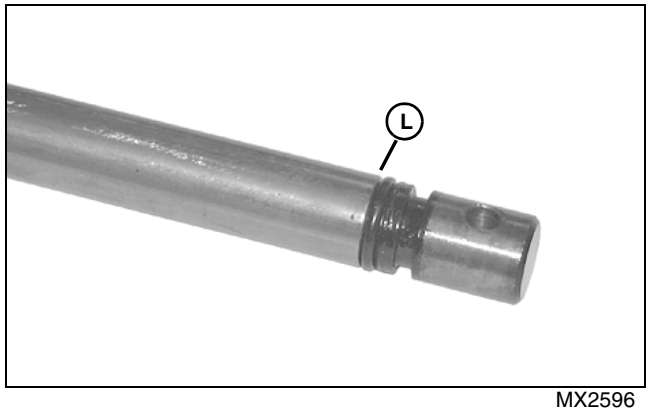
MX2579

5. Remove spring pin (E).
6. Remove external shifter arm (F).
7. Remove cap screw (G) and retainer plate (H).



MX2594

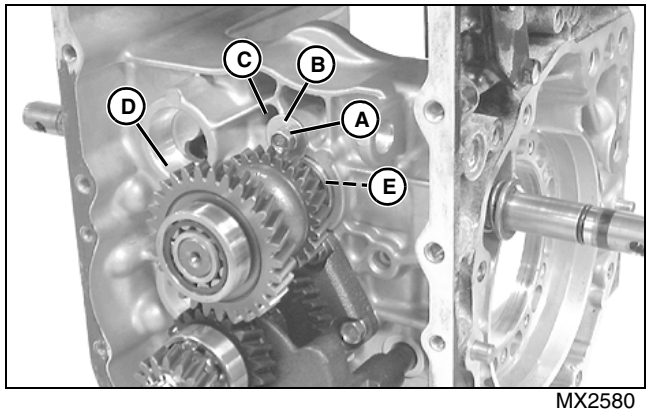
8. Remove spring pin (I).
9. Remove range shift shaft (J) and arm (K).



MX2596

10.Remove O-ring (L).

Idler and Pinion Shaft Assemblies

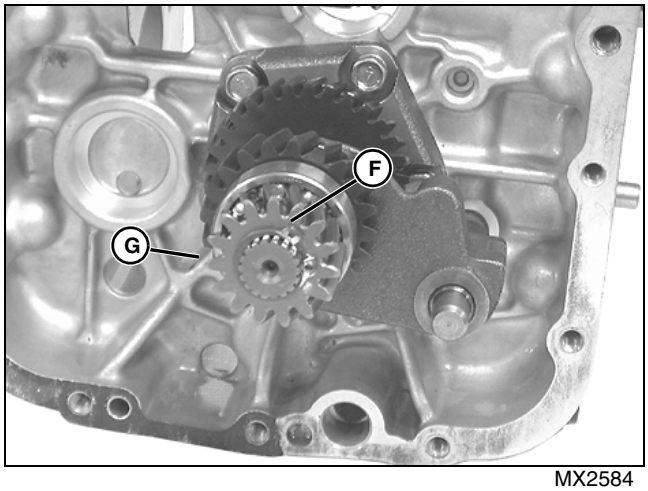


MX2580

1. Remove cap screw (A), lock washer (B) and flat washer (C).

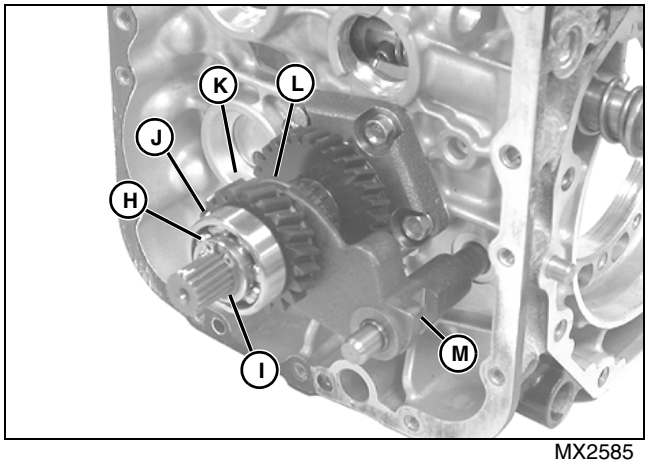
NOTE: Record the number of shims removed to ensure proper alignment when installing.

2. Remove idler shaft assembly (D) and shims (E).



MX2584

3. Remove snap ring (F) and MRWD drive gear (G).



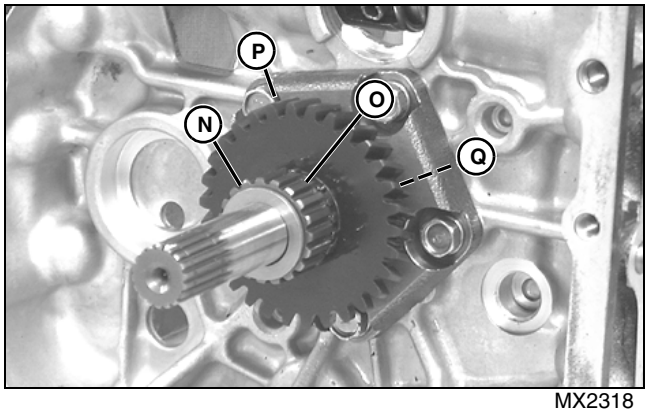
MX2585

4. Remove snap ring (H) and spacer (I).

5. Remove bearing (J) using a knife-edge puller.

6. Remove gear (K) and sleeve.

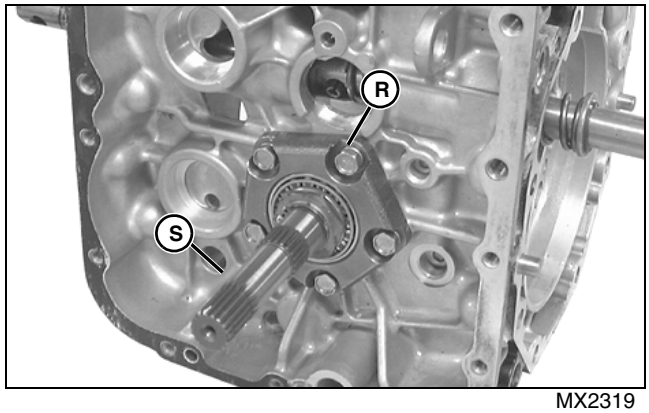
7. Remove shift collar (L) and range shift fork assembly (M).



MX2318

8. Remove washer (N).

9. Remove splined coupler (O), gear (P) and special washer (Q).



MX2319

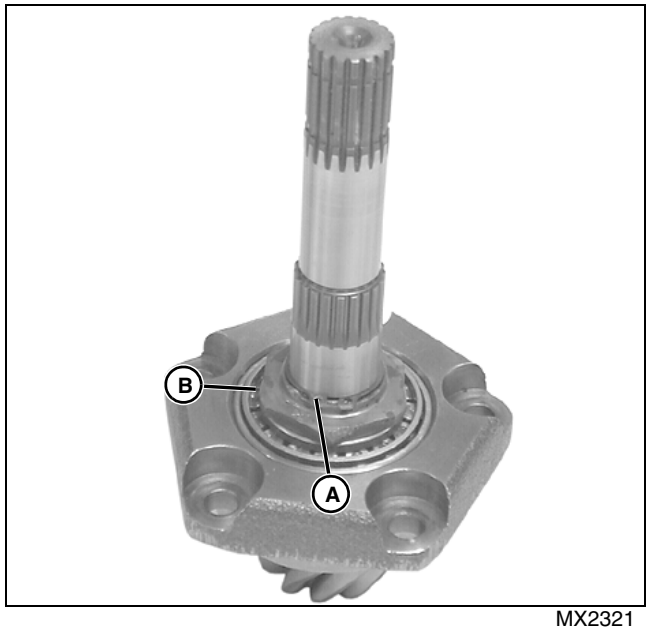
10.Remove five cap screws (R).

NOTE: Record the number of shims removed to ensure proper preloading when installing.

11.Remove differential pinion shaft assembly (S) and shims.

Pinion Shaft Assembly

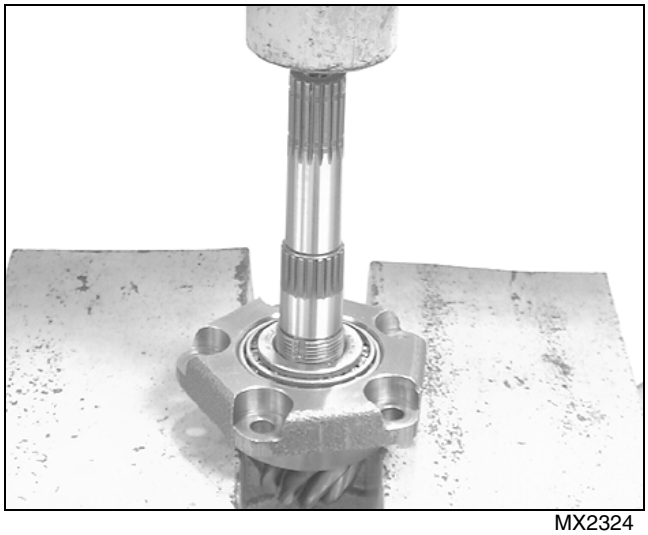
NOTE: The pinion shaft assembly does not have to be disassembled unless repair is required. Inspect the components for damage and the bearings for wear before disassembly.



MX2321

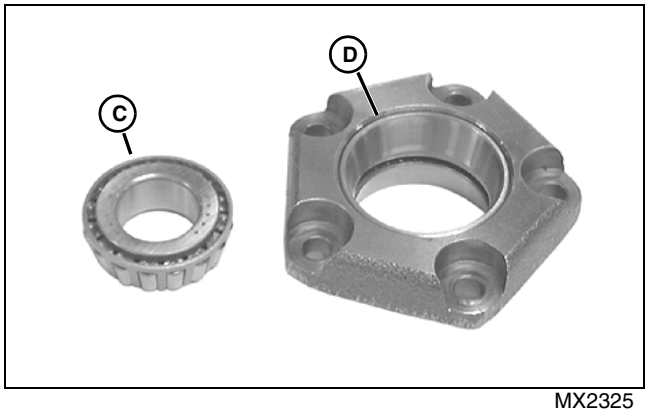
1. Remove snap ring (A).

2. Remove nut (B).



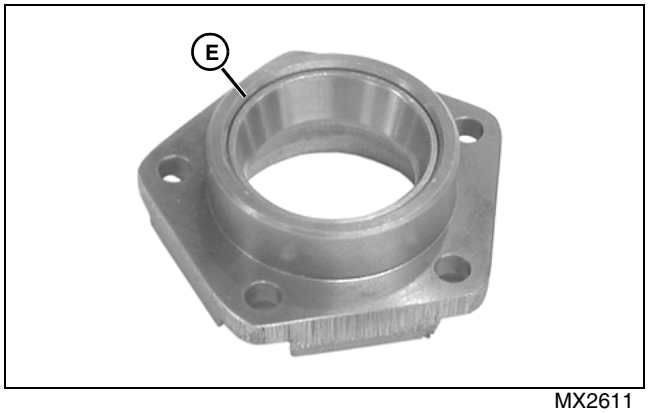
MX2324

3. Using a press, remove pinion shaft from housing.



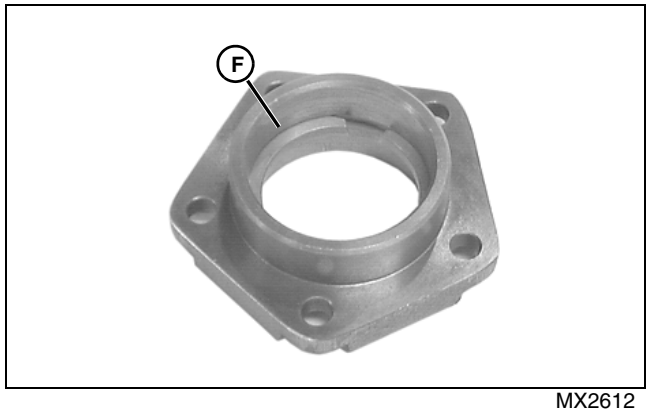
MX2325

4. Remove bearing (C) and bearing cone (D).



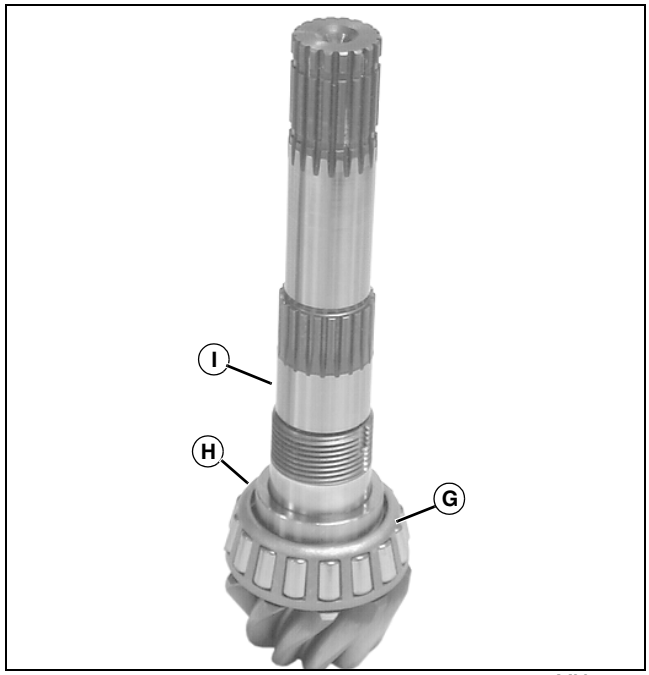
MX2611

5. Turn housing over and remove inner bearing cone (E).



MX2612

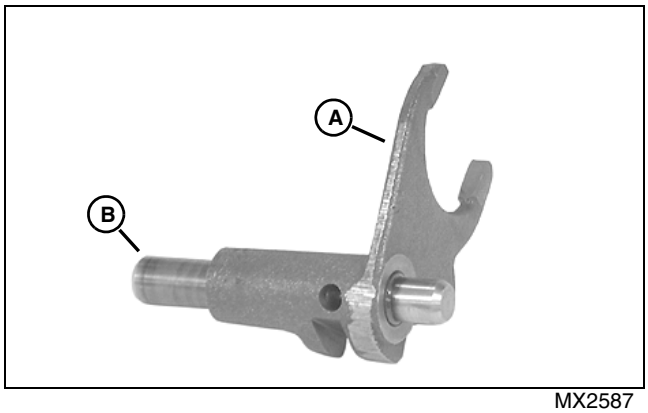
6. Inspect snap ring (F). Replace as needed.



MX2610

7. Using a knife-edge puller, remove the bearing (G) and inner race (H) from the pinion shaft (I).

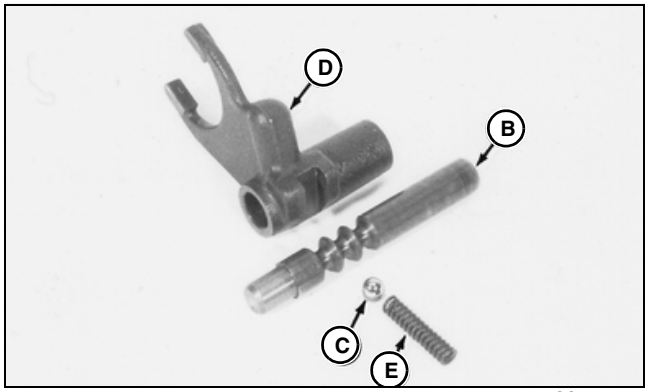
Range Shift Fork Assembly



MX2587

1. Inspect range shift fork assembly. Hold fork (A) and apply pressure to the end of the shaft (B). The shaft should move from one detent to another and firmly lock in place. Disassemble only if the shaft does not move or does not hold in detent positions.

NOTE: Detent ball is spring loaded in the housing (D). DO NOT lose them when removing the shaft.

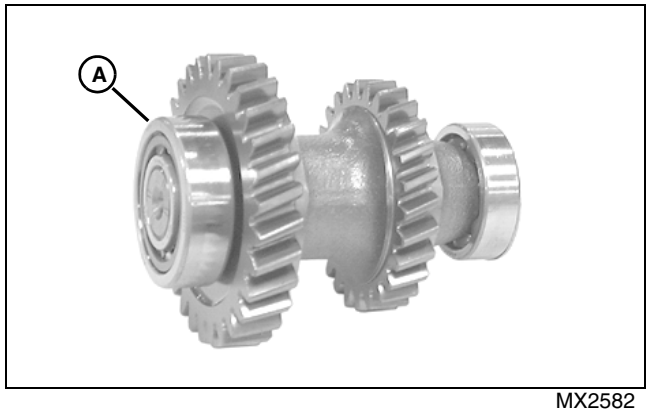


M79660

2. Remove shaft (B), detent ball (C), and spring (E). Replace parts as needed.

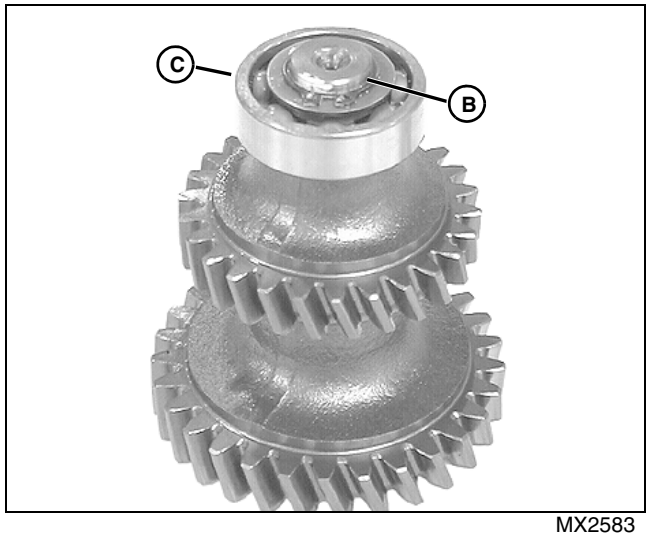
Idler Shaft Assembly

NOTE: The idler shaft assembly does not have to be disassembled unless repair is required. Inspect the components for damage and the bearings for wear before disassembly.



MX2582

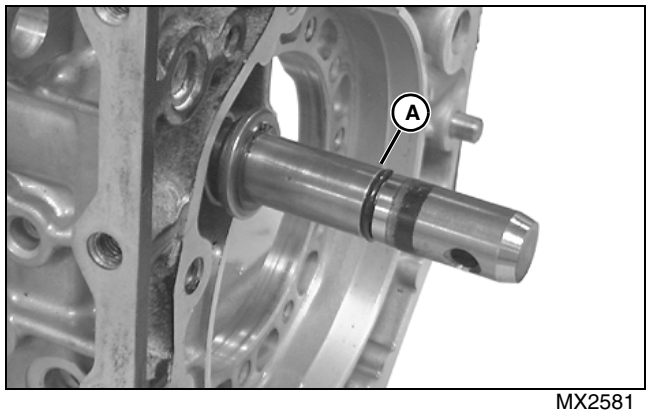
1. Remove roller bearing and inner race (A).



MX2583

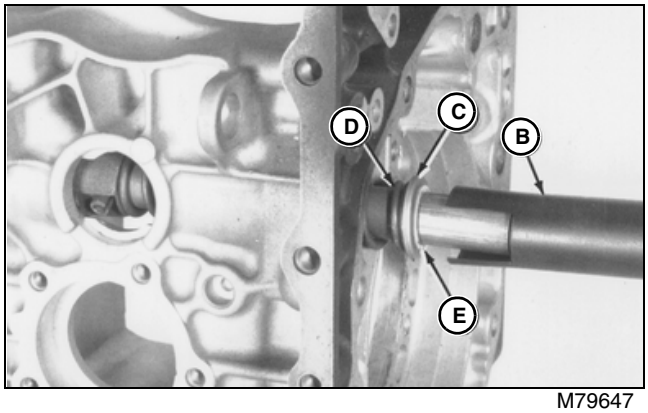
2. Remove snap ring (B).
3. Remove ball bearing (C) using a knife-edge puller.

Differential Lock Shaft



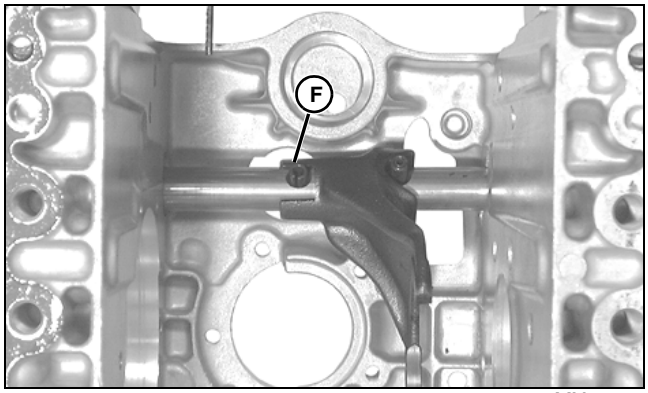
MX2581

1. Remove O-ring (A).



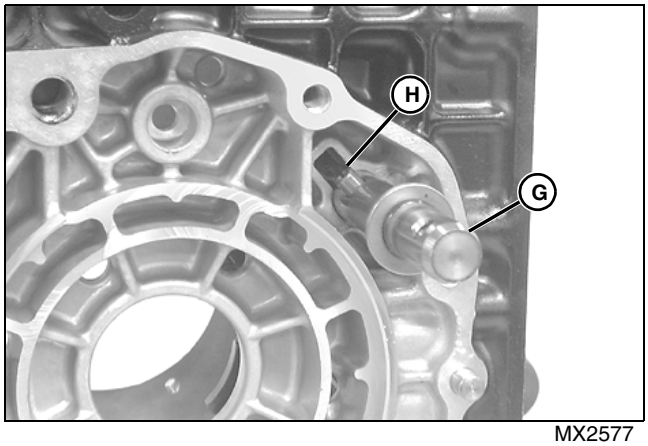
M79647

2. Place spring compression tool (B) against washer (C) and depress and hold spring (D).
3. Remove snap ring (E).
4. Slowly release spring.
5. Remove spring (D) and washer (C).

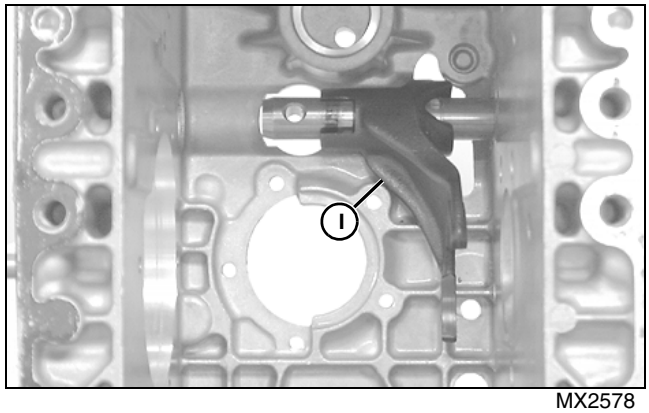


MX2576

6. Remove spring pin (F).

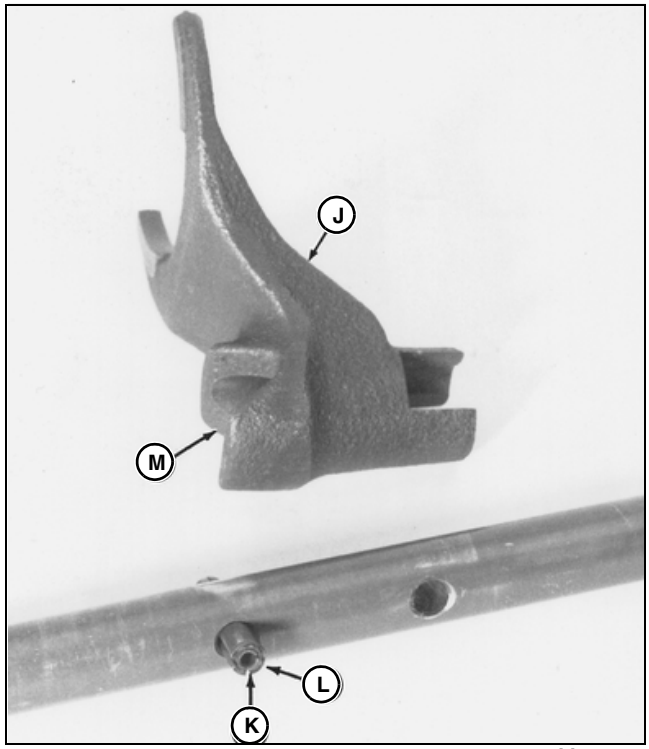


MX2577



MX2578

7. Rotate the differential lock shaft (G) until the spring pin (H) aligns with the slot in the housing.
8. Pull the shaft out slowly and remove the shift fork (I).



M79649

9. Inspect shift fork (J) for wear or damage. Replace as needed.
10. Inspect the double spring pins (K and L). The large (outside) spring pin (L) should have the open side facing away from the groove (M) of the shift fork. The small (inside) spring pin (K) should have the open side toward the groove of the shift fork. Replace as needed.

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

11.Clean all parts with solvent and blow dry using compressed air.

Transaxle Assembly

Special or Required Tools

Tool Name	Tool No.	Tool Use
Bushing, Bearing, and Seal Driver Set	NA	Used to install bearing and differential assembly. Used to install axle housing seal.
Pipe with Inside Diameter of 51 mm (2 in.)	NA	Used to install oil seal wear sleeve on axle shaft.
Pipe with Inside Diameter of 40 mm (1-9/16 in.)	NA	Used to install new inner bearing in axle shaft housing.

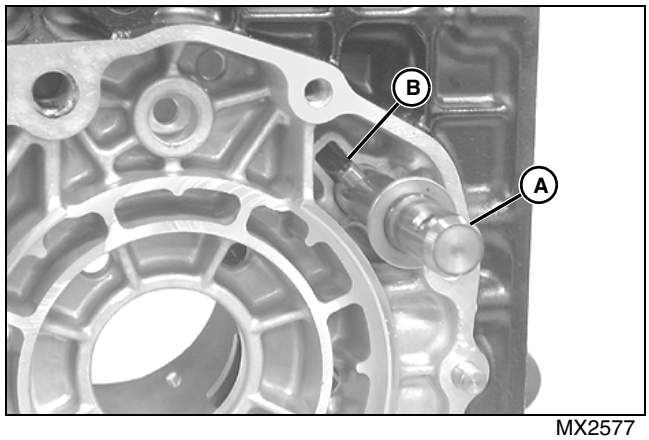
Other Material

Part No.	Part Name	Part Use
TY16285 (US) 7649 (LOCTITE®) CXTY16285 (Canada)	Cure Primer	Applied to threads of ring gear cap screws before installation.
T43512 (US) 242 (LOCTITE) TY9473 (Canada)	Thread Lock and Sealer (Medium Strength)	Applied to threads of ring gear cap screws before installation.

Differential Lock Shaft

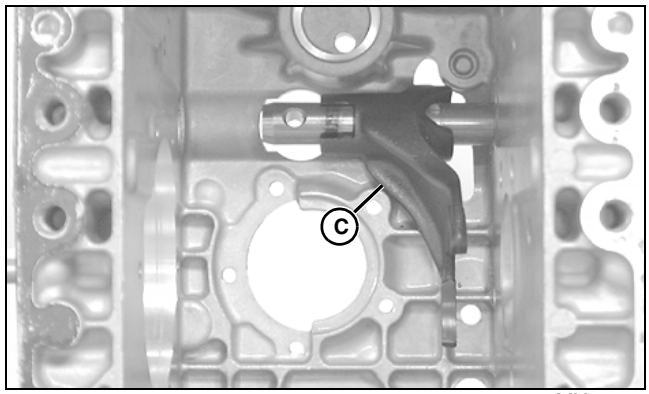
IMPORTANT: Avoid damage! Always use new O-rings and seals. Damaged or used parts will leak.

NOTE: Apply a light film of clean hydraulic oil to all internal parts before installing.



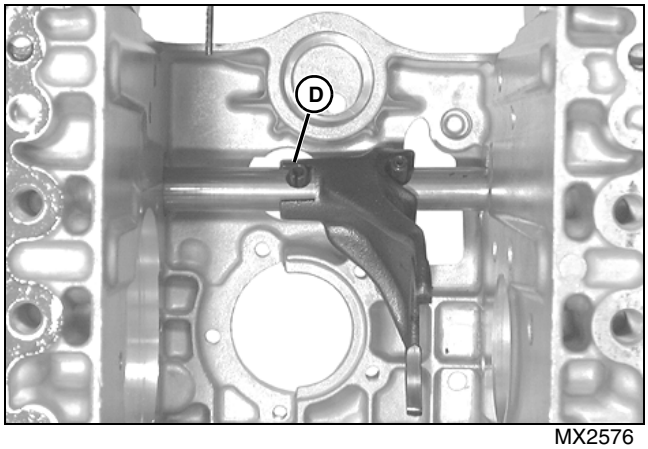
MX2577

1. Install the differential lock shaft (A) into the housing. Rotate the shaft until the spring pin (B) aligns with the slot in the housing, but do not slide the shaft through the hole in the other side of the housing.



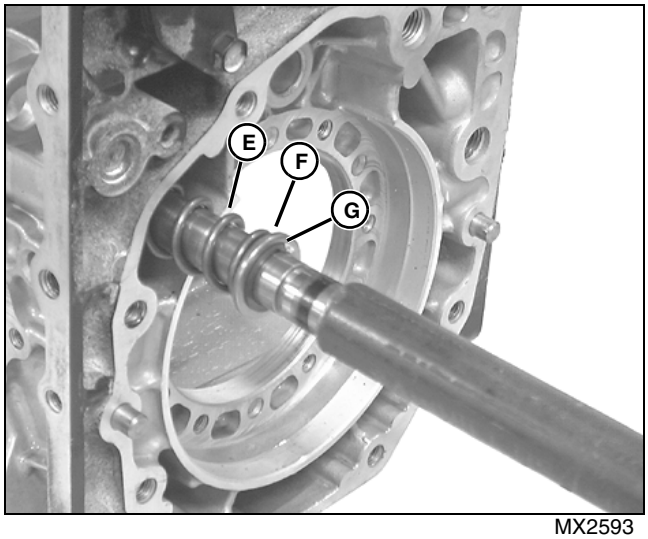
MX2578

2. Install the shift fork (C) onto the differential lock shaft, and slide the shaft through the hole in the other side of the housing.



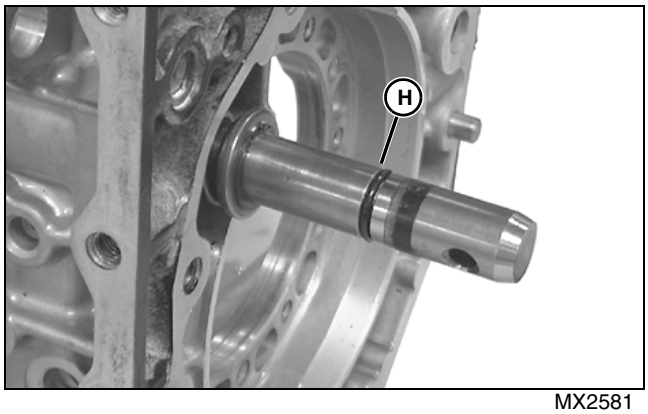
MX2576

3. Install spring pin (D).



MX2593

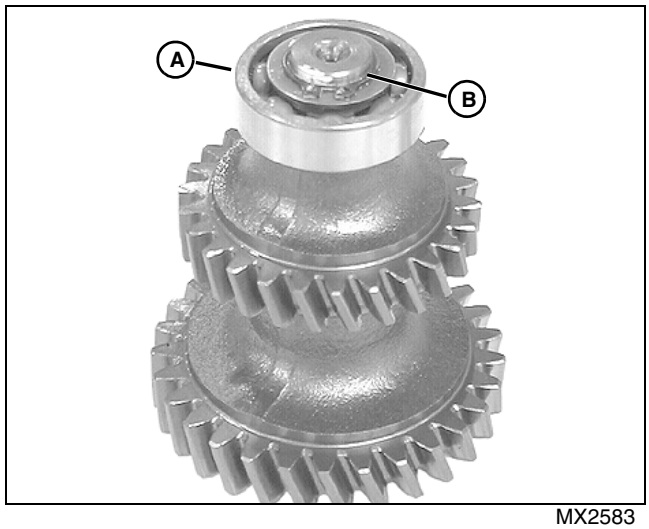
4. Install spring (E) and washer (F).
5. Install snap ring (G) on the shaft past the O-ring groove.
6. Using a length of 25 mm (1 in.) inside diameter pipe, push the snap ring, washer, and spring in until the snap ring is seated in its groove.



MX2581

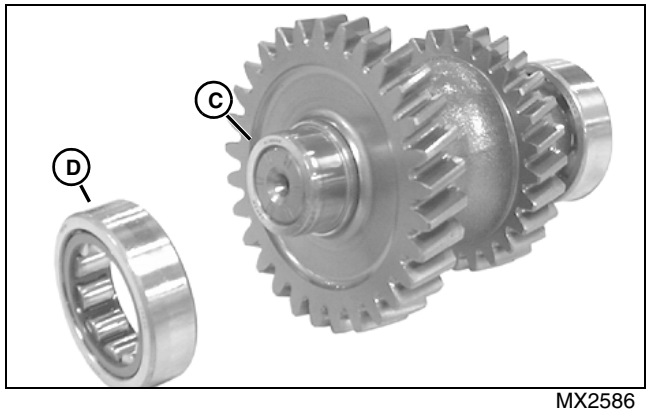
7. Install O-ring (H).

Idler Shaft Assembly



MX2583

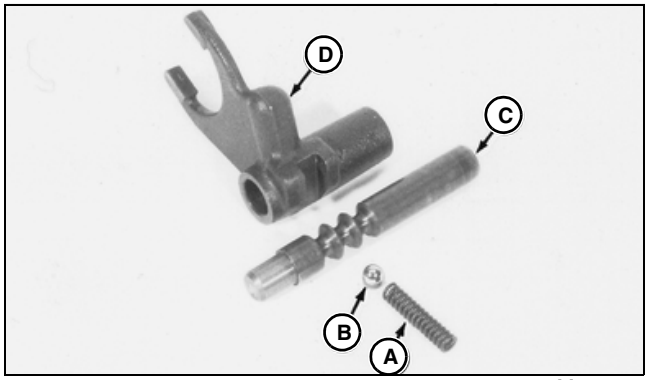
1. Install ball bearing (A).
2. Install snap ring (B).



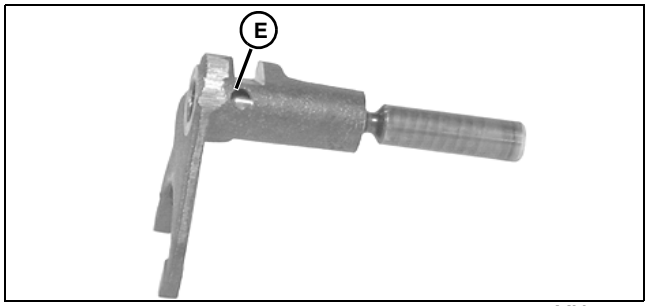
MX2586

3. Install inner bearing race (C) with shoulder toward gear.
4. Install roller bearing (D).

Range Shift Fork Assembly



M79660

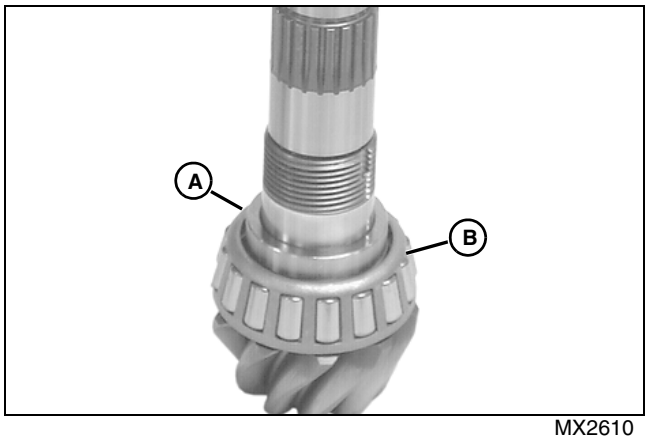


MX2588

1. Install spring (A) and detent ball (B).
2. Slide shaft (C) into housing (D).
3. Insert a punch through the hole (E) in the lever to compress the detent ball and spring. Hold the punch while pushing the shaft into the housing. Remove the punch once the shaft is covering the ball and spring.

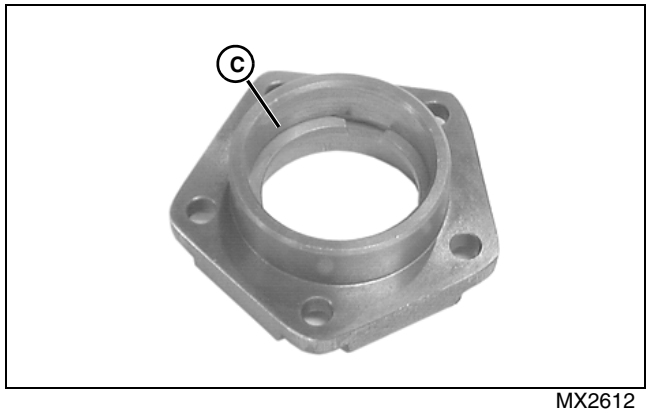
Pinion Shaft Assembly

IMPORTANT: Avoid damage! Press on inner race only to prevent damaging the bearing.



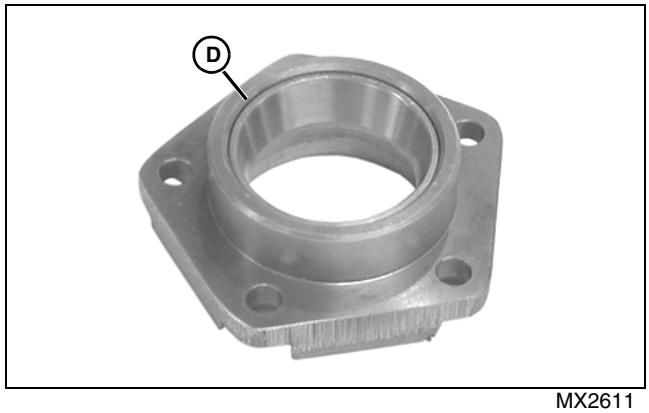
MX2610

1. Install bearing (B) and inner race (A). Press bearing onto shaft until the inner race makes contact with the pinion flange.



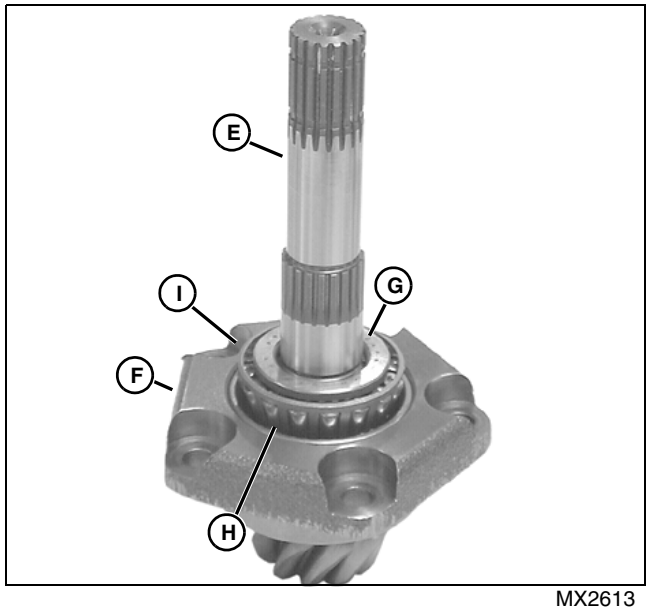
MX2612

2. Install snap ring (C).



MX2611

3. Install bearing cone (D).



MX2613

4. Install pinion shaft (E) in housing (F).

IMPORTANT: Avoid damage! Press on the inner race only to prevent damaging the bearing.

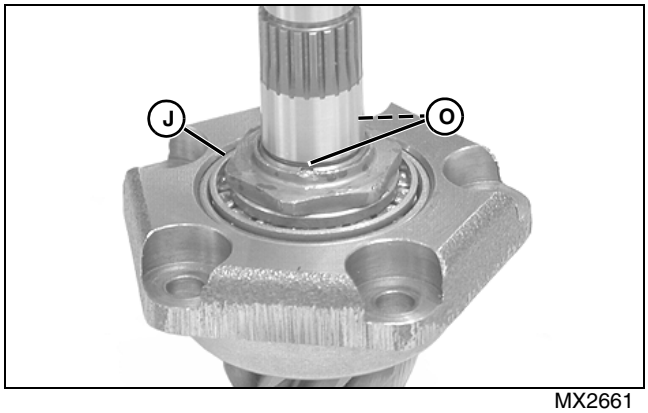
5. Install bearing cone (H) and bearing (I). Press on bearing inner race (G) to seat the bearing into the housing.

NOTE: In order to tighten the pinion nut to the correct specifications, it will be necessary to use a crows-foot extension added to the torque wrench. Whenever an extension is used, the calculation shown will be needed to obtain the correct torque specifications.

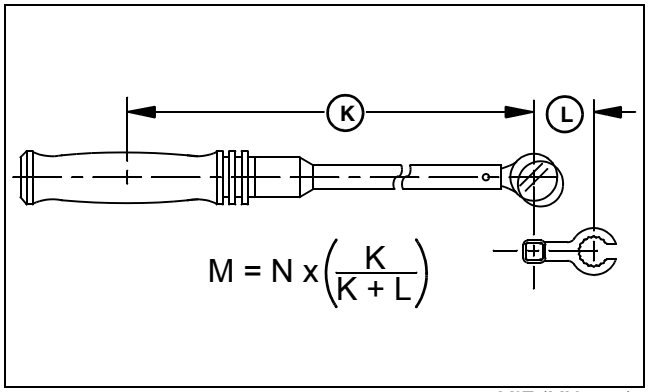
With the extension installed, the centerline of the torque wrench must point through the centerline of the items being tightened.

The length of the torque wrench (K) is measured from the center of the drive to center of the grip.

The effective length of the extension (L) is measured from the center of the drive to the center of the item being tightened.



MX2661

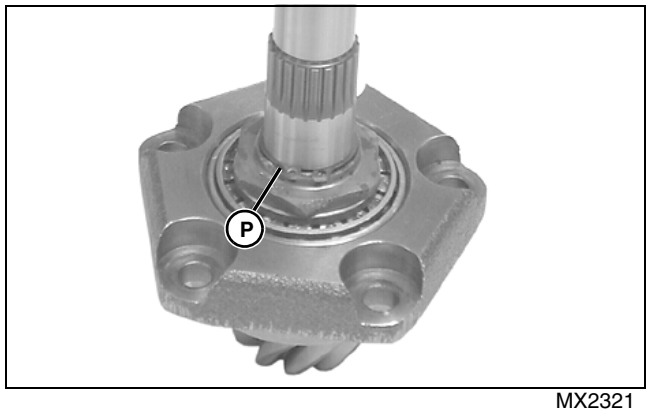


MIF (MX2664)

A - Length of Torque Wrench
B - Effective Length of Extension
C - Torque Wrench Setting
D - Torque Applied to Item

6. Install pinion nut (J). Tighten nut to specification.

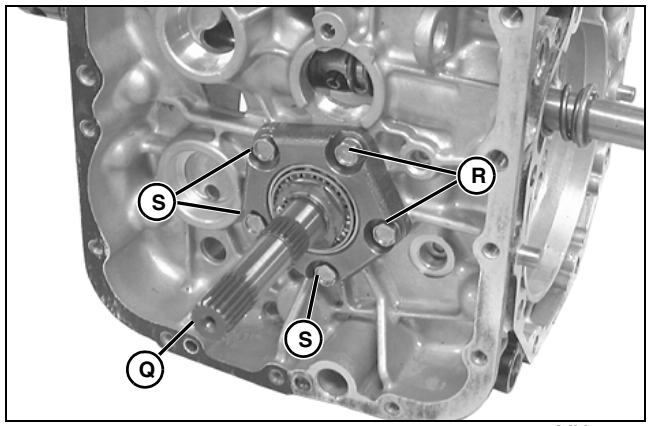
7. Using a punch, stake the nut at the notches, 180° apart (O) on the pinion shaft, to prevent the nut from turning.



MX2321

8. Install snap ring (P).

IMPORTANT: Avoid damage! Install the same number of shims that were removed to obtain the proper preload.

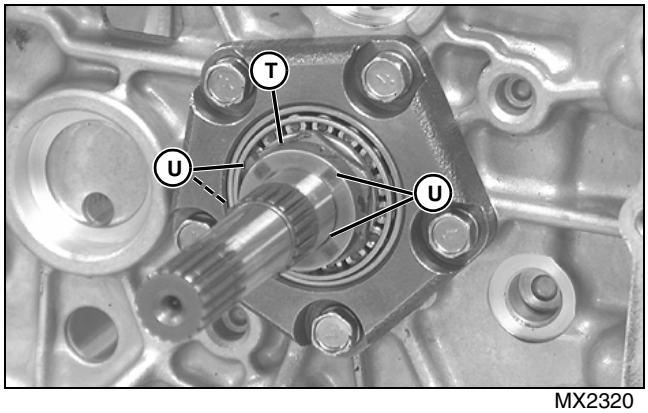


MX2319

9. Install differential pinion shaft assembly (Q) and shims.

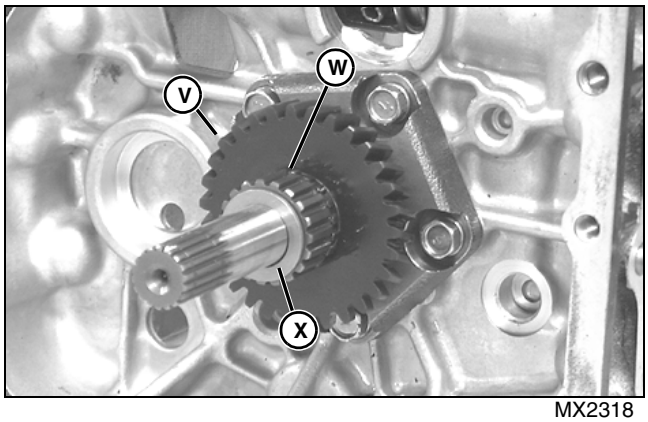
10. Install two cap screws (R) on the right side. Tighten to specification.

11. Install three remaining cap screws (S). Tighten to specification.



MX2320

12.Install special washer (T) with dished areas (U) facing away from bearings.

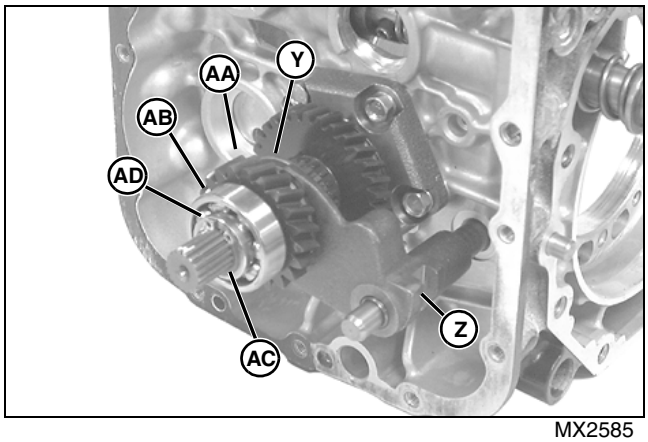


MX2318

13.Install gear (V)

14.Install splined coupler (W) with smooth end of inner bore toward gear.

15.Install washer (X).



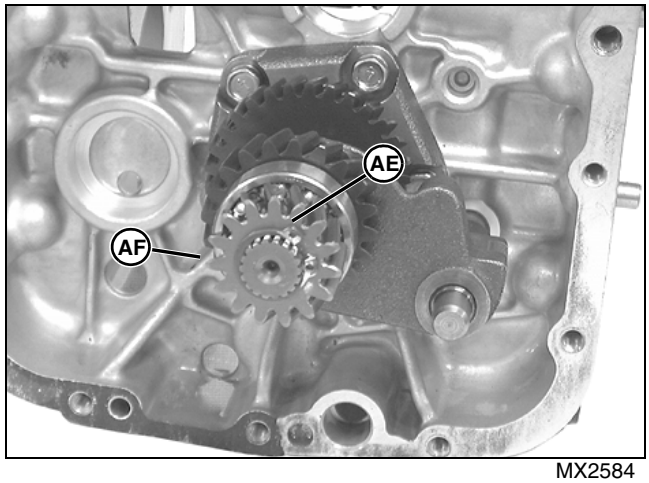
MX2585

16.Install shift collar (Y) and range shift fork assembly (Z).

17.Install gear (AA) and sleeve.

18.Install bearing (AB).

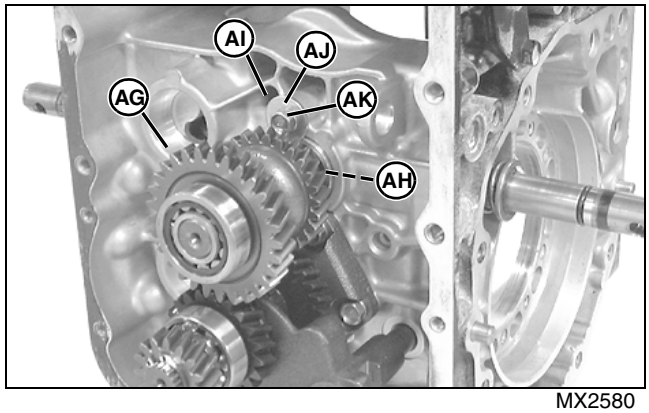
19.Install spacer (AC) and snap ring (AD).



MX2584

20.Install MRWD drive gear (AE) and snap ring (AF).

IMPORTANT: Avoid damage! Install the same number of shims that were removed to obtain the proper alignment.

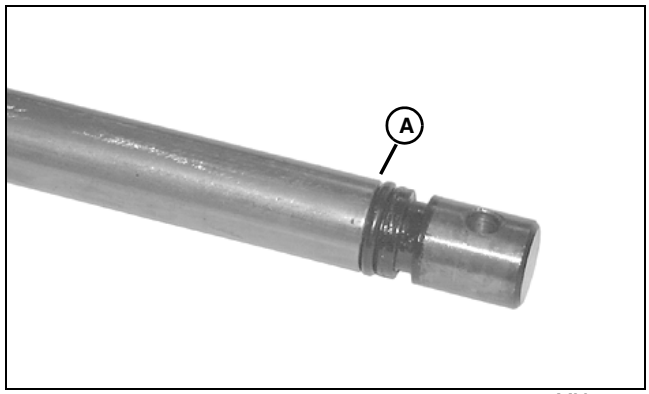


MX2580

21.Install idler shaft assembly (AG) and shim(s) (AH).

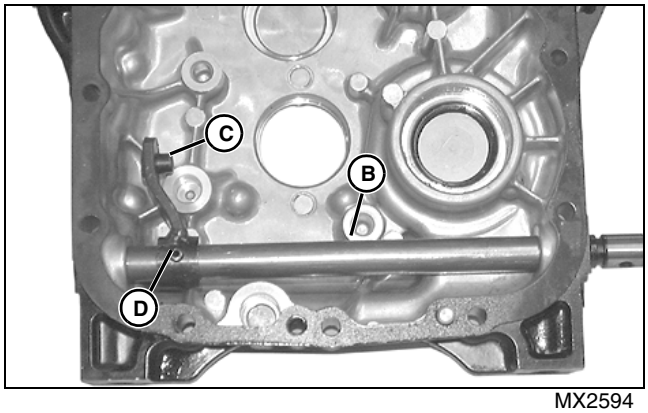
22.Install flat washer (AI), lock washer (AJ) and cap (AK).

Rear Cover Assembly



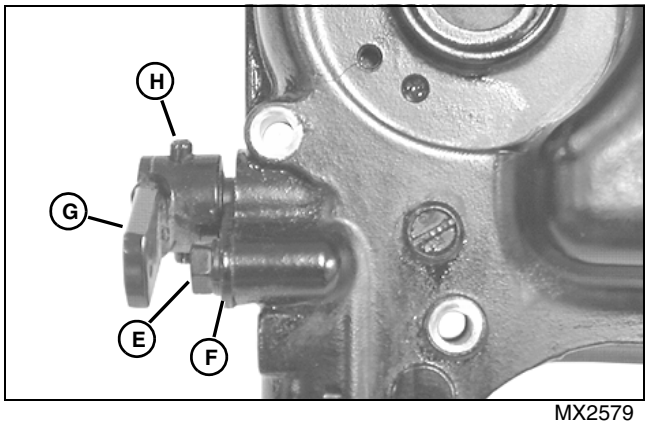
MX2596

1. Install new O-ring (A) on range shift shaft.



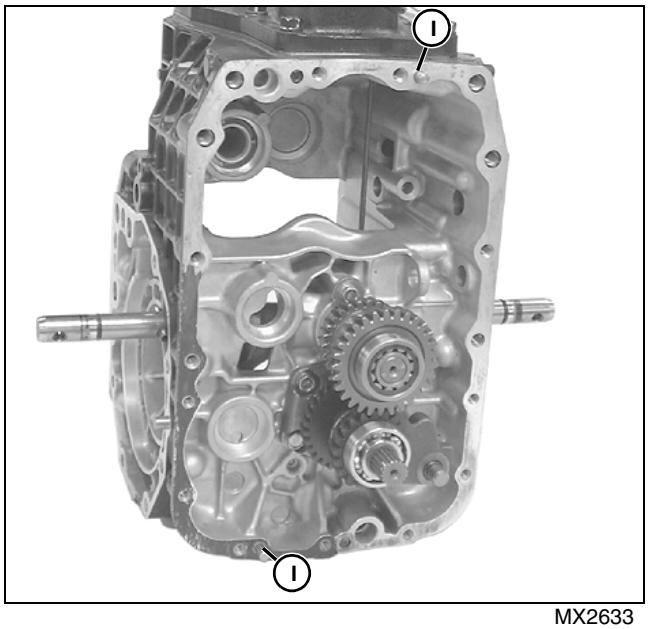
MX2594

2. Install range shift shaft (B) and arm (C)
3. Install spring pin (D).



MX2579

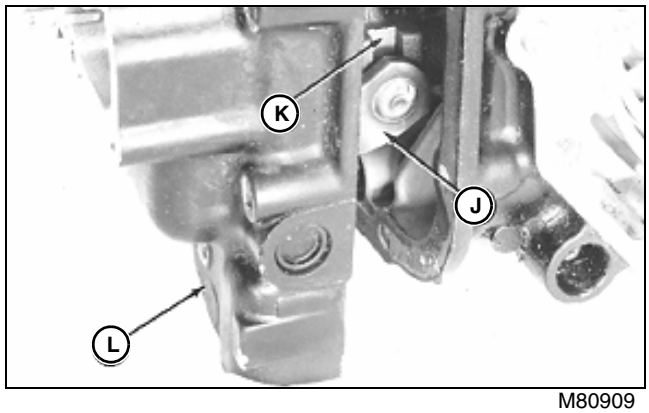
4. Install cap screw (E) and retainer plate (F).
5. Install external shifter arm (G).
6. Install spring pin (H).



MX2633

7. Install upper and lower alignment pins (I).

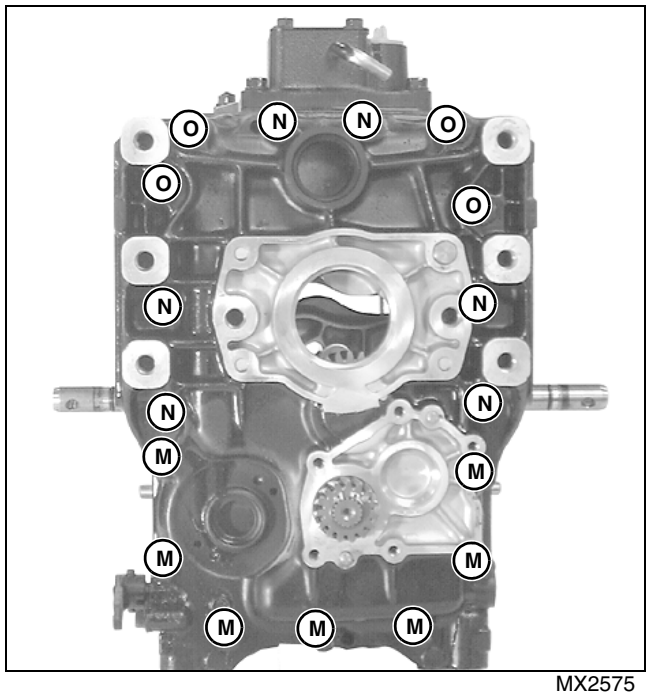
8. Install a new gasket over alignment pins.



M80909

9. Engage the internal range arm (J) into the range shifter fork slot (K) as the cover is installed. Check alignment of all bearings and shaft ends.

10. Install rear cover (L).



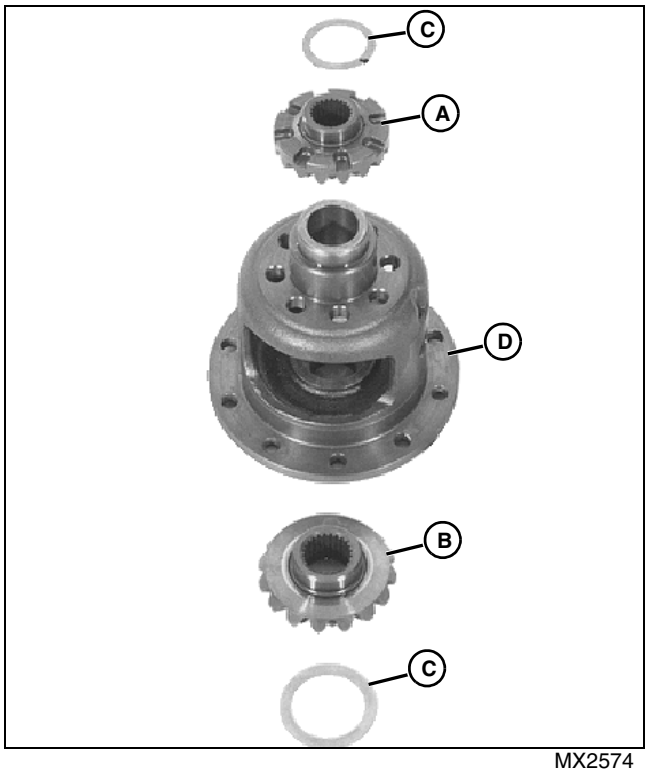
MX2575

11. Install seven M8 x 50 cap screws (M). Tighten to specification.

12. Install six M10 x 50 cap screws (N). Tighten to specification.

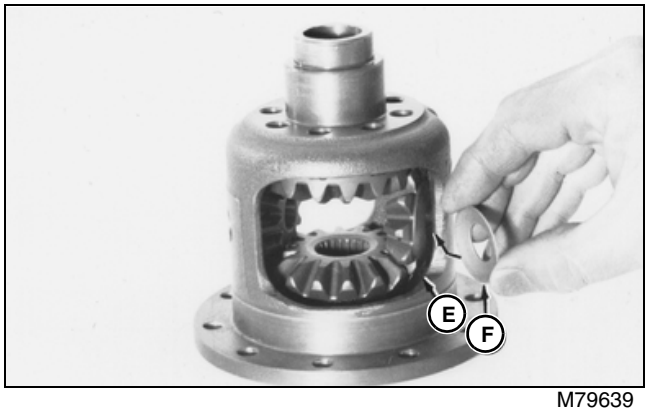
13. Install four M12 x 80 cap screws (O). Tighten to specification.

Differential Assembly



MX2574

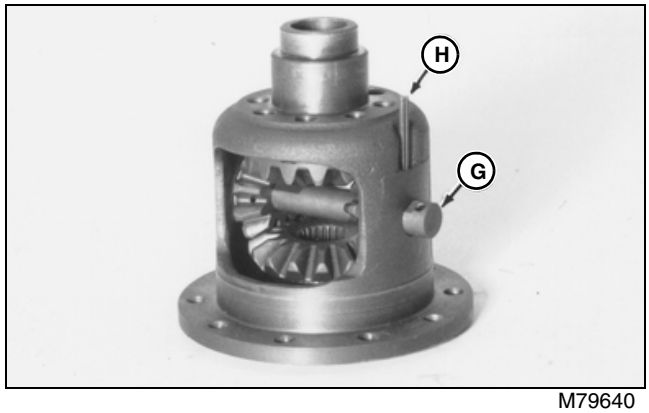
1. Install side gears (A and B) with flat thrust washers (C) inside housing (D).



M79639

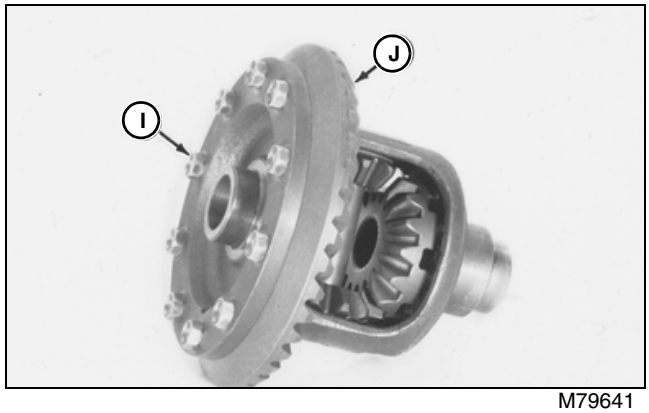
2. Install pinion gears (E) between side gears.

3. Slide the bevel thrust washers (F) between pinion gears and differential housing.



M79640

4. Install pinion shaft (G), and secure it with spring pin (H).

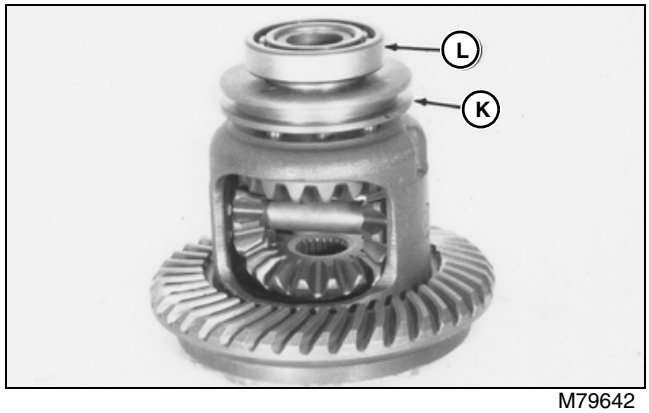


M79641

5. Clean threads of cap screws (I) and threads of ring gear (J) with cure primer.

6. Apply thread lock and sealer (medium strength) to threads of cap screws.

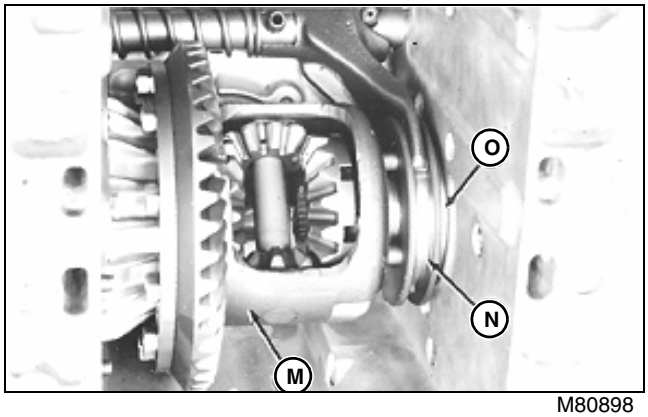
7. Install ring gear with ten cap screws. Tighten cap screws to specification.



M79642

8. Install shift collar (K).

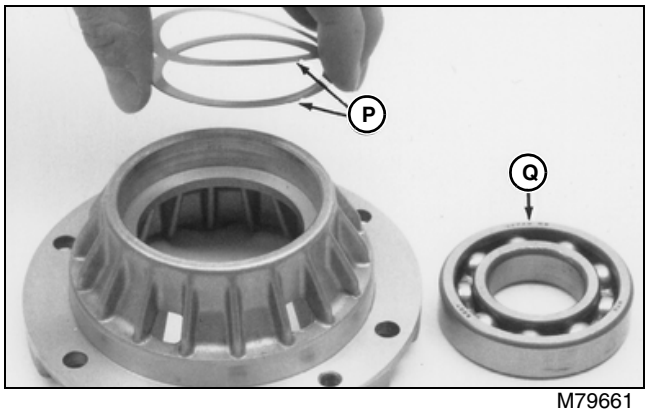
9. Install bearing (L).



M80898

10.Apply a light film of grease to bearing surfaces before installation.

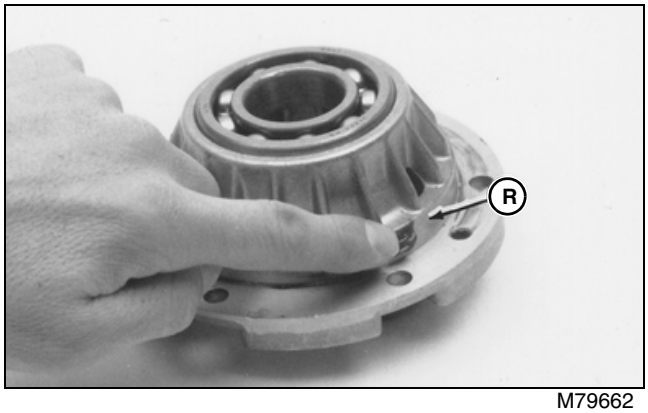
11.Install the differential assembly (M), aligning the shift fork with the shift collar (N) and differential pinion gear. Move the assembly to the right, to seat the bearing (O) in the housing.



M79661

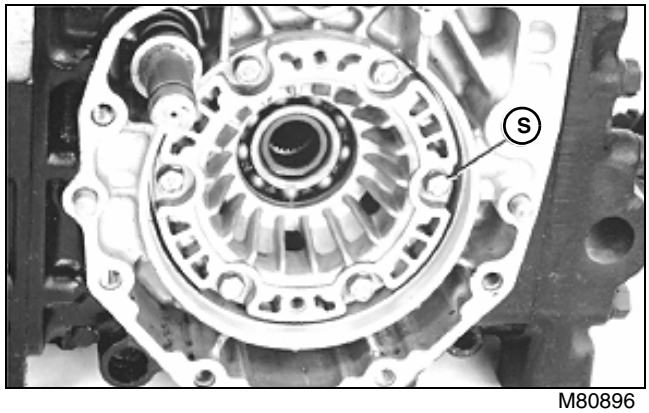
12.Install the same number of shims (P) that were removed in the carrier.

13.Install bearing (Q).



M79662

14.Apply a light film of grease to the outside surface (R) of the carrier.



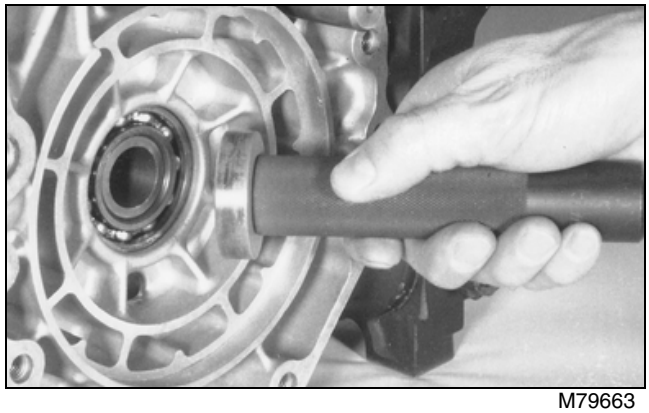
M80896

15.Install the carrier, positioning the bearing onto the shoulder of the differential assembly.

16.Install six caps screws (S). Tighten to specification.

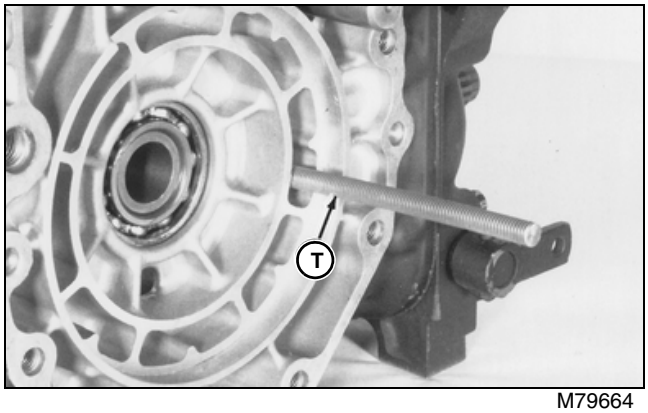
IMPORTANT: Avoid damage! DO NOT apply excessive force to disk driver. Damage to differential may result.

NOTE: The differential assembly must be tight against the shims and side carrier before the backlash is checked.


M79663

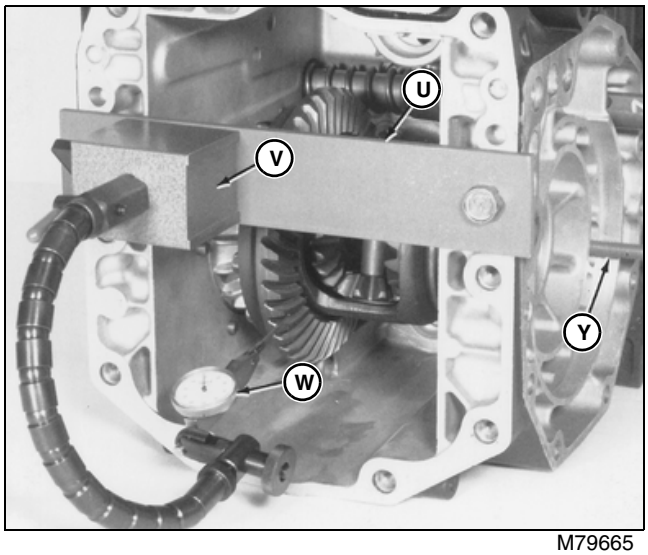
17.Using a disk driver, push the bearing and differential assembly to fully seat the bearing against the shims.

NOTE: The rod is used to prevent movement of the pinion gear while adjusting gear backlash.

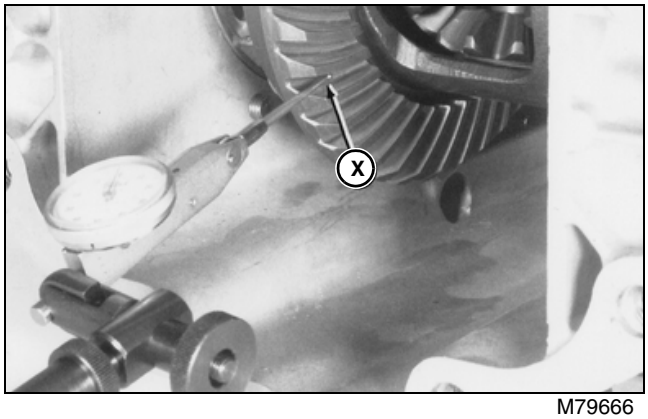


M79664

18.Install a rod (T) through the hole in the housing into the differential drive pinion (worm) gear.



M79665



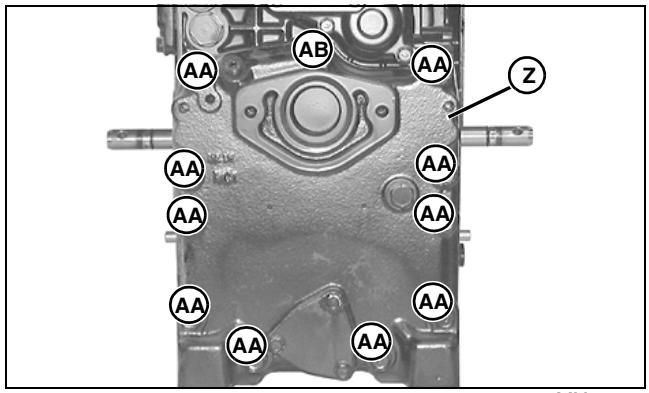
M79666

19.Install a fabricated steel plate (U) across the transaxle case. Attach using two M12 cap screws.

20.Mount the magnetic indicator base (V) on the plate. Position a deflection gauge (W) against one of the ring gear teeth (X).

21.Hold rod (Y) firmly against the pinion gear while moving the ring gear back and forth. Total ring gear backlash should be to specification.

22.If backlash is not within specification, disassemble the carrier and add shims to decrease backlash, or remove shims to increase backlash.



MX2572

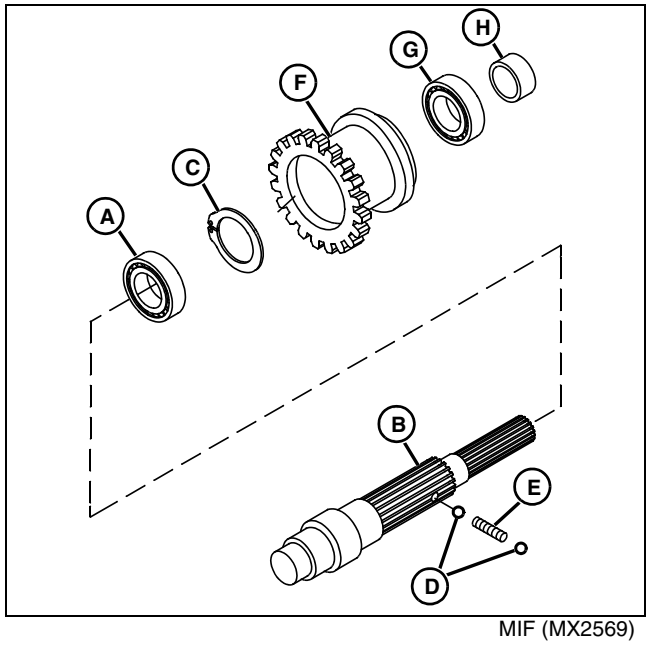
23.Install front cover (Z).

24.Install ten M12 cap screws (AA). Tighten to specification.

25.Install M10 cap screw (AB). Tighten to specification.

MRWD Gear Case

IMPORTANT: Avoid damage! Always use new O-rings and seals. Damaged or used parts will leak.



MIF (MX2569)

1. Press bearing (A) onto the splined end of the output shaft (B) until it rests against the shoulder on the shaft.

2. Install snap ring (C).

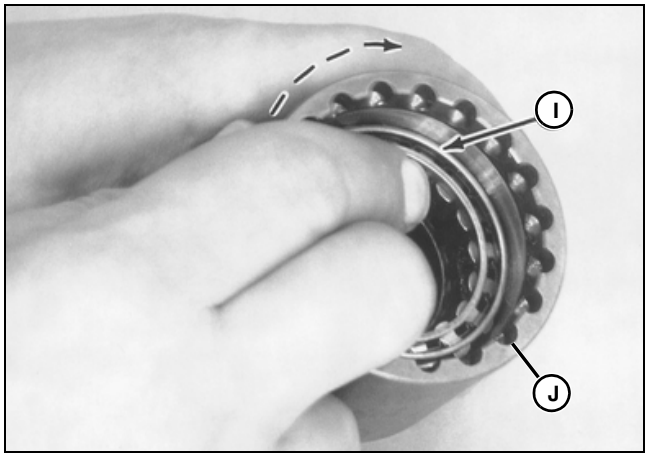
3. Install the detent balls (D) and spring (E) into the hole in the output shaft and hold in place.

4. Install the shift collar (F) onto the shaft, with the external splines toward the bearing.

5. Using a press, install bearing (G) onto the splined end of the output shaft (B) until it rests against the shoulder on the shaft.

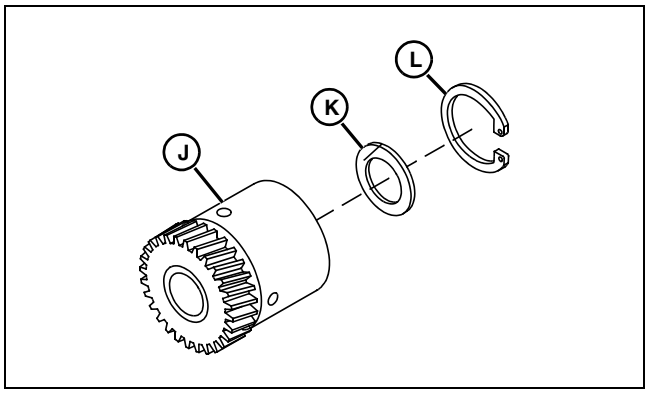
6. Install the oil seal wear sleeve (H) onto the output shaft, with the chamfer toward the bearing.

IMPORTANT: Avoid damage! The clutch sprag bearing is designed to allow free-wheeling in only one direction. Verify that the sprag bearing is installed correctly. Turn the output shaft inside the clutch housing, it should turn in a clockwise direction only.



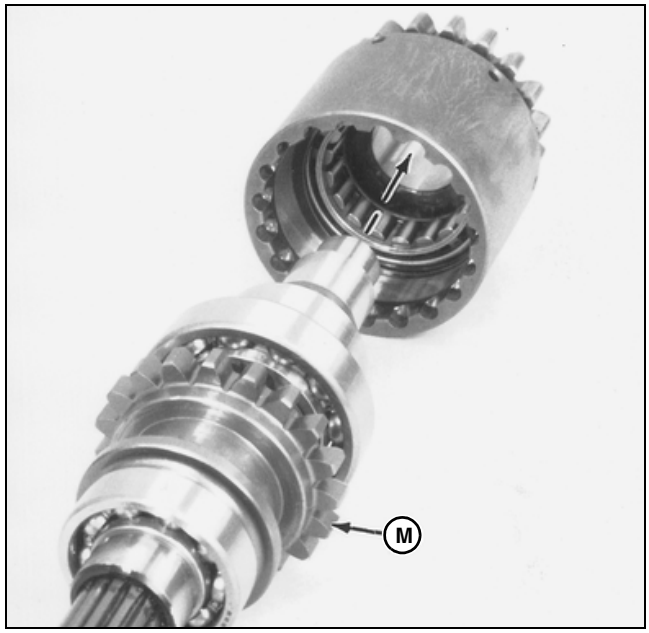
M79355

7. Install the clutch sprag bearing (I) by tilting one edge inside the clutch housing (J) and turning it clockwise until it snaps into place up against the seat.



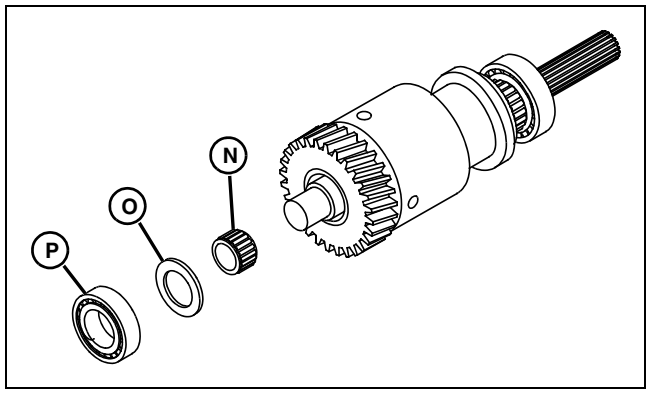
MIF (MX2570)

8. Install over running clutch bearing (K) and snap ring (L) into clutch housing (J).



M79356

9. Align the external splines (M) of the shift collar with the internal splines of the clutch housing, and install the shaft into the housing.

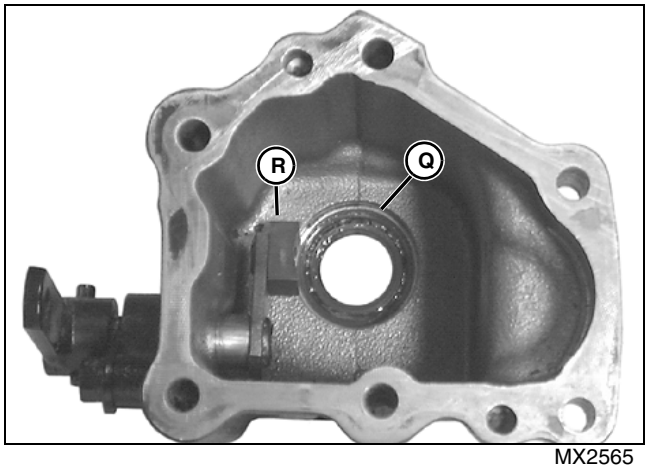


MIF (MX2665)

10. Install needle roller bearing (N).

11. Install washer (O).

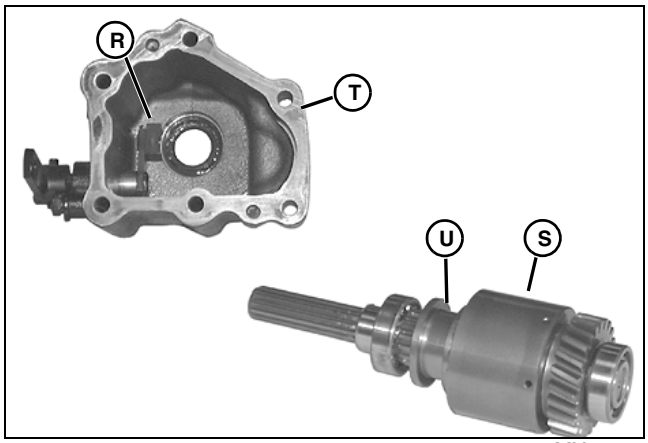
12. Install bearing (P).



MX2565

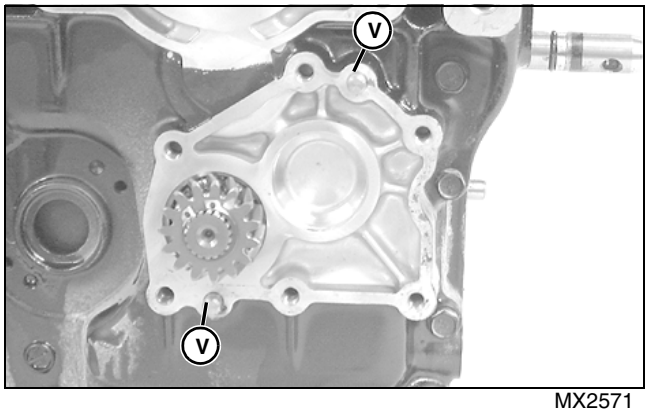
13.Install a new seal (Q).

14.Install shift block (R).



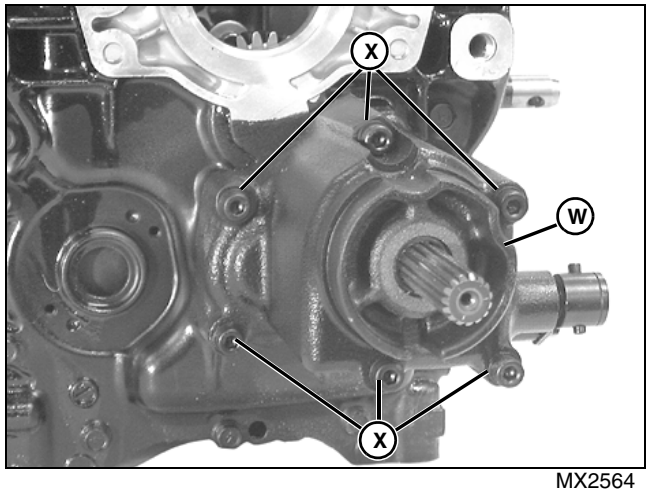
MX2567

15.Install shaft assembly (S) into housing (T), aligning the shift block with the groove (U) in shift collar.



MX2571

16.Install alignment pins (V).



MX2564

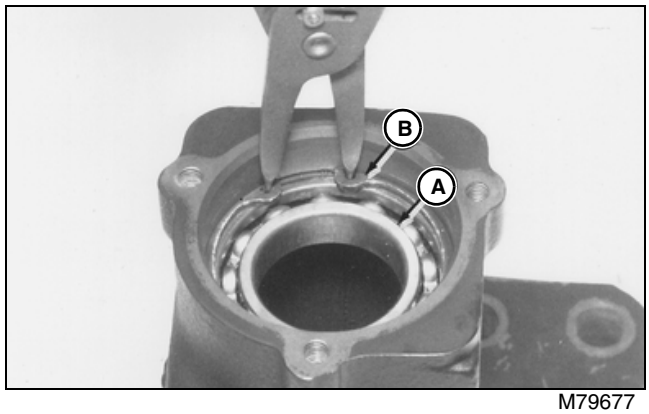
17.Install a new gasket on gear case assembly.

18.Install MRWD gear case assembly (W).

19.Install six socket-head cap screws and washers (X).

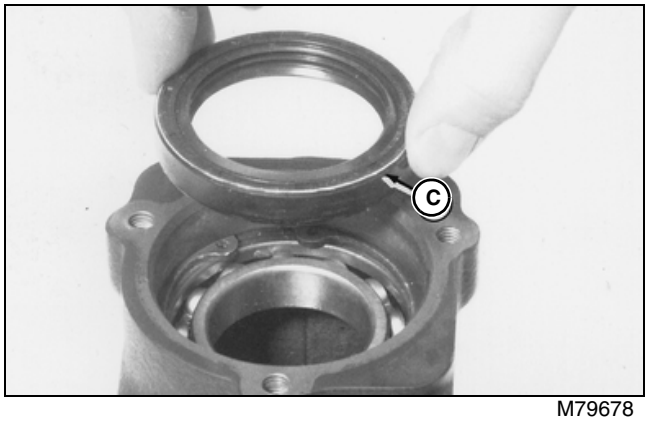
Axle Shaft Housings

IMPORTANT: Avoid damage! Always use new O-rings and seals. Damaged or used parts will leak.



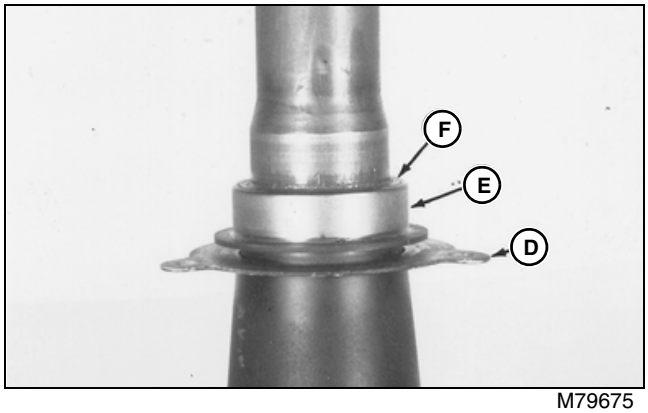
M79677

1. Install new outer bearing (A) (if needed).
2. Install snap ring (B).



M79678

3. Install a new seal (C). Push seal into housing using 75 mm (2-15/16 in.) driver disk. Seal must bottom against the snap ring.



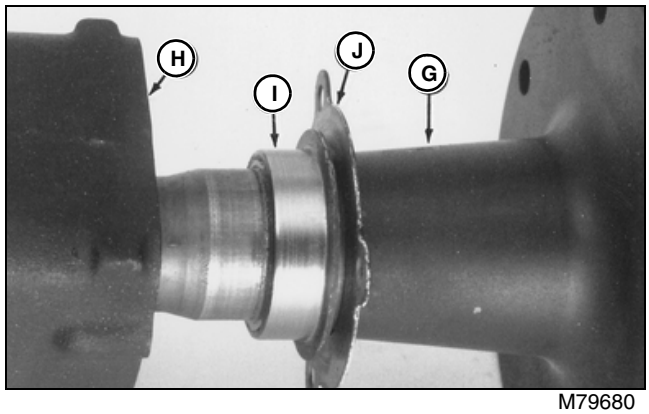
M79675

4. Install seal cover (D) over axle shaft.

5. Apply multipurpose grease to the inside surface of the oil seal wear sleeve (E).

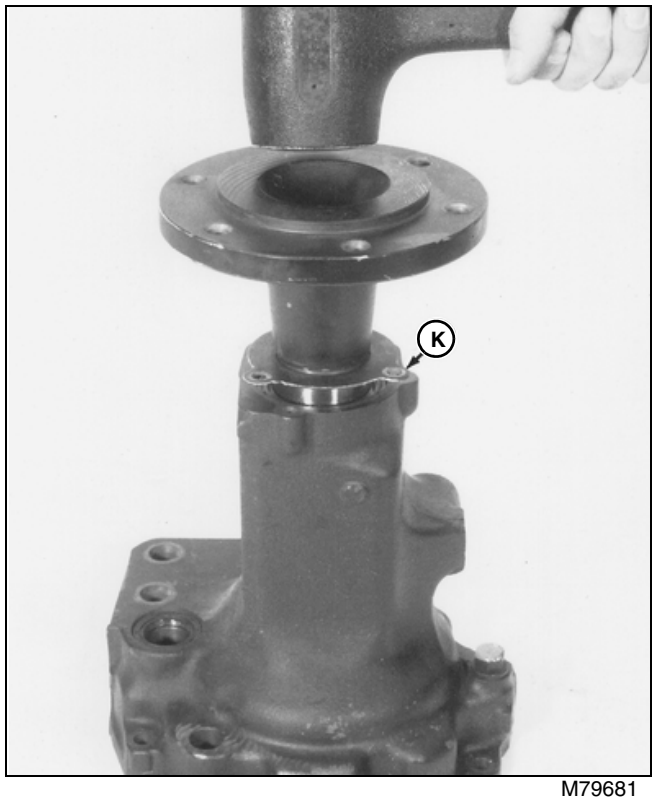
6. Install oil seal wear sleeve on axle shaft using a pipe with an inside diameter of 51 mm (2 in.). The top of the sleeve must be flush with the lip on the axle shaft (F).

IMPORTANT: Avoid damage! Wrap the splines of the axle shaft with tape to prevent damaging the oil seal when installing the axle shaft.



M79680

7. Carefully slide the axle shaft (G) into the housing (H) until the oil seal contact sleeve (I) contacts the end of the housing, and the cover (J) aligns with the holes in the end of the housing.

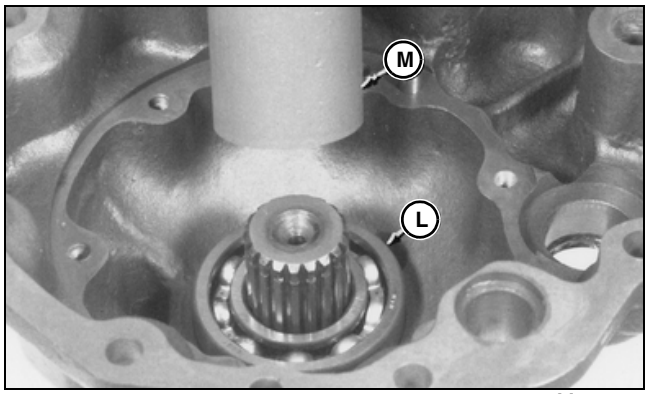


M79681

8. Drive the axle into the housing until the oil seal wear sleeve bottoms against the bearing snap ring.

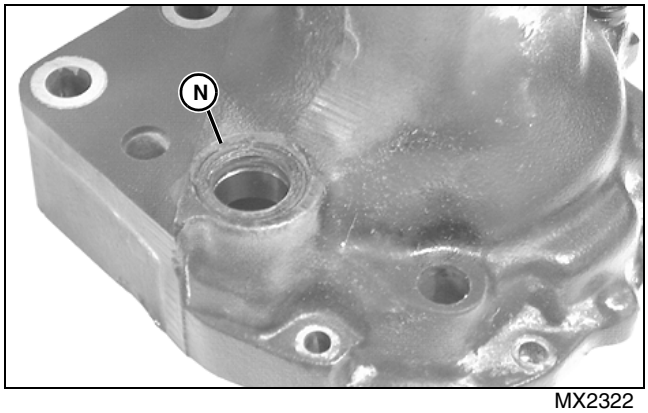
9. Fasten the seal cover (K) to the housing using three cap screws. Tighten cap screws to specification.

IMPORTANT: Avoid damage! Press on inner bearing race only to avoid damaging bearing.



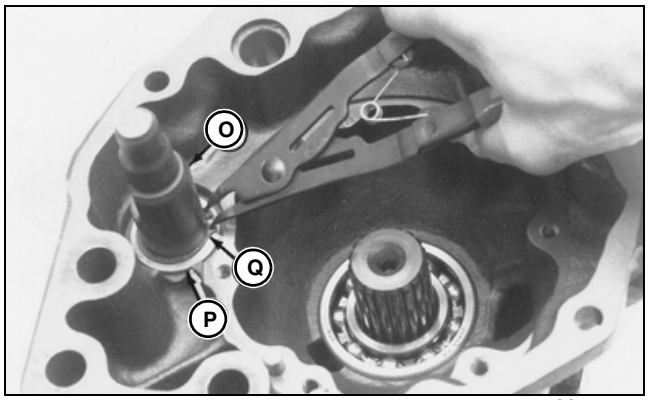
M79682

10.Install new inner bearing (L) into housing. Push the bearing into place using a length of pipe (M) with an inside diameter of 40 mm (1-9/16 in.).



MX2322

11.Install a new brake camshaft oil seal (N).

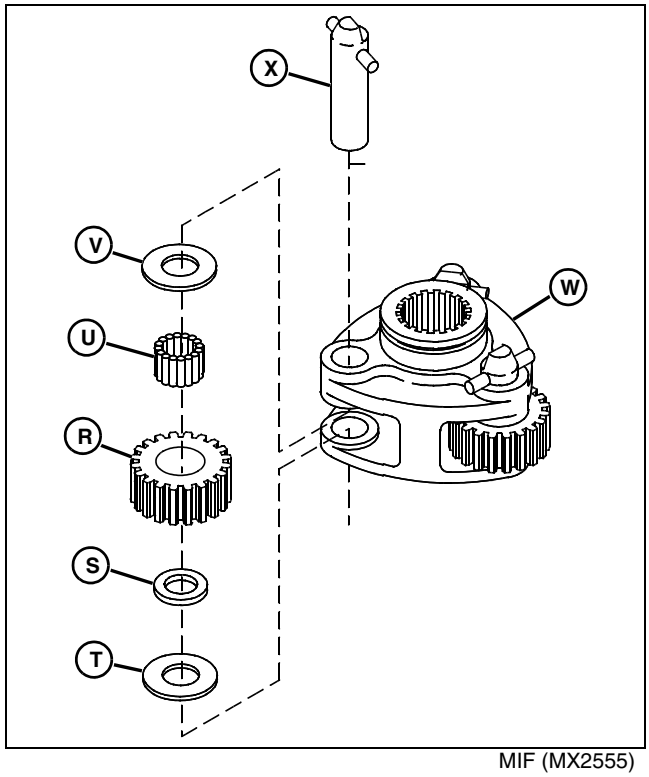


M79671

12.Install brake camshaft (O).

13.Install flat washer (P).

14.Install snap ring (Q).



MIF (MX2555)

15.Apply a light film of petroleum jelly to the inside diameter of the pinion gear (R).

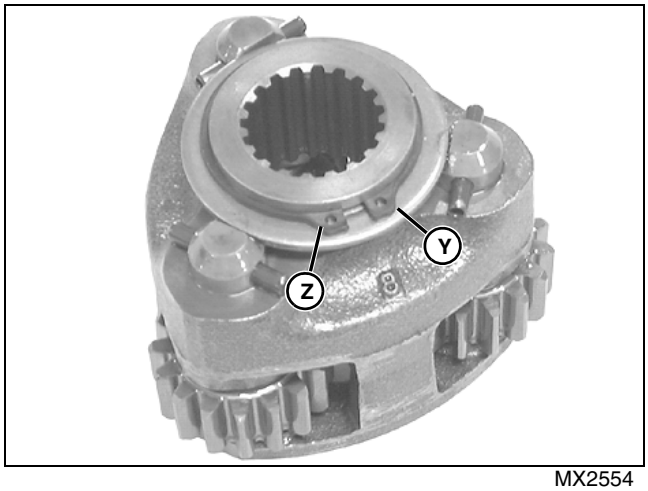
16.Install the small diameter washer (S) inside the pinion gear, and place the gear and washer on the lower washer (T).

17.Install the 22 needle bearings (U) around the inside diameter of the pinion gear.

18.Place the upper washer (V) on the pinion gear.

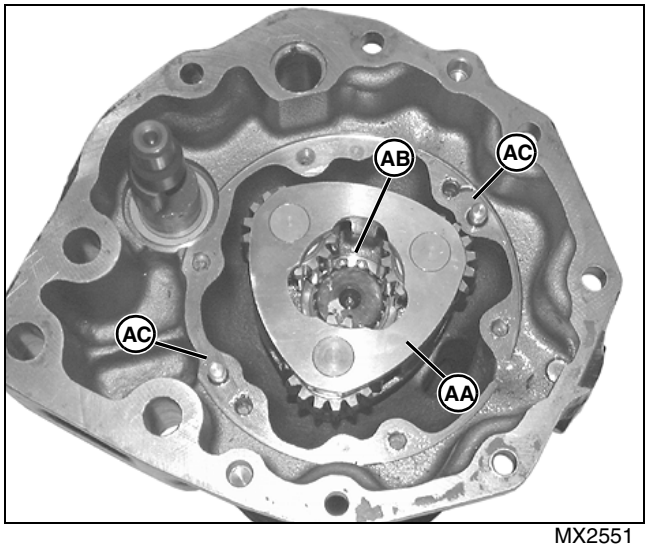
19.Hold the pinion gear/bearing/washer assembly together, and slide the assembly into the housing (W).

20.Install the pinion shafts (X) into the housing with the notch toward the center of the housing.



MX2554

21.Install washer (Y) and snap ring (Z).



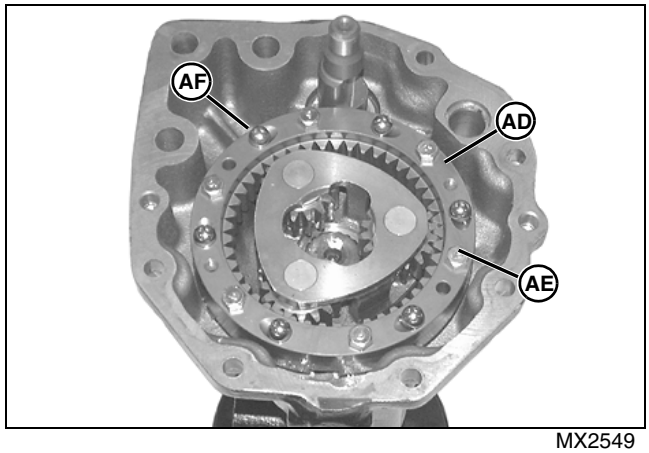
MX2551

22.Install planetary gear assembly (AA)

23.Install snap ring (AB).

24.Install alignment pins (AC).

NOTE: The spring mounting holes on the bottom of the ring gear are not symmetrical with the alignment pins. Make sure the ring gear is positioned so that the spring mounting hole is not directly next to the brake camshaft.



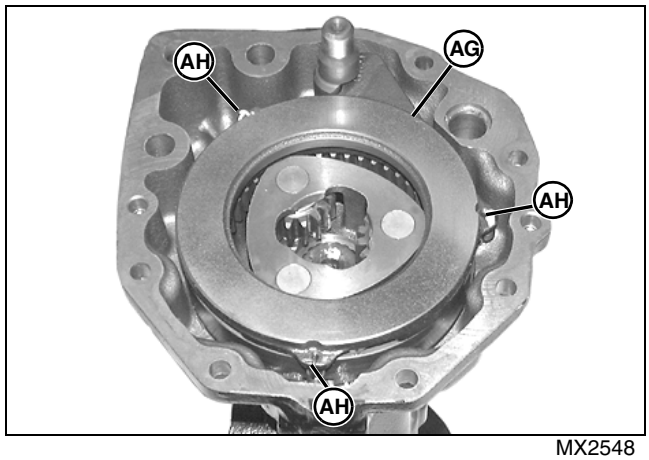
MX2549

25.Install ring gear (AD).

26.Install six cap screws (AE). Tighten to specification.

27.Install six steel balls (AF).

28.Apply petroleum jelly to the six steel balls.

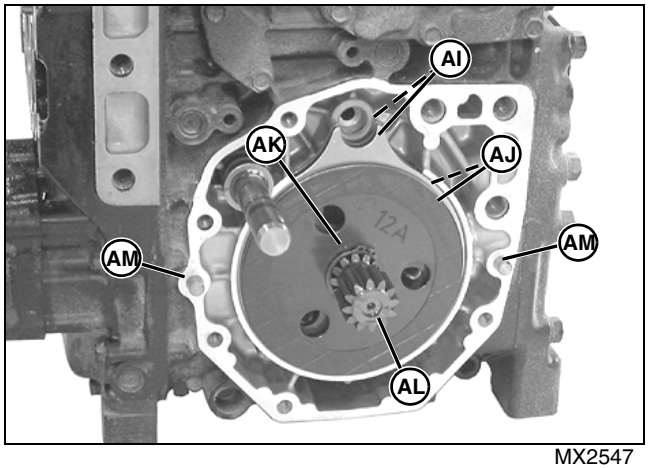


MX2548

29.Install actuator plate (AG).

NOTE: Attach the shorter hook of the springs to the ring gear.

30.Install three springs (AH).

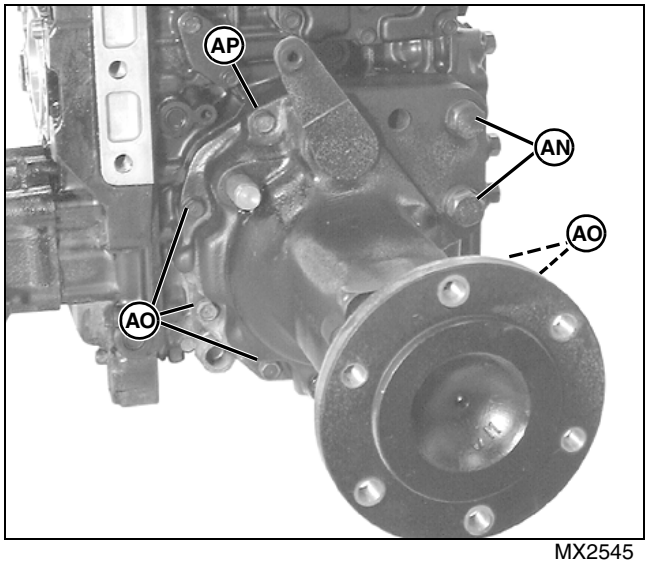


MX2547

31.Install two separator disks (AI) and brake disks (AJ) alternately in place against snap ring (AK) on the drive pinion shaft (AL). Install the pinion shaft/brake disk assembly into the transaxle housing.

32.Install alignment pins (AM).

33.Install a new gasket on axle shaft housing.



MX2545

34.Install the axle shaft housing assembly.

35.Install two large cap screws, flat and lock washers (AN).

36.Install five M10 x 35 cap screws (AO). Tighten to specification.

37.Install M10 x 50 cap screw (AP). Tighten to specification.

Specifications

Pinion Nut Torque . . . . . 91 N•m (67 lb-ft)
Differential Pinion Shaft
Cap Screw Torque . . . . . 26 N•m (230 lb-in.)
Rear Cover Assembly M8 x 50
Cap Screw Torque . . . . . 26 N•m (230 lb-in.)
Rear Cover Assembly M10 x 50
Cap Screw Torque . . . . . 50 N•m (37 lb-ft)
Rear Cover Assembly M12 x 80
Cap Screw Torque . . . . . 90 N•m (66 lb-ft)
Ring Gear Cap Screw Torque . . . . . 26 N•m (230 lb-in.)
Carrier Cap Screw Torque . . . . . 26 N•m (230 lb-in.)
Ring Gear Backlash . . . . 0.15-0.21 mm (0.006-0.008 in.)
Differential Assembly M12
Cap Screw Torque . . . . . 90 N•m (66 lb-ft)
Differential Assembly M10
Cap Screw Torque . . . . . 50 n•m (37 lb-ft)
Seal Cover Cap Screw Torque . . . . . 26 N•m (230 lb-in.)
Axle Shaft Housing M10 x 35
Cap Screw Torque . . . . . 51 N•m (38 lb-ft)
Axle Shaft Housing M10 x 50
Cap Screw Torque . . . . . 51 N•m (38 lb-ft)

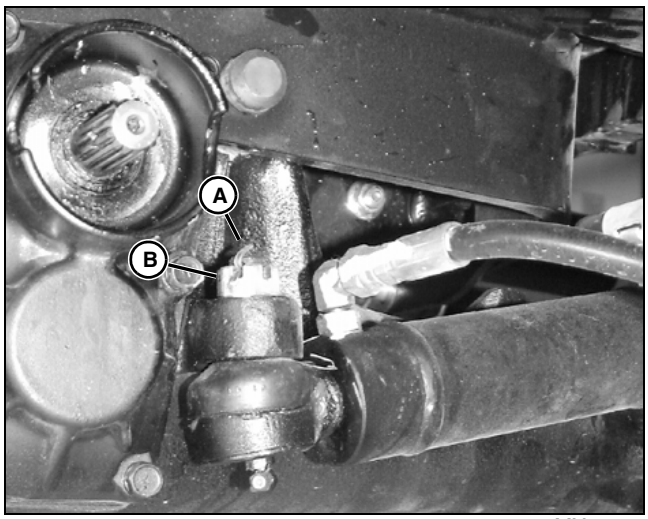
MRWD Axle Removal and Installation

Special or Required Tools

Tool Name	Tool No.	Tool Use
Wedge-Fork Driver	NA	Used to separate steering cylinder from mounting.

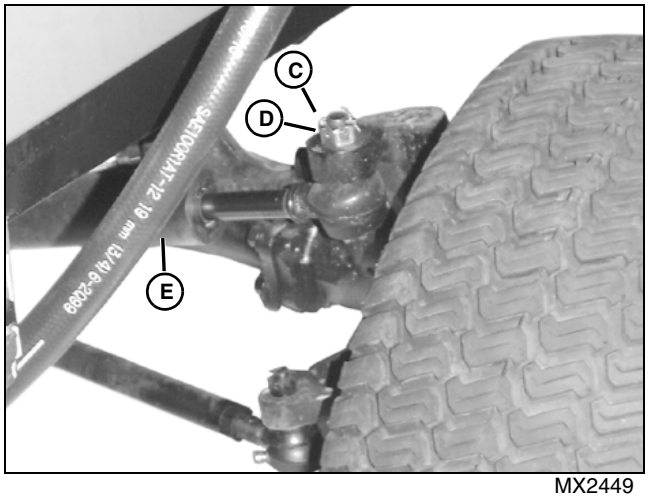
Removal

1. Remove MWRD drive shaft.



MX2448

2. Remove cotter pin (A) and castle nut (B) from steering cylinder.



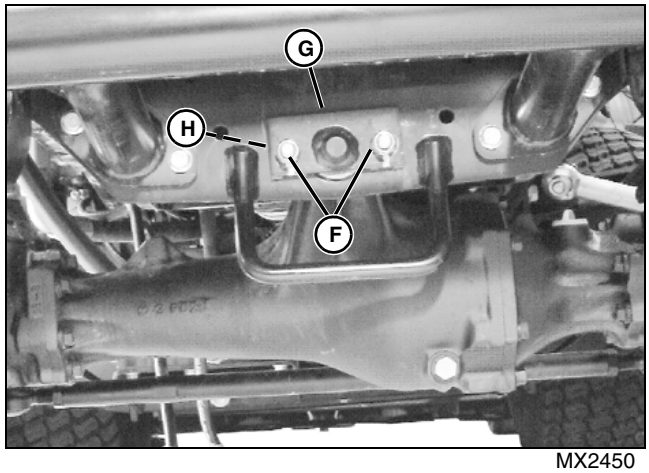
MX2449

3. Remove cotter pin (C) and castle nut (D) from steering cylinder.

4. Separate steering cylinder from mounting using a wedge-fork driver.

NOTE: Use wire ties to secure steering cylinder to frame, rather than letting it hang by the hoses.

5. Remove steering cylinder (E).



MX2450

6. Support the rear of the machine.

7. Remove two cap screws and nuts (F).

8. Remove pivot pin (G) and shims (H).

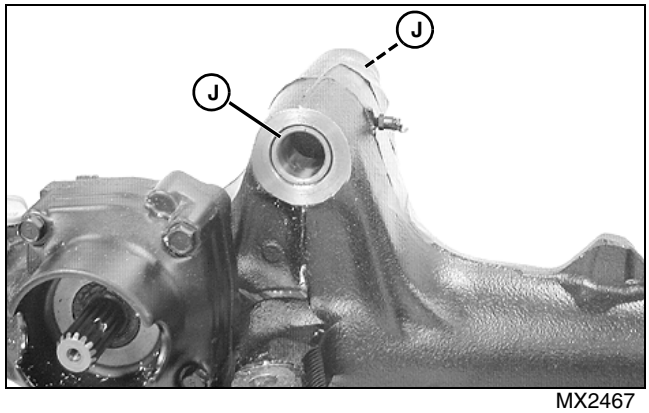
IMPORTANT: Avoid damage! DO NOT lift or support the rear of the machine by the rear bumper, as it is not designed to support the weight of the machine.

9. Using a safe lifting device, lift the rear of the machine. Place blocks or jackstands under machine frame.

10. Remove axle from machine.

11. Remove rear wheels.

12. Inspect frame sleeve (I) for wear or damage. Replace as needed.



MX2467

13. Inspect axle pivot bushings (J) (front and rear) for wear or damage. Replace as needed.

Installation

Installation is done in the reverse order of removal.

- Apply multipurpose grease to pivot pin before installation.
- Check and adjust MRWD axle end play.

- Tighten steering cylinder castle nuts (B) and (D) to specification before installing cotter pins.
- Tighten cap screws and nuts (F) to specification.
- Adjust steering toe-in.

Specifications

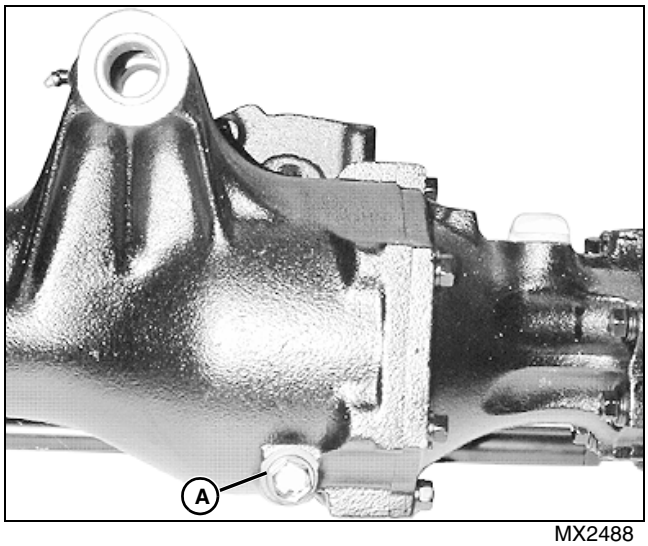
Steering Cylinder Castle Nut Torque . 75 N•m (55 lb-ft)
Steering Cylinder Cap Screw Torque . 88 N•m (65 lb-ft)

MRWD Axle Disassembly and Inspection

Special or Required Tools

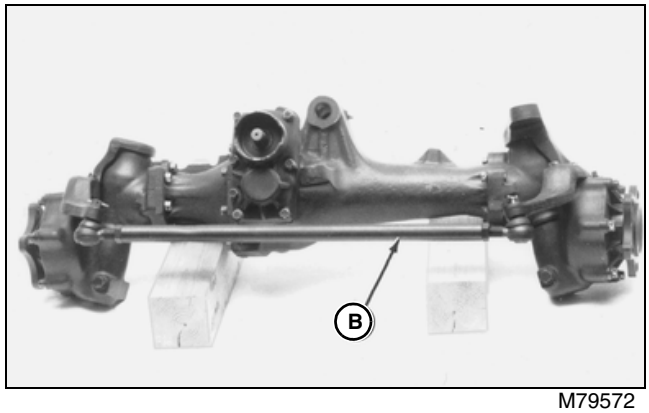
Tool Name	Tool No.	Tool Use
Bushing, Bearing, and Seal Driver Set	NA	Used to remove spindle gear case needle bearing.
Internal Puller	NA	Used to remove top bearing from upper gear case.
Bearing Puller	NA	Used to remove bearing from spindle shaft and differential pinion shaft.

NOTE: Axle oil capacity is approximately 2.5 L (2.6 qt).



MX2488

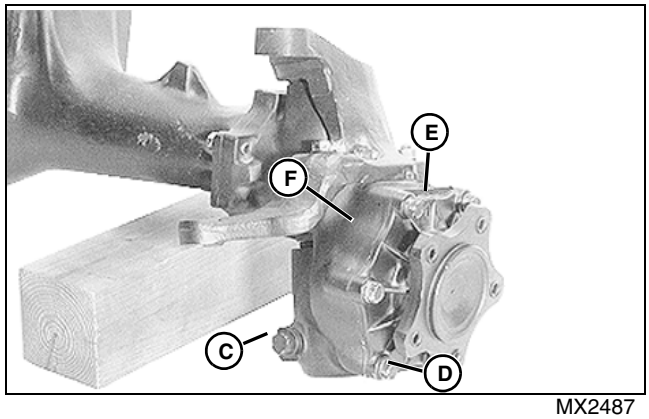
1. Remove drain plugs at differential housing (A) and drain oil into a properly marked container.



M79572

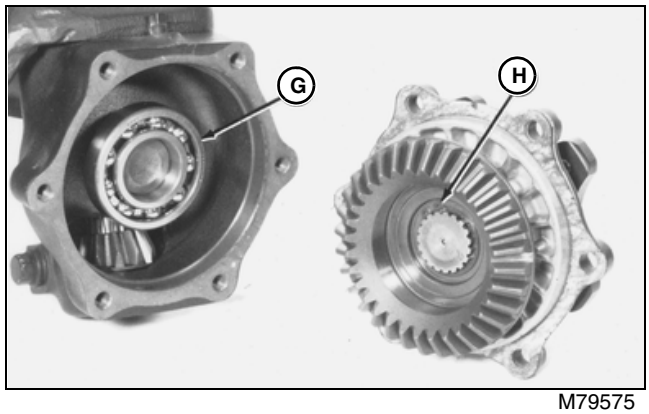
2. Remove tie rod (B).

Final Drives



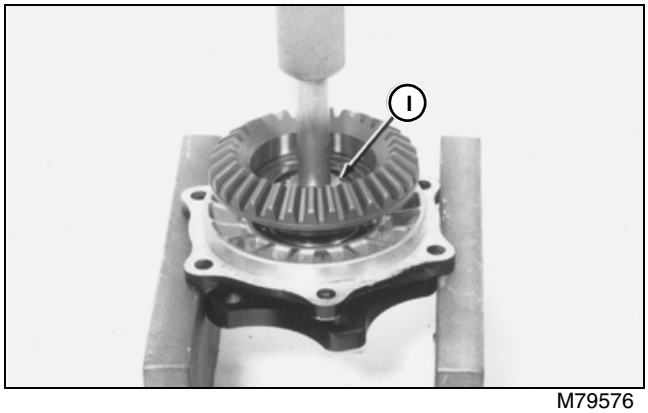
MX2487

1. Remove drain plugs at final drives (C) and drain oil into a properly marked container.
2. Remove six cover cap screws (D).
3. Tap on cover (E) with a rubber hammer to separate the cover from the spindle housing (F). Remove cover.



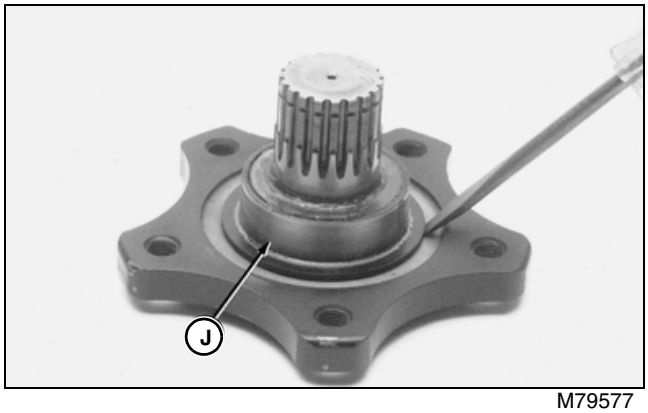
M79575

4. Remove bearing (G) from bearing case mount.
5. Remove snap ring (H) from hub shaft.



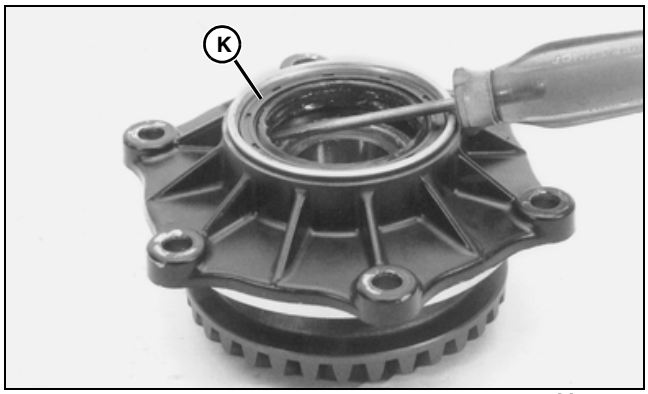
M79576

6. Press hub shaft (I) out of cover assembly.



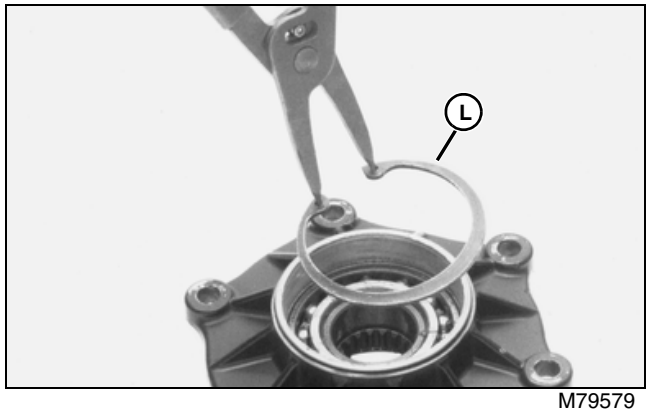
M79577

7. Inspect oil seal wear sleeve (J) for wear or damage. Replace as needed.



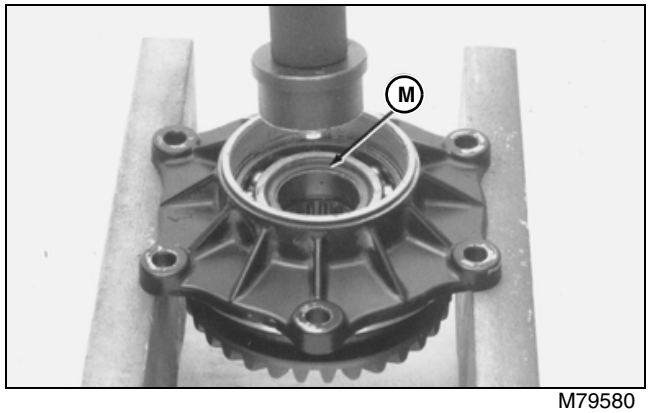
M79578

8. Remove oil seal (K).



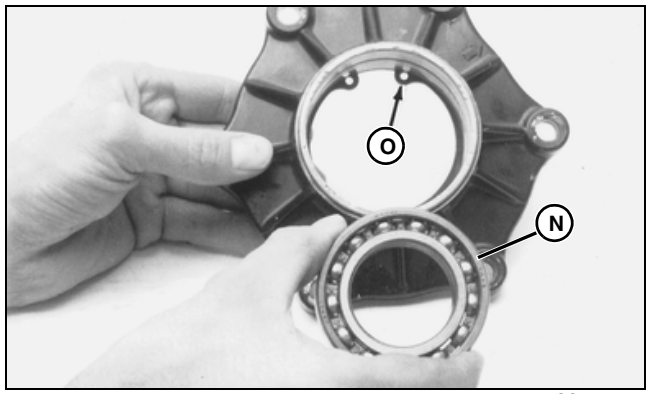
M79579

9. Remove outer snap ring (L).



M79580

10.Press on ring gear surface (M) to press it out of the bearing.



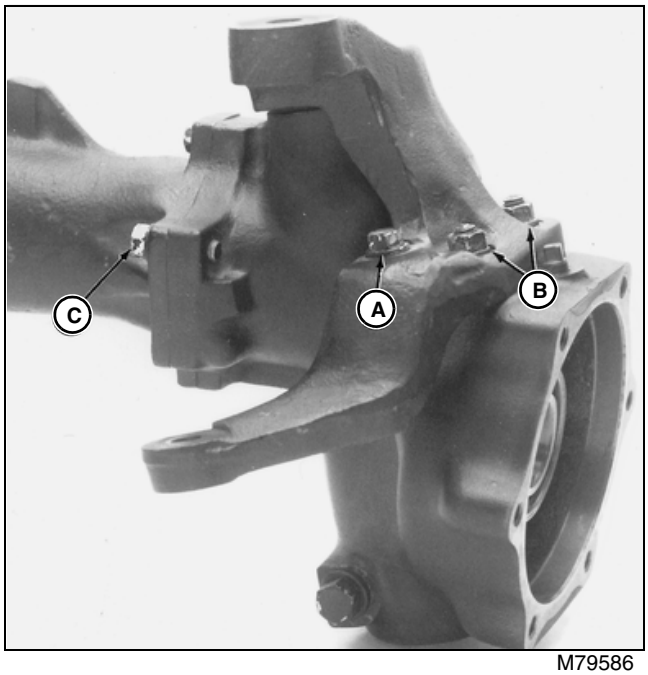
M79581

11.Remove bearing (N).

12.Inspect bearing for wear or damage. Replace as needed.

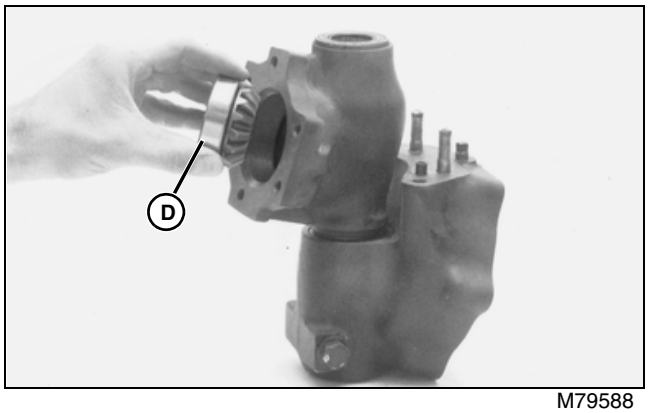
13.Remove inner snap ring (O).

Spindle Gear Case



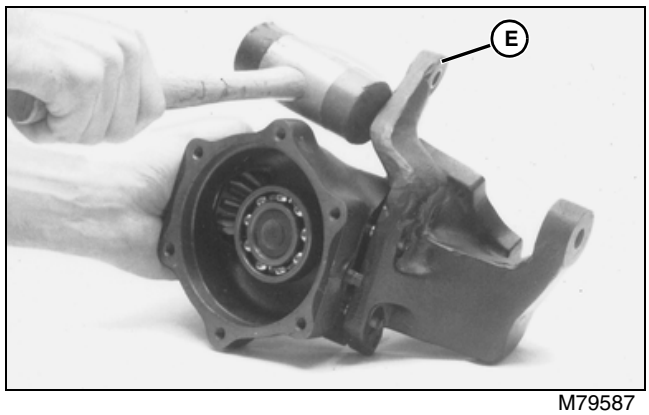
M79586

1. Remove two cap screws (A).
2. Remove two nuts (B).
3. Remove six cap screws (C).
4. Tap on final drive housing with a rubber hammer to separate the final drive housing from the axle housing. Remove final drive housing.



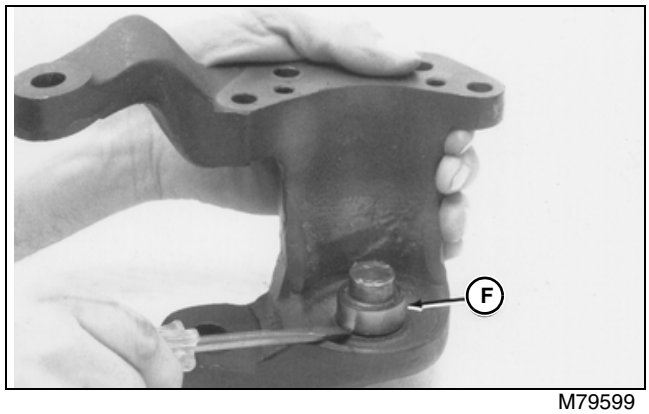
M79588

5. Remove bevel gear and bearing (D) from upper spindle gear case.
6. Inspect bevel gear and bearing for wear or damage. Replace as needed.



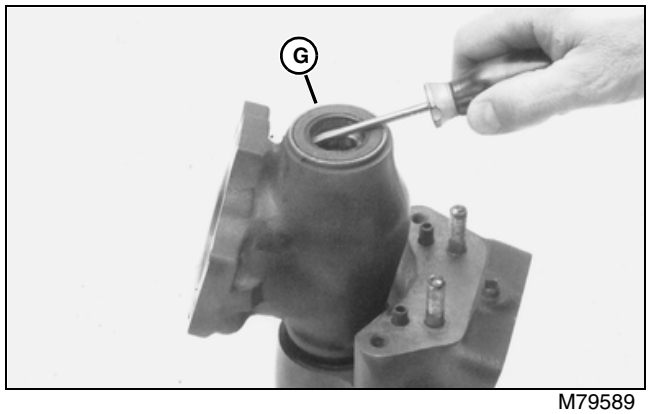
M79587

7. Tap on steering arm (E) with a rubber hammer to separate steering arm from housing. Remove steering arm.



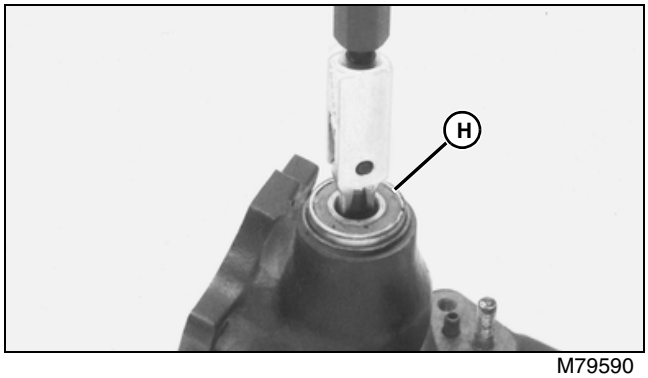
M79599

8. Inspect oil seal wear sleeve (F) for wear or damage. Replace as needed.



M79589

9. Remove upper case oil seal (G).



M79590

10.Use an internal puller to remove top bearing (H) from upper case.

11.Inspect bearing for wear, damage, or rough movement. Replace as needed.

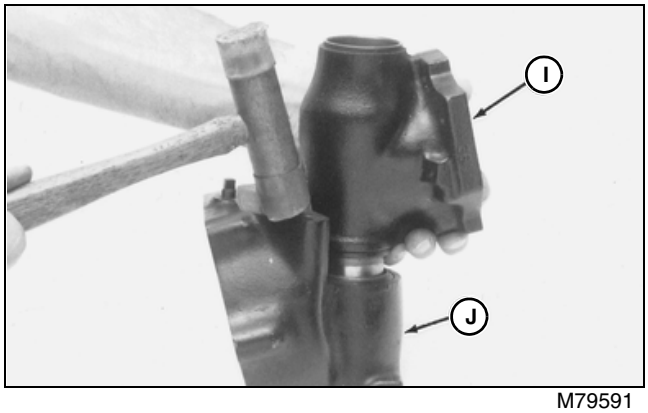
NOTE: Bearings in upper gear case are identical.

The spindle shaft may or may not stay in the lower bearing of the upper case and/or the bearing may fall out with the shaft.

If the bearing and shaft remain with the upper gear case: Drive the spindle shaft from the lower bearing and remove the lower bearing and washer from the upper gear case.

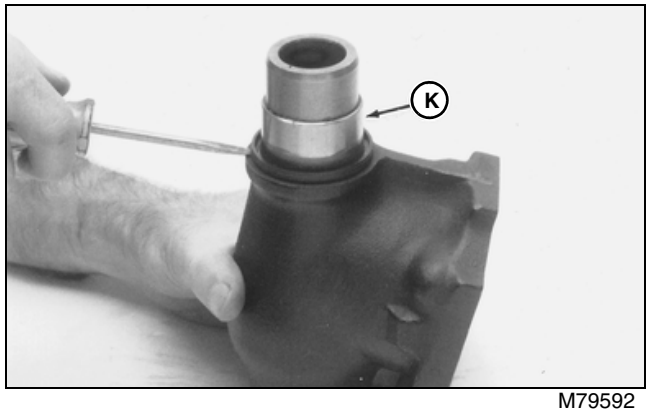
If the bearing and shaft separate from the upper gear case: Hold the upper case up against the spindle gear while driving the shaft from the bearing, gear and upper case.

The spindle shaft could also remain in the bottom drive gear and ball bearing of the lower gear case, separating itself from the upper case components. If this happens, wiggle the shaft out of the ball bearing and gear, or walk the bearing and gear out, using the shaft as a handle, or use a bearing puller to remove the bearing from the spindle shaft.



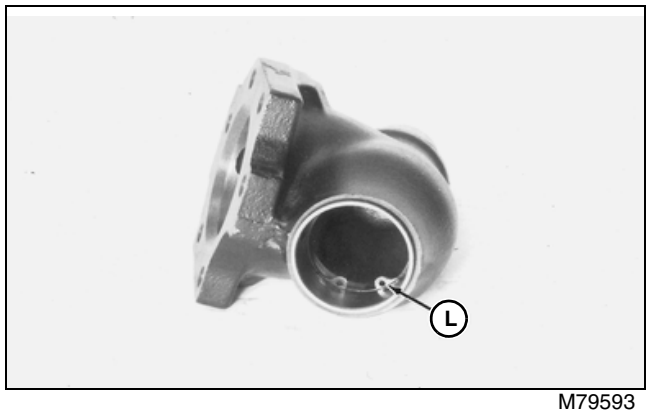
M79591

12.Tap on upper gear case (I) with a rubber hammer to separate upper gear case from lower gear case (J). Remove upper gear case.



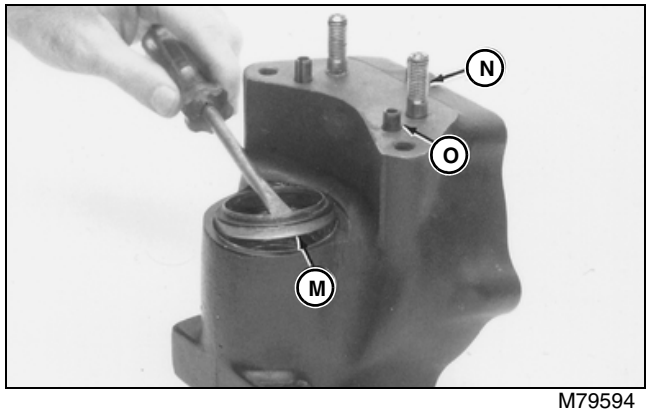
M79592

13.Inspect oil seal wear sleeve (K) for wear or damage. Replace as needed.



M79593

14.Inspect upper gear case snap ring (L) for damage. Replace as needed.

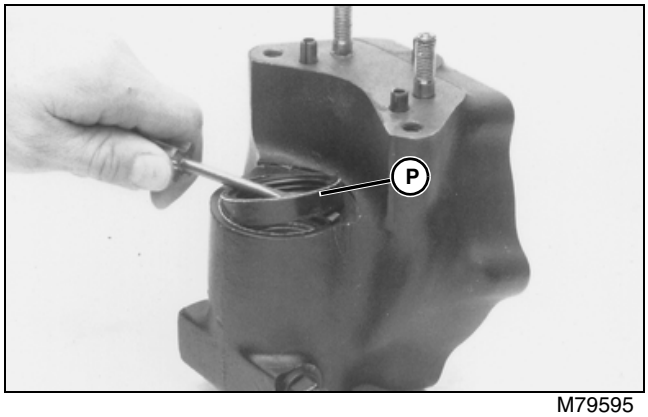


M79594

15.Remove sleeve (M) from lower gear case.

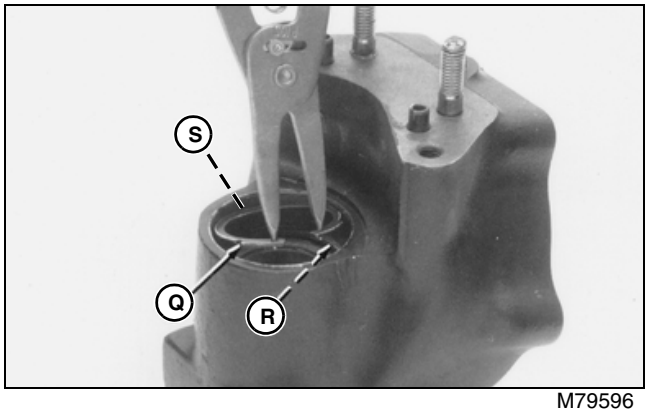
16.Inspect sleeve for wear or damage. Replace as needed.

17.Inspect studs (N) and spring pins (O) for damage. Replace as needed.



M79595

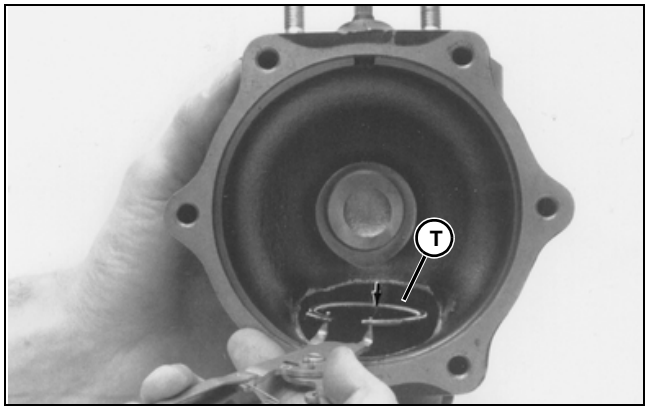
18.Remove and discard oil seal (P).



M79596

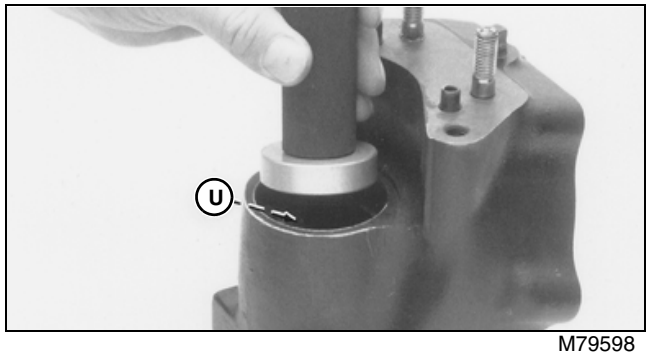
19.Remove upper snap ring (Q) and washer (R).

20.Remove and inspect inner bearing race (S). Replace as needed.



M79597

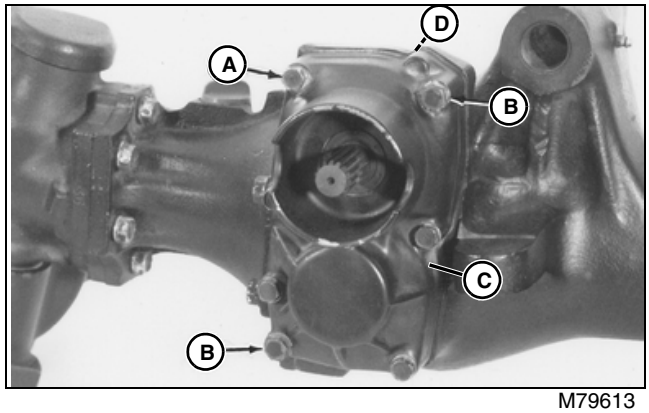
21.Remove lower snap ring (T).



M79598

22.Remove needle bearing (U) using a bearing driver.

Differential Input Housing

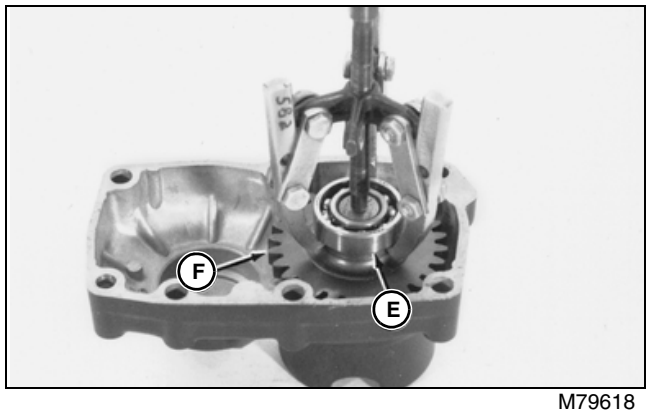


M79613

1. Remove five cap screws (A).
2. Remove two special cap screws (B).

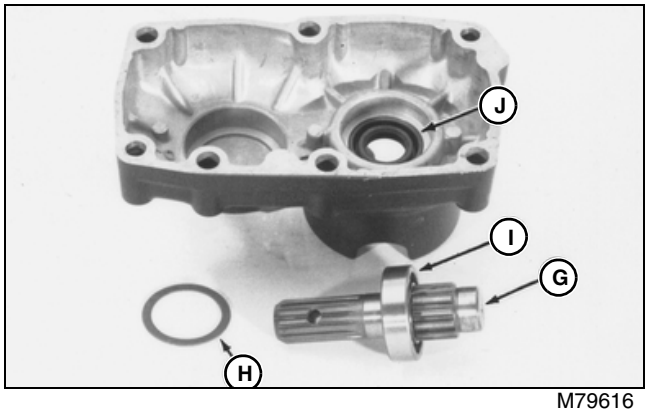
NOTE: Input shaft, gear, and bearing may not come off with input cover. If they remain in the differential housing, hold the end of the input shaft and walk the bearing out of the seat.

3. Remove input housing (C) and gasket (D).



M79618

4. Remove bearing (E) from input gear (F).
5. Remove gear from input shaft.
6. Inspect parts for wear or damage. Replace parts as needed.

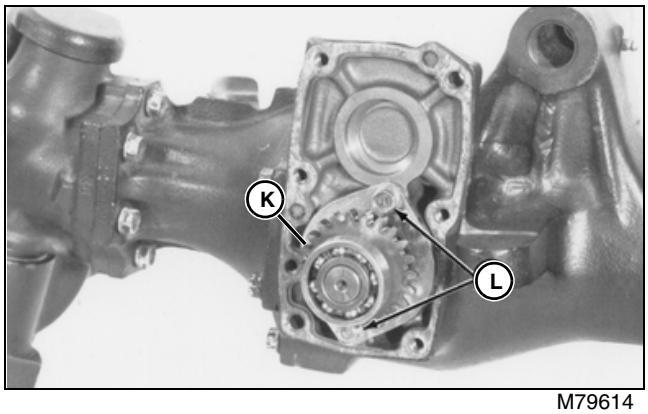


M79616

7. Remove input shaft (G) and washer (H) from housing.

8. Inspect shaft and bearing (I) for wear or damage. Replace parts as needed.

9. Remove oil seal (J).

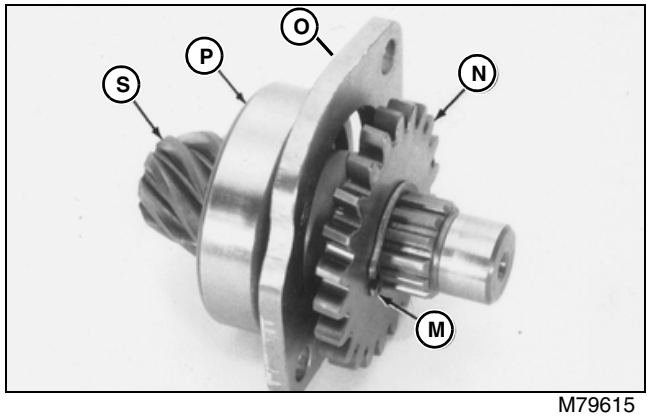


M79614

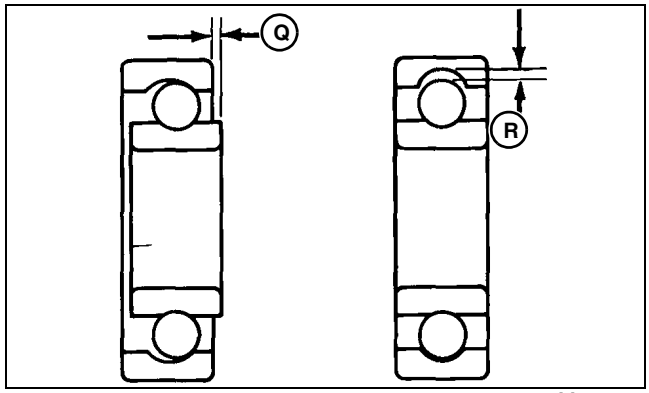
10.Remove bearing (K) from differential pinion shaft using a puller.

11.Remove cap screws (L).

12.Remove retaining plate, large bearing, and pinion drive shaft.



M79615



M38073

13.Remove snap ring (M).

14.Remove transfer gear (N).

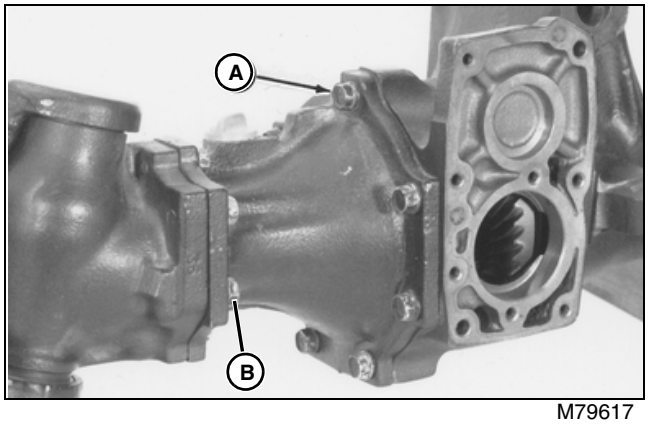
15.Remove retaining plate (O).

16.Inspect bearing (P) for axial (Q) and/or radial (R) free play or rough movement.

If the bearing is worn, remove the bearing from the pinion gear drive shaft (S).

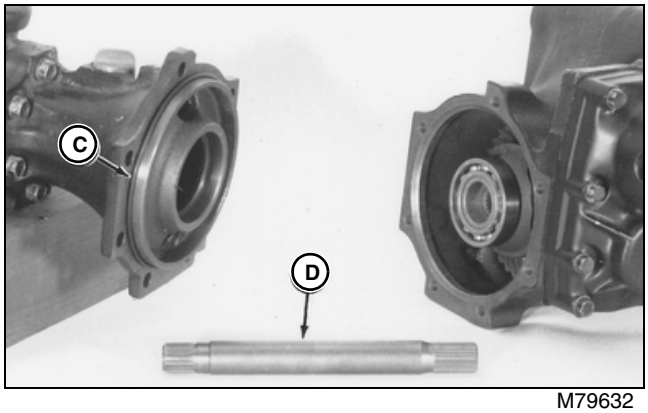
17.Inspect all parts for wear or damage. Replace parts as needed.

Differential Assembly



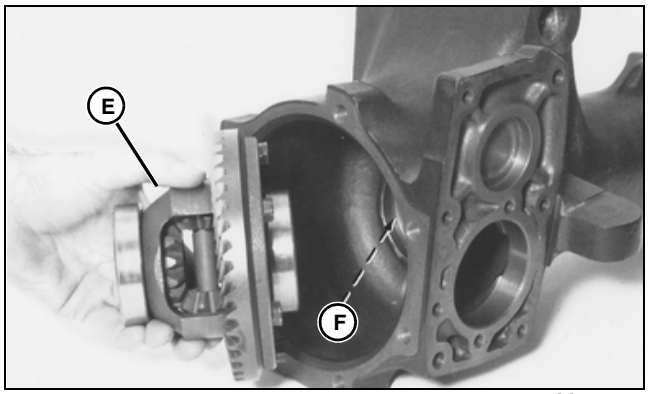
M79617

1. Remove seven cap screws (A) from left axle housing.
2. Remove left axle housing (B) from differential center housing.



M79632

3. Remove seal (C).
4. Remove axle shaft (D).

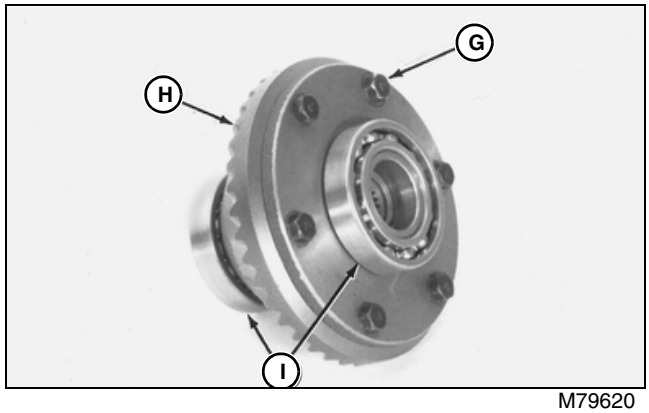


M79619

5. Remove differential assembly (E) from housing.

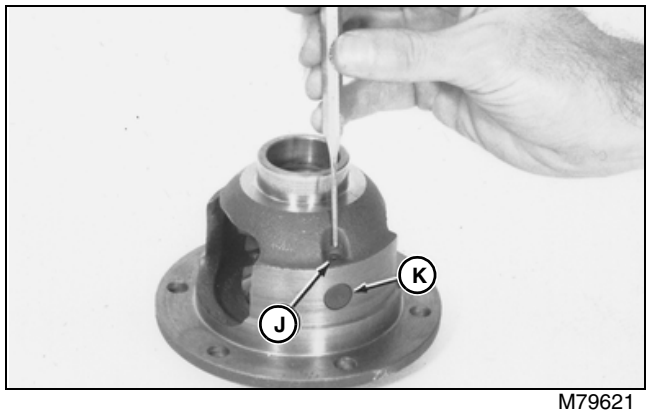
NOTE: Keep shims together for installation.

6. Remove all shims (F).



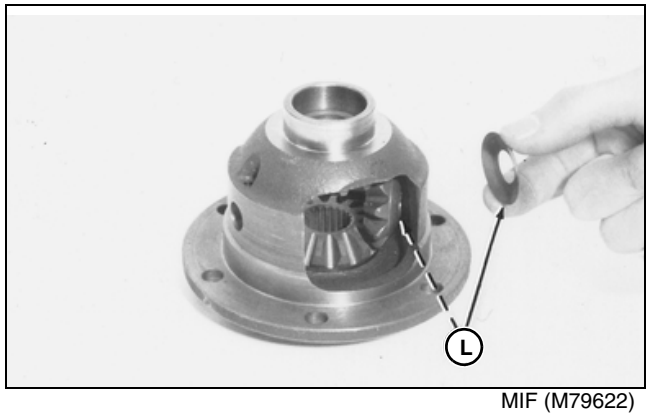
M79620

7. Remove six cap screws (G).
8. Remove ring gear (H).
9. Inspect bearings (I) for wear or damage. Remove bearings only if replacement is required.



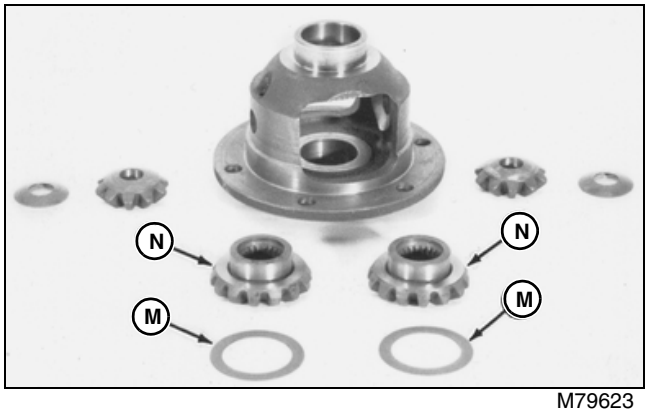
M79621

10. Drive spring pin (J) out of the differential housing and pinion shaft.
11. Remove pinion shaft (K).



MIF (M79622)

12. Remove thrust washers and pinion gears (L).



M79623

13.Remove thrust washers (M) and side pinion gears (N).

MRWD Axle Assembly

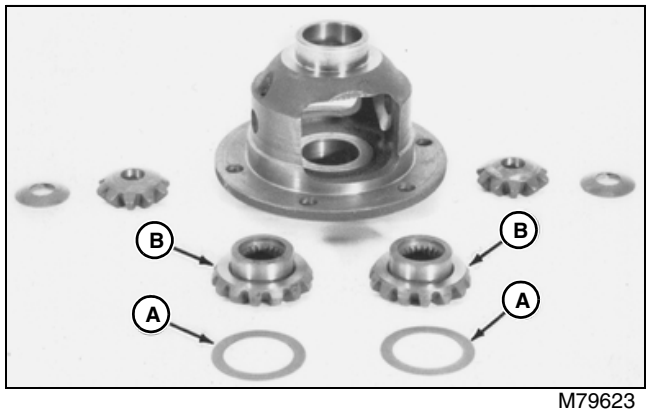
Special or Required Tools

Tool Name	Tool No.	Tool Use
Pipe with Inside Diameter of 40 mm (1-9/16 in.)	NA	Used to install oil seal wear sleeves in spindle gear case.

Other Material

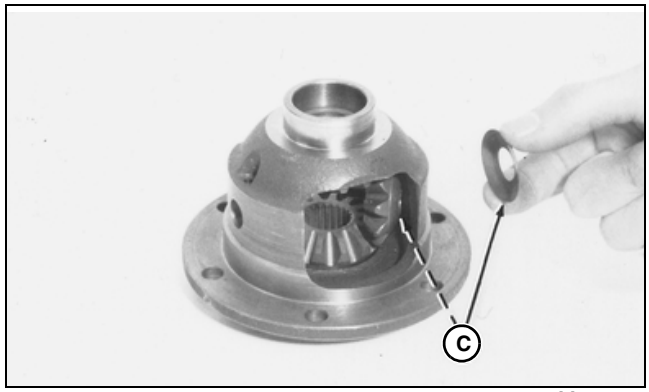
Part No.	Part Name	Part Use
TY16285 (US) 7649 (LOCTITE®) CXTY16285 (Canada)	Cure Primer	Applied to threads of differential housing cap screws before installation.
T43512 (US) 242 (LOCTITE) TY9473 (Canada)	Thread Lock and Sealer (Medium Strength)	Applied to threads of differential housing cap screws before installation.

Differential



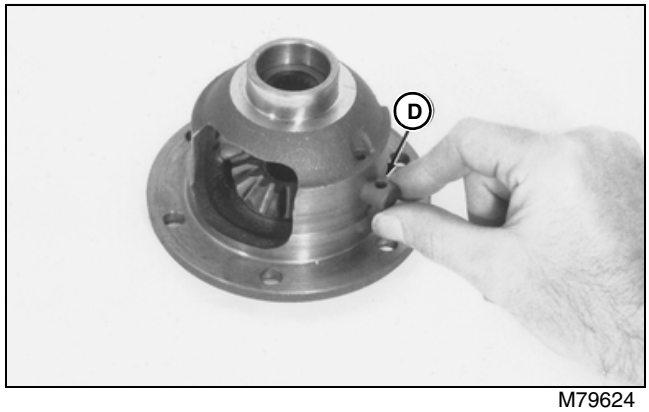
M79623

1. Install thrust washers (A) onto side pinion gears (B) and install into drive housing.



M79622

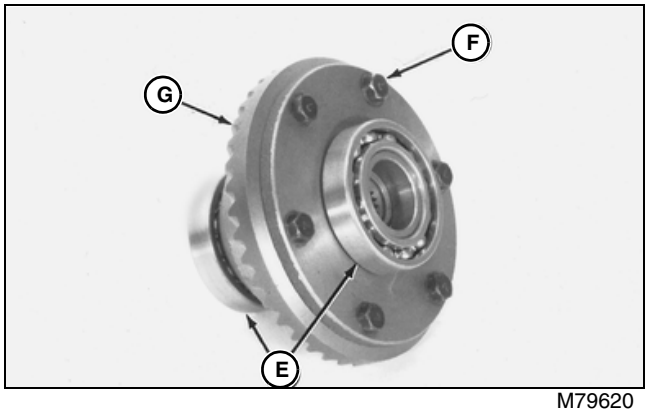
2. Install pinion gears and thrust washers (C), align the gears and washers with the housing pinion shaft bores.



M79624

3. Install pinion shaft (D) and align the hole in the shaft with the hole in the housing.

4. Install spring pin.



M79620

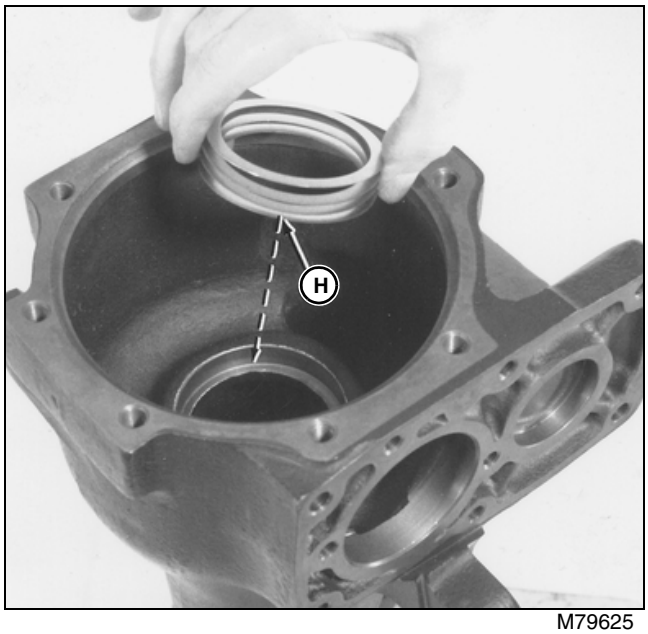
5. Install bearings (E).

6. Clean threads of cap screws (F) and differential housing with cure primer.

7. Apply thread lock and sealer (medium strength) to threads of cap screws (F).

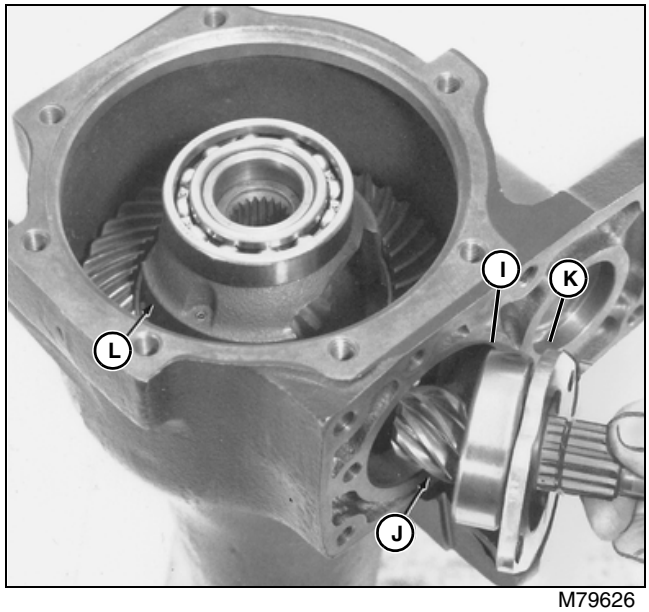
8. Install ring gear (G) and cap screws (F). Tighten cap screws to specification.

NOTE: Assemble and adjust the differential assembly with the axle housing vertical.



M79625

9. Install the same number of shims (H) that were removed into the housing.



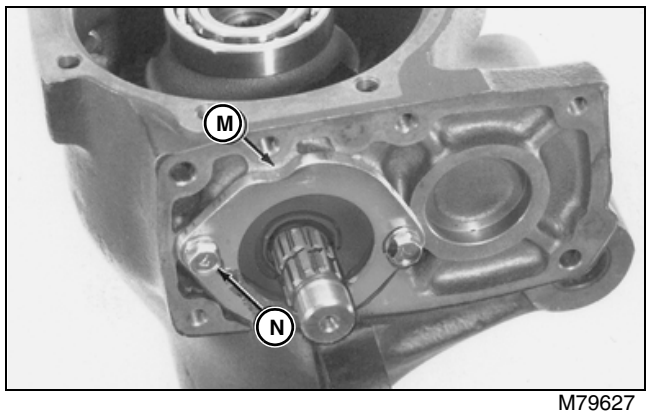
M79626

10. Install new bearing (I) onto pinion gear drive shaft (J).

11. Install retaining plate (K) over shaft.

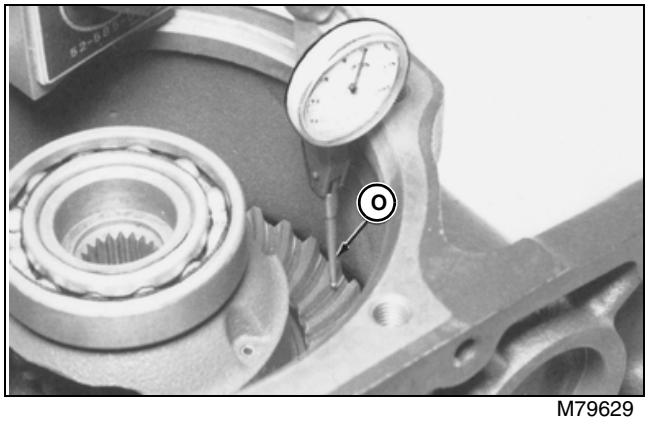
12. Install differential assembly (L) into housing.

13. Install differential input shaft assembly into housing.



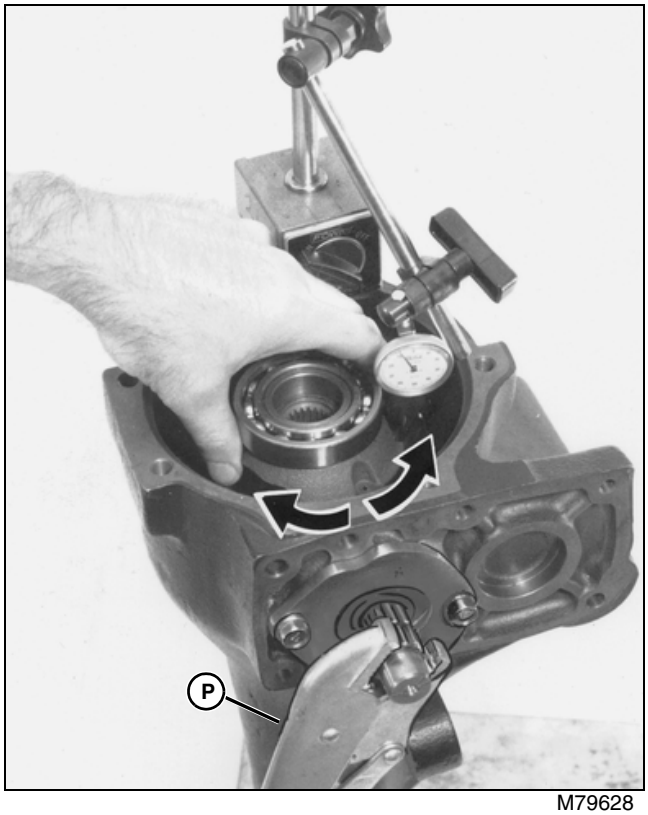
M79627

14. Position notch (M) as shown. Install and tighten two M8 x 20 bearing retainer cap screws (N) to specification.



M79629

15.Install a side deflection gauge on differential housing. Position pointer (O) to the side of the tooth, 1/3 of the way to the outside of the ring gear.



M79628

16.Fasten a clamping pliers (P) to the splines to the right of the snap ring groove of the pinion gear drive shaft. Let the pliers rest against the power steering cylinder mounting of the axle housing.

17.Adjust the gauge to zero. Lightly move differential back and forth. Total backlash should be to specification.

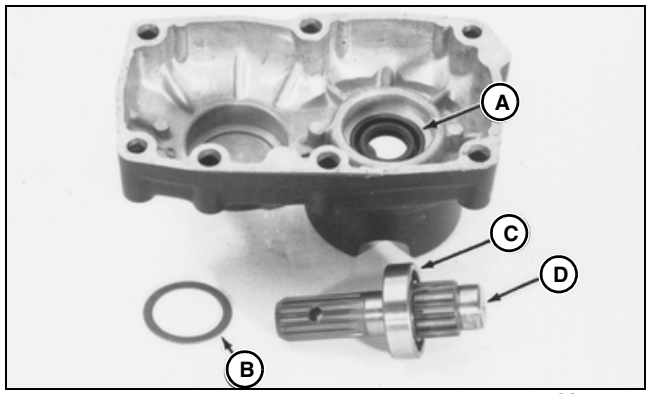
IMPORTANT: Avoid damage! The pinion gear drive shaft must be removed each time a shim adjustment is made. Tighten the bearing retainer plate each time it is installed to properly recheck the backlash.

NOTE: Shims are available in a kit. Shims come in 0.1 mm (0.004 in.), 0.3 mm (0.012 in.), and 0.5 mm (0.02 in.) thicknesses.

18.Adjust backlash by adding or removing shims between the differential assembly bearing and axle housing seat.

19.Tighten bearing retainer plate cap screws to specification after final backlash has been set. Install transfer gear and snap ring on pinion gear drive shaft at this time.

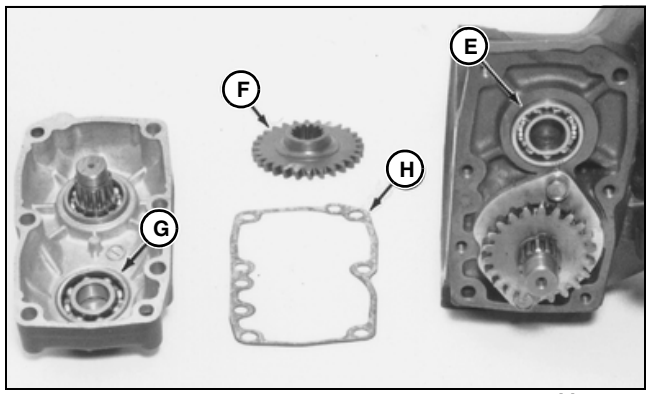
Differential Input Housing



M79616

1. Install new oil seal (A), place thrust washer (B) on top of oil seal, and press bearing (C) onto input shaft (D).

2. Install the shaft in the housing-long splines through the inside of the oil seal first. The shaft bearing must seat fully inside the housing cover.



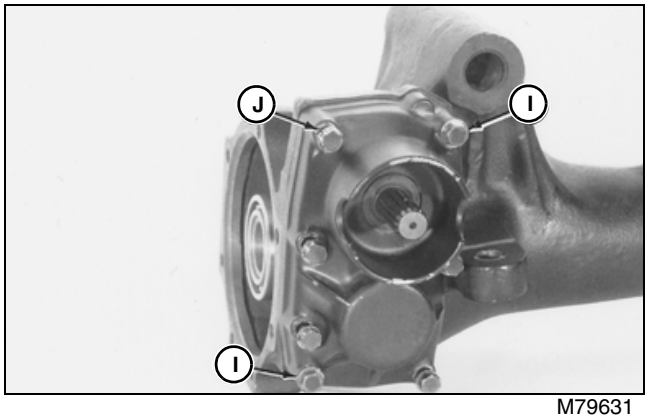
M79630

3. Install bearing (E).

4. Install input gear (F) on input shaft with raised side of gear up and away from the seal.

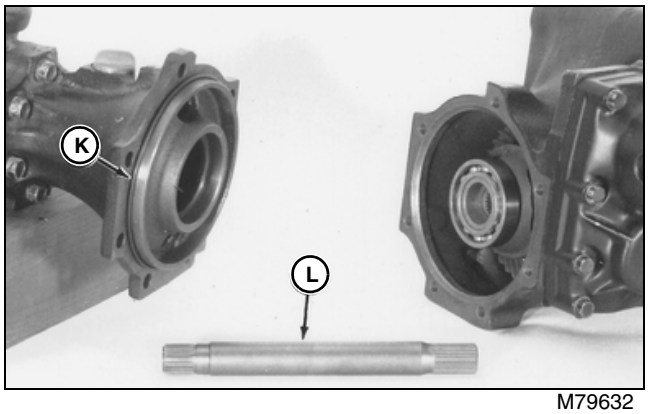
5. Install bearing (G).

6. Align gears, ends of shafts, and gasket (H) and install input housing cover on differential axle housing.



M79631

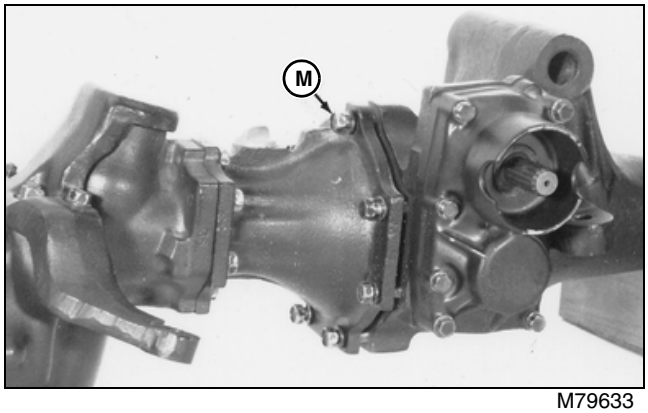
7. Loosely install larger centering cap screws (I).
8. Loosely install remaining cap screws (J)
9. Tighten centering cap screws (I) to specification.
10. Tighten remaining cap screws (J) to specification.



M79632

11. Install seal (K).
12. Install shaft (L) with short splines into spindle input gear inside left axle housing. Align long splines of left axle shaft with splines of differential assembly.

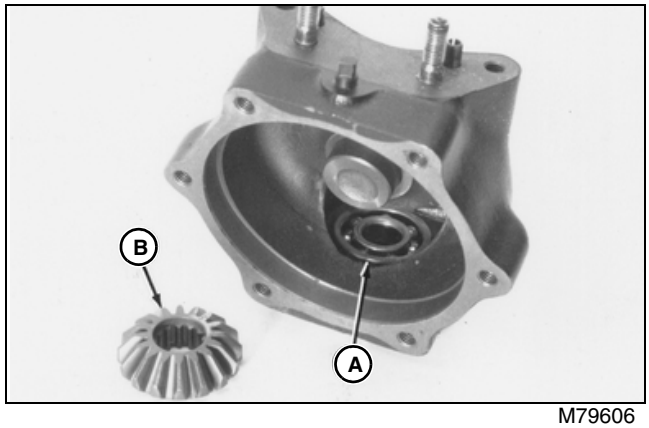
NOTE: Make sure seal remains in its groove when installing housing on differential housing.



M79633

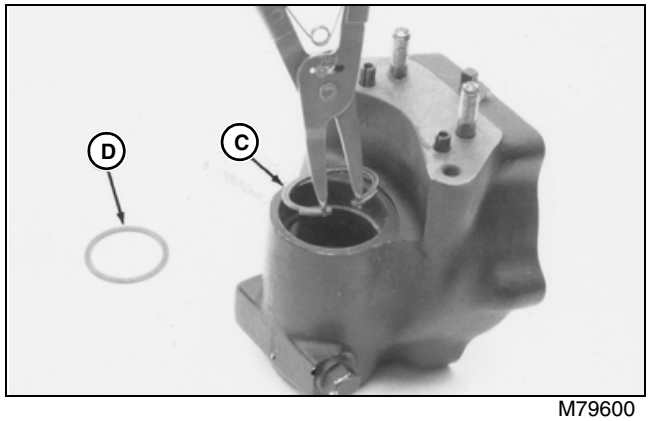
13. Clean all cap screws and housing threads using cure primer.
14. Apply thread lock and sealer (medium strength) to the threads of cap screws (M).
15. Tighten cap screws to specification.

Spindle Gear Case



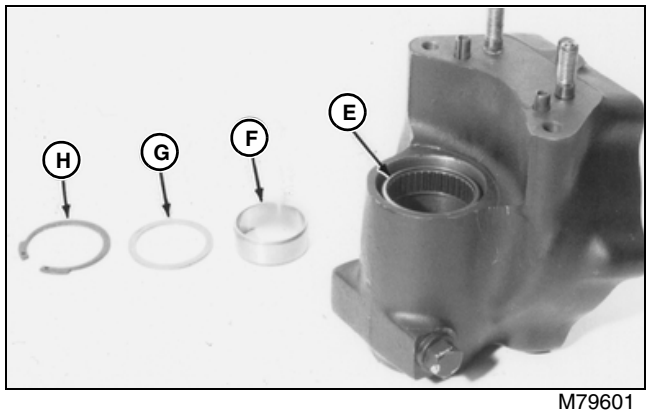
M79606

1. Install bearing (A) in the bottom of the lower gear case.
2. Install gear (B) on bearing.



M79600

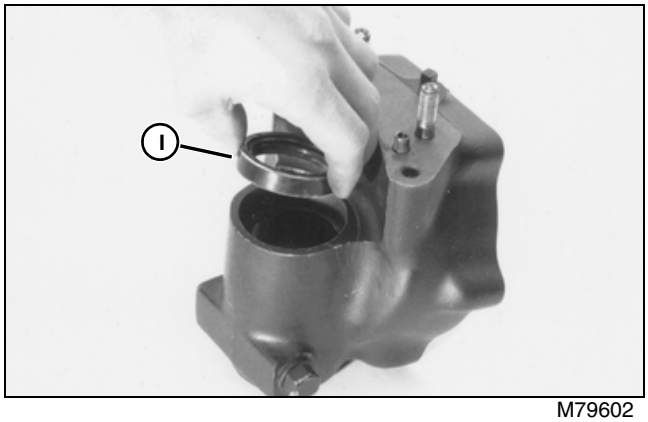
3. Install snap ring (C) in lower groove.
4. Install washer (D) on top of snap ring.



M79601

5. Install needle bearing (E) until the bearing is seated against the lower washer.

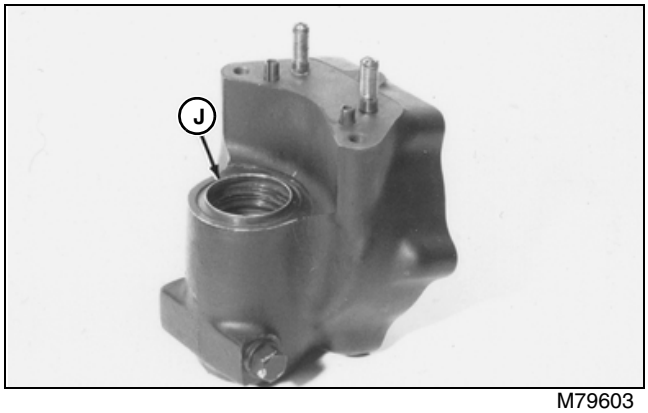
6. Install inner race (F), upper washer (G) and upper snap ring (H).



M79602

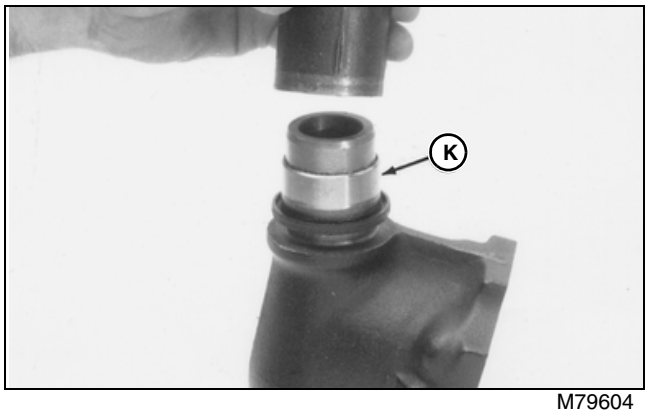
7. Apply grease to surface of seal (I).

8. Install seal in housing, until it is seated against the upper snap ring.



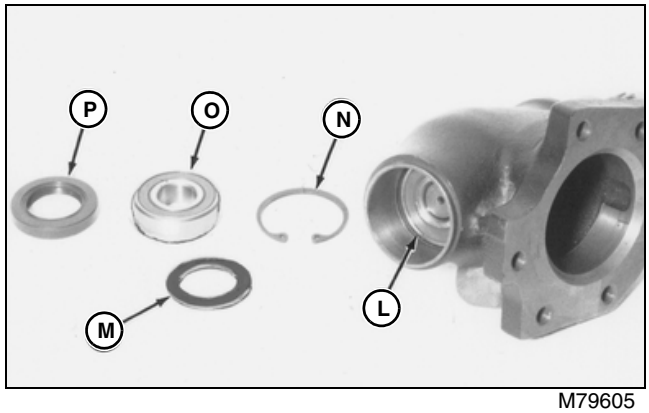
M79603

9. Install collar (J) until it is seated against the oil seal.



M79604

10.Install oil seal wear sleeve (K) on upper gear case using a 40 mm (1-9/16 in.) inside diameter pipe.

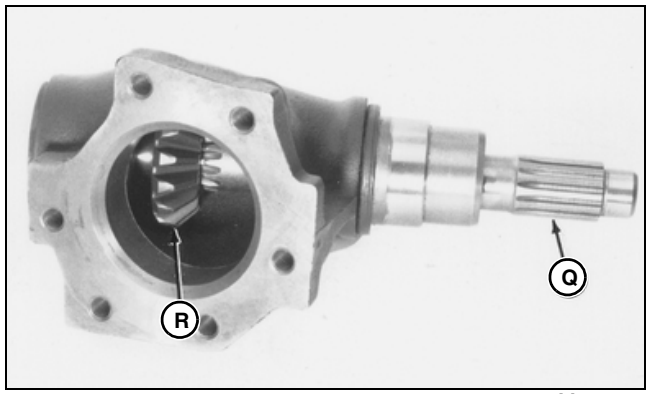


M79605

11.Install bearing (L) in upper gear case. The top of the bearing should be 2 mm (0.0625 in.) below the snap ring groove.

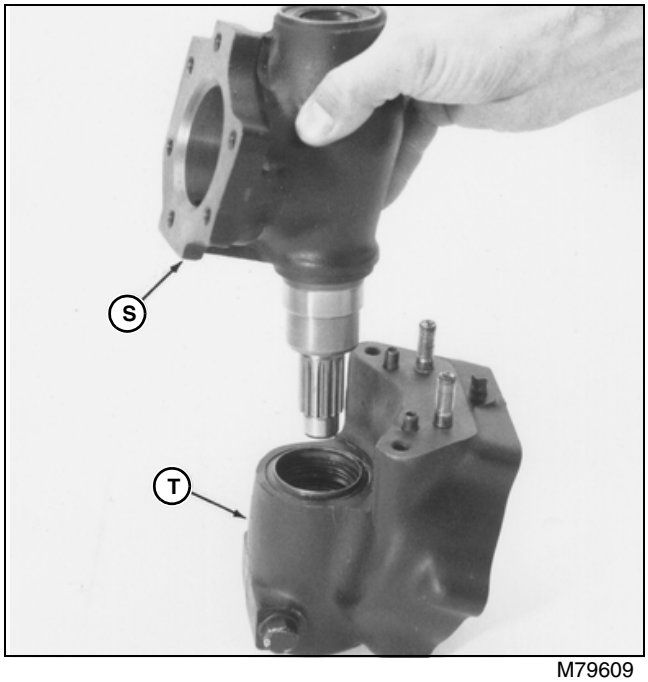
12.Install washer (M).

13.Install snap ring (N), bearing (O), and oil seal (P).



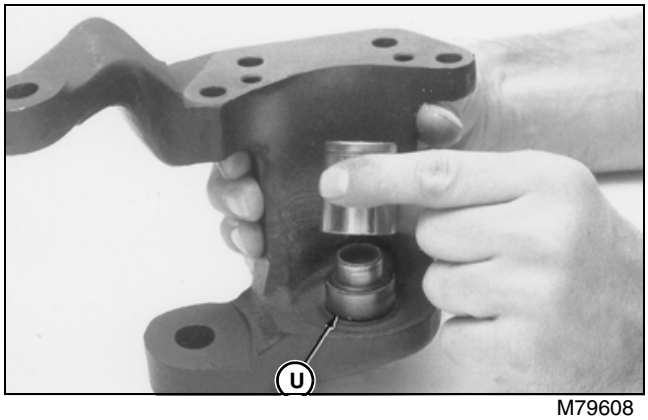
M79607

14.Install spindle shaft (Q) in gear case; install short splines of the shaft through the gear (R) and smooth surface of end shaft into the bearing. Tap the shaft into the bearing with a rubber hammer until fully seated.



M79609

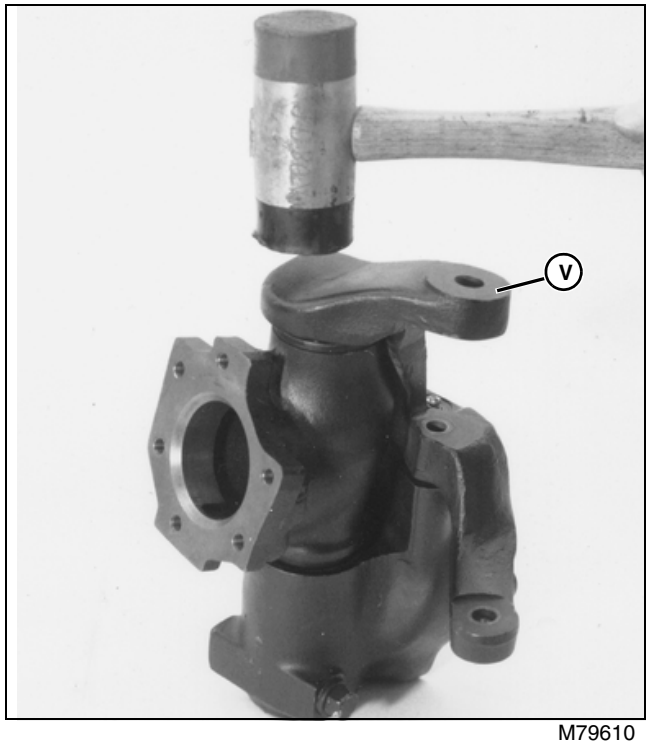
15.Install upper gear case assembly (S) into lower gear case assembly (T). The spindle shaft splines must align with the gear in the bottom of lower gear case.



M79608

16.Apply grease to oil seal wear sleeve (U).

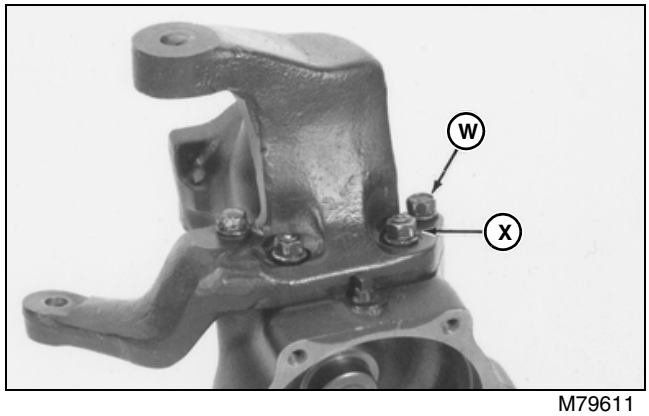
17.Install new oil seal wear sleeve using a socket or short pipe.



M79610

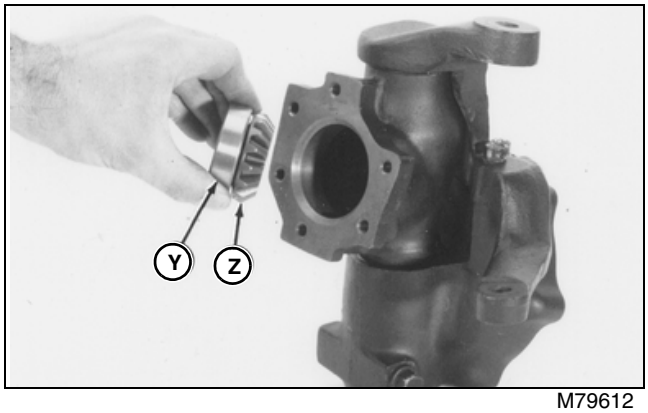
18.Install steering arm (V). Tap steering arm with a rubber hammer to seat, if needed.

NOTE: DO NOT tighten cap screws and nuts until after the spindle case is installed to the axle housing.



M79611

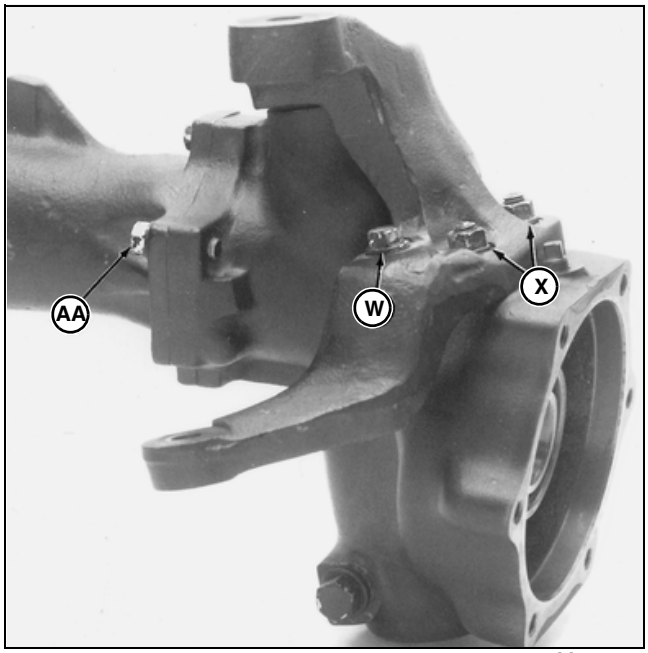
19.Loosely install M10 x 30 mm cap screws (W) and nuts (X).



M79612

20.Assemble the bearing (Y) and gear (Z).

21.Install the bearing and gear into the upper gear case.



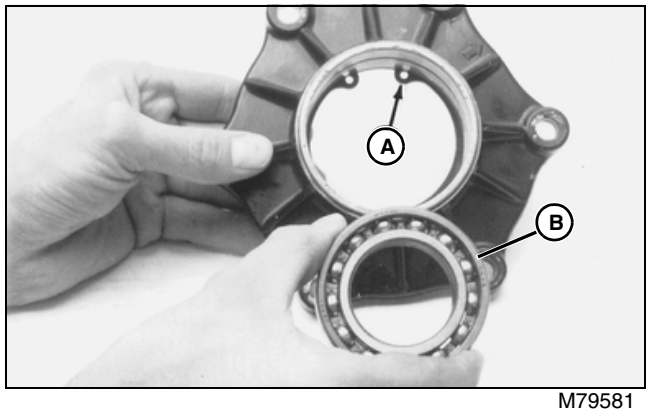
M79586

22.Install and tighten six cap screws (AA).

23.Tighten two cap screws (W).

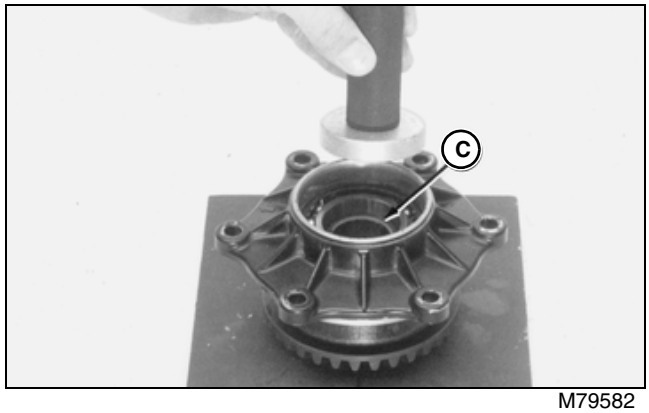
24.Tighten two nuts (X).

Final Drives



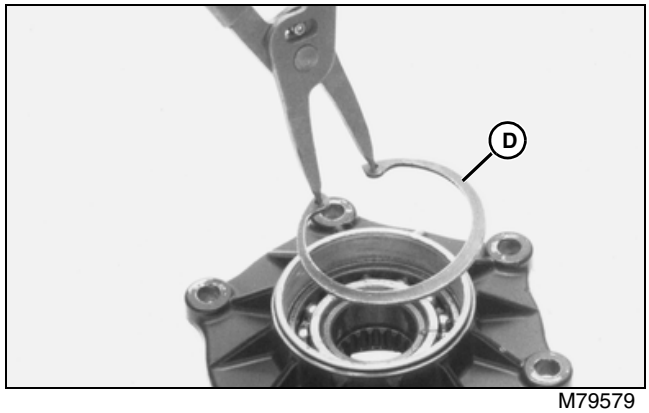
M79581

1. Install snap ring (A) in lower groove.
2. Install bearing (B).



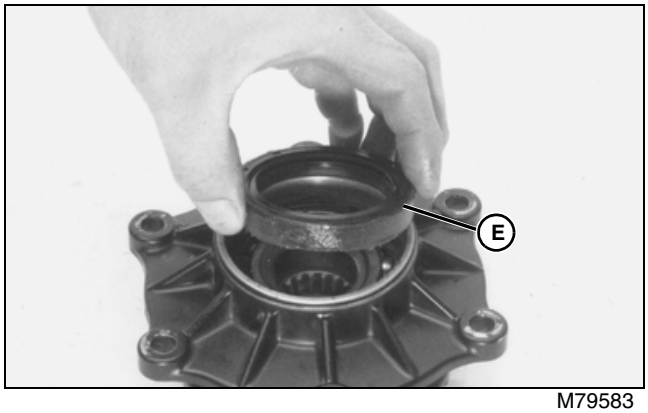
M79582

3. Place ring gear (C) on a firm surface, and position the cover over the ring gear. Press on inner race surface of bearing to install.



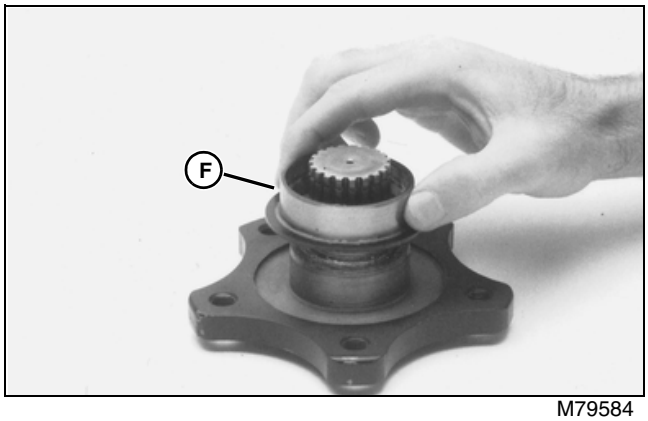
M79579

4. Install outer snap ring (D).



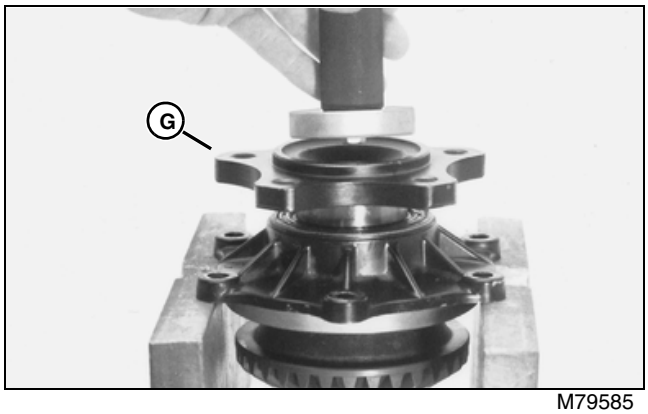
M79583

5. Apply grease to surface of seal (E).
6. Install seal in housing.



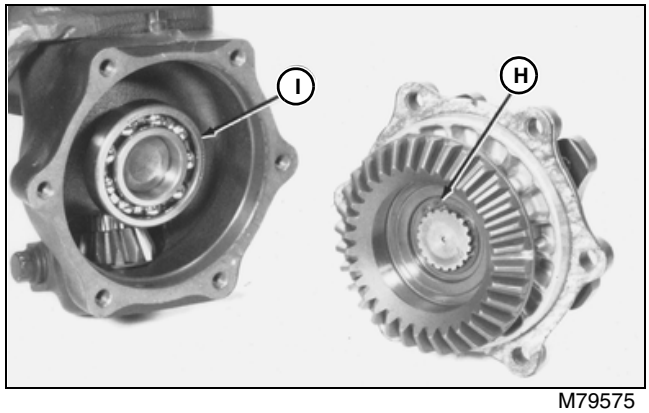
M79584

7. Install oil seal wear sleeve (F) on hub shaft.



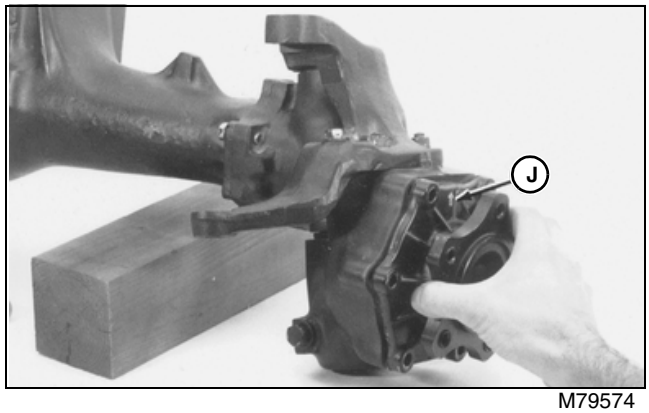
M79585

8. Press hub (G) onto cover assembly.



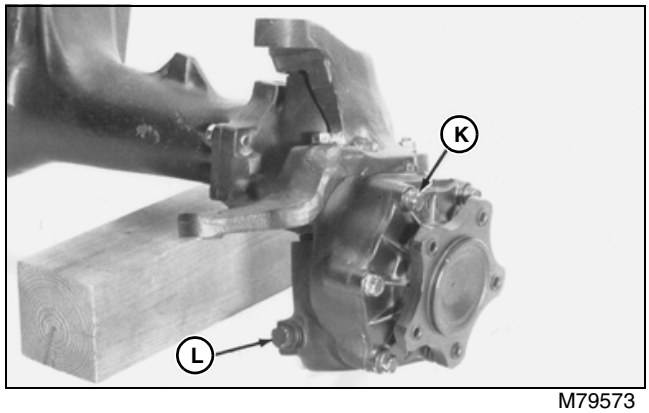
M79575

9. Install snap ring (H) in hub shaft groove.
10. Install bearing (I) on bearing case mount.



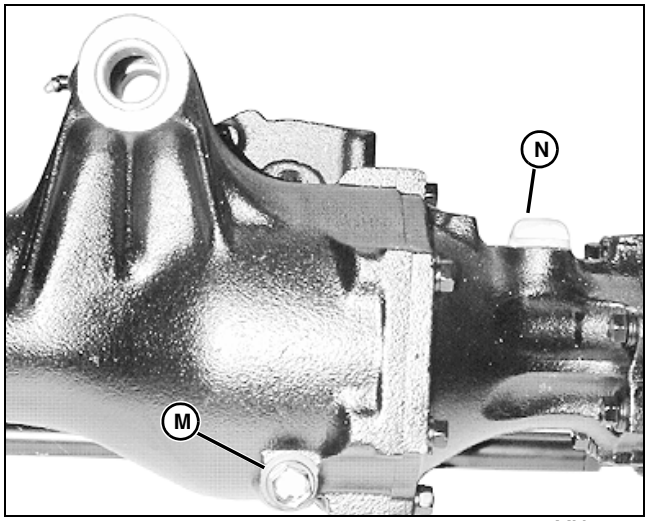
M79574

11. Install cover assembly with arrow (J) pointing up.



M79573

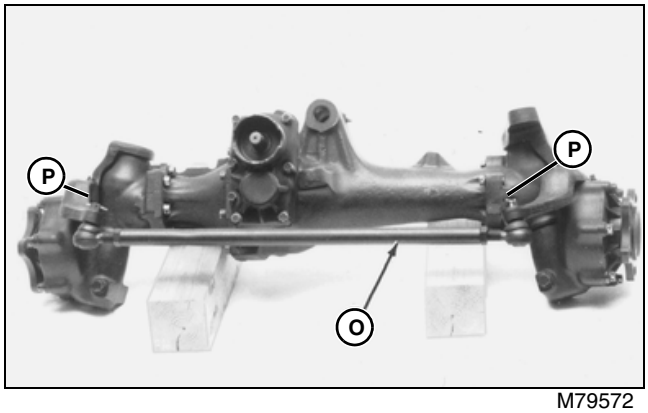
12. Clean all cap screw and housing threads using cure primer.
13. Apply thread lock and sealer (medium strength) to the threads of cap screws.
14. Install M10 x 30 cap screws (K). Tighten cap screws in an alternating pattern to specification.
15. Install drain plug (L).



MX2488

16.Install drain plug (M).

17.Remove filler cap (N) and fill axle with GL5 gear oil.



M79572

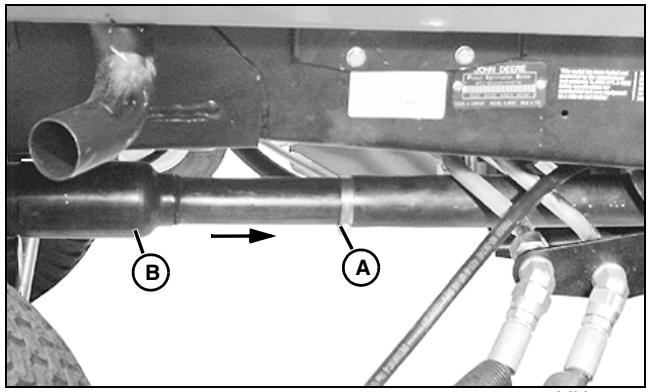
18.Install tie rod (O). Tighten tie rod castle nuts (P) to specification, turn nut forward to drilled hole and install cotter pin.

Specifications

Differential Housing Cap Screw Torque 22 N•m (195 lb-in.)
Differential Input Shaft Assembly
Retaining Cap Screw Torque . . . . . 26 N•m (230 lb-in.)
Differential Backlash . . . 0.17-0.23 mm (0.007-0.009 in.)
Bearing Retainer Plate
Cap Screw Torque . . . . . 26 N•m (230 lb-in.)
Differential Input Housing
Cap Screw Torque . . . . . 26 N•m (230 lb-in.)
Differential Input Housing
Cap Screw Final Torque . . . . . 52 N•m (38 lb-ft)
Assembly Cover Cap Screw Torque . . 52 N•m (38 lb-ft)
Tie Rod Castle Nut Torque . . . . . 53 N•m (39 lb-ft)

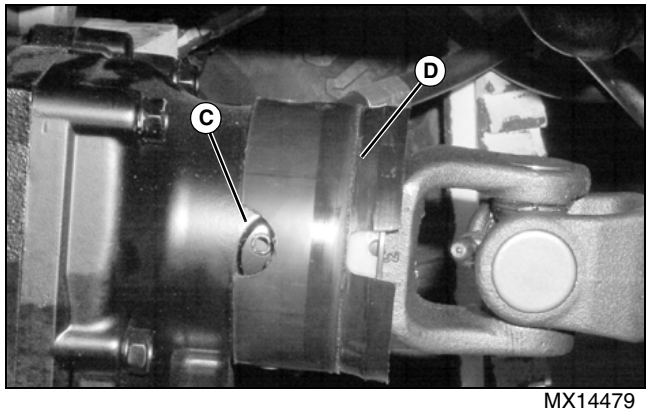
MRWD Drive Shaft Removal and Installation

Removal



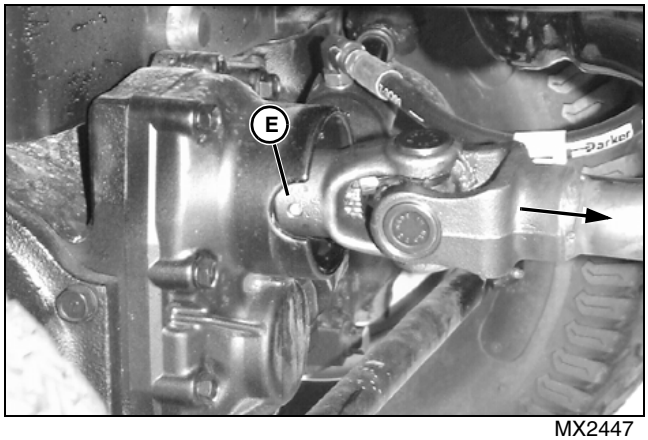
MX2446

1. **On Models 1600/1620:**
   a. Loosen clamp (A).
   b. Slide shield (B) forward.



MX14479

2. **On Model 1600 Turbo:** Rotate guard (D) to align with housing (C) opening.



MX2447

3. Rotate drive shaft until spring pin (E) aligns with opening.

4. Drive spring pin out using a punch.

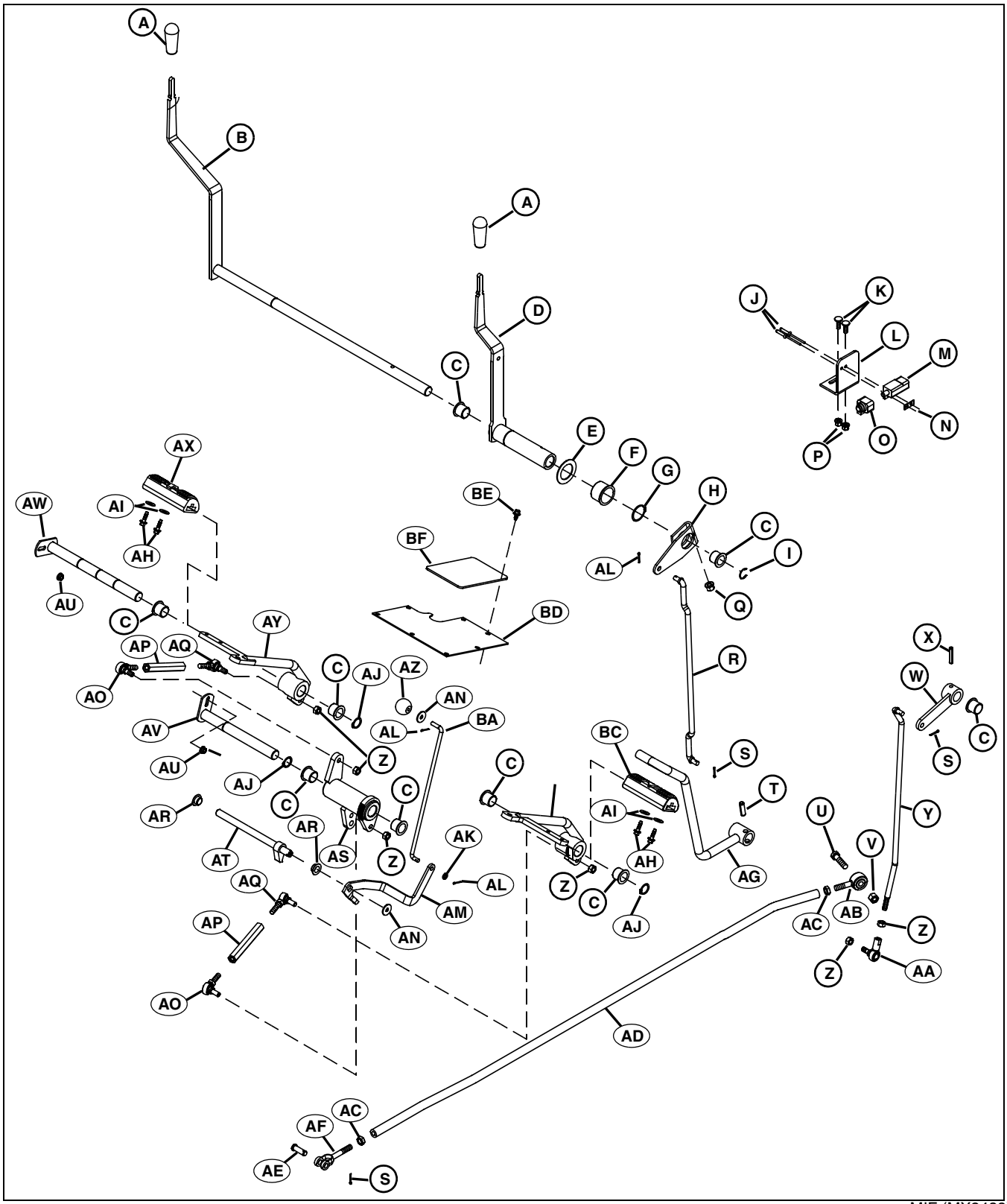
5. Slide rear drive shaft section forward and remove drive shaft.

Installation

Installation is done in the reverse order of removal.

Apply anti-corrosion grease to drive shaft splines before installation.

Transmission Control Linkage Repair - Models 1600 and 1620

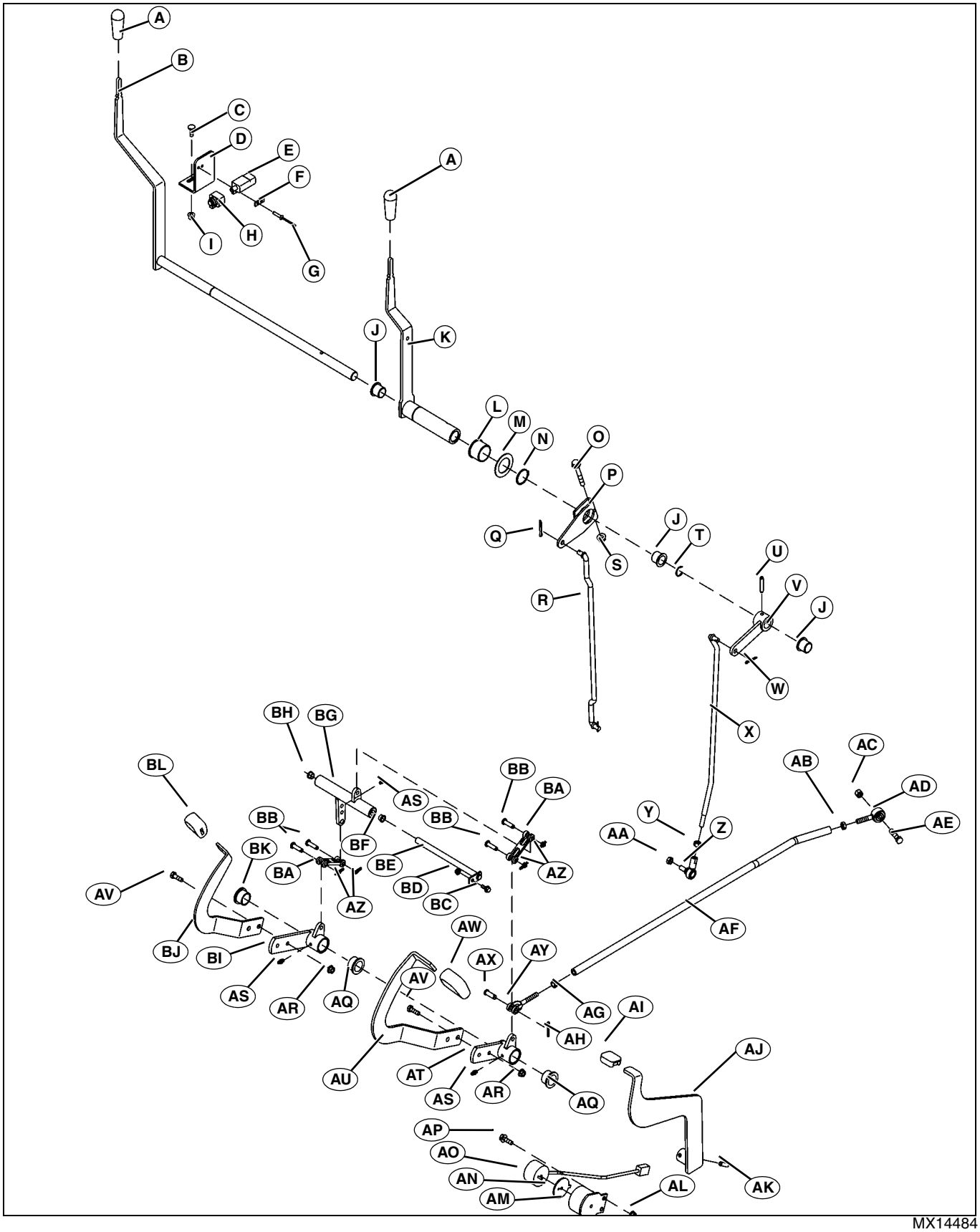


MIF (MX2438)

A - Knob (2 used)
B - Lever
C - Bushing (9 used)
D - Lever
E - Bushing
F - Bushing
G - Washer
H - Arm
I - Snap Ring
J - Rivet (2 used)
K - Cap Screw (2 used)
L - Support
M - Switch
N - Strap
O - Boot
P - Lock Nut (2 used)
Q - Flange Nut
R - Rod
S - Cotter Pin (3 used)
T - Spring Pin
U - Cap Screw
V - Lock Nut
W - Arm
X - Spring Pin
Y - Rod
Z - Nut (6 used)
AA- Ball Joint
AB- Tie Rod End
AC- Nut (2 used)
AD- Rod
AE- Pin
AF- Yoke
AG- Pedal
AH- Screw (4 used)
AI - Washer (4 used)
AJ- Snap Ring (3 used)
AK- Washer
AL- Cotter Pin (2 used)
AM- Arm
AN- Washer (2 used)
AO- Ball Joint (2 used)
AP- Turnbuckle (2 used)
AQ- Ball Joint (2 used)
AR- Bushing (2 used)
AS- Bell Crank
AT- Latch
AU- Flange Nut (2 used)
AV- Shaft
AW- Shaft
AX- Pad
AY- Pedal
AZ- Knob
BA- Rod
BB- Pedal
BC- Pad
BD- Cover
BE- Screw
BF- Mat

- Inspect all parts for wear or damage. Replace parts as needed.
- Adjust linkage as needed.

Transmission Control Linkage Repair - Model 1600 Turbo

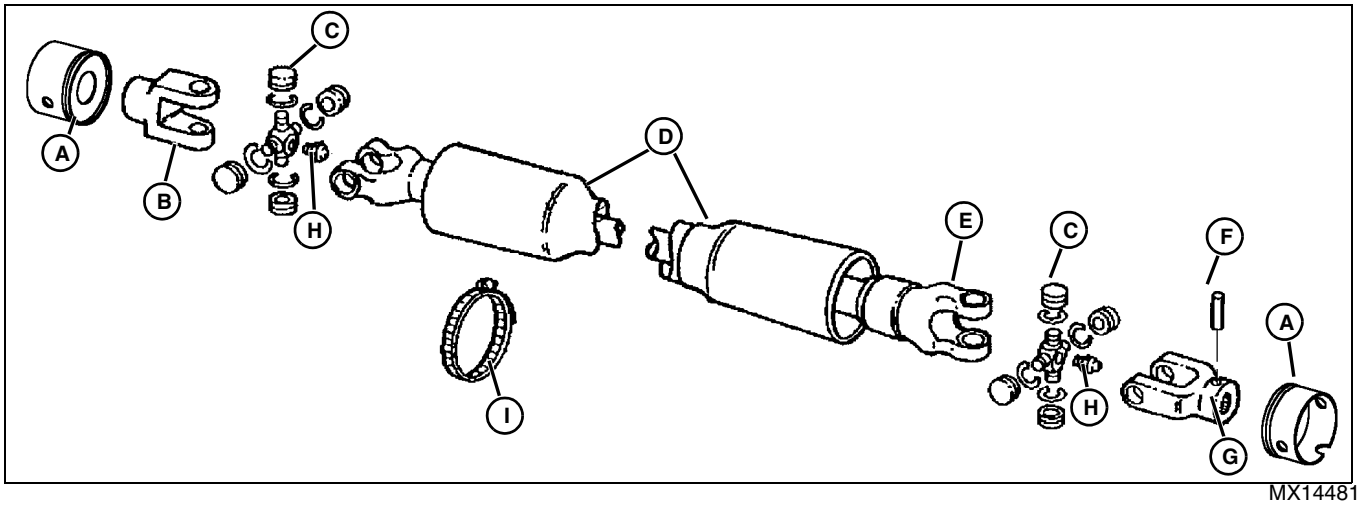


MX14484

A - Knob (2 used)
B - Lever
C - Cap Screw (2 used)
D - Support
E - Switch
F - Strap
G - Rivet (2 used)
H - Boot
I - Lock Nut (2 used)
J - Bushing (2 used)
K - Lever
L - Bushing
M - Washer
N - Snap Ring
O - Cap Screw
P - Arm
Q - Cotter Pin (2 used)
R - Rod
S - Flange Nut
T - Snap Ring
U - Spring Pin
V - Arm
W - Cotter Pin
X - Rod
Y - Nut
Z - Ball Joint
AA- Nut
AB- Nut
AC- Nut
AD- Tie End Rod
AE- Cap Screw
AF- Rod
AG- Nut
AH- Cotter Pin
AI - Pad
AJ- Pedal
AK- Spring Pin
AL- Nut (2 used)
AM- Bracket
AN- Guide
AO- Magnet
AP- Cap Screw (2 used)
AQ- Bushing (4 used)
AR- Flange Nut (5 used)
AS- Lubrication Fitting (3 used)
AT- Arm
AU- Arm
AV- Cap Screw (4 used)
AW- Pad
AX- Pin Fastener
AY- Yoke
AZ- Pin (4 used)
BA- Link (2 used)
BB- Pin Fastener (4 used)
BC- Screw
BD- Flange Nut
BE- Shaft
BF- Bushing (2 used)
BG- Pivot
BH- Pin Fastener
BI - Arm
BJ- Arm

- Inspect all parts for wear or damage. Replace parts as needed.
- Adjust linkage as needed.

MRWD Drive Shaft Repair



MX14481

A - Guard (2 used) (Model 1600 Turbo Only)
B - Yoke
C - Universal Joint Assembly (2 used)
D - Guard (Models 1600/1620 Only)
E - Drive Shaft
F - Pin
G - Yoke
H - Lubrication Fitting (1 used per Universal Joint) (Apply Grease)
I - Clamp (Models 1600/1620 Only)

- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multi-purpose grease to lubrication fittings (H).
- Apply anti-corrosion grease to yoke splines (B and G).

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Specifications

Test and Adjustment Specifications

Hydraulic Oil Operating Temperature	49°C (120°F)
System Charge Relief Valve Pressure	
At SLOW Idle	1034 ± 103 kPa (150 ± 30 psi)
At FAST Idle	1379 ± 134 kPa (200 ± 50 psi)
Steering Pump Flow at 13 790 kPa (2000 psi)	
Models 1600/1600 Turbo	20.1 L/min (4.5 gpm)
Model 1620	15.0 L/min (4.0 gpm)
Lift Pump Flow (Min) at 13 790 kPa (2000 psi)	
Models 1600/1600 Turbo	25.0 L/min (6.0 gpm)
Model 1620	23.0 L/min (6.0 gpm)
Mower Deck Drive Pump Volumetric Efficiency (Min)	0.80 (80%)
Mower Deck Motor Case Drain (Max)	1.9 L/min (0.5 gpm)
Lift Relief Valve Pressure	11 032 kPa (1600 psi)
Spindle Speed	2200 ± 50 rpm

Repair Specifications

Hydraulic System	58.7 L (15.5 gal)
Hydraulic System - 1600 Turbo S.N. (050001-)	50.7 L (13.4 gal)
Triple Pump Control Linkage	
Mower Deck Drive Pump Stroke Arm Mounting Cap Screw Torque	142 N•m (105 lb-ft)
Mower Deck Drive Pump Stroke Arm-to-Ball Joint Mounting Cap Screw Torque	81 N•m (60 lb-ft)
Triple Pump Assembly	
Mower Deck Drive Pump Housing Needle Bearing Installation (Depth Below Seal Ledge	1.78 mm (0.07 in.)
Mower Deck Drive Pump Cover Plate Cap Screw Torque	41 N•m (30 lb-ft)
Mower Deck Drive Pump Manifold Needle Bearing Installation Depth (Extending Above Manifold Surface)	1.91 mm (0.075 in.)
Traction Drive Pump Housing Needle Bearing Installation Depth (Below Seal Ledge)	1.78 mm (0.07 in.)
Traction Drive Pump Cover Plate Cap Screw Torque	41 N•m (30 lb-ft)
Traction Drive Pump Manifold Needle Bearing Installation Depth (Extending Above Manifold Surface)	1.91 mm (0.075 in.)
Mower Deck Drive Motor	
Large Socket Head Cap Screw Torque	61 N•m (45 lb-ft)
Small Socket Head Cap Screw Torque	34 N•m (25 lb-ft)
Mower Deck Lift Control Valve	
Relief Valve Torque	44 N•m (33 lb-ft)
Pilot Valve Torque	44 N•m (33 lb-ft)
Poppet Valve Torque	44 N•m (33 lb-ft)
Small Solenoid Valve Torque	20.3 N•m (180 lb-in.)

Large Solenoid Valve Torque	**40.7 N•m (30 lb-ft)**
Solenoid Valve Retaining Nut Torque	**6 N•m (53 lb-in.)**

Mower Deck Motor Control Valve (Model 1600)

Relief Valve Torque	**44 N•m (33 lb-ft)**
Pilot Valve Torque	**85 N•m (63 lb-ft)**
Poppet Valve (LC1 and LC3) Torque	**85 N•m (63 lb-ft)**
Poppet Valve (CV1A and CV2A) Torque	**58 N•m (43 lb-ft)**
Solenoid Valve Torque	**18 N•m (160 lb-in.)**
Check Valve Torque	**45 N•m (33 lb-ft)**
Mower Deck Motor Control Valve Solenoid Valve Retaining Nut Torque	**6 N•m (53 lb-in.)**

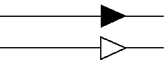
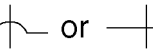
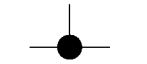
Mower Deck Motor Control Valve (Model 1600 Turbo)

Solenoid Coil Retaining Nut (SV1, SV2) Torque	**5.6-6.2 N•m (50-55 lb-in.)**
-7 Cartridge (SV1, SV2) Torque	**27-34 N•m (20-25 lb-ft)**
-10 Cartridge (C1, C2, R1, R2) Torque	**41-47 N•m (30-35 lb-ft)**
-16 Cartridge (PD1, PD2) Torque	**81-88 N•m (61-65 lb-ft)**
-4 NWD Plug (OR) Torque	**14.7-15.3 N•m (130-136 lb-in.)**
-12 NWD Plug (Other) Torque	**115-118 N•m (85-87 lb-ft)**
-14 NWD Plug (PIS1, PIS2, Other) Torque	**148-152 N•m (109-112 lb-ft)**

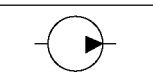
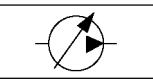
Schematics and Harnesses

JIC Hydraulic Circuit Symbols

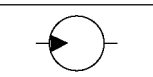
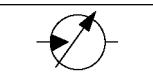
LINES

1		Working (Main) Lines
2		Pilot Control Lines
3		Drain Line
4		Hydraulic / Pneumatic } Flow Direction
5		Crossing Lines
6		Joining Lines
7		Flexible Line

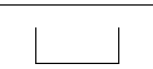
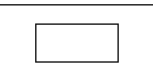
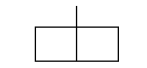
PUMPS

8		Fixed Displacement
9		Variable Displacement

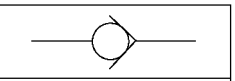
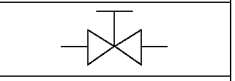
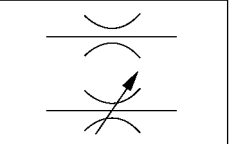
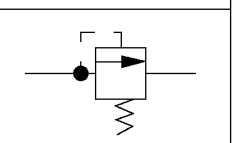
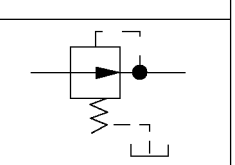
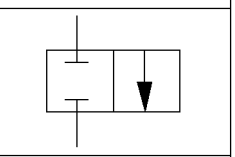
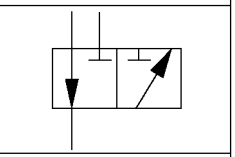
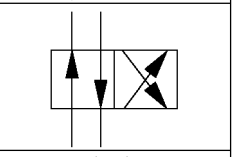
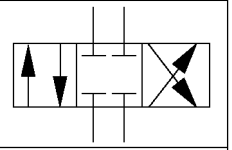
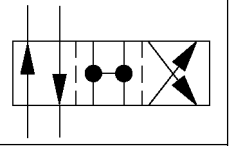
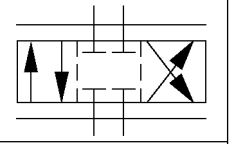
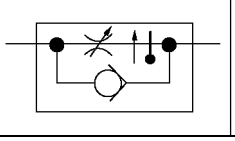
MOTORS

10		Fixed Displacement
11		Variable Displacement

RESERVOIR

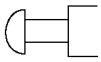
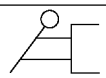
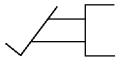
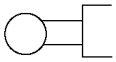
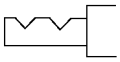
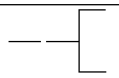
12		Vented Reservoir
13		Pressurized Reservoir
14		Reservoir Return -Above Fluid Level
15		Reservoir Return -Below Fluid Level

VALVES

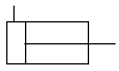
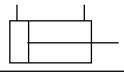
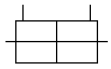
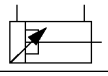
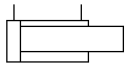
16		Check Valve
17		Manual On/Off Valve
18		Fixed / Variable } Orientation
19		Pressure Relief Valve
20		Pressure Reduction Valve
21		Two Position, Two Connection Valve
22		Two Position, Three Connection Valve
23		Two Position, Four Connection Valve
24		Three Position, Four Connection Valve
25		Two Position, Four Connection Valve with Transmission
26		Three Position, Four Connection Valve with Infinite Positioning
27		Adjustable Flow Control Valve (Temperature and Pressure Compensated)

M82612AE

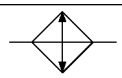
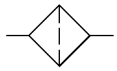
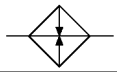
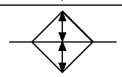
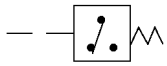
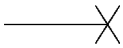
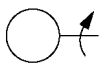
VALVE OPERATORS

28		Spring
29		Manual
30		Push Button
31		Push/Pull Lever
32		Pedal or Treadle
33		Mechanical
34		Detents
35		Pressure Compensated
36		Solenoid-Single Winding
37		Reversing Motor
38		Pilot Pressure -Remote Supply
39		Pilot Pressure -Internal Supply

CYLINDERS

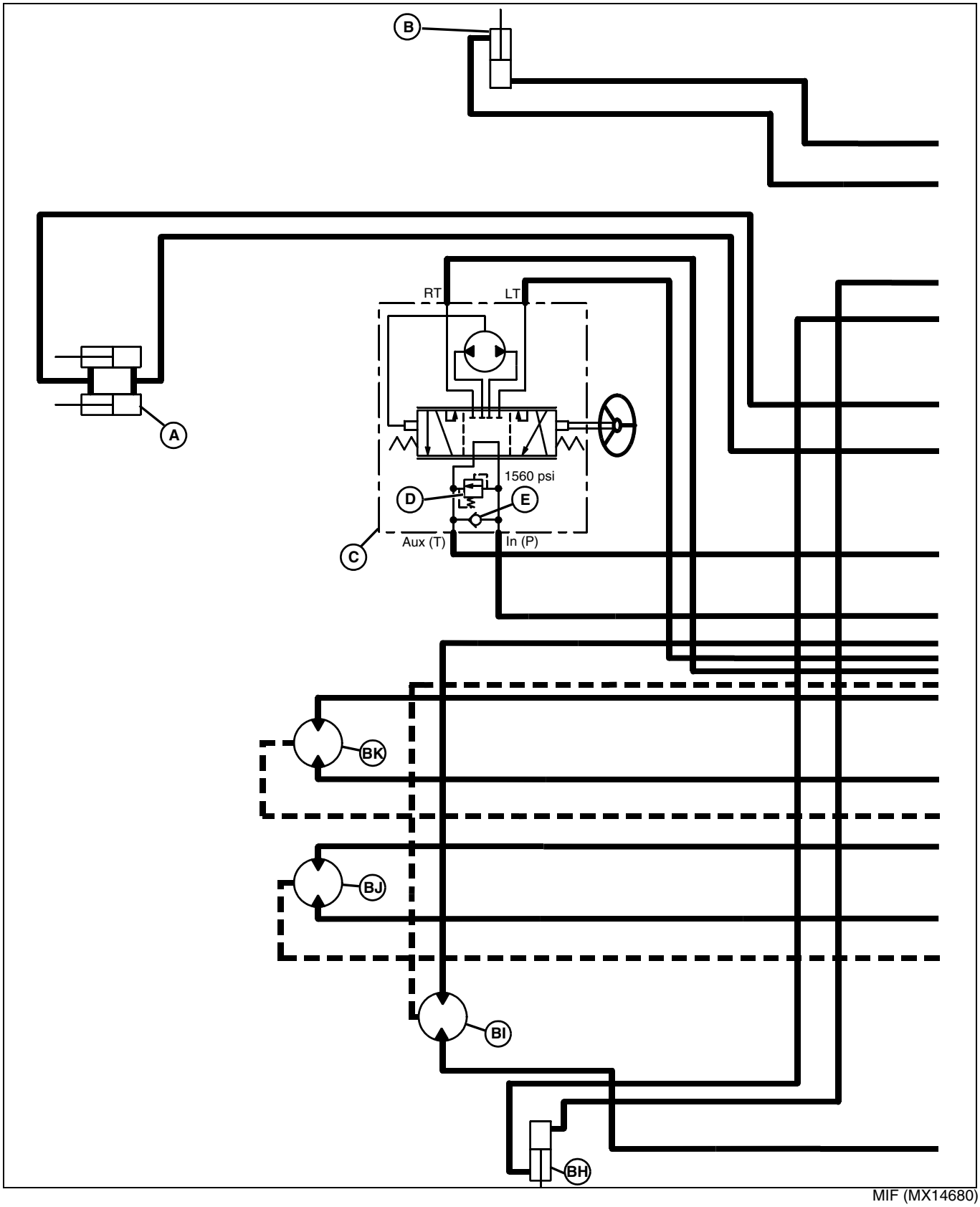
40		Single Acting
41		Double Acting, Single Rod
42		Double Acting, Double Rod
43		Double Acting, Adj. Cushion, Extend Only
44		Double Acting, Differential Piston

MISCELLANEOUS

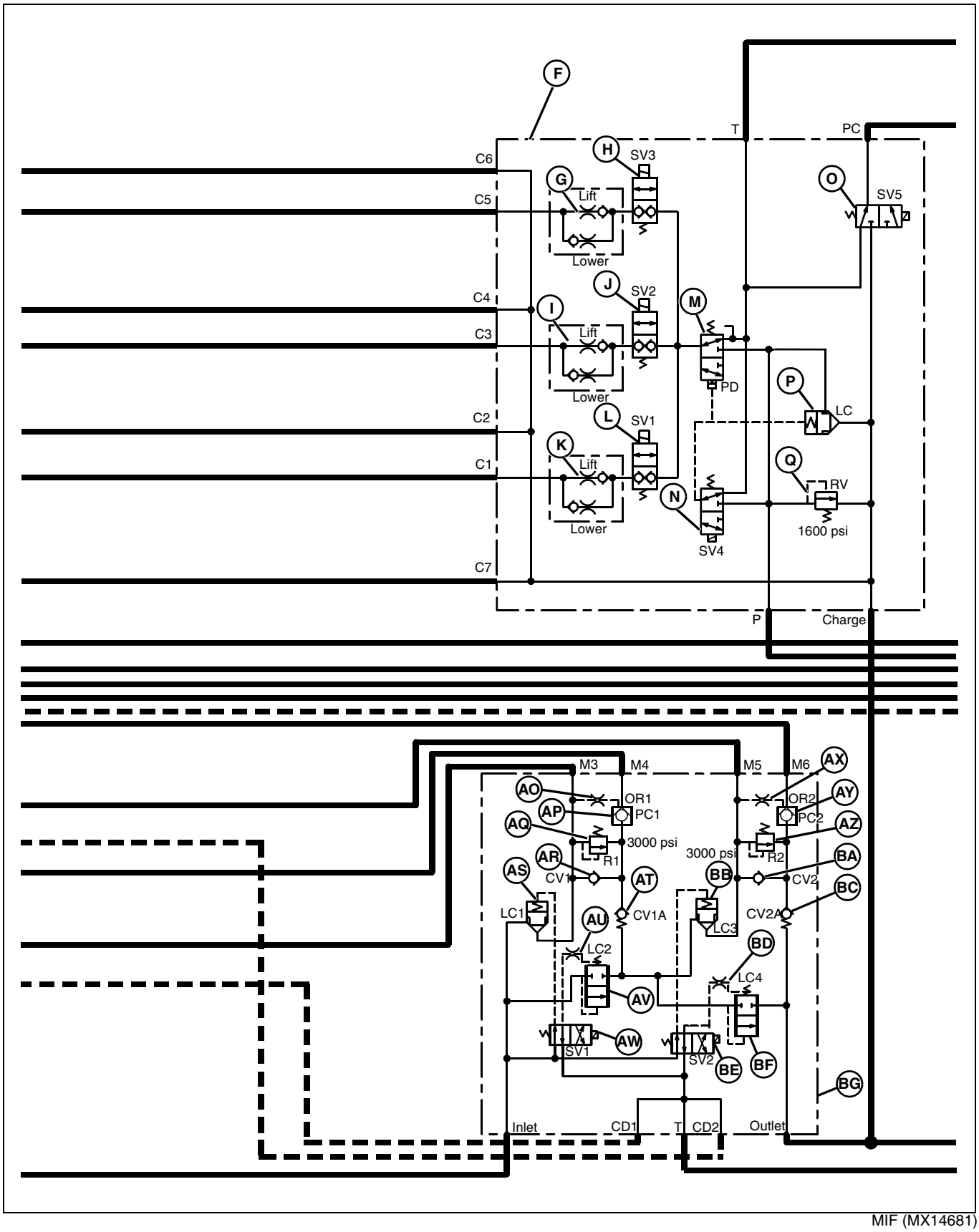
45		Cooler
46		Filter, Strainer
47		Heater
48		Temperature Controller
49		Pressure Switch
50		Pressure Indicator
51		Temperature Indicator
52		Pressure Compensated
53		Variable Component (Symbol Thru Component)
54		Plug, Test Port, Pressure Supply Test
55		Gas Charged Accumulator
56		Spring Loaded Accumulator
57		Electric Motor
58		Shaft Rotation (Arrow on Near Side of Shaft)
59		Component Outline

M82613AE

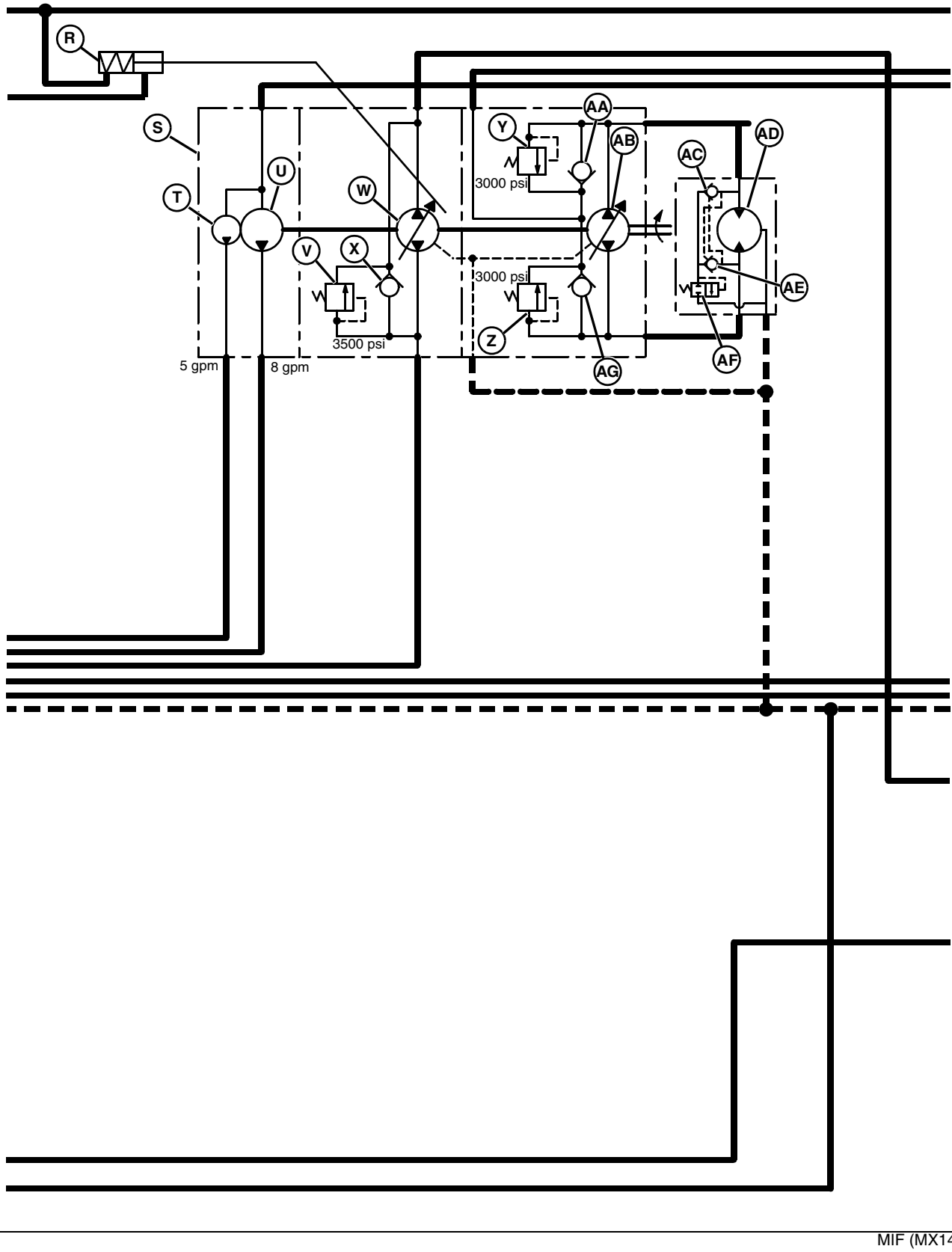
Hydraulic Schematics - Model 1600



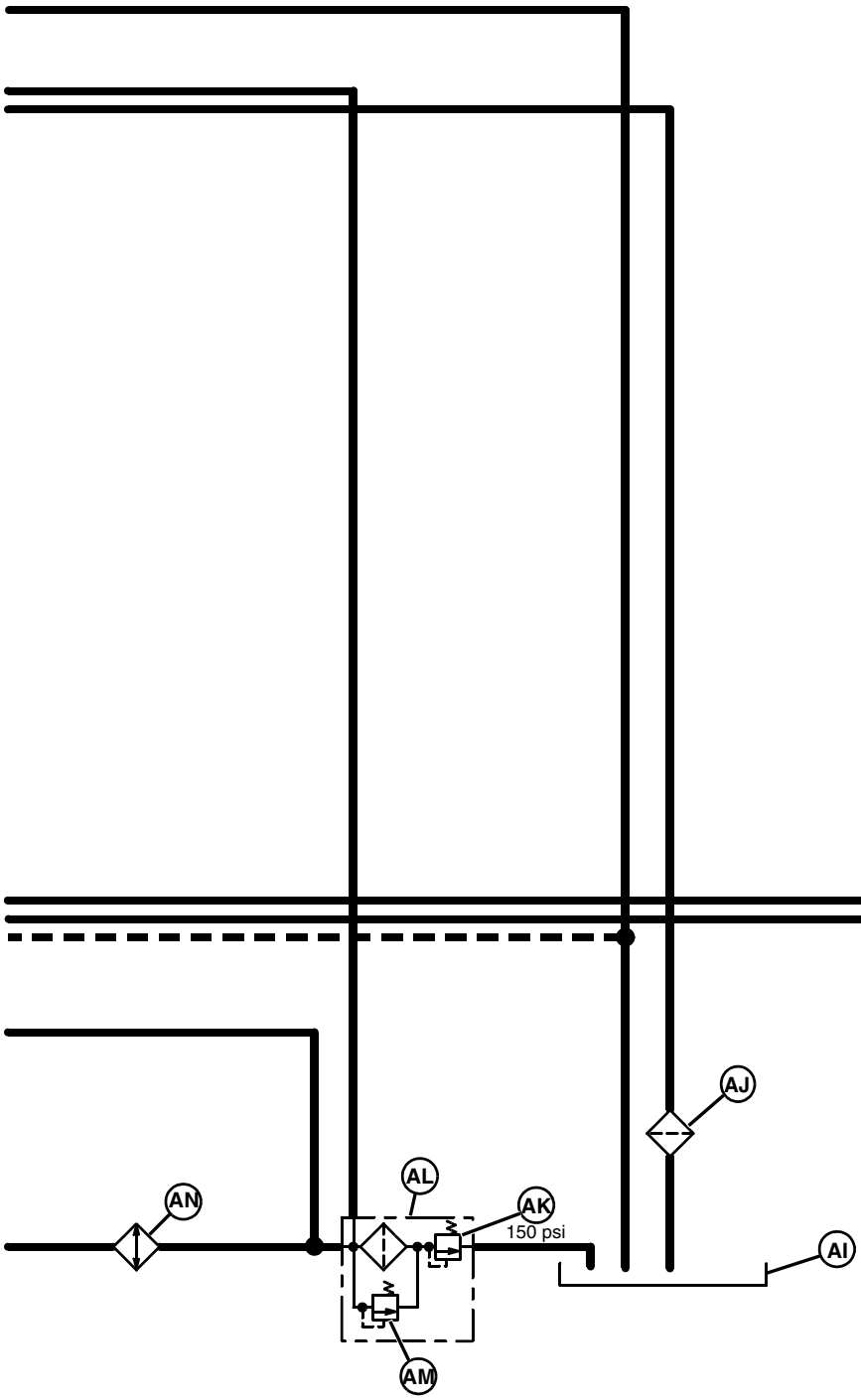
MIF (MX14680)


F
T
PC
H
SV3
G
Lift
Lower
C6
C5
O
SV5
J
SV2
C4
I
Lift
Lower
C3
M
PD
P
LC
C2
L
SV1
K
Lift
Lower
C1
Q
RV
1600 psi
N
SV4
C7
P
Charge
M3
M4
M5
M6
AO
AP
AQ
OR1
PC1
3000 psi
R1
AR
CV1
AS
AT
LC1
AU
CV1A
LC2
AV
SV1
AW
AX
AY
OR2
PC2
AZ
3000 psi
R2
BA
BB
CV2
BC
LC3
CV2A
BD
LC4
SV2
BE
BF
BG
Inlet
CD1
T
CD2
Outlet

MIF (MX14681)


R
S
T
U
V
W
X
Y
Z
AA
AB
AC
AD
AE
AF
AG
3000 psi
3000 psi
3500 psi
5 gpm
8 gpm

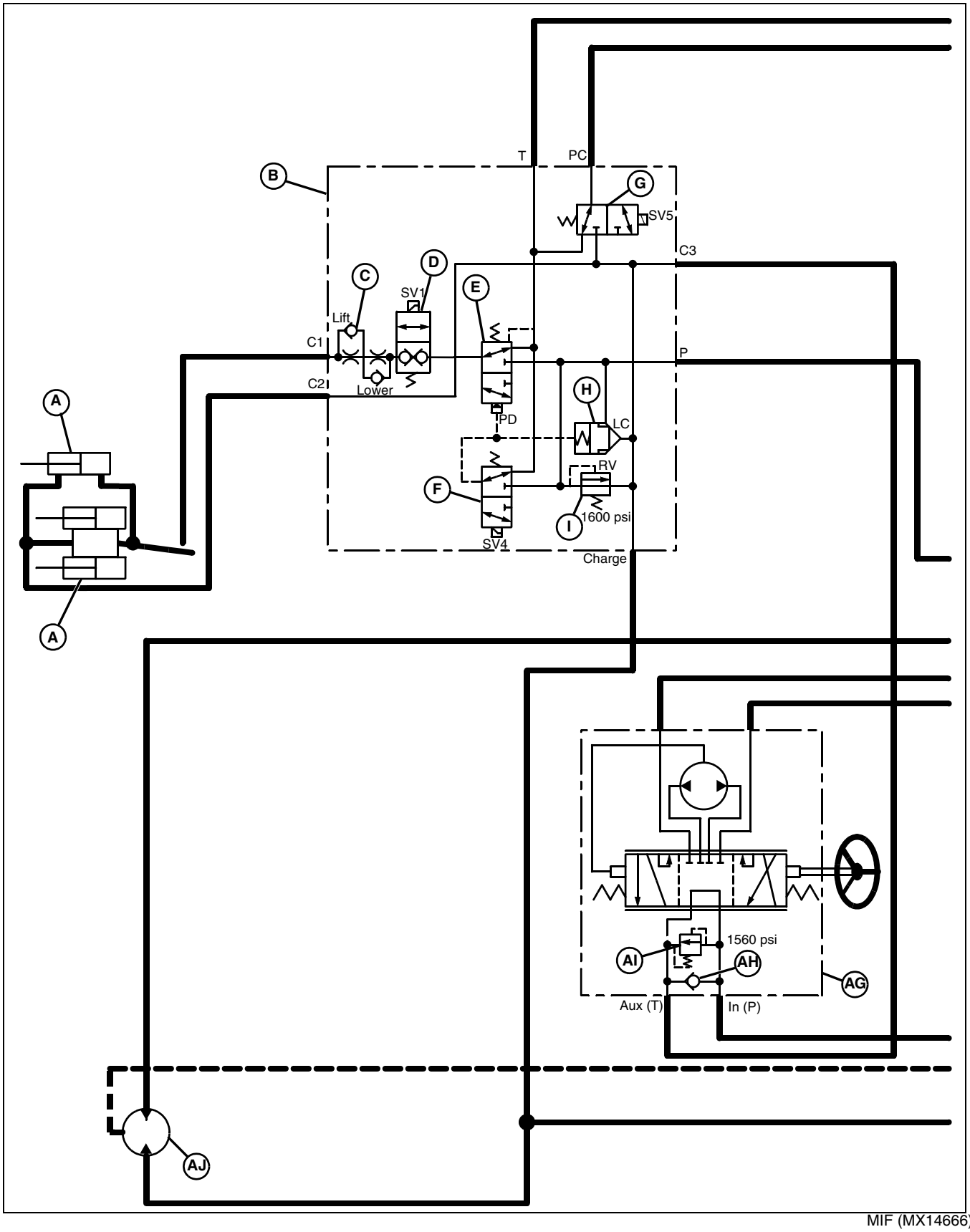
MIF (MX14682)



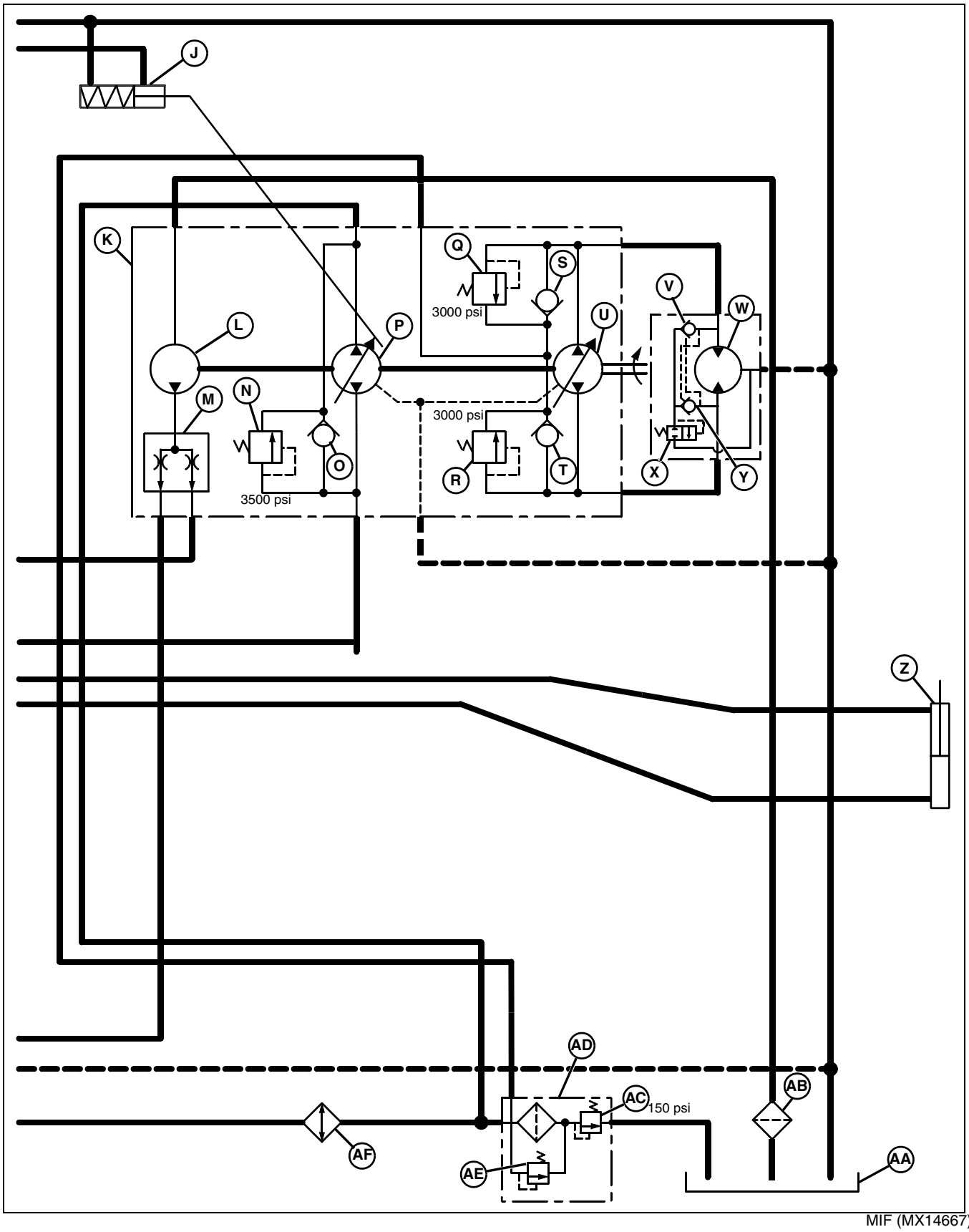
MIF (MX14683)

A - Front Deck Lift Cylinders
B - Right Deck Lift Cylinder
C - Steering Valve
D - Steering Relief Valve
E - Manual Steering Check Valve
F - Deck Lift Control Valve
G - Right Deck Bi-Directional Orifice Disk
H - Right Deck Raise/Lower Solenoid Valve (SV3)
I - Left Deck Bi-Directional Orifice Disk
J - Left Deck Raise/Lower Solenoid Valve (SV2)
K - Front Deck Bi-Directional Orifice Disk
L - Front Deck Raise/Lower Solenoid Valve (SV1)
M - Deck Lift Pilot Direction Valve (PD)
N - Deck Lift Solenoid Valve (SV4)
O - Deck Drive Stroke Control Cylinder Solenoid Valve (SV5)
P - Lift Logic Valve (LC)
Q - Lift Pressure Relief Valve (RV)
R - Deck Drive Stroke Control Cylinder
S - Triple Pump Assembly
T - Steering Pump
U - Lift Pump
V - Deck Drive Pump Pressure Relief Valve
W - Deck Drive Pump
X - Anti-Cavitation Check Valve
Y - Hydrostatic Pressure Relief Valve (Forward)
Z - Hydrostatic Pressure Relief Valve (Reverse)
AA- Hydrostatic Pump Check Valve (Forward)
AB- Traction Drive Pump
AC- Traction Drive Motor Check Valve (Forward)
AD- Traction Drive Motor
AE- Traction Drive Motor Check Valve (Reverse)
AF- Traction Drive Motor Back Pressure Valve
AG- Hydrostatic Pump Check Valve (Reverse)
AH- Steering Cylinder
AI - Vented Reservoir (Tank)
AJ- Screen Filter (in Tank)
AK- Charge Pressure Relief Valve
AL- Oil Filter Assembly
AM- Filter Bypass Relief Valve
AN- Oil Cooler Assembly
AO- Left Deck Orifice (OR1)
AP- Left Deck Breaking Valve (PC1)
AQ- Left Deck Relief Valve (R1)
AR- Left Deck Anti-Cavitation Valve (CV1)
AS- Left Deck Motor Logic Valve (LC1)
AT- Left Deck Positive Stop Check Valve (CV1A)
AU- Left Deck Pilot Valve Orifice
AV- Left Deck Pilot Valve (LC2)
AW- Left Deck Motor Solenoid Valve (SV1)
AX- Right Deck Orifice (OR2)
AY- Right Deck Breaking Valve (PC2)
AZ- Right Deck Relief Valve (R2)
BA- Right Deck Anti-Cavitation Valve (CV2)
BB- Right Deck Motor Logic Valve (LC3)
BC- Right Deck Positive Stop Check Valve (CV2A)
BD- Right Deck Pilot Valve Orifice
BE- Right Deck Motor Solenoid Valve (SV2)
BF- Right Deck Pilot Valve (LC4)
BG- Deck Drive Motor
BH- Left Deck Lift Cylinder
BI - Front Deck Drive Motor
BJ- Left Deck Drive Motor
BK- Right Deck Drive Motor

Hydraulic Schematics - Model 1620



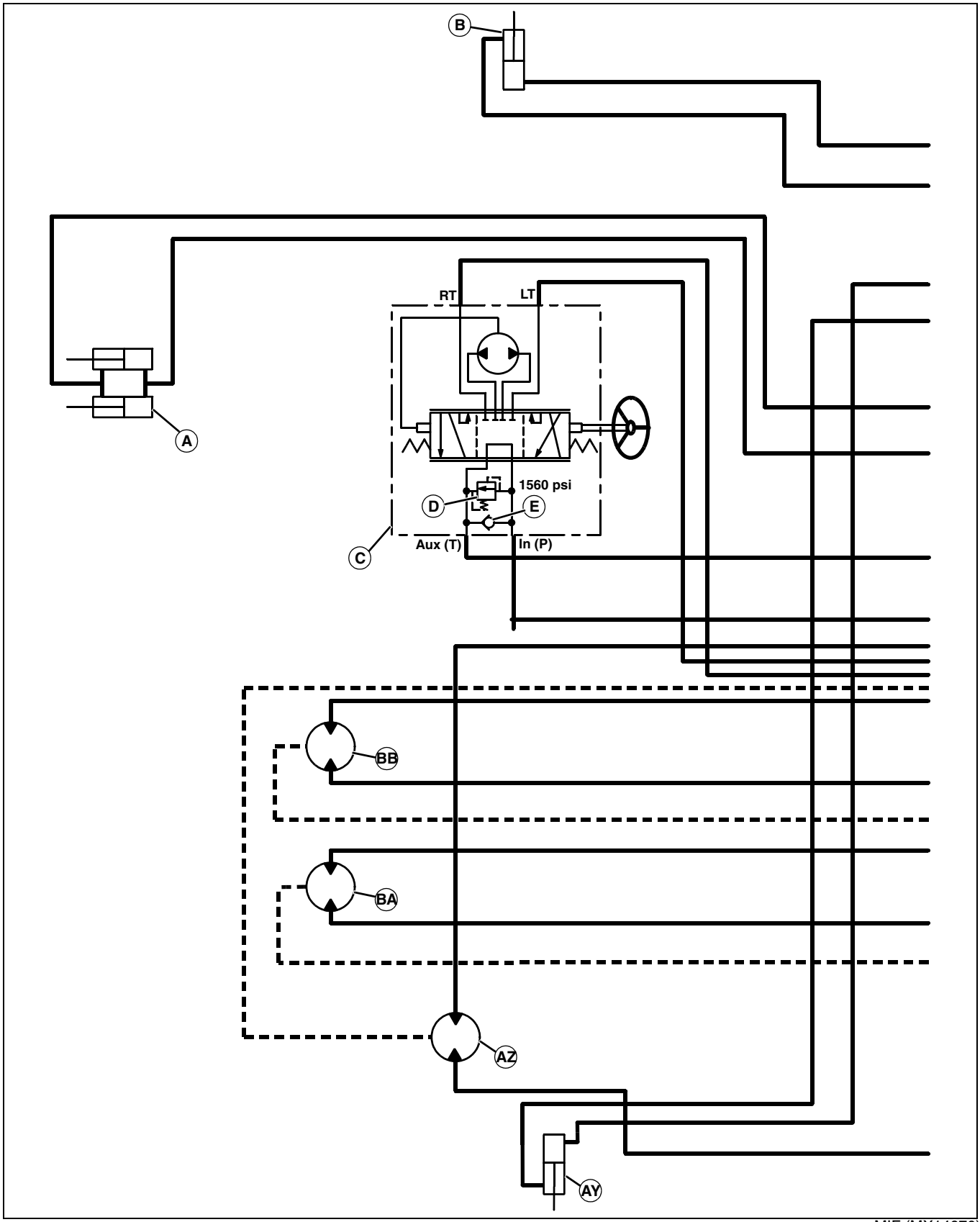
MIF (MX14666)


J
K
Q
S
3000 psi
V
W
L
P
U
M
N
3000 psi
O
R
T
X
Y
3500 psi
Z
AD
AC
150 psi
AB
AF
AE
AA

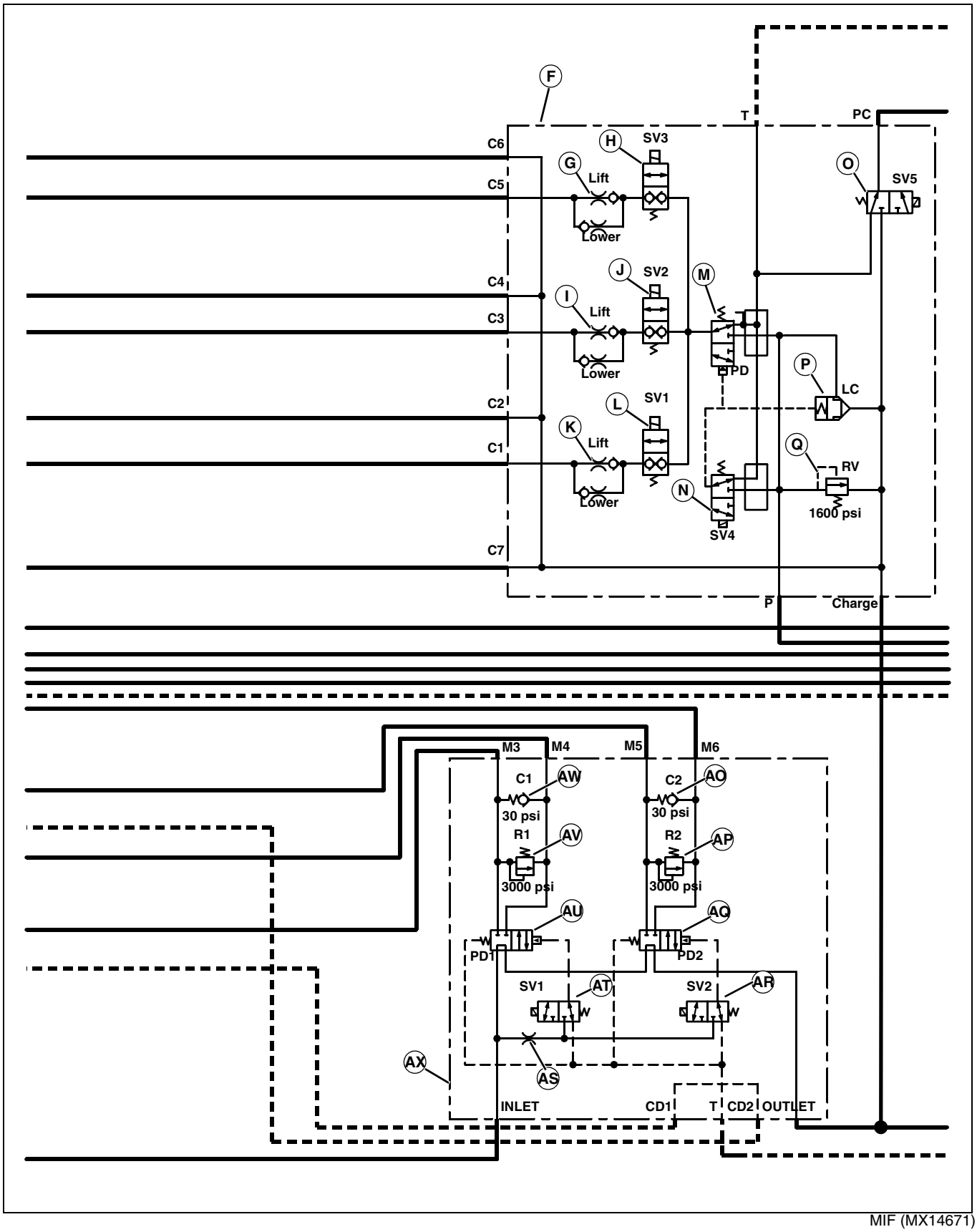
MIF (MX14667)

A - Deck Lift Cylinders
B - Deck Lift Control Valve
C - Deck Bi-Directional Orifice Disk
D - Deck Raise/Lower Solenoid (SV1)
E - Deck Lift Hydraulic Actuated Valve (PD)
F - Deck Lift Solenoid Valve (SV4)
G - Deck Drive Stroke Control Cylinder Solenoid Valve (SV5)
H - Lift Logic Valve (LC)
I - Lift Pressure Relief Valve (RV)
J - Deck Drive Stroke Control Cylinder
K - Triple Pump Assembly
L - Steering/Lift Pump
M - Flow Divider Valve
N - Deck Drive Pump Relief Valve
O - Anti-Cavitation Valve
P - Deck Drive Pump
Q - Hydrostatic Pressure Relief Valve (Forward)
R - Hydrostatic Pressure Relief Valve (Reverse)
S - Hydrostatic Pump Check Valve (Forward)
T - Hydrostatic Pump Check Valve (Reverse)
U - Traction Drive Pump
V - Deck Drive Pump Pressure Relief Valve
W - Traction Drive Motor
X - Traction Drive Motor Back Pressure Valve
Y - Traction Drive Motor Check Valve (Reverse)
Z - Steering Cylinder
AA- Vented Reservoir (Tank)
AB- Screen Filter (in Tank)
AC- Charge Pressure Relief Valve
AD- Oil Filter Assembly
AE- Filter Bypass Relief Valve
AF- Oil Cooler Assembly
AG- Steering Valve
AH- Manual Steering Check Valve
AI - Steering Relief Valve
AJ- Deck Drive Motor

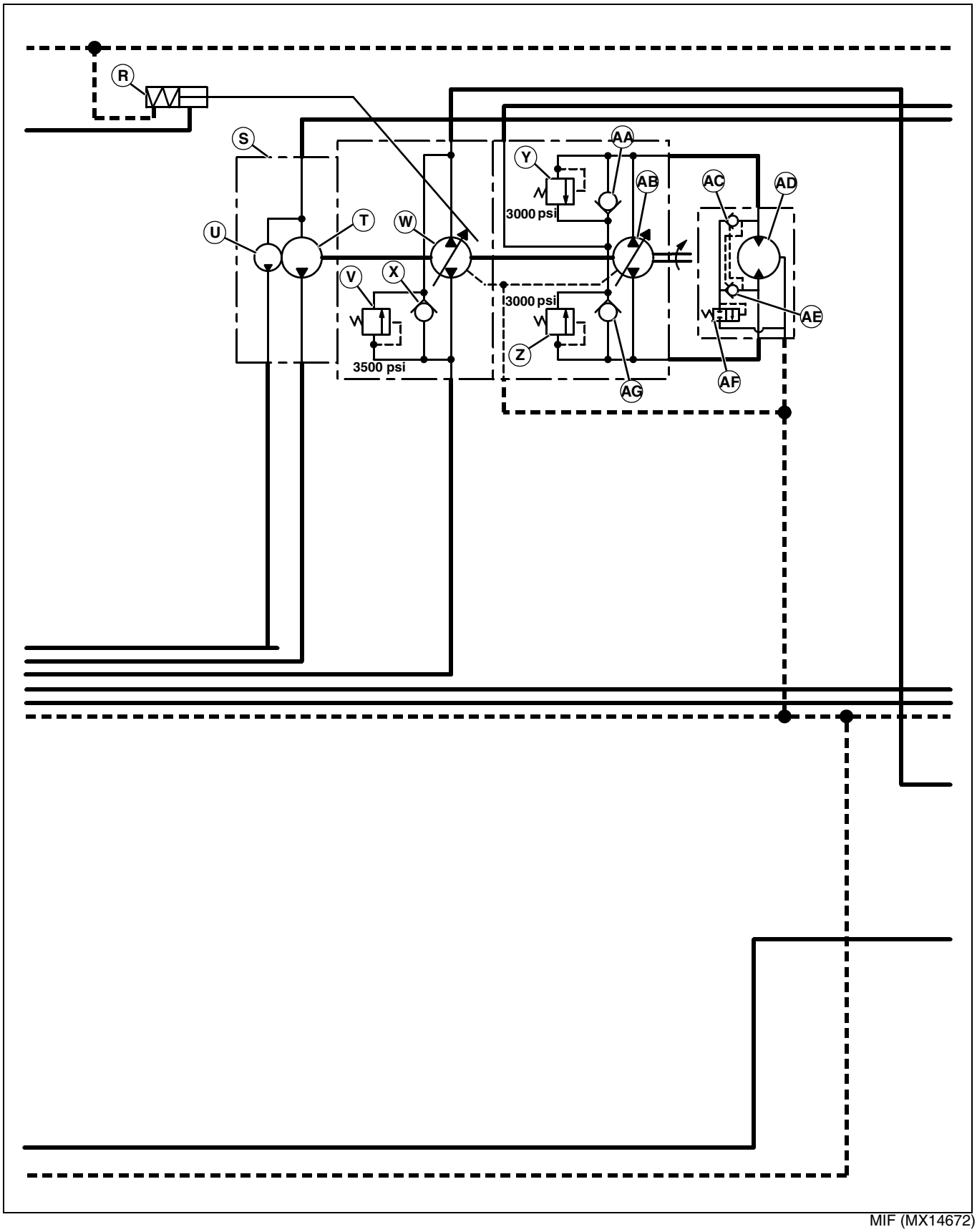
Hydraulic Schematics - Model 1600 Turbo



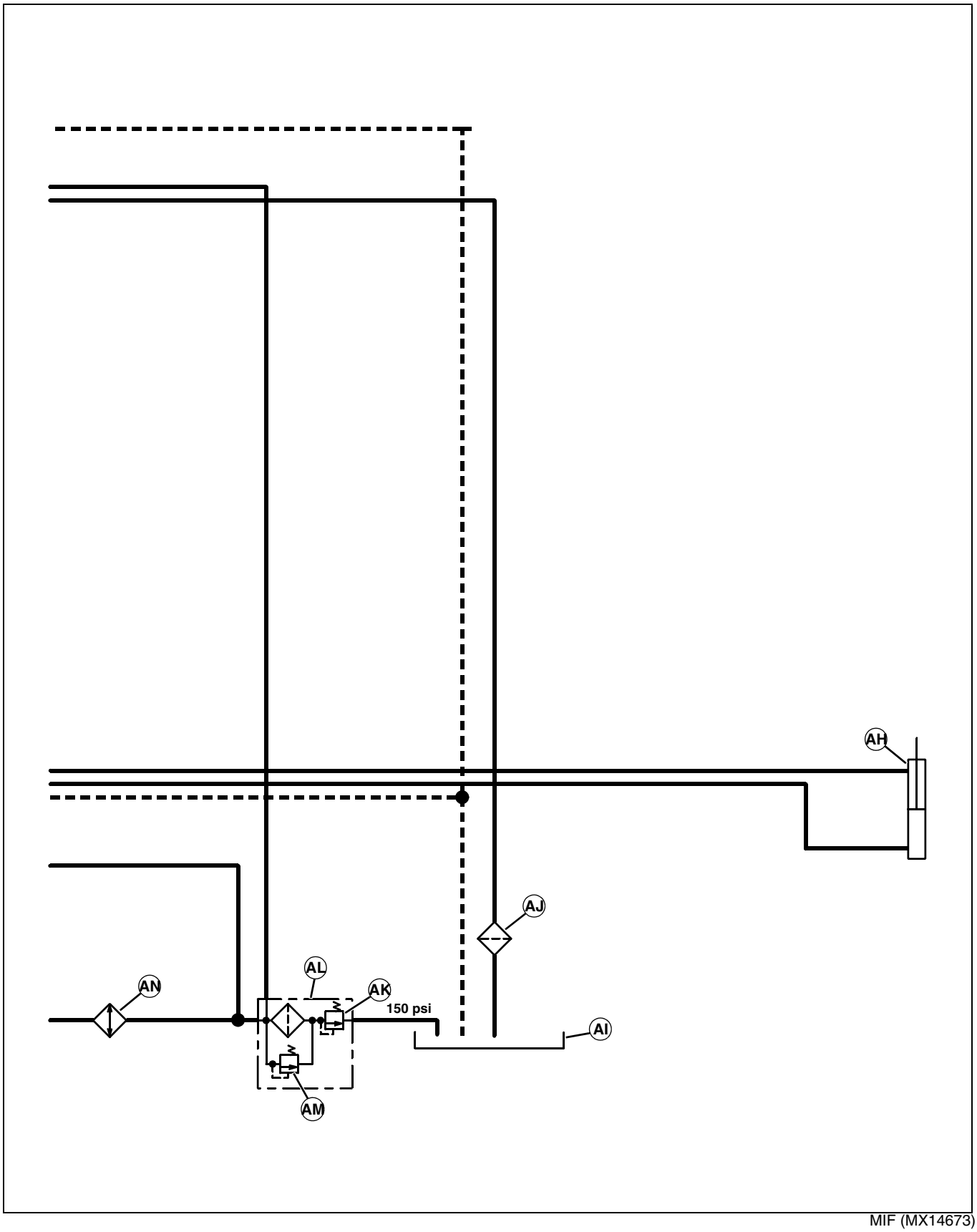
MIF (MX14670)


F
T
PC
C6
C5
C4
C3
C2
C1
C7
H
SV3
G
Lift
Lower
O
SV5
J
SV2
M
I
Lift
Lower
PD
P
LC
L
SV1
K
Lift
Lower
Q
RV
1600 psi
N
SV4
P
Charge
M3
M4
M5
M6
C1
AW
30 psi
R1
AV
3000 psi
C2
AO
30 psi
R2
AP
3000 psi
AU
AQ
PD1
PD2
SV1
AT
SV2
AR
AX
AS
INLET
CD1
T
CD2
OUTLET

MIF (MX14671)



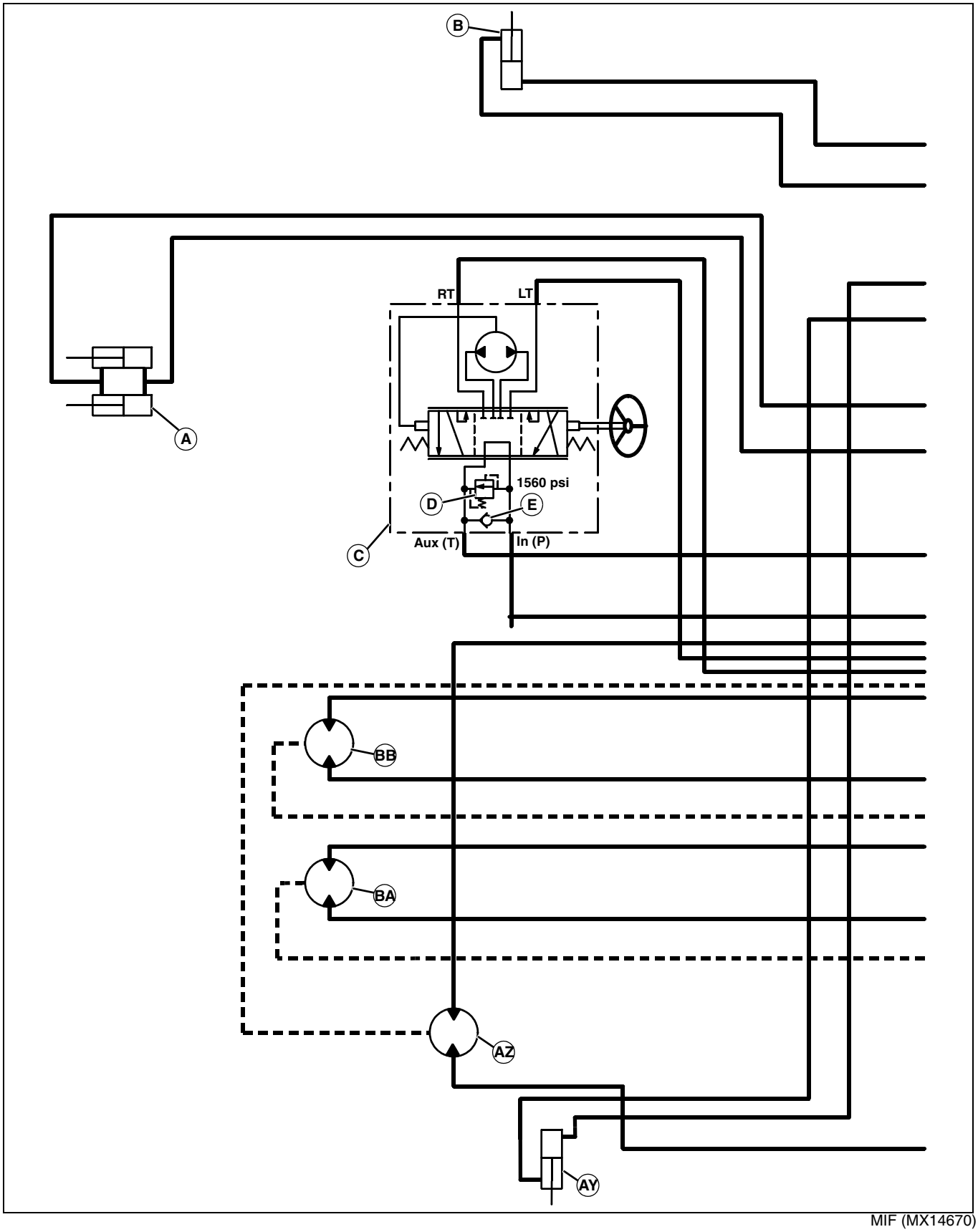
MIF (MX14672)



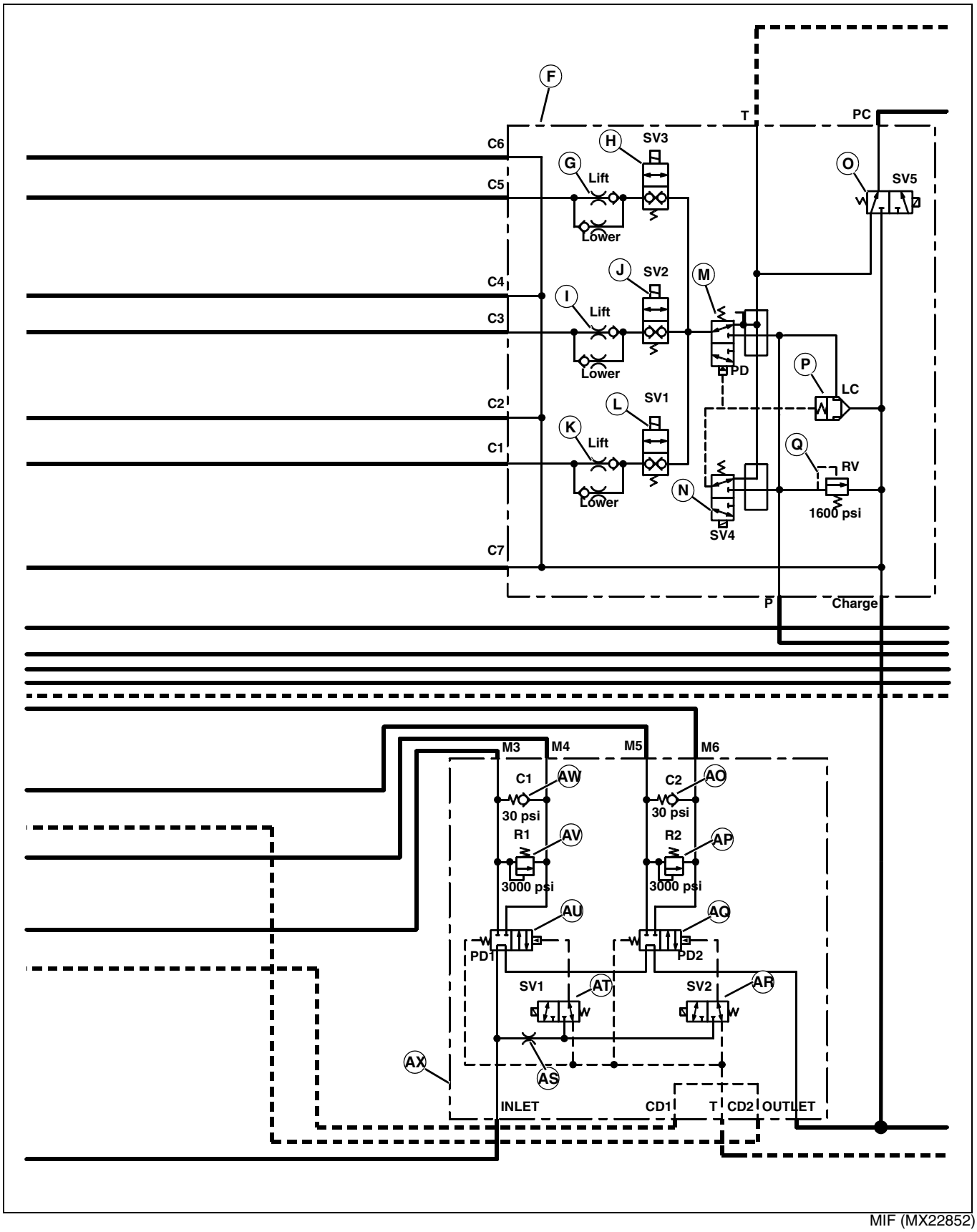
MIF (MX14673)

A - Front Deck Lift Cylinders
B - Right Deck Lift Cylinder
C - Steering Valve
D - Steering Relief Valve
E - Manual Steering Check Valve
F - Deck Lift Control Valve
G - Right Deck Bi-Directional Orifice Disk
H - Right Deck Raise/Lower Solenoid Valve (SV3)
I - Left Deck Bi-Directional Orifice Disk
J - Left Deck Raise/Lower Solenoid Valve (SV2)
K - Front Deck Bi-Directional Orifice Disk
L - Front Deck Raise/Lower Solenoid Valve (SV1)
M - Deck Lift Pilot Direction Valve (PD)
N - Deck Lift Solenoid Valve (SV4)
O - Deck Drive Stroke Control Cylinder Solenoid Valve (SV5)
P - Lift Logic Valve (LC)
Q - Lift Pressure Relief Valve (RV)
R - Deck Drive Stroke Control Cylinder
S - Triple Pump Assembly
T - Steering Pump
U - Lift Pump
V - Deck Drive Pump Pressure Relief Valve
W - Deck Drive Pump
X - Anti-Cavitation Check Valve
Y - Hydrostatic Pressure Relief Valve (Forward)
Z - Hydrostatic Pressure Relief Valve (Reverse)
AA- Hydrostatic Pump Check Valve (Forward)
AB- Traction Drive Pump
AC- Traction Drive Motor Check Valve (Forward)
AD- Traction Drive Motor
AE- Traction Drive Motor Check Valve (Reverse)
AF- Traction Drive Motor Back Pressure Valve
AG- Hydrostatic Pump Check Valve (Reverse)
AH- Steering Cylinder
AI - Vented Reservoir (Tank)
AJ- Screen Filter (in Tank)
AK- Charge Pressure Relief Valve
AL- Oil Filter Assembly
AM- Filter Bypass Relief Valve
AN- Oil Cooler Assembly
AO- Right Deck Check Valve (C2)
AP- Right Deck Relief Valve (R2)
AQ- Right Deck Pilot Control Valve (PD2)
AR- Right Deck Solenoid Valve (SV2)
AS- Control Orifice 0.031 in. (0.787 mm) (OR)
AT- Left Deck Solenoid Valve (SV1)
AU- Left Deck Pilot Control Valve (PD1)
AV- Left Deck Relief Valve (R1)
AW- Left Deck Check Valve (C1)
AX- Deck Drive Motor Control Valve
AY- Left Deck Lift Cylinder
AZ- Front Deck Drive Motor
BA- Left Deck Drive Motor
BB- Right Deck Drive Motor

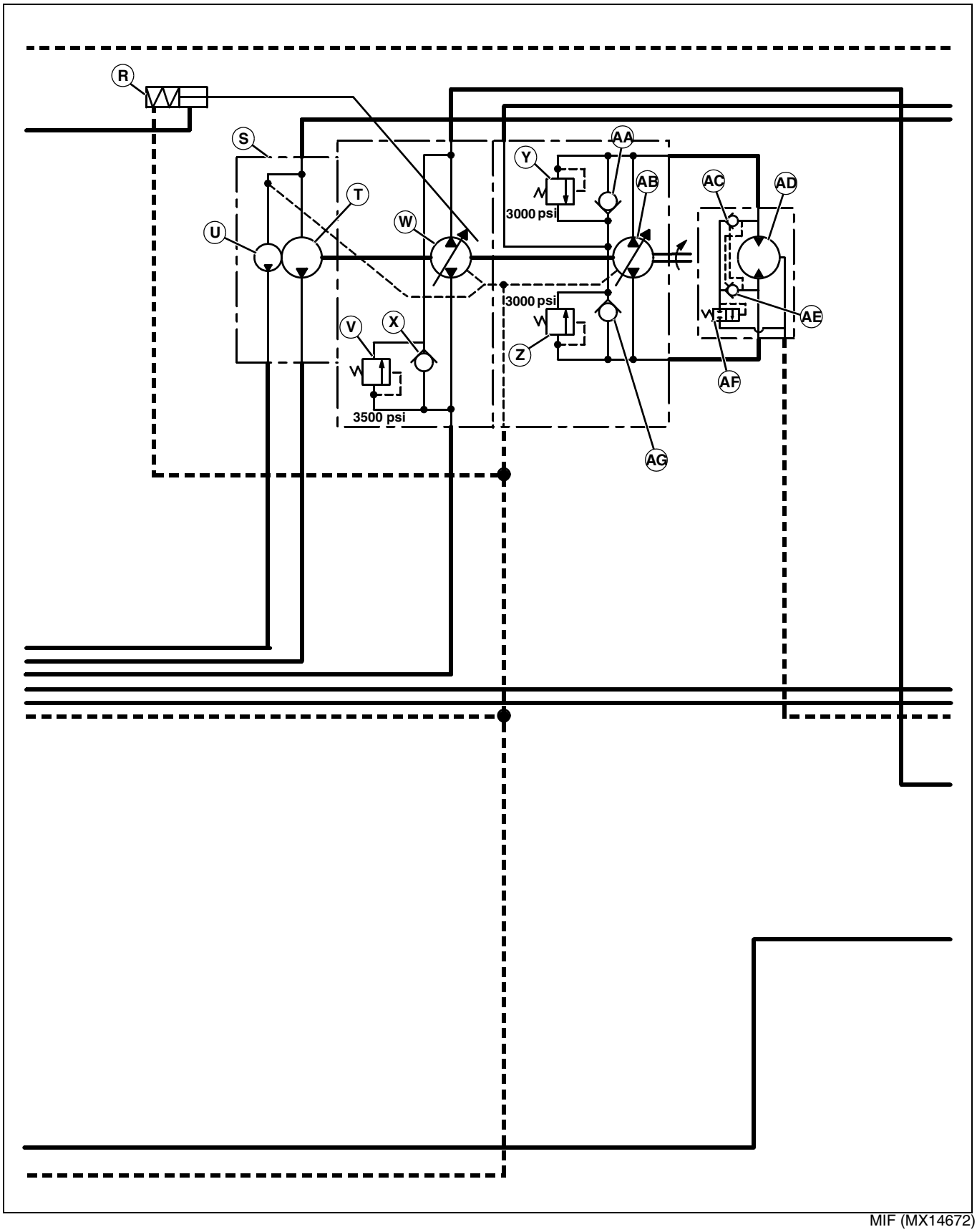
Hydraulic Schematics - Model 1600 Turbo (Series II)



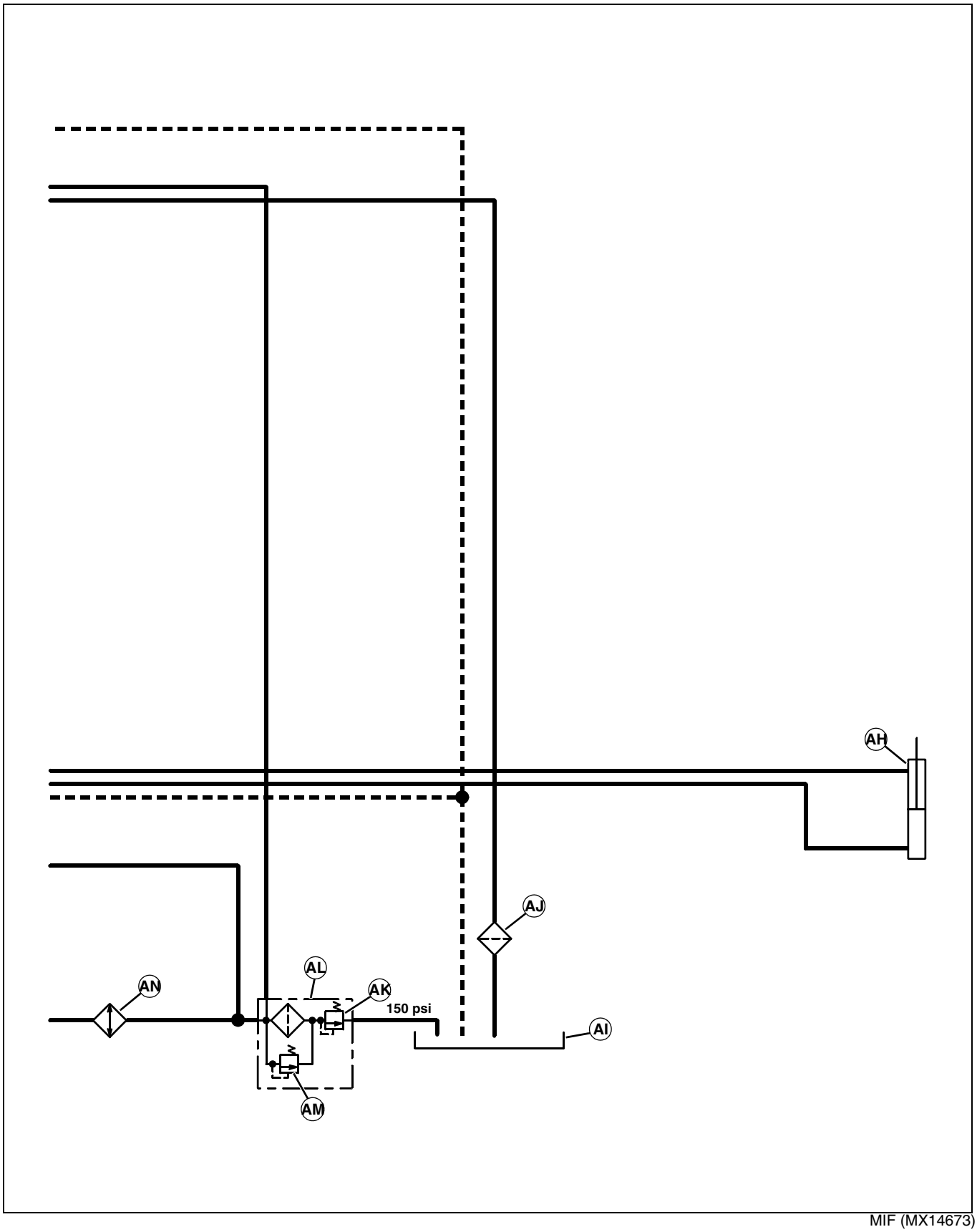
MIF (MX14670)


F
T
PC
C6
C5
C4
C3
C2
C1
C7
H
SV3
G
Lift
Lower
O
SV5
J
SV2
M
I
Lift
Lower
PD
P
LC
L
SV1
K
Lift
Lower
Q
RV
1600 psi
N
SV4
P
Charge
M3
M4
M5
M6
C1
AW
30 psi
C2
AO
30 psi
R1
AV
3000 psi
R2
AP
3000 psi
AU
AQ
PD1
PD2
SV1
AT
SV2
AR
AX
AS
INLET
CD1
T
CD2
OUTLET

MIF (MX22852)



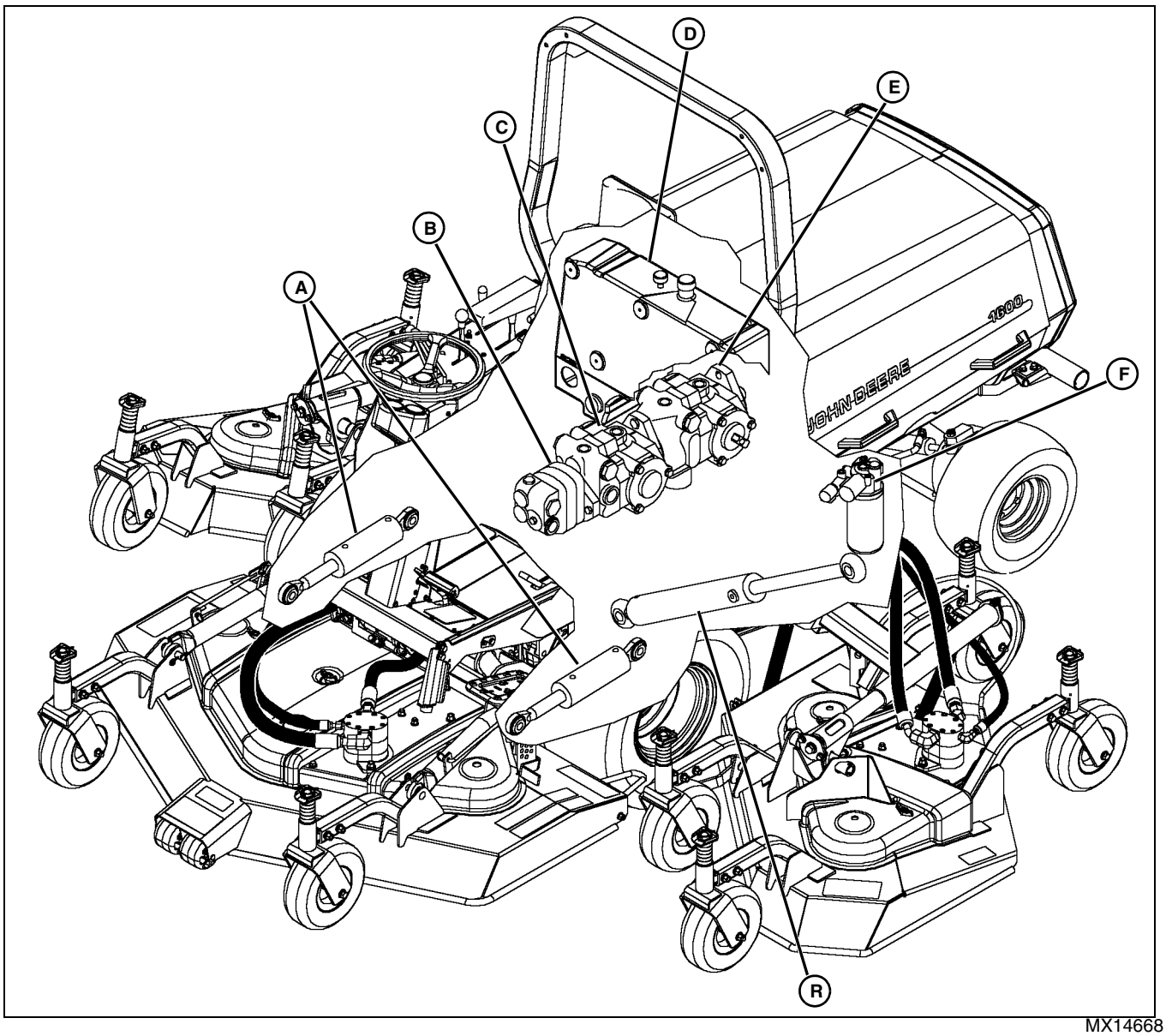
MIF (MX14672)



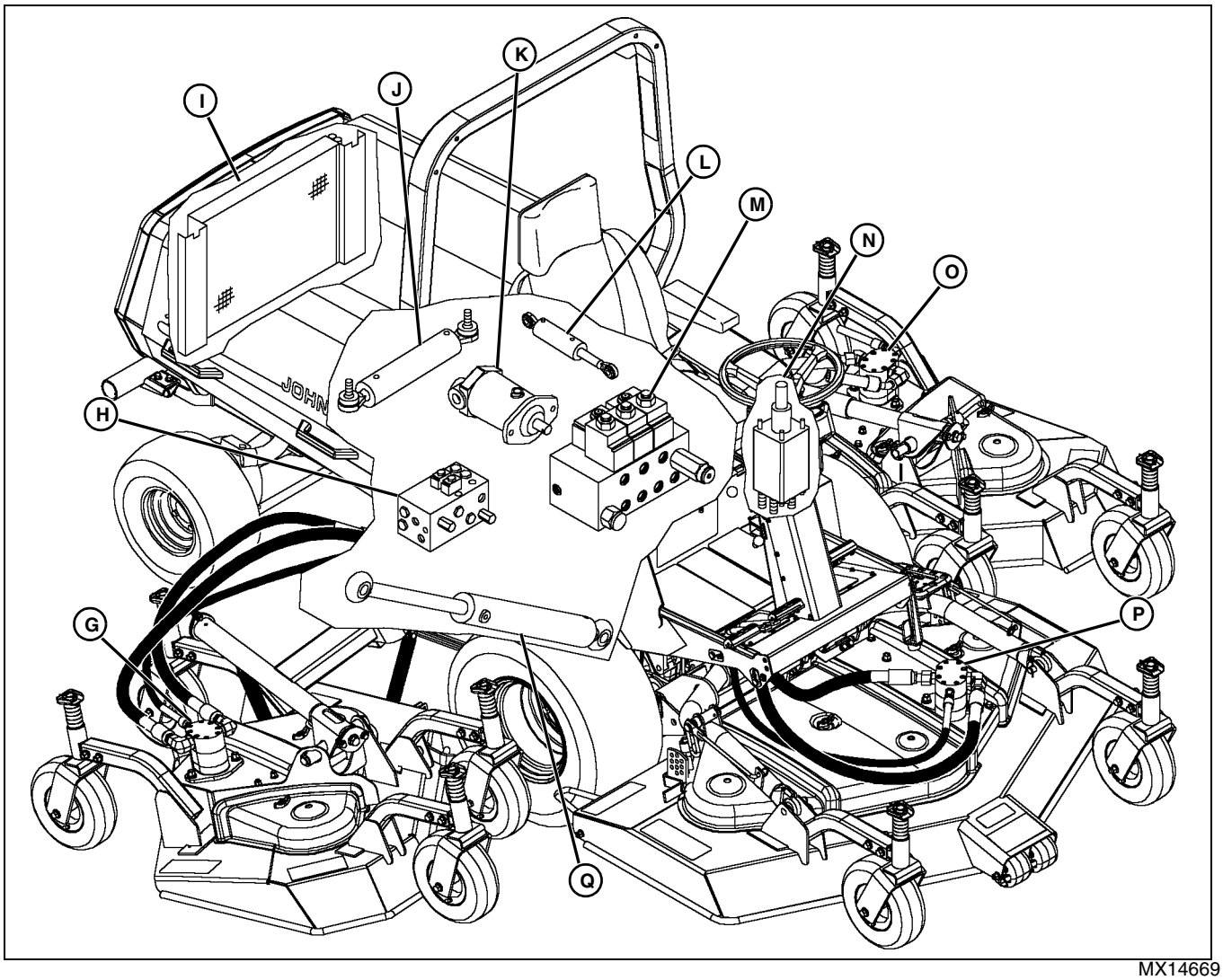
MIF (MX14673)

A - Front Deck Lift Cylinders
B - Right Deck Lift Cylinder
C - Steering Valve
D - Steering Relief Valve
E - Manual Steering Check Valve
F - Deck Lift Control Valve
G - Right Deck Bi-Directional Orifice Disk
H - Right Deck Raise/Lower Solenoid Valve (SV3)
I - Left Deck Bi-Directional Orifice Disk
J - Left Deck Raise/Lower Solenoid Valve (SV2)
K - Front Deck Bi-Directional Orifice Disk
L - Front Deck Raise/Lower Solenoid Valve (SV1)
M - Deck Lift Pilot Direction Valve (PD)
N - Deck Lift Solenoid Valve (SV4)
O - Deck Drive Stroke Control Cylinder Solenoid Valve (SV5)
P - Lift Logic Valve (LC)
Q - Lift Pressure Relief Valve (RV)
R - Deck Drive Stroke Control Cylinder
S - Triple Pump Assembly
T - Steering Pump
U - Lift Pump
V - Deck Drive Pump Pressure Relief Valve
W - Deck Drive Pump
X - Anti-Cavitation Check Valve
Y - Hydrostatic Pressure Relief Valve (Forward)
Z - Hydrostatic Pressure Relief Valve (Reverse)
AA- Hydrostatic Pump Check Valve (Forward)
AB- Traction Drive Pump
AC- Traction Drive Motor Check Valve (Forward)
AD- Traction Drive Motor
AE- Traction Drive Motor Check Valve (Reverse)
AF- Traction Drive Motor Back Pressure Valve
AG- Hydrostatic Pump Check Valve (Reverse)
AH- Steering Cylinder
AI - Vented Reservoir (Tank)
AJ- Screen Filter (in Tank)
AK- Charge Pressure Relief Valve
AL- Oil Filter Assembly
AM- Filter Bypass Relief Valve
AN- Oil Cooler Assembly
AO- Right Deck Check Valve (C2)
AP- Right Deck Relief Valve (R2)
AQ- Right Deck Pilot Control Valve (PD2)
AR- Right Deck Solenoid Valve (SV2)
AS- Control Orifice 0.031 in. (0.787 mm) (OR)
AT- Left Deck Solenoid Valve (SV1)
AU- Left Deck Pilot Control Valve (PD1)
AV- Left Deck Relief Valve (R1)
AW- Left Deck Check Valve (C1)
AX- Deck Drive Motor Control Valve
AY- Left Deck Lift Cylinder
AZ- Front Deck Drive Motor
BA- Left Deck Drive Motor
BB- Right Deck Drive Motor

Component Location **Hydraulic System Component Location**



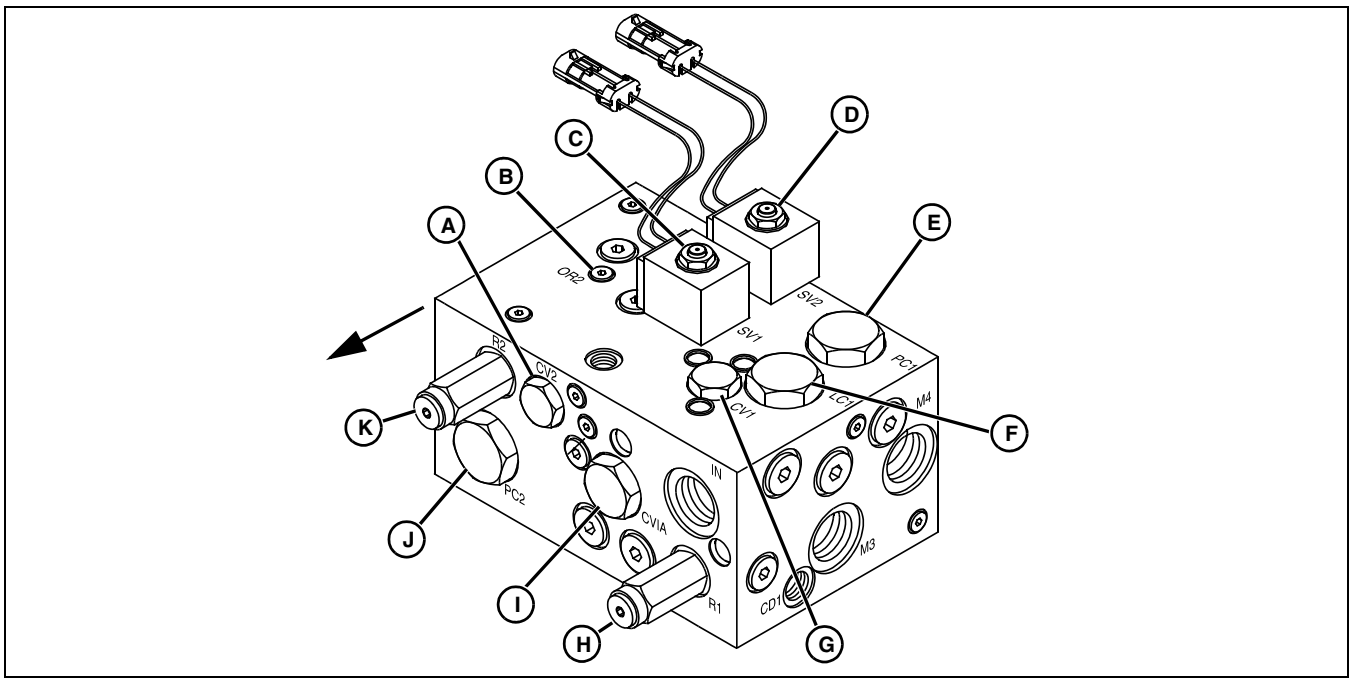
MX14668



MX14669

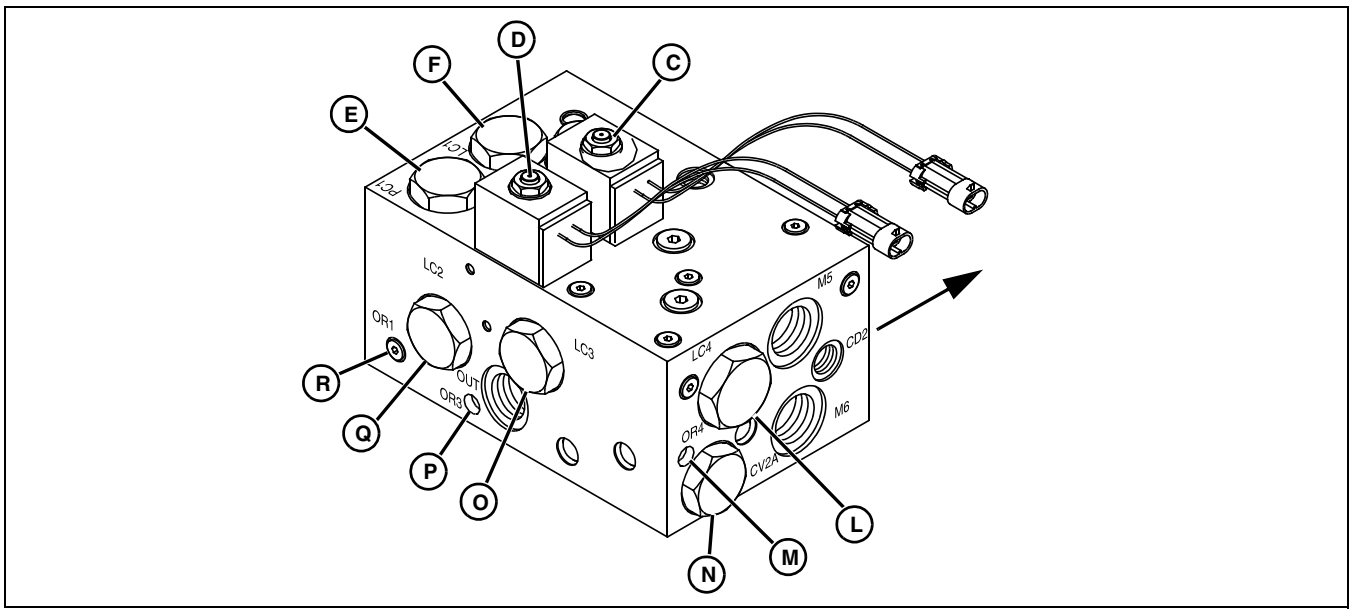
A - Front Lift Cylinder (2 used)
B - Steering/Lift Pump
C - Mower Deck Drive Pump
D - Hydraulic Oil Reservoir
E - Traction Drive Pump
F - Oil Filter
G - Right Mower Deck Drive Motor
H - Mow Control Valve Assembly
I - Oil Cooler
J - Steering Cylinder
K - Traction Drive Motor
L - Deck Drive Stroke Control Cylinder
M - Lift Control Valve Assembly
N - Steering Valve
O - Left Mower Deck Drive Motor
P - Front Mower Deck Drive Motor
Q - Right Mower Deck Lift Cylinder
R - Left Mower Deck Lift Cylinder

Mow Control Valve Assembly Component Location - Model 1600



MIF (MX2558)

Picture Note: Arrow Points to Front of Machine

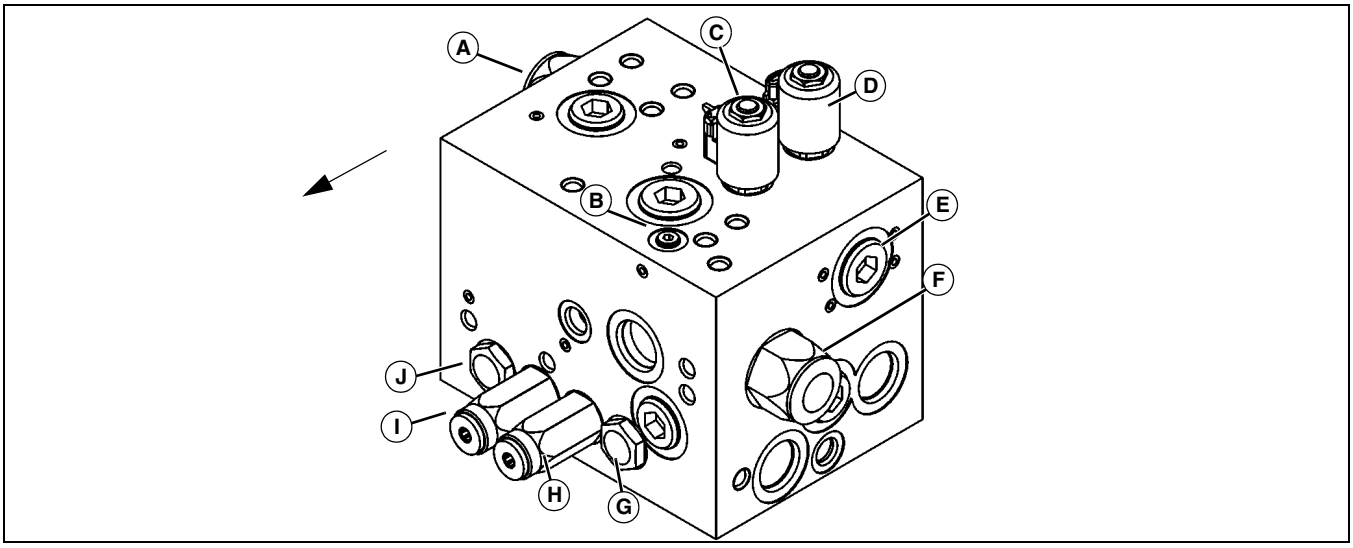


MIF (MX2559)

Picture Note: Arrow Points to Front of Machine

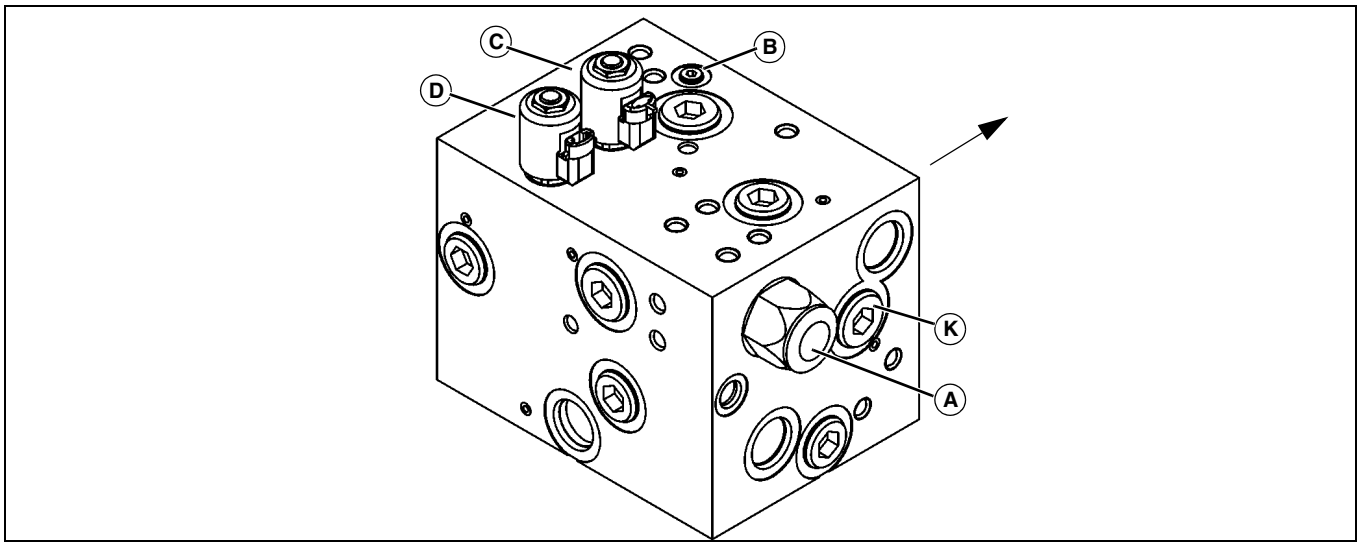
A - Right Deck Check, Anti-Cavitation Valve (CV2)
B - Right Deck Braking Valve Orifice
C - Left Deck Motor Solenoid Valve (SV1)
D - Right Deck Motor Solenoid Valve (SV2)
E - Left Deck Positive Braking Valve (PC1)
F - Left Deck Motor Logic Valve (LC1)
G - Left Deck Check, Anti-Cavitation Valve (CV1)
H - Left Deck Relief Valve (R1)
I - Left Deck Positive Stop Check Valve (CV1A)
J - Right Deck Positive Braking Valve (PC2)
K - Right Deck Relief Valve (R2)
L - Right Deck Pilot Valve (LC4)
M - Left Deck Pilot Valve Orifice
N - Right Deck Positive Stop Check Valve (CV2A)
O - Right Deck Motor Logic Valve (LC3)
P - Right Deck Pilot Valve Orifice
Q - Left Deck Pilot Valve (LC2)
R - Left Deck Braking Valve Orifice

Mow Control Valve Assembly Component Location - Model 1600 Turbo



MX6339

Picture Note: Arrow Points to Front of Machine

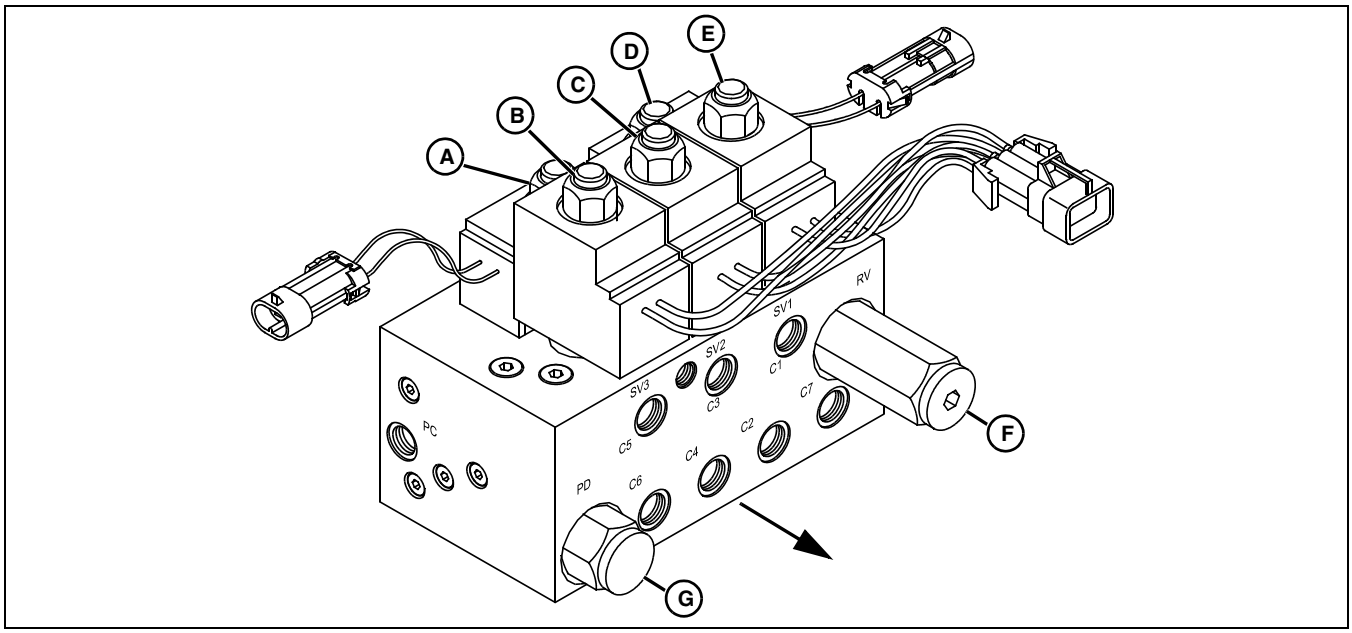


MX6340

Picture Note: Arrow Points to Front of Machine

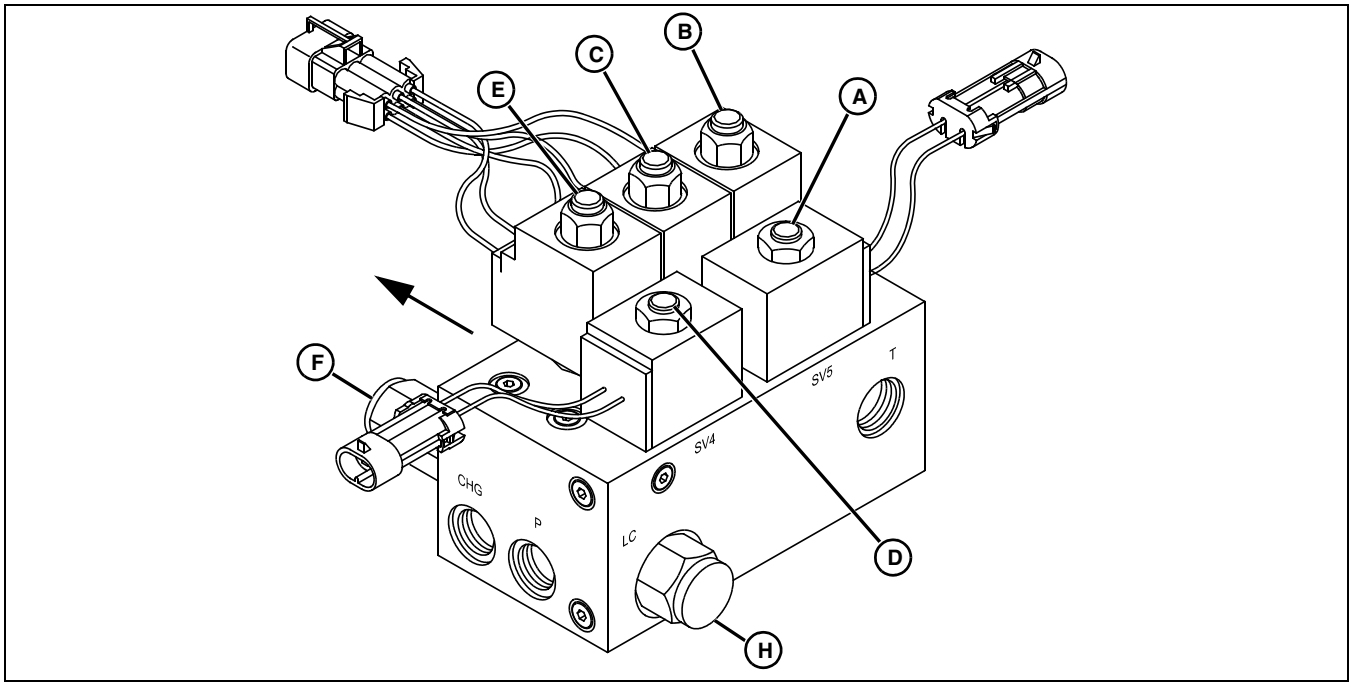
A - Right Deck Pilot Control Valve (PD2)
B - Orifice 0.031 in. (0.787 mm) (OR)
C - Left Deck Solenoid Valve (SV1)
D - Right Deck Solenoid Valve (SV2)
E - Right Deck Control Piston (PIS2)
F - Left Deck Pilot Control Valve (PD1)
G - Left Deck Check Valve (C1)
H - Left Deck Relief Valve (R1)
I - Right Deck Relief Valve (R2)
J - Right Deck Check Valve (C2)
K - Left Deck Control Piston (PIS1)

Lift Control Valve Assembly Component Location



MIF (MX2560)

Picture Note: Arrow Points to Front of Machine



MIF (MX2561)

Picture Note: Arrow Points to Front of Machine

A - Deck Drive Stroke Control Cylinder Solenoid Valve (SV5)

B - Right Deck Raise/Lower Solenoid Valve (SV3)

C - Left Deck Raise/Lower Solenoid Valve (SV2)

D - Deck Lift Solenoid Valve (SV4)

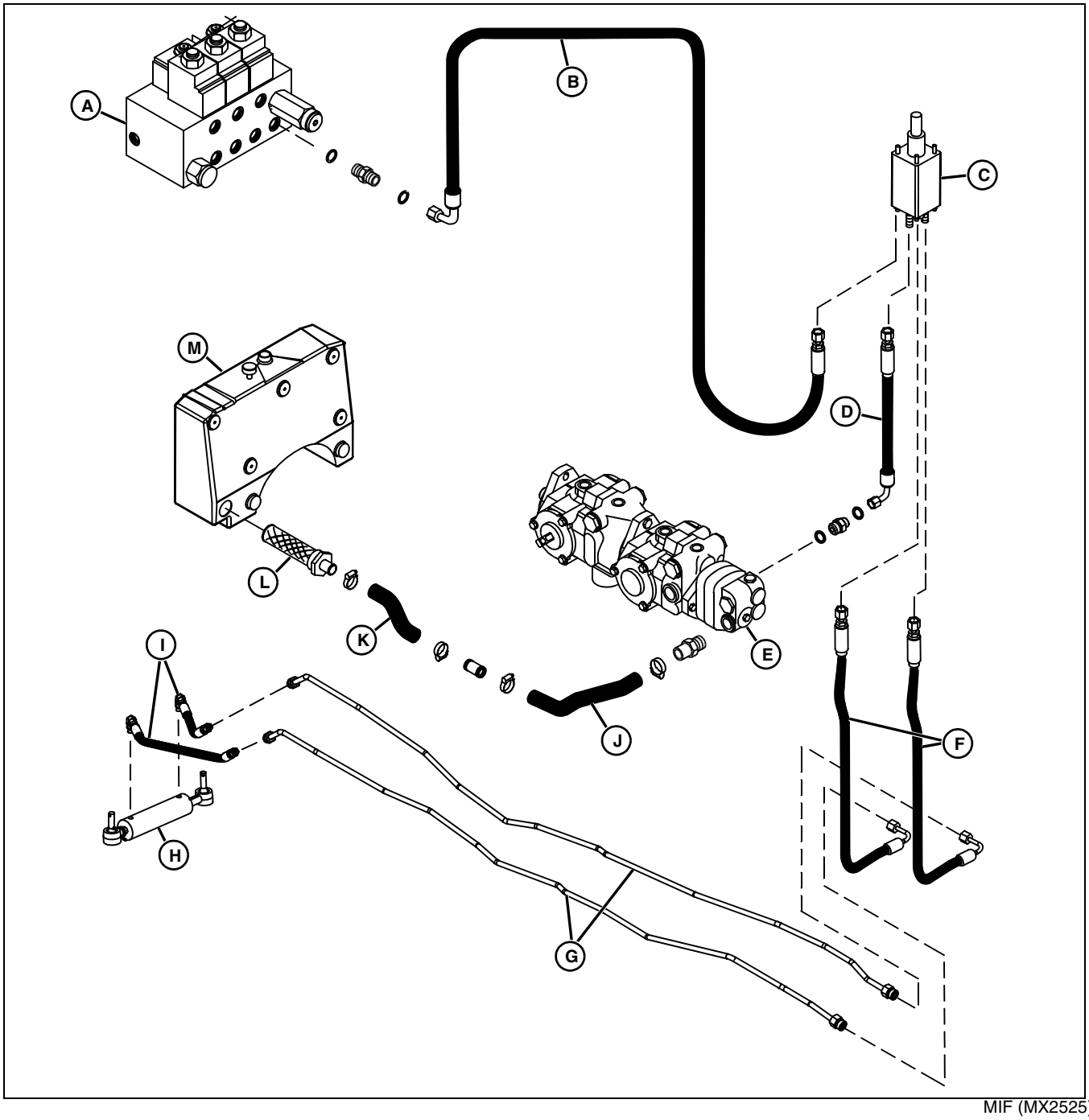
E - Front Deck Raise/Lower Solenoid Valve (SV1)

F - Lift Pressure Relief Valve (RV)

G - Deck Lift Hydraulic Actuated Valve (PD)

H - Deck Lift Logic Valve (LC)

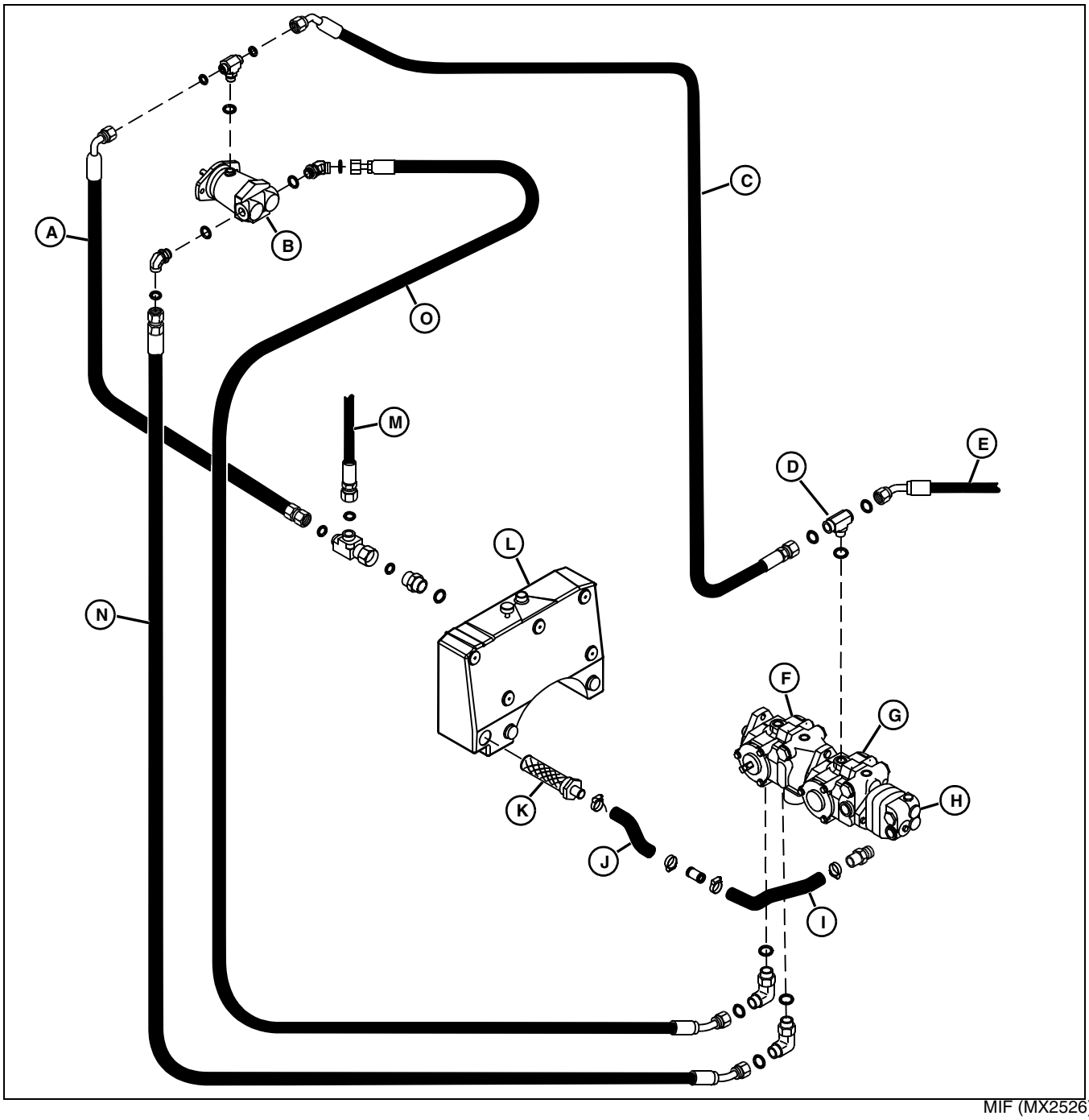
Steering System Hydraulic Hose Routing



MIF (MX2525)

- **A - Lift Valve Assembly**
- **B - Pressure Hose to Lift Valve, Port C7 from Steering Valve, Port AUX**
- **C - Steering Valve**
- **D - Pressure Hose to Steering Valve, Port IN**
- **E - Steering/Lift Pump**
- **F - Steering Valve Output Hose**
- **G - Steering Valve-to-Cylinder Lines**
- **H - Steering Cylinder**
- **I - Steering Cylinder Hose (2 used)**
- **J - Pump Supply Hose**
- **K - Pump Supply Hose**
- **L - Strainer**
- **M - Hydraulic Oil Reservoir**

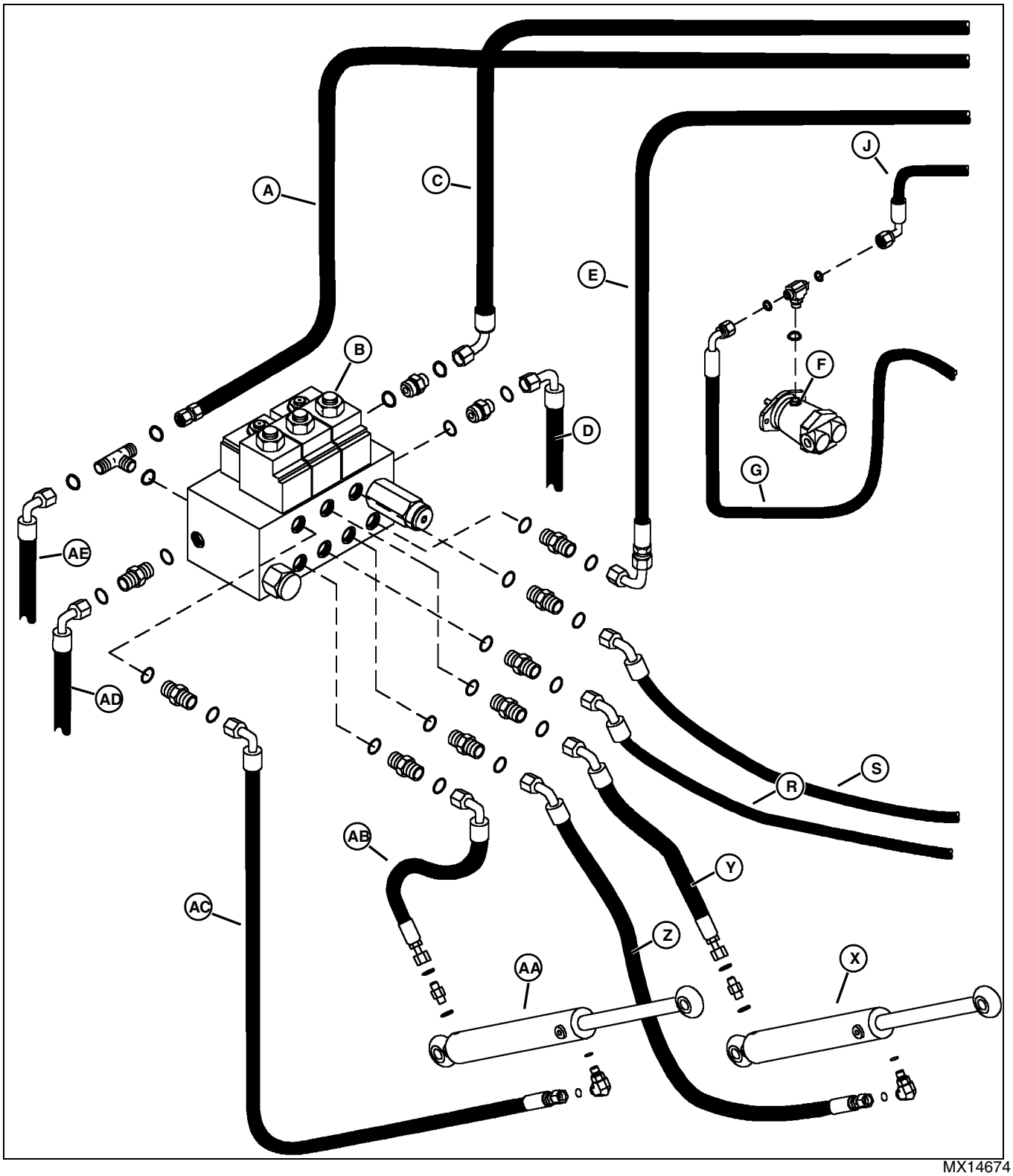
Traction Drive System Hydraulic Hose Routing



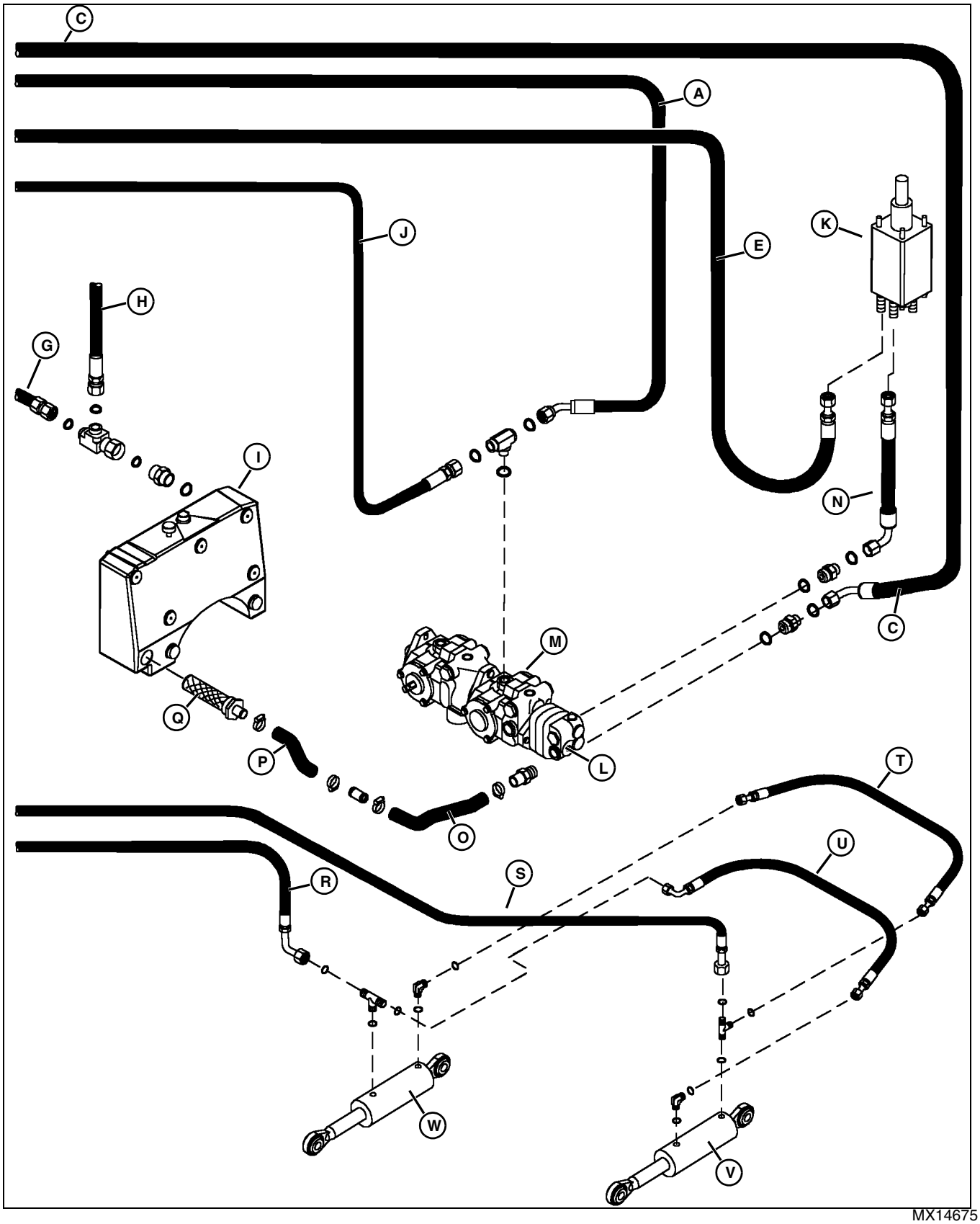
MIF (MX2526)

- **A - Case Drain Hose**
- **B - Traction Drive Motor**
- **C - Case Drain Hose**
- **D - Tee Fitting (not used on 1600 Turbo Series II machines)**
- **E - Case Drain Hose from Lift Valve (not used on 1600 Turbo Series II machines)**
- **F - Traction Drive Pump**
- **G - Mower Deck Drive Pump**
- **H - Steering/Lift Pump**
- **I - Pump Supply Hose**
- **J - Pump Supply Hose**
- **K - Strainer**
- **L - Hydraulic Oil Reservoir**
- **M - Return Hose from Oil Filter**
- **N - Pressure Hose**
- **O - Pressure Hose**

Lift System Hydraulic Hose Routing - Model 1600



MX14674



MX14675

A - Case Drain Hose to Lift Valve, Port T

B - Lift Valve Assembly

C - Lift Valve Pressure Supply Hose to Lift Valve, Port P

D - Charge Pressure Hose from Lift Valve, Port CHG to Mower Deck Control Valve, Port OUT

E - Pressure Hose to Lift Valve, Port C7 from Steering Valve, Port AUX

F - Traction Drive Motor

G - Case Drain Hose

H - Return Hose from Oil Filter

I - Hydraulic Oil Reservoir

J - Case Drain Hose

K - Steering Valve

L - Steering/Lift Pump

M - Mower Deck Drive Pump

N - Steering Supply Hose

O - Pump Supply Hose

P - Pressure Hose to Steering Valve, Port IN

Q - Strainer

R - Return Hose from Front Right Lift Cylinder to Lift Valve, Port C

S - Pressure Hose from Lift Valve, Port C1 to Front Left Lift Cylinder

T - Second Lift Cylinder Pressure Hose

U - Second Lift Cylinder Return Hose

V - Front Left Lift Cylinder

W - Front Right Lift Cylinder

X - Left Lift Cylinder

Y - Pressure Hose from Lift Valve, Port C3 to Left Lift Cylinder

Z - Pressure Hose from Lift Valve, Port C2 to Left Lift Cylinder

AA- Right Lift Cylinder

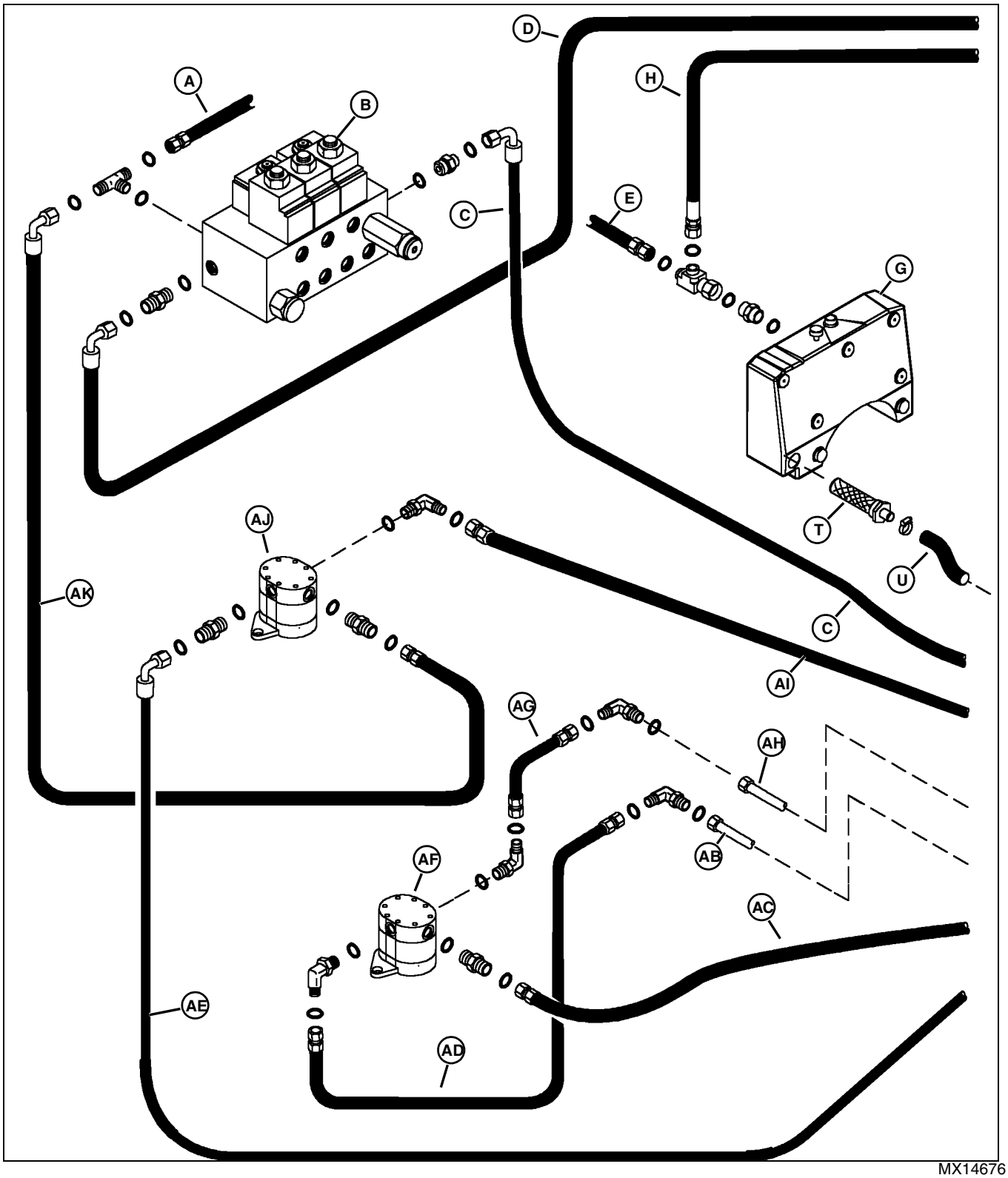
AB- Pressure Hose from Lift Valve, Port C6 to Right Lift Cylinder

AC- Pressure Hose from Lift Valve, Port C5 to Right Lift Cylinder

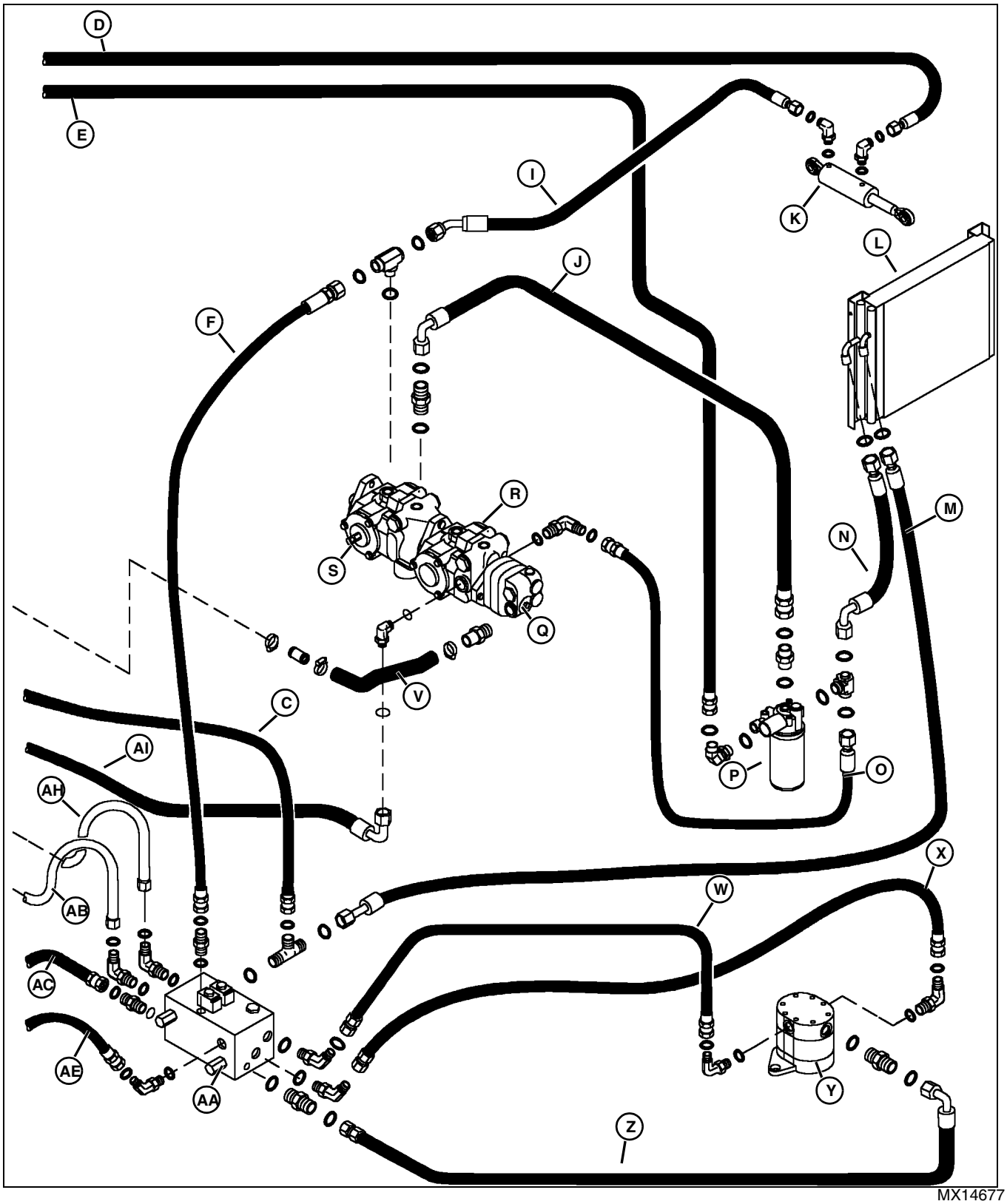
AD- Pressure Hose from Lift Valve, Port PC to Deck Drive Stroke Control Cylinder

AE- Case Drain Hose

Mower Deck Drive System Hydraulic Hose Routing - Model 1600



MX14676



MX14677

A - Case Drain Hose

B - Lift Valve Assembly

C - Charge Pressure Hose from Lift Valve, Port CHG to Mower Deck Control Valve, Port OUT

D - Pressure Hose from Lift Valve, Port PC to Deck Drive Stroke Control Cylinder

E - Case Drain Hose

F - Case Drain Hose

G - Hydraulic Oil Reservoir

H - Return Hose from Oil Filter

I - Return Hose from Deck Drive Stroke Control Cylinder

J - Charge Pressure from Oil Filter

K - Deck Drive Stroke Control Cylinder

L - Oil Cooler

M - Charge Pressure Hose from Mower Deck Control Valve, Port OUT to Oil Cooler

N - Charge Pressure Hose from Oil Cooler to Oil Filter

O - Charge Pressure Hose from Oil Filter to Mower Deck Motor Drive Pump

P - Oil Filter

Q - Steering/Lift Pump

R - Mower Deck Drive Pump

S - Traction Drive Pump

T - Strainer

U - Pump Supply Hose

V - Pump Supply Hose

W - Return Hose from Left Mower Deck Motor to Mower Control Valve, Port M4

X - Pressure Hose from Left Mower Deck Motor to Mower Control Valve, Port M3

Y - Left Mower Deck Motor

Z - Case Drain Hose from Left Mower Deck Motor to Mower Control Valve, Port CD1

AA- Mower Control Valve

AB- Hydraulic Line from Right Mower Deck Motor Return Hose to Mower Control Valve, Port M6

AC- Case Drain Hose from Right Mower Deck Motor to Mower Control Valve, Port CD2

AD- Return Hose from Right Mower Deck Motor to Hydraulic Line

AE- Return Hose from Front Mower Deck Motor to Mower Control Valve, Port IN

AF- Right Mower Deck Motor

AG- Pressure Hose from Hydraulic Line to Right Mower Deck Motor

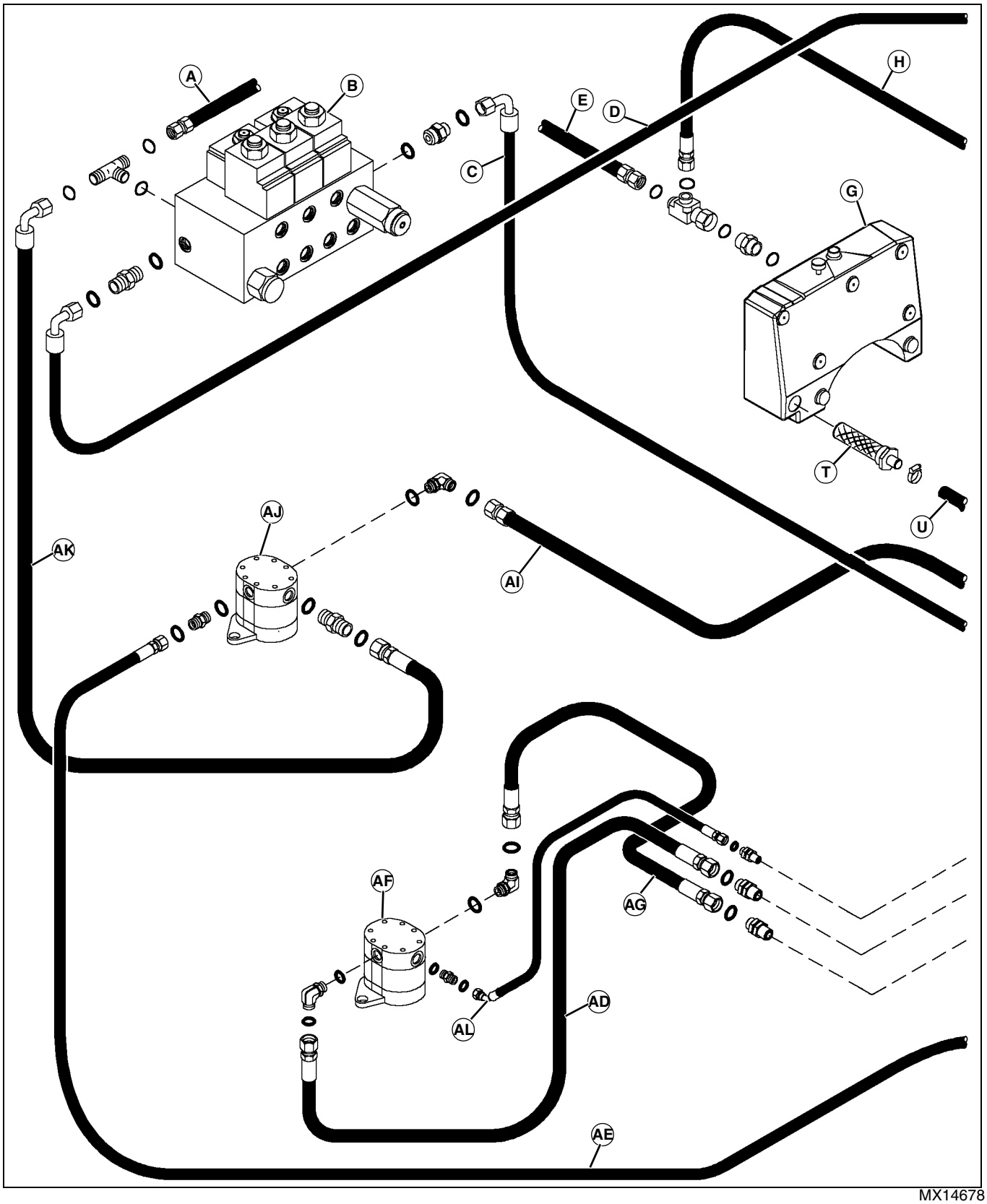
AH- Hydraulic Line from Right Mower Deck Motor Pressure Hose to Mower Control Valve, Port M5

AI - Pressure Hose from Mower Deck Drive Pump to Front Mower Deck Motor

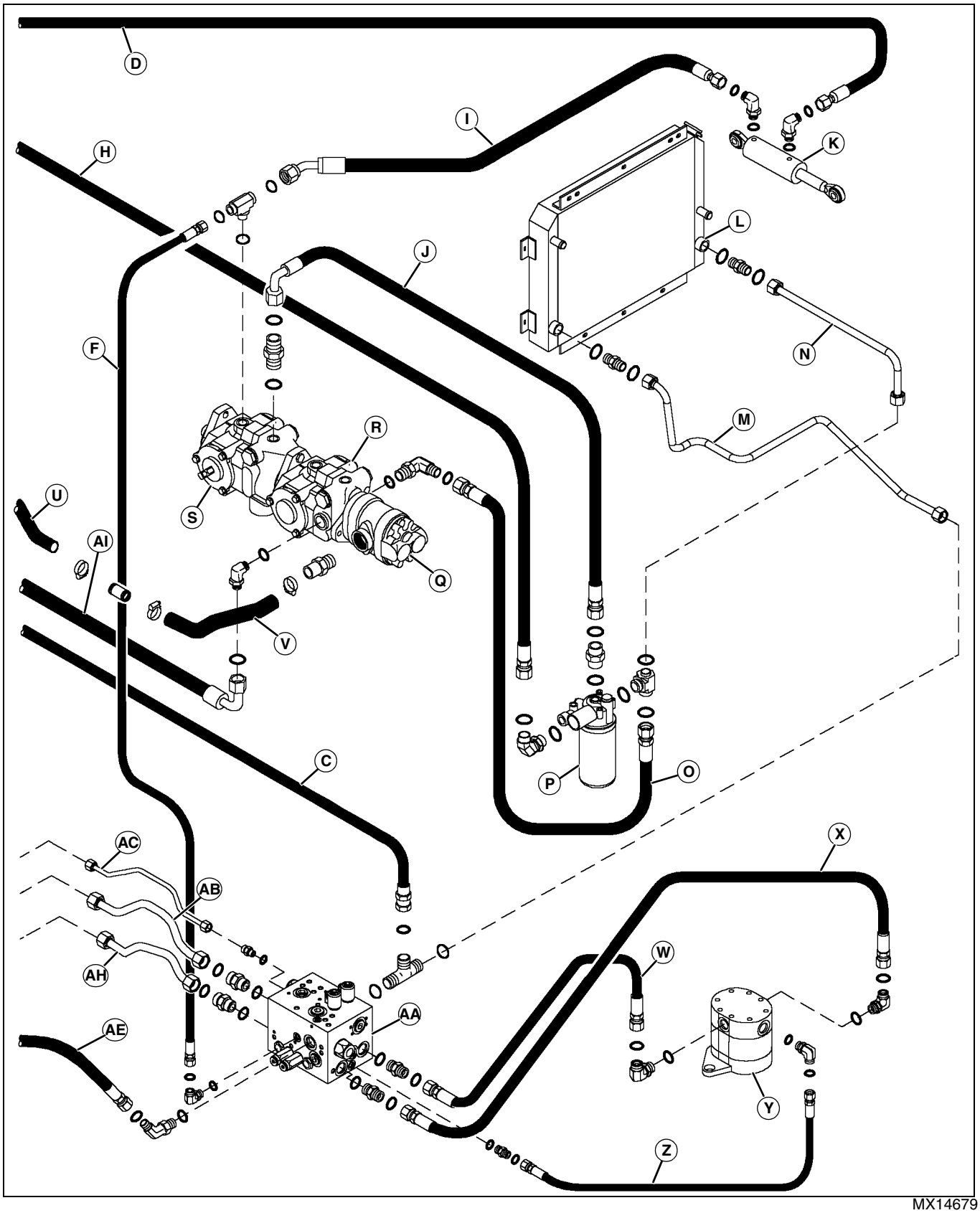
AJ- Front Mower Deck Motor

AK- Case Drain Hose

Mower Deck Drive System Hydraulic Hose Routing - Model 1600 Turbo



MX14678



MX14679

A - Case Drain Hose

B - Lift Valve Assembly

C - Charge Pressure Hose from Lift Valve, Port CHG to Mower Deck Control Valve, Port OUT

D - Pressure Hose from Lift Valve, Port PC to Deck Drive Stroke Control Cylinder

E - Case Drain Hose

F - Case Drain Hose

G - Hydraulic Oil Reservoir

H - Return Hose from Oil Filter

I - Return Hose from Deck Drive Stroke Control Cylinder

J - Charge Pressure Hose from Oil Filter

K - Deck Drive Stroke Control Cylinder

L - Oil Cooler

M - Charge Pressure Line from Mower Deck Control Valve, Port OUT to Oil Cooler

N - Charge Pressure Line from Oil Cooler to Oil Filter

O - Charge Pressure Hose from Oil Filter to Mower Deck Motor Drive Pump

P - Oil Filter

Q - Steering/Lift Pump

R - Mower Deck Drive Pump

S - Traction Drive Pump

T - Strainer

U - Pump Supply Hose

V - Pump Supply Hose

W - Return Hose from Left Mower Deck Motor to Mower Control Valve, Port M4

X - Pressure Hose from Left Mower Deck Motor to Mower Control Valve, Port M3

Y - Left Mower Deck Motor

Z - Case Drain Hose from Left Mower Deck Motor to Mower Control Valve, Port CD1

AA- Mower Control Valve

AB- Hydraulic Line from Right Mower Deck Motor Return Hose to Mower Control Valve, Port M6

AC- Case Drain Line from Right Mower Deck Motor to Mower Control Valve, Port CD2

AD- Return Hose from Right Mower Deck Motor to Hydraulic Line

AE- Return Hose from Front Mower Deck Motor to Mower Control Valve, Port IN

AF- Right Mower Deck Motor

AG- Pressure Hose from Hydraulic Line to Right Mower Deck Motor

AH- Hydraulic Line from Right Mower Deck Motor Pressure Hose to Mower Control Valve, Port M5

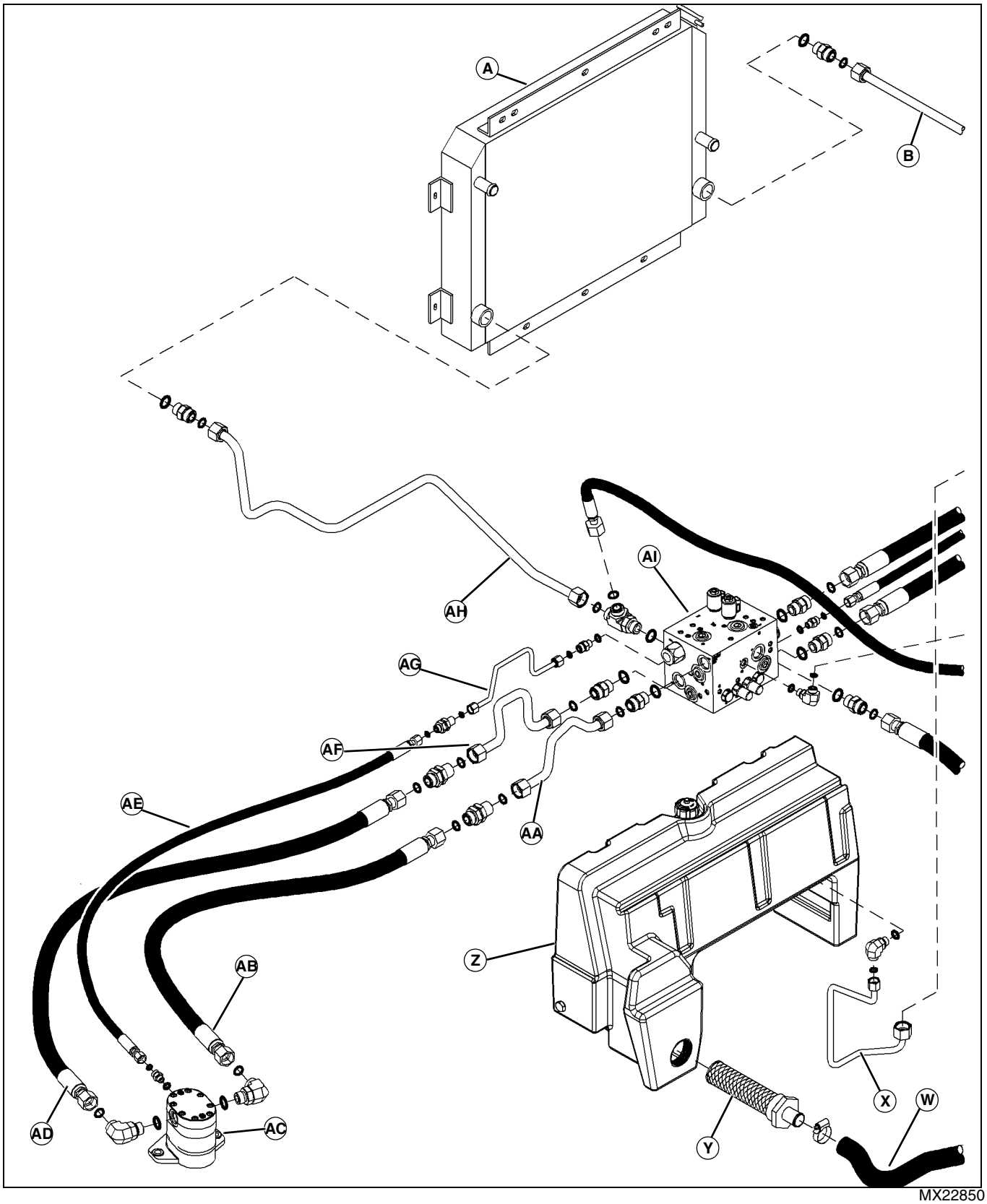
AI - Pressure Hose from Mower Deck Drive Pump to Front Mower Deck Motor

AJ- Front Mower Deck Motor

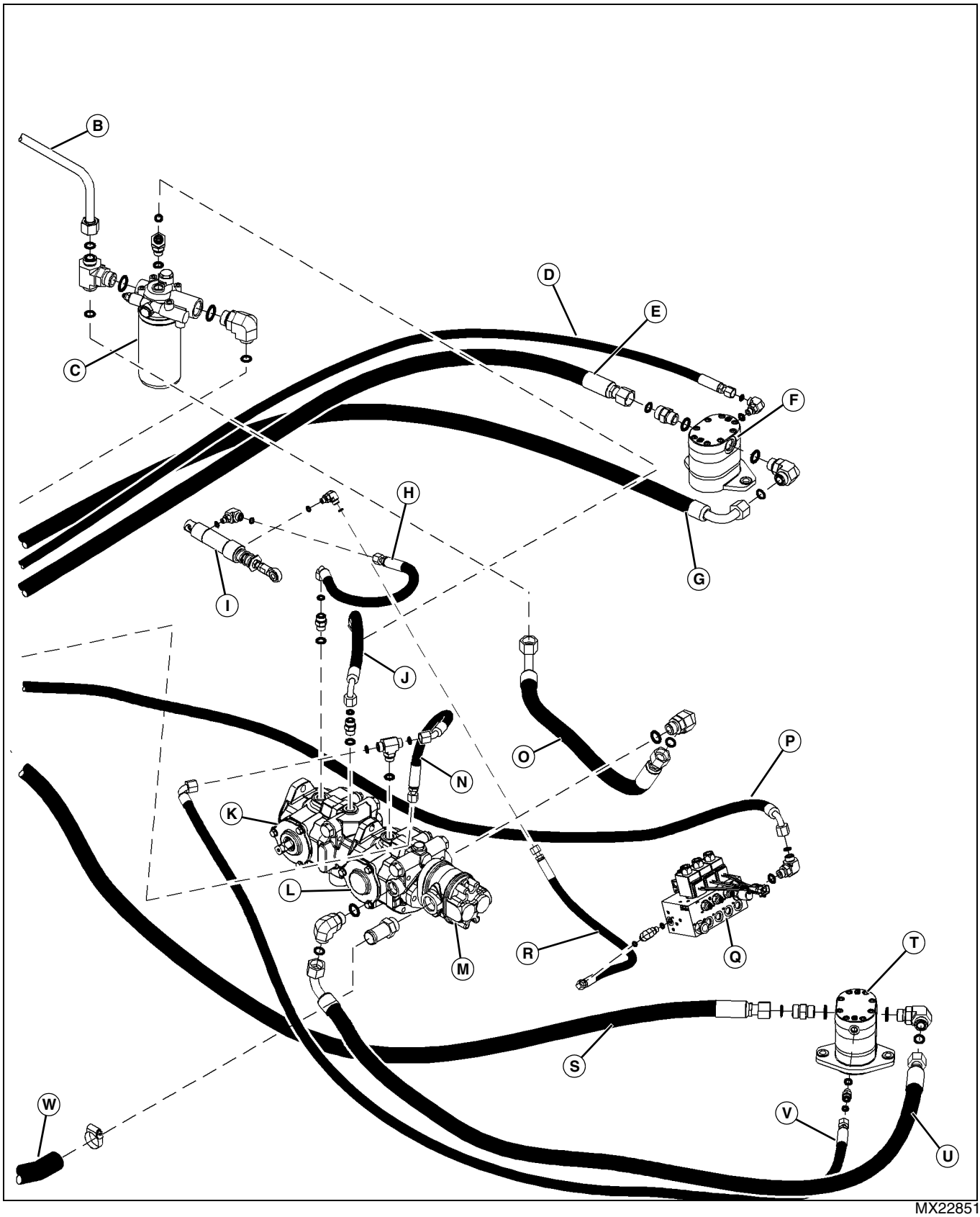
AK- Case Drain Hose

AL- Case Drain Hose from Right Mower Deck Motor to Mower Control Valve, Port CD2

Mower Deck Drive System Hydraulic Hose Routing - Model 1600 Turbo (Series II)



MX22850



MX22851

A - Oil Cooler

B - Charge Pressure Line from Oil Cooler to Oil Filter

C - Oil Filter

D - Case Drain Hose from Left Mower Deck Motor to Mower Control Valve, Port CD1

E - Pressure Hose from Left Mower Deck Motor to Mower Control Valve, Port M5

F - Left Mower Deck Motor

G - Return Hose from Left Mower Deck Motor to Mower Control Valve, Port M6

H - Return Hose from Deck Drive Stroke Control Cylinder

I - Deck Drive Stroke Control Cylinder

J - Charge Pressure Hose from Oil Filter

K - Traction Drive Pump

L - Mower Deck Drive Pump

M - Steering/Lift Pump

N - Case Drain Hose

O - Charge Pressure Hose from Oil Filter to Mower Deck Motor Drive Pump

P - Charge Pressure Hose from Lift Valve, Port CHG to Mower Deck Control Valve, Port OUT

Q - Lift Valve Assembly

R - Pressure Hose from Lift Valve, Port PC to Deck Drive Stroke Control Cylinder

S - Return Hose from Front Mower Deck Motor to Mower Control Valve, Port IN

T - Front Mower Deck Motor

U - Pressure Hose from Front Mower Deck Drive Pump to Front Motor Deck Motor

V - Case Drain Hose

W - Pump Supply Hose

X - Return Line from Oil Filter

Y - Strainer

Z - Hydraulic Oil Reservoir

AA- Hydraulic Line from Right Mower Deck Motor Return Hose to Mower Control Valve, Port M4

AB- Return Hose from Right Mower Deck Motor to Hydraulic Line

AC- Right Mower Deck Motor

AD- Pressure Hose from Hydraulic Line to Right Mower Deck Motor

AE- Case Drain Hose from Right Mower Deck Motor to Case Drain Line

AF- Hydraulic Line from Right Mower Deck Motor Pressure Hose to Mower Control Valve, Port M3

AG- Case Drain Line from Right Mower Deck Motor Case Drain Hose to Mower Control Valve, Port CD2

AH- Charge Pressure Line from Mower Deck Control Valve, Port OUT to Oil Cooler

AI - Mower Control Valve

Theory of Operation

Mower Deck Drive System Mow Operation - Model 1600

Function

To drive the front, left, and right mower deck motors.

Theory of Operation

NOTE: The following conditions must be met for the left and right mower deck(s) to function:

- Operator in seat
- Park brake OFF
- All mower decks lowered to ground
- PTO switch ON

NOTE: The following describes the system operation for all motors running.

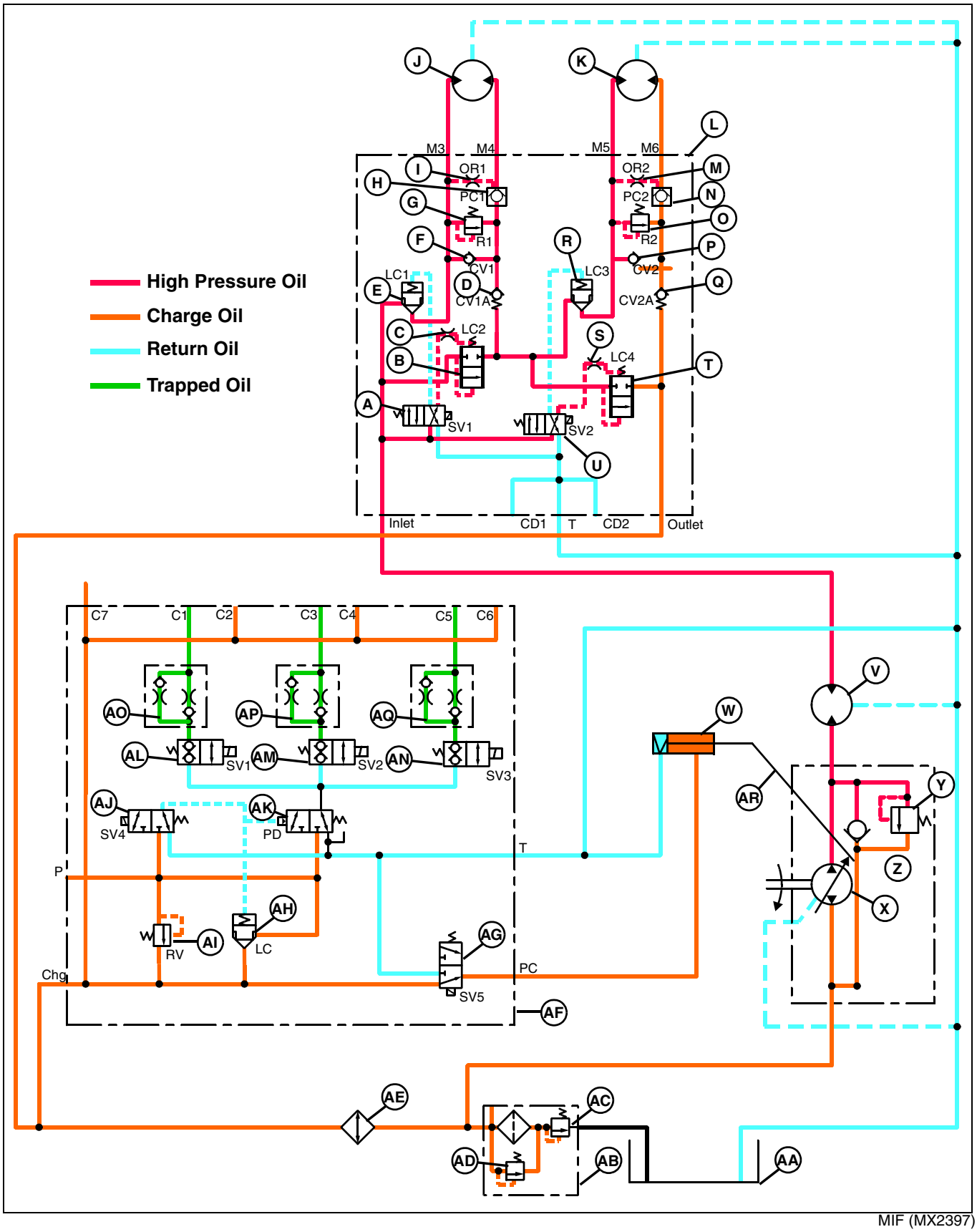
The mower deck drive system circuit for the front, left, and right mower decks is a hydraulic circuit consisting of the vented reservoir (AA), screen filter, deck drive pump (X), deck drive stroke control cylinder (W), front deck drive motor (V), deck lift control valve (AF), deck drive motor control valve (L), left and right deck drive motors (J and K), oil cooler assembly (AE), and oil filter assembly (AB).

When operating conditions have been met, the electronic control module energizes the deck drive stroke control cylinder solenoid valve SV5 (AG). Charge pressure oil then flows to the rod end of the deck drive stroke control cylinder. This retracts the deck drive stroke control cylinder and moves the swash plate of the mower deck pump by way of a mechanical link. Oil from the other side of the deck drive stroke control cylinder is returned to the reservoir.

Moving the swash plate from NEUTRAL position creates oil flow in the front mow circuit. Charge pressure is taken from the inlet of the oil filter assembly; oil is supplied to the mower deck drive pump and is pressurized. Pressurized oil then flows to the front mower deck drive motor. Oil exits the front deck drive motor in two forms, charge system oil and case drain oil. Case drain oil flows immediately back to the reservoir, while the charge system oil is routed to the inlet port of the deck motor control valve.

Once inside the deck motor control valve, charge system oil flows to deck motor control solenoid valves SV1 (A) and SV2 (U). Solenoid valve SV1 sends charge oil to pilot valve LC2 (B) and logic control valve LC1 (E). If left deck motor is not running, LC2 will open and bypass oil. With SV1 energized, pressure is relieved, opening LC1 and allowing oil flow to the left deck drive motor. Oil flows from the left deck drive motor to case drain and to port M4 of the deck motor control valve as charge pressure oil. This charge oil then passes through deck braking valve PC1 (H), and positive stop check valve CV1A (D).

From this point, solenoid valve SV2 sends charge oil to pilot valve LC4 (T) and logic control valve LC3 (R). If right deck motor is not running, LC4 will bypass oil. With SV2 energized, pressure is relieved, and LC3 opens, allowing oil to flow to the right deck drive motor. Oil flows from the right deck drive motor to case drain and to port M6 of the deck motor control valve as charge pressure oil. This oil then passes through deck braking valve PC2 (N) and positive stop check valve CV2A (Q). Then the oil is combined with charge flow, then routed through oil cooler and to the mower deck drive pump.


High Pressure Oil
Charge Oil
Return Oil
Trapped Oil
J
K
L
M3
M4
M5
M6
I
OR1
OR2
M
H
PC1
PC2
N
G
O
F
R1
R2
P
R
CV1
LC3
CV2
LC1
E
D
CV1A
CV2A
Q
C
LC2
S
LC4
B
T
A
SV1
SV2
U
Inlet
CD1
T
CD2
Outlet
C7
C1
C2
C3
C4
C5
C6
AO
AP
AQ
V
W
AL
SV1
AM
SV2
AN
SV3
AR
Y
AJ
SV4
AK
PD
T
Z
P
AH
X
RV
AI
LC
AG
Chg
SV5
PC
AF
AE
AC
AD
AB
AA

MIF (MX2397)

A - Left Deck Solenoid Valve (SV1)
B - Left Deck Pilot Valve (LC2)
C - Left Deck Pilot Valve Orifice
D - Left Deck Positive Stop Check Valve (CV1A)
E - Left Deck Motor Logic Valve (LC1)
F - Left Deck Anti-Cavitation Valve (CV1)
G - Left Deck Relief Valve (R1)
H - Left Deck Braking Valve (PC1)
I - Left Deck Orifice (OR1)
J - Left Deck Drive Motor
K - Right Deck Drive Motor
L - Deck Drive Motor Control Valve
M - Right Deck Orifice (OR2)
N - Right Deck Braking Valve (PC2)
O - Right Deck Relief Valve (R2)
P - Right Deck Anti-Cavitation Valve (CV2)
Q - Right Deck Positive Stop Check Valve (CV2A)
R - Right Motor Logic Valve (LC3)
S - Right Deck Pilot Valve Orifice
T - Right Deck Pilot Valve (LC4)
U - Right Deck Solenoid Valve (SV2)
V - Front Deck Drive Motor
W - Deck Drive Pump Stroke Control Cylinder
X - Deck Drive Pump
Y - Deck Drive Pump Pressure Relief Valve
Z - Charge Pressure Check Valve
AA- Vented Reservoir (Tank)
AB- Oil Filter
AC- Charge Pressure Relief Valve
AD- Filter Bypass Relief Valve
AE- Oil Cooler Assembly
AF- Deck Lift Control Valve
AG- Deck Drive Stroke Control Cylinder Solenoid Valve (SV5)
AH- Lift Logic Valve (LC)
AI - Lift Pressure Relief Valve (RV)
AJ- Deck Lift Solenoid Valve (SV4)
AK- Deck Lift Pilot Direction Valve (PD)
AL- Front Deck Raise/Lower Solenoid Valve (SV1)
AM- Left Deck Raise/Lower Solenoid Valve (SV2)
AN- Right Deck Raise/Lower Solenoid Valve (SV3)
AO- Front Deck Bi-Directional Orifice Disk
AP- Left Deck Bi-Directional Orifice Disk
AQ- Right Deck Bi-Directional Orifice Disk
AR- Mechanical Link

Mower Deck Drive System Mow Operation - Model 1600 Turbo

Function

To drive the front, left, and right mower deck motors.

Theory of Operation

NOTE: The following conditions must be met for the left and right mower deck(s) to function:

- Operator in seat
- Park brake OFF
- All mower decks lowered to ground
- PTO switch ON

NOTE: The following describes the system operation for all motors running.

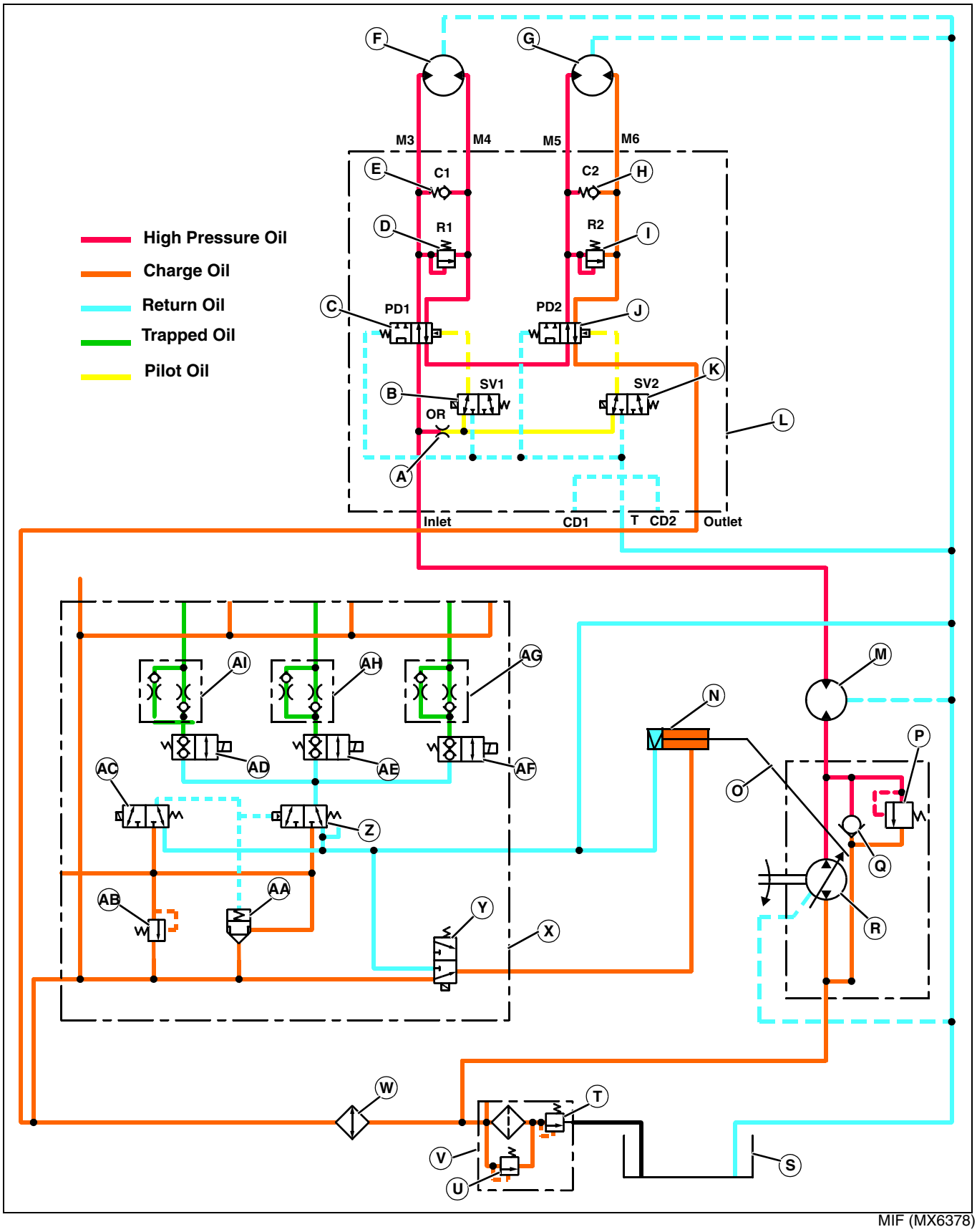
The mower deck drive system circuit for the front, left, and right mower decks is a hydraulic circuit consisting of the vented reservoir (S), screen filter, deck drive pump (R), deck drive pump stroke control cylinder (N), front deck drive motor (M), deck lift control valve (X), deck drive motor control valve (L), left and right deck drive motors (F) and (G), oil cooler (W), and oil filter assembly (V).

When operating conditions have been met, the electronic control module energizes the stroke control cylinder solenoid valve SV5. Charge oil then flows to the rod end of the deck drive stroke control cylinder. This retracts the deck drive stroke control cylinder and moves the swash plate of the deck drive pump by way of a mechanical link (O). Oil from the other side of the deck drive stroke control cylinder is returned to the reservoir.

Moving the swash plate from NEUTRAL position creates oil flow to the mow circuit. Charge oil is taken from the inlet of the oil filter assembly; oil is supplied to the mower deck drive pump and is pressurized. High pressure oil then flows to the front mower deck drive motor. Oil exits the front deck drive motor in two forms, high pressure oil and case drain oil. Case drain oil flows immediately back to the reservoir, while the high pressure oil is routed to the inlet port of the deck motor control valve.

Once inside the deck motor control valve, high pressure oil flows through the control orifice OR (0.31 in.). This orifice controls the rate of flow to the solenoid valves SV1 and SV2. The solenoid valves then send pilot oil to the left and right deck pilot control valves PD1 and PD2, shifting the spools, allowing high pressure oil to flow to the deck motors. If only one solenoid valve is energized, the de-energized solenoid valve will open to tank, allowing the pilot control valve in that circuit to shift to neutral. In the neutral position, the pilot control valve allows high pressure oil to flow through it. In this way the right and left deck motors can run independently. The deck motor control valve is also equipped with anti-cavitation check valves C1 and C2 and relief valves R1 and R2.

Charge oil flows from the deck motor control valve outlet port, combines with charge oil from the deck lift control valve, which is then routed through the oil cooler and on to the deck drive pump.


High Pressure Oil
Charge Oil
Return Oil
Trapped Oil
Pilot Oil
F
G
M3
M4
M5
M6
E
C1
C2
H
D
R1
R2
I
C
PD1
PD2
J
K
B
SV1
SV2
OR
L
A
Inlet
CD1
T
CD2
Outlet
AI
AH
AG
AD
AE
AF
AC
Z
AB
AA
Y
X
N
M
O
P
Q
R
W
T
V
U
S

MIF (MX6378)

A - Control Orifice 0.31 in. (OR)
B - Left Deck Solenoid Valve (SV1)
C - Left Deck Pilot Control Valve (PD1)
D - Left Deck Relief Valve (R1)
E - Left Deck Anti-Cavitation Check Valve (C1)
F - Left Deck Drive Motor
G - Right Deck Drive Motor
H - Right Deck Anti-Cavitation Check Valve (C2)
I - Right Deck Relief Valve (R2)
J - Right Deck Pilot Control Valve (PD2)
K - Right Deck Solenoid Valve (SV2)
L - Deck Drive Motor Control Valve
M - Front Deck Drive Motor
N - Deck Drive Pump Stroke Control Cylinder
O - Mechanical Link
P - Deck Drive Pump Relief Valve
Q - Deck Drive Pump Anti-Cavitation Valve
R - Deck Drive Pump
S - Reservoir (Vented)
T - Charge Pressure Relief Valve
U - Filter Bypass Relief Valve
V - Oil Filter Assembly
W - Oil Cooler
X - Deck Lift Control Valve
Y - Stroke Control Cylinder Solenoid Valve
Z - Lift Pilot Valve
AA- Lift Logic Valve
AB- Lift Relief Valve
AC- Lift Solenoid Valve
AD- Front Deck Raise/Lower Solenoid Valve
AE- Left Deck Raise/Lower Solenoid Valve
AF- Right Deck Raise/Lower Solenoid Valve
AG- Right Deck Bi-Directional Orifice Disk
AH- Left Deck Bi-Directional Orifice Disk
AI - Front Deck Bi-Directional Orifice Disk

Mower Deck Drive System Mow Operation - Model 1600 Turbo (Series II)

Function

To drive the front, left, and right mower deck motors.

Theory of Operation

NOTE: The following conditions must be met for the left and right mower deck(s) to function:

- Operator in seat
- Park brake OFF
- All mower decks lowered to ground
- PTO switch ON

NOTE: The following describes the system operation for all motors running.

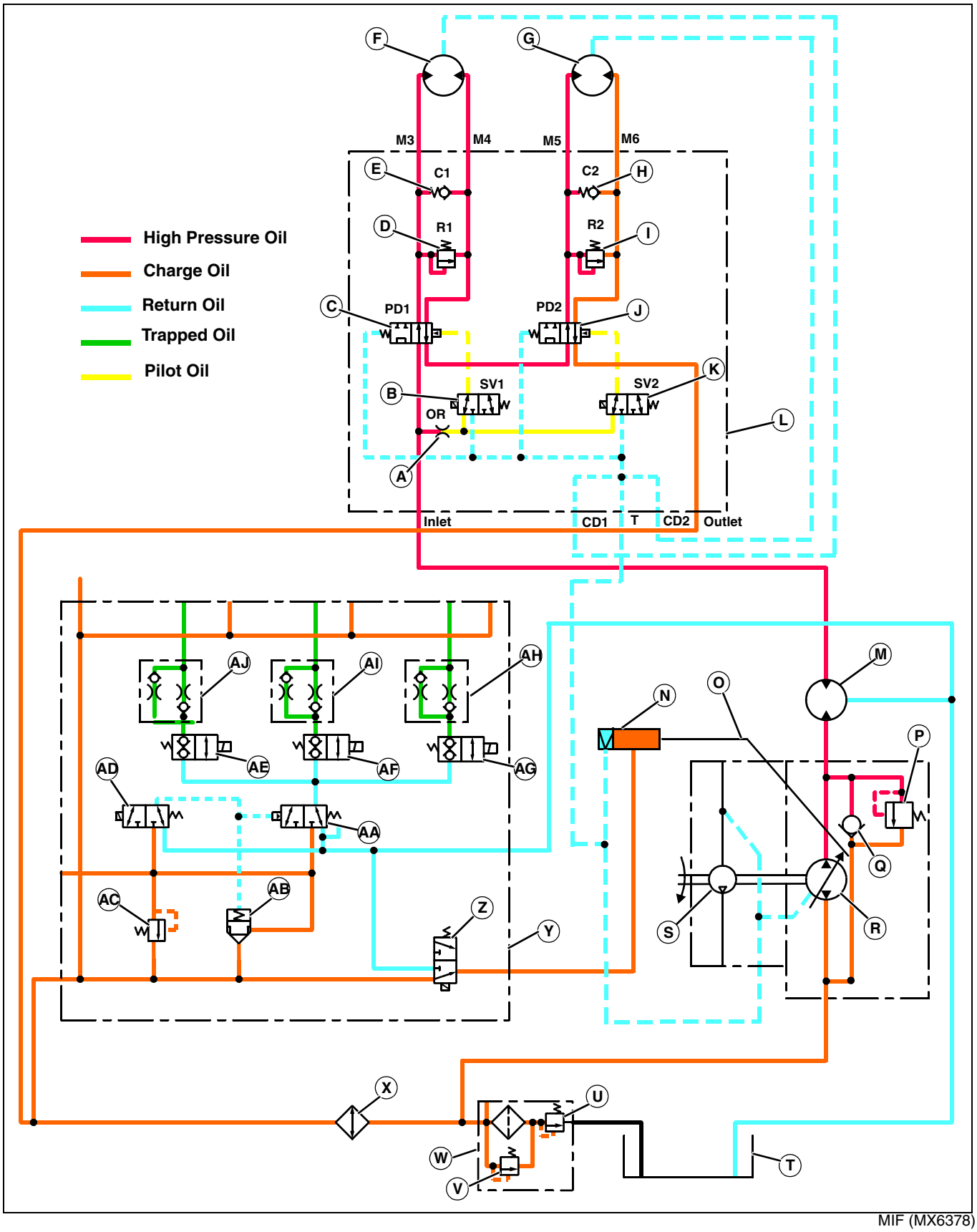
The mower deck drive system circuit for the front, left, and right mower decks is a hydraulic circuit consisting of the vented reservoir (S), screen filter, deck drive pump (R), deck drive pump stroke control cylinder (N), front deck drive motor (M), deck lift control valve (X), deck drive motor control valve (L), left and right deck drive motors (F) and (G), oil cooler (W), and oil filter assembly (V).

When operating conditions have been met, the electronic control module energizes the stroke control cylinder solenoid valve SV5. Charge oil then flows to the rod end of the deck drive stroke control cylinder. This retracts the deck drive stroke control cylinder and moves the swash plate of the deck drive pump by way of a mechanical link (O). Oil from the other side of the deck drive stroke control cylinder is returned to the reservoir.

Moving the swash plate from NEUTRAL position creates oil flow to the mow circuit. Charge oil is taken from the inlet of the oil filter assembly; oil is supplied to the mower deck drive pump and is pressurized. High pressure oil then flows to the front mower deck drive motor. Oil exits the front deck drive motor in two forms, high pressure oil and case drain oil. Case drain oil flows internally to the triple pump to the lift pump inlet, while the high pressure oil is routed to the inlet port of the deck motor control valve.

Once inside the deck motor control valve, high pressure oil flows through the control orifice OR (0.31 in.). This orifice controls the rate of flow to the solenoid valves SV1 and SV2. The solenoid valves then send pilot oil to the left and right deck pilot control valves PD1 and PD2, shifting the spools, allowing high pressure oil to flow to the deck motors. If only one solenoid valve is energized, the de-energized solenoid valve will open to tank, allowing the pilot control valve in that circuit to shift to neutral. In the neutral position, the pilot control valve allows high pressure oil to flow through it. In this way the right and left deck motors can run independently. The deck motor control valve is also equipped with anti-cavitation check valves C1 and C2 and relief valves R1 and R2.

Charge oil flows from the deck motor control valve outlet port, combines with charge oil from the deck lift control valve, which is then routed through the oil cooler and on to the deck drive pump.


High Pressure Oil
Charge Oil
Return Oil
Trapped Oil
Pilot Oil
F
G
M3
M4
M5
M6
E
C1
C2
H
D
R1
R2
I
C
PD1
PD2
J
K
B
SV1
SV2
OR
L
A
Inlet
CD1
T
CD2
Outlet
AJ
AI
AH
AE
AF
AG
AD
AA
AC
AB
Z
Y
N
O
M
P
Q
R
S
X
U
W
V
T

MIF (MX6378)

A - Control Orifice 0.31 in. (OR)
B - Left Deck Solenoid Valve (SV1)
C - Left Deck Pilot Control Valve (PD1)
D - Left Deck Relief Valve (R1)
E - Left Deck Anti-Cavitation Check Valve (C1)
F - Left Deck Drive Motor
G - Right Deck Drive Motor
H - Right Deck Anti-Cavitation Check Valve (C2)
I - Right Deck Relief Valve (R2)
J - Right Deck Pilot Control Valve (PD2)
K - Right Deck Solenoid Valve (SV2)
L - Deck Drive Motor Control Valve
M - Front Deck Drive Motor
N - Deck Drive Pump Stroke Control Cylinder
O - Mechanical Link
P - Deck Drive Pump Relief Valve
Q - Deck Drive Pump Anti-Cavitation Valve
R - Deck Drive Pump
S - Lift Pump
T - Reservoir (Vented)
U - Charge Pressure Relief Valve
V - Filter Bypass Relief Valve
W - Oil Filter Assembly
X - Oil Cooler
Y - Deck Lift Control Valve
Z - Stroke Control Cylinder Solenoid Valve
AA- Lift Pilot Valve
AB- Lift Logic Valve
AC- Lift Relief Valve
AD- Lift Solenoid Valve
AE- Front Deck Raise/Lower Solenoid Valve
AF- Left Deck Raise/Lower Solenoid Valve
AG- Right Deck Raise/Lower Solenoid Valve
AH- Right Deck Bi-Directional Orifice Disk
AI - Left Deck Bi-Directional Orifice Disk
AJ- Front Deck Bi-Directional Orifice Disk

Mower Deck Lift System Operation - Lift

Function

To lift the front, left, and right mower decks.

NOTE: Left and front decks shown in LIFT mode.

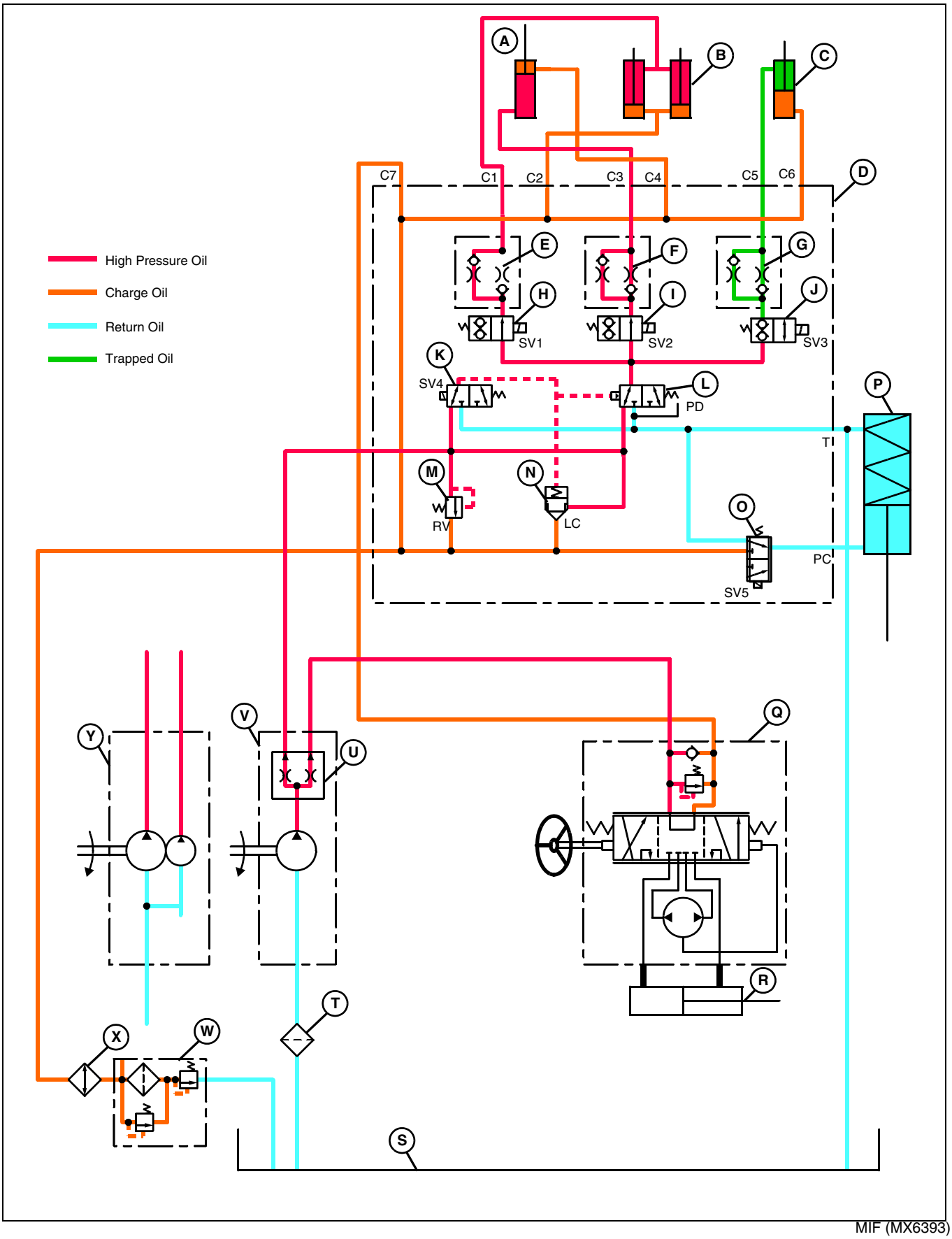
The lift system is designed so that the front deck cylinders extend to lift, while the left and right deck cylinders retract to lift.

Theory of Operation

The lift system is a hydraulic circuit consisting of the hydraulic reservoir (S), steering/lift pump (V or Y), deck lift control valve (D), front deck lift cylinders (B), left and right deck lift cylinders (A and C), oil cooler assembly (X) and oil filter assembly (W).

Hydraulic oil is pulled from the reservoir, through the in-tank screen filter (T), routed to the steering/lift pump where it is pressurized. Pressurized oil is divided by the flow divider valve (U) and routed to the IN port of the steering valve and port P of the deck lift control valve. This oil is stopped at hydraulic actuated valve PD (L) through logic valve LC (N) and flows to the oil cooler and into the charge circuit.

When a raise/lower lever is moved to the RAISE position, the electronic control module energizes deck lift solenoid valve SV4 (K), as well as the appropriate raise/lower solenoid valve. Oil is allowed to flow, moving hydraulic valve PD, and also closes logic valve LC. Oil can now flow from port P, through hydraulic actuated valve PD to each of the three raise/lower solenoid valves (H, I, and/or J). Hydraulic oil then flows through the energized raise/lower solenoid valves and bi-directional orifice disks (E, F, and G). Disks control oil flow rate into the appropriate lift cylinder. Oil from the opposite side of the hydraulic lift cylinder then returns to the charge oil circuit through ports C2, C4 or C6, depending on which deck is being lifted.


High Pressure Oil
Charge Oil
Return Oil
Trapped Oil
A
B
C
D
C7
C1
C2
C3
C4
C5
C6
E
F
G
H
I
J
SV1
SV2
SV3
K
SV4
L
PD
P
TI
M
RV
N
LC
O
PC
SV5
Q
R
Y
V
U
T
X
W
S

MIF (MX6393)

A - Left Deck Lift Cylinder
B - Front Deck Lift Cylinders (2 used)
C - Right Deck Lift Cylinder
D - Deck Lift Control Valve
E - Front Deck Bi-Directional Orifice Disk
F - Left Deck Bi-Directional Orifice Disk
G - Right Deck Bi-Directional Orifice Disk
H - Front Deck Raise/Lower Solenoid Valve (SV1)
I - Left Deck Raise/Lower Solenoid Valve (SV2)
J - Right Deck Raise/Lower Solenoid Valve (SV3)
K - Deck Lift Solenoid Valve (SV4)
L - Deck Lift Hydraulic Actuated Valve (PD)
M - Lift Pressure Relief Valve (RV)
N - Lift Logic Valve (LC)
O - Deck Drive Stroke Control Cylinder Solenoid Valve (SV5)
P - Deck Drive Stroke Control Cylinder
Q - Steering Valve
R - Steering Cylinder
S - Vented Reservoir (Tank)
T - Screen Filter (In Tank)
U - Flow Divider Valve - Model 1620
V - Steering/Lift Pump - Model 1620
W - Oil Filter Assembly
X - Oil Cooler Assembly
Y - Steering/Lift Pump - Models 1600/1600 Turbo

Mower Deck Lift System Operation - Lower

Function

To lower the front, left, and right mower decks.

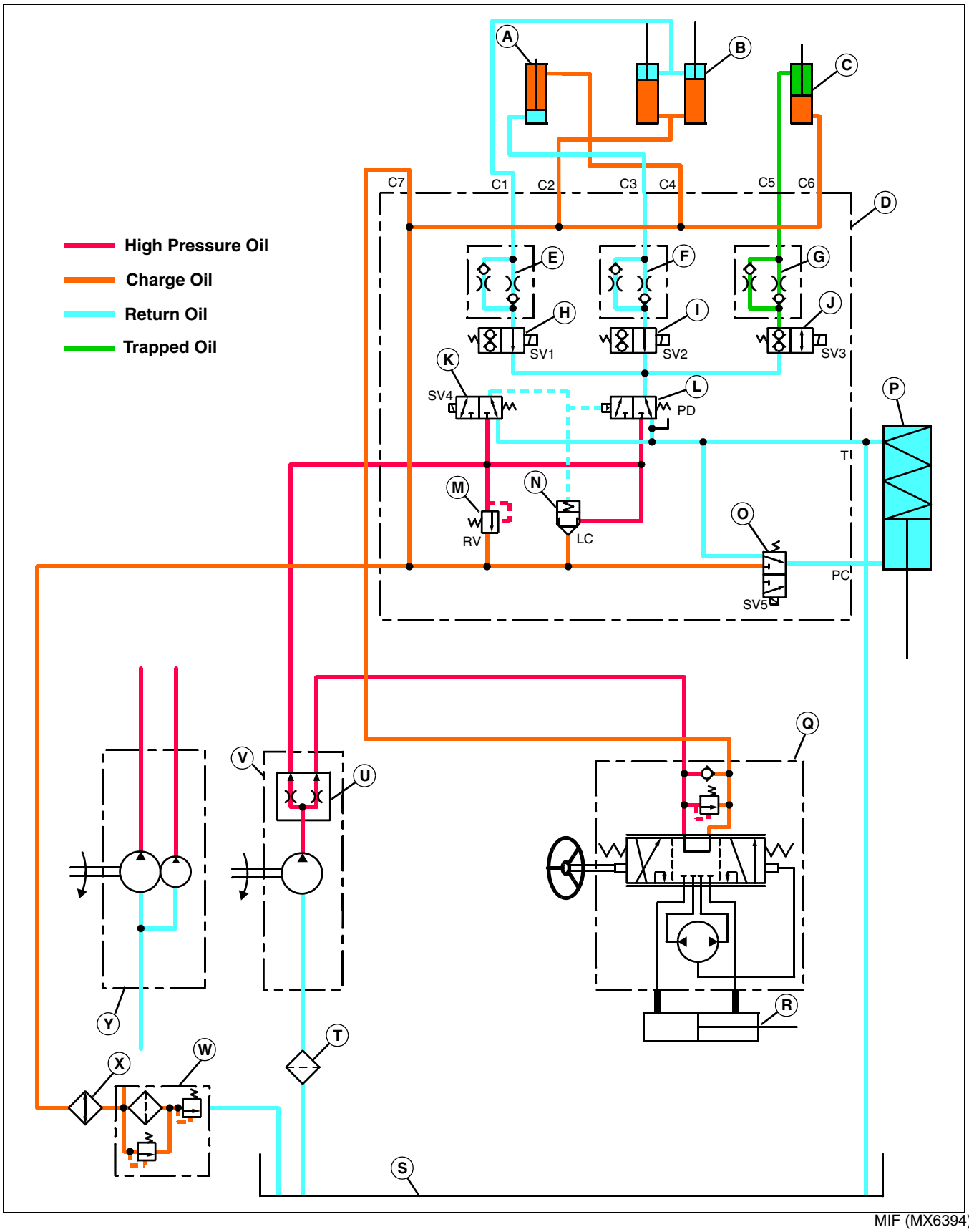
NOTE: Left and front decks shown in LOWER mode.

The lower system is designed so that the front deck cylinders retract to lower, while the left and right cylinders extend to lower.

Theory of Operation

The lower system is a hydraulic circuit consisting of the front lift cylinders (B), left and right lift cylinders (A) and (C), deck lift control valve (D), deck drive stroke control cylinder solenoid valve (O), and the vented reservoir (S).

Moving the raise/lower lever to the LOWER position will energize the appropriate raise/lower solenoid valve through the electronic control module. The weight of the deck and charge pressure oil push oil from the lift cylinder into the deck lift valve through the appropriate ports C1, C3 or C5. Oil then flows through the bi-directional orifice disk (E, F, or G) regulating the drop rate of the mower deck, and proceeds through the appropriate raise/lower solenoid valve. Oil is then directed through deck lift hydraulic actuated valve PD (L), into the return line through port T and finally to the reservoir.


High Pressure Oil
Charge Oil
Return Oil
Trapped Oil
A
B
C
C7
C1
C2
C3
C4
C5
C6
D
E
F
G
H
I
J
SV1
SV2
SV3
K
SV4
L
PD
P
TI
M
RV
N
LC
O
SV5
PC
Q
V
U
R
Y
T
W
X
S

MIF (MX6394)

A - Left Deck Lift Cylinder
B - Front Deck Lift Cylinders (2 used)
C - Right Deck Lift Cylinder
D - Deck Lift Control Valve
E - Front Deck Bi-Directional Orifice Disk
F - Left Deck Bi-Directional Orifice Disk
G - Right Deck Bi-Directional Orifice Disk
H - Front Deck Raise/Lower Solenoid Valve (SV1)
I - Left Deck Raise/Lower Solenoid Valve (SV2)
J - Right Deck Raise/Lower Solenoid Valve (SV3)
K - Deck Lift Solenoid Valve (SV4)
L - Deck Lift Hydraulic Actuated Valve (PD)
M - Lift Pressure Relief Valve (RV)
N - Lift Logic Valve (LC)
O - Deck Drive Stroke Control Cylinder Solenoid Valve (SV5)
P - Deck Drive Stroke Control Cylinder
Q - Steering Valve
R - Steering Cylinder
S - Vented Reservoir (Tank)
T - Screen Filter (In Tank)
U - Flow Divider Valve - Model 1620
V - Steering/Lift Pump - Model 1620
W - Oil Filter Assembly
X - Oil Cooler
Y - Steering/Lift Pump - Models 1600/1600 Turbo

Diagnostics

Front Mower Deck Drive Motor Does Not Operate

NOTE: In order to properly diagnose the hydraulic system, it is important to verify that the electrical components and control function inputs and outputs related to the hydraulic system are working properly before diagnosing hydraulic components.

In many cases, the sequence of activation of controls is critical to successful mower deck system activation. Follow the sequence listed in the test conditions to ensure proper activation.

Test Conditions:

- Machine parked safely. (See "Park Machine Safely" on page 3.)
- Key switch in STOP position.

System: Front Mower Deck Drive Motor Does Not Operate

(1) Mower Drive Belt.
Is incorrect belt installed or is it damaged, worn, stretched, or broken?

Yes - Replace belt.

No - Go To Step (2)

(2) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (3)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See "Hydraulic Oil Foams" on page 519.)

System: Front Mower Deck Drive Motor Does Not Operate

(3) Hydraulic Hoses.
Do hoses have sharp bends, restrictions or damaged areas?
Are hoses improperly routed?
Are hose connections loose or leaking?

Yes - Hoses have sharp bends or restrictions. **Replace hose(s) with hose(**s) of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions.

Yes - Hose connections are loose or leaking. Tighten connections and/or replace O-rings as needed.

No - Go To Step (4)

(4) Mower Deck Pump Control Linkage.
Are stops adjusted properly on deck drive stroke control cylinder and mower deck pump control linkage?
Are control linkages properly tightened and undamaged?
Does linkage move freely without obstructions?

Yes - Go To Step (5)

No - Stops are not adjusted properly. Adjust stops to obtain proper spindle speed.

No - Control linkages are loose or damaged. Tighten or repair linkage as needed.

No - Linkage does not move freely and/or is obstructed. Reroute hoses and/or remove obstructions.

(5) Deck Drive Motor. Are hoses connected to proper ports on motor?

Yes - Go To Step (6)

No - Connect pressure, return, and case drain hoses to proper ports.

System: Front Mower Deck Drive Motor Does Not Operate

(6) Operator on seat.
Engine running at FAST idle.
Mower decks lowered to the ground.
Park brake lock in RELEASED position.
PTO switch in OFF position.
Speed range lever in SLOW position.

Move front mower deck raise/lower lever to LOWER and back to its resting position, then move PTO switch to ON position.

Control Module Lights (D15 and D22).
Does PTO input light (D15) turn on?
Does deck drive output light (D22) turn on?
Does front mower deck engage?

Yes - Go To Step (7)

No - PTO input light (D15) does not turn on. Check PTO switch input circuit.

No - Deck drive output light (D22) does not turn on. Check the remaining electronic control module inputs and outputs.

No - Front mower deck does not engage, but PTO input light (D15) and deck drive output light (D22) do turn on. Check the motor control valve solenoid and front mower deck angle (proximity) switch input circuit.

(7) Move the front mower deck raise/lower lever to LOWER.
Control Module Lights (D6 and D26).
Does lower front input light (D6) turn on?
Does front deck valve output light (D26) turn on?

Yes - Go To Step (8)

No - Lower front input light (D6) does not turn on. Check front mower deck raise/lower switch circuit.

No - Front deck valve output light (D26) does not turn on but lower front input light (D6) does turn on. Check seat switch input circuit.

(8) Control Module Light (D17).
Is park brake input light (D17) on?

Yes - Go To Step (9)

No - Check park brake switch input circuit.

System: Front Mower Deck Drive Motor Does Not Operate

(9) Control Module Light (D11).
Is front angle (proximity) switch input light (D11) on?

Yes - Go To Step (10)

No - Check front mower deck angle (proximity) switch input circuit.

(10) Control Module Light (D18).
Is transaxle low input light (D18) on?

Yes - Go To Step (11)

No - Check transaxle low range switch input circuit.

(11) Cycle PTO switch OFF and ON.
Deck Drive Solenoid Valve (SV5).
Does solenoid (SV5) activate (clicking sound)?

Yes - Go To Step (13)

No - Go To Step (12)

(12) Deck Drive Solenoid Valve (SV5) Cartridge.
Is valve cartridge binding or damaged?

Yes - Check solenoid valve cartridge. Replace as needed.

No - Test raise/lower select solenoid (Y5). (See “Deck Drive and Raise and Lower Select Solenoid Test” on page 370.)

(13) Deck Drive Stroke Control Cylinder.
Is cylinder worn, damaged, or binding?

Yes - Replace deck drive stroke control cylinder.

No - Go To Step (14)

(14) Deck Drive Motor.
Is deck drive motor operating properly?

Yes - Go To Step (15)

No - Check deck motor for internal leakage. Repair or replace as needed.

(15) Mower Deck Drive Pump.
Is pump operating properly?

No - Test mower deck drive pump and check relief valve. Repair or replace mower deck drive pump assembly as needed.

Left and Right Mower Deck Drive Motor(s) Do Not Operate

NOTE: The left and right mower deck operation is dependent on the front mower deck operating properly. Verify front mower deck operation before beginning left and right mower deck diagnosis.

NOTE: In order to properly diagnose the hydraulic system, it is important to verify that the electrical components and control function inputs and outputs related to the hydraulic system are working properly before diagnosing hydraulic components.

In many cases, the sequence of activation of controls is critical to successful mower deck system activation. Follow the sequence listed in the test conditions to ensure proper activation.

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Key switch in STOP position.

System: Left and Right Mower Deck Drive Motor(s) Do Not Operate

(1) Mower Deck Drive Belt.
Is correct belt installed?
Is belt free of damage, not worn, and not stretched?
Is belt properly tensioned?

Yes - Go To Step (2)

No - Incorrect belt is installed. Replace belt.

No - Belt is damaged, worn, or stretched. Replace belt.

No - Belt is not properly adjusted. Adjust belt tension.

(2) Hydraulic Hoses.
Do hoses have sharp bends or restrictions?
Are hoses improperly routed?
Are hose connections loose or leaking?
Are hoses damaged or badly scuffed?

Yes - Hoses have sharp bends or restrictions. Replace hose(s) with hose(s) of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions.

Yes - Hose connections are loose or leaking. Tighten connections and/or replace O-rings as needed.

No - Go To Step (3)

System: Left and Right Mower Deck Drive Motor(s) Do Not Operate

(3) Deck Drive Motor.
Are hoses connected to proper ports on motor?

Yes - Go To Step (4)

No - Connect pressure, return, and case drain hoses to proper ports.

(4) Operator on seat.
Engine running at FAST idle.
Mower decks lowered to the ground.
Park brake lock in RELEASED position.
Speed range lever in SLOW position.
Front mower engaged and operating normally.
Left and right mower decks in raised position.
Left and right mower deck transport locks released.

Move left mower deck raise/lower lever to LOWER and back to its resting position (front mower is already engaged).
Left Mower Deck.
Does the left mower deck lower and engage when it is approximately 460 mm (18 in.) from the ground?

Yes - Go To Step (5)

No - The mower deck does not lower. (See “Lift System Will Not Lower Mower Decks or Not Lower Smoothly” on page 517.)

No - The mower deck lowers, but the mower deck drive motor does not engage. Check right mower deck angle (proximity) switch input circuit and right mower deck solenoid valve circuit.

(5) Move right mower deck raise/lower lever to LOWER and back to its resting position (front mower is already engaged).
Right Mower Deck.
Does the right mower deck lower and engage when it is approximately 460 mm (18 in.) from the ground?

Yes - Go To Step (6)

No - The mower deck does not lower. (See “Lift System Will Not Lower Mower Decks or Not Lower Smoothly” on page 517.)

No - The mower deck lowers, but the mower deck drive motor does not engage. Check left mower deck angle (proximity) switch input circuit and right mower deck solenoid valve circuit.

System: Left and Right Mower Deck Drive Motor(s) Do Not Operate

(6) Cycle left mower deck raise/lower lever back and forth from LOWER to RAISE.
Left Mower Deck Solenoid Valve (SV1).
Does left mower deck solenoid valve (SV1) activate (clicking sound)?

Yes - Go To Step (8)

No - Go To Step (7)

(7) Left Mower Deck Solenoid Valve (SV1) Cartridge.
Is solenoid valve (SV1) cartridge binding or damaged?

Yes - Check solenoid valve (SV1) cartridge. Replace as needed.

No - Test left deck drive solenoid (Y6). (See “Deck Drive and Raise and Lower Select Solenoid Test” on page 370.)

(8) Cycle right mower deck raise/lower lever back and forth from LOWER to RAISE.
Right Mower Deck Solenoid Valve (SV2).
Does right mower deck solenoid valve (SV2) activate (clicking sound)?

Yes - Go To Step (10)

No - Go To Step (9)

(9) Right Mower Deck Solenoid Valve Cartridge (SV2).
Is solenoid valve (SV2) cartridge binding or damaged?

Yes - Check solenoid valve (SV2) cartridge. Replace as needed.

No - Test left deck drive solenoid (Y8). (See “Deck Drive and Raise and Lower Select Solenoid Test” on page 370.)

(10) Deck Drive Motors.
Are left and right deck drive motors operating properly?

No - Check deck motor(s) for internal leakage. Repair or replace as needed.

Poor Mower Deck Performance

System: Poor Mower Deck Performance

(1) Mower Deck Drive Belt.
Is correct belt installed?
Is belt free of damage, not worn, and not stretched?
Is belt properly tensioned?

Yes - Go To Step (2)

No - Incorrect belt is installed. Replace belt.

No - Belt is damaged, worn, or stretched. Replace belt.

No - Belt is not properly adjusted. Adjust belt tension.

(2) Mower Deck Spindle Assemblies.
Are spindle assemblies damaged or are bearings worn or damaged?
Do spindles or blades have debris (e.g., string, long grass, or weeds) wrapped around them?

Yes - Spindles are damaged or bearings are worn or damaged. Repair or replace as needed.

Yes - Spindles or blades have debris. Remove debris.

No - Go To Step (3)

(3) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (4)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 519.)

System: Poor Mower Deck Performance

(4) Pressure Hoses.
Do hoses have sharp bends, restrictions or damaged areas?
Are hoses improperly routed?
Are hose connections loose or leaking?

Yes - Hoses have sharp bends or restrictions. Replace hose(s) with hose(s) of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions.

Yes - Hose connections are loose or leaking. Tighten connections and/or replace O-rings as need.

No - Go To Step (5)

(5) Deck Drive Stroke Control Cylinder.
Are stops improperly adjusted?
Are control linkages damaged or have loose connections?
Is cylinder worn, damaged, or binding?

Yes - Stops are improperly adjusted. Adjust stops to obtain proper spindle speed.

Yes - Linkages are damaged or have loose connections. Tighten or repair linkage as needed.

Yes - Cylinder is worn, damaged, or binding. Replace deck drive stroke control cylinder.

No - Go To Step (6)

(6) Deck Drive Motors.
Are deck drive motors operating properly?

Yes - Go To Step (7)

No - Check deck motor(s) for internal leakage. Repair or replace as needed.

(7) Mower Deck Drive Pump.
Is pump operating properly?
Are incoming charge pressure and flow rate correct?

No - Pump is not operating properly. Test mower deck drive pump and check relief valve. Repair or replace mower deck drive pump assembly as needed.

No - Charge pressure and flow rate are incorrect. Check hydraulic hoses for flow restrictions. Check gear pump and charge relief.

Lift System Will Not Raise Mower Decks or Not Raise Smoothly

NOTE: In order to properly diagnose the hydraulic system, it is important to verify that the electrical components and control function inputs and outputs related to the hydraulic system are working properly before diagnosing hydraulic components.

Test Conditions:

- Key switch in STOP position.
- Machine parked safely. (See “Park Machine Safely” on page 3.)

System: Lift System Will Not Raise Mower Decks or Not Raise Smoothly

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 519.)

(2) Hydraulic Hoses.
Do hoses have sharp bends or restrictions?
Are hoses improperly routed?
Are hoses connected to incorrect ports on cylinders and lift valve?

Yes - Hoses have sharp bends or restrictions. Replace hose(s) with hose(s) of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions.

Yes - Hoses are connected to incorrect ports. Connect hoses to correct ports.

No - Go To Step (3)

System: Lift System Will Not Raise Mower Decks or Not Raise Smoothly

(3) Front, Left, and Right Lift Arm Linkage.
Are lift arm bushings worn or damaged?
Is lift arm linkage obstructed?

Yes - Bushings are worn or damaged. Replace bushings.

Yes - Linkage is obstructed. Remove obstructions.

No - Go To Step (4)

(4) Operator on seat.
Engine running at FAST idle.
Front mower deck lowered to the ground.
Park brake lock in RELEASED position.
Speed range lever in SLOW position.

Move front mower deck raise/lower lever to RAISE.
Control Module Lights (D3, D21, and D26).
Does raise front input light (D3) turn on?
Does deck valve output light (D26) turn on?
Does raise valve output light (D21) turn on?

Yes - Go To Step (5)

No - Raise front input light (D3) does not turn on. Check front mower deck raise/lower switch circuit.

No - Raise front input light (D3) does turn on, but deck valve output light (D26) and raise valve output light (D21) do not turn on. Check seat switch input circuit.

(5) Move right mower deck raise/lower lever to RAISE.
Control Module Lights (D1, D21, and D27).
Does raise right input light (D1) turn on?
Does deck valve output light (D27) turn on?
Does raise valve output light (D21) turn on?

Yes - Go To Step (6)

No - Raise right input light (D1) does not turn on. Check right mower deck raise/lower switch circuit.

No - Raise right input light (D1) does turn on, but deck valve output light (D27) and raise valve output light (D21) do not turn on. Check seat switch input circuit.

System: Lift System Will Not Raise Mower Decks or Not Raise Smoothly

(6) Move left mower deck raise/lower lever to RAISE.
Control Module Lights (D2, D21, and D24).
Does raise left input light (D2) turn on?
Does deck valve output light (D24) turn on?
Does raise valve output light (D21) turn on?

Yes - Go To Step (7)

No - Raise left input light (D2) does not turn on. Check left mower deck raise/lower switch circuit.

No - Raise left input light (D2) does turn on, but deck valve output light (D24) and raise valve output light (D21) do not turn on. Check seat switch input circuit.

(7) Lift Valve Assembly.
Cycle front, left and right raise/lower levers back and forth from raise to lower.
Do front, left, right and deck lift solenoid valves (SV1, SV2, SV3, and SV4) activate (clicking sound)?

Yes - Go To Step (9)

No - Go To Step (8)

(8) Lift Valve Assembly Valve Cartridges.
Are valve cartridges (SV1, SV2, SV3, and/or SV4) binding or damaged?

Yes - Check solenoid valve cartridge. Replace as needed.

No - Test solenoid coil(s) (Y2, Y3, Y4, and/or Y5). (See “Raise and Lower Solenoid Coil Test” on page 371.)

(9) Deck Lift Pilot Direction Valve (PD).
Is pilot direction valve (PD) operating properly without damage and not binding?

Yes - Go To Step (10)

No - Replace PD cartridge as needed.

(10) Logic Valve (LC).
Is logic valve (LC) operating properly with no leakage past valve?

Yes - Go To Step (11)

No - Replace logic valve.

System: Lift System Will Not Raise Mower Decks or Not Raise Smoothly

(11) Lift Pressure Relief Valve (RV).
Is lift pressure relief valve opening pressure to specifications? (See "Lift Pressure Relief Valve Test" on page 532.)

Yes - Go To Step (12)

No - Replace lift relief valve cartridge.

(12) Steering/Lift Pump.
Is pump operating properly with no internal leakage or damage?

Yes - Go To Step (13)

No - Test pump. Replace lift/steering pump assembly as needed.

(13) Front, Left, and Right Lift Cylinders.
Are lift cylinder(s) operating properly without internal leakage or damage?

No - Replace lift cylinder(s).

Specifications

Lift Pressure Relief Valve
Opening Pressure. . . . . 11032 kPa (1600 psi)

Lift System Will Not Lower Mower Decks or Not Lower Smoothly

CAUTION: Avoid injury! Sudden deck movement may occur. To avoid injury from sudden deck movement, keep area around raised mower decks clear.

NOTE: In order to properly diagnose the hydraulic system, it is important to verify that the electrical components and control function inputs and outputs related to the hydraulic system are working properly before diagnosing hydraulic components.

In many cases, the sequence of activation of controls is critical to successful mower deck system activation. Follow the sequence listed in the test conditions to ensure proper activation.

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

System: Lift System Will Not Lower Mower Decks or Not Lower Smoothly

(1) Hydraulic Hoses.
Do hoses have sharp bends or restrictions?
Are hoses improperly routed?
Are hoses connected to incorrect ports on cylinders and lift valve?

Yes - Hoses have sharp bends or restrictions. Replace hose(s) with hose(s) of proper size.

Yes - Hoses are improperly routed. Route hoses away from obstructions.

Yes - Hoses are connected to incorrect ports. Connect hoses to correct ports.

No - Go To Step (2)

(2) Front, Left, and Right Lift Arm Linkage.
Are lift arm bushings worn or damaged?
Is lift arm linkage obstructed?

Yes - Bushings are worn or damaged. Replace bushings.

Yes - Linkage is obstructed. Remove obstructions.

No - Go To Step (3)

System: Lift System Will Not Lower Mower Decks or Not Lower Smoothly

(3) Deck Lift Pilot Direction Valve (PD).
Is pilot direction valve (PD) operating properly without damage and not binding?

Yes - Go To Step (4)

No - Replace valve as needed.

(4) Front, Left and Right Bi-Directional Orifice Disks.
Do orifice disks move freely, not binding, damaged, or clogged?

Yes - Go To Step (5)

No - Clean or replace orifice disk(s) as needed.

(5) Operator on seat.
Engine running at FAST idle.
Left and right mower decks in raised position.
Park brake lock in RELEASED position.
Speed range lever in SLOW position.

Move front mower deck raise/lower lever to LOWER.
Control Module Lights (D6 and D26).
Does lower front input light (D6) turn on?
Does deck valve output light (D26) turn on?

Yes - Go To Step (6)

No - Lower front input light (D6) does not turn on. Check front mower deck raise/lower switch circuit.

No - Lower front input light (D6) does turn on, but deck valve output light (D26) does not turn on. Check seat switch input circuit.

(6) Move right mower deck raise/lower lever to LOWER.
Control Module Lights (D4 and D27).
Does lower right input light (D4) turn on?
Does deck valve output light (D27) turn on?

Yes - Go To Step (7)

No - Lower right input light (D4) does not turn on. Check right mower deck raise/lower switch circuit.

No - Lower right input light (D4) does turn on, but deck valve output light (D27) does not turn on. Check seat switch input circuit.

System: Lift System Will Not Lower Mower Decks or Not Lower Smoothly

(7) Move left mower deck raise/lower lever to LOWER.
Control Module Lights (D5 and D24).
Does lower left input light (D5) turn on?
Does deck valve output light (D24) turn on?

Yes - Go To Step (8)

No - Lower left input light (D4) does not turn on. Check left mower deck raise/lower switch circuit.

No - Lower left input light (D4) does turn on, but deck valve output light (D24) does not turn on. Check seat switch input circuit.

(8) Lift Valve Assembly.
Cycle front, left and right raise/lower levers back and forth from raise to lower.
Do front, left, right and deck lift solenoid valves (SV1, SV2, SV3, and SV4) activate (clicking sound)?

No - Go To Step (9)

(9) Are valve cartridges (SV1, SV2, SV3, and/or SV4) binding or damaged?

Yes - Check solenoid valve cartridges. Replace as needed.

No - Test solenoid coil(s) (Y2, Y3, Y4, and/or Y5). (See “Raise and Lower Solenoid Coil Test” on page 371.)

Hydraulic Oil Foams

Test Conditions:

- Key switch in STOP position.
- Machine parked safely. (See “Park Machine Safely” on page 3.)

System: Hydraulic Oil Foams

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

(2) Hydraulic Pressure Hoses.
Check pressure hoses.
Do hoses have sharp bends or restrictions?
Are connections leaking?

Yes - Hoses have sharp bends and/or restrictions. Replace hose(s).

Yes - Connections are leaking. Tighten connections and/or replace hoses.

No - Go To Step (3)

(3) Hydraulic Suction Hoses.
Check suction hoses.
Are hoses cracked, cut, or badly scuffed?
Are hose connections loose or leaking?

Yes - Hoses are cracked, cut, or badly scuffed. Replace hoses as needed with hoses of proper size.

Yes - Hose connections loose or leaking. Tighten connections and/or replace O-rings as needed.

Frequent Failure of Hydraulic Hoses and O-Rings

Test Conditions:

- Key switch in STOP position.
- Machine parked safely. (See “Park Machine Safely” on page 3.)

System: Frequent Failure of Hydraulic Hoses and O-Rings

(1) Hydraulic Hose Connections.
Are hydraulic hose connections loose or leaking?

Yes - Tighten connections and/or replace O-rings as needed.

No - Go To Step (2)

(2) Hydraulic Hoses.
Are hoses chafed, pinched, or damaged?

Yes - Replace hoses as needed. Route hoses in a manner to prevent rubbing, and away from moving parts and heat sources.

Tests and Adjustments

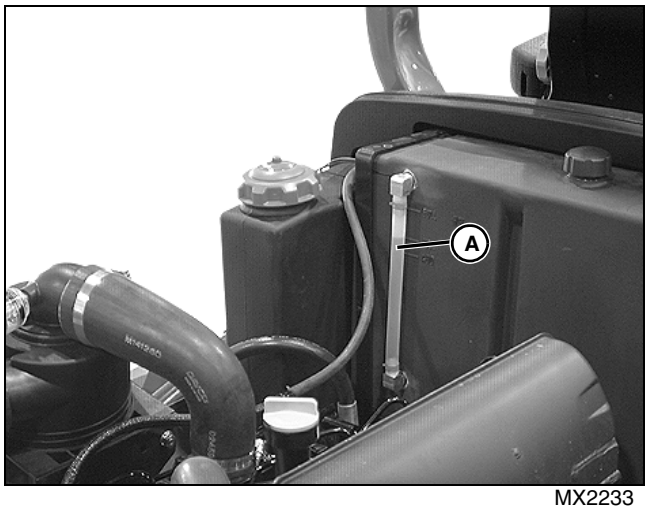
Hydraulic Reservoir Oil Level Check

Conditions

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

Procedure

1. Raise hood.



MX2233

2. Check oil level at sight glass (A) on the hydraulic oil reservoir.

3. Inspect oil for signs of contamination or foaming.

Normal

- Oil level should be at the FULL COLD level of the sight glass.

NOTE: Oil should be clear, not white, yellow, or cloudy.

- Oil should show no signs of foaming or contamination.

If Not Normal

- If oil level is below the FULL COLD level, remove the hydraulic reservoir filler cap and add hydraulic oil until the reservoir is full.
- If the oil level is low, check hydraulic hoses and connections for leaks. Repair as needed.
- If oil shows signs of foaming or contamination, drain hydraulic reservoir, replace filter, and refill reservoir with clean hydraulic oil.

Hydraulic Oil Warm-Up Procedure

Reason

To ensure that the hydraulic oil is at specified operating temperature prior to test procedures.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Temperature Gauge	JDG282	Used to measure hydraulic oil temperature.

Procedure

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

2. Install JDG282 Temperature Gauge on hydraulic oil filter assembly or triple pump assembly.

3. Start and run engine at FAST idle.

NOTE: Periodically cycle all hydraulic functions to distribute heated oil.

4. Run engine until oil temperature reaches specification (reservoir warm to the touch).

Specifications

Hydraulic Oil Operating Temperature . . . . 49°C (120°F)

Hydraulic System Bleeding Procedure

Reason

To ensure that air is purged from the hydraulic system after the hydraulic hoses/lines have been disconnected.

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Check level of hydraulic oil. Fill as needed.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

3. Start engine and run at SLOW idle.
4. Turn steering wheel full left and hold for five seconds.
5. Turn steering wheel straight forward and hold for ten seconds.
6. Turn steering wheel full right and hold for five seconds.
7. Cycle the mower decks up and down ten times.
8. Return steering wheel to the straight forward position.
9. Drive machine forward approximately 20 feet, then make two hard left turns, and then make two hard right turns.
10. Drive machine in reverse approximately 10 feet.
11. Turn key switch to STOP position.
12. Check all hoses and connections for leaks. Tighten connections and/or replace hoses as needed.
13. Check oil level at sight tube on hydraulic reservoir. Add oil as needed.

System Charge Relief Valve Pressure Test

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

Reason

To verify proper function of the system charge relief valve.

Special or Required Tools

Tool Name	Tool No.	Tool Use
13/16-16 (-8) F ORFS Sw x 13/16-16 (-8) M ORFS x 13/16-16 (-8) M ORFS Tee	38H1031	Used to adapt hose.
7/16-20 M 37° x 13/16-16 (-8) F ORFS Sw	JT03457	Used to adapt hose.
2000 kPa (300 psi) Pressure Gauge with Male Quick Coupler	JT05474	Used to measure pressure.
Hose with Female Quick Coupler	JT03017	Used to connect pressure gauge to machine.

Test Conditions

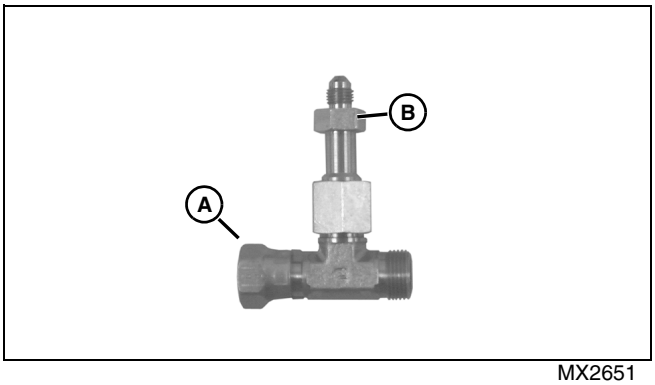
- Operator on seat
- Hydraulic oil at operating temperature
- Mower decks lowered to ground
- Engine at SLOW idle
- PTO switch OFF

Procedure

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

2. Turn key switch to OFF position.

NOTE: Thoroughly clean area around all hydraulic test connection points to eliminate possibility of contaminating internal parts during disassembly.

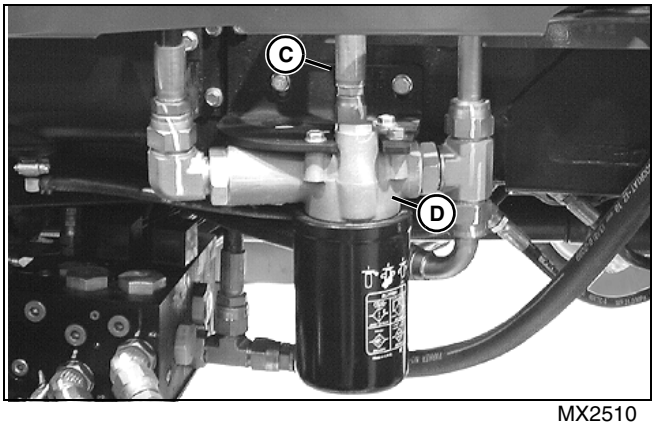


MX2651

3. Assemble fittings 38H1031 (A) and JT03457 (B) as shown.

4. Connect hydraulic test hose/gauge to fitting assembly from step 3.

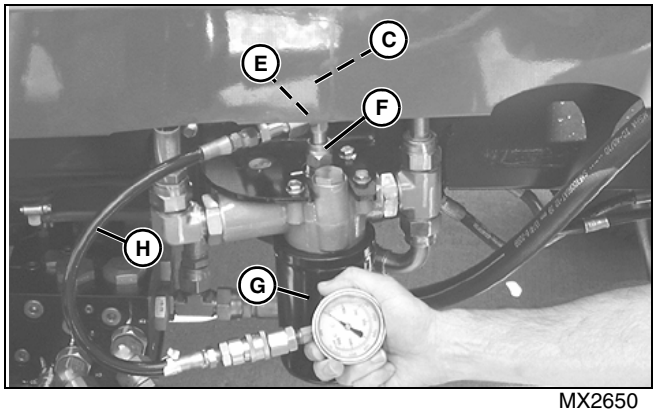
NOTE: Work quickly when disconnecting hoses and connecting the test fittings to reduce oil loss.



MX2510

Picture Note: Models 1600/1620 Shown

5. Disconnect charge pressure hose (C) from charge port on oil filter housing (D).



MX2650

Picture Note: Models 1600/1620 Shown

6. Connect JT05474 Pressure Gauge (G), JT03017 Hose (H), and fitting assembly (E) to charge port (F) on top of oil filter housing, and connect machine charge pressure hose (C) to top of fitting assembly.

7. Tighten all fittings.

8. Start engine and run at FAST idle.

9. Bring hydraulic oil to operating temperature.

10. Check gauge reading and record results.

11. Reduce engine to SLOW idle.

12. Check gauge reading and record results.

Results

- At SLOW idle, gauge should read to specification.
- At FAST idle, gauge should read to specification.
- If specifications are not met, replace oil filter head.

Specifications

System Charge Relief Valve Pressure:

At SLOW Idle. . . . . 1034 ± 103 kPa (150 ± 30 psi)
At FAST Idle . . . . . 1379 ± 134 kPa (200 ± 50 psi)

Steering Pump Flow Test

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

CAUTION: Avoid injury! Help prevent serious injury. Use caution when performing this service procedure. Keep hands, feet and clothing away from rotating blades, pulleys and other components.

NOTE: Two persons are required to perform this test.

Reason

To verify proper steering pump flow.

Special or Required Tools

Tool Name	Tool No.	Tool Use
In-Line Hydraulic Tester	D01169AA	Used to test system flow.
1-1/16-12 37° F Flare Sw x 3/4 F NPT	JT03012	Used to adapt hoses.
13/16-16 (-8) M-ORFS x 1/2 M NPT	JT03367	Used to adapt hoses.
1/2 F NPT x 3/4 F NPT	JT03369	Used to adapt hoses.
11/16-16 (-6) F ORFS Sw x 1-1/16-12 37° M Flare	JT05687	Used to adapt hoses.
11/16-16 (-6) F ORFS Sw x 11/16-16 (-6) M ORFS 90° Elbow	38H1094	Used to adapt hoses.
13/16-16 (-8) F ORFS Sw x 11/16-16 (H6) M ORFS	38H1481	Used to adapt hoses.
3/4 M NPT x 3/4 M NPT Hydraulic Test Hose (2 used)	JT03377	Used to connect tester to machine.

Test Conditions

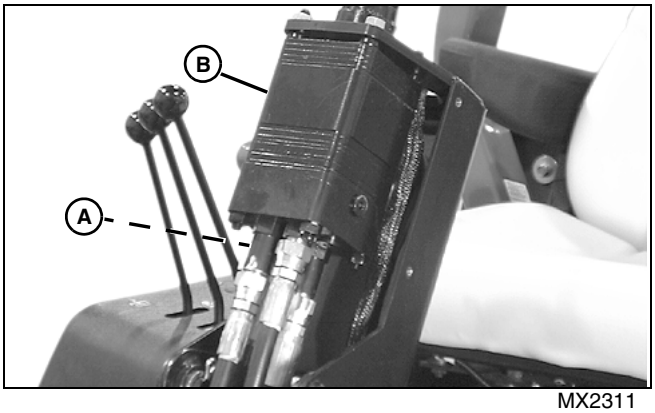
- Operator on seat
- Second person to operate in-line hydraulic tester
- Hydraulic oil at operating temperature
- Mower decks lowered to ground
- Engine at FAST idle

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Lower mower decks to ground.
3. Turn key switch to STOP position.

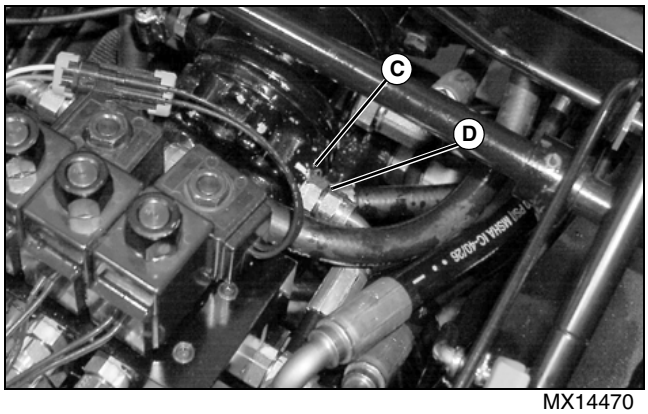
NOTE: Thoroughly clean area around all hydraulic test connection points to eliminate possibility of contaminating internal parts during disassembly.

4. Remove steering wheel.
5. Remove steering column covers.



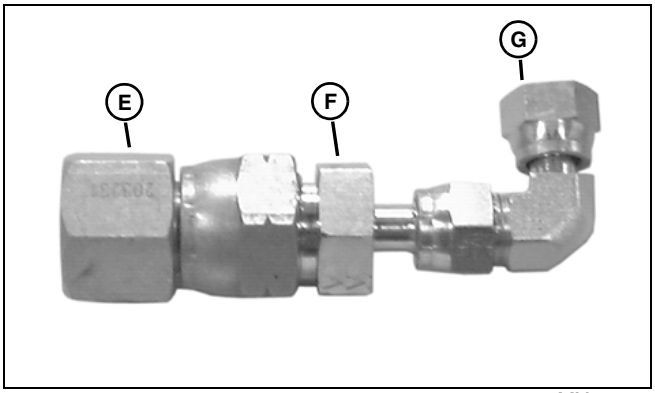
MX2311

6. **On Models 1600/1620:** Disconnect pressure hose (A) from steering valve (B).



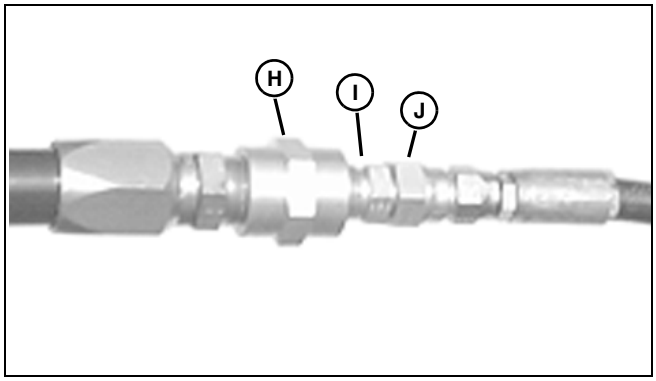
MX14470

7. **On Model 1600 Turbo:** Disconnect pressure hose (D) from steering pump (C).



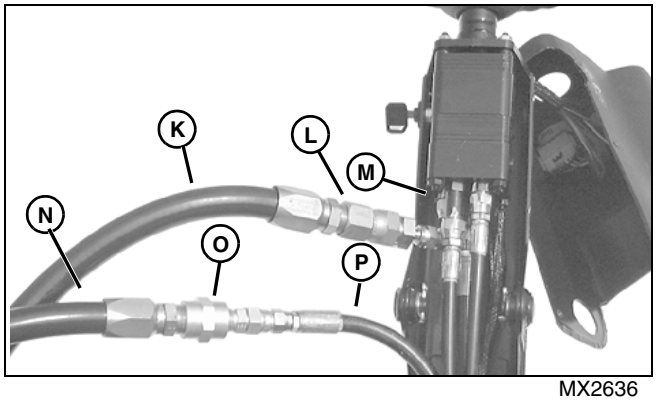
MX2639

8. Assemble JT03012 (E), JT05687 (F), and 38H1094 (G) fittings as shown.



MX2644

9. Assemble JT03369 (H), JT03367 (I), and 38H1481 (J) fittings as shown.

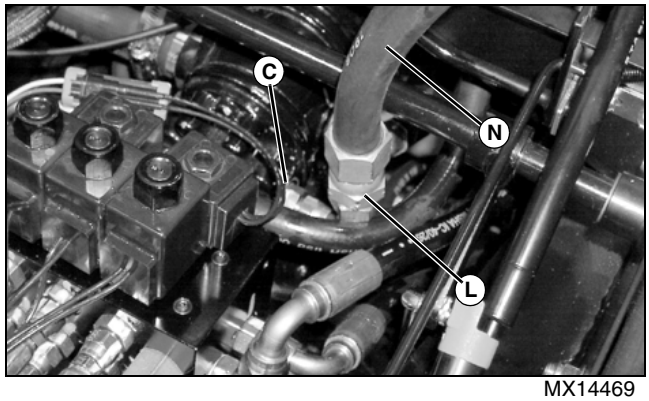


MX2636

10. **On Models 1600/1620:**

a. Connect first JT03377 Hydraulic Test Hose (K) and fitting assembly (L) to IN port (M) of steering valve.

b. Connect second JT03377 Hydraulic Test Hose (N) and fitting assembly (O) to machine pressure hose (P).

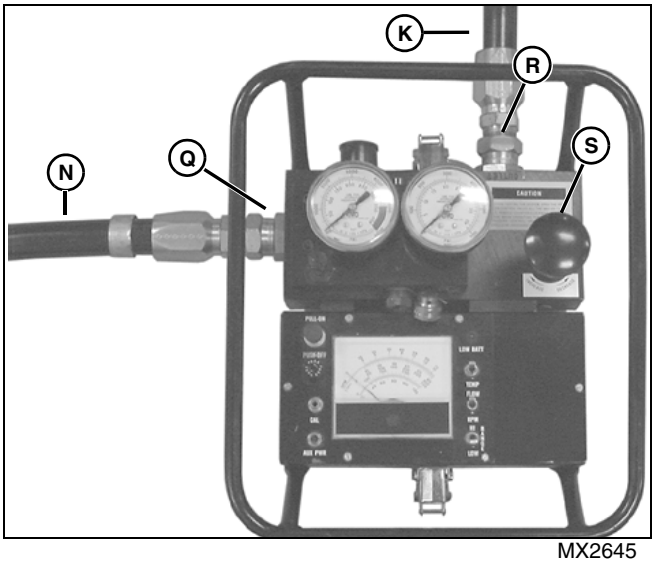


MX14469

11. **On Model 1600 Turbo:**

a. Connect first JT03377 Hydraulic Test Hose (K) and straight fitting assembly to pressure hose (D).

b. Connect second JT03377 Hydraulic Test Hose (N) and fitting assembly (L) to steering pump (C).



MX2645

12.Connect hydraulic test hose (N) to INLET (Q) of D01169AA In-Line Hydraulic Tester.

13.Connect hydraulic test hose (K) to OUTLET (R) of D01169AA In-Line Hydraulic Tester.

14.Tighten all fittings.

IMPORTANT: Avoid damage! Turn load valve (S) counterclockwise to fully decrease load on hydraulic tester before starting warm-up procedure.

15.Bring hydraulic oil to operating temperature.

16.Perform bleed procedures to remove air from hydraulic system.

17.Run engine at FAST idle.

NOTE: DO NOT turn steering wheel during testing.

18.Increase load on in-line hydraulic tester to 13 790 kPa (2000 psi) and record test results.

IMPORTANT: Avoid damage! DO NOT exceed 13 790 kPa (2000 psi) or pump damage may result.

19.Decrease load completely on in-line hydraulic tester.

Results

If test is not within specification, rebuild or replace steering/ lift pump.

Specifications

Steering Flow at 13 790 kPa (2000 psi):

Models 1600/1600 Turbo . . . . . 20.1 L/min (4.5 gpm)
Model 1620 . . . . . 15.0 L/min (4.0 gpm)

Lift Pump Pressure and Flow Test

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

CAUTION: Avoid injury! Help prevent serious injury. Use caution when performing this service procedure. Keep hands, feet and clothing away from rotating blades, pulleys and other components.

NOTE: Two persons are required to perform this test.

Reason

To verify proper charge pressure and flow of hydraulic oil in the lift system.

Special or Required Tools

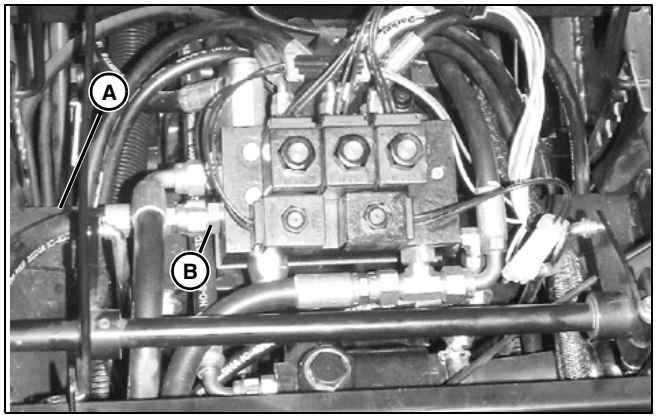
Tool Name	Tool No.	Tool Use
In-Line Hydraulic Tester	D01169AA	Used to test system flow.
13/16-16 (-8) M ORFS x 1/2 M NPT	JT03367	Used to adapt hoses.
3/4 F NPT x 13/16-16 (-8) F ORFS Sw 45° Elbow	JT03368	Used to adapt hoses.
1/2 F NPT x 3/4 F NPT	JT03369	Used to adapt hoses.
13/16-16 (-8) F ORFS Sw x 13/16-16 (-8) M ORFS 90° Elbow	38H1095	Used to adapt hoses.
3/4 M NPT x 3/4 M NPT Hydraulic Test Hose (2 used)	JT03377	Used to connect tester to machine.

Test Conditions

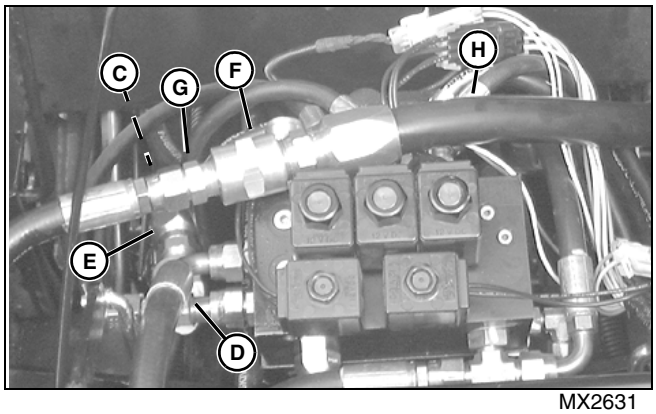
- Operator in seat
- Second person to operate in-line hydraulic tester.
- Hydraulic oil at operating temperature
- Mower decks lowered to ground
- Engine at FAST idle

Procedure

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Lower mower decks to ground.
3. Turn key switch to STOP position.
4. Tilt seat forward to gain access to the deck lift control valve.

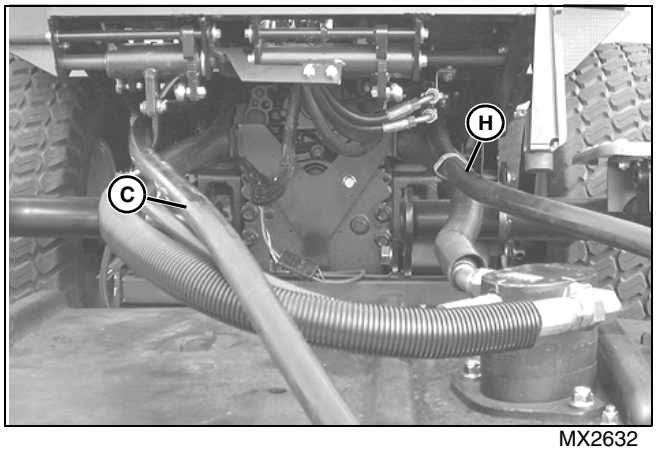


5. Disconnect pressure hose (A) from port P of deck lift control valve, leaving male fitting (B) in deck lift control valve.



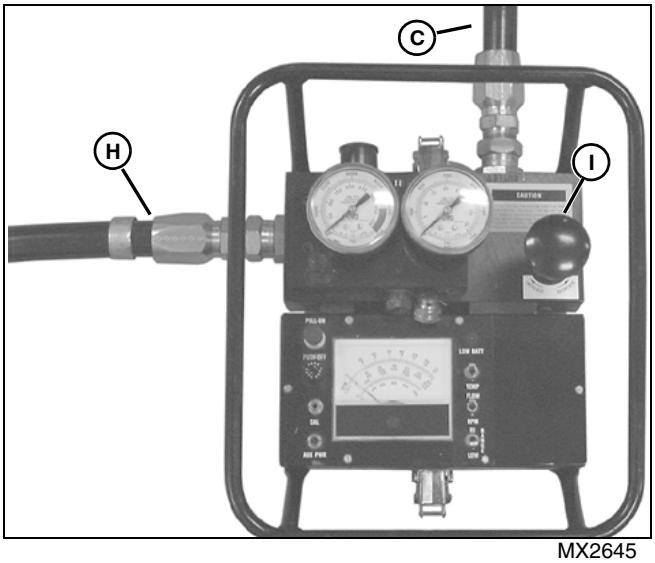
MX2631

6. Connect first JT03377 Hydraulic Test Hose (C) with fittings 38H1095 (D) and JT03368 (E) and route hose from deck lift control valve out through left front of machine and tighten connections.
7. Assemble fittings JT03367 (G), JT03369 (F), and second JT03377 Hydraulic Test Hose (H) to machine pressure hose (A).



MX2632

8. Route hydraulic test hose (C) from right side of machine.
9. Route hydraulic test hose (H) from left side of machine.



MX2645

10.Connect hydraulic test hose (C) to INLET of D01169AA In-Line Hydraulic Tester.

11.Connect hydraulic test hose (H) to OUTLET of D01169AA In-Line Hydraulic Tester.

12.Tighten all fittings.

IMPORTANT: Avoid damage! Turn load valve (I) counterclockwise to fully decrease load on hydraulic tester before starting warm-up procedure.

13.Bring hydraulic oil to operating temperature.

14.Perform bleed procedures to remove air from hydraulic system.

15.Run engine at FAST idle.

16.Have second person operate in-line hydraulic tester.

IMPORTANT: Avoid damage! DO NOT exceed 13 790 kPa (2000 psi) or pump damage may result.

17.Raise front mow deck. Record flow and pressure indicated on in-line hydraulic tester.

18.Raise left and right mower decks. Record flow and pressure indicated on in-line hydraulic tester while raising each left and right deck separately.

Results

If tests are not within specification, rebuild or replace steering/lift pump.

Specifications

Lift Pump Flow (Min) at 13 790 kPa (2000 psi):

Models 1600/1600 Turbo . . . . . 25.0 L/min (6.0 gpm)
Model 1620 . . . . . 23.0 L/min (6.0 gpm)

Mower Deck Drive Pump Test

Reason

To determine if the mower deck drive pump is producing the correct amount of flow to operate deck motors.

Special or Required Tools

Tool Name	Tool No.	Tool Use
In-Line Hydraulic Tester	D01169AA	Used to test system flow.
3/4 F NPT x 1-1/16 (-12) F 37° Flare	JT03012	Used to adapt hoses.
1-3/16-12 (-12) F ORFS Sw x 1-1/16-12 37° M Flare Connector (2 used)	JT05690	Used to adapt hoses.
1-1/16-12 37° F Flare Sw x 3/4 F NPT Connector	JT05687	Used to adapt hoses.
1-3/16-12 (-12) M ORFS x 1-3/16-12 (-12) M ORFS Union	38H1272	Used to adapt hoses.
3/4 M NPT x 3/4 M NPT Hydraulic Test Hose (2 used)	JT03377	Used to connect tester to machine.

Test Conditions

- Operator in seat
- Second person to operate hydraulic tester
- Hydraulic oil at operating temperature
- Mower decks lowered to ground
- PTO switch ON
- Mowers running
- Engine at FAST idle

Procedure

NOTE: Two persons are required to perform this test.

CAUTION: Avoid injury! Help prevent serious injury. Use caution when performing this service procedure. Keep hands, feet and clothing away from rotating blades, pulleys and other components.

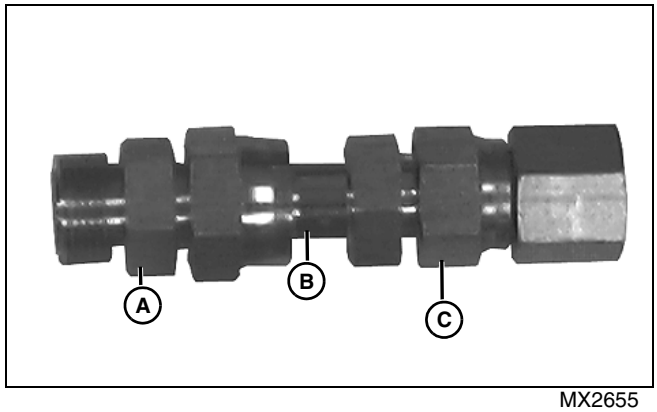
CAUTION: Avoid injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

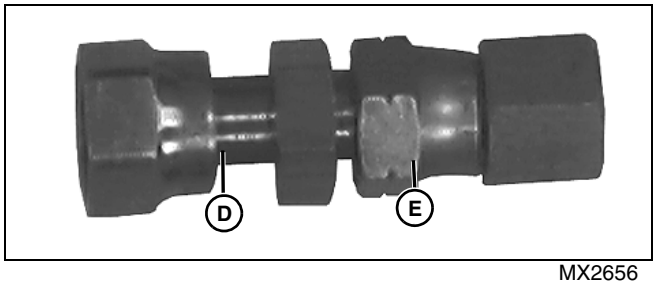
Always try to work in a well-ventilated area.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise left and right mower decks and lock.
3. Turn key switch to OFF position.



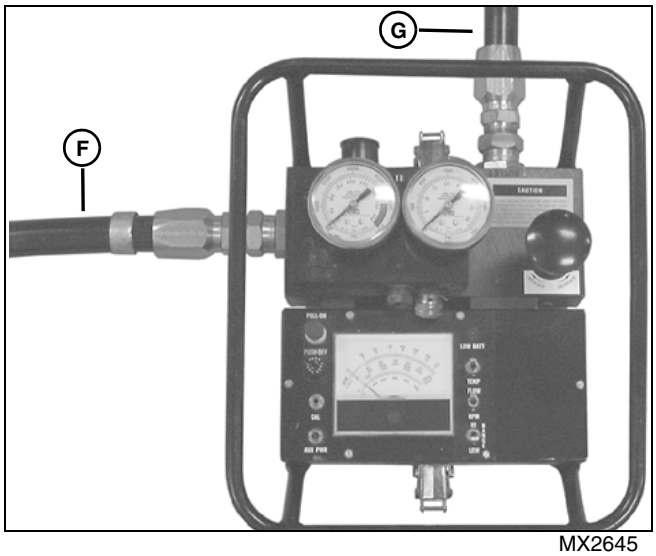
MX2655

4. Assemble fittings 38H1272 (A), JT05690 (B), and JT03012 (C).



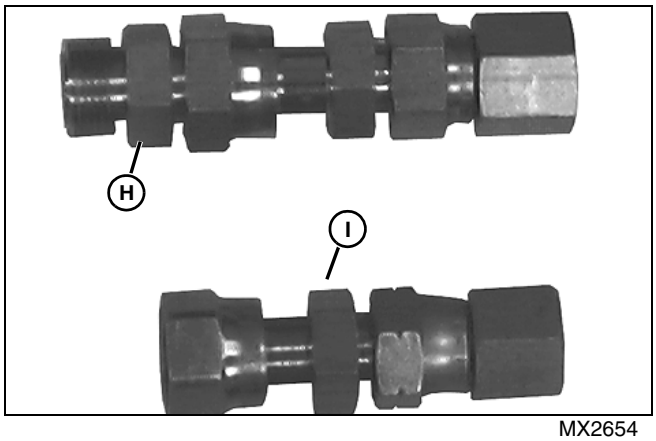
MX2656

5. Assemble fittings JT05687 (D) and JT05690 (E).



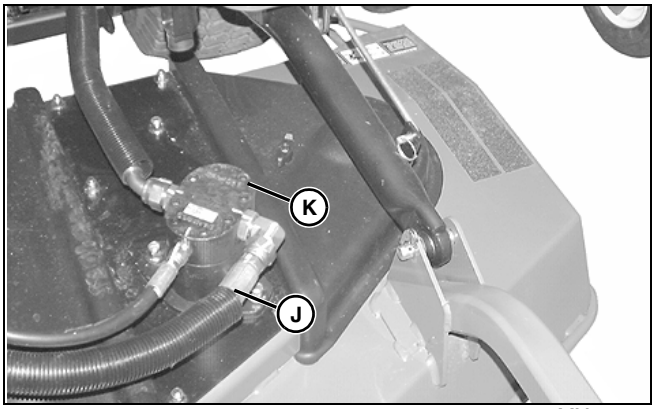
MX2645

6. Connect JT03377 Hydraulic Test Hose (F) to INLET, and JT03377 Hydraulic Test Hose (G) to OUTLET of D01169AA In-Line Hydraulic Tester.



MX2654

7. Connect fitting assembly (H) to end of hydraulic test hose (F).
8. Connect fitting assembly (I) to hydraulic test hose (G).



MX2331

9. Disconnect hydraulic hose (J) from inlet of mower deck motor (K).

10.Connect first hydraulic test hose with fitting assembly (I) to inlet fitting of mower deck motor.

11.Connect second hydraulic test hose with fitting assembly (H) to hydraulic hose (J).

12.Tighten all fittings.

IMPORTANT: Avoid damage! Turn load valve counterclockwise to fully decrease load on hydraulic tester before starting warm-up procedure.

13.Bring hydraulic oil to operating temperature.

14.Run engine at FAST idle.

15.Have second person adjust load knob on in-line hydraulic tester to 6895 kPa (1000 psi). Check meter and record test results.

16.Check engine rpm at fast idle. Record results.

17.Multiply the gallons per minute in by 231, and divide the product by the engine speed to determine displacement “A”.

18.Adjust load valve on in-line hydraulic tester to 13 790 kPa (2000 psi). Check meter and record test results.

19.Check engine rpm at fast idle. Record results.

20.Multiply the gallons per minute in by 231, and divide the product by the engine speed to determine displacement “B”.

21.Divide displacement “A” by displacement “B”. This will give you the ratio of volumetric efficiency of the pump which should be NO LESS than specification.

Example

Results ”A” at 1000 psi:

- 21 gpm Pump Flow
- 3100 rpm Engine Speed

Results ”B” at 1000 psi:

- 19 gpm Pump Flow
- 3000 rpm Engine Speed

A

$$\frac{\text{Pump Output “A” x 231}}{\text{Engine Speed}} = \text{Displacement “A”}$$

$$\frac{21 \times 231}{3100} = 1.56$$

B

$$\frac{\text{Pump Output “B” x 231}}{\text{Engine Speed}} = \text{Displacement “B”}$$

$$\frac{19 \times 231}{3000} = 1.46$$

C—Efficiency Calculation

$$\frac{\text{Displacement “B”}}{\text{Displacement “A”}} = 0.80 \text{ or Higher}$$

$$\frac{1.46}{1.56} = 0.94\ (94\%)$$

MIF

Results

- Volumetric efficiency should be NO LESS than specification.
- If specifications are not met, clean, check and/or replace mower deck drive relief valve and repeat test.
- If specifications are still not met, rebuild or replace pump.

Specifications

Mower Deck Drive Pump
Volumetric Efficiency (Min) 0.80 (80%)

Mower Deck Motor Case Drain Test

Reason

To determine if there is excessive wear or leakage in the mower deck motor.

Special or Required Tools

Tool Name	Tool No.	Tool Use
11/16-16 (-6) F ORFS Sw x 1-1/16-12 37° M Flare	JT05687	Used to adapt hose.
1-1/16-12 37° F Flare Sw x 1/2 F NPT	JT03070	Used to adapt hose.
1/2 M NPT x 1/2 Hose Adapter	JT03212	Used to adapt hose.
13 mm (1/2-in.) Inside Diameter Hose with Clamp (Approximately 610 mm [2 ft] long)	NA	Used to drain oil.
11/16-16 (-6) M ORFS Plug	38H1146	Used to plug hose.
Graduated Container, Minimum 7.6 L (2 gal) Capacity	NA	Used to collect oil.

Procedure

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

Always try to work in a well-ventilated area.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Check the hydraulic oil reservoir and fill as necessary.
3. Bring the hydraulic oil to operating temperature.

IMPORTANT: Avoid damage! When performing this test on the front mower deck motor, raise both left and right mower decks and latch to prevent them from operating.

When performing this test on a left and right mower deck motor, operate the front mower deck and only the left and right mower deck being tested. Raise the other left and right mower deck and latch to prevent it from operating.

NOTE: To operate left and right mower decks, the front mower deck must be lowered and operating.

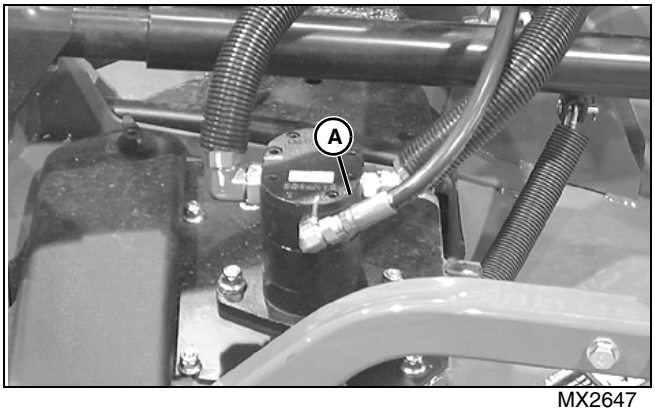
4. If testing the front mower deck motor, lower the front mower deck completely and raise both left and right mower decks completely and latch the lift arms.

If testing a left and right mower deck motor, lower the front mower deck and only the left and right mower deck to be tested completely and raise the other left and right mower deck completely and latch the lift arms.

IMPORTANT: Avoid damage! DO NOT allow oil to get on the mower deck drive belt.

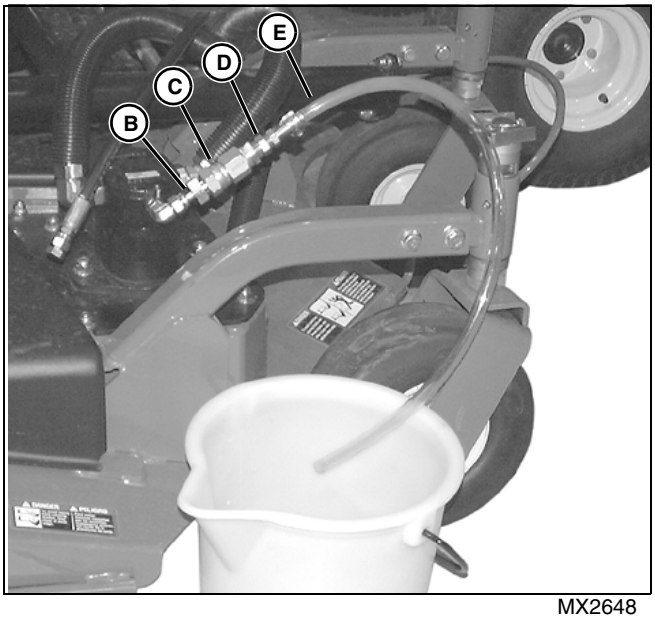
Clean the area around the hoses before disconnecting.

NOTE: Work quickly when disconnecting hoses and connecting the test fittings to reduce oil loss.



MX2647

5. Disconnect hose (A) from mower deck motor and install 38H1146 Plug on hose.



MX2648

6. Connect JT05687 (B), JT03070 (C), and JT03212 (D) fittings to fitting on the mower deck motor.

7. Connect 13 mm (1/2 in.) hose (E) to the end of JT03212 (D) fitting and put the other end of the hose into a clean graduated container that can hold at least 7.6 L (2 gal).

8. Operate engine at FAST idle and engage the PTO for one minute, then disengage PTO.

9. Record the amount of case drain oil that has flowed from the mower deck motor into the graduated container.

IMPORTANT: Avoid damage! Check the level of the hydraulic oil in the reservoir each time before repeating this test. Use clean oil to replace oil used during the test.

10.Replace the hydraulic reservoir oil used during the test and repeat steps 8 and 9 two more times.

11.Add the three measurements and divide by three to obtain the average amount of case drain oil and record the average amount.

12.Repeat steps 4-11 for the remaining mower deck motors to be tested.

Results

- The maximum amount of case drain oil from the mower deck motor in one minute should be to specification.
- If the amount is more than specified, repair or replace mower deck motor.

Specifications

Mower Deck Motor Case Drain (Max) . . . . . 1.9 L/min (0.5 gpm)

Lift Pressure Relief Valve Test

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

Reason

To verify proper function of the lift pressure relief valve.

Special or Required Tools

Tool Name	Tool No.	Tool Use
13/16-16 (-8) F ORFS SW x 13/16-16 (-8) M ORFS x 13/16-16 (-8) M ORFS Tee (2 used)	38H1031	Used to adapt hose.
13/16-16 (-8) F ORFS Sw x 13/16-16 (-8) M ORFS 90° Elbow	38H1095	Used to adapt hose.
13/16-16 (-8) F ORFS Sw x 7/16-20 M 37° Flare Connector (2 used)	JT03457	Used to adapt hose.
Hose with Female Quick Coupler (2 used)	JT03017	Used to connect pressure gauge to machine.

Special or Required Tools

Tool Name	Tool No.	Tool Use
20 000 kPa (3000 psi) Pressure Gauge with Male Quick Coupler	JT03345	Used to measure pressure.
7000 kPa (1000 psi) Pressure Gauge with Male Quick Coupler	JT05471	Used to measure pressure.

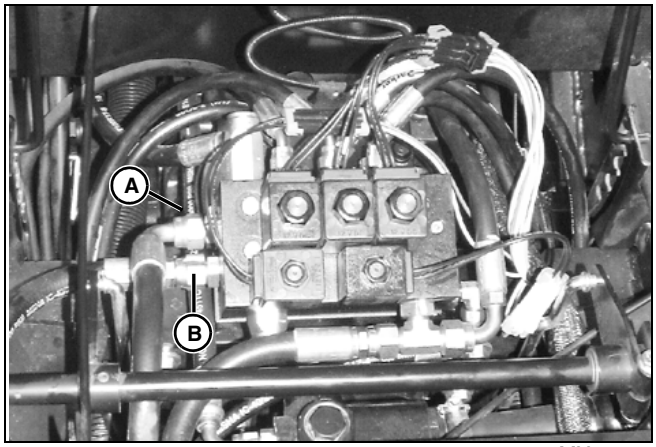
Test Conditions

- Operator in seat
- Hydraulic oil at operating temperature
- Mower decks lowered to ground
- Engine at FAST idle
- PTO switch OFF

Procedure

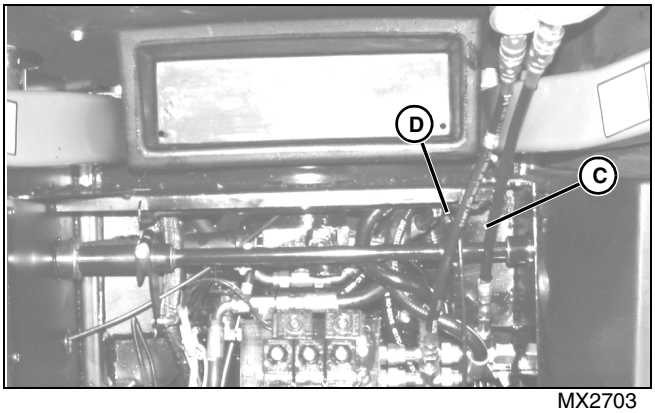
1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Lower mower decks to ground.
3. Turn key switch to STOP position.
4. Tilt seat forward to access deck lift control valve.

NOTE: Models 1600/1620 shown. 1600 Turbo model is similar.



MX2501

5. Disconnect charge pressure hose (A) and pressure port hose (B) from deck lift control valve.



MX2703

6. Assemble 38H1031 Tee Fitting, 38H1095 Elbow, JT03457 Flare Connector, JT03017 Hose, and JT05471 7000 kPa (1000 psi) Pressure Gauge to make assembly (C).

7. Install gauge assembly into PRESSURE port of deck lift control valve.

8. Assemble 38H1031 Tee Fitting, JT03457 Flare Connector, JT03017 Hose, and JT03345 20 000 kPa (3000 psi) Pressure Gauge to make assembly (D).

9. Install gauge assembly into CHARGE port of deck lift control valve.

10.Tighten all fittings.

11.Bring hydraulic oil to operating temperature.

12.Bring engine to FAST idle.

13.Lift front mower deck and hold lift lever in the RAISE position.

14.Monitor readings of both test gauges while holding raise lever to bypass and record results.

15.Subtract reading of CHARGE port gauge from PRESSURE port gauge to determine relief valve opening pressure. Compare to specification.

Results

If not within specification, replace relief valve cartridge.

Specifications

Lift Relief Valve Pressure. . . . . 11 032 kPa (1600 psi)

Spindle Speed Check and Adjustments

CAUTION: Avoid injury! •Use caution when performing this service procedure. Keep hands, feet and clothing away from rotating blades, pulleys and other components.

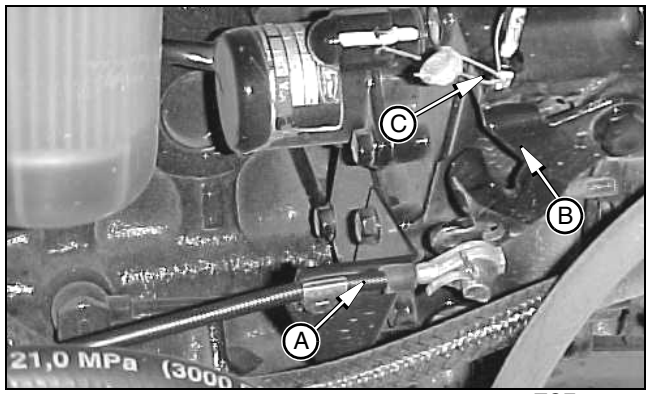
- **Engine fumes can cause sickness or death.**
- **If it is necessary to run an engine in an enclosed area, use an exhaust pip extension to remove the fumes**

IMPORTANT: Avoid damage! This procedure must be performed with hydraulic oil at operating temperature.

Prepare Machine

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

2. Move throttle lever to FAST idle position.



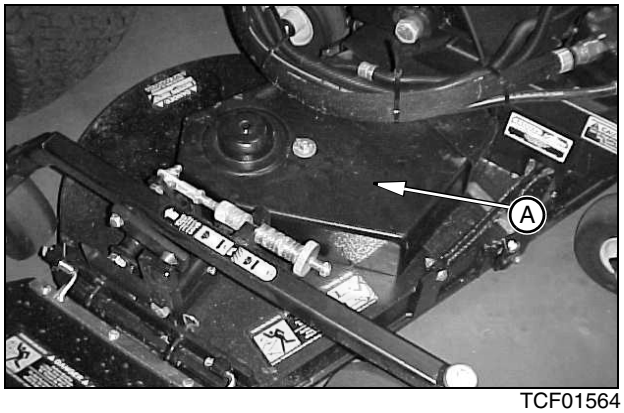
TCF01591

3. Open hood. Verify proper cable travel. Cable (A) must bring throttle lever (B) to rest against fast idle stop (C). Use finger to check if lever is against stop. Adjust cable as necessary.

Spindle Speed Check

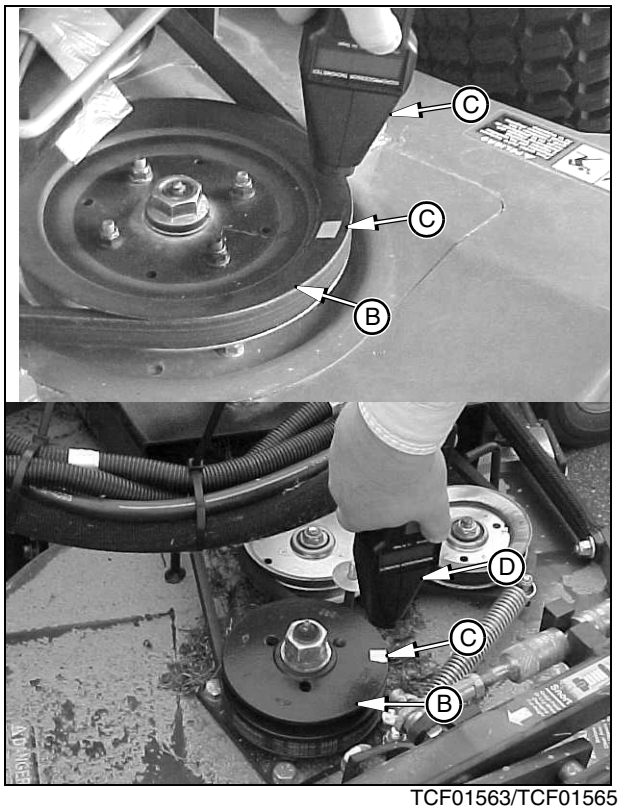
NOTE: Two people are required to perform this check and adjustments.

1. **Models 1600/1600 Turbo only:** Remove left drive belt shield from front mower deck.



TCF01564

2. **Model 1620 only:** Remove right side mower deck belt shield (A).



TCF01563/TCF01565

Picture Note: Upper Photo Shows Model 1600; Lower Photo Shows Model 1620

3. Paint sheave (B) with black paint if necessary, to eliminate glare to ensure a correct tachometer reading. After paint is dry, install strip of reflective tape (C) on outer edge of pulley.

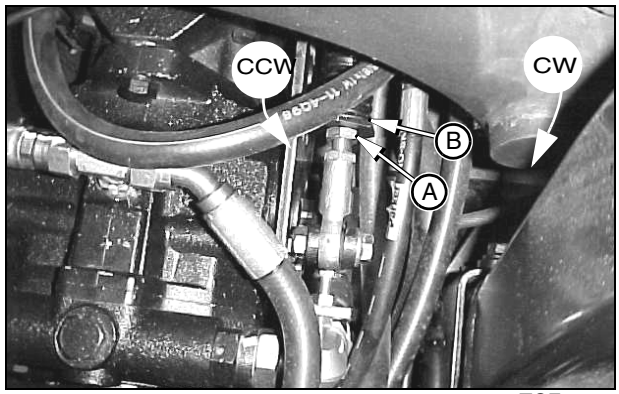
4. Run machine with mower deck engaged to bring hydraulic system oil to operating temperature of 49°C (120°F).

5. Run engine at FAST idle.

6. Have second person take a reading of spindle speed with tachometer (D). If not within following specification, proceed to Adjustment Procedure.

- Models 1600/1600 Turbo - 2200 ± 50 rpm
- Model 1620 - 2500 ± 50 rpm

Adjustment Procedure



TCF01566

1. Loosen lock nut (A) and turn large nut (B):

NOTE: One full turn of large nut can increase or decrease spindle speed as much as 100 rpm's.

- Clockwise (CW) to decrease speed.
- Counter clockwise (CCW) to increase speed.

2. Once speed is set, hold large nut and tighten jam nut against it. Hold ball joint and tighten jam nut against it. Check spindle speed again, adjust as needed.

Solenoid Valve Check

Reason

To determine if the solenoid valves are mechanically functional.

Special or Required Tools

Tool Name	Tool No.	Tool Use
12-Volt Power Supply or 12-Volt Battery	NA	Used to supply power.

Procedure

1. Park machine safely. (See "Park Machine Safely" on page 3.)

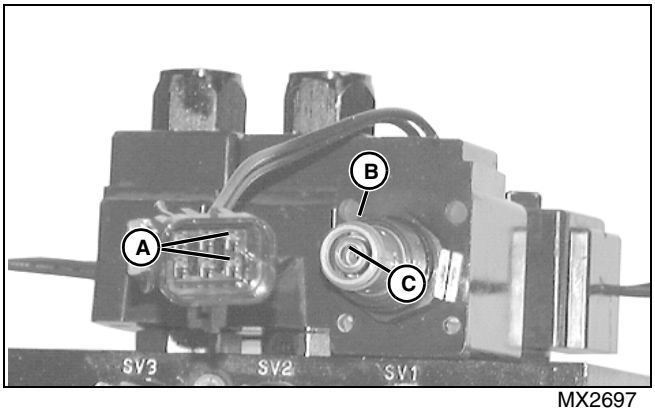
2. Disconnect solenoid connector.

IMPORTANT: Avoid damage! Mark solenoid coils to ensure correct location during installation.

3. Remove solenoid coil.

4. Remove solenoid valve from valve block.
5. Assemble solenoid valve and coil.

Lift Valve - Solenoid Valve (SV1) Check

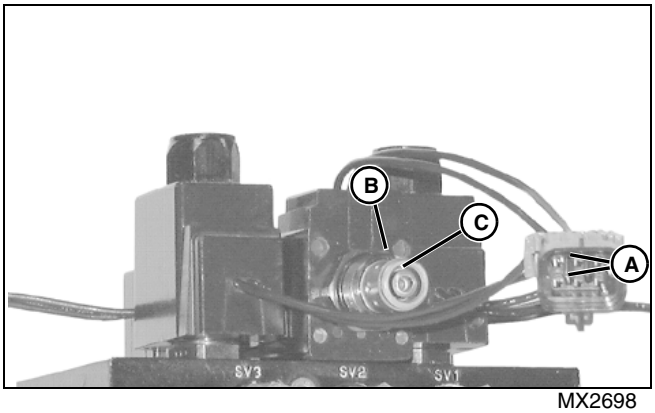


MX2697

Apply 12 volts to terminals A and F (A) of solenoid coil connector.

- Solenoid valve cartridge (B) should click when the 12-volt supply is applied and removed.
- Valve (C) should move in the cartridge when the 12-volt supply is applied and removed.

Lift Valve - Solenoid Valve (SV2) Check

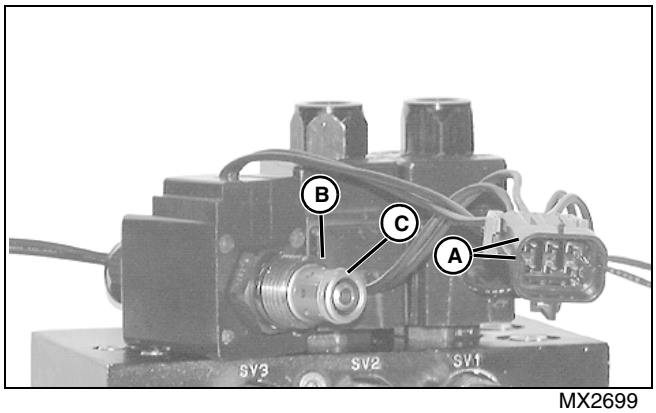


MX2698

Apply 12 volts to terminals B and E (A) of solenoid coil connector.

- Solenoid valve cartridge (B) should click when the 12-volt supply is applied and removed.
- Valve (C) should move in the cartridge when the 12-volt supply is applied and removed.

Lift Valve - Solenoid Valve (SV3) Check

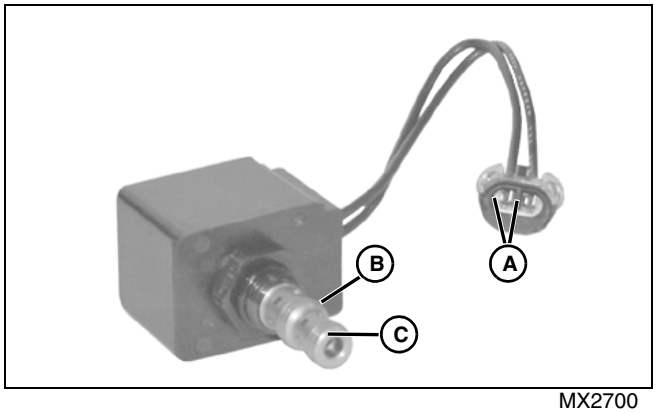


MX2699

Apply 12 volts to terminals C and D (A) of solenoid coil connector.

- Solenoid valve cartridge (B) should click when the 12-volt supply is applied and removed.
- Valve (C) should move in the cartridge when the 12-volt supply is applied and removed.

Lift Valve - Solenoid Valves (SV4 and SV5) and Mower Deck Motor Control Valve - Solenoid Valves (SV1 and SV2) Check



MX2700

NOTE: Models 1600/1620 solenoid coil with pigtail connector shown. 1600 Turbo model has connector that is part of solenoid coil.

Apply 12 volts to terminals (A) of solenoid coil connector.

- Solenoid valve cartridge (B) should click when the 12-volt supply is applied and removed.
- Valve (C) should move in the cartridge when the 12-volt supply is applied and removed.

Results

If valve cartridge does not click or valve does not move when 12 volts is applied and removed, remove any visible obstruction or replace solenoid valve cartridge.

Repair

Hydraulic Reservoir Removal and Installation

Removal

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

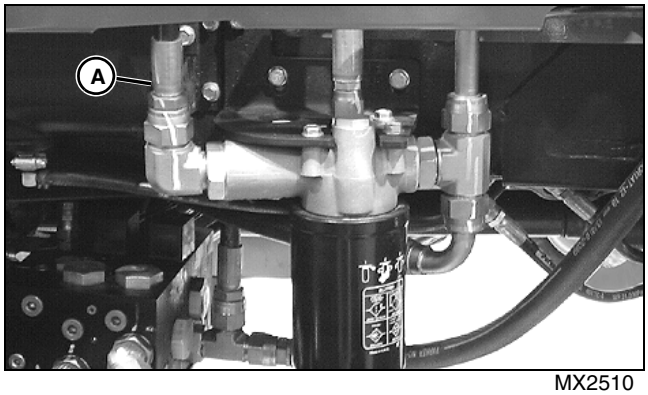
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

1. Remove bulkhead.
2. **On Models 1600/1620:**
   a. Remove battery.
   b. Remove electronic control module.

NOTE: The best method for draining the reservoir is by using a pump. If a pump is not available, see steps 4 and 5 below.

Hydraulic oil reservoir capacity is approximately 58.7 L (15.5 gal).

3. Loosen the hydraulic oil reservoir cap.

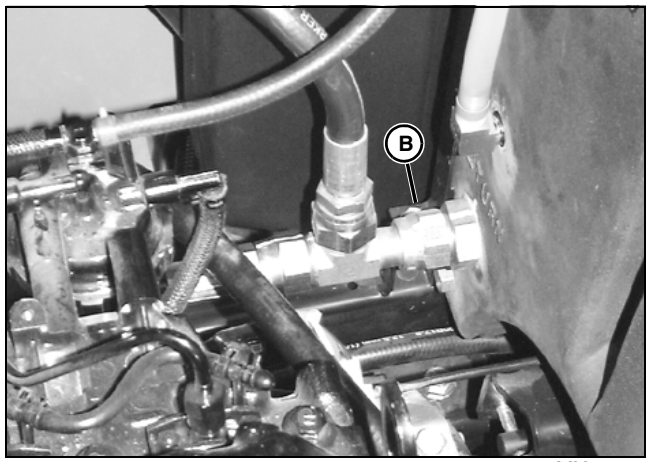


MX2510

4. Disconnect hose (A) and drain oil into a clean container.

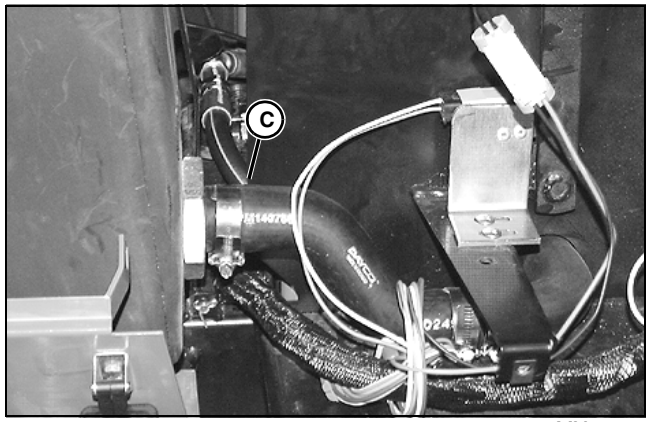
NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

A small amount of oil (approximately 3.8 L [1 gal]) will remain in the lower portion on each side of the reservoir. Place a drip pan under the machine to catch oil that will leak out when hoses are disconnected.



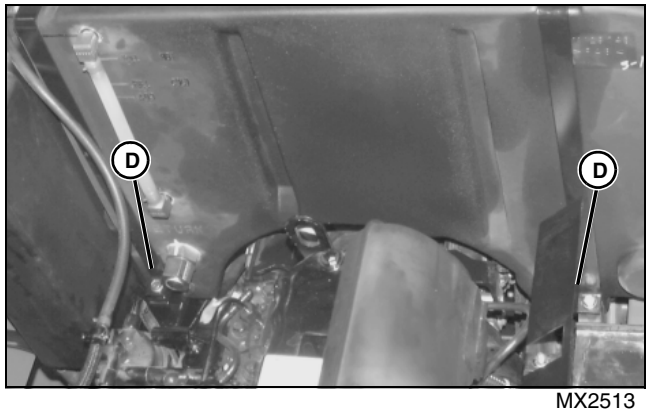
MX2511

5. Disconnect tee fitting connector (B).



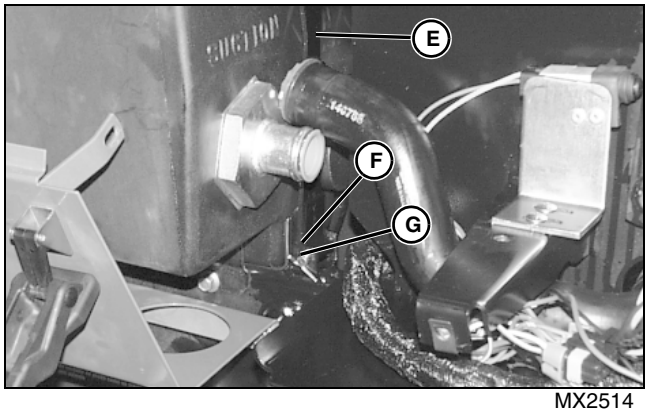
MX2512

6. Disconnect supply hose (C).



MX2513

7. Remove two cap screws and spacers (D).



MX2514

8. Remove cotter pin (F) and anchor pin (G).

9. Remove right-side retaining strap (E).

10. Remove reservoir.

11. Inspect the reservoir for wear or damage. Replace as needed.

Installation

Installation is done in the reverse order of removal.

NOTE: Hydraulic oil drained from the system in step 4 can be reused if the oil is clean and free of contamination. Use a strainer when filling reservoir.

- Fill hydraulic reservoir to correct level with oil meeting specifications.
- Check all connection for leaks. Repair as needed.
- Bleed air from hydraulic system.

Hydraulic Oil Cooler Removal and Installation - Models 1600 and 1620

Removal

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

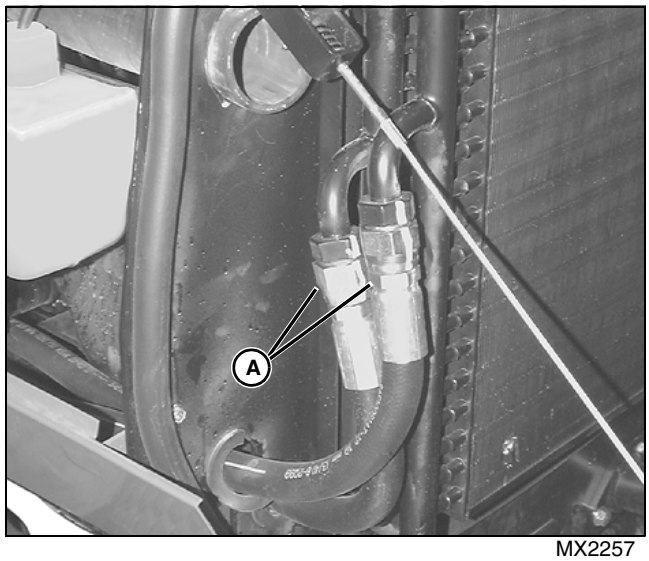
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

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

2. Raise hood.

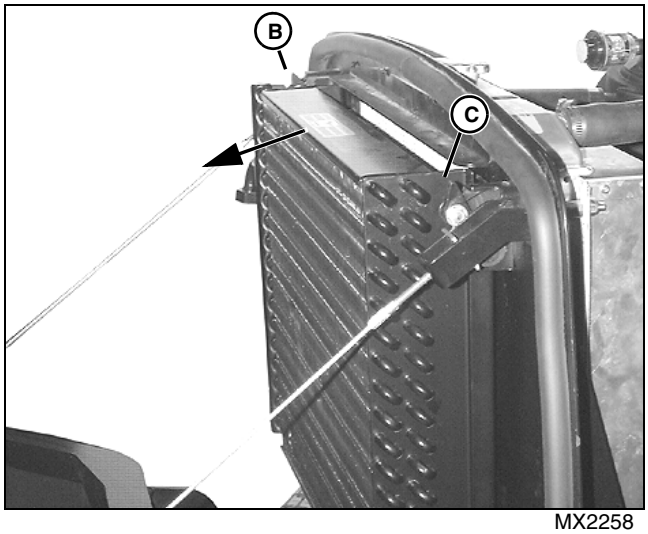
3. Turn key switch to STOP position and allow the machine to cool.

NOTE: Mark hoses to ensure correct installation.



MX2257

4. Disconnect and cap hydraulic hoses (A).



MX2258

5. Release latches (B and C).

6. Tilt the top of oil cooler toward the rear of the machine and lift the oil cooler from lower brackets.

Installation

Installation is done in the reverse order of removal.

- Fill hydraulic reservoir to correct level with oil meeting specifications.
- Check all connections for leaks. Repair as needed.
- Bleed air from hydraulic system.

Hydraulic Oil Cooler Inspection - Models 1600 and 1620

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

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

1. Check oil cooler for debris lodged in fins. Clean oil cooler using compressed air or pressure washer.

2. Inspect oil cooler for bent fins, cracks, and damaged seams. Repair or replace oil cooler if necessary.

Hydraulic Oil Cooler Removal and Installation - Model 1600 Turbo

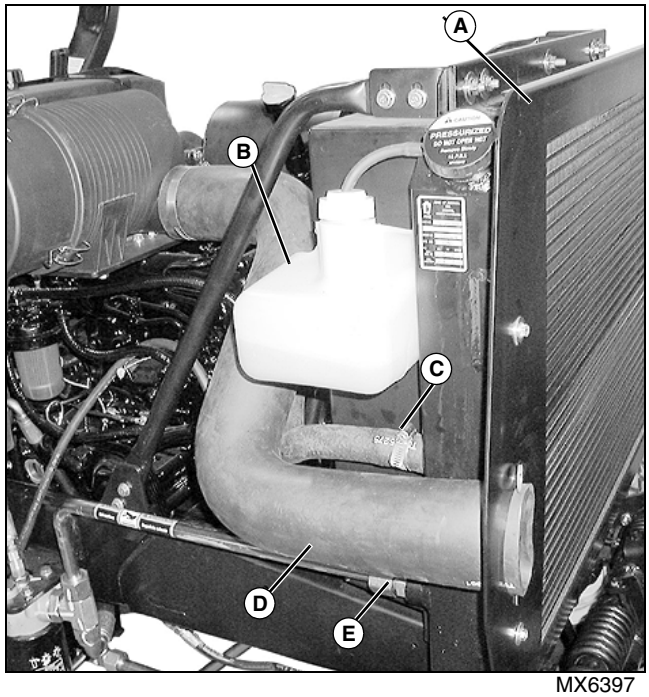
CAUTION: Avoid injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

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

2. Turn key switch to STOP position and allow machine to cool.

3. Raise hood.



MX6397

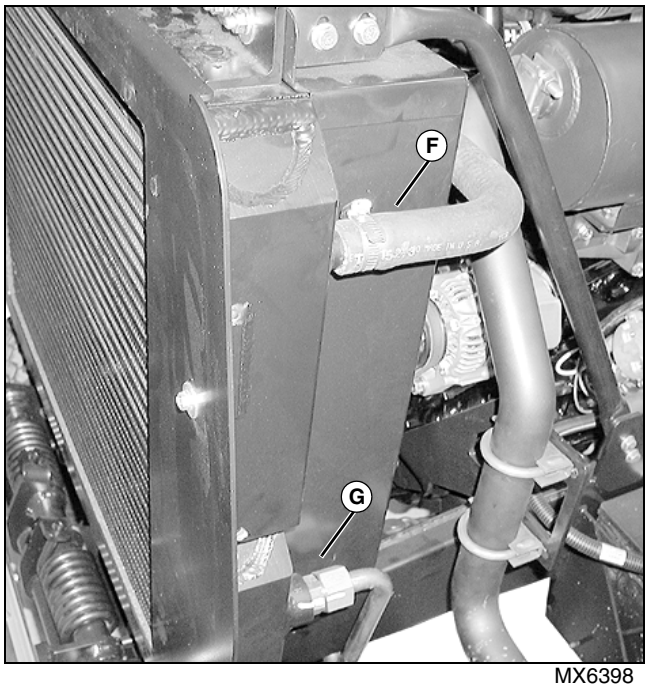
4. Disconnect air intake hose (D) from seal plate (A). Remove seal plate.

5. Unscrew cap from coolant overflow tank (B). Remove cap and hose from tank.

6. Drain engine coolant.

NOTE: Mark hoses before disconnecting to ensure correct installation. Close all openings with caps and plugs.

7. Disconnect radiator hose (C) and hydraulic line (E) on left side of cooling unit.



MX6398

8. Disconnect radiator hose (F) and hydraulic line (G) on right side of cooling unit.

9. Support cooling unit with hoist.

10. Disconnect cooling unit from fan shroud.

11. Remove cooling unit from machine.

Installation

Installation is done in the reverse order of removal.

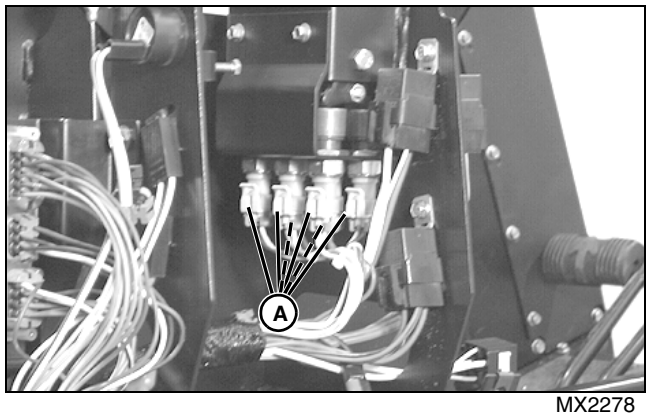
- Fill hydraulic reservoir to correct level with oil meeting specifications.
- Fill engine cooling system to correct level with coolant meeting specifications.
- Check all connections for leaks. Repair as needed.
- Bleed air from hydraulic system.

Raise and Lower Lever Assembly Removal and Installation - Early Models 1600 and 1620

Removal

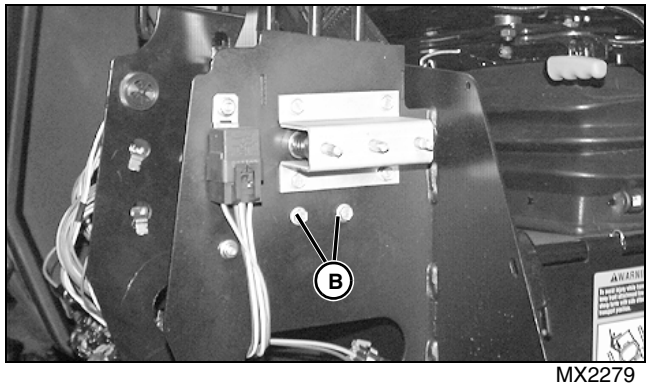
1. Remove console cover.

NOTE: Mark wiring connectors before removing to ensure correct installation.



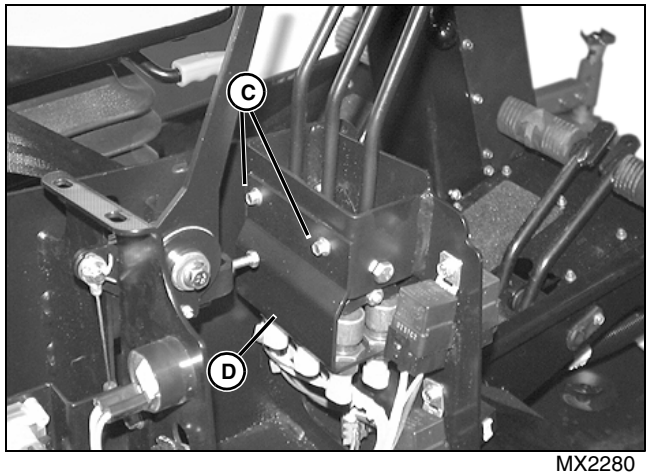
MX2278

2. Disconnect six raise/lower switch connectors (A).



MX2279

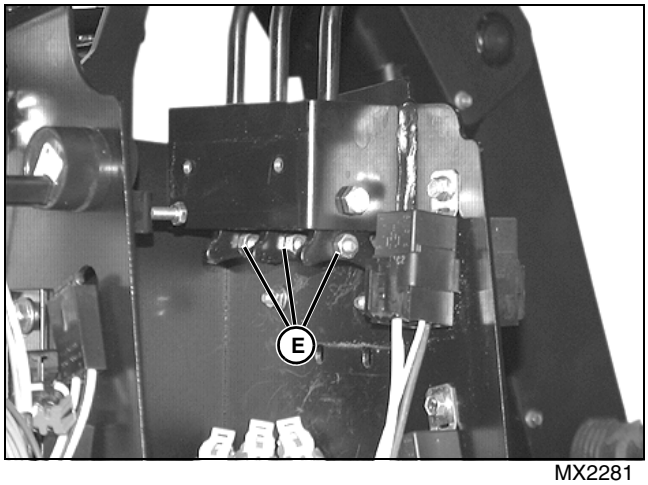
3. Remove two cap screws (B) and nuts.



MX2280

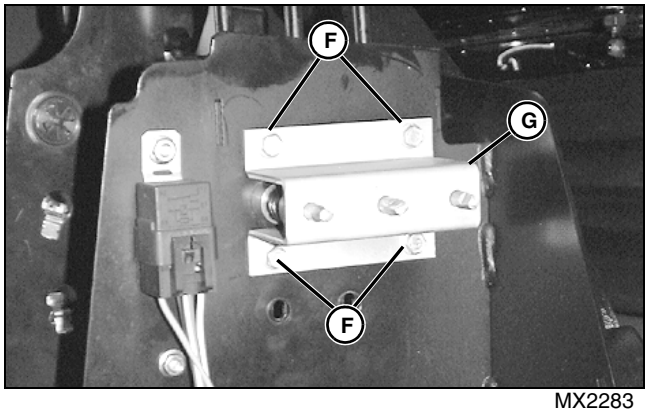
4. Remove two cap screws (C).

5. Remove switch bracket (D).



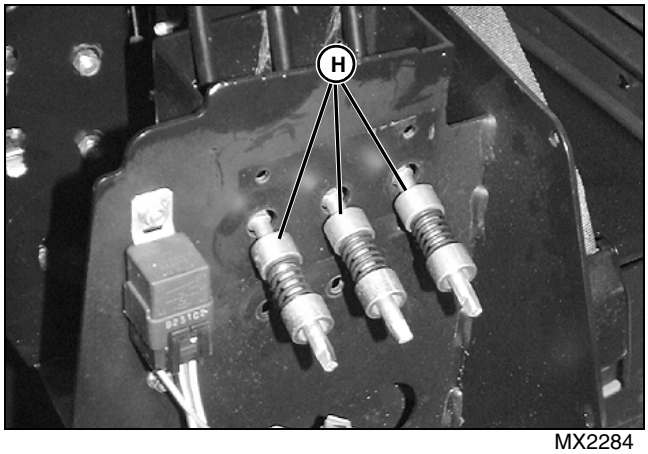
MX2281

6. Remove nuts (E) and disconnect centering linkage.



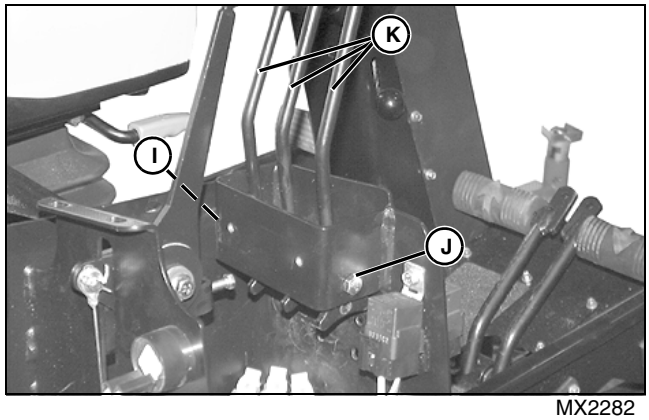
MX2283

7. Remove four cap screws and nuts (F).
8. Remove bracket (G).



MX2284

9. Remove centering spring assemblies (H).



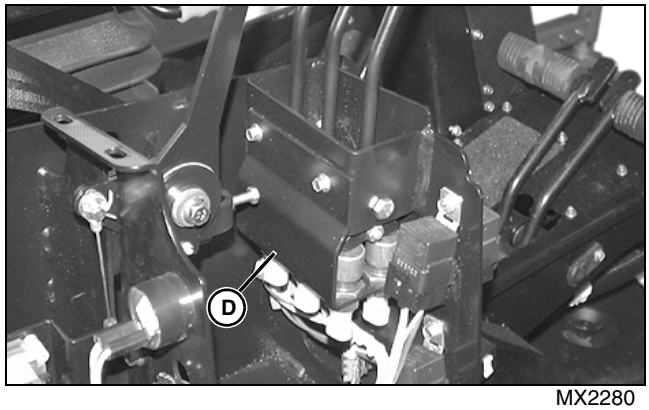
MX2282

10. Remove nut (I) and cap screw (J).
11. Remove levers (K).
12. Inspect all parts for wear or damage. Replace as needed.

Installation

Installation is done in the reverse order of removal.

- DO NOT over-tighten cap screw (J) and nut (I). Over-tightening could cause raise/lower levers to bind. Levers must be able to return to center position freely.



MX2280

- Check switch (input light) operation. Adjust switch bracket (D) as needed.

Triple Pump Assembly Removal and Installation

Removal

NOTE: The triple pump assembly consists of the steering/lift pump, traction drive pump, and mower deck drive pump and their associated linkage bracket assemblies.

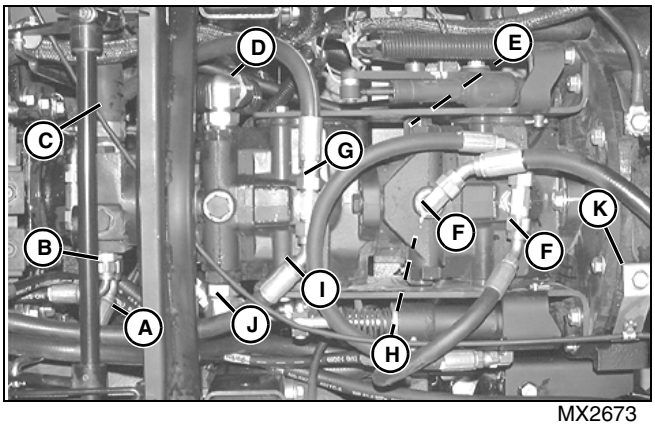
Models 1600/1620 shown. Model 1600 Turbo is similar.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Remove seat and platform.
3. Remove hydraulic reservoir.
4. Remove MRWD drive shaft.

NOTE: Hydraulic hoses (E and H) are located under machine.

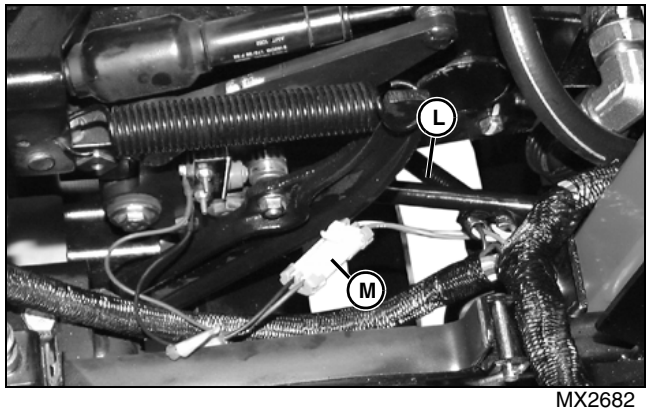
Mark all hydraulic hoses and connection points before removing to ensure correct installation. It is critical to route hoses in the same manner in which they were installed at the factory.

Close all open hoses and fittings using caps and plugs.



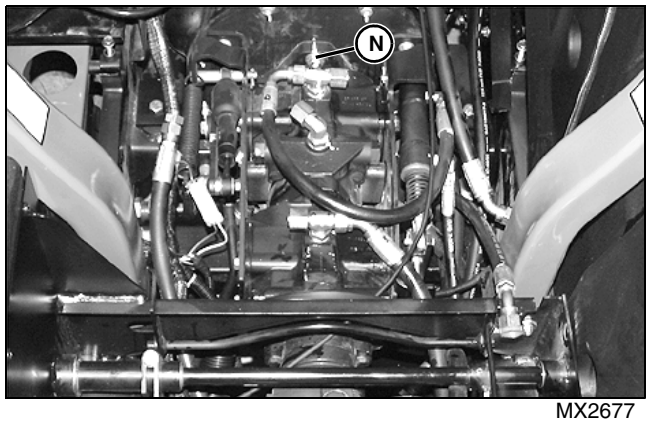
MX2673

5. Disconnect hydraulic hoses (A-J).
6. Disconnect throttle cable bracket (K).



MX2682

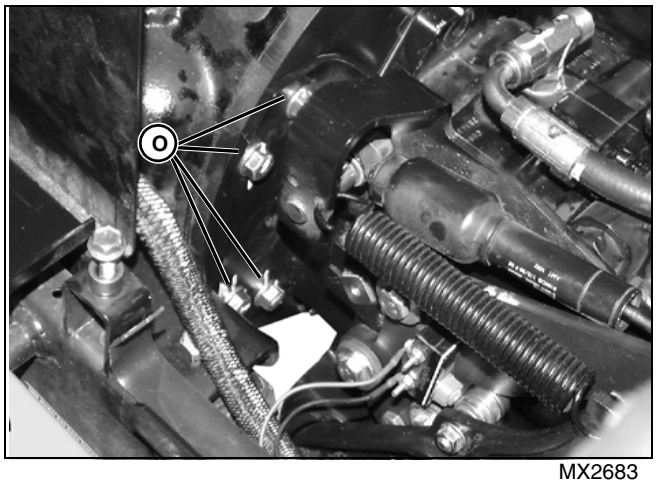
7. Disconnect forward/reverse linkage (L) from arm on triple pump.
8. Disconnect transmission neutral switch at wiring connector (M).



MX2677

Picture Note: Top Cap Screw Shown

9. Remove two cap screws (N) from triple pump flange (top and bottom).



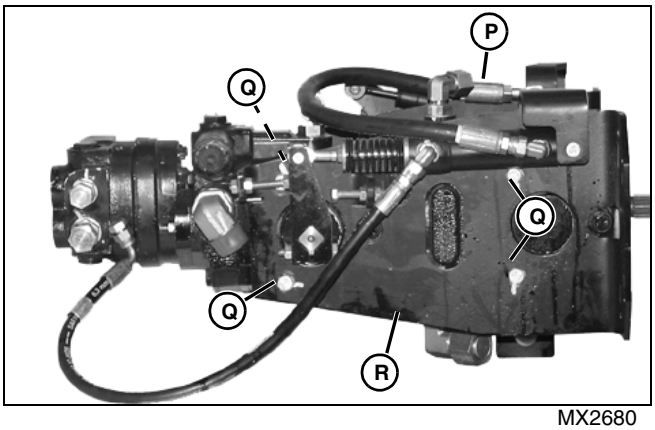
MX2683

10. Attach a suitable lifting device to triple pump, and support triple pump assembly.

11.Remove eight control bracket mounting cap screws (O) (four on each side) and slide triple pump assembly away from engine.

12.Remove triple pump.

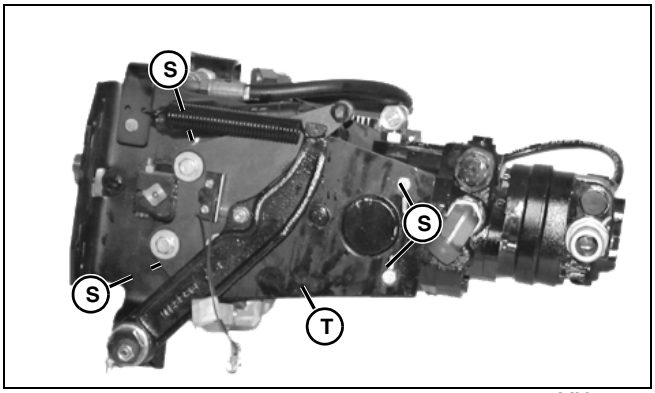
13.Remove hydraulic hoses and fittings.



MX2680

14.Disconnect hydraulic hose (P) at tee fitting.

15.Remove four cap screws (Q) and remove left side triple pump control linkage plate assembly (R).



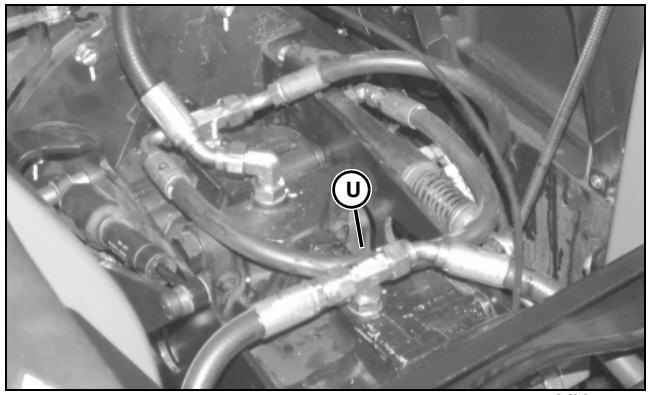
MX2681

16.Remove cap screws (S) and remove right side triple pump control linkage plate assembly (T).

Installation

Installation is done in the reverse order of removal.

- Tighten cap screws (Q and S) to specification.



MX2701

- Before installing the hydraulic reservoir, remove the traction pump case drain tee fitting (U) and fill pump with clean hydraulic oil.

NOTE: Hydraulic oil drained from the system can be reused if the oil is clean and free of contaminants. Use a strainer when filling reservoir.

After reservoir is 100% filled, run machine slowly to fill all lines. Add oil to reservoir as needed to maintain level.

- Fill hydraulic reservoir to correct level with oil meeting specifications.
- Check all connections for leaks. Repair as needed.
- Bleed air from hydraulic system.

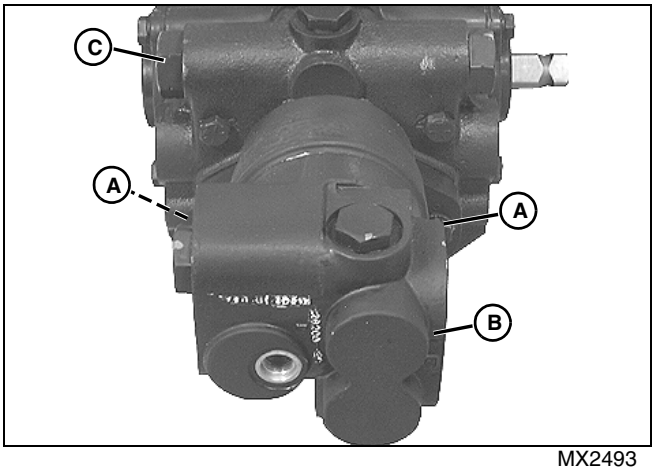
Specifications

Linkage Plate Assembly
Cap Screw Torque . . . . . 41 N•m (30 lb-ft)

Triple Pump Assembly Disassembly and Assembly

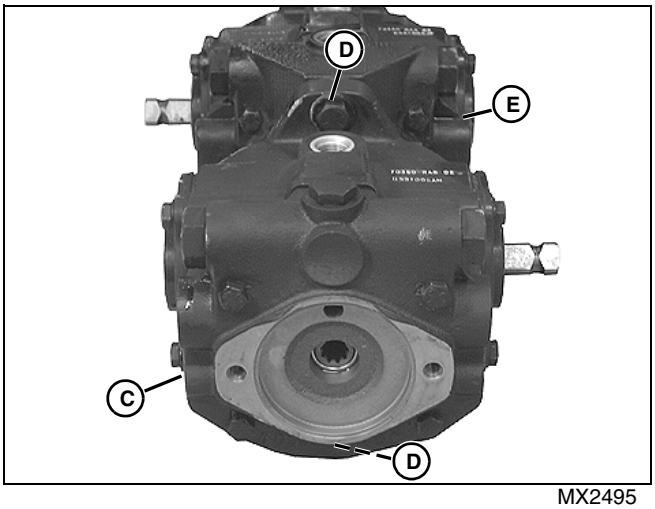
NOTE: Thoroughly clean outside of pump and port areas to eliminate possibility of contamination of internal parts of pump during disassembly.

Model 1620 shown. Models 1600 and 1600 Turbo are similar.



MX2493

1. Remove two cap screws (A).
2. Remove steering/lift pump (B) from mower deck drive pump (C).



MX2495

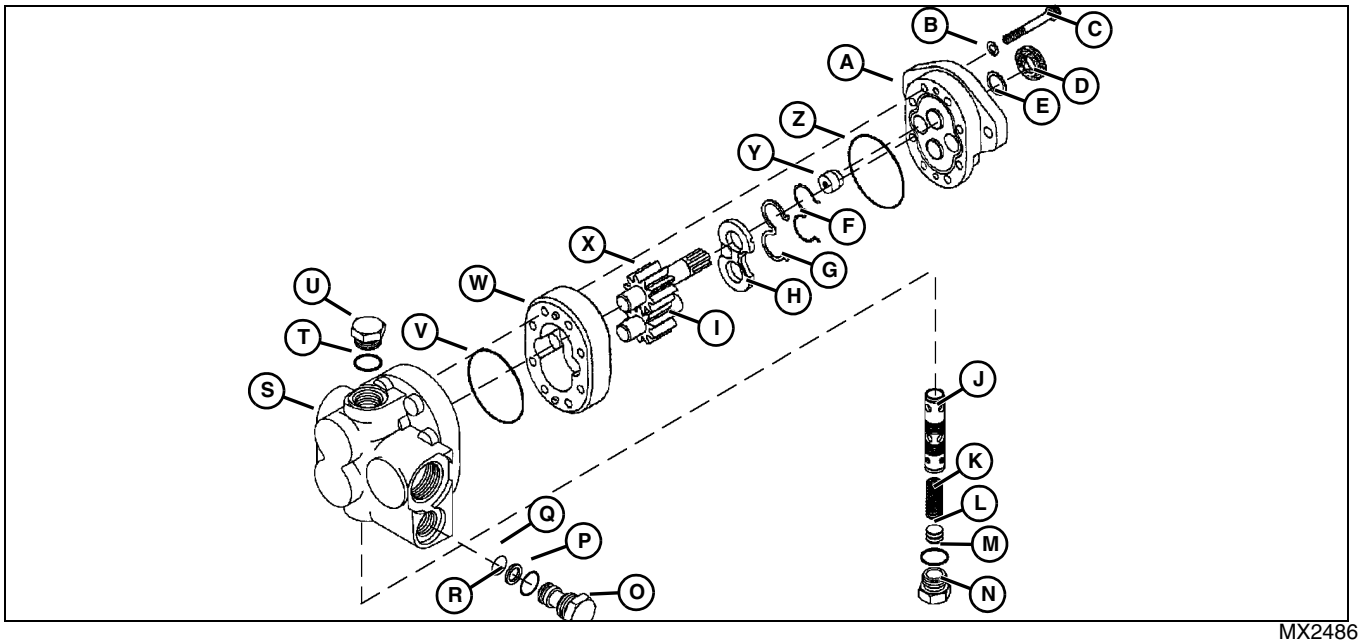
3. Remove two cap screws (D).
4. Remove mower deck drive pump (C) from traction drive pump (E).
5. Repair or replace individual pumps as needed.

Assembly is done in the reverse order of disassembly.

Steering and Lift Pump Disassembly and Assembly - Model 1620

NOTE: Thoroughly clean outside of pump and port areas to eliminate possibility of contamination of internal parts of pump during disassembly.

Disassembly



MX2486

A - Front Plate
B - Washer (4 used)
C - Cap Screw (8 used)
D - Shaft Seal
E - Washer
F - Backup Gasket
G - Seal
H - Wear Plate
I - Idler Gear
J - Flow Divider Valve Spool Assembly
K - Spring
L - Shim (as required)
M - O-Ring
N - Plug
O - Plug
P - O-Ring
Q - Seal
R - O-Ring
S - Manifold
T - O-Ring
U - Plug
V - O-Ring
W - Pump Housing
X - Drive Gear
Y - Plug
Z - O-Ring

1. Mark the front plate (A), pump housing (W), and manifold (S) with a solvent-resistant marker to ensure correct assembly.

IMPORTANT: Avoid damage! When clamping the pump in a vise, always clamp across the pump's mounting flange, NOT the pump housing. Use a vise with soft jaws between vise and pump. DO NOT apply excessive clamping force to pump; otherwise distortion to pump housing may result.

2. Clamp pump in a soft-jawed vise, with shaft facing upward.

NOTE: Only the four upper (exposed) cap screws will have washers.

3. Remove eight cap screws (C) and washers (B).

4. Gently tap on front plate flanges using a plastic mallet to separate front plate (A) from pump housing (W).

5. Remove wear plate (H) from pump body.

6. Remove backup gasket (F) and seal (G) from wear plate.

7. Remove idler gear (I) and drive gear (X).

8. Remove pump assembly from vise.

9. Separate the pump housing from the manifold (S) by placing the idler and drive gear assembly into gear pocket. Hold pump housing firmly in hand and tap protruding end of gear shaft with soft-faced mallet. Remove drive gear assembly.

NOTE: It is not necessary to remove the plug (Y) from the front plate assembly. If the plug is removed from the front plate, make sure it is installed in the pressure-side hole during reassembly.

10.Remove shaft seal (D) and washer (E) from front plate (A) using a blunt punch from the rear.

NOTE: Record the number of shims removed to ensure the same number are installed during assembly.

11.Remove plug (N), shims (L), spring (K), and flow divider valve spool assembly (J).

12.Remove plug (O) and seal (Q).

CAUTION: Avoid injury! Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on pump components. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

13.Clean all metal parts with solvent and blow dry with compressed air.

14.Inspect all parts for damage, nicks or unusual wear. Replace parts as needed.

Assembly

Assembly is done in the reverse order of disassembly.

IMPORTANT: Avoid damage! Always install new O-rings. Damaged or used O-rings will leak.

- Lubricate all O-rings with petroleum jelly before installing.
- Apply clean hydraulic oil to all internal parts prior to assembly.

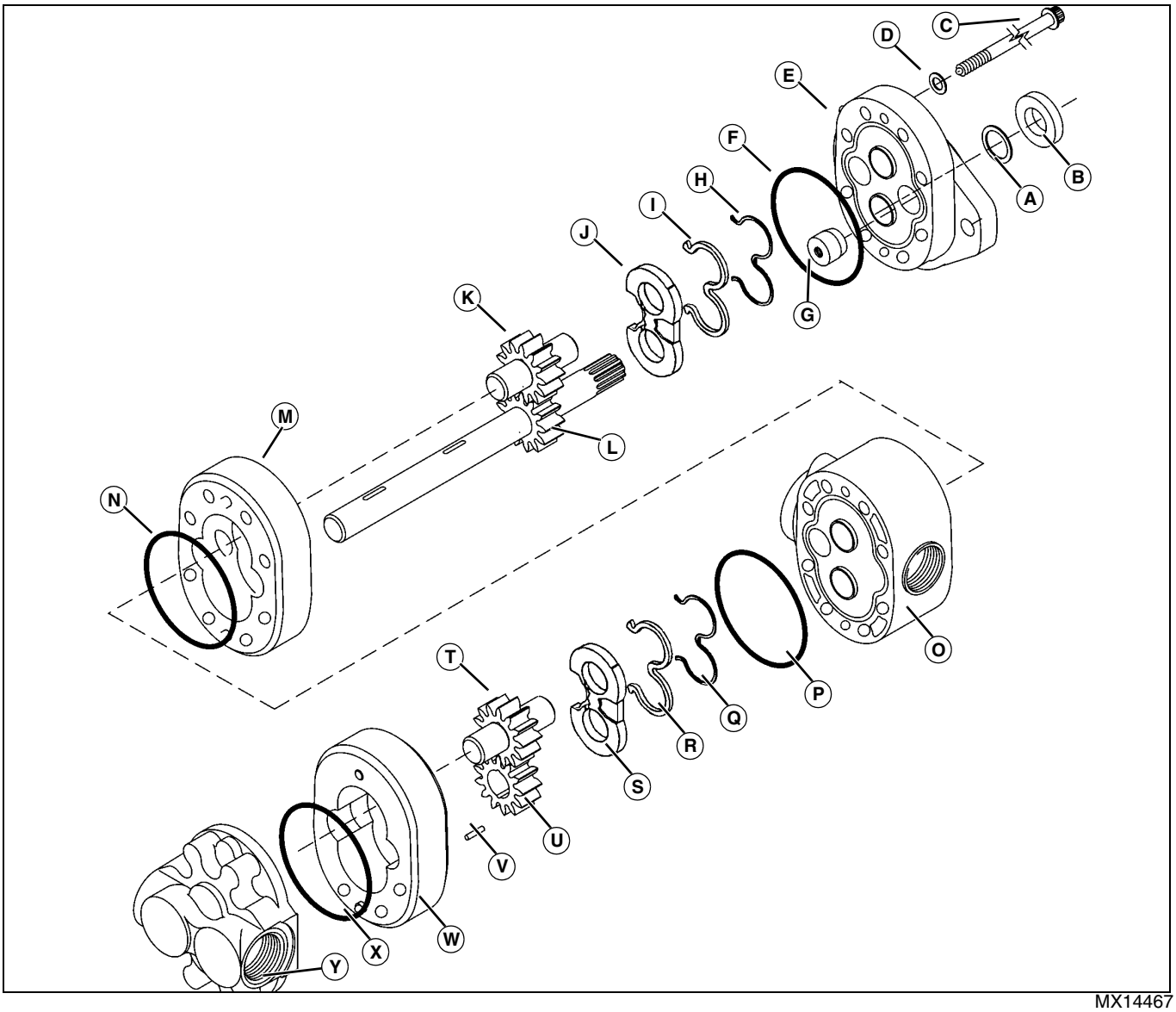
IMPORTANT: Avoid damage! Place wear plate (H), seal (G), and backup gasket (F) into gear pocket with seal and backup gasket next to front plate. The side of the wear plate with the midsection cut away must be on the suction side of pump.

NOTE: The suction side of the pump is the side where the front plate has the large opening next to the inlet.

Steering and Lift Pump Disassembly and Assembly - Models 1600 and 1600 Turbo

NOTE: Thoroughly clean outside of pump and port areas to eliminate possibility of contamination of internal parts of pump during assembly.

Disassembly



MX14467

A - Washer
B - Shaft Seal
C - Cap Screw (8 used)
D - Washer (4 used)
E - Front Plate
F - O-Ring
G - Plug
H - Backup Gasket
I - Seal
J - Wear Plate
K - Idler Gear
L - Drive Gear and Shaft
M - Pump Housing
N - O-Ring
O - Manifold
P - O-Ring
Q - Backup Gasket
R - Seal
S - Wear Plate
T - Idler Gear
U - Drive Gear
V - Pin
W - Pump Housing
X - O-Ring
Y - Manifold

1. Mark the front plate (E), pump housings (M and W), and manifolds (O and Y) with a solvent-resistant marker to ensure correct assembly.

IMPORTANT: Avoid damage! When clamping the pump in a vise, always clamp across the pump's mounting flange, NOT the pump housing. Use a vise with soft jaws between vise and pump. DO NOT apply excessive clamping force to pump; otherwise distortion to pump housing may result.

2. Clamp pump in a soft-jawed vise.

NOTE: Only the four upper (exposed) cap screws will have washers.

3. Remove eight cap screws (C) and four washers (D).

4. Separate manifold (Y) from pump housing (W).

5. Remove idler gear (T).

6. Remove drive gear (U) and pin (V).

7. Separate pump housing from manifold (O).

8. Remove wear plate (S). Separate backup gasket (Q) and seal (R) from wear plate.

9. Separate manifold (O) from pump housing (M).

10. Remove idler gear (K).

11. Remove drive gear and shaft (L).

12. Separate pump housing (M) from front plate (E).

13. Remove wear plate (J). Separate backup gasket (H) and seal (I) from seal plate.

NOTE: It is not necessary to remove the plug (G) from the front plate assembly. If the plug is removed from the front plate, make sure it is installed in the pressure-side hole during assembly.

14. Remove shaft seal (B) and washer (A) from front plate (E), using a blunt punch from the rear.

CAUTION: Avoid injury! Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

NOTE: Record the number of shims removed to ensure the same number are installed during assembly.

15. Clean all metal parts with solvent and blow dry with compressed air.

16. Inspect all parts for damage, nicks, or unusual wear. Replace parts as needed.

Assembly

Assembly is done in the reverse order of disassembly.

IMPORTANT: Avoid damage! Always install new O-rings. Damaged or used O-rings will leak.

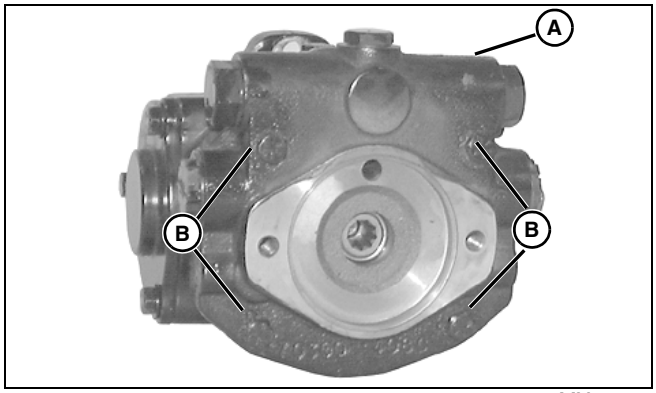
- Lubricate all O-rings with petroleum jelly before installing.
- Apply clean hydraulic oil to all internal parts prior to assembly.

IMPORTANT: Avoid damage! The side of the wear plate with the midsection cut away must be on the suction side of the pump.

NOTE: The suction side of the pump is the side where the front plate has the large opening next to the inlet.

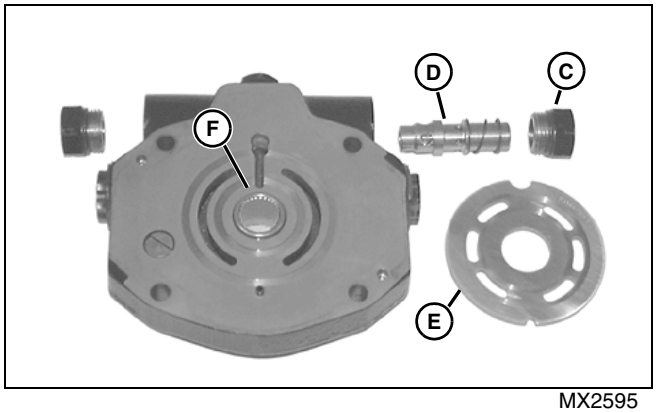
Mower Deck Drive Pump Disassembly and Inspection

NOTE: Thoroughly clean outside of pump and port areas to eliminate possibility of contamination of internal pump parts during disassembly.



MX2589

1. Remove four cap screws (B) from manifold (A) and remove manifold from pump body.



MX2595

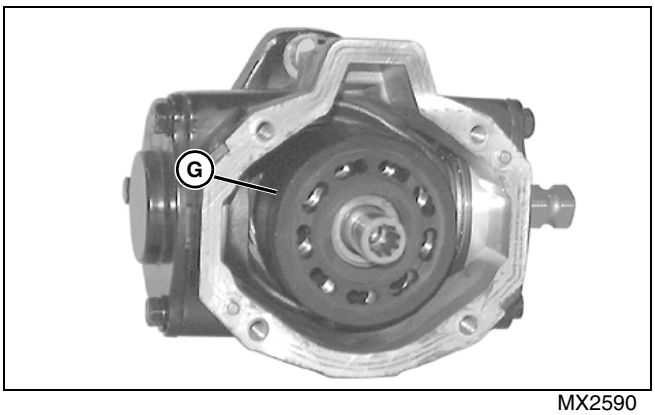
2. Remove plug (C) and inspect valve (D).

3. Inspect bronze side of valve plate (E) for wear. Replace valve plate if any scoring or scratches are present.

NOTE: Remove needle bearing only if replacement is required.

4. Inspect needle bearing (F). Replace the needle bearing if needles do not remain in the bearing cage; are discolored, broken, or pitted; or are not free to move.

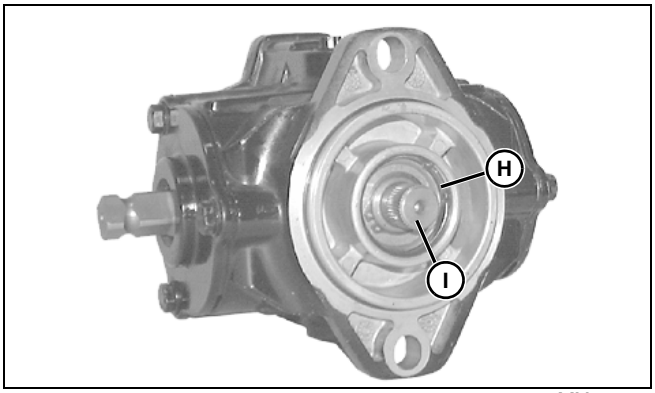
NOTE: Keep pistons and piston block together as an assembly when removing the piston rotating assembly.



MX2590

5. Remove piston rotating assembly (G) by holding on to it and tilting the pump body, letting the piston rotating assembly slide down off the drive shaft.

NOTE: Snap ring, bearing race, and thrust bearings will come out with drive shaft.

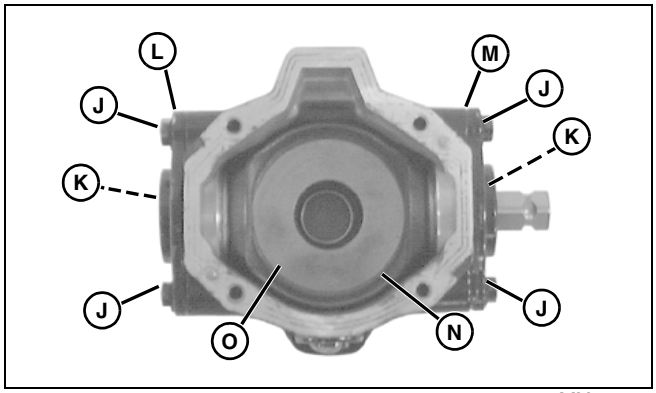


MX2592

6. Remove large snap ring (H).

7. Slide drive shaft (I) out of pump body.

NOTE: Cap screws (J) were removed when the pump control linkage side plates were removed from the pump assembly.



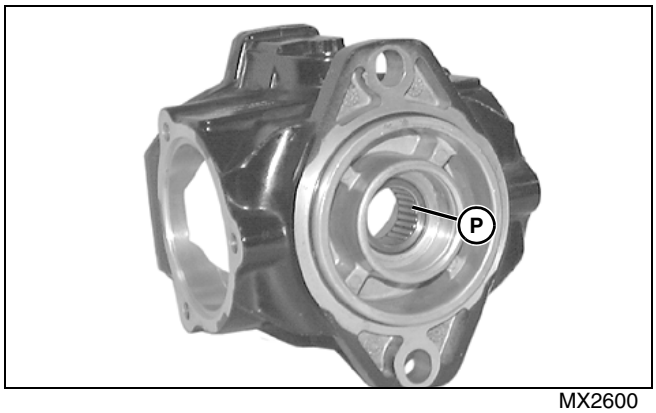
MX2591

8. Remove two cap screws with washers (K) and remove cover plates (L and M).

NOTE: For reference during assembly, mark side of pump body to indicate on which side the control shaft is located.

9. Remove cam plate (N) and cam plate insert (O).

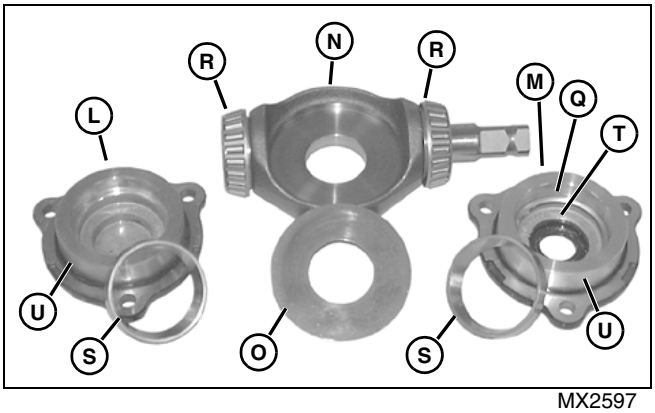
NOTE: Remove needle bearing only if replacement is required.



MX2600

10.Inspect needle bearing (P) in pump housing. Replace the needle bearing if needles do not remain in the bearing cage; are discolored, broken, or pitted; or are not free to move.

NOTE: There is a crush washer (Q) located inside cover plate (L). This item is not serviceable. Shims must be installed from a shim kit if necessary after service.



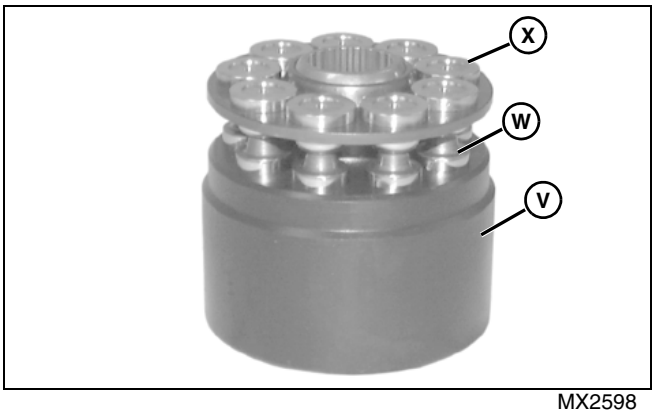
MX2597

11.Inspect cam plate bearing cones (R) and bearing cups (S) in cover plates (L and M).

12.Inspect cam plate (N) and cam plate insert (O). Surfaces should be smooth and free of deep scratches.

13.Discard seal (T) and O-rings (U) in cover plates.

NOTE: Piston rotating assembly is not serviceable. Replace entire assembly if any of its components are damaged.

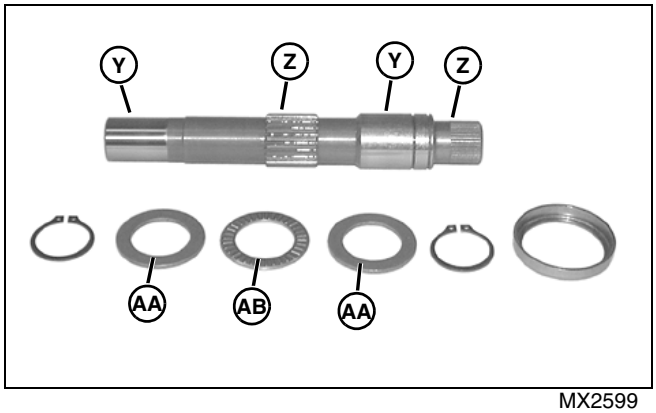


MX2598

14.Check movement of pistons (W) in bore. If pistons do not move freely in bore, replace piston rotating assembly.

15.Inspect the outside diameter of the pistons. Pistons should not show deep scratches.

16.Inspect the shoes (X) for a snug fit on the ball end of the pistons. The shoes should have a flat smooth surface.



MX2599

17.Inspect drive shaft bearing surfaces (Y) and spline areas (Z).

18.Inspect thrust washers (AA) and thrust bearing (AB).

CAUTION: Avoid injury! Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on pump components. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

19.Clean all metal parts with solvent and blow dry with compressed air.

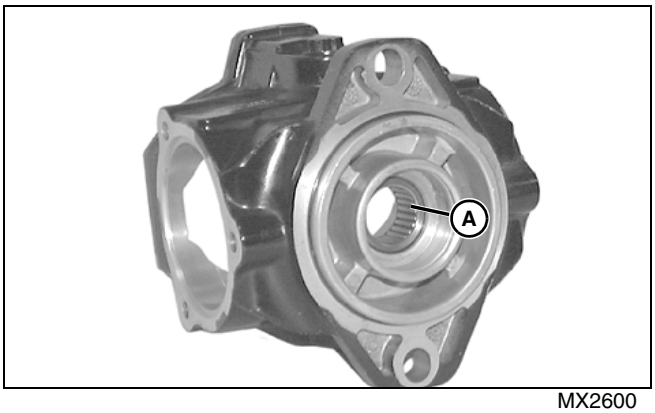
20.Inspect all parts for damage, nicks or unusual wear. Replace parts as needed.

Mower Deck Drive Pump Assembly

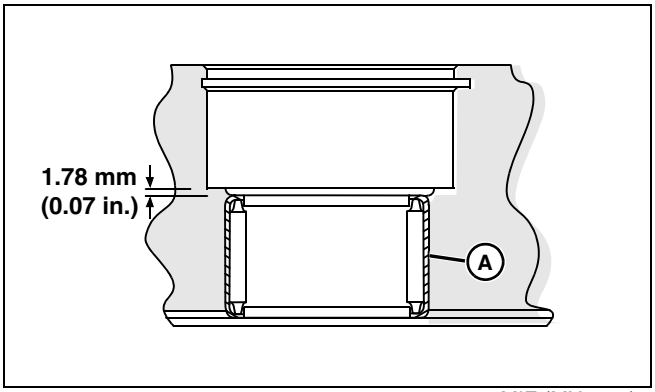
Special or Required Tools

Tool Name	Tool No.	Tool Use
Bushing, Bearing, and Seal Driver Set	NA	Used to install new seal in cover plate.

Procedure

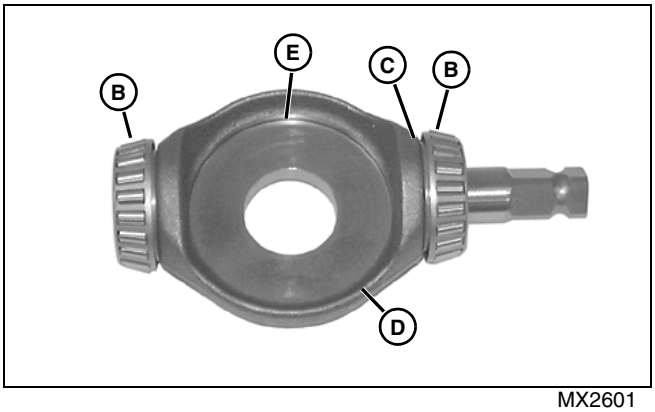


MX2600



MIF (MX2621)

1. Install a new needle bearing (A) (if required), with the numbered end of the bearing facing away from the pump body and pressed below the seal ledge to specification.

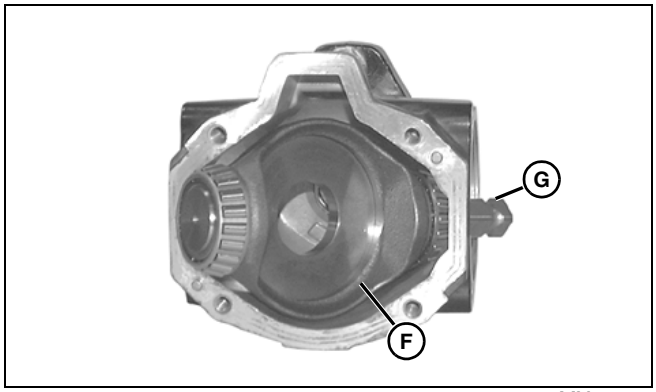


MX2601

2. Install bearings (B) and cam plate insert (C) on cam plate (D).

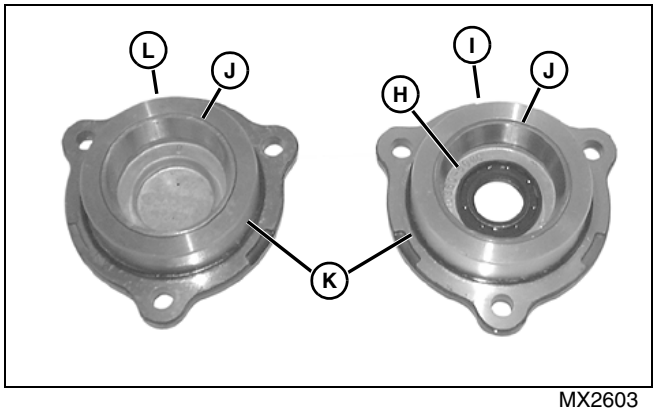
3. If necessary to obtain proper bearing preload, install shims (E) between bearing and cam plate on control shaft side.

NOTE: Since it is possible to assemble the pump with the control shaft on either side, refer to the mark placed on the pump body before disassembly to make sure the control shaft is installed on the proper side.



MX2602

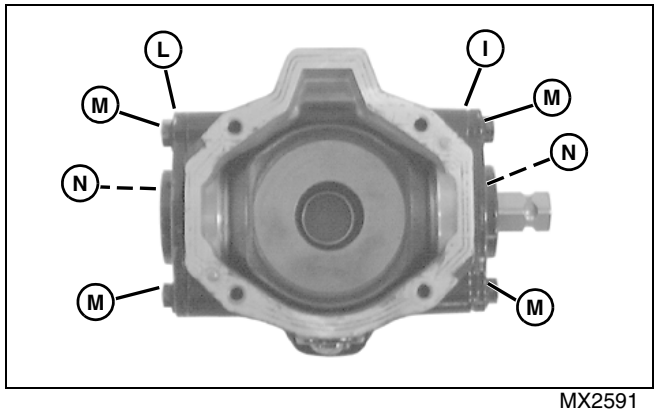
4. Install cam plate (F) into the pump housing by tilting the cam plate slightly and inserting the control shaft (G) into the pump body. Make sure the control shaft is on the same side as before disassembly.



MX2603

5. Using a seal driver, install new seal (H) in cover plate (I). Make sure channel in seal faces inside of cover plate.

6. Install bearing cups (J) and O-rings (K) in both cover plates (I and L).



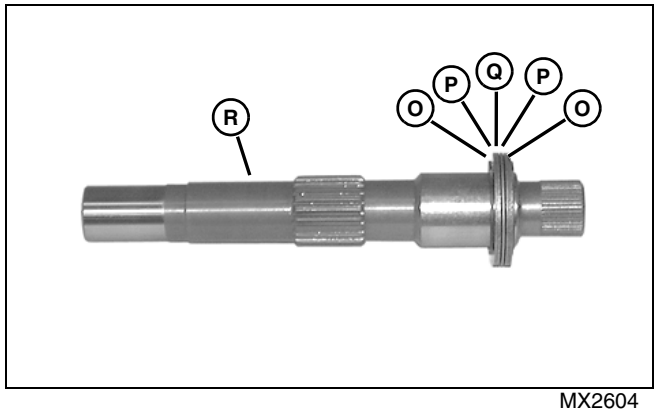
MX2591

7. Install cover plates.

NOTE: Use four cap screws from control linkage side plates to install cover plates, in order to obtain proper bearing preload. These cap screws will be removed later to install the side plates.

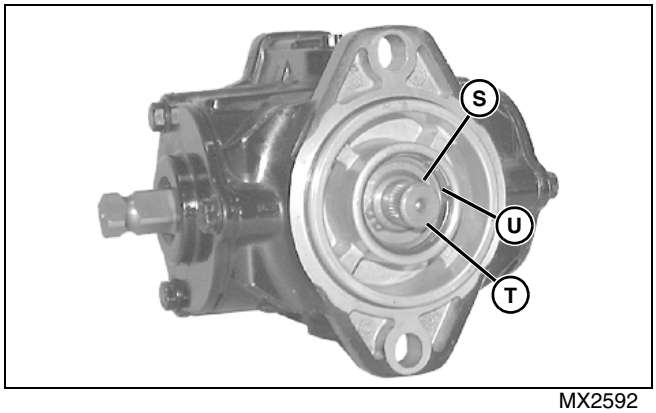
8. Install cap screws and washers (M and N) and tighten to specifications.

9. Check cam plate for proper bearing preload. Proper preload is indicated when cam plate has only light resistance to tilting due to seal on control shaft and little or no end play. If preload is not correct, install shims as necessary (see step 3).



MX2604

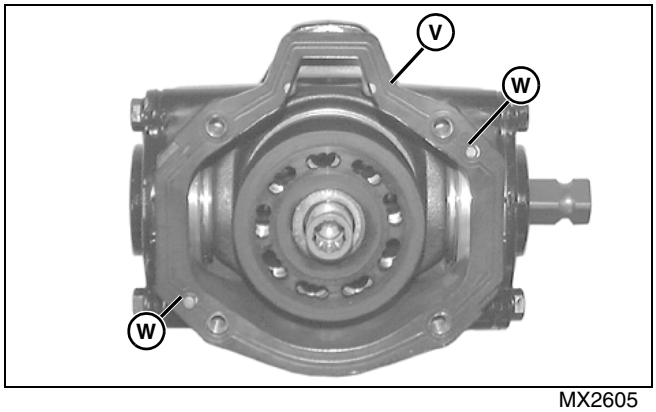
10.Install snap rings (O), thrust washers (P) and thrust bearing (Q) on drive shaft (R).



MX2592

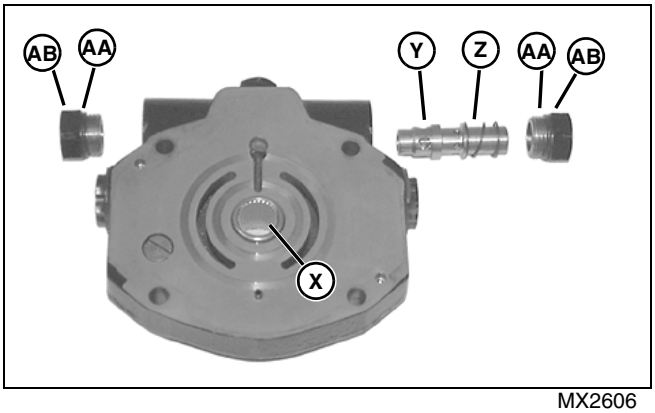
11.Install drive shaft assembly (S) and spacer (T) from the drive input side of the pump.

12.Install large snap ring (U).

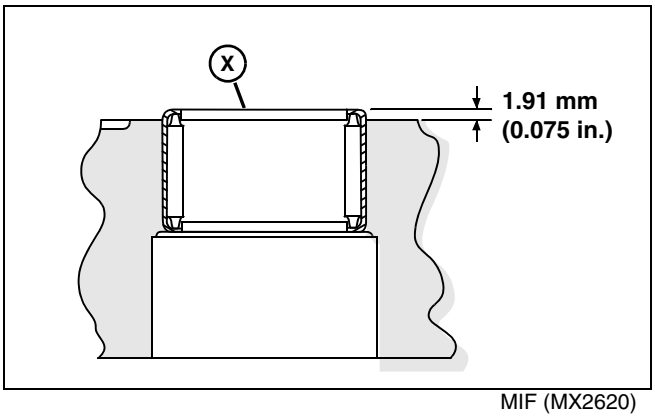


MX2605

13.Install new gasket (V) on pump body. Dowel pins (W) should protrude through holes in gasket.



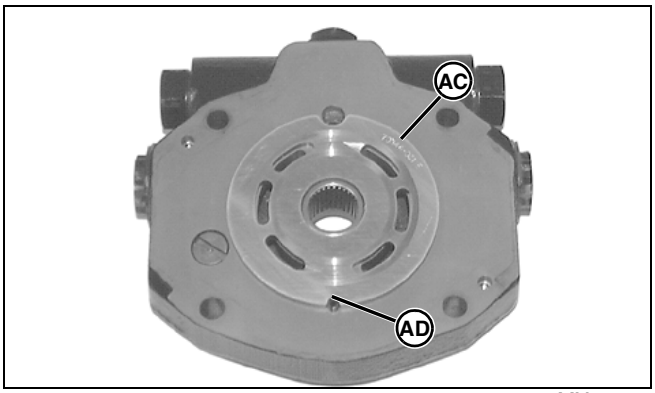
MX2606



MIF (MX2620)

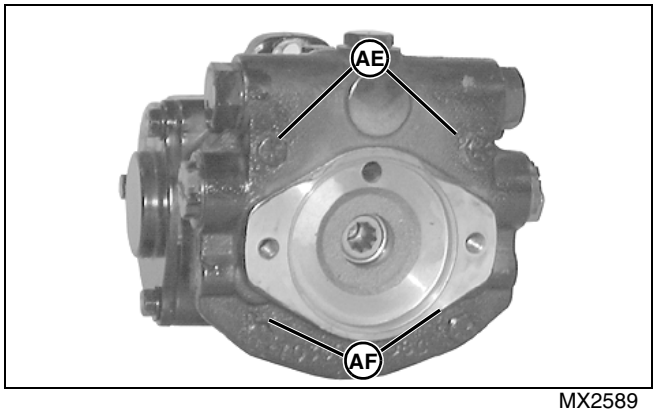
14.Install a new needle bearing (X) (if required) in the manifold, with the numbered end of the bearing facing the valve plate side and extending above the surface of the manifold to specification.

15.Install relief valve (Y), spring (Z), new O-rings (AA), and plugs (AB) in manifold.



MX2607

16.Install bronze side of valve plate (AC) facing up on manifold so that spring pin (AD) is in small notch on valve plate.



MX2589

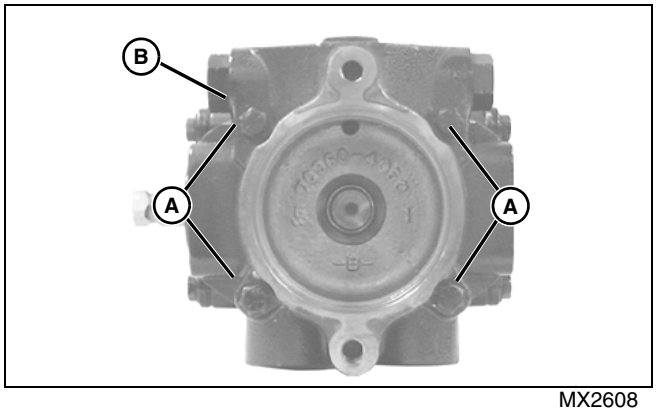
17.Install manifold on pump body and secure with two long cap screws (AE) and two short cap screws (AF).

Specifications

Drive Pump Cover Plate
Cap Screw Torque . . . . . 41 N•m (30 lb-ft)
Housing Needle Bearing Installation
Depth (below Seal Edge) . . . . . 1.78 mm (0.07 in.)
Manifold Needle Bearing Installation
Depth (above Manifold Surface) . . . 1.91 mm (0.075 in.)

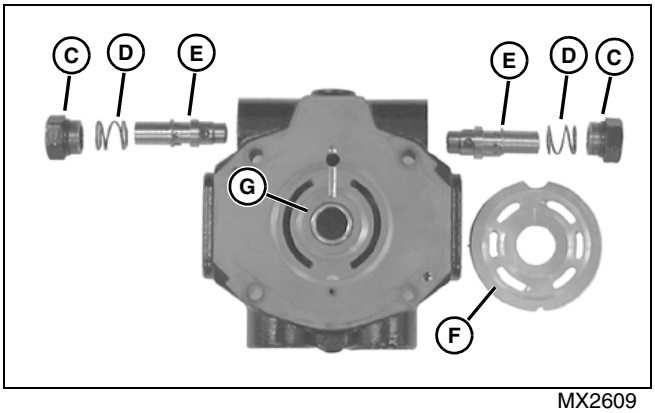
Traction Drive Pump Disassembly and Inspection

NOTE: Thoroughly clean outside of pump and port areas to eliminate possibility of contamination of internal pump parts during disassembly.



MX2608

1. Remove four cap screws (A) from manifold (B) and remove manifold from pump body.



MX2609

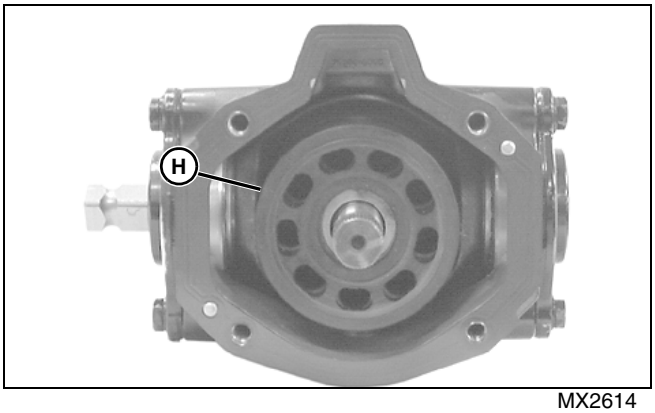
2. Remove plugs (C) and inspect springs (D) and relief valve spools (E).

3. Inspect bronze side of valve plate (F) for wear. Replace valve plate if any scoring or scratches are present.

NOTE: Remove needle bearing only if replacement is required.

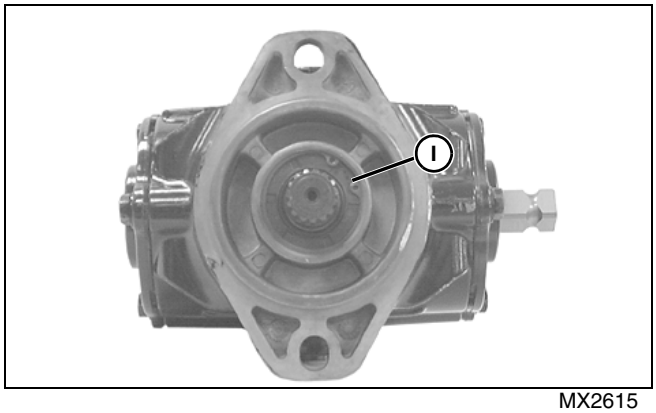
4. Inspect needle bearing (G). Replace the needle bearing if needles do not remain in the bearing cage; are discolored, broken, or pitted; or are not free to move.

NOTE: Keep pistons and piston block together as an assembly when removing the piston rotating assembly.



MX2614

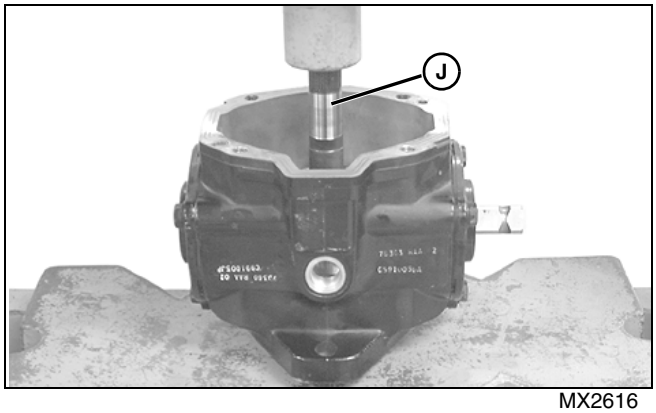
5. Remove piston rotating assembly (H) by holding on to it and tilting the pump body, letting the piston rotating assembly slide down off the drive shaft.



MX2615

6. Remove large snap ring (I).

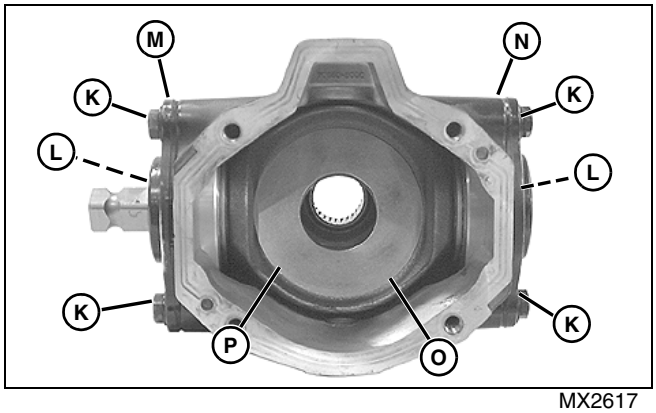
NOTE: Snap rings, bearing races, thrust bearing, and seal will come out with drive shaft.



MX2616

7. Using a press, push drive shaft (J) out of pump body.

NOTE: Cap screws (K) were removed when the pump control linkage side plates were removed from the pump assembly.



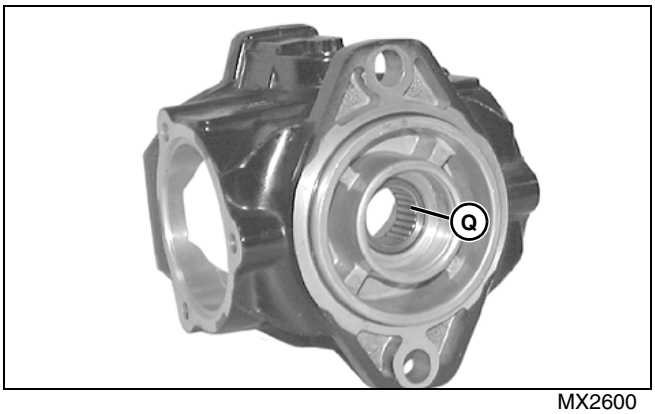
MX2617

8. Remove two cap screws with washers (L) and remove cover plates (M and N).

NOTE: For reference during assembly, mark side of pump body to indicate on which side the control shaft is located.

9. Remove cam plate (O) and cam plate insert (P).

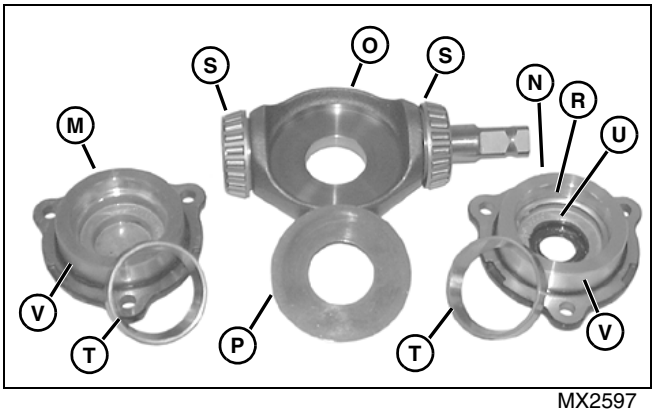
NOTE: Remove needle bearing only if replacement is required.



MX2600

10.Inspect needle bearing (Q) in pump housing. Replace the needle bearing if needles do not remain in the bearing cage; are discolored, broken, or pitted; or are not free to move.

NOTE: There is a crush washer (R) located inside cover plate (N). This item is not serviceable. Shims must be installed from a shim kit if necessary after service.



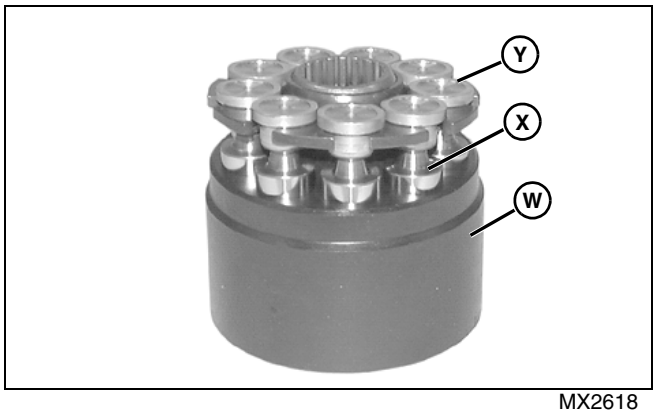
MX2597

11.Inspect cam plate bearing cones (S) and bearing cups (T) in cover plates (M and N).

12.Inspect cam plate (O) and cam plate insert (P). Surfaces should be smooth and free of deep scratches.

13.Discard seal (U) and O-rings (V) in cover plates.

NOTE: Piston rotating assembly is not serviceable. Replace entire assembly if any of its components are damaged.

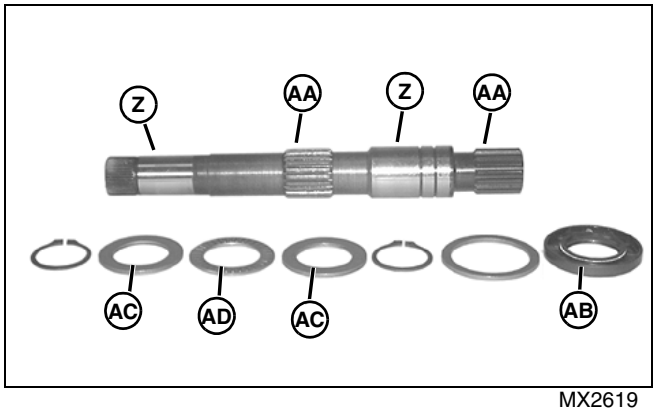


MX2618

14.Check movement of pistons (X) in bore. If pistons do not move freely in bore, replace piston rotating assembly.

15.Inspect the OD of the pistons. Pistons should not show deep scratches.

16.Inspect the shoes (Y) for a snug fit on the ball end of the pistons. The shoes should have a flat smooth surface.



MX2619

17.Inspect drive shaft bearing surfaces (Z) and spline areas (AA).

18.Inspect seal (AB), thrust washers (AC), and thrust bearing (AD).

CAUTION: Avoid injury! Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on pump components. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

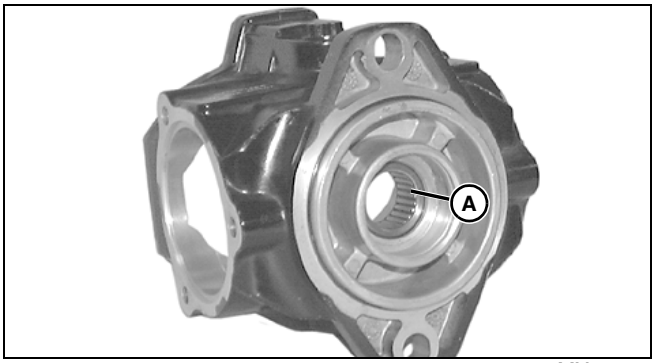
19.Clean all metal parts with solvent and blow dry with compressed air.

20.Inspect all parts for damage, nicks or unusual wear. Replace parts as needed.

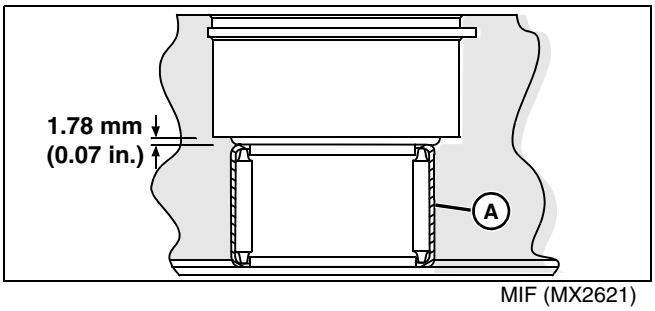
Traction Drive Pump Assembly

Special or Required Tools

Tool Name	Tool No.	Tool Use
Bushing, Bearing, and Seal Driver Set	NA	Used to install new seal in cover plate.

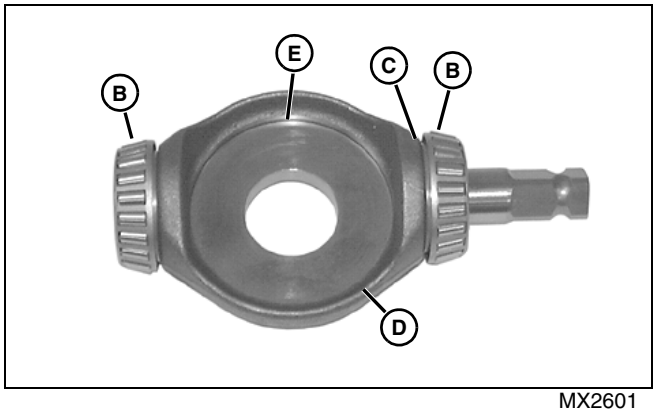


MX2600



MIF (MX2621)

1. Install a new needle bearing (A) (if required), with the numbered end of the bearing facing away from the pump body and pressed to specified depth below the seal ledge.

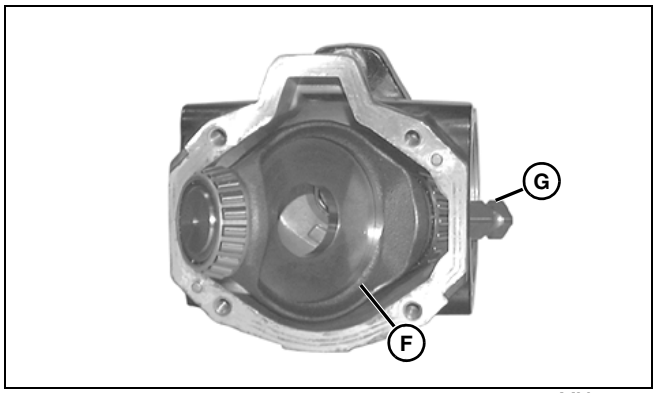


MX2601

2. Install bearings (B) and cam plate insert (C) on cam plate (D).

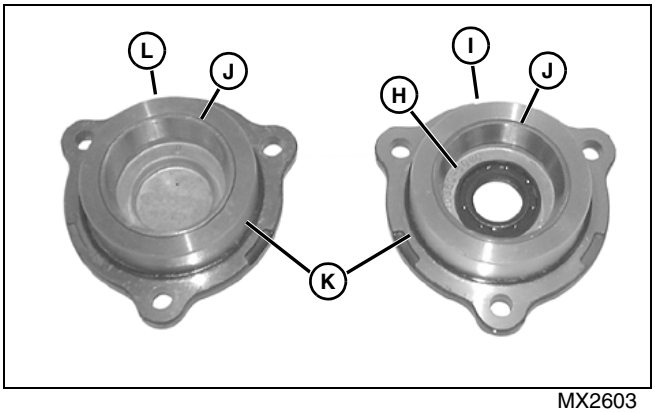
3. If necessary to obtain proper bearing preload, install shims (E) between bearing and cam plate on control shaft side.

NOTE: Since it is possible to assemble the pump with the control shaft on either side, refer to the mark placed on the pump body before disassembly to make sure the control shaft is installed on the proper side.



MX2602

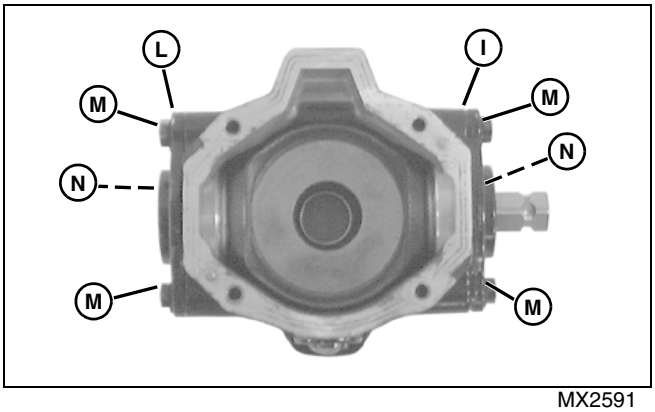
4. Install cam plate (F) into the pump housing by tilting the cam plate slightly and inserting the control shaft (G) into the pump body. Make sure the control shaft is on the same side as before disassembly.



MX2603

5. Using a seal driver, install new seal (H) in cover plate (I). Make sure channel in seal faces inside of cover plate.

6. Install bearing cups (J) and O-rings (K) in both cover plates (I and L).



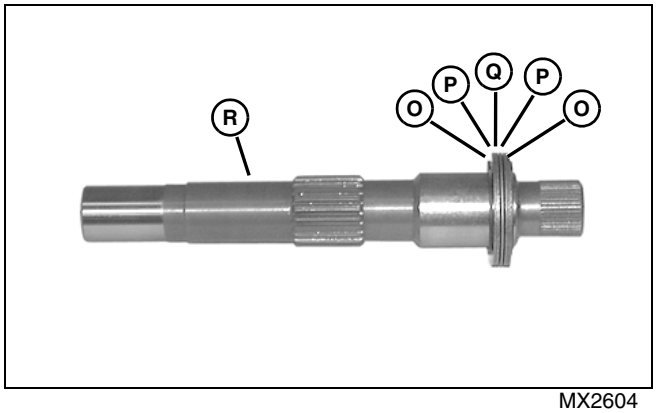
MX2591

7. Install cover plates.

NOTE: Use four cap screws from control linkage side plates to install cover plates, in order to obtain proper bearing preload. These cap screws will be removed later to install the side plates.

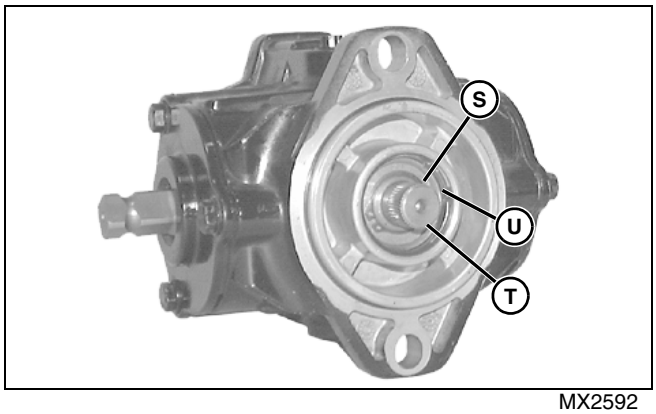
8. Install cap screws and washers (M and N) and tighten to specification.

9. Check cam plate for proper bearing preload. Proper preload is indicated when cam plate has only light resistance to tilting due to seal on control shaft and little or no end play. If preload is not correct, install shims as necessary (see step 3).



MX2604

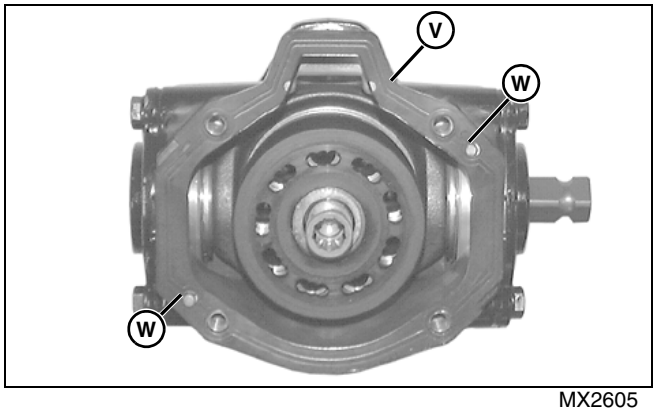
10. Install snap rings (O), thrust washers (P), and thrust bearing (Q) on drive shaft (R).



MX2592

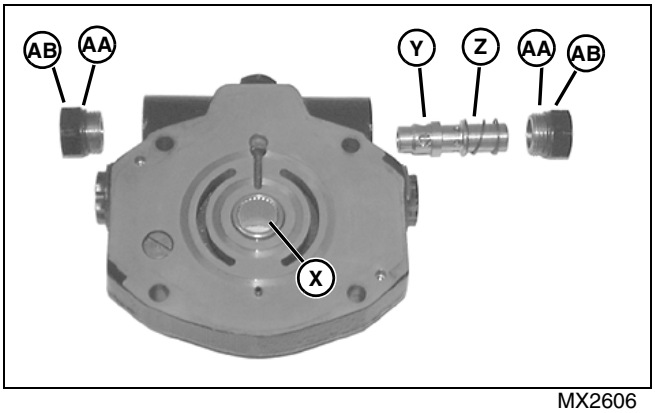
11. Install drive shaft assembly (S) and spacer (T) from the drive input side of the pump.

12. Install large snap ring (U).

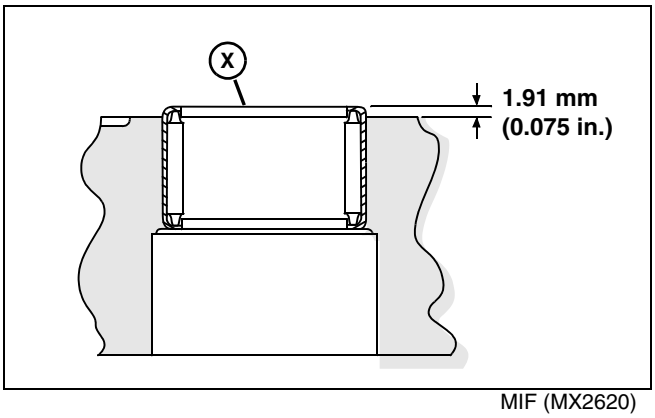


MX2605

13. Install new gasket (V) on pump body. Dowel pins (W) should protrude through holes in gasket.



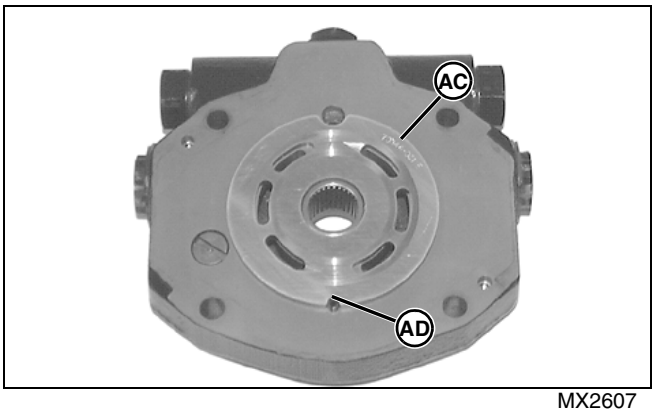
MX2606



MIF (MX2620)

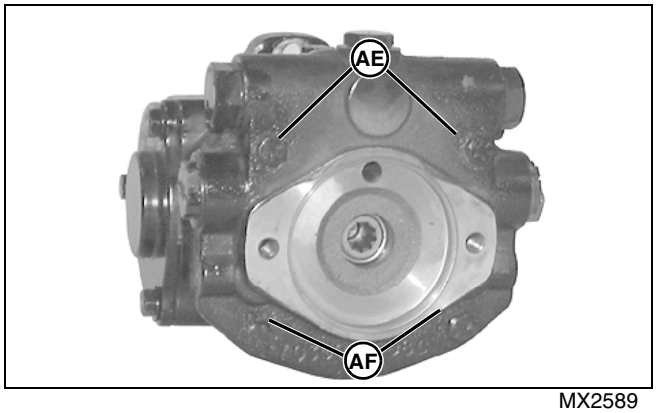
14.Install a new needle bearing (X) (if required) in the manifold, with the numbered end of the bearing facing the valve plate side and extending the specified distance above the surface of the manifold.

15.Install relief valve (Y), spring (Z), new O-rings (AA), and plugs (AB) in manifold.



MX2607

16.Install bronze side of valve plate (AC) facing up on manifold so that spring pin (AD) is in small notch on valve plate.



MX2589

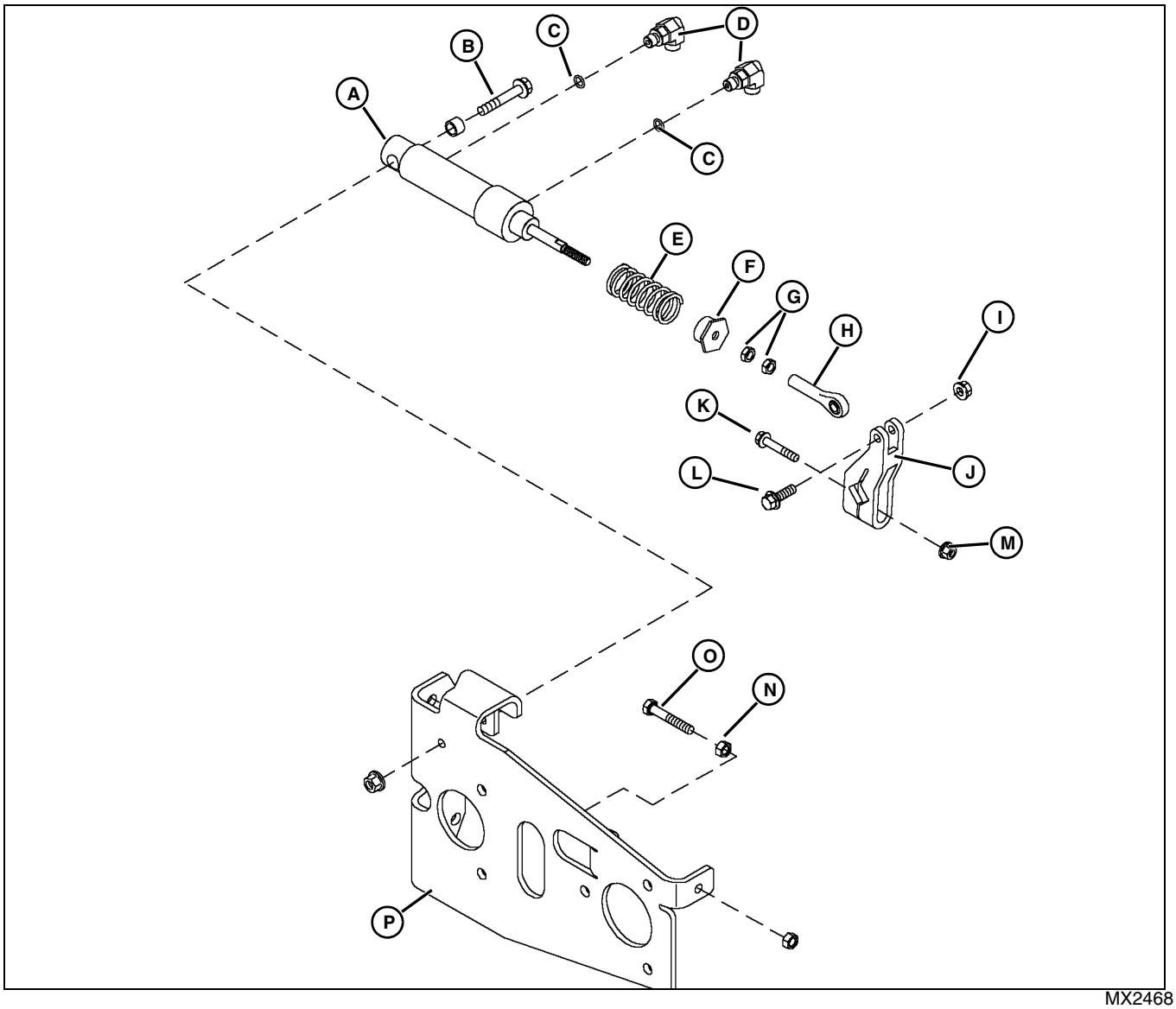
17.Install manifold on pump body and secure with two long cap screws (AE) and two short cap screws (AF).

Specifications

Drive Pump Cover Plate
Cap Screw Torque . . . . . 41 N•m (30 lb-ft)
Housing Needle Bearing Installation
Depth (below Seal Edge) . . . . . 1.78 mm (0.07 in.)
Manifold Needle Bearing Installation
Depth (above Manifold Surface) . . . 1.91 mm (0.075 in.)

Triple Pump Control Linkage

Repair - Left Side (Deck Drive Stroke Control)



MX2468

A - Hydraulic Cylinder
B - Cap Screw
C - O-Ring (2 used)
D - Elbow Fitting (2 used)
E - Spring
F - Washer
G - Nut (2 used)
H - Ball Joint
I - Nut
J - Arm
K - Cap Screw
L - Cap Screw
M - Nut
N - Nut (4 used)
O - Cap Screw (2 used)
P - Bracket

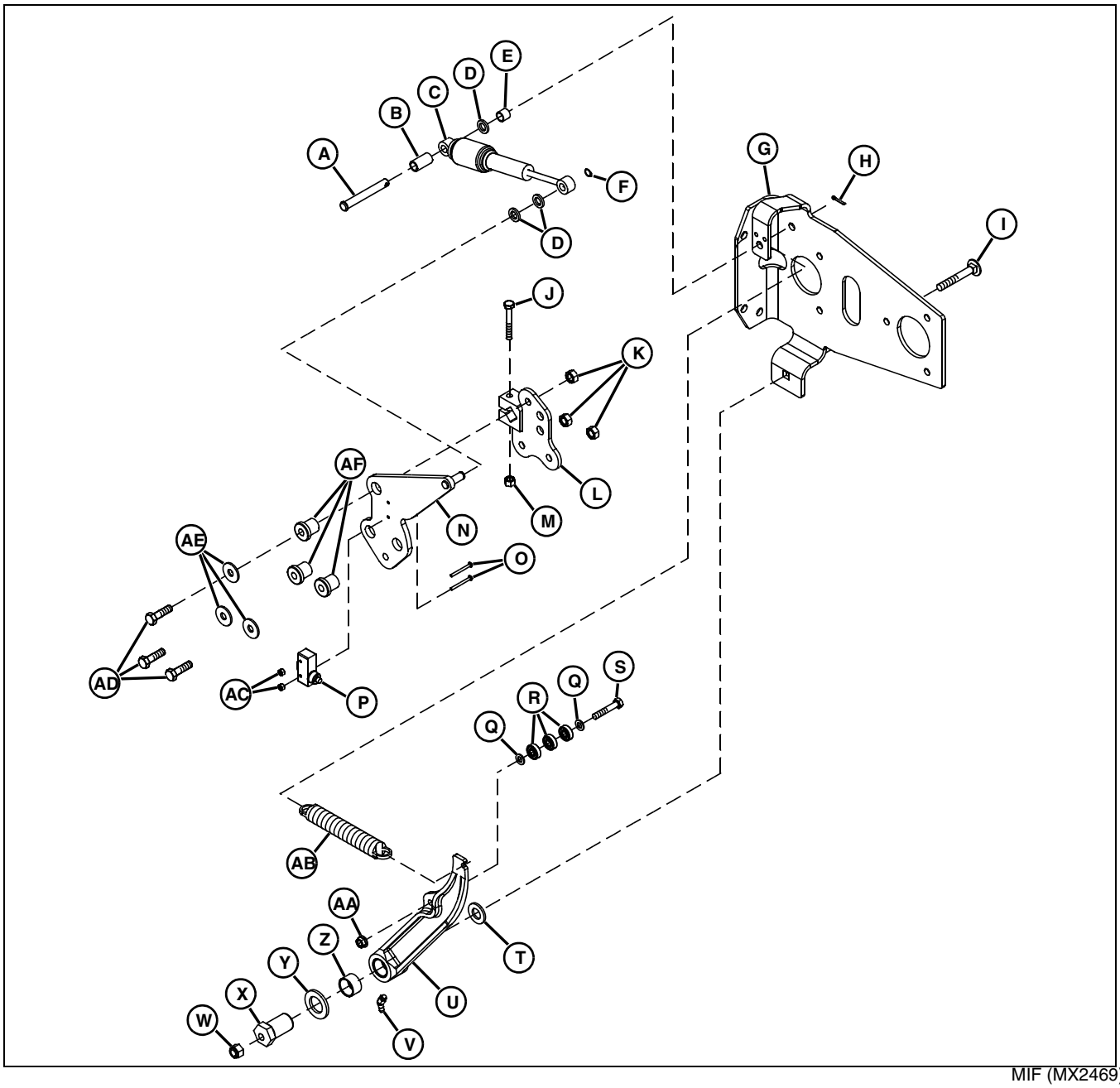
Inspect all parts for wear or damage. Replace parts as needed.

Specifications

Triple Pump Control Linkage

Mower Deck Drive Pump Stroke Arm Mounting Cap Screw Torque. . . . . 142 N•m (105 lb-ft)
Mower Deck Drive Pump Stroke Arm-to-Ball Joint Mounting Cap Screw Torque . . . . . 81 N•m (60 lb-ft)

Repair - Right Side (Traction Drive Pump Control)



MIF (MX2469)

A - Pin
B - Spacer
C - Shock Absorber
D - Washer (3 used)
E - Spacer
F - Snap Ring
G - Support
H - Cotter Pin
I - Cap Screw
J - Cap Screw
K - Nut (3 used)
L - Plate
M - Lock Nut
N - Plate
O - Screw (2 used)
P - Neutral Switch
Q - Washer (2 used)
R - Ball Bearing (3 used)
S - Cap Screw
T - Washer
U - Arm
V - Lubrication Fitting

W - Lock Nut
X - Eccentric
Y - Washer
Z - Bushing
AA- Flange Nut
AB- Spring
AC- Lock Nut (2 used)
AD- Cap Screw (3 used)
AE- Washer (3 used)
AF- Isolator (3 used)

- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fitting (V).

Mower Deck Drive Motor and Plate Assembly Removal and Installation

Removal

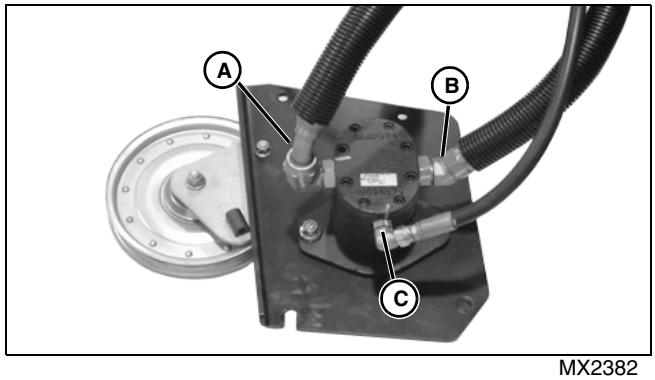
CAUTION: Avoid injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

NOTE: The procedure for removing the mower deck drive plate assembly is similar for all three mower decks. The left mower deck drive plate is shown.

1. Remove mower deck drive belt.

NOTE: Mark all hoses before removing to ensure correct installation.



MX2382

2. Disconnect and cap hydraulic lines (A-C).

Installation

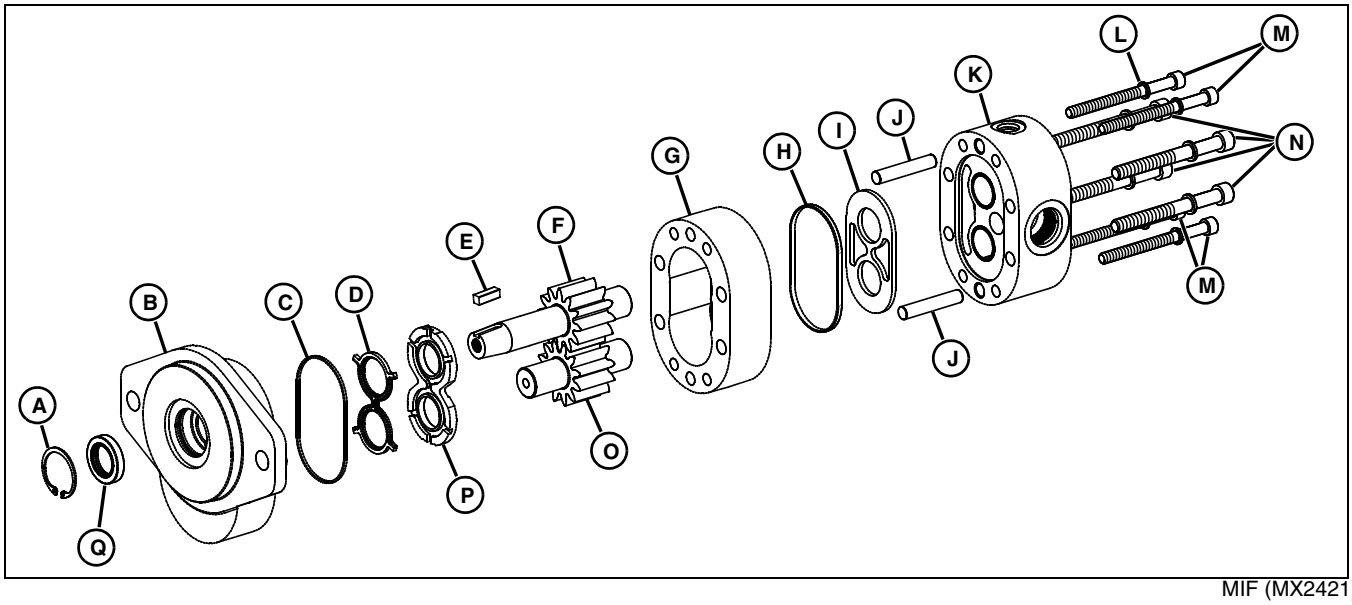
Installation is done in the reverse order of removal.

- Adjust drive belt tension.
- Fill hydraulic reservoir to correct level.
- Bleed air from hydraulic system.

Mower Deck Drive Motor Disassembly and Assembly

Disassembly

IMPORTANT: Avoid damage! Use caution when cleaning machined surfaces. DO NOT pry components apart. If resistance is noticed, tap lightly on the input shaft using a plastic hammer.



MIF (MX2421)

A - Retaining Ring
B - Front Plate
C - O-Ring
D - Seal
E - Key
F - Drive Gear
G - Body
H - O-Ring
I - Wear Plate
J - Alignment Pin (2 used)
K - Back Plate
L - Washer (8 used)
M - Socket Head Cap Screw (4 used)
N - Socket Head Cap Screw (4 used)
O - Idler Gear
P - Wear Plate
Q - Shaft Seal

1. Thoroughly clean the outside of the motor before disassembly.

IMPORTANT: Avoid damage! Excessive clamping pressure will distort motor housing.

2. Place motor in a soft-jaw vise, using just enough pressure to prevent the motor from turning while removing socket head cap screws (M and N).

3. Drain excess hydraulic oil from motor.

4. Remove cap screws (M and N).

5. Remove back plate (K).

6. Remove alignment pins (J), wear plate (I) and O-ring (H).

7. Remove motor body (G) from front plate (B).

8. Remove retaining ring (A) from drive gear (F).

9. Remove idler gear (O) and drive gear (F).

10. Remove wear plate (P), seal (D), and O-ring (C) from front plate (B).

11. Remove shaft seal (Q) from front plate (B).

CAUTION: Avoid injury! Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on motor components. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

12.Clean all metal parts with solvent and blow dry with compressed air.

13.Inspect all parts for damage, nicks, or unusual wear. Replace entire motor if any parts other than seals and O-rings are worn or damaged.

Assembly

Assembly is done in reverse order of disassembly.

IMPORTANT: Avoid damage! Always use new O-rings and seals. Damaged or used parts will leak.

NOTE: Apply hydraulic oil to all internal parts and seals prior to assembly.

Use a soft mallet or block of wood when installing shaft seal (Q) to prevent damage during installation.

- Tighten large socket head cap screws (M) to specification.
- Tighten small socket head cap screws (N) to specification.

Specifications

Mower Deck Drive Motor Large
Socket Head Cap Screw Torque . . . . . 61 N•m (45 lb-ft)
Mower Deck Drive Motor Small
Socket Head Cap Screw Torque . . . . . 34 N•m (25 lb-ft)

Mower Deck Lift Control Valve Removal and Installation

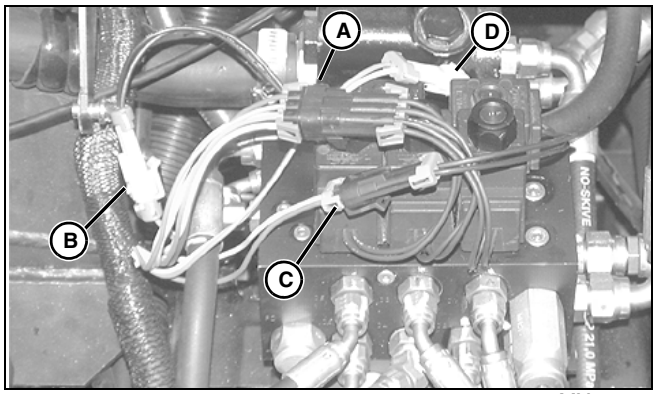
Removal

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

NOTE: All valve cartridges can and should be serviced without removing the valve body from the machine; however, it may be necessary to remove the valve assembly to perform service on other components.

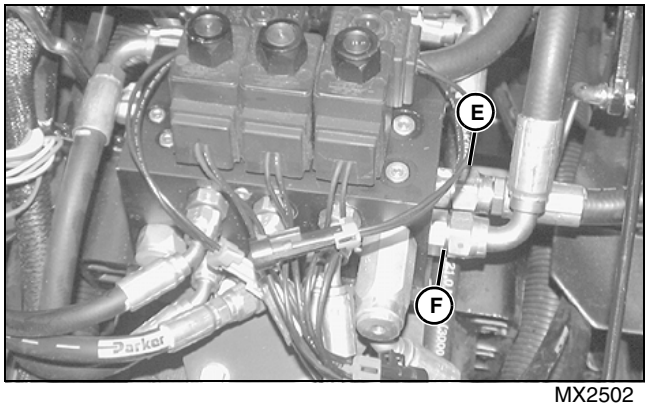
1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Remove seat and platform.
3. Disconnect negative (-) cable at battery.



MX2667

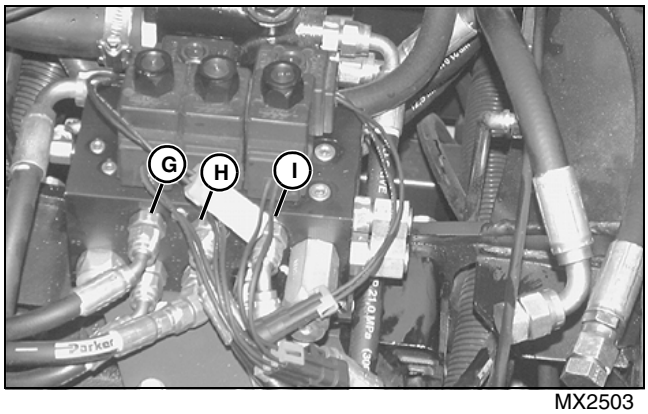
4. Disconnect wiring connectors (A, B, C, and D).

NOTE: Mark all hydraulic hoses and connection points before removing to ensure correct installation.



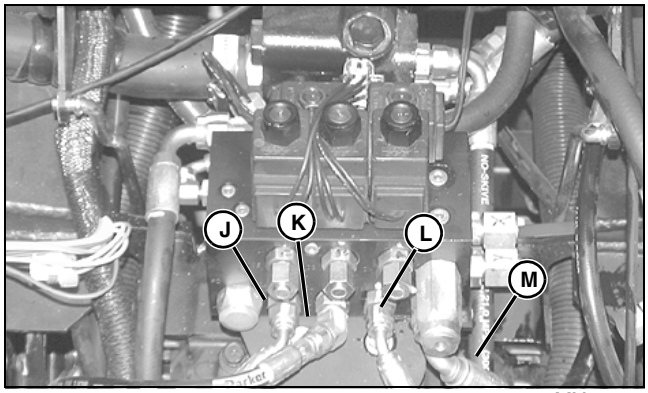
MX2502

5. Disconnect hydraulic hoses (E and F).



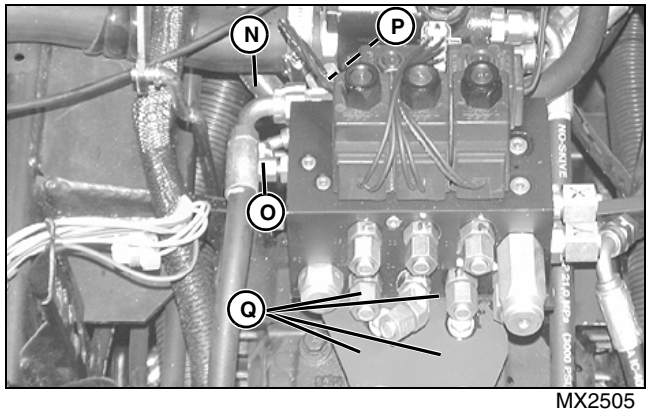
MX2503

6. Disconnect top row of hydraulic hoses (G, H, and I).



MX2504

7. Disconnect bottom row of hydraulic hoses (J, K, L, and M).

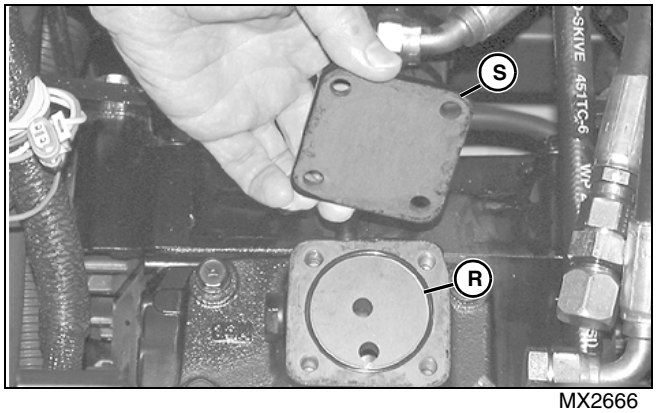


MX2505

8. Disconnect hydraulic hoses (N, O, and P).

9. Remove four cap screws (Q) from mounting plate.

10. Remove mower deck lift control valve.



MX2666

11. Inspect O-ring (R) for damage and that it is seated properly.

12. Install cover plate (S) prior to installation of mower deck lift control valve onto transaxle.

Installation

Installation is done in the reverse order of removal.

- Fill hydraulic reservoir to correct level.
- Bleed air from hydraulic system.

Lift Control Valve Repair

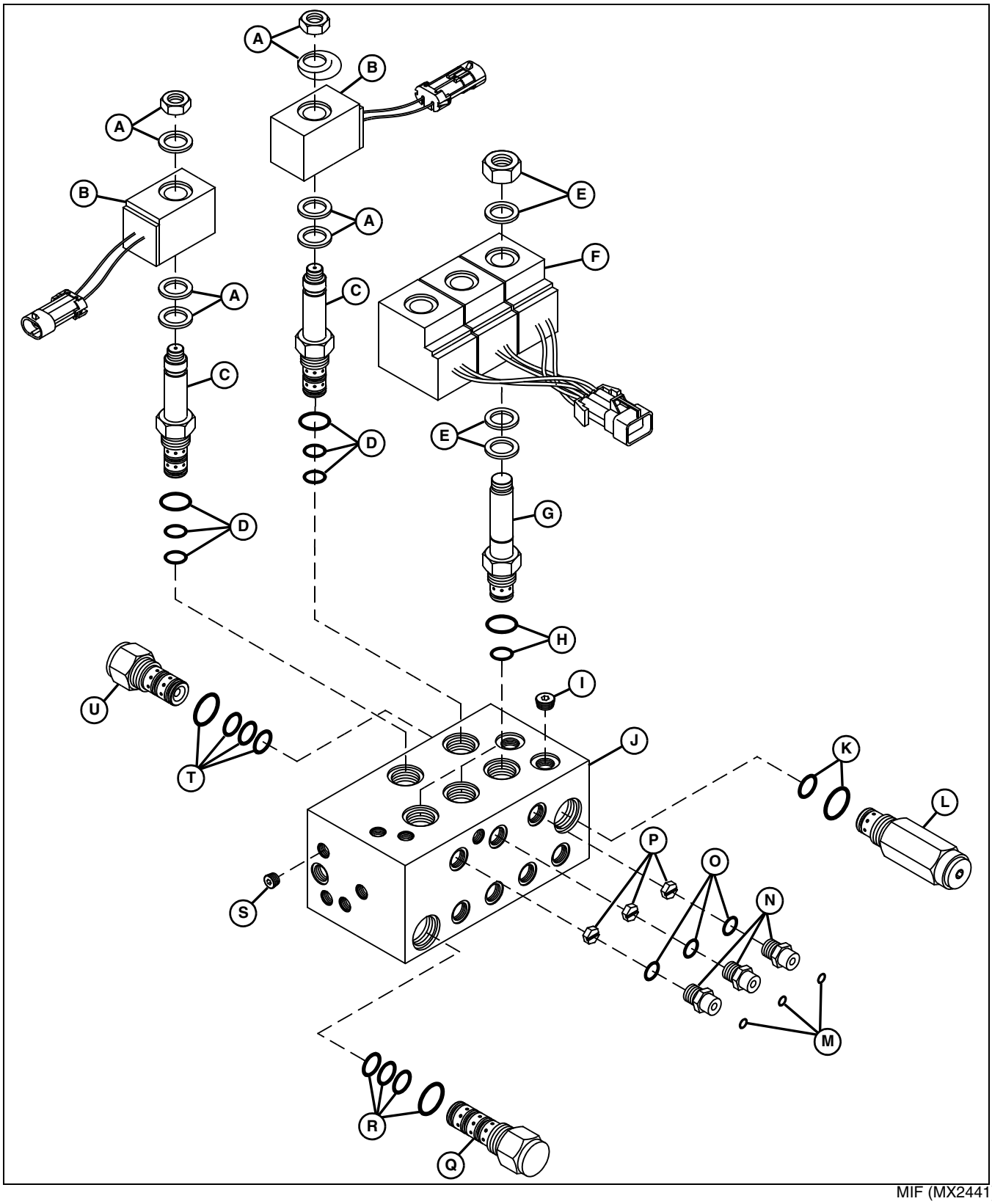
Special or Required Tools

Tool Name	Tool No.	Tool Use
12-Volt Power Supply or 12-Volt Battery	NA	Used to supply power for testing valve actuation.

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on valve components. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

NOTE: Make note of the position of the coil packs (F) before removing, to ensure correct installation.



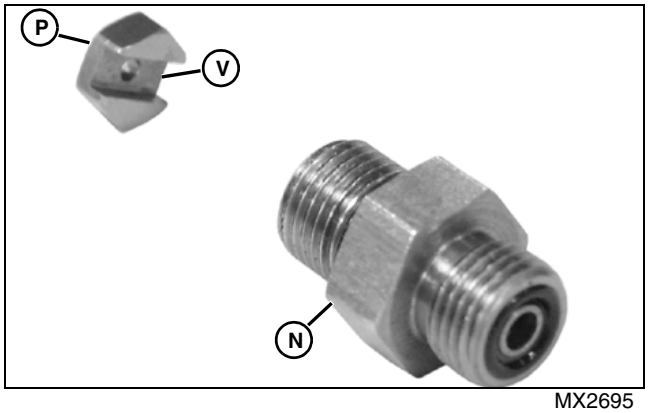
MIF (MX2441)

A - Washer/Nut Kit
B - Coil Pack (2 used)
C - Solenoid Valve (2 used)
D - O-Ring Kit
E - Washer/Nut Kit
F - Coil Pack Assembly
G - Solenoid Valve (3 used)
H - O-Ring Kit
I - Port Plug
J - Body
K - O-Ring Kit
L - Relief Valve
M - O-Ring Kit
N - Fittings (3 used)
O - O-Ring Kit
P - Orifice Disks (3 used)
Q - Pilot Valve
R - O-Ring Kit
S - Port Plug
T - O-Ring Kit
U - Poppet Valve

- Clean and inspect valve body and components.
- Using a 12-volt power source, test solenoid valve for actuation (listen for click).

IMPORTANT: Avoid damage! Always install new O-rings. Damaged or used O-rings will leak.

- Inspect all parts for wear, damage, or contamination. Replace parts as needed.



MX2695

- Install orifice disks (P) in ports C1, C3, and C5 with notch (V) toward fitting (N).
- Lubricate all O-rings with petroleum jelly before installing valves.
- Apply clean oil to spools and O-rings prior to assembly.

Specifications

Washer Nut/Kit Torque. . . . . 6 N•m (53 lb-in.)
Solenoid Valve Torque. . . . . 18 N•m (160 lb-in.)
Relief Valve Torque . . . . . 44 N•m (33 lb-ft)
Pilot Valve Torque . . . . . 44 N•m (33 lb-ft)
Poppet Valve Torque . . . . . 44 N•m (33 lb-ft)

Mower Deck Motor Control Valve Removal and Installation - Model 1600

Removal

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

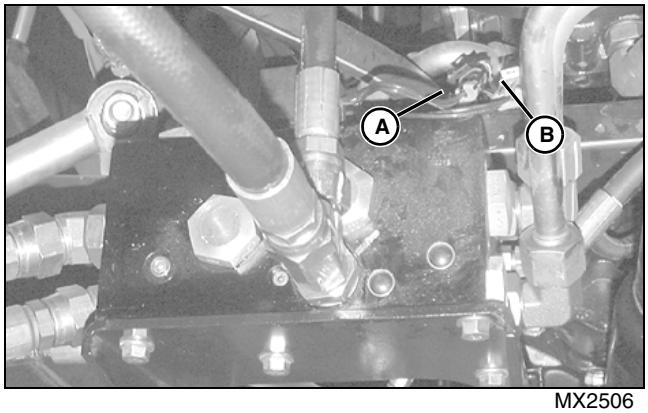
IMPORTANT: Avoid damage! DO NOT lift or support the rear of the machine by the rear bumper, as it is not designed to support the weight of the machine.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Using a safe lifting device, lift the rear of the machine. Place blocks or jackstands under machine frame.

IMPORTANT: Avoid damage! Clean area around hoses before disconnecting.

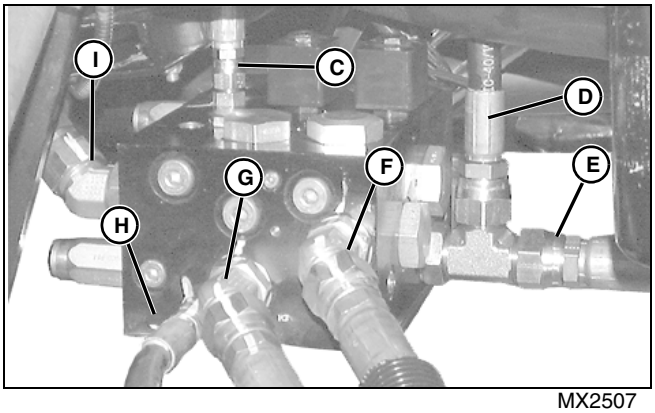
NOTE: Mark all hydraulic hoses and lines before removing to ensure correct installation.

Close all open hoses and fittings using caps and plugs.



MX2506

3. Disconnect solenoid wiring connectors (A and B).



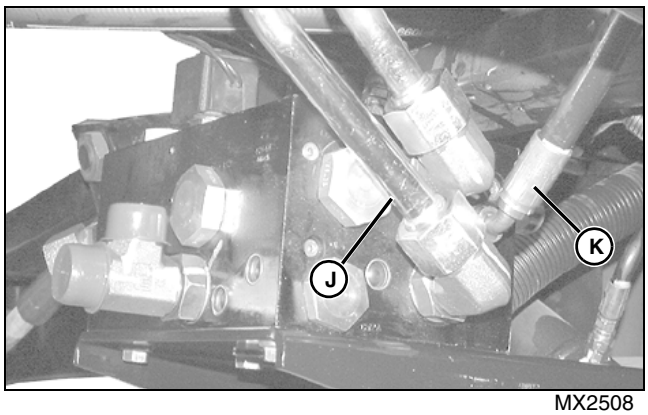
MX2507

4. Disconnect hydraulic hose (C) from top of valve.

5. Disconnect hydraulic hoses (D and E) from tee on rear of valve.

6. Disconnect left mower deck motor hydraulic hoses (F-H).

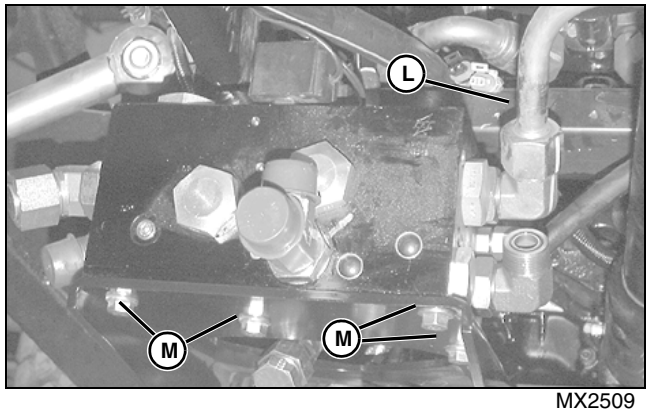
7. Disconnect hydraulic hose (I) from front of valve.



MX2508

8. Remove right mower deck motor hydraulic line (J).

9. Disconnect right mower deck motor hydraulic hose (K).



MX2509

10. Disconnect right mower deck motor hydraulic line (L) from valve.

11. Remove four cap screws (M).

12. Remove valve assembly.

Installation

Installation is done in the reverse order of removal.

- Fill hydraulic reservoir to correct level.
- Bleed air from hydraulic system.

Mower Deck Mow Control Valve Repair - Model 1600

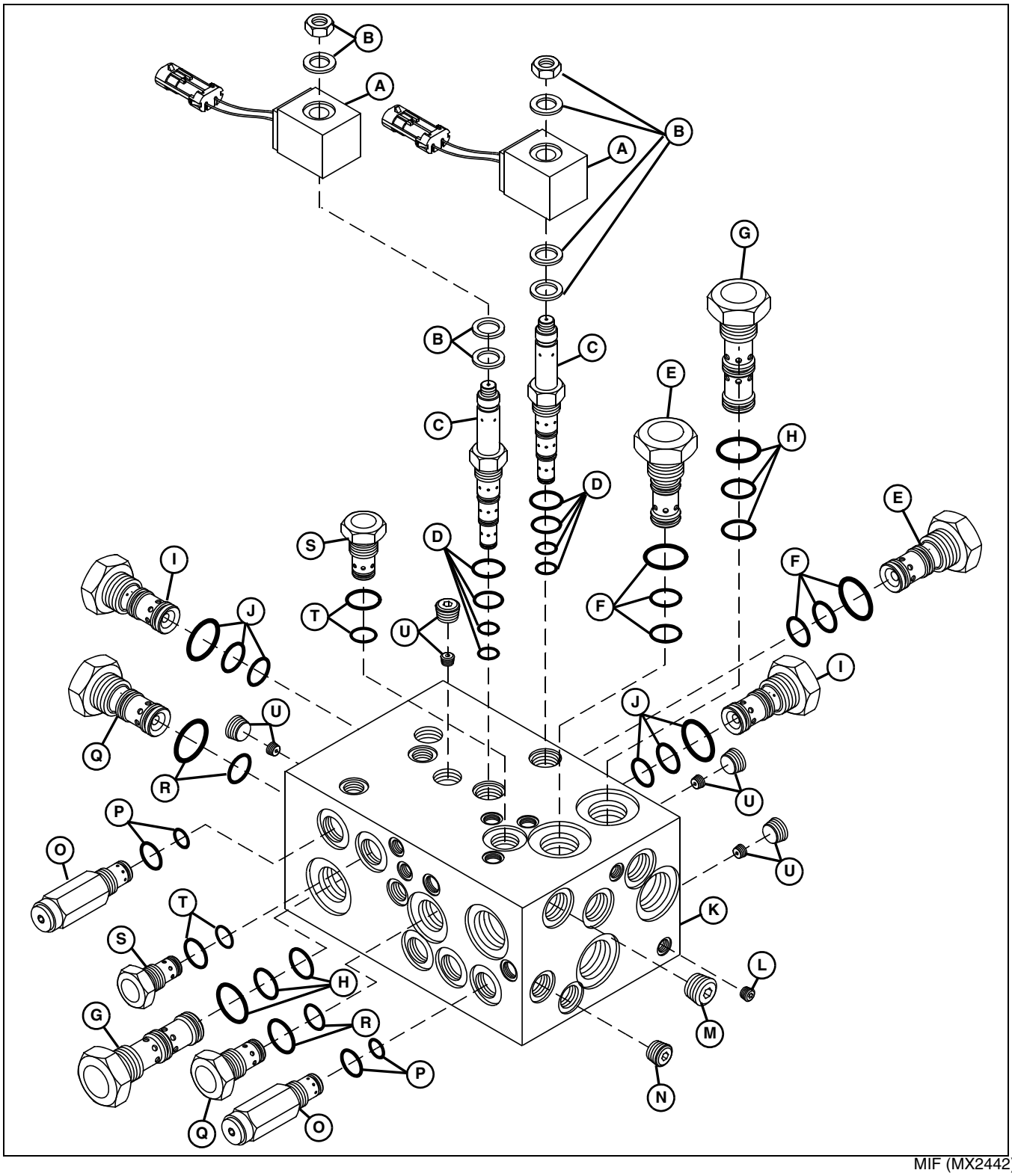
Special or Required Tools

Tool Name	Tool No.	Tool Use
12-Volt Power Supply or 12-Volt Battery	NA	Used to supply power to test valve actuation.

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on valve components. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

NOTE: Mark the location of valve cartridges before removing to ensure correct installation.



MIF (MX2442)

A - Coil Pack (2 used)
B - Washer/Nut Kit (2 used)
C - Solenoid Valve (2 used)
D - O-Ring Kit (2 used)
E - Motor Logic Valve (2 used)
F - O-Ring Kit (2 used)
G - Pilot Check Valve (2 used)
H - O-Ring Kit (2 used)
I - Pilot Check Valve (2 used)
J - O-Ring Kit (2 used)

K - Valve Body
L - Port Plug (11 used)
M - Port Plug (7 used)
N - Port Plug (7 used)
O - Relief Valve (2 used)
P - O-Ring Kit (2 used)
Q - Positive Stop Check Valve (2 used)
R - O-Ring Kit (2 used)
S - Check Valve (2 used)
T - O-Ring Kit (2 used)
U - Orifice (4 used)

- Clean and inspect valve body and components.

IMPORTANT: Avoid damage! Always install new O-rings. Damaged or used O-rings will leak.

- Using a 12-volt power source, test solenoid valve for actuation (listen for click).
- Inspect all parts for wear, damage, or contamination. Replace parts as needed.

NOTE: LC1 and LC3 valve cartridges function identically and can be interchanged.

LC2 and LC4 valve cartridges function identically and can be interchanged.

LC1, LC3 and LC2, LC4 will fit into each other's ports, but will not function properly if interchanged.

- Lubricate all O-rings with petroleum jelly before installing valves.
- Apply clean oil to spools and O-rings prior to assembly.

Specifications

Washer/Nut Kit Torque	**6 N•m (53 lb-in.)**
Solenoid Valve Torque	**18 N•m (160 lb-in.)**
Motor Logic Valve Torque	**85 N•m (63 lb-ft)**
Pilot Check Valve Torque	**85 N•m (63 lb-ft)**
Relief Valve Torque	**45 N•m (33 lb-ft)**
Positive Stop Check Valve Torque	**58 N•m (43 lb-ft)**
Check Valve Torque	**45 N•m (33 lb-ft)**

Mower Deck Motor Control Valve Removal and Installation - Model 1600 Turbo

Removal

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

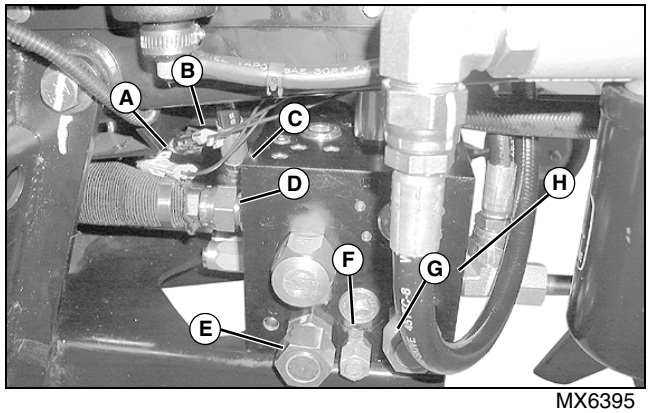
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

1. Park machine safely. (See "Park Machine Safely" on page 3.)

IMPORTANT: Avoid damage! Clean area around hoses before disconnecting.

NOTE: Mark all hydraulic hoses and lines before removing to ensure correct installation.

Close all ports and lines using caps and plugs.



MX6395

A - Connector for Solenoid SV1
B - Connector for Solenoid SV2
C - Port T
D - Port TN

E - Port M3

F - Port CD1

G - Port M4

H - Port OUT

2. Disconnect hoses from ports (E-G).

3. Remove left mower deck.

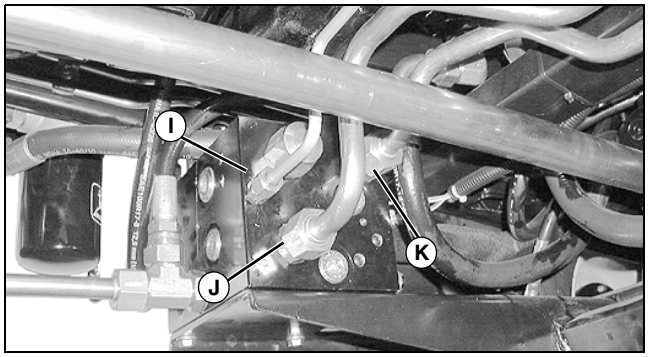
IMPORTANT: Avoid damage! DO NOT lift or support the rear of the machine by the rear bumper, as it is not designed to support the weight of the machine.

4. Using a safe lifting device, lift the rear of the machine. Place blocks or jackstands under machine frame.

5. Disconnect wiring connectors (A and B) from solenoids on top of valve block.

6. Disconnect hoses for ports (C and D).

7. Disconnect hose and line from tee fitting on port (H).



MX6396

A - Port CD2

B - Port M6

C - Port M5

8. Disconnect lines from ports (I-K) on right side of valve block.

9. Remove cap screws from bottom of valve block.

10. Remove valve block from machine.

Installation

Installation is done in the reverse order of removal.

- Fill hydraulic reservoir to correct level.
- Bleed air from hydraulic system.

Mower Deck Mow Control Valve Repair - Model 1600 Turbo

Special or Required Tools

Tool Name	Tool No.	Tool Use
12-Volt Power Supply or 12-Volt Battery	NA	Used to supply power to test valve actuation.

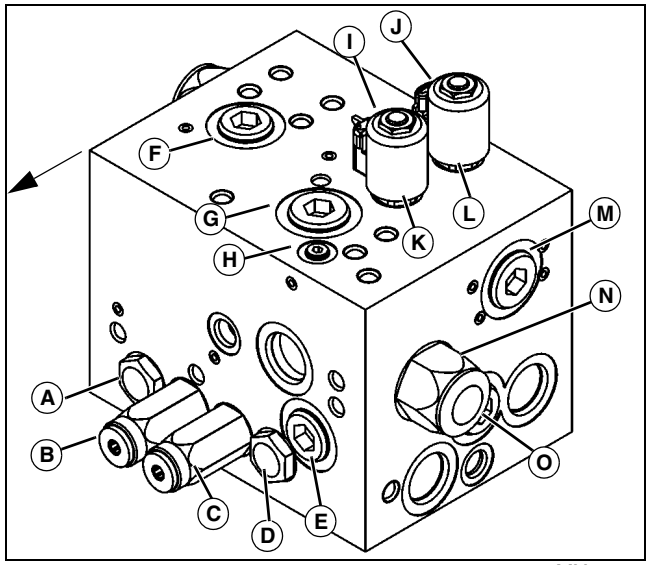
Other Material

Part No.	Part Name	Part Use
T43512 (US) 242 (LOCTITE®) TY9473 (Canada)	Thread Lock and Sealer (Medium Strength)	Applied to threads of all NWD plugs before installation.

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on valve components. Contamination can result in serious damage or inadequate operation.

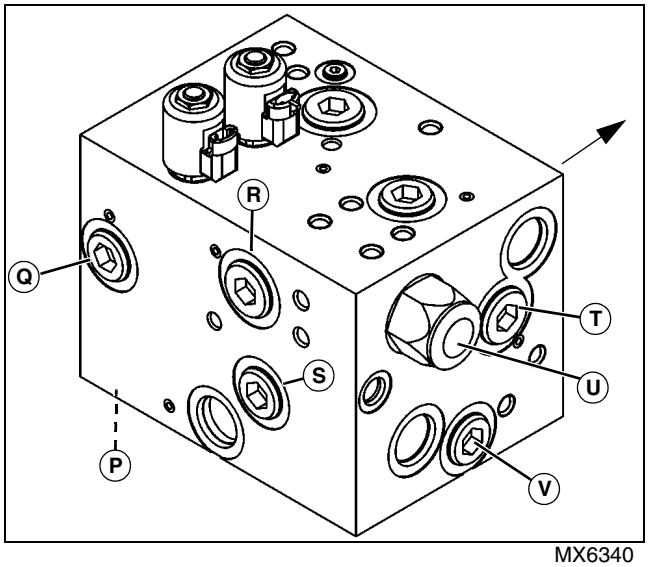
DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

NOTE: Mark the location of valve cartridges before removing, to ensure correct installation.



MX6339

Picture Note: Arrow Points to Front of Machine



MX6340

Picture Note: Arrow Points to Front of Machine

A - Right Deck Check Valve (C2) (-10 Cartridge)
B - Right Deck Relief Valve (R2) (-10 Cartridge)
C - Left Deck Relief Valve (R1) (-10 Cartridge)
D - Left Deck Check Valve (C1) (-10 Cartridge)
E - Plug (-12 NWD)
F - Plug (-12 NWD)
G - Plug (-14 NWD)
H - Orifice 0.031 in. (0.787 mm) (OR) with Plug (-4 NWD)
I - Left Deck Solenoid Coil with Retaining Nut (SV1)
J - Right Deck Solenoid Coil with Retaining Nut (SV2)
K - Left Deck Solenoid Valve (SV1) (-7 Cartridge)
L - Right Deck Solenoid Valve (SV2) (-7 Cartridge)
M - Right Deck Control Piston (PIS2) with Plug (-14 NWD)
N - Left Deck Pilot Control Valve (PD1) (-16 Cartridge)
O - Plug (-12 NWD)
P - Plug (-12 NWD)
Q - Plug (-12 NWD)
R - Plug (-14 NWD)
S - Plug (-12 NWD)
T - Left Deck Control Piston (PIS1) with Plug (-14 NWD)
U - Right Deck Pilot Control Valve (PD2) (-16 Cartridge)
V - Plug (-12 NWD)

- Clean and inspect valve body and components.
- Using a 12-volt power source, test solenoid valve for actuation (listen for click).

IMPORTANT: Avoid damage! Always use new O-rings. Damaged or used O-rings will leak.

- Inspect all parts for wear, damage, or contamination. Replace parts as needed.

NOTE: Pilot control valves (N and U) function identically and can be interchanged.

Check valves (A and D) function identically and can be interchanged.

Relief valves (B and C) function identically and can be interchanged.

Pistons (M and T) function identically and can be interchanged.

Solenoid valves (K and L) function identically and can be interchanged.

DO NOT use solenoid coils (I and J) interchangeably.

- Lubricate all O-rings with petroleum jelly before installing valve.
- Apply clean oil to spools and O-rings prior to assembly.
- Apply LOCTITE 242 thread lock and sealer (medium strength) to threads of all NWD plugs.

Specifications

Solenoid Coil Retaining Nut
(SV1, SV2) Torque . . . . . 5.6-6.2 N•m (50-55 lb-in.)
-7 Cartridge
(SV1, SV2) Torque . . . . . 27-34 N•m (20-25 lb-ft)
-10 Cartridge
(C1, C2, R1, R2) Torque . . . . . 41-47 N•m (30-35 lb-ft)
-16 Cartridge
(PD1, PD2) Torque . . . . . 81-88 N•m (61-65 lb-ft)
-4 NWD Plug
(OR) Torque. . . . . 14.7-15.3 N•m (130-135 lb-in.)
-12 NWD Plug
(Other) Torque . . . . . 115-118 N•m (85-87 lb-ft)
-14 MWD Plug
(PIS1, PIS2, Other) Torque. 148-152 N•m (109-112 lb-ft)

Front Lift Cylinder Removal and Installation

Removal

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

1. Remove front mower deck.

2. Using a safe lifting device, jack the front of the machine under the front lift linkage frame, high enough to raise both wheels off the ground.

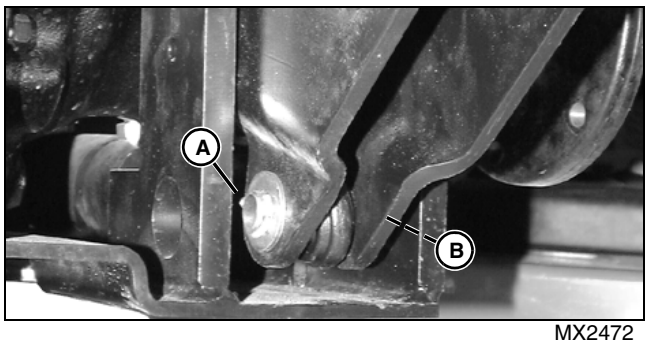
IMPORTANT: Avoid damage! Use caution when placing blocks under the subframe to avoid pinching or crushing the lift cylinder hydraulic hose.

3. Place wood blocks or other suitable blocking material under the wing (side) mower deck lift subframe.

4. Lower the machine onto the wood blocks.

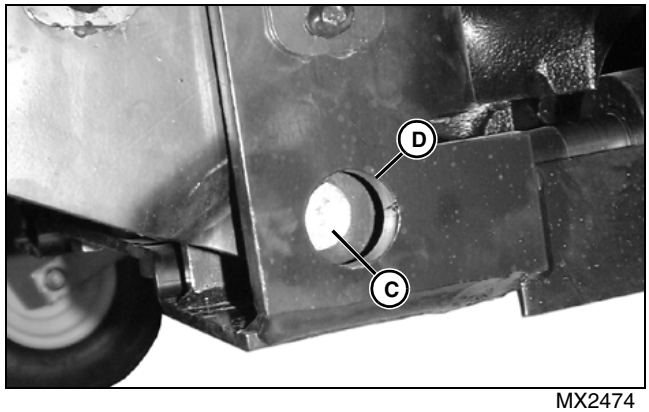
5. Remove front wheels.

6. Raise front lift arms to fully raised position.



MX2472

7. Remove cotter pin (A) and washer (B) (both sides of machine).



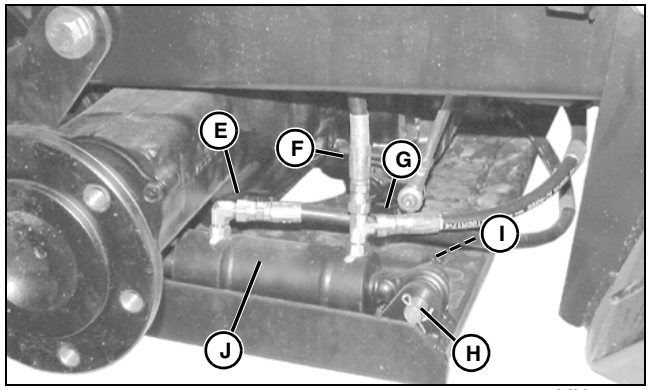
MX2474

8. Lower lift arms until the anchor pins (C) align with holes (D) in frame.

9. Support the lift arms.

10. Remove anchor pins (C) (both sides of the machine).

NOTE: Mark all hoses before removing to ensure correct installation.



MX2475

11. Disconnect and plug hydraulic hoses (E, F, and G).

12. Remove cotter pin (H).

13. Remove anchor pin (I).

14. Remove cylinder (J).

Installation

Installation is done in the reverse order of removal.

- Fill hydraulic reservoir to correct level.
- Bleed air from hydraulic system.

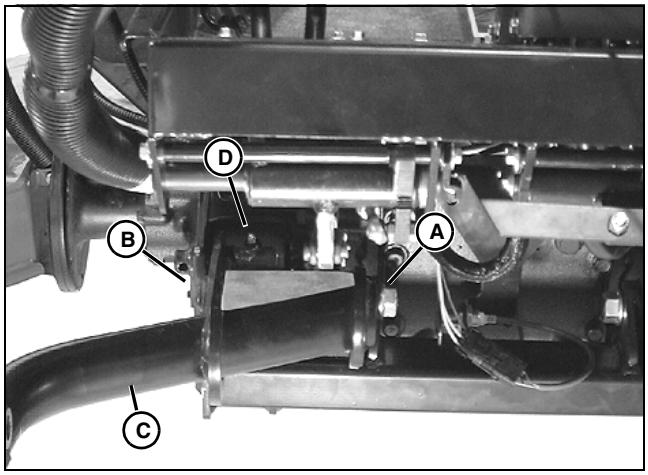
Front Mower Deck Lift Arm Removal and Installation

Removal

1. Remove front mower deck.
2. Lower the front lift arms.
3. Using a safe lifting device, jack the front of the machine under the front lift linkage frame, high enough to raise both wheels off the ground.

IMPORTANT: Avoid damage! Use caution when placing blocks under the subframe to avoid pinching or crushing the lift cylinder hydraulic hose.

4. Place wood blocks or other suitable blocking material under the wing (side) mower deck lift subframe.
5. Lower the machine onto the wood blocks.
6. Remove front wheels.



MX2477

7. Remove nut (A) and pin (B) (both sides of the machine).
8. Remove lift arm (C).

Installation

Installation is done in the reverse order of removal.

Apply chassis and roller water-resistant grease to lubrication fitting (D).

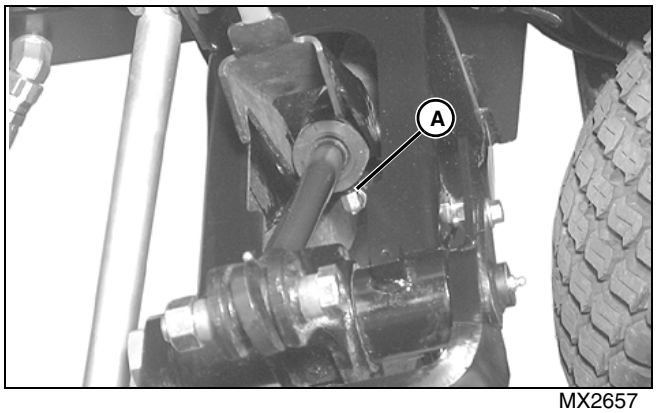
Side Mower Deck Lift Cylinder Removal and Installation

Removal

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Lower decks completely to the ground.
3. While sitting in the seat with the key in the RUN position and the engine OFF, move the raise/lower levers to the raise and lower positions several times to relieve pressure.

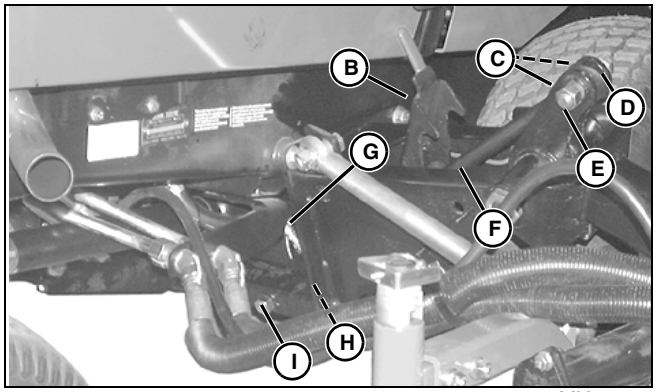
IMPORTANT: Avoid damage! Clean the area around the hoses before disconnecting.

NOTE: Mark all hoses before removing to ensure correct installation.



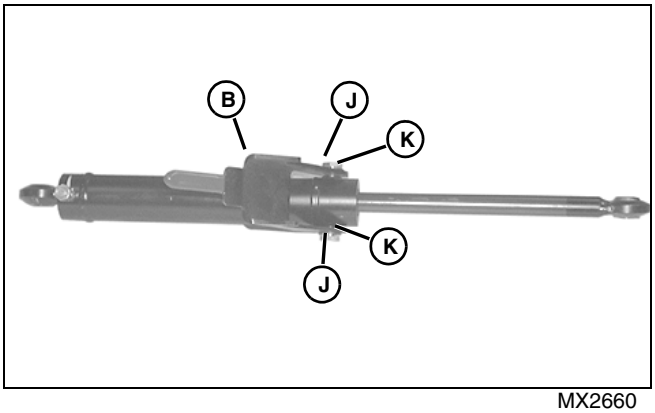
MX2657

4. Disconnect hydraulic hose (A).



MX2659

5. Disconnect hydraulic hose (G).
6. Remove nut (E), cap screw (D), and two spacers (C).
7. Remove cap screw (I) and nut (H) and remove lift cylinder (F) with latch (B) attached.



MX2660

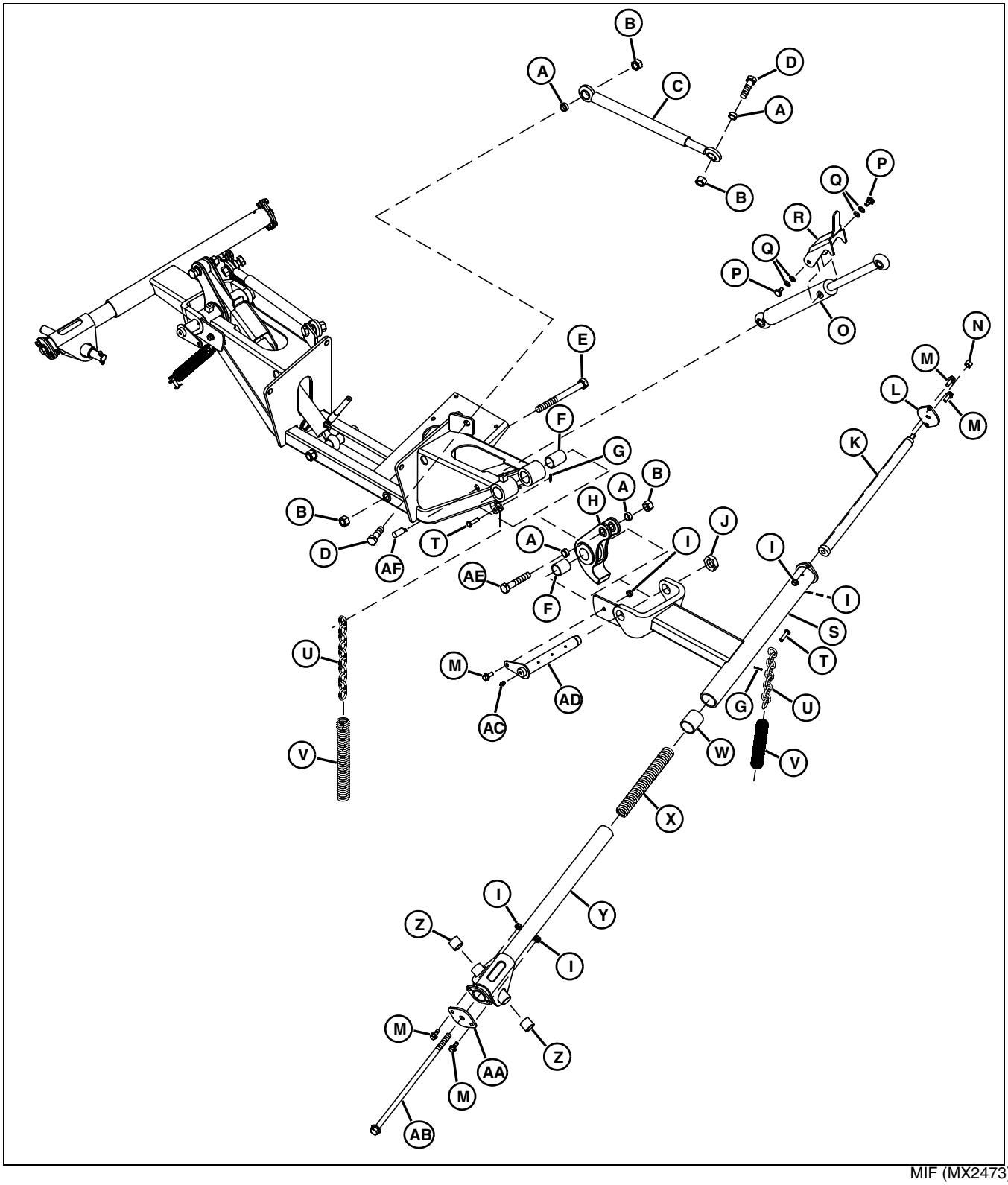
8. Remove two cap screws (J) and washers (K).
9. Remove latch (B).

Installation

Installation is done in the reverse order of removal.

Bleed air from hydraulic system.

Side Mower Deck Lift Subframe Repair



MIF (MX2473)

A - Spacer (4 used)
B - Nut (4 used)
C - Link
D - Cap Screw (2 used)
E - Cap Screw
F - Bushing (8 used)
G - Cotter Pin (2 used)
H - Lift Link
I - Flange Nut (5 used)
J - Nut
K - Shaft
L - Flange
M - Cap Screw (5 used)
N - Lock Nut
O - Lift Cylinder
P - Cap Screw (2 used)
Q - Washer (4 used)
R - Transport Latch
S - Arm
T - Pin (2 used)
U - Lift Chain (2 used)
V - Sleeve (2 used)
W - Bushing
X - Spring
Y - Bracket
Z - Bushing (2 used)
AA- Plate
AB- Cap Screw
AC- Lubrication Fitting (Apply Grease)
AD- Pin
AE- Cap Screw
AF- Lift (Proximity) Switch

NOTE: Left mower deck lift arm shown. Right lift arm is similar.

Quantities listed are per side.

- Inspect all parts for wear or damage. Replace parts as needed.
- Apply chassis and roller water-resistant grease to lubrication fitting (AC).

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Specifications

Test and Adjustment Specifications

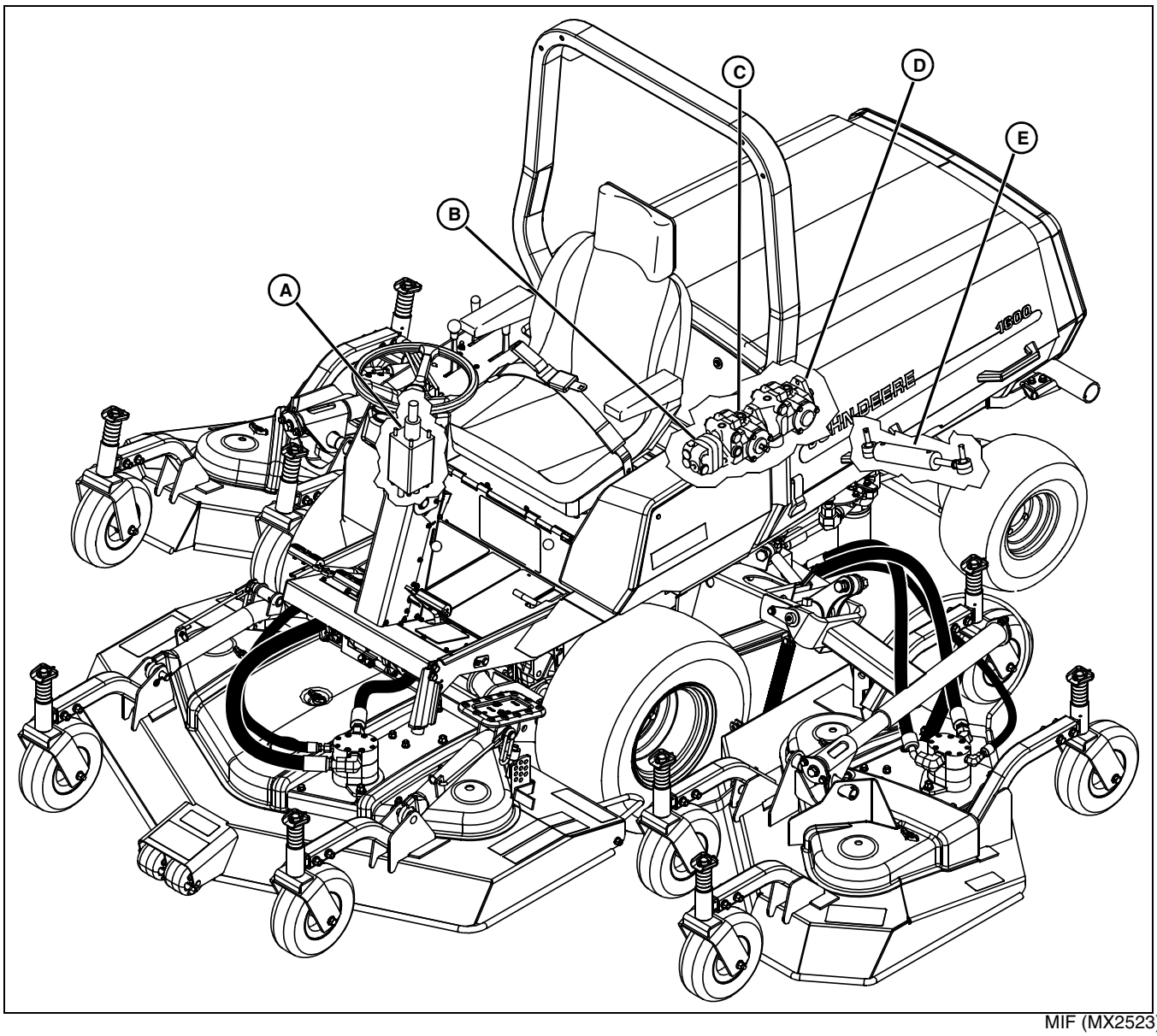
Rear Tire Air Pressure[3]	**138 kPa (20 psi)**
Rear Tire Air Pressure - 1600 Turbo S.N. (040001-)	**193 kPa (28 psi)**
Steering Toe-In Difference (Less in Front than the Rear)	**3-4 mm (0.118-0.157 in.)**
Leakage Test Applied Torque	**6.8 N•m (72 lb-in.)**
Steering Relief Valve Opening Pressure (Differential)	**10 756 kPa (1560 psi)**

Repair Specifications

Steering Wheel Nut Torque	**38 N•m (28 lb-ft)**
Steering Cylinder Castle Nut Torque	**75 N•m (55 lb-ft)**

3. 1600 Turbo S.N. (-040000) see SIB 05-11-70-2

Component Location and Operation **Steering System Component Location**



MIF (MX2523)

A - Steering Valve
B - Steering/Lift Pump
C - Mower Deck Drive Pump
D - Traction Drive Pump
E - Steering Cylinder

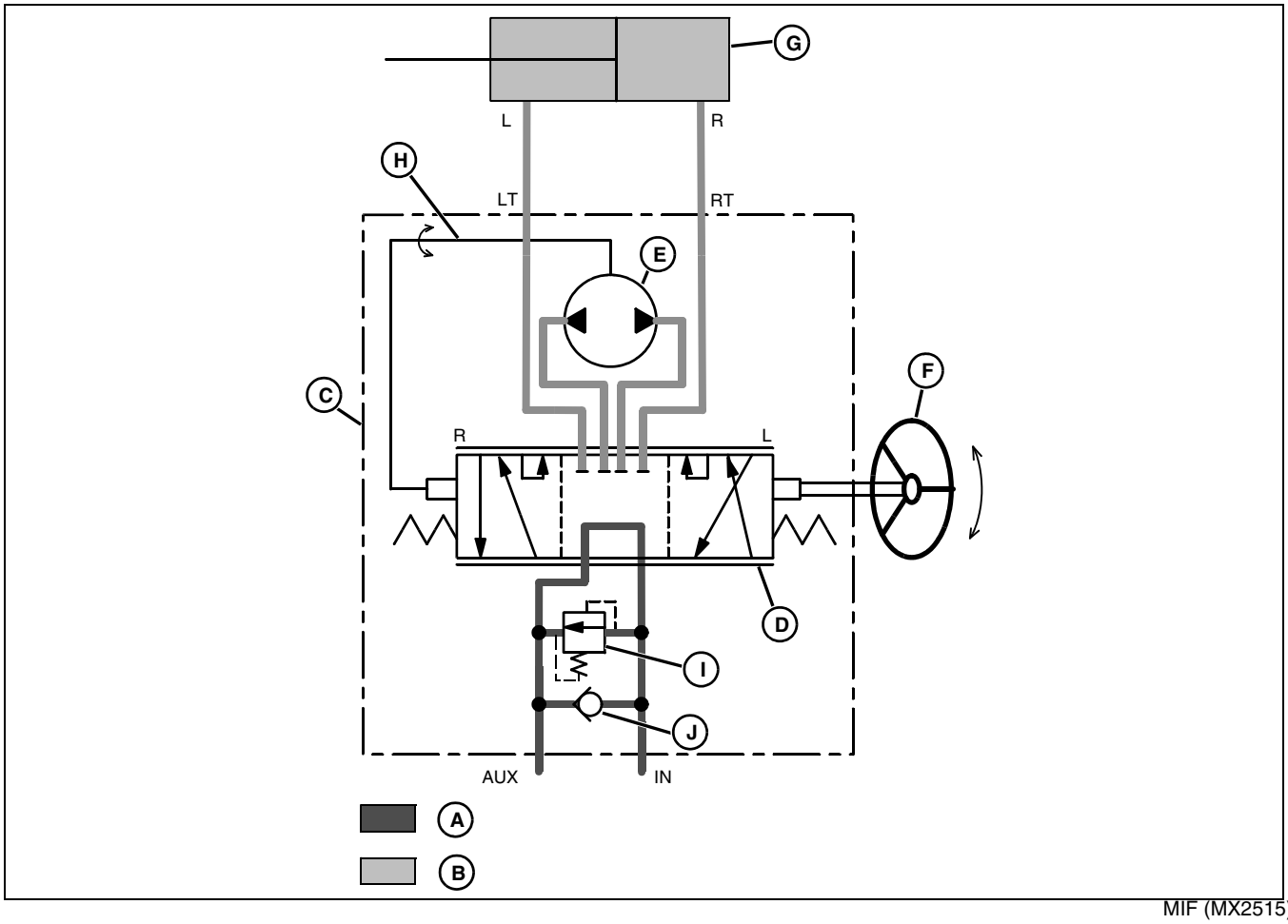
Theory of Operation

Steering System Operation - Neutral

Function

To block the flow of pressurized oil to the steering cylinder when no turning action is desired.

Theory of Operation



MIF (MX2515)

A - High-Pressure Oil
B - Trapped Oil
C - Steering Valve Assembly
D - Control Valve Section
E - Gerotor
F - Steering Wheel
G - Steering Cylinder
H - Mechanical Link
I - Relief Valve
J - Check Valve

The steering valve assembly (C) consists of a self-centering fluid control valve section (D) and a gerotor (E). These are hydraulically and mechanically interconnected inside the unit.

Pressurized oil (A) is supplied to the steering valve IN port by the steering/lift pump.

Whenever the steering wheel (F) is released, spring pressure moves the control valve section to the neutral position. In this position, pressurized oil from the steering/lift pump enters the steering valve at the IN port. It is then allowed to flow through the control valve section and flows out through the AUX port. In this position, the control valve prevents pressurized oil from reaching the gerotor, and stops the flow of pressurized oil to the steering cylinder (G).

As the oil exits the AUX port of the steering valve, the oil is used as charge flow for the mower deck drive and traction drive pumps.

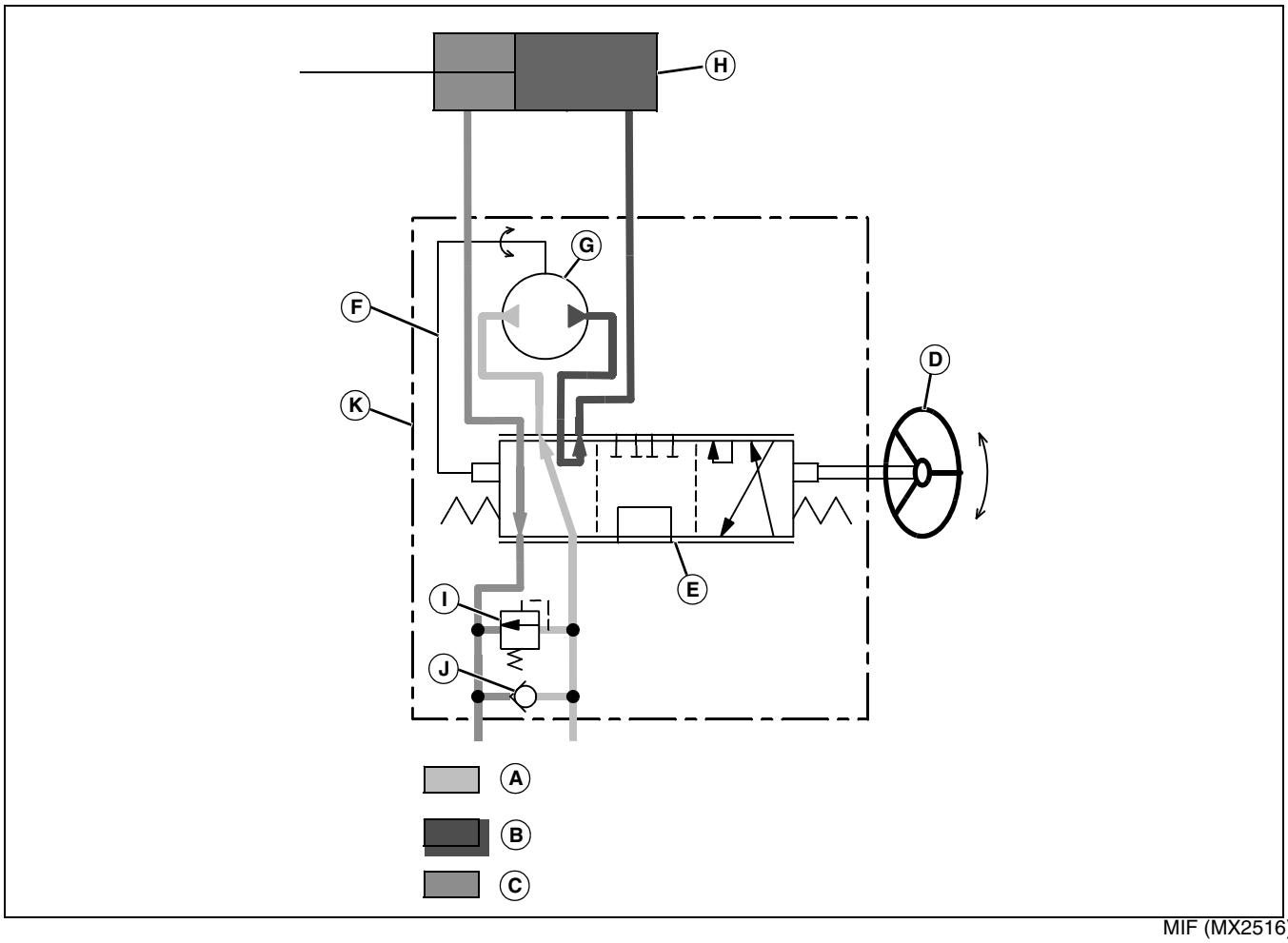
While the steering valve is in the neutral position, trapped oil (B) in the steering cylinder is allowed to flow into the control valve section. This slight flow will give the operator a feel of any change in direction of the rear wheel, through the steering system, because of the mechanical link (H) between the gerotor and steering wheel.

Steering System Operation - Power Turn

Function

To supply pressurized oil to the proper side of the steering cylinder to turn the rear wheels.

Theory of Operation



MIF (MX2516)

Picture Note: Right Turn Shown

A - High-Pressure Oil
B - Metered Oil
C - Return (Charge Pressure) Oil
D - Steering Wheel
E - Control Valve Section
F - Mechanical Link
G - Gerotor
H - Steering Cylinder
I - Relief Valve
J - Check Valve
K - Steering Valve Assembly

When the steering wheel (D) is turned to the right, the control valve section (E) is shifted by the mechanical link (F). This allows pressurized oil to flow through the control valve section to the inlet of the gerotor (G). As the steering wheel continues to turn, system oil is forced through the gerotor and control valve section. Metered oil (B) is directed to the right side of the steering cylinder (H), forcing the piston to the left. Oil is forced out the other side of the cylinder and flows back to the control valve section. This oil then continues to flow to the lift valve, oil cooler, oil filter and charge pressure relief valve to be used as charge flow for the hydrostatic pumps.

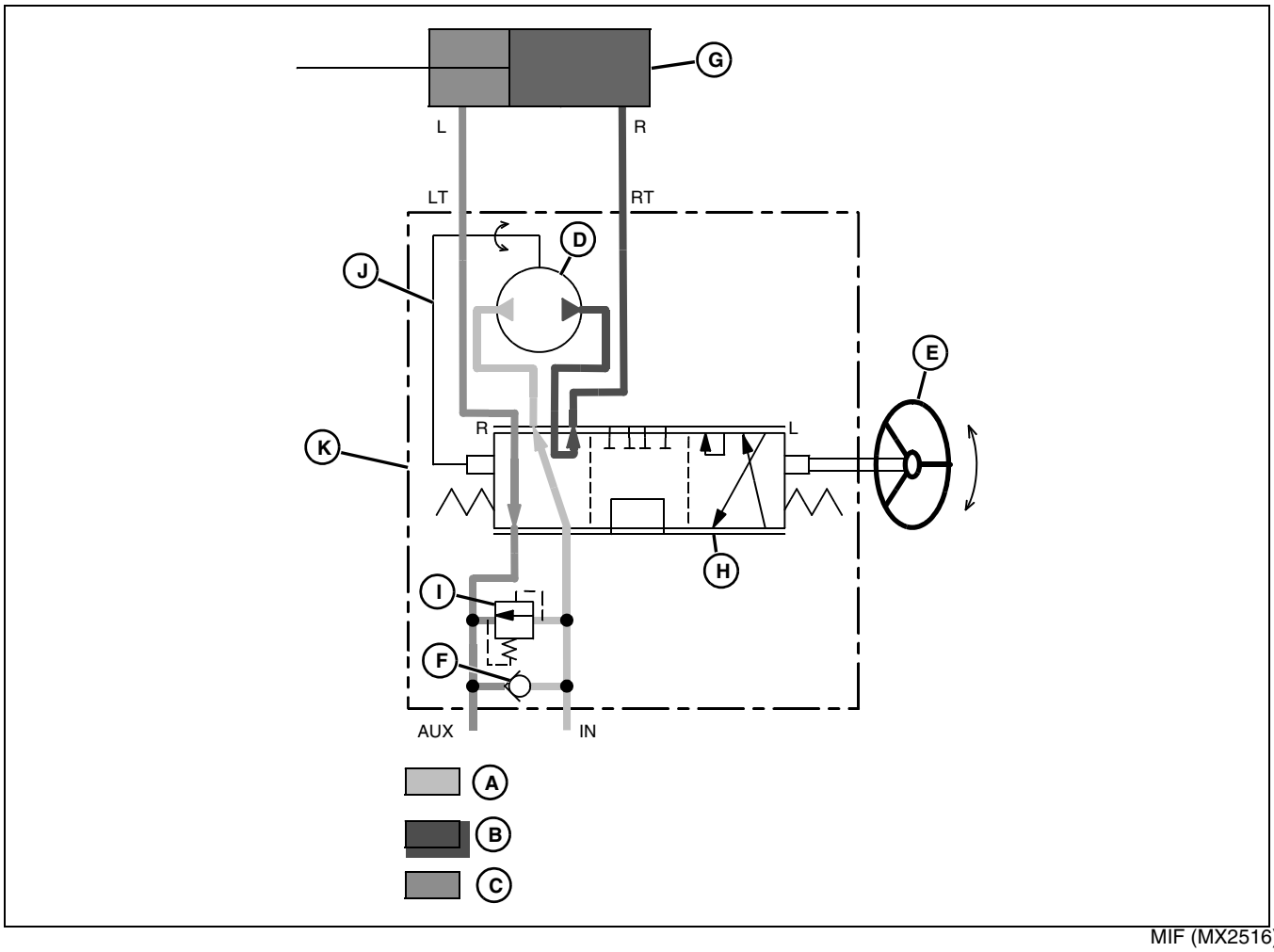
If the steering wheel is held against the stop, the relief valve (I) will open at 10 756 kPa (1560 psi) differential, allowing the high-pressure oil to bypass the control valve and exit the steering valve assembly.

Steering System Operation - Manual Turn

Function

To allow manual steering if hydraulic pressure is not available.

Theory of Operation



MIF (MX2516)

Picture Note: Right Turn Shown

A - Low-Pressure Oil
B - Metered Oil
C - Return (Charge Pressure) Oil
D - Gerotor
E - Steering Wheel
F - Check Valve
G - Steering Cylinder
H - Control Valve Section
I - Relief Valve
J - Mechanical Link
K - Steering Valve Assembly

If hydraulic pressure is lost, the machine can still be steered without hydraulic assistance. All components still function the same, with the exception of the gerotor and check valve.

The gerotor (D) now acts as a pump, moving oil from one side of the gerotor to the other as the steering wheel (E) is turned. The check valve (F) opens, allowing oil to be drawn from the return side of the steering cylinder (G). Hydraulic oil is forced by the gerotor to either end of the steering cylinder, depending on which way the steering wheel is turned.

When the steering wheel is released, the centering springs move the control valve section (H) to the center (neutral) position, and will remain there until the steering wheel is turned again.

Diagnostics

Steering Not Driving Straight

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Steering Not Driving Straight

(1) Tires.
Are tires inflated to correct pressure?

Yes - Go To Step (2)

No - Inflate rear tires to specification.

(2) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (3)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 591.)

(3) Rear Wheels.
Are rear wheel bearings dirty or worn?

Yes - Replace wheel bearings.

No - Go To Step (4)

(4) Spindle Bearings.
Are spindle bearings worn?

Yes - Replace spindle bearings.

No - Go To Step (5)

(5) Steering Cylinder.
Are ball joints worn?
Is mounting hardware loose or out of place?

Yes - Ball Joints are worn. Replace steering cylinder.

Yes - Mounting hardware is loose or missing. Tighten and/or replace missing hardware.

No - Go To Step (6)

Symptom: Steering Not Driving Straight

(6) Steering Valve.
Engine running at FAST idle.
Forward/reverse pedals in NEUTRAL position.
Park brake ENGAGED.
Is valve damaged, sticking, or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See “Steering System Leakage Test” on page 592.)

No - Go To Step (7)

(7) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See “Steering Valve Leakage Test” on page 593.)

No - Go To Step (8)

(8) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Are hoses or connections leaking?

Yes - Tighten connections and/or replace hoses.

Specifications

Rear Tire Air Pressure . . . . . 138 kPa (20 psi)
Rear Tire Air Pressure - 1600 Turbo S.N. (040001-). . . . . 193 kPa (28 psi)

Steering Wheel Vibration

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Steering Wheel Vibration

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See "Hydraulic Oil Foams" on page 591.)

(2) Tires.
Are tires inflated to correct pressure?

Yes - Go To Step (3)

No - Inflate rear tires to specification.

(3) Rear Wheels.
Are rear wheel bearings dirty or worn?

Yes - Replace wheel bearings.

No - Go To Step (4)

(4) Spindle Bearings.
Are spindle bearings worn?

Yes - Replace spindle bearings.

No - Go To Step (5)

(5) Steering Cylinder.
Are ball joints worn?
Is mounting hardware loose or missing?

Yes - Ball joints are worn. Replace steering cylinder.

Yes - Mounting hardware is loose or missing. Tighten and/or replace missing hardware.

Specifications

Rear Tire Air Pressure . . . . . 138 kPa (20 psi)
Rear Tire Air Pressure - 1600 Turbo S.N. (040001-) . . . . . 193 kPa (28 psi)

Sluggish Steering Response

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Sluggish Steering Response

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?

(1) Is hydraulic oil free of foam (air in system)?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See "Hydraulic Oil Foams" on page 591.)

(2) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Do hoses have any sharp bends or restrictions?

Yes - Replace hoses.

No - Go To Step (3)

(3) Steering Valve.
Engine running at FAST idle.
Forward/reverse pedals in NEUTRAL position.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See "Steering System Leakage Test" on page 592.)

No - Go To Step (4)

(4) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See "Steering Valve Leakage Test" on page 593.)

No - Go To Step (5)

Symptom: Sluggish Steering Response

(5) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Are hoses or connections leaking?

Yes - Tighten connections and/or replace hoses.

No - Go To Step (6)

(6) Steering/Lift Pump.
Is pump damaged or operating improperly?

Yes - Check steering/lift pump output flow. (See "Steering Pump Flow Test" on page 523. See "Lift Pump Pressure and Flow Test" on page 525.) Repair or replace steering/lift pump as needed.

Yes - Check steering relief valve pressure. (See "Steering Relief Valve Test" on page 594.) Repair or replace steering/lift pump as needed.

High Steering Effort in Both Directions

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: High Steering Effort in Both Directions

(1) Tires.
Are tires inflated to correct pressure?

Yes - Go To Step (2)

No - Inflate rear tires to specification.

(2) Rear Wheels.
Are rear wheels aligned with correct toe-in?

Yes - Go To Step (3)

No - Adjust toe-in. (See "Steering Toe-In Check and Adjustment" on page 592.)

Symptom: High Steering Effort in Both Directions

(3) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?
Is inlet strainer clean?

Yes - Go To Step (4)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See "Hydraulic Oil Foams" on page 591.)

No - Inlet strainer is plugged. Clean or replace inlet strainer.

(4) Spindle Bearings.
Are spindle bearings worn?

Yes - Replace spindle bearings.

No - Go To Step (5)

(5) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Do hoses have any sharp bends or restrictions?

Yes - Replace hoses.

No - Go To Step (6)

(6) Steering Cylinder.
Are ball joints worn or seized?

Yes - Replace steering cylinder. (See "Steering Cylinder Removal and Installation" on page 602.)

No - Go To Step (7)

Symptom: High Steering Effort in Both Directions

(7) Engine running at FAST idle.
Forward/reverse travel pedals in NEUTRAL position.
Steering/Lift Pump.
Is pump damaged or operating improperly?

Yes - Check steering/lift pump output flow. (See “Steering Pump Flow Test” on page 523. See “Lift Pump Pressure and Flow Test” on page 525.) Repair or replace steering/lift pump as needed.

Yes - Check steering relief valve pressure. (See “Steering Relief Valve Test” on page 594.) Repair or replace steering/lift pump as needed.

No - Go To Step (8)

(8) Steering Valve.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See “Steering System Leakage Test” on page 592.)

No - Go To Step (9)

(9) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See “Steering Valve Leakage Test” on page 593.)

Steering Effort Is Not Smooth

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Steering Effort Is Not Smooth

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?
Is inlet strainer clean?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 591.)

No - Inlet strainer is plugged. Clean or replace inlet strainer.

(2) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Do hoses have any sharp bends or restrictions?

Yes - Replace hoses.

No - Go To Step (3)

(3) Engine running at FAST idle.
Forward/reverse pedals in NEUTRAL position.
Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Are hoses or connections leaking?

Yes - Tighten connections and/or replace hoses.

No - Go To Step (4)

Symptom: Steering Effort Is Not Smooth

(4) Engine running at FAST idle.
Forward/reverse pedals in NEUTRAL position.
Park brake ENGAGED.
Steering Valve.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See “Steering System Leakage Test” on page 592.)

No - Go To Step (5)

(5) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See “Steering Valve Leakage Test” on page 593.)

No - Go To Step (6)

(6) Engine running at FAST idle.
Forward/reverse travel pedals in NEUTRAL position.
Steering/Lift Pump.
Is pump damaged or operating improperly?

Yes - Check steering/lift pump output flow. (See “Steering Pump Flow Test” on page 523. See “Lift Pump Pressure and Flow Test” on page 525.) Repair or replace steering/lift pump as needed.

Yes - Check steering relief valve pressure. (See “Steering Relief Valve Test” on page 594.) Repair or replace steering/lift pump as needed.

Machine Continues to Turn after Steering Wheel Has Returned to Center Position

Test Conditions:

- Park brake ENGAGED.
- Engine running at FAST idle.
- Forward/reverse pedals in NEUTRAL position.

Symptom: Machine Continues to Turn after Steering Wheel Has Returned to Center Position

(1) Steering Valve.
Does steering valve operate smoothly without sticking?

Yes - Go To Step (2)

No - Replace steering valve. (See “Steering Valve Removal and Installation” on page 600.)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

(2) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?
Is inlet strainer clean?

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 591.)

No - Inlet strainer is plugged. Clean or replace inlet strainer.

Lost Motion at Steering Wheel

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Lost Motion at Steering Wheel

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?
Is inlet strainer clean?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. See “Hydraulic Oil Foams” on page 591

No - Inlet strainer is plugged. Clean or replace inlet strainer.

(2) Steering Valve.
Is steering valve securely mounted?

Yes - Go To Step (3)

No - Tighten mounting cap screws.

(3) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See “Steering Valve Leakage Test” on page 593.)

No - Go To Step (4)

(4) Engine running at FAST idle.
Forward/reverse pedals in NEUTRAL position.
Park brake ENGAGED.
Steering Valve.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See “Steering System Leakage Test” on page 592.)

Steering Operation Reversed

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Steering Operation Reversed

(1) Steering Cylinder.
Are pressure hoses properly connected to steering cylinder and not reversed?

Yes - Go To Step (2)

No - Connect hoses to proper fittings on cylinder.

(2) Are pressure hoses properly connected to steering valve and not reversed?

No - Connect hoses to proper fittings on steering valve.

Hydraulic Oil Foams

Test Conditions:

- Key switch in STOP position.
- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Hydraulic Oil Foams

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?

Yes - Go To Step (2)

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

(2) Check pressure hoses.
Do hoses have sharp bends or restrictions?
Are connections leaking?

Yes - Hoses have sharp bends and/or restrictions. Replace hose(s).

Yes - Connections are leaking. Tighten connections and/or replace hoses.

No - Go To Step (3)

(3) Hydraulic Suction Hoses.
Check suction hoses.
Are hoses cracked, cut, or badly scuffed?
Are hose connections loose or leaking?

Yes - Hoses are cracked, cut, or badly scuffed. Replace hoses as needed with hoses of proper size.

Yes - Hose connections loose or leaking. Tighten connections and/or replace O-rings as needed.

Checks, Tests, and Adjustments

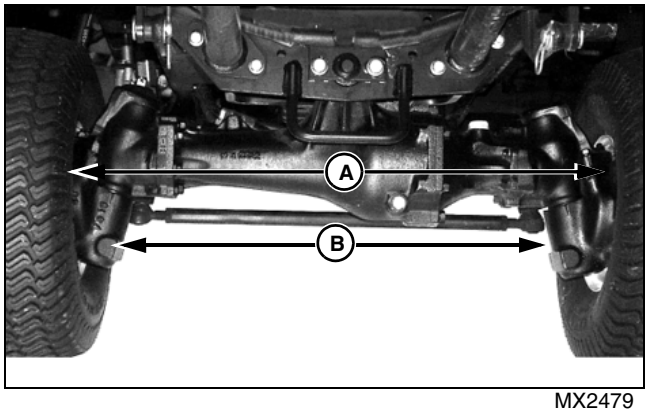
Steering Toe-In Check and Adjustment

Reason

Correct toe-in prevents excessive tire wear and steering wander.

Check Procedure

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

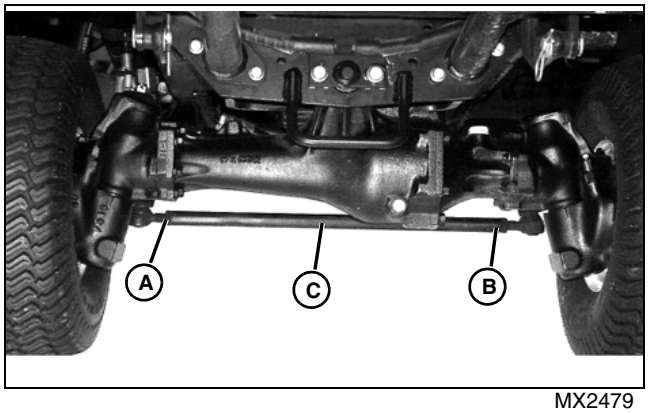


MX2479

2. Measure the distance between the rear tires at the rear of the tires (A).

3. Measure the distance between the rear tires at the front of the tires (B). The distance between tires (toe-in) should be less in the front than the rear to specification. If adjustment is required, perform adjustment procedure.

Adjustment Procedure



MX2479

1. Loosen lock nuts (A and B) on left and right tie rod ends.
2. Turn tie rod (C) to adjust toe-in.
3. Check toe-in. If within specification, tighten lock nuts.

Specifications

Steering Toe-In Difference (Less in Front than the Rear) . 3-4 mm (0.118-0.157 in.)

Steering System Leakage Test

Reason

To check the steering system for internal leakage.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Torque Wrench	NA	Used to count rotations of steering wheel.

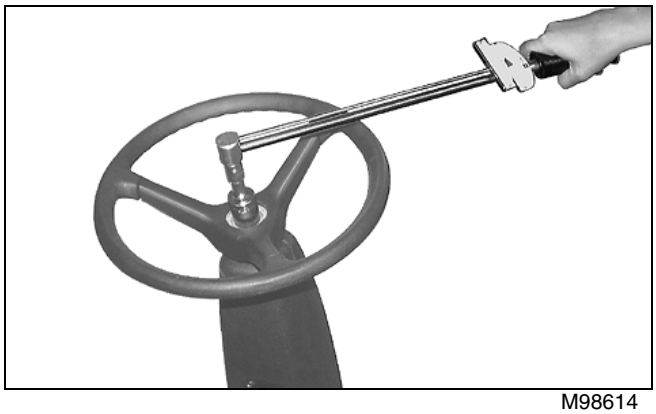
Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Engage park brake.
5. Bring hydraulic system oil to operating temperature.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

Always try to work in a well-ventilated area.

6. Start engine and set throttle to SLOW idle.



M98614

7. With steering wheel at the maximum right turn position, apply a constant torque to specification. Count the number of rotations occurring in one minute.

8. Repeat step 7 with the steering wheel at the maximum left turn position.

Results

If the number of rotations exceeds 6 per minute, perform steering valve leakage test.

Specifications

Leakage Test Applied Torque . . . . . 6.8 N•m (72 lb-in.)

Steering Valve Leakage Test

Reason

To determine if leakage is in steering valve or in steering cylinder.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Torque Wrench	NA	Used to count rotations of steering wheel.
Plugs	NA	Used to cap the lines at the steering cylinder.

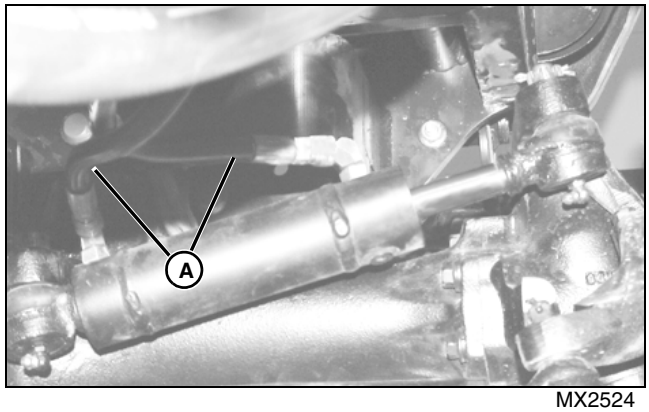
Procedure

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Engage park brake.
5. Bring hydraulic system oil to operating temperature.
6. Move key switch to STOP position.

CAUTION: Avoid injury! To avoid injury from escaping hydraulic oil under pressure, relieve the pressure in the system by operating all the hydraulic controls.



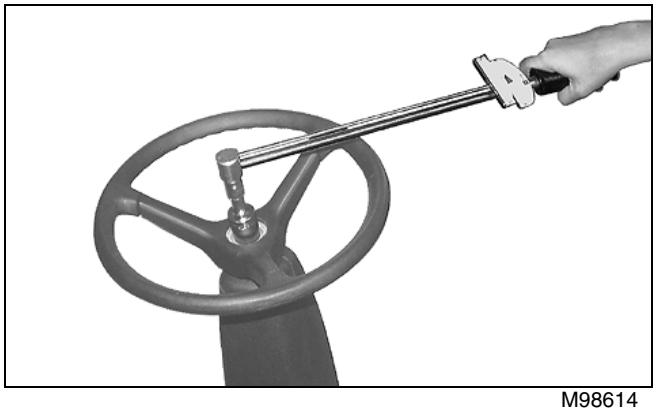
MX2524

7. Disconnect and cap hoses (A) at the steering cylinder.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

Always try to work in a well-ventiated area.

8. Start engine and set throttle to SLOW idle.



M98614

9. With steering wheel at the maximum right turn position, apply a constant torque to specification and count the number of rotations occurring in one minute.

10. Repeat step 9 with the steering wheel at the maximum left turn position.

Results

- If the number of rotations exceeds 6 per minute, replace steering valve.
- If the number of rotations is less than 6 per minute, repair or replace steering cylinder.

Specifications

Leakage Test Applied Torque . . . . . 6.8 N•m (72 lb-in.)

Steering Relief Valve Test

Reason

To determine if the steering relief valve is opening at the correct pressure.

Special or Required Tools

Tool Name	Tool No.	Tool Use
11/16-16 (-6) F ORFS Sw x 11/16-16 (-6) M ORFS x 11/16-16 (-6) M ORFS Tee (2 used)	38H1030	Used to connect steering valve to test hose (Models 1600/1620). Used to connect lift valve and charge pump to test hose (Model 1600 Turbo).
11/16-16 (-6) F ORFS Sw x 7/16-20 M 37° Flare Connector (2 used)	JT03456	Used to reduce tee to test hose connector.
7/16-20 M 37° x 7/16-20 F 37° Sw 90° Elbow (2 used) (1600 Turbo only)	JT05483	Used to connect flare connector to test hose.
Test Hose with Female Quick Coupler (2 used)	JT03017	Used to connect pressure gauge.
20 000 kPa (3000 psi) Pressure Gauge with Male Quick Coupler	JT03345	Used to measure pressure.
7000 kPa (1000 psi) Pressure Gauge with Male Quick Coupler	JT05471	Used to measure pressure.

Procedure

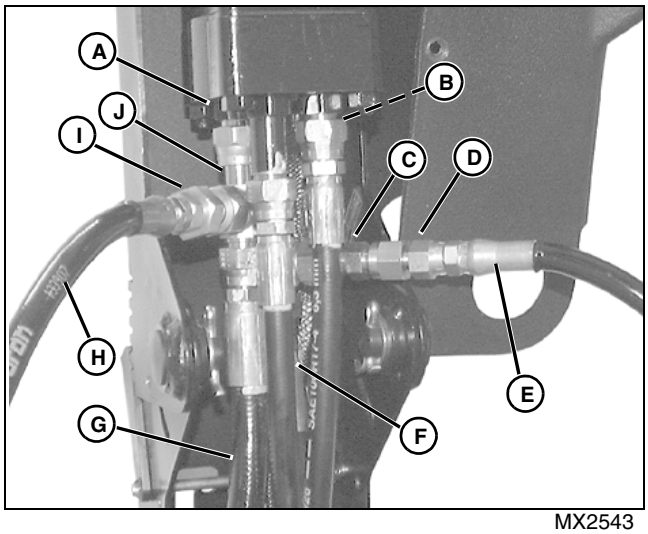
CAUTION: Avoid injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

NOTE: Due to the presence of charge pressure in the system, this test requires pressure readings on both sides of the relief valve. The difference between readings is the relief valve opening pressure.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Check level of hydraulic oil; fill as needed.
3. Remove steering wheel.
4. Remove upper and lower steering column covers. Keep wire harness connected to instrument panel and key switch.
5. Install steering wheel while steering column covers are removed.
6. Install JT03345 Gauge on JT03017 Hose and JT05471 Gauge on JT03017 Hose.

NOTE: Work quickly when disconnecting hoses and connecting the test fittings, as oil will begin to drain from the system. It is helpful to have a second person to assist.



MX2543

7. **Models 1600/1620 Connections:**

   a. Disconnect hose (G) from steering valve IN port (A).

   b. Connect one 38H1030 Tee (J) to the IN port on steering valve.

   c. Connect hose (G) to tee (J).

   d. Connect JT03345 Gauge with JT03017 Hose (H) and one JT03456 Fitting (I) to tee (J).

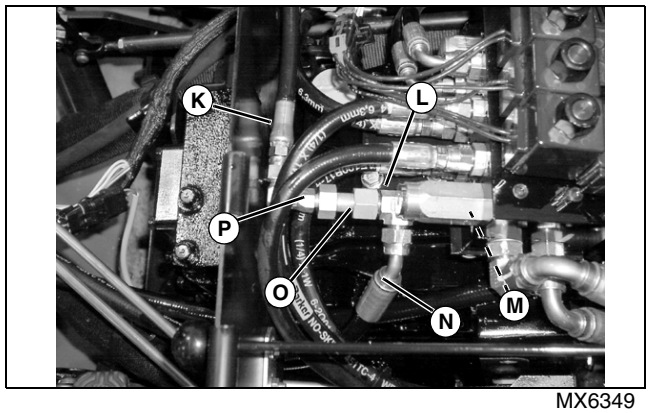
   e. Disconnect hose (F) from steering valve AUX port (B).

   f. Connect second 38H1030 Tee (C) to the AUX port on steering valve.

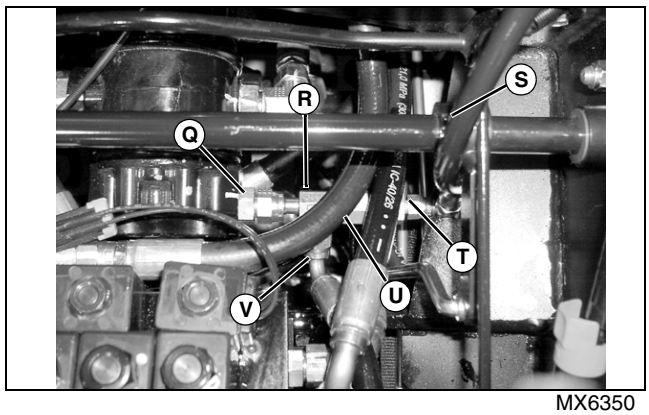
   g. Connect hose (F) to tee (C).

   h. Connect JT05471 Gauge with JT03017 Hose (E) and second JT03456 Fitting (D) to tee (C).

NOTE: Work quickly when disconnecting hoses and connecting the test fittings, as oil will begin to drain from the system. It is helpful to have a second person to assist.



MX6349



MX6350

8. **Model 1600 Turbo Connections:**

   a. Disconnect hose (N) from mower lift valve port C7 (M).

   b. Connect one 38H1030 Tee (L) to port C7 on lift valve.

   c. Connect hose (N) to tee (L).

   d. Connect JT03345 Gauge with JT03017 Hose (K), one JT05483 Elbow (P) and one JT03456 Fitting (O) to tee (L).

   e. Disconnect hose (V) from charge pump (Q).

   f. Connect one 38H1030 Tee (R) to charge pump.

   g. Connect hose (V) to tee (R).

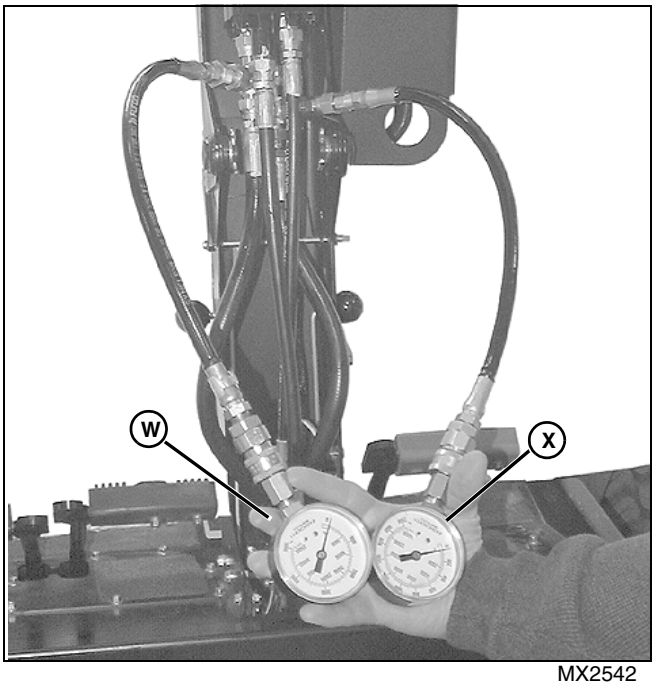
   h. Connect JT03345 Gauge with JT03017 Hose (S), one JT05483 Elbow (T) and one JT03456 Fitting (U) to tee (R).

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.If it is necessary to run an engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

Always try to work in a well-ventilated area.

9. Start engine and run at FAST idle.

10.Bring the hydraulic oil to operating temperature.



MX2542

11.Turn the steering wheel in one direction fully and hold against the stop.

12.Observe readings on pressure gauges (W and X).

13.Calculate relief valve opening pressure (reading on gauge [W] minus reading on gauge [X]).

Results

- The relief valve opening pressure should be to specification.
- If relief valve does not open at the specified pressure, replace steering valve.

Specifications

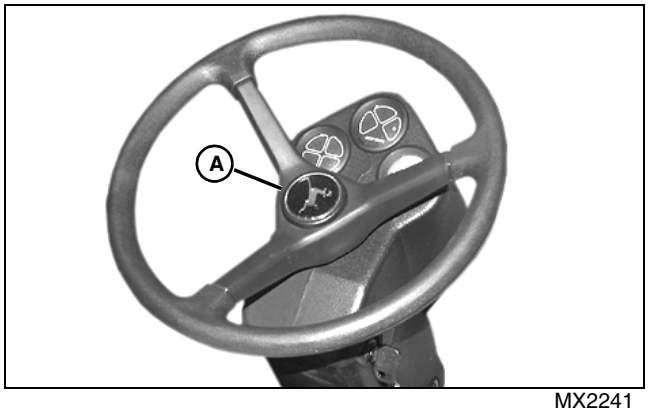
Steering Relief Valve Opening Pressure (Differential) . . . . . 10 756 kPa (1560 psi)

Repair

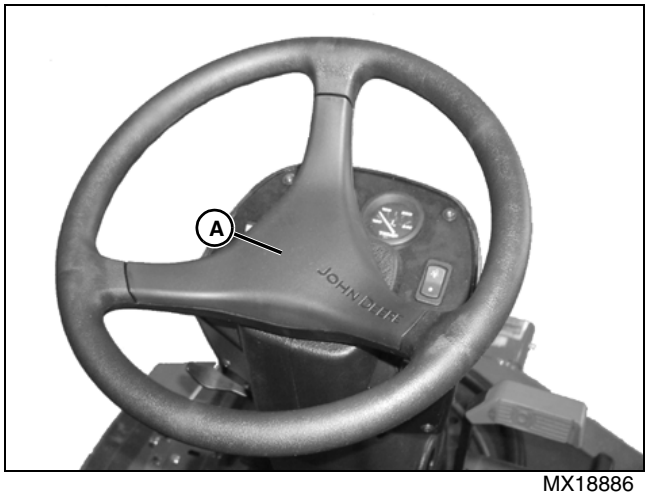
Steering Column Cover - Models 1600 and 1620

NOTE: The upper and lower steering column covers can be removed independently.

Upper Cover Removal

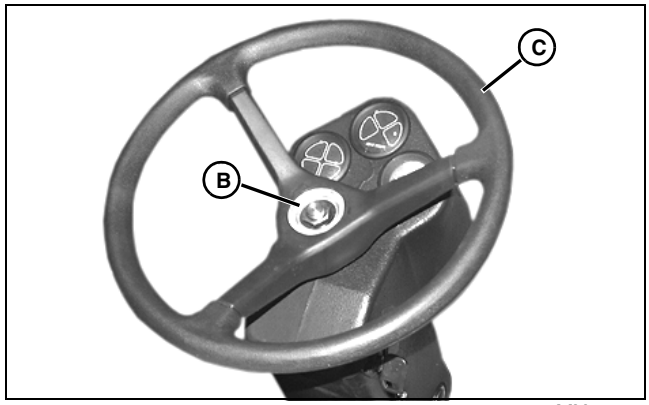


MX2241

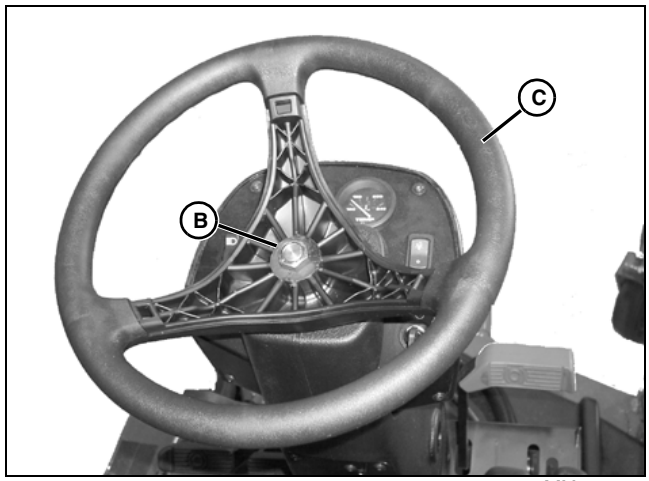


MX18886

1. Remove steering wheel cap (A).



MX2242



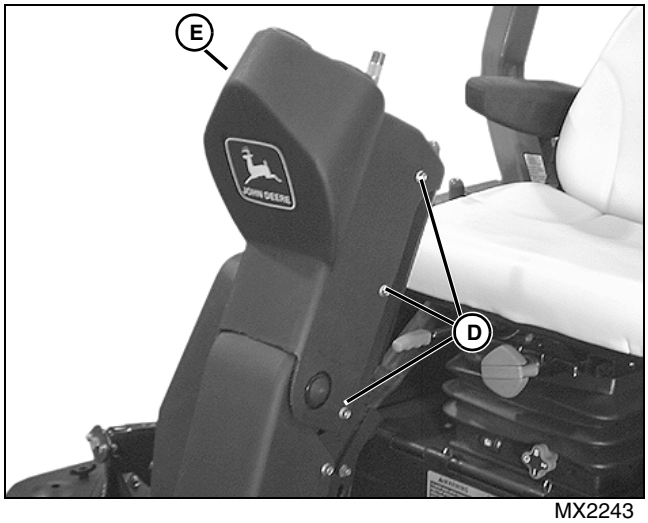
MX18887

2. Remove steering wheel nut (B).

IMPORTANT: Avoid damage! DO NOT use a hammer on the end of steering shaft. Damage can occur to steering valve or shaft.

NOTE: If steering wheel cannot be pulled off shaft easily, use a knife-edge puller to remove.

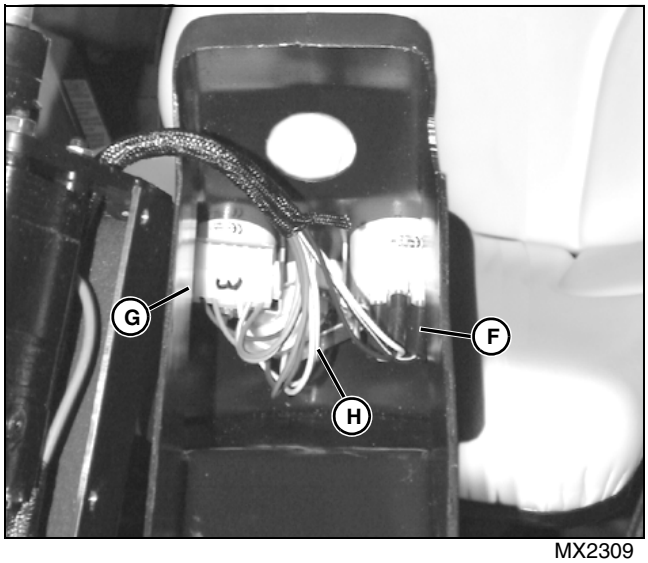
3. Remove steering wheel (C).



MX2243

4. Remove six hex-flange cap screws (D) (both sides of cover).

5. Slide upper cover (E) up off the steering shaft.



MX2309

6. Disconnect fuel gauge (F), warning light module (G), and PTO indicator light module (H) wiring connectors.

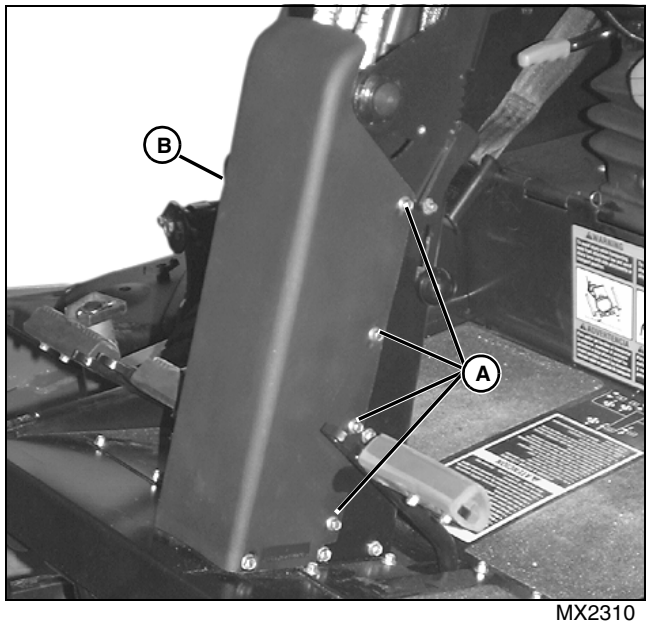
7. Remove upper cover.

Upper Cover Installation

Installation is done in reverse order of removal.

Tighten steering wheel nut to specification.

Lower Cover Removal



MX2310

1. Remove eight hex-flange cap screws (A) (both sides of cover).

2. Remove lower cover (B).

Lower Cover Installation

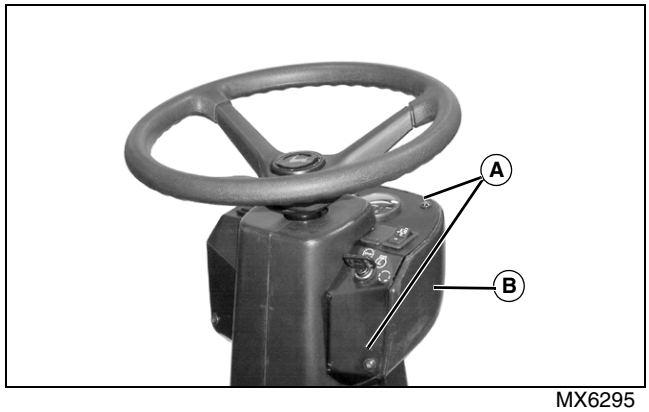
Installation is done in the reverse order of removal.

Specifications

Steering Wheel Nut Torque . . . . . 38 N•m (28 lb-ft)

Steering Column Covers - Model 1600 Turbo

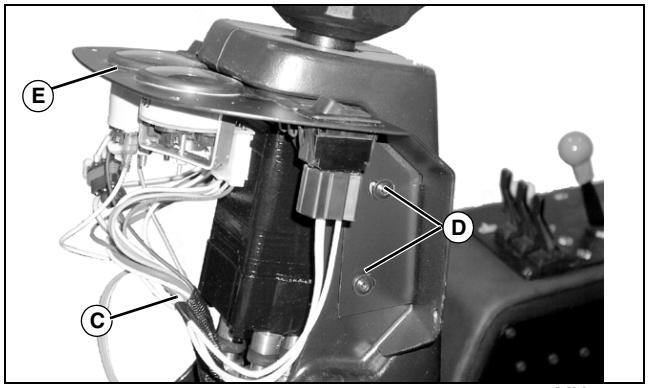
Gauge Panel Cover Removal



MX6295

1. Remove four screws (A) (both sides of cover).

2. Remove gauge panel cover (B).



MX6296

3. Mark and disconnect wires (C) as needed.
4. Remove four screws (D) (both sides of cover).
5. Remove gauge panel (E).

Gauge Panel Cover Installation

Installation is done in reverse order of removal.

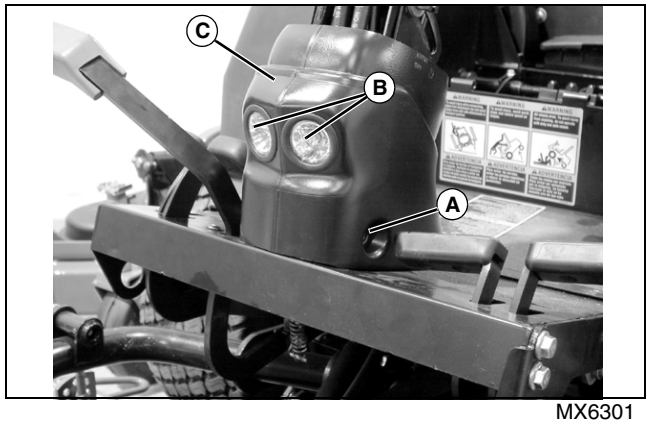
Steering Column Cover Removal

1. Remove gauge panel.
2. Remove steering wheel cap.
3. Remove steering wheel nut.

IMPORTANT: Avoid damage! DO NOT use a hammer on end of steering shaft. Damage can occur to steering valve or shaft.

NOTE: If steering wheel cannot be pulled off shaft easily, use a knife-edge puller to remove.

4. Remove steering wheel.
5. Remove the plastic handle from the parking lock on steering column.
6. Remove six screws from parking lock plate.
7. Remove parking lock plate.
8. Slide steering column cover up off steering shaft.



MX6301

9. Remove two screws (A) (both sides of cover).
10. Disconnect wires and remove two headlights (B).
11. Rotate base cover (C) 90 degrees and slide up off the steering shaft.

Steering Column Cover Installation

Installation is done in reverse order of removal.

Tighten steering wheel nut to specification.

Specifications

Steering Wheel Nut Torque . . . . . 38 N•m (28 lb-ft)

Steering Valve Removal and Installation

Removal

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hose Removal Tool (Model 1600 Turbo)	JDG1518	Used to disconnect hoses from steering valve.

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be 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 Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

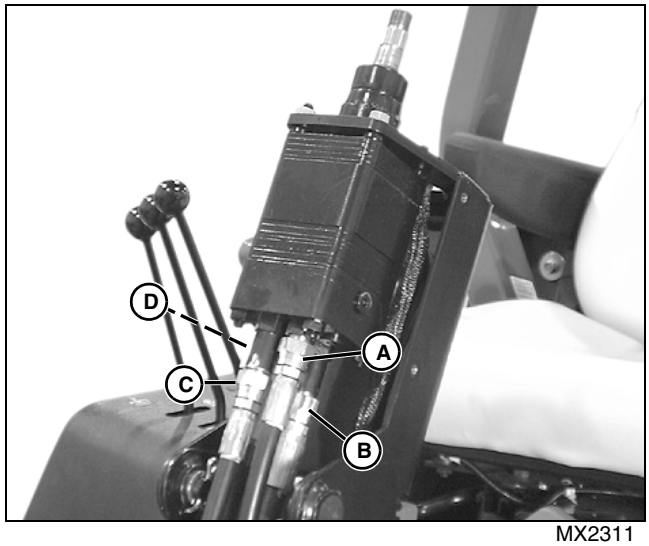
1. Turn steering wheel back and forth several times to relieve hydraulic pressure from system.

2. Remove steering column covers. (See “Steering Column Cover - Models 1600 and 1620” on page 597. See “Steering Column Covers - Model 1600 Turbo” on page 598.)

IMPORTANT: Avoid damage! JDG1518 Hose Removal Tool MUST be installed under plastic collar as shown. Insert tool until it stops. DO NOT pry or twist tool. Once tool is inserted, pull hose out of connector. Prying on connector with tool will damage collar, making connector separation impossible.

NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

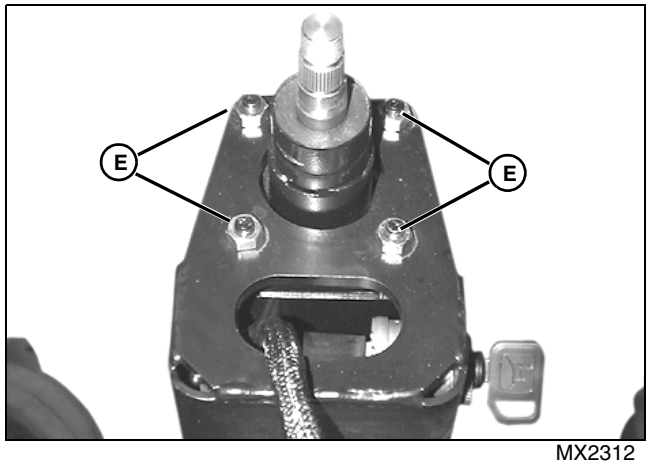
Place drip pan under machine to catch oil that will leak out when hoses are disconnected.



MX2311

Picture Note: Model 1600 Shown

3. Disconnect hoses (A-D). On Model 1600 Turbo, use JDG1518 Hose Removal Tool.



MX2312

Picture Note: Model 1600 Shown

4. Remove four nuts (E).

5. Push steering valve through bracket and remove steering valve.

Installation

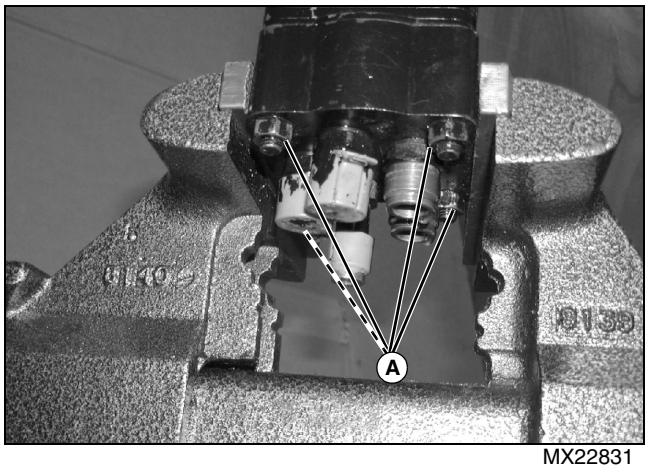
Installation is done in the reverse order of removal.

- Fill hydraulic reservoir to correct level with oil meeting specifications.
- Bleed air from hydraulic system.
- Check all connections for leaks. Repair as needed.

Remove and Install Steering Valve Bushing

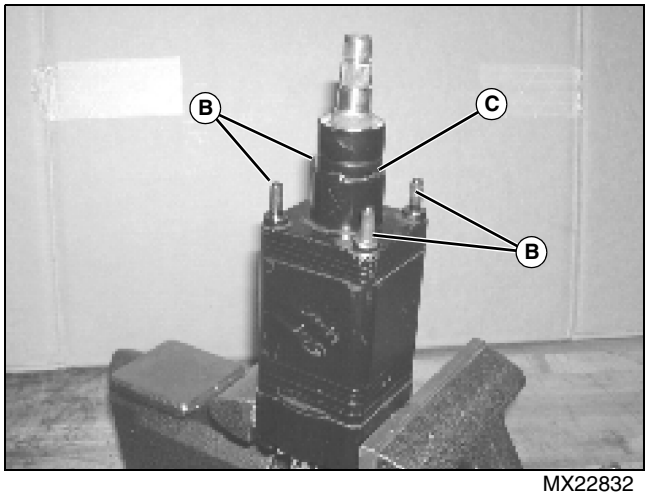
1. Remove steering valve. (See “Steering Valve Removal and Installation” on page 600.)

2. Place steering valve in bench vice.



MX22831

3. Remove nuts (A).

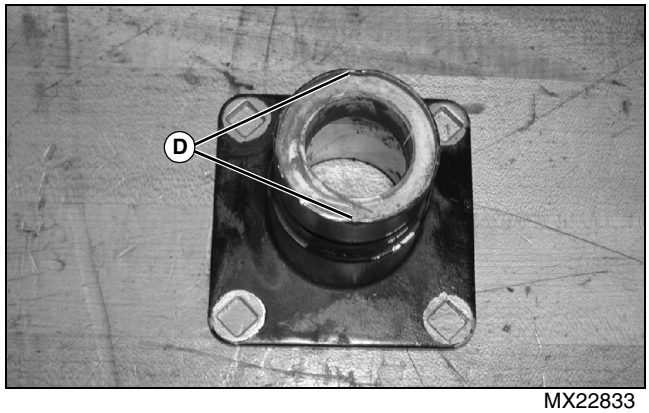


MX22832

4. Remove studs (B).

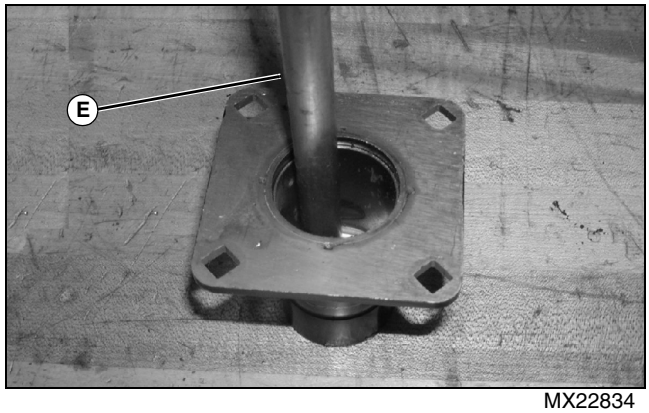
NOTE: To keep valve sections from separating install studs (B) back in valve after bushing housing (C) is removed.

5. Remove top housing (C) holding shaft bushing.



MX22833

6. Bend crimps (D) retaining bushing with pliers.



MX22834

7. Drive bushing out of housing using hammer and punch (E).

Installation

1. Install bushing into housing with appropriately sized bushing driver. Install bushing 2.5 mm (0.100 in.) below top of housing.

2. Crimp housing to retain bushing.

3. Apply multi purpose grease to bushing.

4. Install bushing housing.

5. Install studs and nuts. Tighten to specification.

Specifications

Steering Valve Nut Torque. . . . . 30 N•m (22 lb-ft)

Steering Cylinder Removal and Installation

Special or Required Tools

Tool Name	Tool No.	Tool Use
Wedge-Fork Driver	NA	Used to separate steering cylinder from mounting.

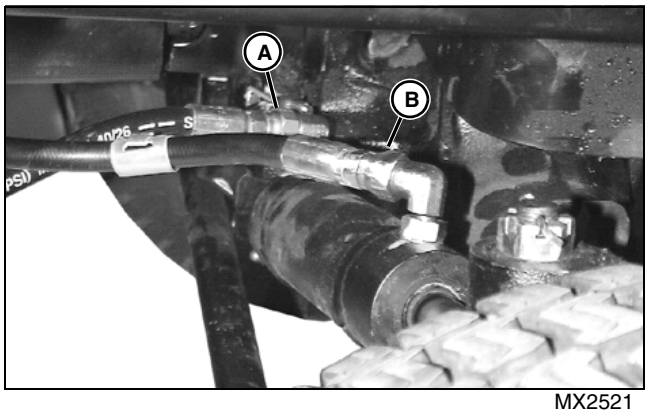
Removal

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

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Sch information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

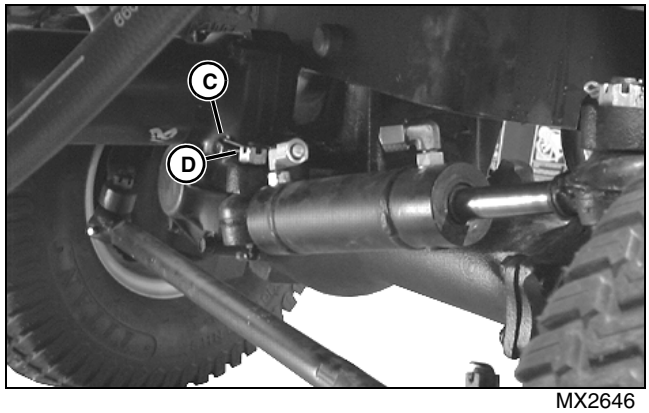
1. Turn steering wheel back and forth several times to relieve hydraulic pressure from system.

NOTE: Mark hoses before removing to ensure correct installation.



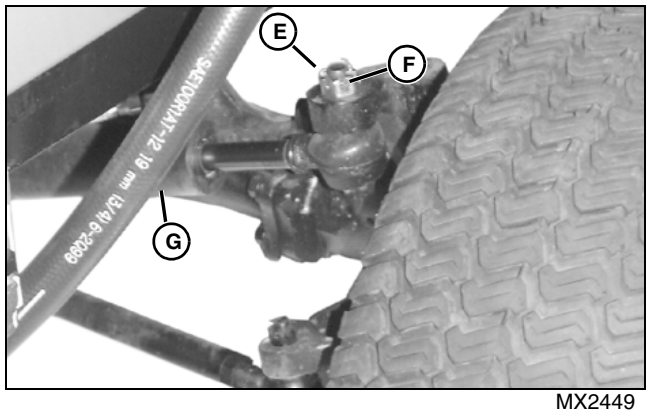
MX2521

2. Disconnect and plug hydraulic hoses (A and B).



MX2646

3. Remove cotter pin (C) and castle nut (D) from steering cylinder.



MX2449

4. Remove cotter pin (E) and castle nut (F) from steering cylinder.

5. Separate steering cylinder from mounting using a wedge-fork driver.

6. Remove steering cylinder (G).

Installation

Installation is done in the reverse order of removal.

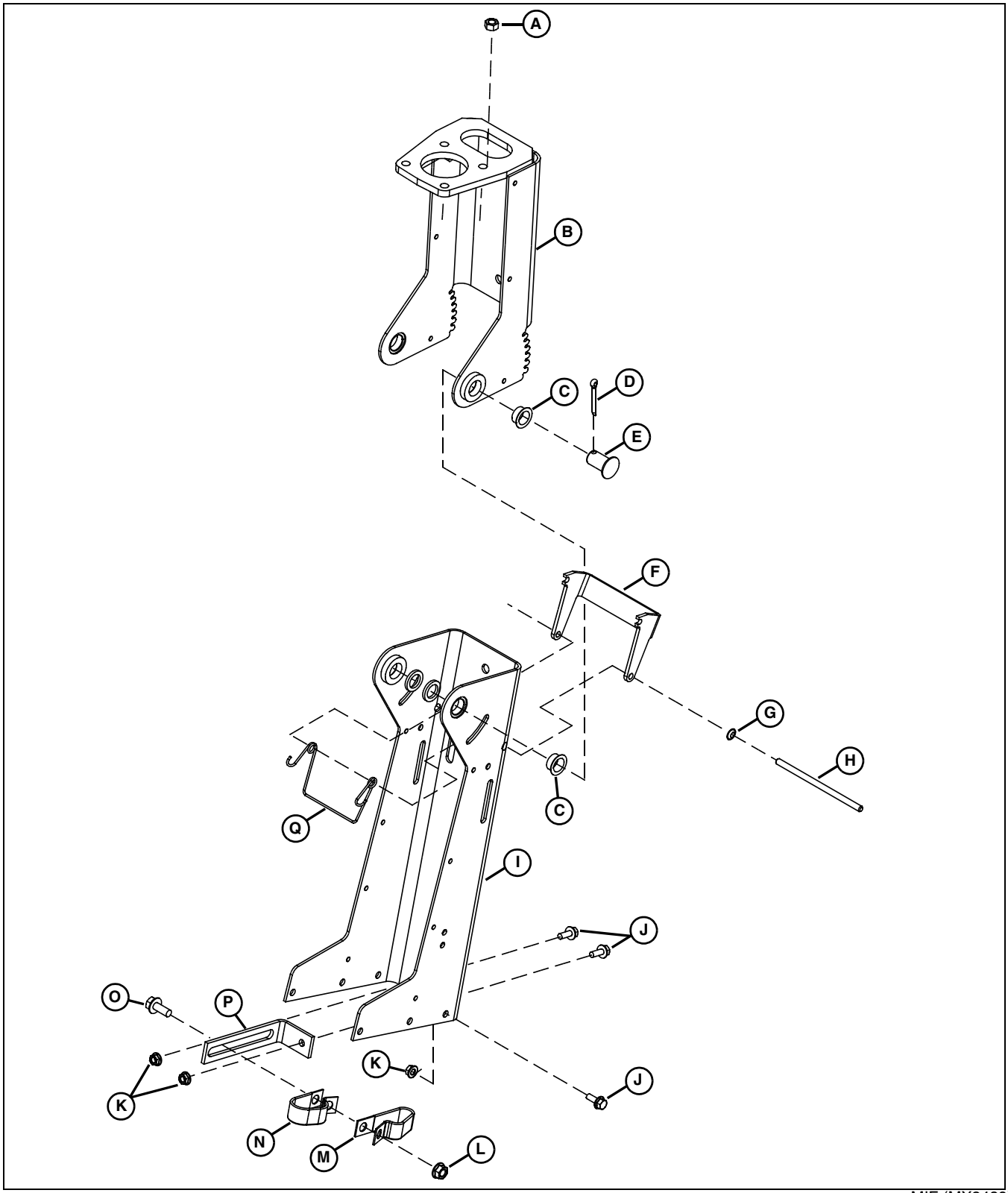
- Tighten castle nuts to specification before installing cotter pins.
- Fill hydraulic reservoir to correct level with oil meeting specifications.
- Bleed air from hydraulic system.
- Check all connections for leaks. Repair as needed.

Specifications

Steering Cylinder Castle Nut Torque . . 75 N•m (55 lb-ft)

Steering Column Linkage - Models 1600 and 1620

Repair



MIF (MX2439)

A - Nut (2 used)
B - Steering Column
C - Bushing (4 used)
D - Cotter Pin (2 used)
E - Pin (2 used)
F - Bracket
G - Nut (2 used)
H - Pin
I - Base
J - Screw (10 used)
K - Flange Nut (10 used)
L - Flange Nut
M - Clip
N - Clamp
O - Screw
P - Bracket
Q - Torsion Spring

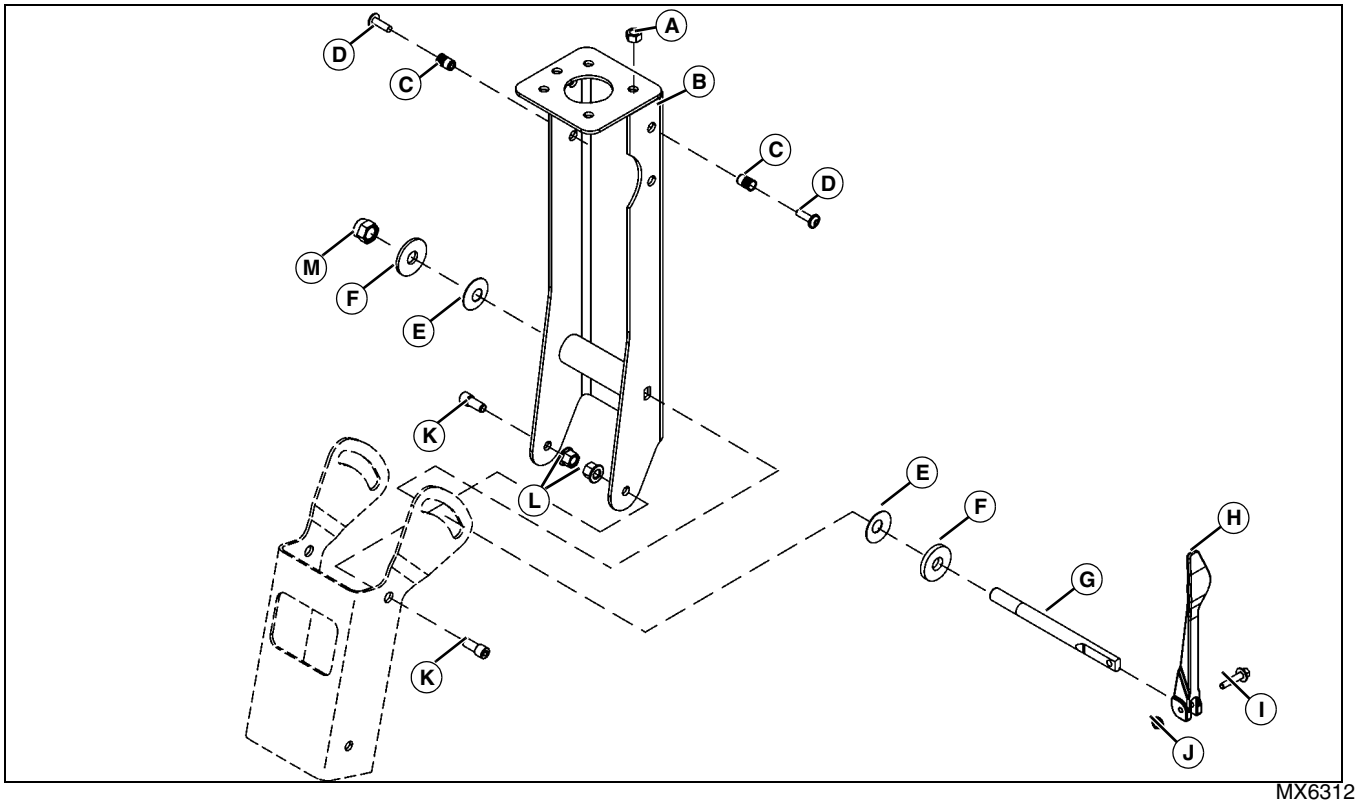
Inspect all parts for wear or damage. Replace parts as needed.

Assembly

Assembly is done in the reverse order of removal.

Steering Column Linkage - Model 1600 Turbo

Repair



MX6312

A - Nut (4 used)
B - Steering Column
C - Insert (4 used)
D - Screw (4 used)
E - Thrust Washer (2 used)
F - Washer (2 used)
G - Rod
H - Lever
I - Screw
J - Flange Nut
K - Pivot (2 used)
L - Lock Nut (2 used)
M - Lock Nut

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

Assembly

Assembly is done in the reverse order of removal.

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Specifications

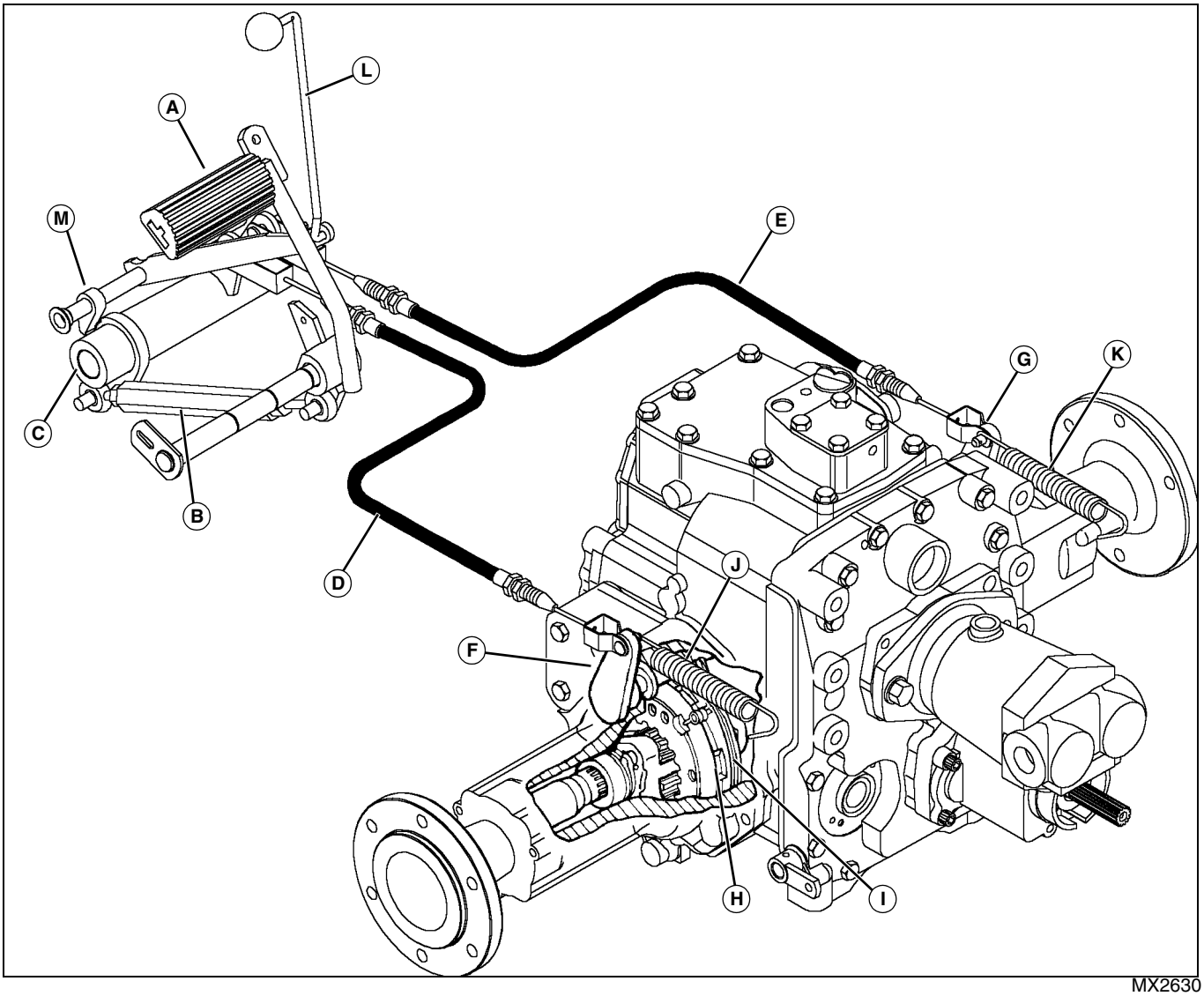
Test and Adjustment Specifications

Turn Brake Pedal Travel	**50 mm (2.2 in.)**

Repair Specifications

Brake Disk Thickness (Min)	**4.4 mm (0.173 in.)**
Brake Disk-to-Shaft Backlash (Max)	**1.2 mm (0.047 in.)**
Brake Separator Disk Thickness (Min)	**2.3 mm (0.090 in.)**
Brake Separator Disk Warpage (Max)	**0.3 mm (0.012 in.)**

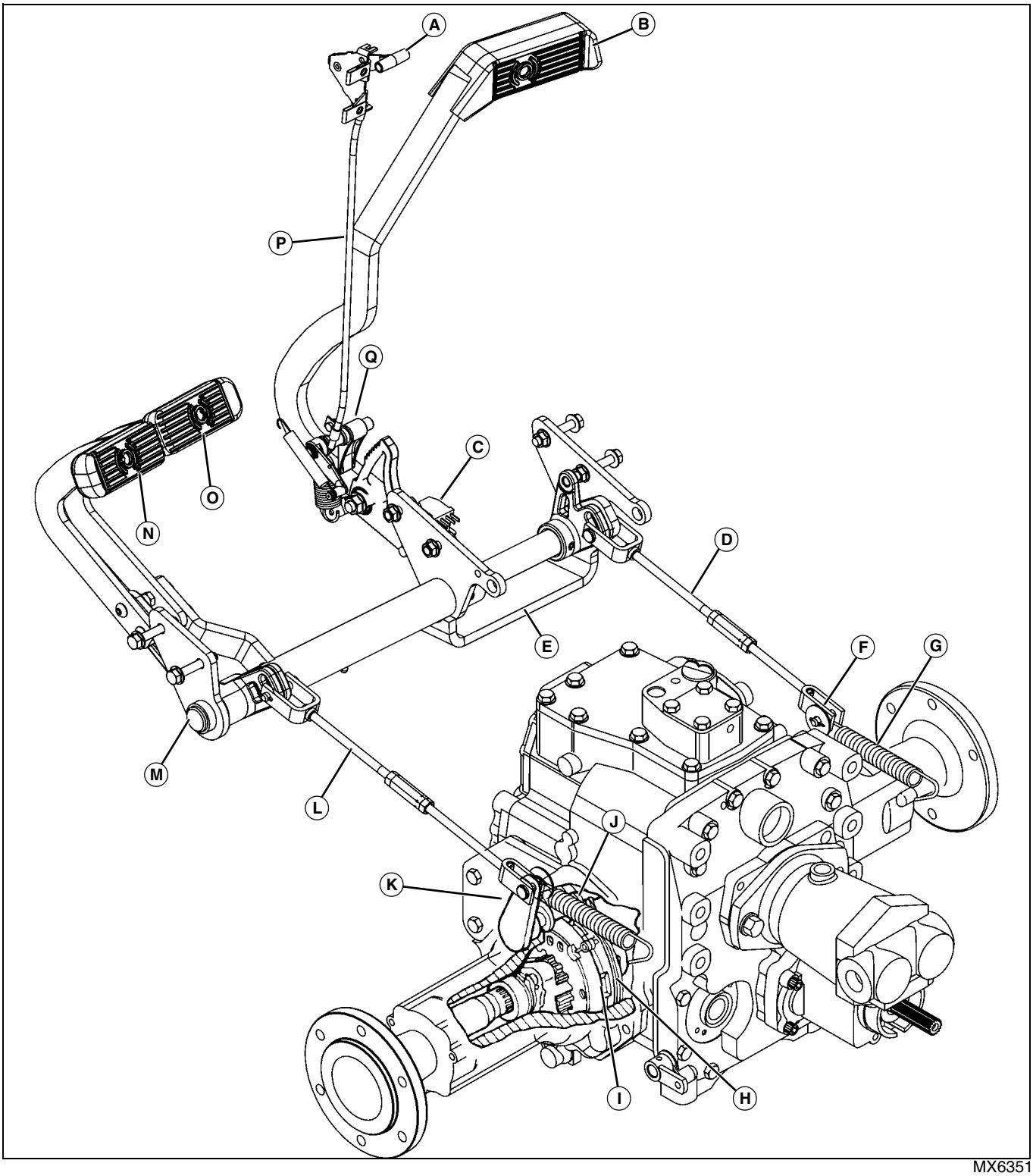
Component Location **Brake System - Models 1600 and 1620**



MX2630

A - Brake Pedal
B - Link Arm
C - Pivot Shaft
D - Left Brake Cable Assembly
E - Right Brake Cable Assembly
F - Left Brake Actuator Lever/Cam
G - Right Brake Actuator Lever/Cam
H - Brake Actuator Plate
I - Brake Friction and Separator Disks (2 Each Used per Side)
J - Left Return Spring
K - Right Return Spring
L - Park Brake Lock Lever
M - Park Brake Pawl

Brake System - Model 1600 Turbo



MX6351

BRAKES COMPONENT LOCATION

A - Park Brake Lock Lever
B - Master Brake Pedal
C - Park Brake Lock Switch
D - Right Linkage Rod
E - Pivot
F - Right Brake Actuator Lever/Cam
G - Right Return Spring
H - Brake Friction and Separator Disks (2 Each Used per Side)
I - Brake Actuator Plate
J - Left Return Spring
K - Left Brake Actuator Lever/Cam
L - Left Linkage Rod
M - Pivot Shaft
N - Left Turn Brake Pedal
O - Right Turn Brake Pedal
P - Park Brake Lock Lever Cable
Q - Park Brake Pawl

Theory of Operation

Brake System - Models 1600 and 1620

The brake system provides a means of stopping the machine and preventing it from moving when not in use.

The brake system consists of a wet pad and disk system located inside the axle housing on each side of the transaxle assembly. The brakes are activated by a common pedal hooked to cables for the individual brake assemblies located in each of the axle shaft housings.

Inside each axle shaft housing, the brake components consist of a brake actuator lever/cam, actuator plate, and pairs of alternating brake friction disks and separator disks.

The brake actuator plate is mounted to the planetary ring gear using three springs. Between the actuator plate and planetary ring gear are six steel balls, which ride inside pockets with ramps on both the ring gear and actuator plate.

The brake friction disks are splined to the axle shafts. The separator disks are keyed to the axle shaft housing and cannot move.

When the brake pedal (A) is depressed, a link arm (B) connected to the pedal rotates the pivot shaft (C), pulling both brake cables (D and E), actuating the brake actuator lever/cams (F and G). As the brake actuator lever/cams rotate, the brake actuator plate (H) is forced to rotate.

As the actuator plate rotates, the ramps on the plate will allow the plate to ride up, forcing the plate against the brake friction and separator disks (I). When the friction and separator disks are forced together, the rotating friction disks (splined to the axle shafts) rub against the stationary separator disks (keyed to the axle housing), causing drag and slowing the machine.

When the pedal is released, the return springs (J and K) return the brake actuator lever/cams to the rest position, allowing the actuator plates to release the pressure on the friction disks and separator disks.

The machine is equipped with a park brake lock. When the brake pedal is depressed and held, and the park brake lock lever (L) is pulled up, a pawl (M) engages with the teeth on the pivot shaft (C), locking the brake linkage.

Brake System - Model 1600 Turbo

The brake system provides a means of stopping the machine and preventing it from moving when not in use.

The brake system consists of a wet pad and disk system located inside the axle housing on each side of the transaxle assembly. The brakes are activated by either of two individual turn brake pedals or by a common (master) pedal hooked to linkage rods for the individual brake assemblies located in each of the axle shaft housings.

Inside each axle shaft housing, the brake components consist of a brake actuator lever/cam, actuator plate, and pairs of alternating brake friction disks and separator disks.

The brake actuator plate is mounted to the planetary ring gear using three springs. Between the actuator plate and planetary ring gear are six steel balls, which ride inside pockets with ramps on both the ring gear and actuator plate.

The brake friction disks are splined to the axle shafts. The separator disks are keyed to the axle shaft housing and cannot move.

The brake actuator plates are activated in any of three ways:

- When turn brake pedal (N) is depressed, a linkage rod (L) actuates brake actuator lever/cam (K). As the brake actuator lever/cam rotates, a brake actuator plate (I) on the left side is forced to rotate.
- When turn brake pedal (O) is depressed, a linkage rod (D) actuates brake actuator lever/cam (F). As the brake actuator lever/cam rotates, a brake actuator plate on the right side [similar to (I) on the left side] is forced to rotate.
- When the master brake pedal (B) is depressed, both linkage rods (D and L) actuate both brake actuator lever/cams (F and K). As the brake actuator lever/cams rotate, the brake actuator plate on each side is forced to rotate.

As the actuator plate rotates, the ramps on the plate will allow the plate to ride up, forcing the plate against the brake friction and separator disks (H). When the friction and separator disks are forced together, the rotating friction disks (splined to the axle shafts) rub against the stationary separator disks (keyed to the axle housing), causing drag and slowing the machine.

When the pedal is released, the return springs (G and J) return the brake actuator lever/cams to the rest position, allowing the actuator plates to release the pressure on the friction disks and separator disks.

The machine is equipped with a park brake lock. When the master brake pedal is depressed and held, and the park brake lock lever (A) is pulled up, a pawl (Q) engages, locking the brake linkage.

Diagnostics

Machine Will Not Move

NOTE: This condition may be caused by systems other than brakes. Check the power train system if the following procedure does not correct the problem.

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Park brake RELEASED.

Symptom: Machine Will Not Move

(1) Park Brake Lock Lever Assembly.
Is park brake lock lever assembly worn or damaged?

Yes - Repair or replace park brake lock lever assembly.

No - Go To Step (2)

(2) Brake Actuator Cams.
Check each brake actuator cam. Is each cam moving freely without jamming or binding?

Yes - Go To Step (3)

No - Repair brake actuator cam(s).

(3) Brake Cables/Linkages.
Are brake cables/linkages properly adjusted?

Yes - Go To Step (4)

No - Adjust brake cables/linkages. (See “Brake Cable Check and Adjustment - Models 1600 and 1620” on page 616. See “Turn Brakes Adjustment - Model 1600 Turbo” on page 617.)

(4) Brake Return Springs.
Are brake return springs stretched, broken or missing?

Yes - Replace brake return spring(s).

No - Check power train system.

Brake Will Not Engage or Will Not Hold Machine

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Brake Will Not Engage or Will Not Hold Machine

(1) Brake Cables/Linkage.
Are brake cables/linkage improperly adjusted or damaged?

Yes - Brake cables/linkage are improperly adjusted. Adjust brake cables/linkage. (See “Brake Cable Check and Adjustment - Models 1600 and 1620” on page 616. See “Turn Brakes Adjustment - Model 1600 Turbo” on page 617.)

Yes - Brake cables/linkage are damaged. Replace damaged brake cable(s)/linkage. (See “Brake Cable Removal and Installation - Models 1600 and 1620” on page 621. See “Brake Linkage - Models 1600 and 1620” on page 623.)

No - Go To Step (2)

(2) Brake Friction Disks.
Are brake friction disks worn or damaged?

Yes - Replace brake friction disk(s). (See “Brake Assembly” on page 626.)

No - Go To Step (3)

(3) Brake Separator Disks.
Are brake separator disks worn or damaged?

Yes - Replace brake separator disk(s). (See “Brake Assembly” on page 626.)

Excessive Brake Wear

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)

Symptom: Excessive Brake Wear

(1) Brake Cables/Linkage.
Are brake cables/linkage properly adjusted?

Yes - Go To Step (2)

No - Adjust brake cables. (See “Brake Cable Check and Adjustment - Models 1600 and 1620” on page 616. See “Checking Turn Brake Pedal Free Play” on page 617.)

(2) Park Brake Lock Lever Assembly.
Does park brake lock lever move freely?

Yes - Go To Step (3)

No - Repair or replace park brake lock lever assembly.

(3) Brake Pivot Shaft.
Does brake pivot shaft move freely?

Yes - Go To Step (4)

No - Repair or replace brake pivot shaft. (See “Brake Linkage - Models 1600 and 1620” on page 623.)

(4) Brake Actuator Cams.
Do brake actuator cams move freely without jamming or binding?

Yes - Go To Step (5)

No - Repair brake actuator cam(s). (See “Brake Linkage - Models 1600 and 1620” on page 623.)

(5) Brake Return Springs.
Are brake return springs stretched, broken, or missing?

Yes - Replace brake return spring(s). (See “Brake Linkage - Models 1600 and 1620” on page 623.)

No - Go To Step (6)

(6) Brake Separator Disks.
Are brake separator disks warped?

Yes - Replace brake separator disk(s). (See “Brake Assembly” on page 626.)

Machine Pulls to One Side

NOTE: This condition may be caused by systems other than brakes. Check the power train system if the following procedure does not correct the problem.

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- Park brake RELEASED.

Symptom: Machine Pulls to One Side

(1) Brake Cables/Linkage.
Are brake cables/linkage properly adjusted?

Yes - Go To Step (2)

No - Adjust brake cables/linkage. (See “Brake Cable Check and Adjustment - Models 1600 and 1620” on page 616. See “Turn Brakes Adjustment - Model 1600 Turbo” on page 617.)

(2) Brake Actuator Cams.
Do brake actuator cams move freely without jamming or binding?

Yes - Go To Step (3)

No - Repair brake actuator cam(s). (See “Brake Linkage - Models 1600 and 1620” on page 623.)

(3) Brake Return Springs.
Are brake return springs stretched, broken, or missing?

Yes - Replace brake return spring(s). (See “Brake Linkage - Models 1600 and 1620” on page 623.)

No - Go To Step (4)

(4) Brake Friction Disks.
Are brake friction disks worn or damaged?

Yes - Replace brake friction disk(s). (See “Brake Assembly” on page 626.)

No - Go To Step (5)

(5) Brake Separator Disks.
Are brake separator disks warped?

Yes - Replace brake separator disk(s). (See “Brake Assembly” on page 626.)

Tests and Adjustments

Park Brake Check

Conditions

- Operator on seat.
- Cutting units lowered to the ground.
- Key switch in STOP position.

Procedure

1. Stop the machine on a maximum of 17° slope.
2. Depress and hold the brake pedal.
3. Engage the park brake lock.
4. Move forward/reverse pedals to NEUTRAL position.

Normal

- If properly adjusted, the brakes must prevent the front wheels from turning.

If Not Normal

- If the park brake does not hold the machine, adjust the park brake.

Brake Cable Check and Adjustment - Models 1600 and 1620

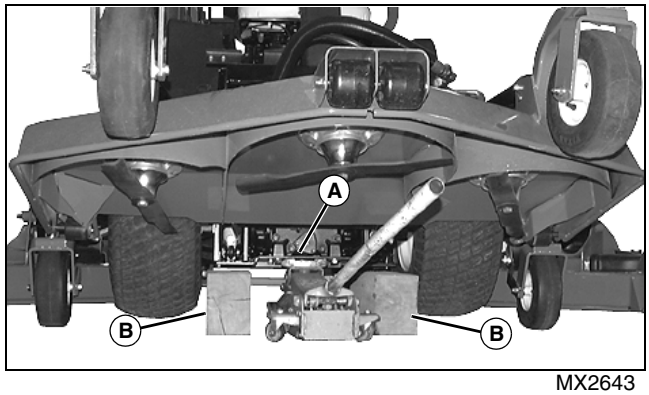
Reason

To allow full and equal activation of the individual brake assemblies in each of the axle shaft housings.

Check Procedure

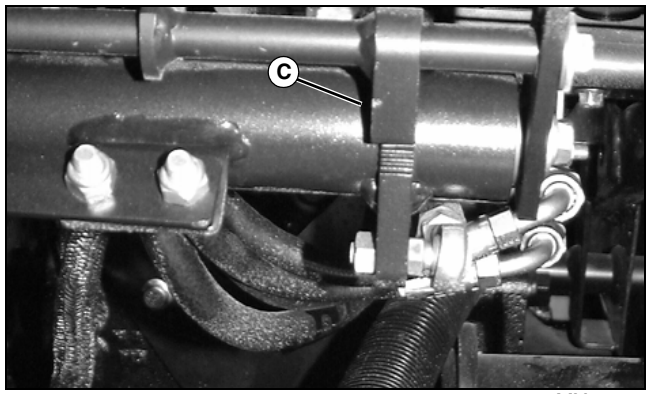
1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Block the rear wheels.
3. Rotate the front mower deck to the service position.

IMPORTANT: Avoid damage! Use care when placing blocks under the subframe to avoid pinching or crushing the lift cylinder hydraulic hose.



MX2643

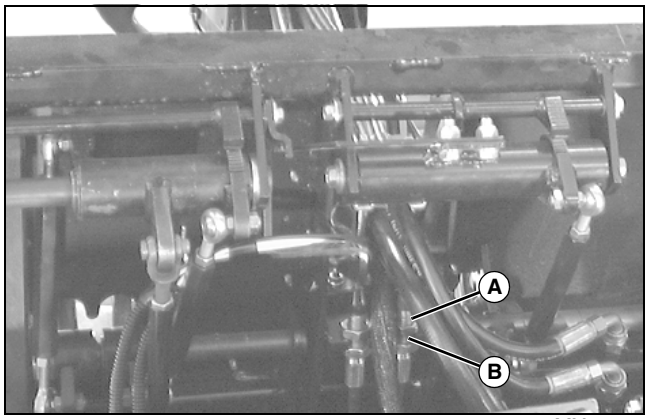
4. Using a safe lifting device, jack up the front of the machine under the front lift arm support plate (A) so both front wheels are above the ground.
5. Install blocking material (B) under the front lift arm support plates and lower machine onto blocks. Make sure the front wheels can turn freely.



MX2676

6. Depress brake pedal lightly, until the park brake pawl (C) is between the second and fourth notches. Engage the park brake lock.
7. Turn the wheel while a second person is holding the other wheel. Note the amount of resistance; a light drag should be noticed. Switch sides and repeat the process.
8. Compare the resistance from side to side. Adjust the brake cables as needed until the drag on both sides is equal.

Adjustment Procedure



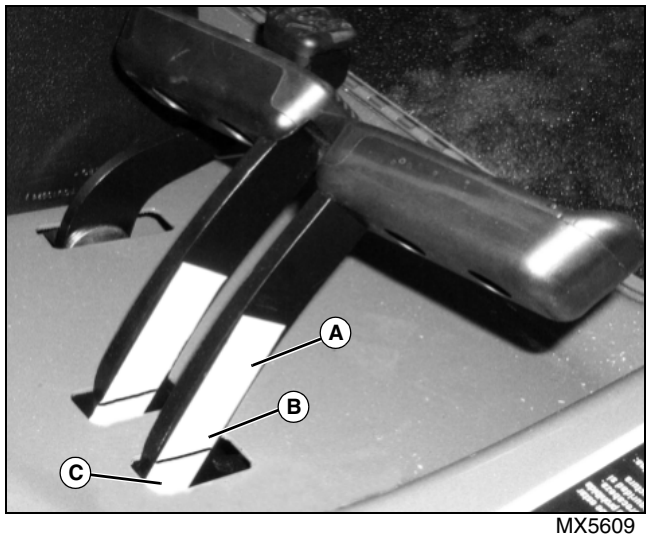
MX2635

1. Adjust brake cable:
   - **To increase brake drag:** Loosen jam nut (A) and turn nut (B) counterclockwise.
   - **To decrease brake drag:** Loosen jam nut (B) and turn jam nut (A) clockwise.
2. Tighten jam nut (A or B).
3. Repeat check procedure.

Turn Brakes Adjustment - Model 1600 Turbo

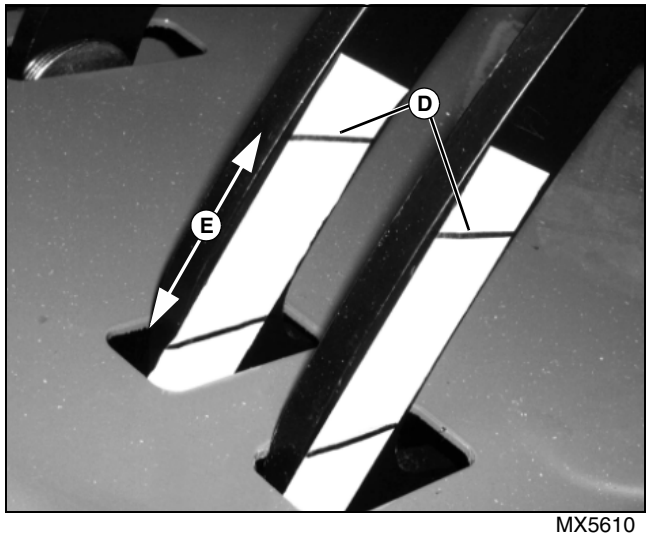
Checking Turn Brake Pedal Free Play

1. Park vehicle on level ground.
2. Unlock park brake.



MX5609

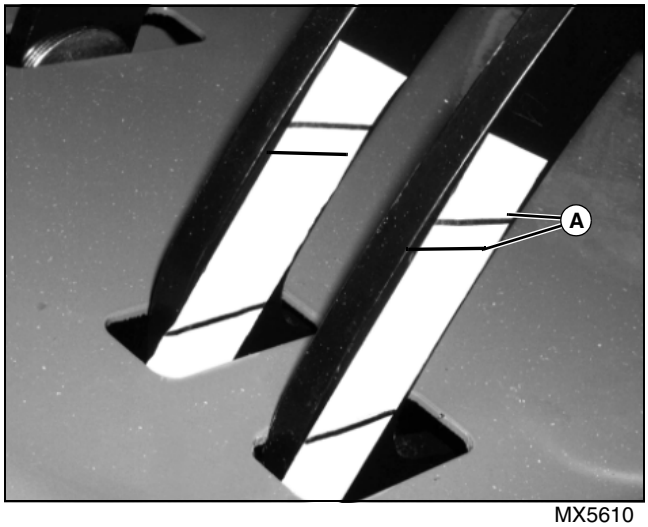
3. Place a piece of tape (A) on the side of each turn brake pedal and extending below the floor (C).
4. Make a mark (B) at the same height of the floor on the tape.



MX5610

5. Press turn brake pedal until brake engages. Mark position of floor (D) on tape.
6. Release brake pedal and measure the distance (E) between the front edge of the marks on the tape to determine pedal travel.
7. Repeat steps 3-6 for the other turn brake pedal.
8. If brake pedal travel is greater than specification, proceed to brake adjustment.

Brake Adjustment



MX5610

1. Using tape installed during check procedure, make two marks (A) at 50 and 56 mm (2.0 and 2.2 in.) above the floor.

2. Loosen lock nuts and adjust turnbuckle on brake linkage rod until brake begins to engage when the floor is between the marks (A) on the pedal.

3. Repeat for other pedal, keeping left and right pedals adjusted evenly.

4. Tighten turnbuckle lock nuts on brake linkage rods.

5. If brakes cannot be adjusted within the range of the turnbuckles, check the transaxle brake plates and separator disks. (See “Brake Assembly” on page 626)

Specifications

Turn Brake Pedal Travel . . . . . 50 mm (2.2 in.)

Park Brake Lock Switch Test and Adjustment - Models 1600 and 1620

Reason

To ensure the park brake lock switch is activated when the park brake is engaged.

Test

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

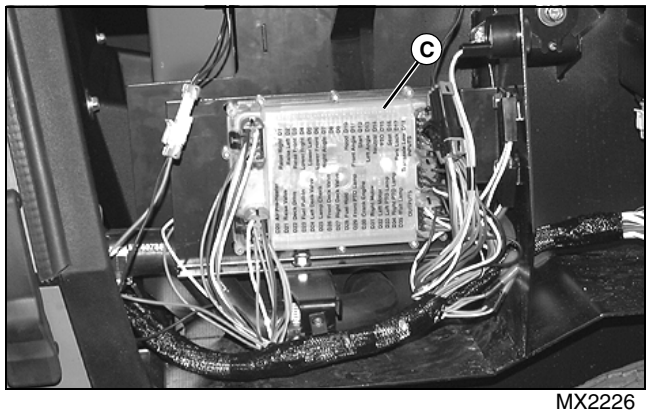
2. Remove lower steering column cover. (See “Steering Column Cover - Models 1600 and 1620” on page 597.)



MX2225

3. Remove two screws (A).

4. Remove access panel (B).



MX2226

5. Move key switch to RUN position.

6. Engage park brake.

NOTE: When checking the input/output lights, identify lights by using the numbers printed directly on the circuit board next to the lights. DO NOT use identification numbers on the label on the control box cover to determine location of the lights, because the label might not be correctly aligned with the lights.

7. Observe the brake input light (D17) (C) on the electronic control module. The light should be ON when the park brake is engaged. If the light does not come on, adjust park brake lock switch.

Adjustment

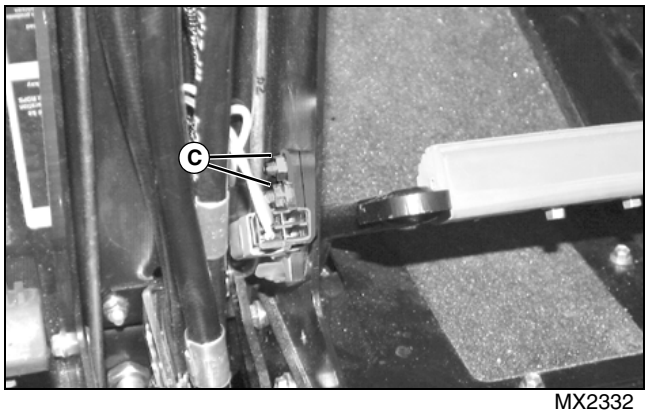
1. Park machine safely. (See “Park Machine Safely” on page 3.)

2. Remove lower steering column cover.



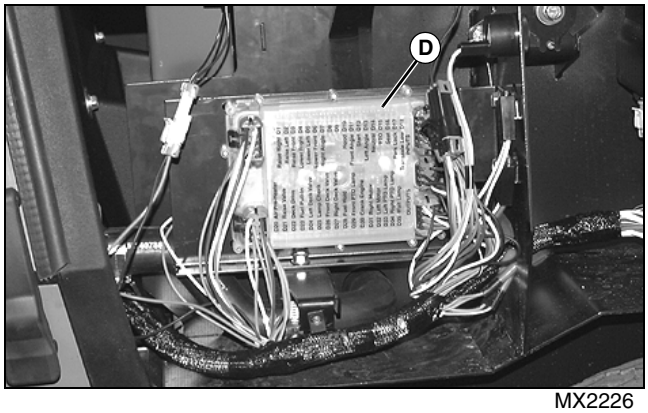
MX2225

3. Remove two screws (A).
4. Remove access panel (B).
5. Move key switch to RUN position.
6. Engage park brake.



MX2332

7. Loosen the two nuts (C).



MX2226

8. Slide the bracket forward until the brake input light (D17) (D) on the electronic control module is ON.
9. Tighten the nuts.
10. Release the brake. The brake input light (D17) on the electronic control module should go OFF.

Park Brake Lock Switch Test and Adjustment - Model 1600 Turbo

Reason

To ensure the park brake lock switch is properly activated by the master brake pedal.

Check

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Remove right access panel.
3. Move key switch to RUN position.

NOTE: When checking the input/output lights, identify lights by using the numbers printed directly on the circuit board next to the lights. DO NOT use identification numbers on the label on the control box cover to determine location of the lights, because the label might not be correctly aligned with the lights.

4. Depress the master brake pedal. Observe brake 1 (D17) input light and brake 2 (D9) input light on the electronic control module. D17 should be on and D9 should be off when the brake is engaged.
5. Release the master brake pedal. D17 should be off and D9 should be on when the brake is disengaged.
6. If the lights do not operate as described above, adjust park brake lock switch.

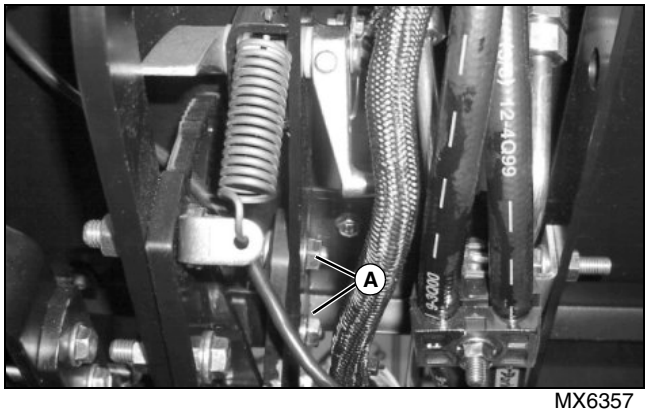
Adjustment

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

2. Remove right access panel.

3. Move key switch to RUN position.

4. Release the master brake pedal. (May require releasing the park brake lock lever.)



MX6357

5. Loosen two nuts (A) on park brake lock switch.

6. Adjust park brake lock switch until brake 2 (D9) input light comes on. Tighten nuts.

Repair

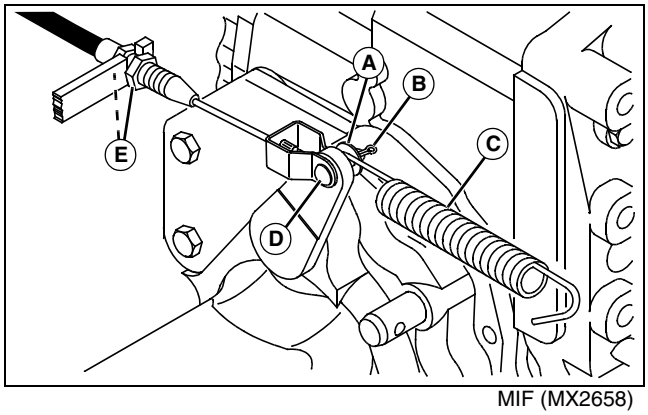
Brake Cable Removal and Installation - Models 1600 and 1620

Removal

NOTE: Illustrations for this procedure are for the left brake cable. The right brake cable is similar.

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

2. Remove lower steering column cover. (See “Steering Column Cover - Models 1600 and 1620” on page 597.)

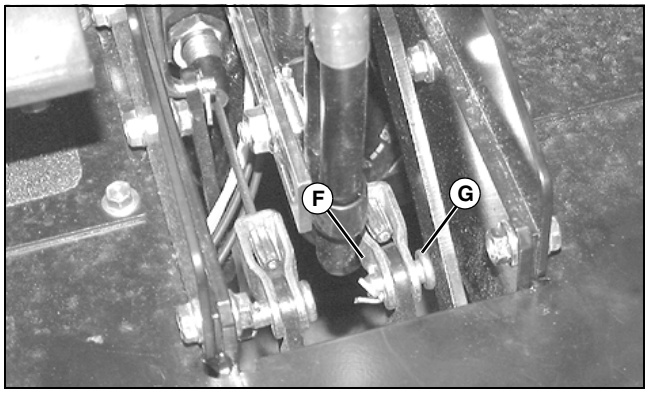


MIF (MX2658)

3. Disconnect return spring (C).

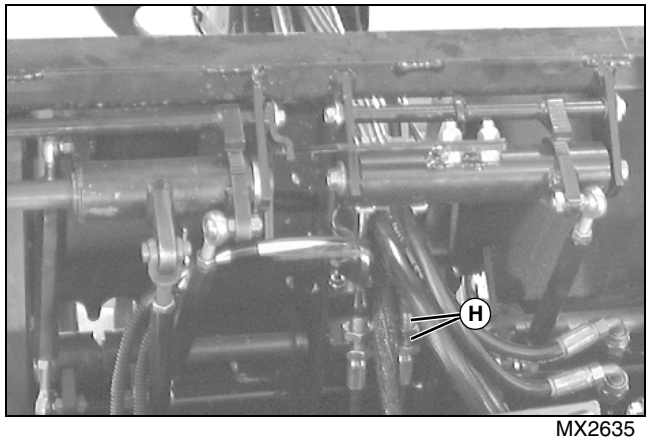
4. Remove cotter pin (B), washer (A), and anchor pin (D).

5. Loosen jam nuts (E) and slide the cable out of the bracket.



MX2634

6. Remove cotter pin (F) and anchor pin (G).

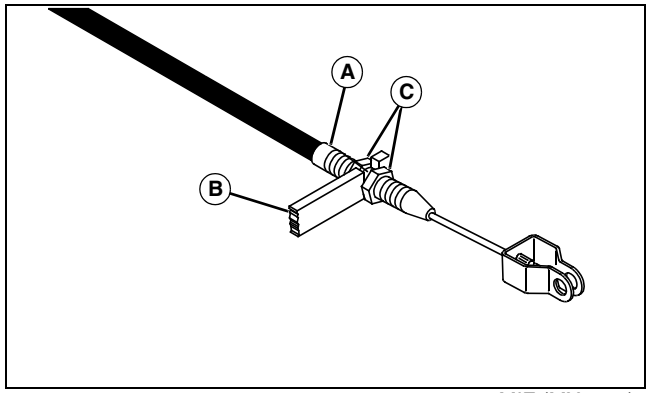


MX2635

7. Loosen jam nuts (H).

8. Remove brake cable.

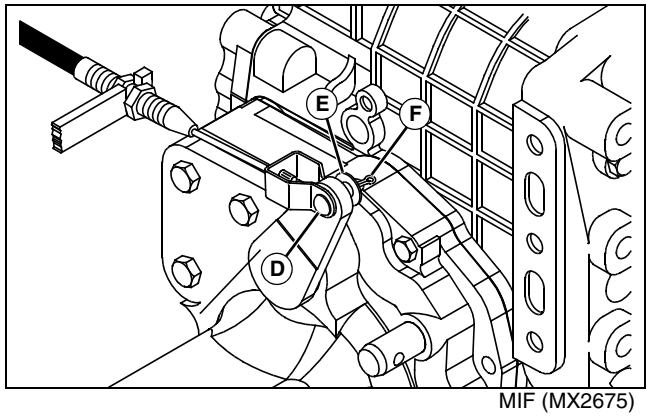
Installation



MIF (MX2674)

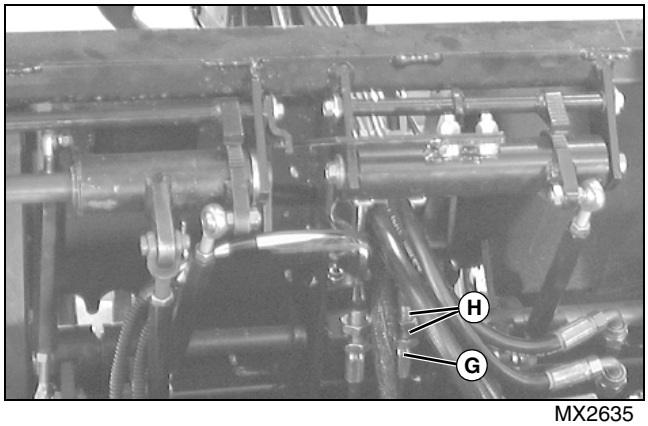
1. Install the cable sheath (A) in the slot in the rear mounting bracket (B).

2. Turn the jam nuts (C) until there is an equal amount of threads showing on both sides of the jam nuts. Tighten the jam nuts.



MIF (MX2675)

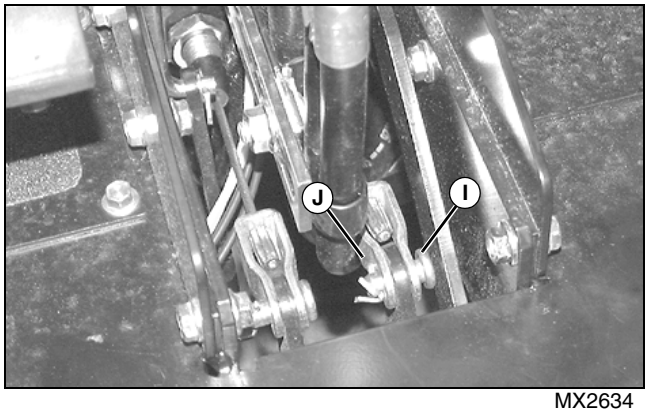
3. Connect the brake cable clevis to the brake actuator arm using an anchor pin (D), washer (E), and cotter pin (F).



MX2635

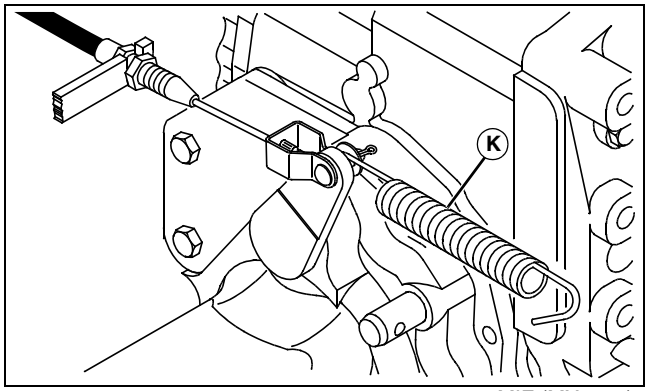
4. Install the cable sheath (G) in the slot in the front mounting bracket.

5. With the brake pedal held against the stop (released position), turn the jam nuts (H) until the holes in the clevis align with the holes in the bellcrank. Tighten the jam nuts.



MX2634

6. Connect the brake cable clevis to the bellcrank using an anchor pin (I) and cotter pin (J).

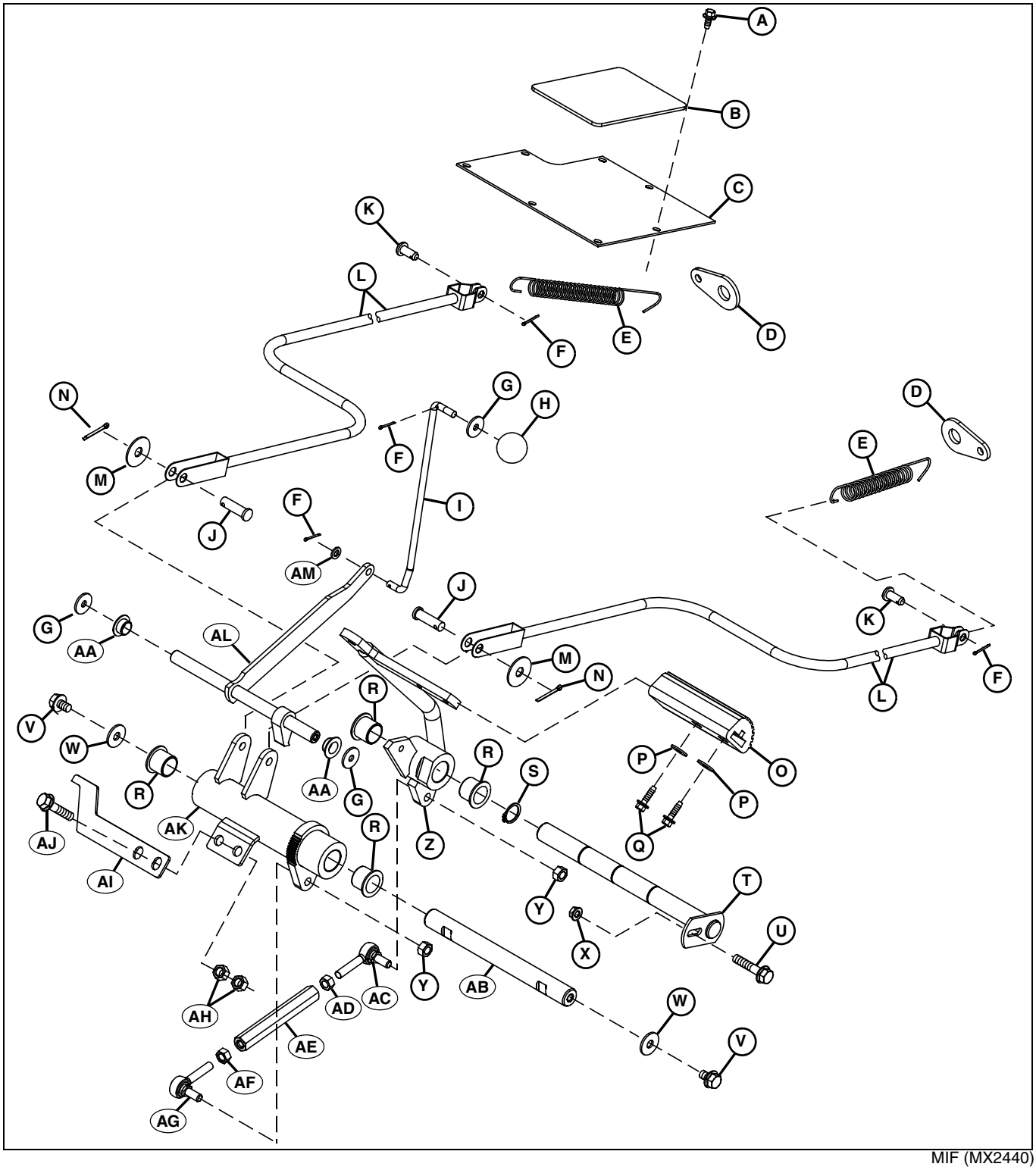


MIF (MX2658)

7. Install return spring (K).

8. Adjust brake cables. (See “Brake Cable Check and Adjustment - Models 1600 and 1620” on page 616.)

Brake Linkage - Models 1600 and 1620

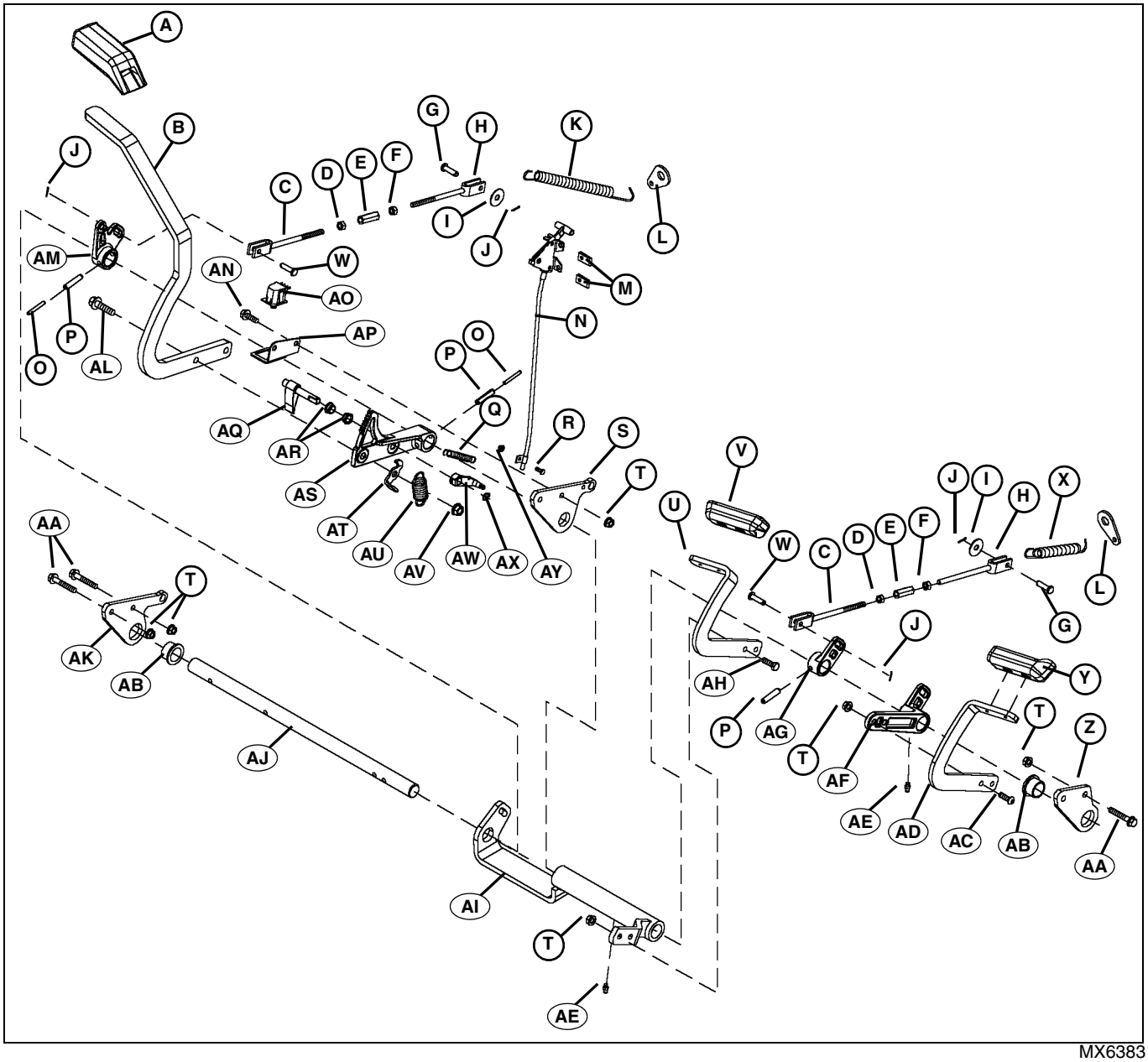


MIF (MX2440)

A - Screw (7 used)
B - Mat
C - Cover
D - Clip (2 used)
E - Return Spring (2 used)
F - Cotter Pin (4 used)
G - Washer (3 used)
H - Knob
I - Rod
J - Pin (2 used)
K - Pin (2 used)
L - Cable (2 used)
M - Washer (2 used)
N - Cotter Pin (2 used)
O - Pad
P - Washer (2 used)
Q - Screw (2 used)]
R - Bushing (4 used)
S - Snap Ring
T - Shaft
U - Screw
V - Screw (2 used)
W - Washer (2 used)
X - Flange Nut
Y - Nut (2 used)
Z - Pedal
AA- Bushing (2 used)
AB- Pivot Pin
AC- Ball Joint
AD- Nut
AE- Turnbuckle
AF- Nut
AG- Ball Joint
AH- Flange Nut (2 used)
AI - Arm
AJ- Screw (2 used)
AK- Pivot Shaft
AL- Lock Lever
AM- Washer

- Inspect all parts for wear and damage. Replace parts as needed.
- Assembly is done in the reverse order of removal.
- Adjust linkage as needed.

Brake Linkage - Model 1600 Turbo



MX6383

A - Pad
B - Master Brake Pedal
C - Link (2 used)
D - Nut (2 used)
E - Turnbuckle (2 used)
F - Nut (2 used)
G - Pin (2 used)
H - Link (2 used)
I - Washer (2 used)
J - Cotter Pin (4 used)
K - Return Spring
L - Clip (2 used)
M - Lock Nut (2 used)
N - Park Brake Lock Linkage
O - Spring Pin (2 used)
P - Spring Pin (3 used)
Q - Spring
R - Cap Screw
S - Plate
T - Flange Nut (10 used)
U - Right Turn Brake Pedal
V - Pad
W - Pin (2 used)
X - Return Spring
Y - Pad
Z - Bracket
AA- Cap Screw (4 used)
AB- Bushing (2 used)
AC- Cap Screw (2 used)
AD- Left Turn Brake Pedal
AE- Lubrication Fitting (2 used)
AF- Arm
AG- Arm
AH- Cap Screw
AI - Pivot
AJ- Pivot Shaft
AK- Plate
AL- Cap Screw (2 used)
AM- Arm
AN- Cap Screw (2 used)
AO- Park Brake Lock Switch
AP- Park Brake Lock Switch Bracket
AQ- Pawl
AR- Bushing (2 used)
AS- Support
AT- Bracket
AU- Spring
AV- Flange Nut (2 used)
AW- Arm
AX- Snap Ring
AY- Flange Nut

- Inspect all parts for wear and damage. Replace parts as needed.
- Assembly is done in the reverse order of removal.
- Adjust linkage as needed.

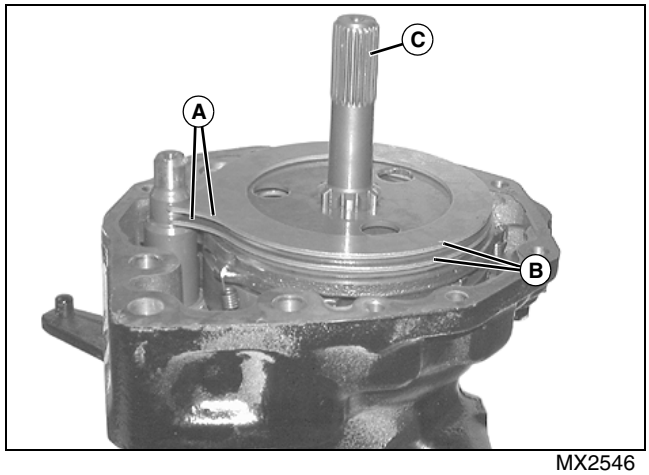
Brake Assembly

Removal

NOTE: The brake assembly is an internal feature of the transaxle assembly. Inspection and repair of the brake assembly require removal and disassembly of the transaxle.

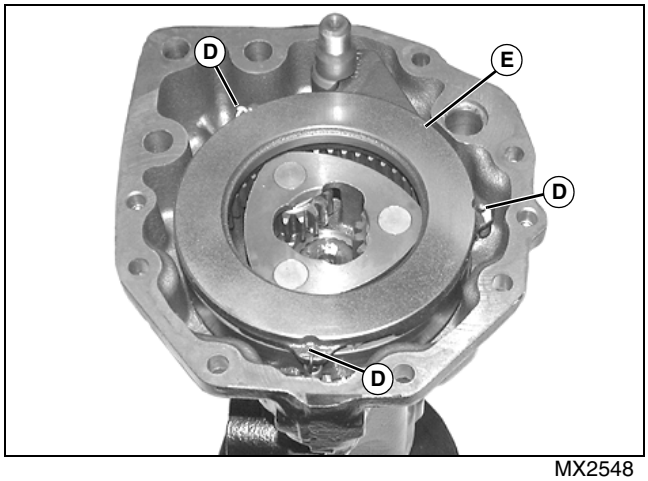
1. Remove transaxle assembly.
2. Remove axle shaft housings.

NOTE: The brake disks, separator disks, and drive pinion shaft may remain with the transaxle housing when the axle shaft drive housing is removed.



MX2546

3. Remove brake separator disks (A) and brake disks (B).
4. Remove drive pinion shaft (C).



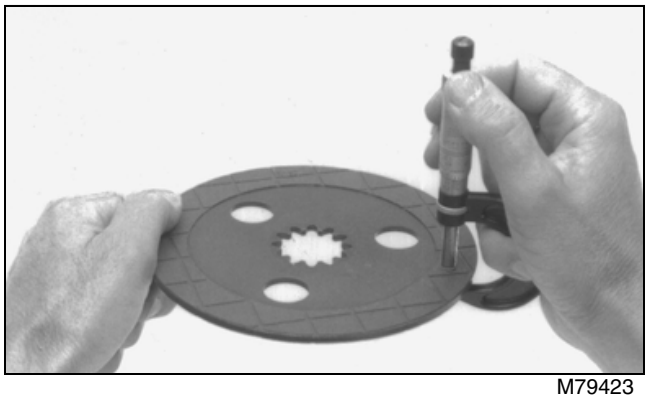
MX2548

5. Remove three springs (D).

6. Remove actuator plate (E).

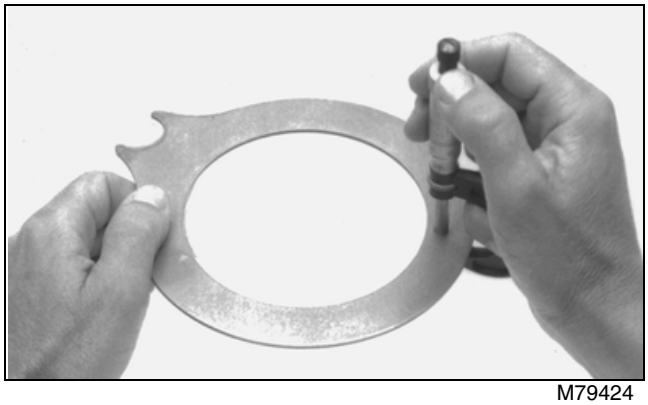
7. Inspect all parts for wear and damage. Replace parts as needed.

Inspection


M79423

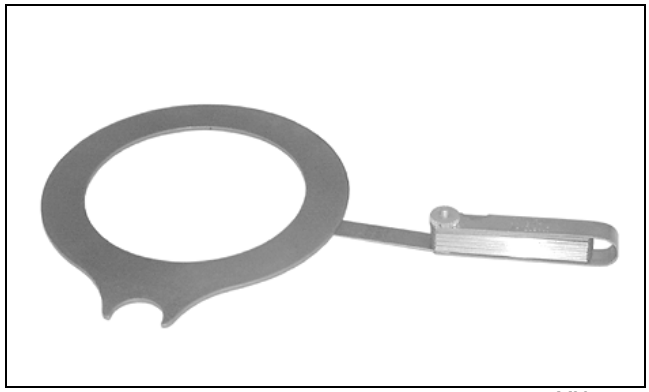
1. Measure the thickness of the brake disks. Replace the disks if the thickness measures less than specification.

2. Check the brake disk-to-shaft backlash. Replace the brake disk if the backlash is greater than specification.

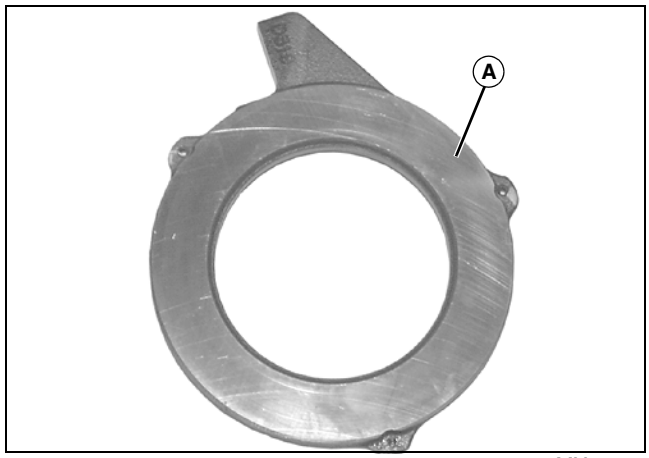

M79424

3. Inspect the brake separator disks for scoring or grooving. Replace as needed.

4. Measure the thickness of the brake separator disks. Replace the separator disks if the thickness measures less than specification.


MX2557

5. Place the separator disks on a known flat surface and check for warpage using a feeler gauge. Replace separator disk if warpage is greater than specification.



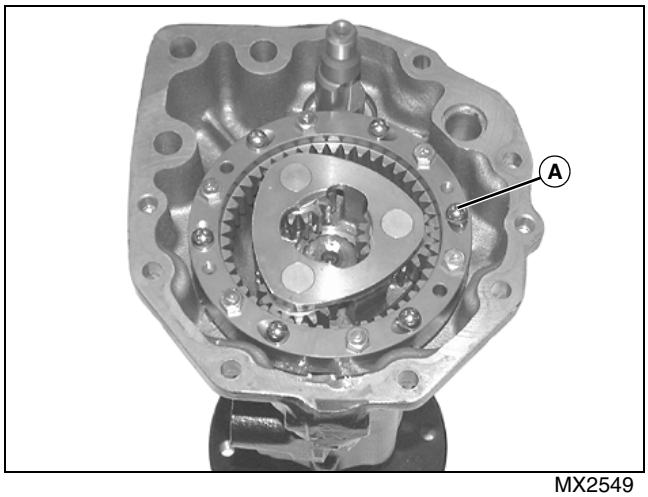
MX2553

6. Inspect the surface (A) of the actuator plate for signs of scoring or roughness. Minor imperfections can be removed using 400-grit emery paper. Replace the actuator as needed.

Specifications

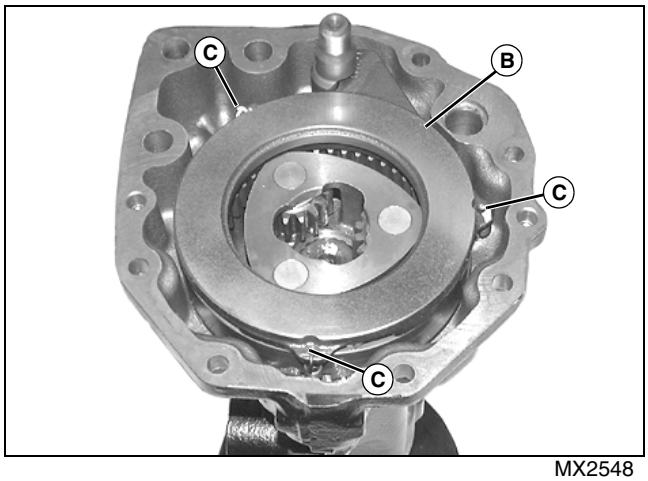
Brake Disk Thickness (Min) . . . . . 4.4 mm (0.173 in.)
Brake Disk-to-Shaft Backlash (Max). 1.2 mm (0.047 in.)
Brake Separator Disk Thickness (Min). . . . . 2.3 mm (0.090 in.)
Brake Separator Disk Warpage (Max) . . . . . 0.3 mm 0.012 in.)

Installation



MX2549

1. Apply petroleum jelly to the six steel balls (A).

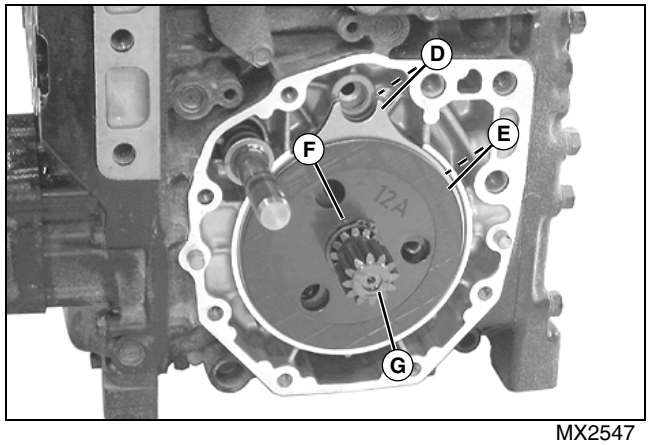


MX2548

2. Install actuator plate (B).

NOTE: Attach the shorter hook of each spring to the ring gear.

3. Install three springs (C).



MX2547

4. Install two separator disks (D) and brake disks (E) alternately in place against snap ring (F) on the drive pinion shaft (G). Install the pinion shaft/brake disk assembly into the transaxle housing.

NOTE: Use a new gasket when installing the axle shaft housing.

5. Install axle shaft housing.

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Specifications

Test and Adjustment Specifications

Front Tire Air Pressure[4]	138 kPa (20 psi)
Rear Tire Air Pressure[2]	138 kPa (20 psi)
Front Tire Air Pressure - 1600 Turbo S.N. (040001-)	207 kPa (30 psi)
Rear Tire Air Pressure - 1600 Turbo S.N. (040001-)	193 kPa (28 psi)
Caster Wheel Tire Air Pressure	275 kPa (40 psi)
Blade Tip Height Difference (Max)	6 mm (0.25 in.)

Repair Specifications

Drive Belt Nut Torque	50 N•m (37 lb-ft)
Blade Cap Screw Torque	122 N•m (90 lb-ft)
Blade Cap Screw Torque (Spindle Nut Removal Only)	320 N•m (236 lb-ft) 0.40 mm (0.016 in.)
Motor Mounting Plate Cap Screw Torque	50 N•m (37 lb-ft)
Spindle Lower Seal Depth	2.57 mm (0.10 in.)
Spindle Flanged Nut Torque	255 N•m (188 lb-ft)
Spindle Mounting Lock Nut Torque	24 ± 4 N•m (18 ± 4 lb-ft)
Sheave-to-Hub Lock Nut Torque	24 ± 4 N•m (18 ± 4 lb-ft)
Caster Wheel Axle Lock Nut Torque	64 N•m (43 lb-ft)
Blade Cutting Edge Width	0.40 mm (0.016 in.)

4. 1600 Turbo S.N. (-040000) see SIB 05-11-70-2

Diagnostics

Mower Drive Checks

Test Conditions:

- Machine safely parked. (See “Park Machine Safely” on page 3.)
- PTO disengaged.

Symptom: Mower Drive Checks

(1) Mower Deck.
Are drive belt and sheaves free of debris?

Yes - Go To Step (2)

No - Remove belt shields and remove debris.

(2) Front Mower Deck Adjustment Linkage.
Is mounting hardware tight?
Is mower deck level side-to-side?
Is mower deck level front-to-back?

Yes - Go To Step (3)

No - Tighten mounting hardware and/or adjust deck as needed.

(3) Mower Deck Drive Belt.
Is incorrect belt installed or is it damaged, worn, stretched or broken?

Yes - Replace belt.

No - Go To Step (4)

(4) Drive Belt Tension Spring.
Is tension spring damaged, worn or weak?

Yes - Replace spring.

No - Go To Step (5)

(5) Drive Belt Idler Arm.
Is drive belt idler arm binding or damaged?

Yes - Repair as needed.

No - Go To Step (6)

(6) Spindle Sheave.
Is sheave damaged, bent or wobbling?
Has belt come off the sheave?

Yes - Sheave damaged, bent or wobbling. Repair or replace as needed.

Yes - Belt has come off the sheave. Install belt.

No - Go To Step (7)

Symptom: Mower Drive Checks

(7) Spindle and Housing.
Does spindle need lubrication?
Is there debris (e.g., string, long grass, or weeds) wrapped around the spindle?
Is the spindle mounting hardware loose?
Are bearings worn, damaged or binding?

Yes - Spindle needs lubrication. Fill with chassis and mower spindle grease.

Yes - Debris is wrapped around the spindle. Remove debris.

Yes - Spindle mounting hardware is loose. Tighten mounting hardware.

Yes - Bearings are worn, damaged or binding. Repair or replace as needed.

No - Go To Step (8)

(8) Blades.
Are blades loose on spindle?
Are blades bent, worn or damaged?
Are blades dull or out of balance?

Yes - Blades are loose. Tighten blade cap screw.

Yes - Blades are bent, worn or damaged. Replace blade(s).

Yes - Blades are dull or out of balance. Sharpen and balance blades.

No - Go To Step (9)

(9) Caster Wheels.
Are caster wheel tires inflated to specification?

Yes - Go To Step (10)

No - Inflate caster wheel tires to specification.

(10) Caster Wheel Yoke Assemblies.
Do caster wheel yoke assemblies need lubrication?
Are bearings in caster wheel yoke assemblies binding, worn, or damaged?

Yes - Caster wheel yoke assemblies need lubrication. Apply chassis and mower spindle grease to lubrication fitting.

Yes - Bearings are binding, worn or damaged. Replace bearings as needed.

No - Go To Step (11)

Symptom: Mower Drive Checks

(11) Machine parked on a clean level surface away from people and objects.
Engine running at FAST idle.
Engine at operating temperature.
Mower decks lowered to the ground.
PTO engaged.
Engine.
Is engine running at correct rpm?

Yes - Go To Step (12)

No - Check engine operation.

(12) Mower Deck.
Does mower deck run rough, with unusual noises, or take a long time to stop?

Yes - Slowly reduce engine rpm and listen for problem area. Disengage PTO and stop engine. Repair or replace faulty or damaged components.

Caster Wheel Tire Air Pressure. . . . . 275 kPa (40 psi)

Mower Deck Will Not Run

NOTE: The mower deck drive motors are hydraulically driven. Check the hydraulic system operation if the following mechanical items are not the cause of the problem.

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- PTO disengaged.

Symptom: Mower Deck Will Not Run

(1) Mower Deck Drive Belt.
Is an incorrect belt installed?
Is the belt damaged, worn, stretched or broken?
Is the belt loose?

Yes - Incorrect belt is installed. Replace belt.

Yes - Belt is damaged, worn, stretched, or broken. Replace belt.

Yes - Belt is loose. Adjust belt tension.

No - Check hydraulic system operation.

Mower Deck Does Not Reach Full Speed

NOTE: The mower deck drive motors are hydraulically driven. Check the hydraulic system operation if the following mechanical items are not the cause of the problem.

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- PTO disengaged.

Symptom: Mower Deck Does Not Reach Full Speed

(1) Mower Deck Drive Belt.
Is an incorrect belt installed?
Is the belt damaged, worn, stretched, or broken?
Is the belt loose?

Yes - Incorrect belt is installed. Replace belt.

Yes - Belt is damaged, worn, stretched, or broken. Replace belt.

Yes - Belt is loose. Adjust belt tension.

No - Go To Step (2)

(2) Spindle Assemblies.
Is there debris (e.g., string, long grass, or weeds) wrapped around the spindle or blades?

Yes - Remove debris.

No - Go To Step (3)

(3) Mower Deck Pump Control Linkage.
Are stops adjusted properly on deck drive stroke control cylinder and mower deck pump control linkage?

Yes - Check hydraulic system operation.

No - Adjust stops to obtain proper spindle speed.

Mower Deck Vibrates

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- PTO disengaged.

Symptom: Mower Deck Vibrates

(1) Mower Deck Drive Motor Mounting Plate.
Is mounting plate bolted firmly to mower deck?

Yes - Go To Step (2)

No - Tighten hardware as needed.

(2) Mower Drive Belt.
Is incorrect belt installed or is it damaged, worn, stretched, or broken?

Yes - Replace belt.

No - Go To Step (4)

(3) Mower Blades.
Are blades loose on spindle?
Are blades bent, worn, or damaged?
Are blades dull or out of balance?

Yes - Blades are loose. Tighten blade cap screw.

Yes - Blades are bent, worn or damaged. Replace blade(s).

Yes - Blades are dull or out of balance. Sharpen and balance blades.

No - Go To Step (4)

(4) Drive Sheaves.
Are sheaves damaged, bent or misaligned?
Do sheaves have debris (e.g., string, long grass, or weeds) in or around them?

Yes - Sheave(s) are damaged, bent, or misaligned. Replace damaged sheave(s).

Yes - Sheaves have debris. Remove shields and remove debris.

No - Go To Step (5)

(5) Spindle Assemblies.
Are spindle assemblies damaged or are bearings worn or damaged?
Do spindles or blades have debris (e.g., string, long grass, or weeds) wrapped around them?

Yes - Spindles are damaged or bearings are worn or damaged. Repair or replace as needed.

Yes - Spindles or blades have debris. Remove debris.

Cuts Unevenly

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- PTO disengaged.

Symptom: Cuts Unevenly

(1) Drive and Caster Wheel Tires.
Are tires inflated to specification?

Yes - Go To Step (2)

No - Inflate tires to specification.

(2) Blades.
Are blades properly sharpened? Are blades in good condition and not damaged or bent?

Yes - Go To Step (3)

No - Blades are not properly sharpened. Sharpen blades.

No - Blades are damaged or bent. Replace blades.

(3) Mower Deck Lift Linkage.
Is mower deck level side-to-side and front-to-rear?
Is mower deck mounting hardware tight, not worn?

Yes - Go To Step (4)

No - Mower deck is not level. Adjust mower deck.

No - Mower deck mounting hardware is loose or worn. Repair mower deck lift linkage.

(4) Spindle Assemblies.
Are spindle assemblies damaged or are bearings worn or damaged?

Yes - Spindles are damaged or bearings are worn or damaged. Repair or replace as needed.

No - Go To Step (5)

(5) Mower Deck Pump Control Linkage.
Are stops adjusted properly on deck drive stroke control cylinder and mower deck pump control linkage? (See “Spindle Speed Check and Adjustments” on page 533.)

No - Adjust stops to obtain proper spindle speed.

Caster Wheel Tire Air Pressure . . . . . 275 kPa (40 psi)

Excessive Noise

Test Conditions:

- Machine parked safely. (See “Park Machine Safely” on page 3.)
- PTO disengaged.

Symptom: Excessive Noise

(1) Blades.
Are blades bent, worn, or damaged?
Are blades dull or out of balance?

Yes - Blades are bent, worn, or damaged. Replace blade(s).

Yes - Blades are dull or out of balance. Sharpen and balance blades.

No - Go To Step (2)

(2) Spindle Assemblies.
Are spindle assemblies damaged or are bearings worn or damaged?

Yes - Spindles are damaged or bearings are worn or damaged. Repair or replace as needed.

No - Go To Step (3)

(3) Mower Deck Pump Control Linkage.
Are stops adjusted properly on deck drive stroke control cylinder and mower deck pump control linkage?

Yes - Go To Step (4)

No - Adjust stops to obtain proper spindle speed.

(4) Mower Deck Drive Motors.
Do mower deck drive motors have internal damage?

Yes - Repair or replace drive motor(s) as needed.

Checks, Tests, and Adjustments

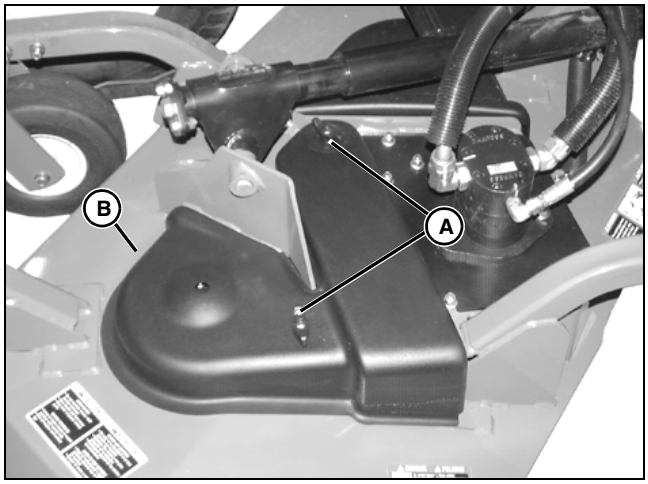
Mower Deck Functional Checks

Conditions

- Operator on seat.
- Machine parked on a level surface.
- Cutting units lowered to the ground.
- Forward/reverse pedals in NEUTRAL position.
- Key switch in STOP position.

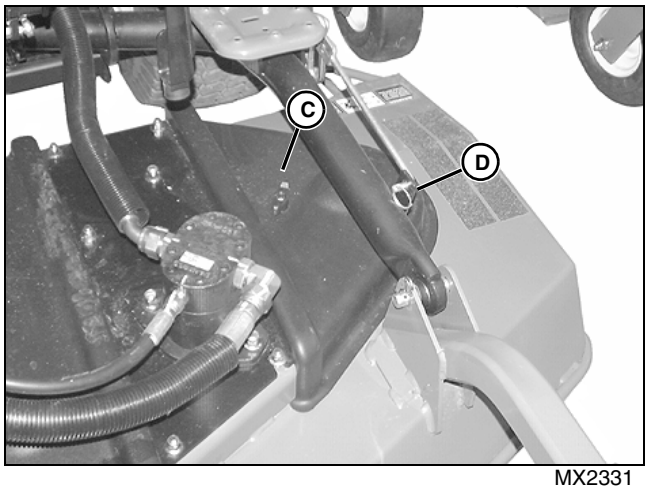
Procedure

NOTE: The mower deck belt shields are removed in order to observe the operation of the mower deck drives.



MX2330

1. Remove wing nuts (A).
2. Remove outer drive belt shield (B).
3. Repeat steps 1 and 2 for the other wing mower deck.



MX2331

4. Remove wing nut (C).
5. Remove left drive belt shield (D) from front mower deck.

CAUTION: Avoid injury! The operator should be on the seat, and the immediate area should be clear of bystanders while the following tests are being performed.

6. Start and run the machine at FAST idle.

NOTE: Mower decks on models S.N. (030001-) will operated in high or low range.

7. Models S.N.(-030000): Move speed range lever to low speed range position.
8. Move PTO switch to ON position. All mower deck motors should engage.

IMPORTANT: Avoid damage! On Models S.N. (010000-020000) 1600/1620 and S.N. (030000-), drive motor will not disengage until mower deck reaches a height of 46 mm (18 in.) from ground.

Models S.N.(020001-030000) 1600/1620 and 1600 Turbo, drive motor will disengage the instant the lift switch is actuated.

9. Move the right mower deck lift lever to the LIFT position.

Normal

- The right mower deck should rise and the drive motor should disengage. On Models 1600/1620 only, the PTO lamp for that deck should flash.

If Not Normal

- If the mower deck does not lift, check the mower deck raise/lower circuit.
- If the mower deck rises, but the mower deck drive motor does not disengage, check the mower deck mow circuit.

10. Move the right mower deck lift lever to the LOWER position.

Normal

- The right mower deck should lower and the drive motor should engage when the mower deck drops.

If Not Normal

- If the mower deck does not lower, check the mower deck raise/lower circuit.
- If the mower deck lowers, but the mower deck drive motor does not engage, check the mower deck mow circuit.

11. Repeat steps 9 and 10 for the left mower deck.
12. Move the front mower deck lift lever to the LIFT position.

Normal

- The front mower deck should rise, and all mower deck drive motors should disengage.

If Not Normal

- If the mower deck does not lift, check the mower deck raise/lower circuit.
- If the mower deck rises, but the mower deck drive motors do not disengage, check the mower deck mow circuit.

13.Move the front mower deck lift lever to the LOWER position.

Normal

- The mower deck should lower to the ground, but should not reengage mower deck drive motor.

If Not Normal

- If the front mower deck does not lower, check the mower deck raise/lower circuit.

14.Move the PTO switch to the OFF position and then back to the ON position.

Normal

- All mower deck motors should start.

If Not Normal

- If the mower deck drive motors do not engage, check the mower deck mow circuit.

Specifications

Drive Motor Disengagement Height . . . . . 46 cm (18 in.)

Mower Deck Level Check and Adjustment

Reason

To ensure that the mower decks are properly adjusted to provide an even cut.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Blade Height Gauge	TY15272	Used to measure blade height.

Check Procedure

CAUTION: Avoid injury! Stop engine and remove ignition key before adjusting mower.

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

2. Check all tires for correct tire pressure. Add air as needed.

3. Check the spacers on all mower deck caster wheels; the spacers should be positioned the same on each side of the mower decks.

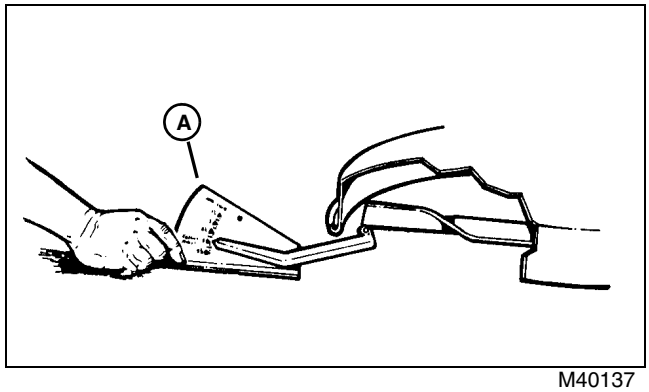
4. Rotate the caster wheels to the rear, as they would be positioned during forward travel.

5. **Front mower deck only:** Check the position of the hanger pins in the adjustment brackets at the rear of the front mower deck. The pins should be in the holes that relate to the cutting height by setting the front caster wheel spacer position. (Refer to Operator’s Manual for cutting height setting information.)

CAUTION: Avoid injury! Wear gloves or wrap blade with a rag to prevent personal injury.

6. Rotate the blades by hand and inspect for sharpness and bent or damaged blades or excessive spindle play. Repair as needed.

7. Rotate the outer blades, so the blade tips are located at the front and rear of the mower deck (parallel to the machine).



M40137

8. Using a TY15272 Blade Height Gauge (A), measure the height of the front and rear blade tips. Repeat for the other outer blade. The rear tips of the blades should be higher than the front blade tips within specification.

9. Rotate the outer blades, so the blade tips are positioned parallel to the front axle.

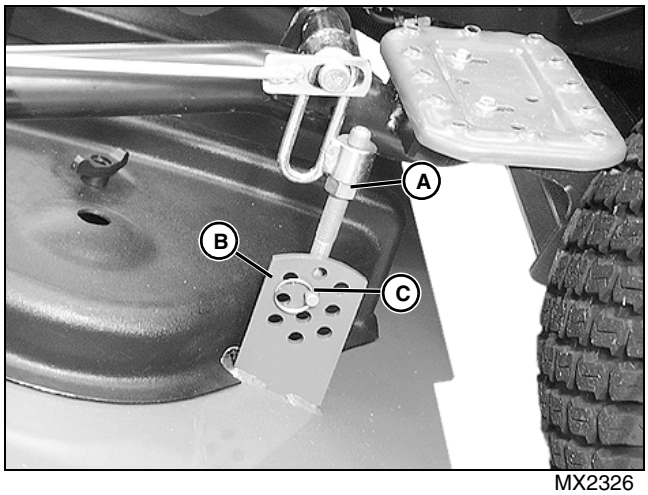
10.Using a TY15272 Blade Height Gauge, measure the height of the outer blade tip on each side of the mower deck. The tips of the blades should be equal height.

Results

- If front-to-back blade height difference is greater than specification, perform the adjustment procedure.
- If blades positioned parallel to the front axle are not level, perform adjustment procedure.

Adjustment Procedure

NOTE: The adjustment of the wing (side) mower decks is limited to adjusting (lowering) the caster tire air pressure on the side of the deck that is high. DO NOT exceed recommended air pressure.



MX2326

NOTE: To ensure the mower deck is returned to its original cutting height, note the location of the hanger pin in the adjustment plate before removing the hanger pin.

In some situations, it may be necessary to reduce caster wheel air pressure on one side only to help level the mower blades.

1. Loosen lock nut (A).
2. Remove retaining ring (B) from hanger pin (C).
3. Rotate hanger pin as needed to adjust the deck height:
   - **To raise the mower deck:** Rotate the hanger pin counterclockwise.
   - **To lower the mower deck:** Rotate the hanger pin clockwise.
4. Install the hanger pin into the same height adjustment hole as it was removed from.
5. Install retaining ring.
6. Tighten lock nut.

Specifications

Front Tire Air Pressure . . . . . 138 kPa (20 psi)
Rear Tire Air Pressure . . . . . 138 kPa (20 psi)
Front Tire Air Pressure - 1600 Turbo S.N. (040001-) . . . . . 207 kPa (30 psi)
Rear Tire Air Pressure - 1600 Turbo S.N. (040001-) . . . . . 193 kPa (28 psi)
Caster Wheel Tire Air Pressure. . . . . 275 kPa (40 psi)
Blade Tip Height Difference (Max) . . . . 6 mm (0.25 in.)

Mower Deck Drive Belt Tension Adjustment

IMPORTANT: Avoid damage! Due to belt stretching, the mower drive belt tension should be checked every 100 hours.

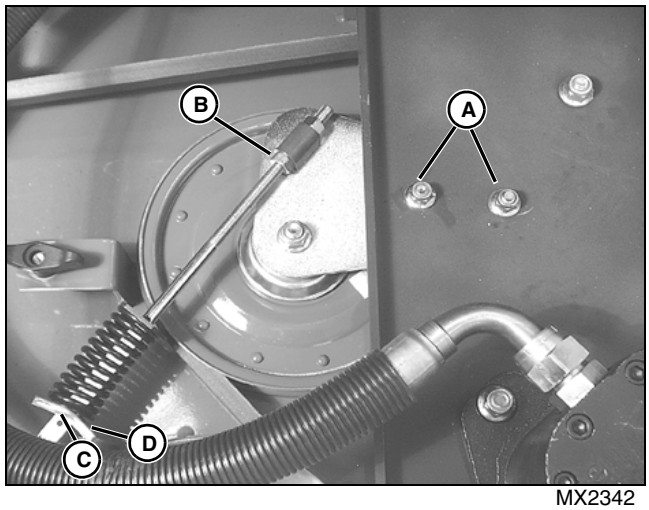
DO NOT over-tension the drive belt. Excess belt tension can cause idler and spindle damage or reduce belt life.

Inadequate drive belt tension will cause belt slippage, belt failure, and poor mowing performance.

Procedure

NOTE: Front mower deck is shown; the procedure for the wing (side) mower deck is the same.

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Lower mower deck to the ground.
3. Remove belt shields.



MX2342

4. Loosen nuts (A).
5. Turn nut (B) clockwise until the tension indicator hole (C) is visible to the outside of the retaining plate (D).
6. Tighten nuts (A) to specification.

Specifications

Drive Belt Nut Torque. . . . . 50 N•m (37 lb-ft)

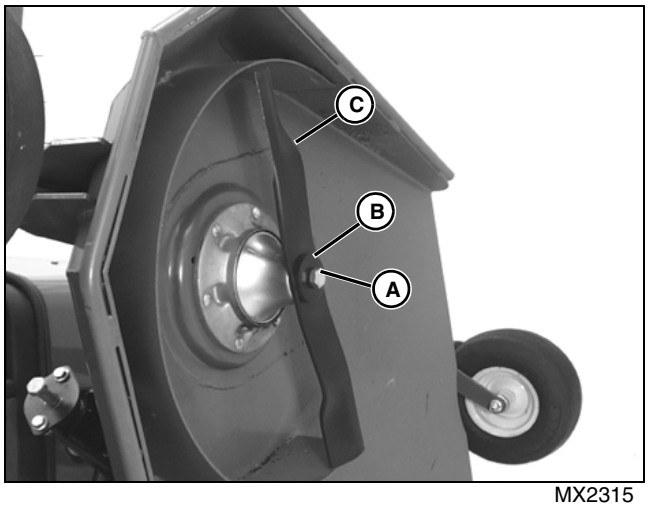
Repair

Mower Deck Blade Removal and Installation

Removal

1. Rotate the front mower deck to the SERVICE position, or raise wing mower decks.

CAUTION: Avoid injury! The blades are sharp. To help prevent injury when you handle the blades, wear heavy gloves or wrap the end of the blade with a rag.



MX2315

2. Remove blade mounting cap screw (A) by turning counterclockwise.

3. Remove washer (B) and blade (C)

4. Inspect blade for cracks, wear, or damage. Replace if necessary.

5. Sharpen and balance blade as needed.

Installation

Installation is done in the reverse order of removal.

- Install blade with bent tips up.
- Tighten cap screw (A) to specification.

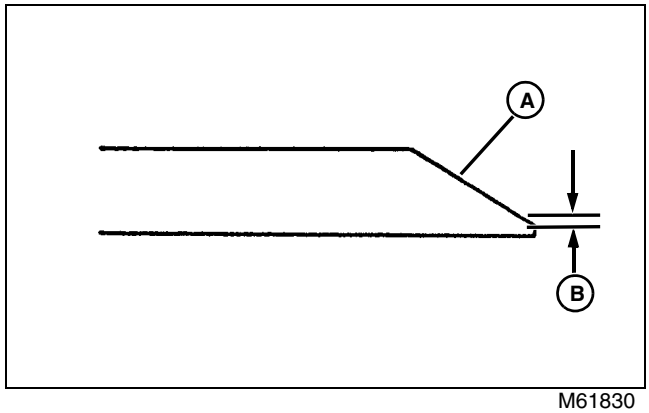
Specifications

Blade Cap Screw Torque . . . . . 122 N•m (90 lb-ft)

Sharpen Mower Deck Blades

CAUTION: Avoid injury! Wear goggles and gloves when sharpening mower blades.

1. Sharpen blade using grinder, file or power sharpener.



M61830

2. DO NOT alter original bevel (A). Blade should have cutting edge (B) to specification, rather than a razor-type edge.

3. Balance blade.

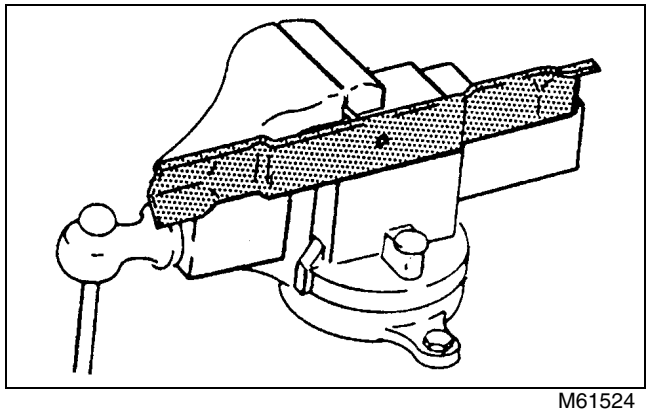
Specifications

Blade Cutting Edge Width . . . . . 0.40 mm (0.016 in.)

Balance Mower Deck Blades

CAUTION: Avoid injury! Wear gloves or wrap blade with rag to prevent personal injury.

1. Clean and inspect blade.



M61524

2. Put blade on a nail in a vise or vertical wall stud.

3. Turn blade to the HORIZONTAL position. If the blade is not balanced, the heavy end will drop.

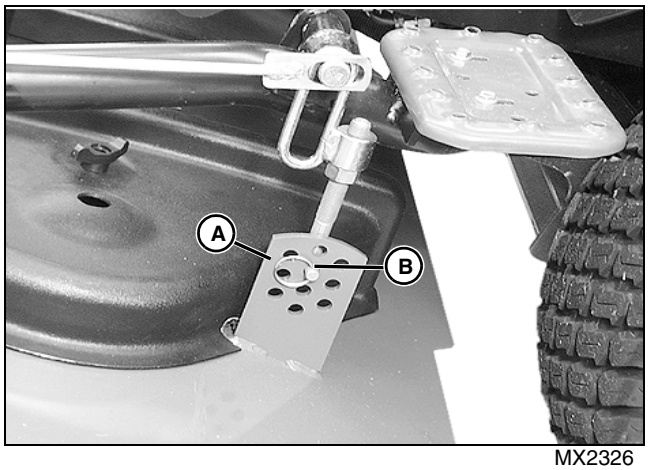
4. Grind bevel of heavy end. DO NOT change blade bevel.

Rotate Front Mower Deck

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

2. Raise front mower deck completely.

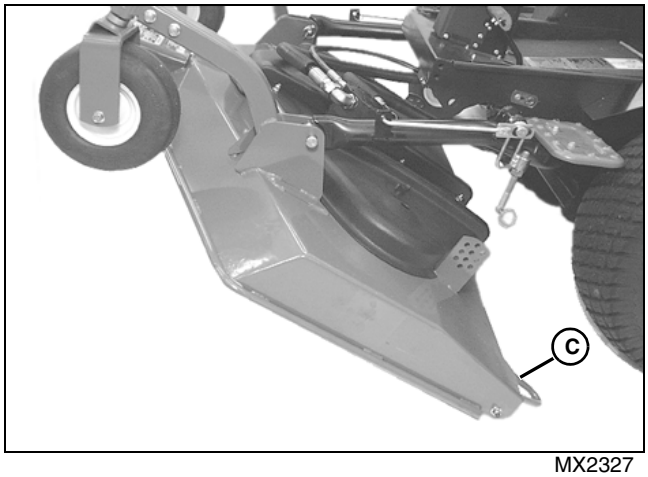
NOTE: To ensure the mower deck is returned to its original cutting height, note the location of the hanger pin in the adjustment plate before removing the hanger pin.



MX2326

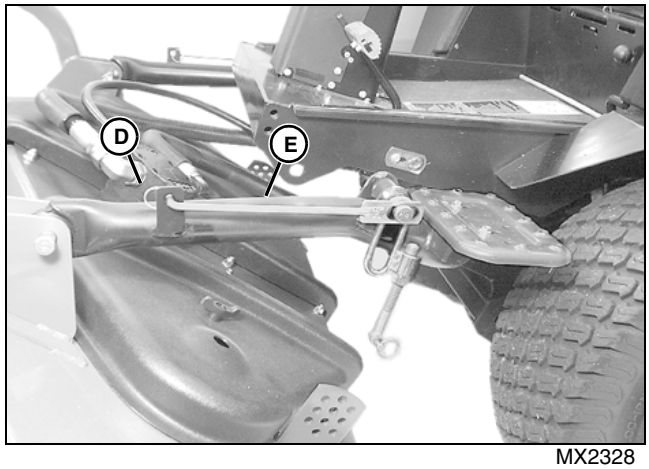
3. Support the rear of the mower deck.

4. Remove retaining ring (A) from hanger pin (B) (both sides of the mower deck).



MX2327

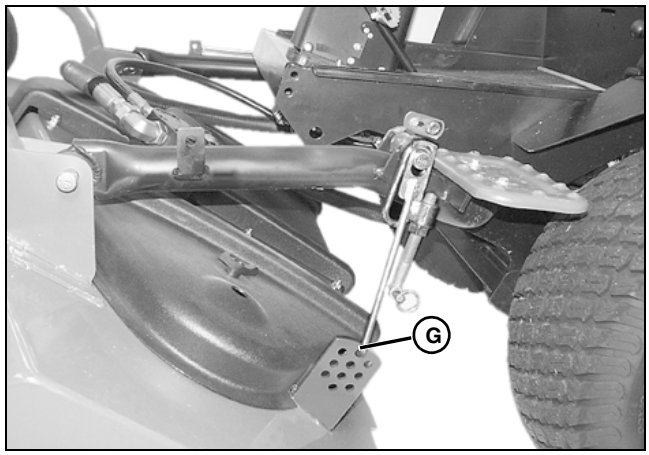
5. Grasp the deck handle (C) and lower the rear of the mower to the ground.



MX2328

6. Remove retaining ring (D) from service lockout rod (E).

7. Remove service lockout rod from mower lift arm.



MX2329

8. Insert service lockout rod into hole (G) in the adjustment plate.

9. Secure service lockout rod with retaining ring.

10. Repeat steps 6-9 for the other side of the mower deck.

Lower Mower Deck

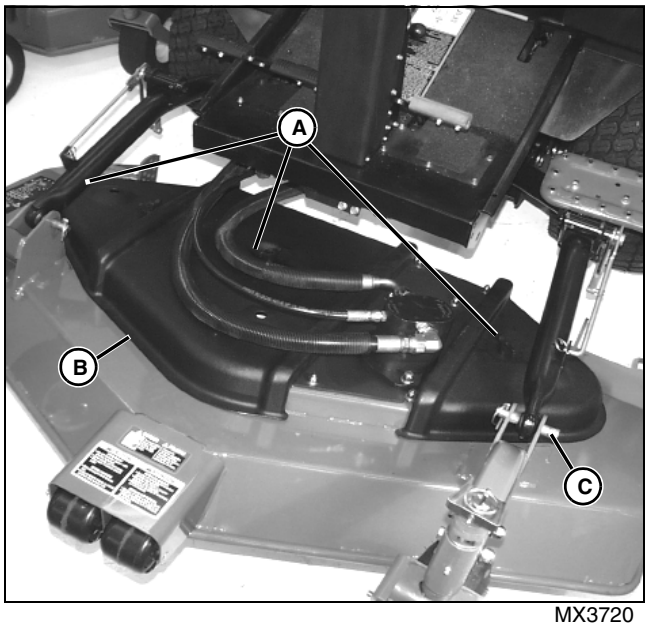
Reverse the order to lower the mower deck to operating position.

Front Mower Deck Belt Shield Removal and Installation

Removal

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

2. Rotate the front deck to SERVICE position, but do not lock service lockout rods into the adjustment plate.



MX3720

3. Remove wing nuts (A).

4. Lift belt shields (B and C) up to clear mounting cap screws. Slide shields out between lift arms and mower deck.

Installation

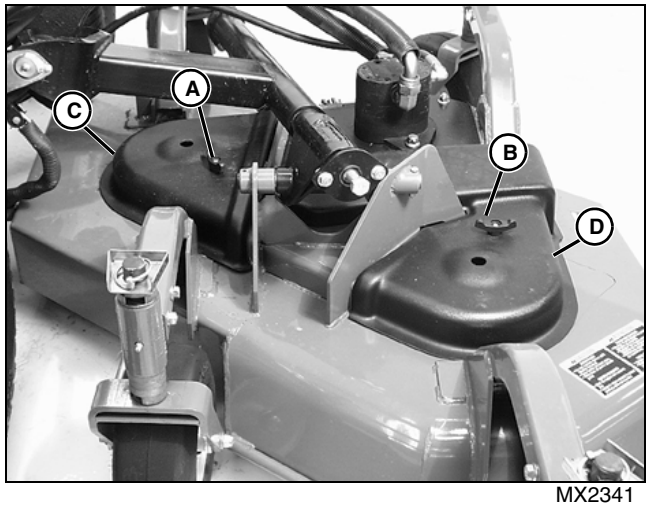
Installation is done in the reverse order of removal.

Wing (Side) Mower Deck Belt Shield Removal and Installation

Removal

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

2. Lower the mower decks to the ground.



MX2341

3. Remove wing nuts (A and B).

4. Remove belt shields (C and D).

Installation

Installation is done in the reverse order of removal.

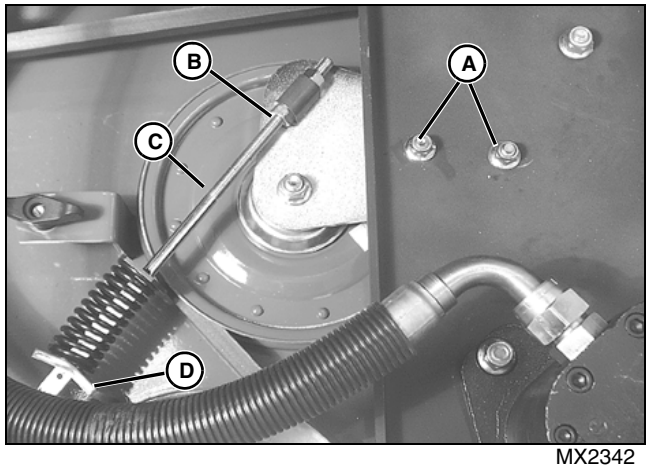
Front Mower Deck Drive Belt Removal and Installation - S.N. (-050000)

Removal

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

2. Lower the mower deck to the ground.

3. Remove belt shields.

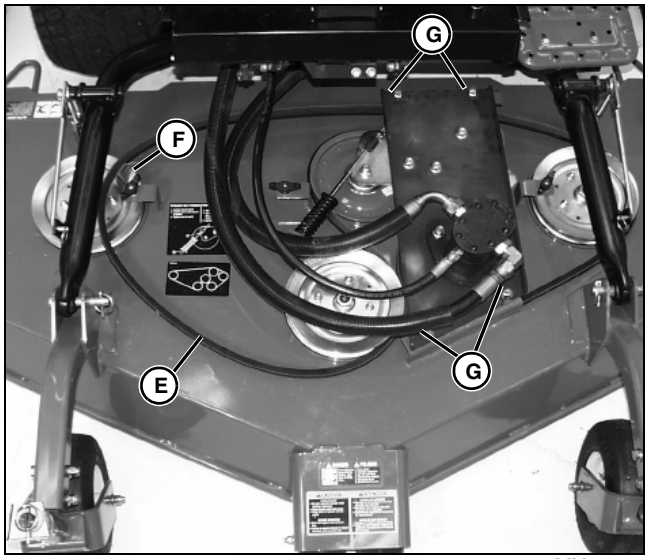


MX2342

4. Loosen nuts (A).

5. Loosen nut (B) completely by turning it counterclockwise.

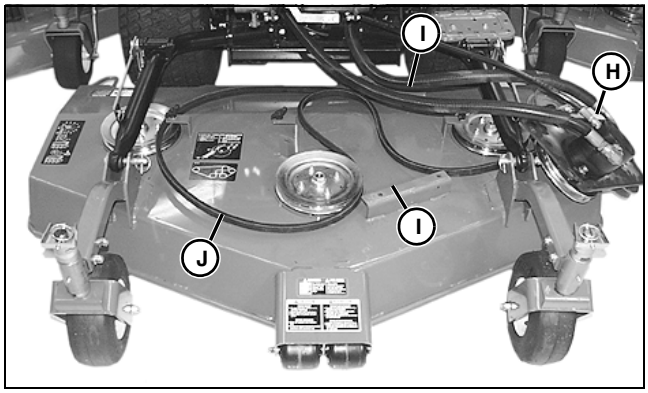
6. Remove tension rod (C) from retaining plate (D).



MX3726

7. Remove drive belt (E) from sheave (F).

8. Remove four cap screws (G) from the motor mounting plate.



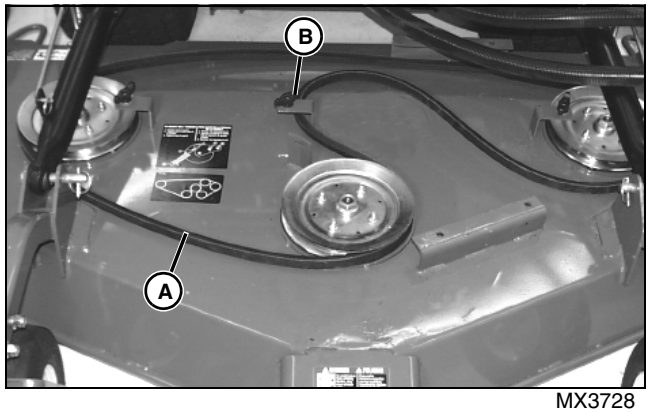
MX2423

9. Slide the motor mounting plate (H) to the rear, so the sheaves clear the mounting brackets (I).

10.Set motor mounting plate assembly aside.

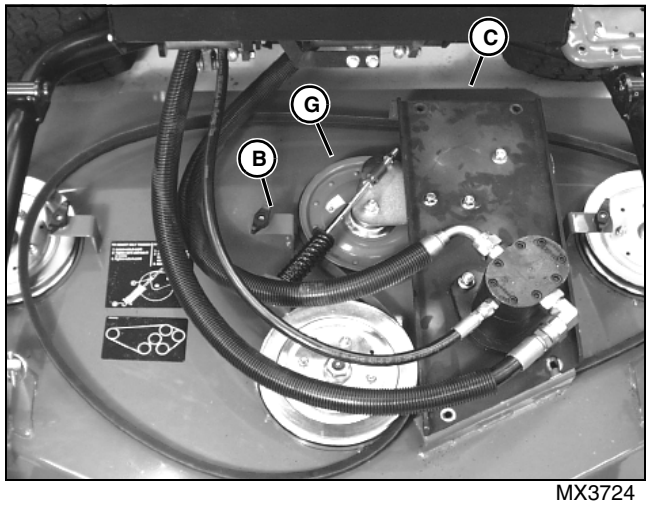
11.Remove drive belt (J).

Installation

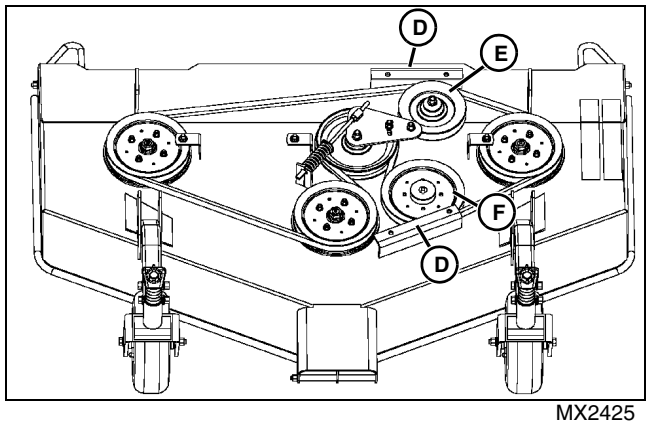


MX3728

1. Route drive belt (A) around sheaves as shown. Place to the outside of the belt shield support bracket (B) to temporarily hold the belt in position.



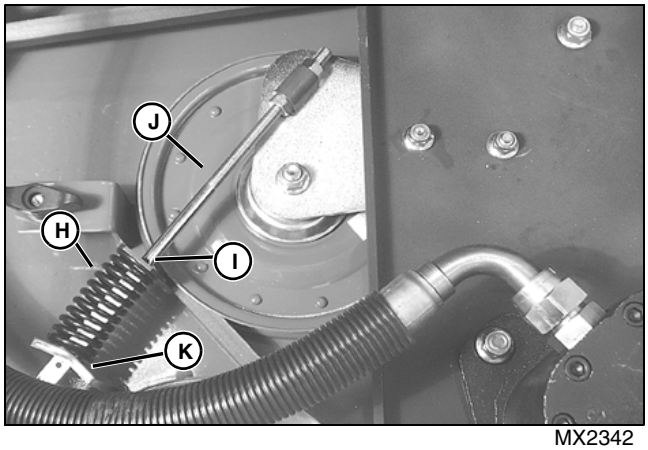
MX3724



MX2425

2. Position motor plate (C) onto mounting brackets (D), so that the drive belt is routed properly around motor drive sheave (E) and idler sheave (F).

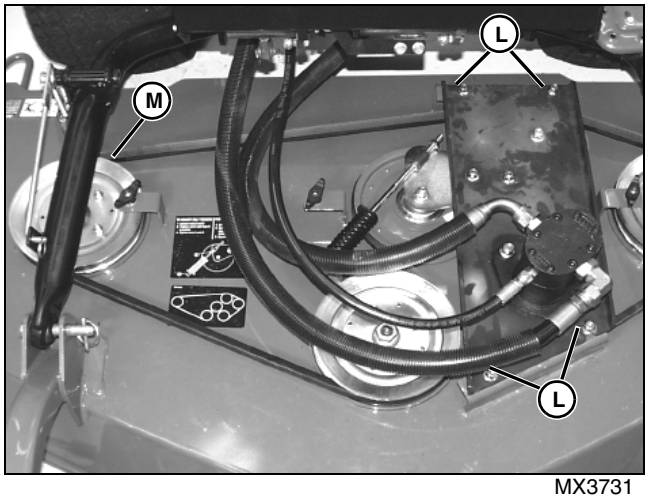
3. Move the drive belt from the outside of the belt shield support bracket, and position it around the tension sheave (G).



MX2342

4. Install spring (H) and spring retainer (I) on the tension rod (J).

5. Install tension rod into retaining plate (K).



MX3731

6. Install cap screws (L). DO NOT tighten at this time.

7. Install drive belt onto sheave (M).

8. Tighten cap screws to specification.

9. Adjust drive belt tension.

10. Move the drive belt by hand to rotate the sheaves. Verify that the belt motion is smooth and the sheaves do not rub on the deck surfaces.

Specifications

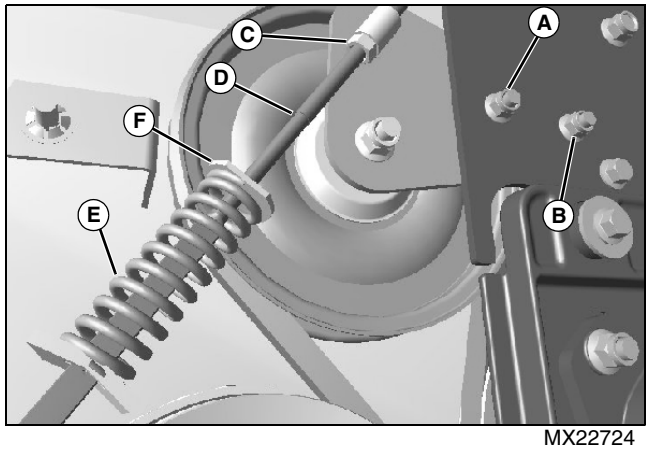
Motor Mounting Plate
Cap Screw Torque . . . . . 50 N•m (37 lb-ft)

Front Mower Deck Drive Belt Removal and Installation - S.N. (050001-)

Front Belt Removal

1. Remove belt shields from mower deck.

2. Lower mower deck completely.



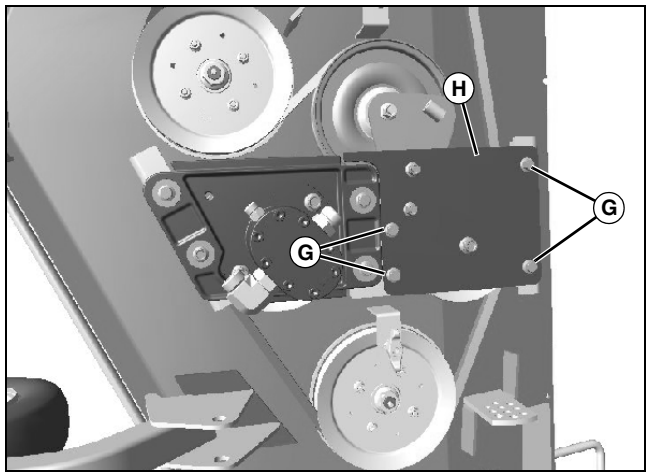
MX22724

3. Loosen hex nuts (A) and (B).

4. Loosen nut (C) until all spring tension is removed.

5. Remove tension rod (D), spring (E), and spring retainer (F).

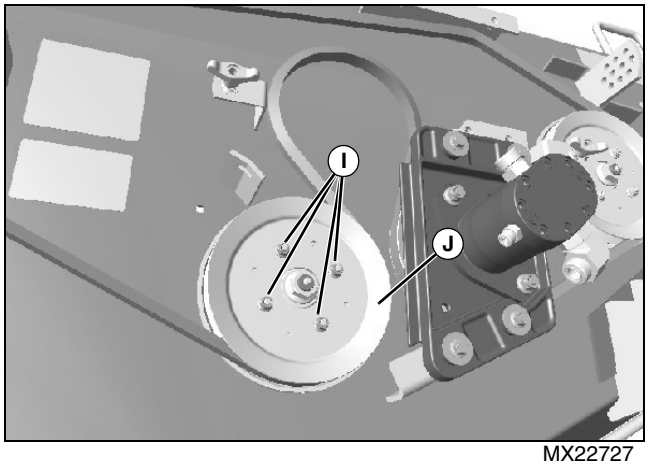
CAUTION: Avoid injury! Rotating parts can catch fingers, loose clothing, or long hair. Wait for engine and all moving parts to stop before leaving operator's station to adjust or service machine.



MX22726

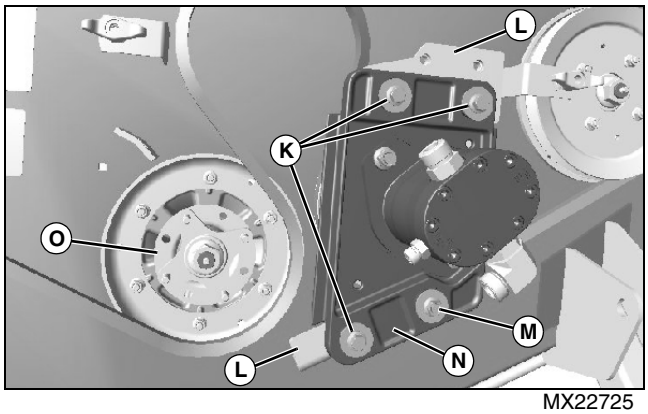
6. Remove four cap screws (G).

7. Remove sheet metal plate (H).



MX22727

8. Remove four hex nuts (I) and mower deck spindle sheave (J).



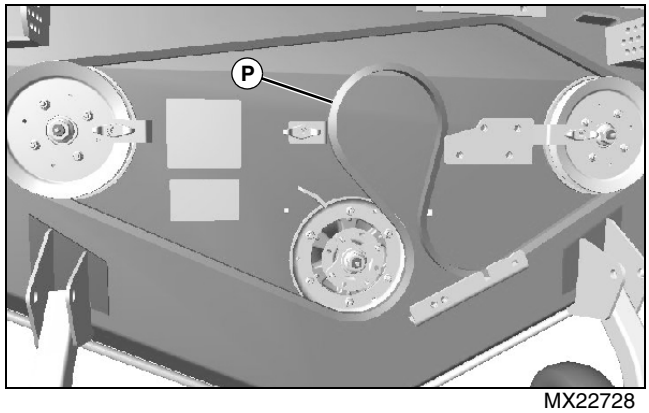
MX22725

9. Remove three cap screws (K), three washers, and three upper rubber isolator halves.

10.Remove nut (M), washer, and rubber isolator half from carriage bolt.

NOTE: The lower halves of the rubber isolators are fit into the deck side of the cast mounting plate. Washers are glued to the bottom of each isolator. Ensure rubber isolators and washers remain installed in the mounting plate during installation of the mounting plate to the mower deck.

11.Slide cast mounting plate (N) towards mower deck spindle (O) to remove it from the mounting brackets (L).

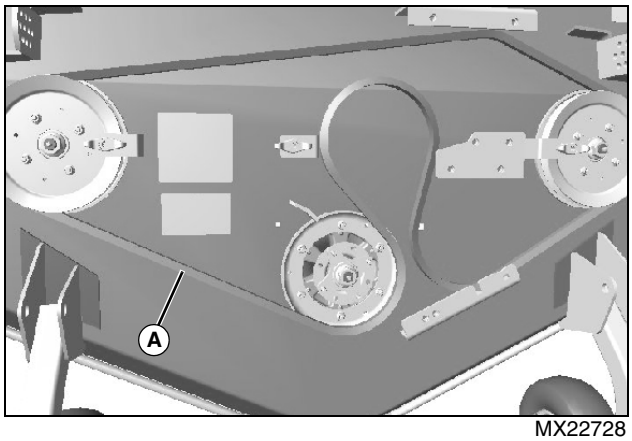


MX22728

12.Remove drive belt (P) from mower deck sheaves.

Front Belt Installation

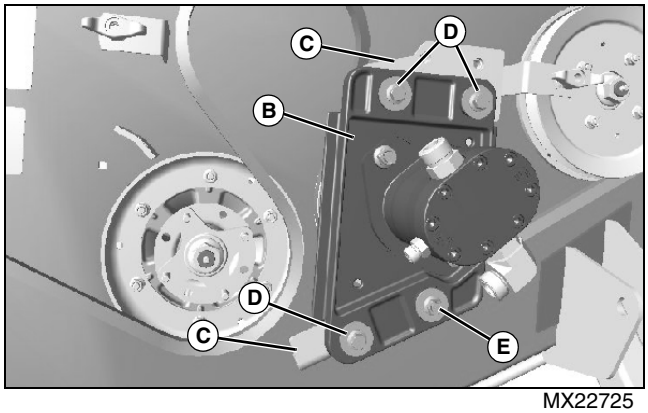
NOTE: Belt routing diagram is affixed to mower deck.



MX22728

1. Route drive belt (A) around mower deck sheaves as shown.

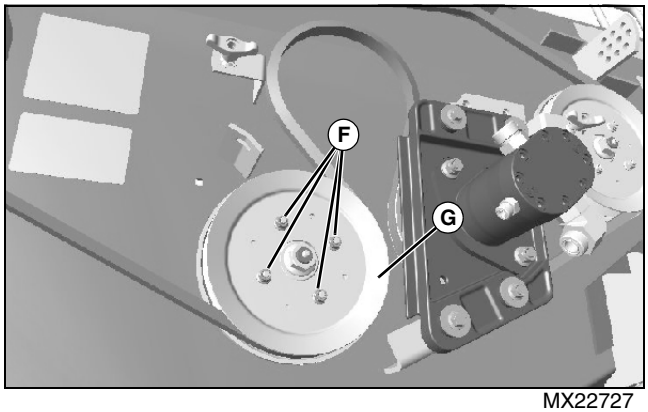
NOTE: The lower halves of the rubber isolators are fit into the deck side of the cast mounting plate. Washers are glued to the bottom of each isolator. Ensure rubber isolators and washers remain installed in the mounting plate during installation of the mounting plate to the mower deck.



MX22725

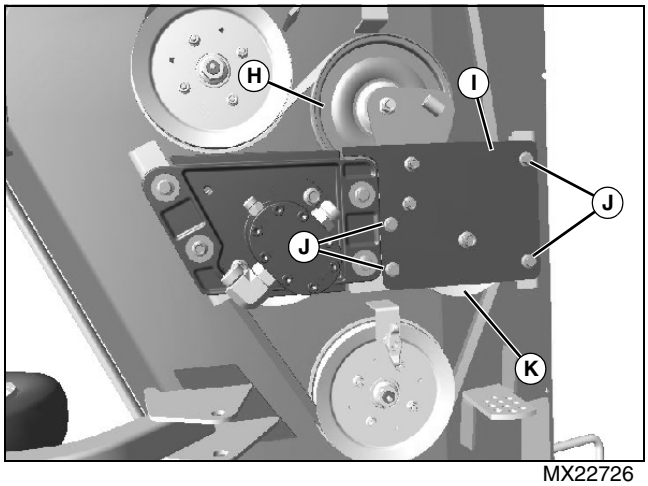
2. Position cast mounting plate (B) onto mounting brackets (C) so that belt is routed properly around drive motor sheave. Install carriage bolt, upper isolator half, washer, and nut (E). Do not tighten.

3. Install 3 upper isolator halves, washers, and cap screws (D). Tighten cap screws (D) and nut (E) to 47 N•m (35 lb-ft).



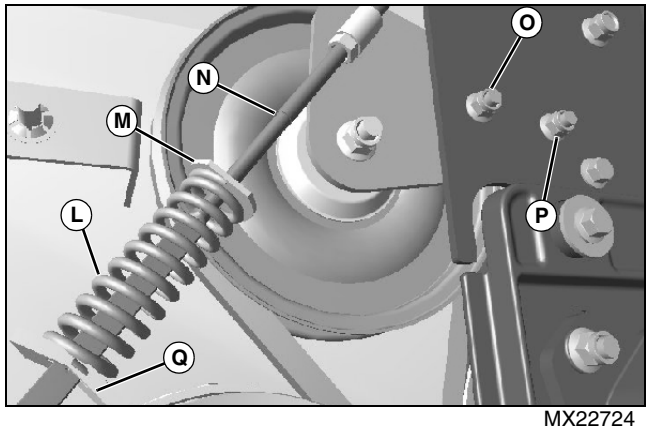
MX22727

4. Install mower deck spindle sheave (G) and four hex nuts (F). Route belt around spindle sheave.



MX22726

5. Install sheet metal plate (I) and route belt around tensioner sheave (H) and idler sheave (K). Install four cap screws (J). Tighten cap screws to 81 N•m (60 lb-ft).



MX22724

6. Ensure spring retainer (M) and spring (L) are installed on tension rod (N). Install tension rod into retaining plate (Q) on mower deck.

7. Adjust drive belt to proper tension.

8. Tighten hex nuts (O) and (P) to 81 N•m (60 lb-ft).

9. Move the drive belt by hand to turn the sheaves. Ensure belt motion is smooth and sheaves do not rub on deck surfaces.

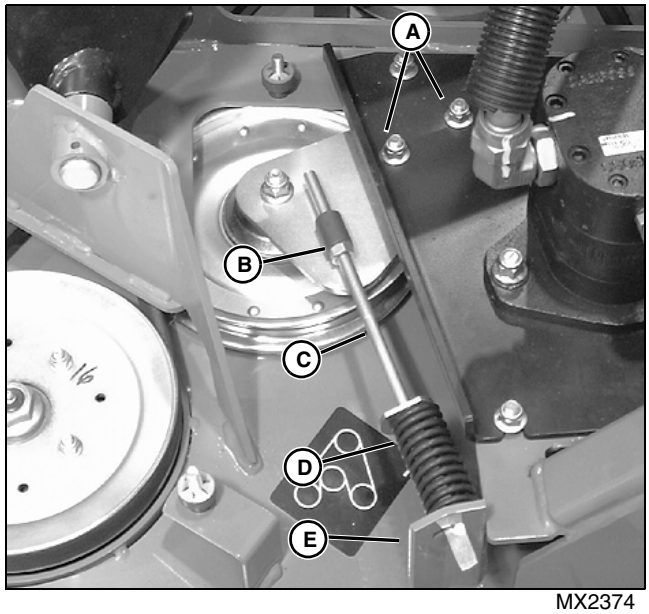
Wing (Side) Mower Deck Drive Belt Removal and Installation

Removal

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

2. Lower the mower decks to the ground.

3. Remove belt shields.

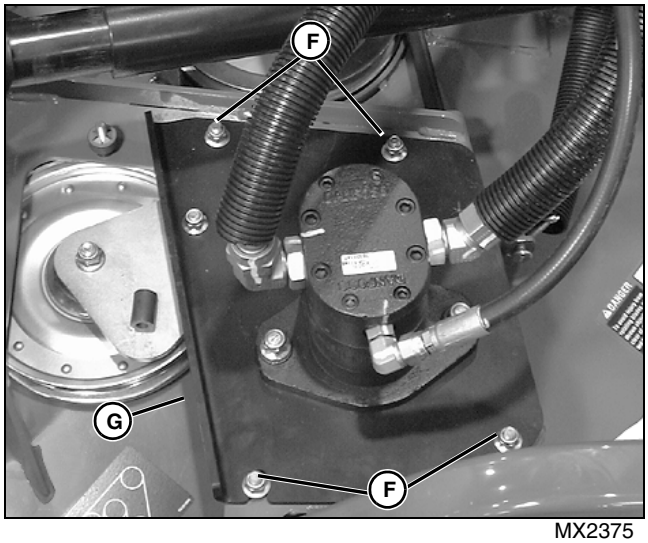


MX2374

4. Loosen nuts (A).

5. Loosen nut (B) completely by turning it counterclockwise.

6. Remove tension rod (C) and spring (D) from retaining plate (E).



MX2375

7. Remove four cap screws (F) from the motor mounting plate.

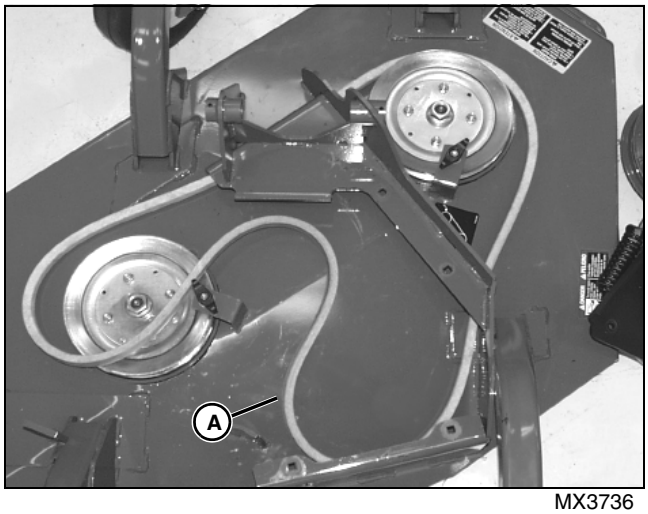
8. Slide the motor mounting plate (G) to the front, so the sheave clears the mounting bracket.

9. Set motor mounting plate assembly aside.

10.Remove drive belt.

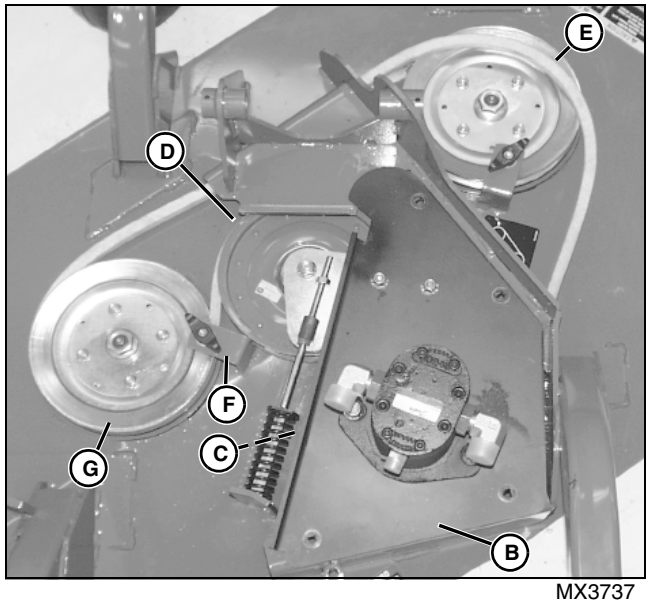
Installation

NOTE: Mower deck removed from machine for photo clarity only.



MX3736

1. Route drive belt (A) as shown.



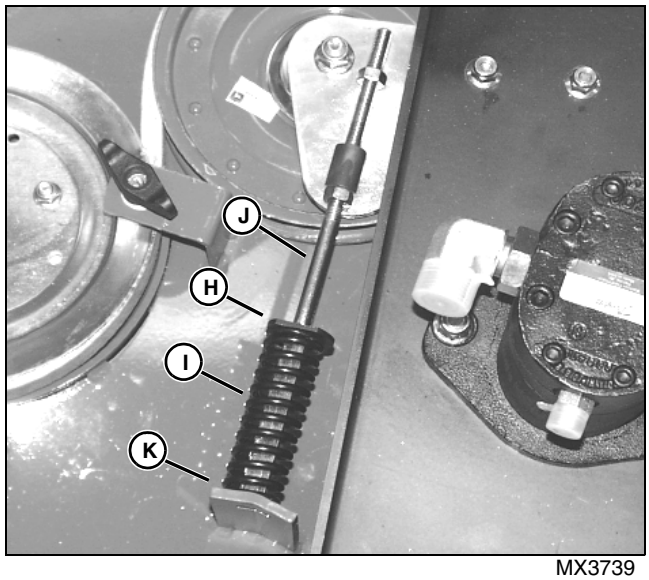
MX3737

2. Position motor plate (B) onto mounting brackets.

3. Route belt around drive motor sheave (C) and tension idler sheave (D).

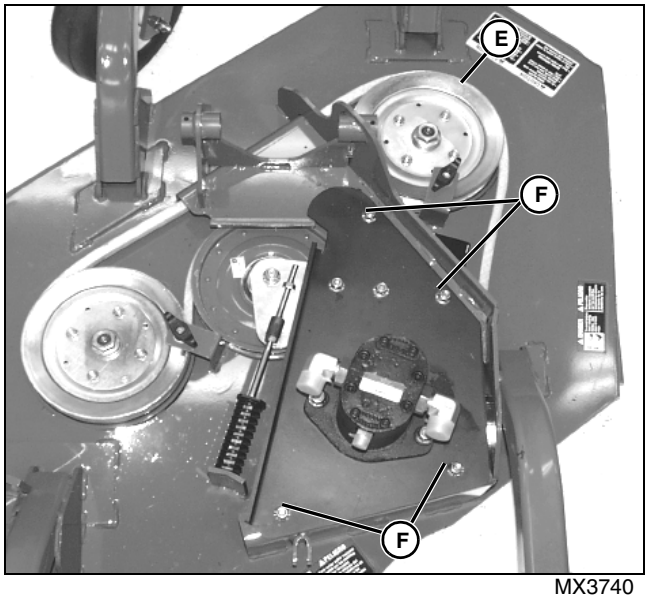
4. Remove belt from spindle sheave (E).

5. Slide drive belt between the belt shield support bracket (F) and spindle sheave (G). Seat belt securely in sheave grooves.



MX3739

6. Verify that the spring retainer (H) and spring (I) are installed on tension rod (J). Insert tension rod into retaining plate (K) on mower deck.



MX3740

7. Install four motor plate cap screws (F), but DO NOT tighten.

8. Install belt over spindle sheave (E).

9. Tighten cap screws (F) to specification.

10. Adjust drive belt tension.

11. Move the drive belt by hand to rotate the sheaves. Verify that the belt motion is smooth and the sheaves do not rub on the deck surfaces.

Specifications

Motor Mounting Plate
Cap Screw Torque . . . . . 50 N•m (37 lb-ft)

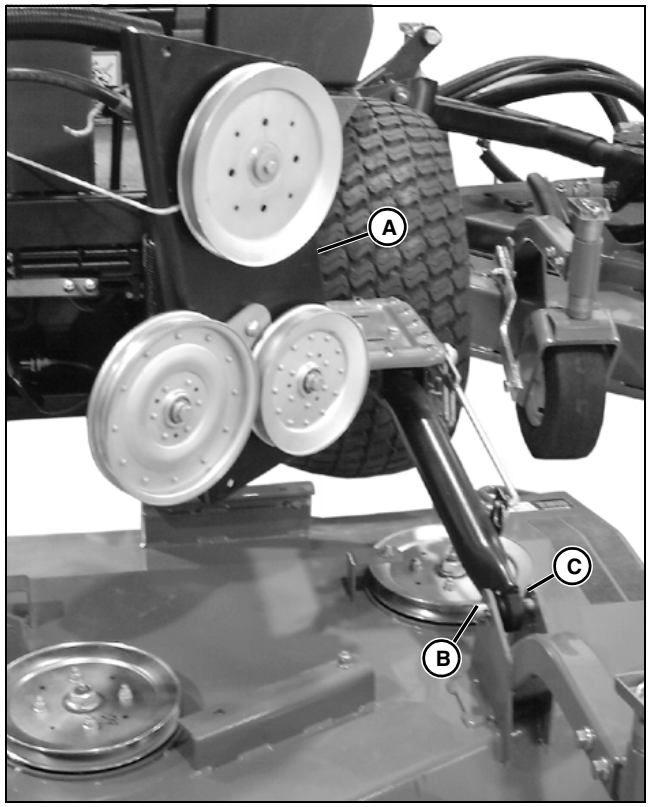
Front Mower Deck Removal and Installation

Removal

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

2. Lower the mower decks to the ground.

3. Remove drive belt.



MX2470

4. Tie motor/plate assembly (A) up to allow clearance.

5. Remove spring clips (B) and pivot pins (C) (two per side of mower deck).

6. Remove mower deck.

Installation

Installation is done in the reverse order of removal.

Tighten motor mounting plate cap screws to specification.

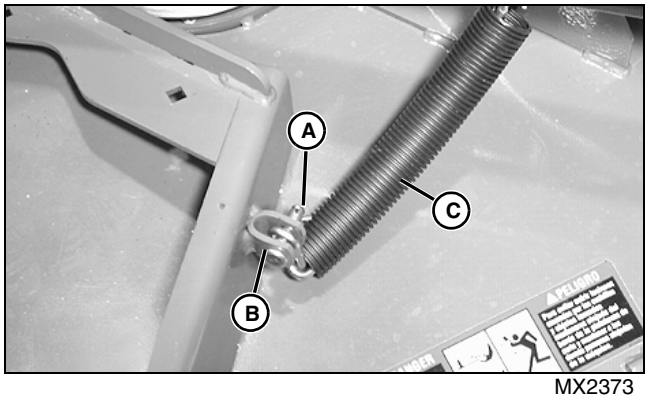
Specifications

Motor Mounting Plate
Cap Screw Torque . . . . . 50 N•m (37 lb-ft)

Wing (Side) Mower Deck Removal and Installation

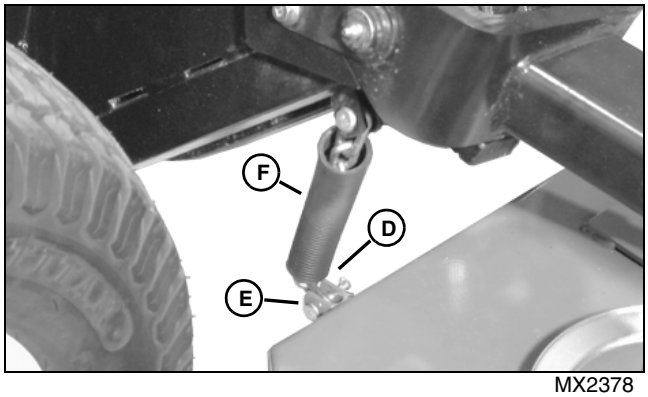
Removal

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Lower the mower decks to the ground.
3. Remove drive belt.



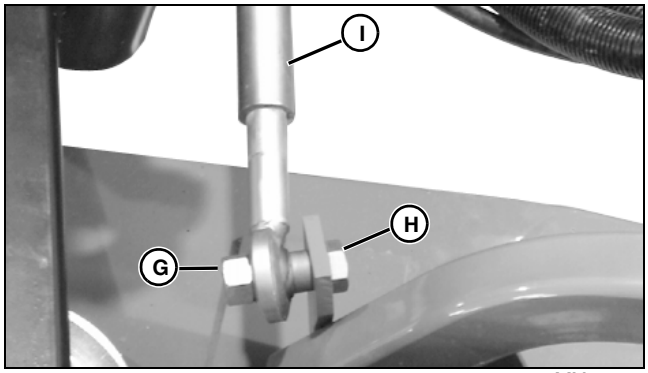
MX2373

4. Remove cotter pin (A).
5. Remove anchor pin (B) and sleeve (C).



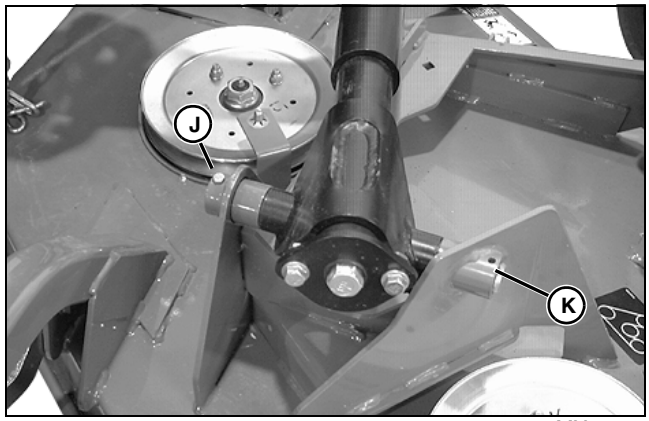
MX2378

6. Remove cotter pin (D).
7. Remove anchor pin (E) and sleeve (F).



MX2376

8. Remove nut (G) and cap screw (H).
9. Disconnect stabilizer arm (I).

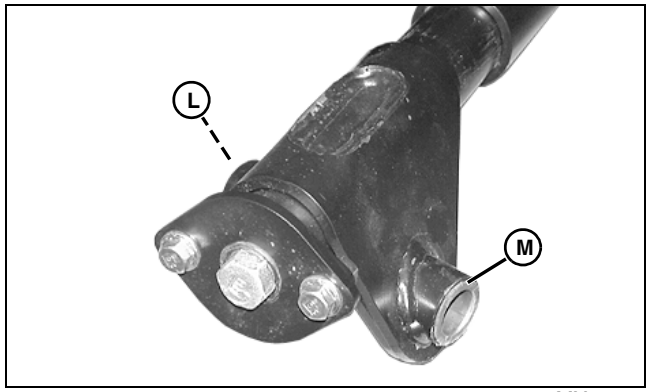


MX2377

10. Remove cap screw and nut (J).
11. Remove pivot pin (K).
12. Start engine and activate the lift lever for the deck being removed.
13. Roll mower deck away from machine.

Installation

Installation is done in the reverse order of removal.



MX2379

- Inspect pivot bushings (L and M) before installing mower deck. Replace as needed.
- Tighten motor mounting plate cap screws to specification.
- Adjust belt tension.

Specifications

Motor Mounting Plate
Cap Screw Torque . . . . . 50 N•m (37 lb-ft)

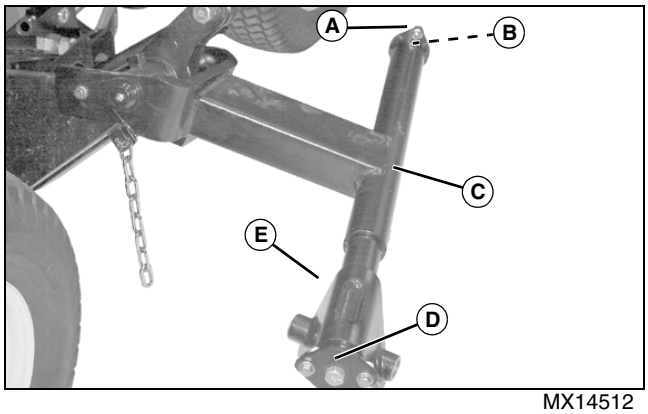
Energy Absorption Bar Removal and Installation

Other Material

Part No.	Part Name	Part Use
TY16285 (US) T7649 (LOCTITE®)	Primer	Used to prepare threads of adjusting screw.
TY15969 (US) 680 (LOCTITE)	Sealant	Used to secure threads of adjusting screw.

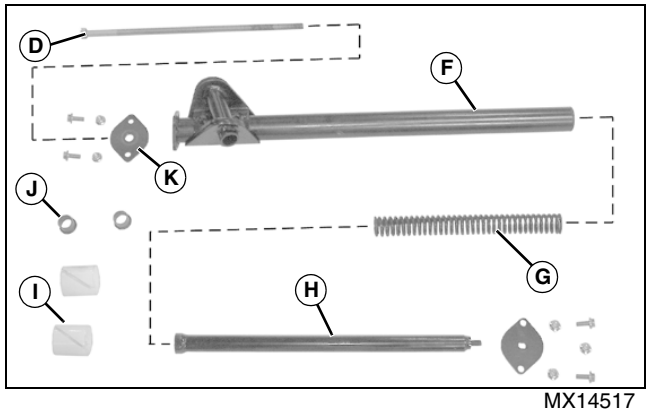
Removal - S.N. (-030000)

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Lower the motor decks to the ground.
3. Remove wing (side) mower deck.



MX14512

4. Turn adjusting screw (D) 2-3 times to loosen the LOCTITE.
5. Remove self-locking nut (B).
6. Remove energy absorption bar assembly (E) from lift arm (C).
7. Remove two nuts and cap screws from end plate (A).

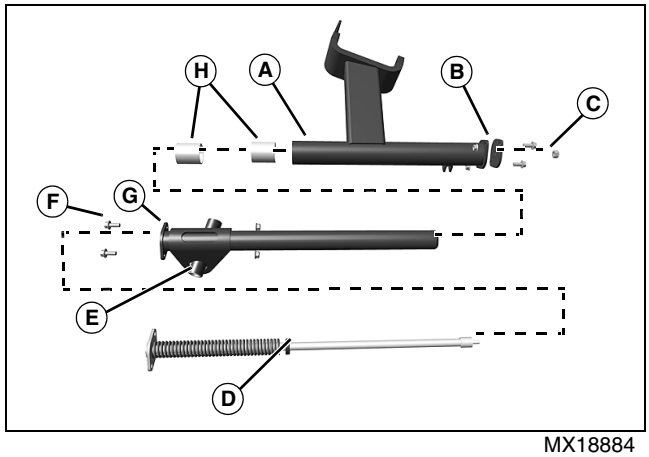


MX14517

8. Remove two nuts and cap screws from end plate (K).
9. Remove end plate, adjusting screw, spring (G), and adjuster shaft (H) from inner tube (F) and disassemble.
10. Remove two bushings (J) from bracket on inner tube.
11. Remove two bushings (I) from lift arm.

Removal - S.N. (030001-)

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Lower the motor decks to the ground.
3. Remove wing (side) mower deck.



MX18884

4. Remove self-locking nut (C).
5. Remove energy absorption bar assembly (F) from lift arm (A).
6. Remove two nuts and cap screws (F).
7. Remove spring assembly (D) from inner tube (G).
8. Remove end plate (B).
9. Remove two bushings (E) from bracket on inner tube.
10. Remove two bushings (H) from lift arm.

Installation - S.N. (-030000)

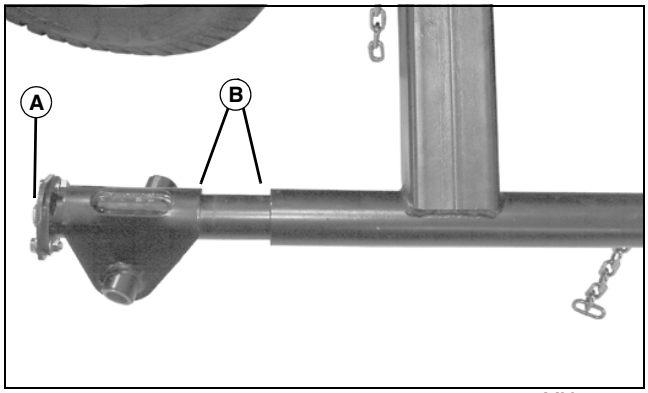
Installation is done in reverse order of removal.

- Apply LOCTITE Primer N T7649 (Deere TY16285) to the area between 305 mm (12 in.) and 356 mm (14 in.) from the head of the adjusting screw.
- Apply LOCTITE primer to inside threads of adjuster shaft.
- Apply LOCTITE Sealant 680 (Deere TY15969) to primed area of adjusting screw.

Installation - S.N. (030001-)

Installation is done in reverse order of removal.

Adjustment



MX14518

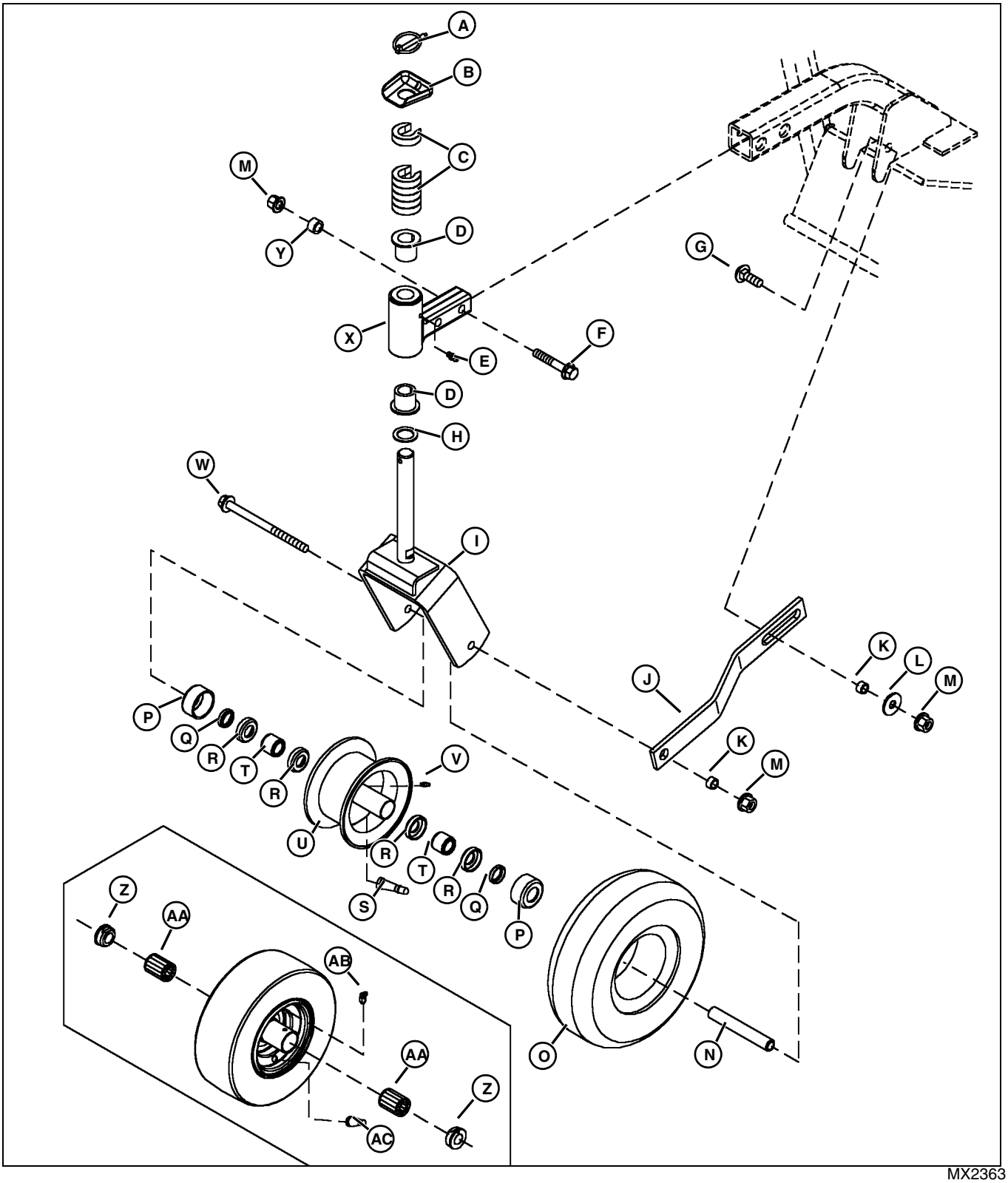
NOTE: If being adjusted while wing (side) mower deck is on the machine, the deck must be lowered to ground.

Adjust energy absorption bar with adjusting screw (A) to distance specification (B).

Specifications

Energy Absorption Bar
Compression Distance. . . . . 76 mm (3 in.)

Caster Wheel, Yoke, and Bearing Repair



MX2363

A - Quick Lock Pin
B - Pin Guard
C - Spacer (6 used)
D - Bushing (2 used)
E - Lubrication Fitting (Apply Grease)
F - Cap Screw (2 used)
G - Cap Screw (Inside Front of Wing Mower Decks Only)
H - Washer
I - Yoke
J - Bracket (Inside Front of Wing Mower Decks Only)
K - Spacer (Inside Front of Wing Mower Decks Only)
L - Washer (Inside Front of Wing Mower Decks Only)
M - Lock Nut (6 used)
N - Bushing
O - Tire (Early Models)
P - Cap (2 used) (Early Models)
Q - Felt Washer (2 used) (Early Models)
R - Cap (4 used) (Early Models)
S - Valve Stem (Early Models)
T - Roller Bearing (2 used) (Early Models)
U - Rim (Early Models)
V - Lubrication Fitting (Apply Grease) (Early Models)
W - Cap Screw
X - Pivot
Y - Bushing
Z - Bushing (2 used) (Late Model)
AA- Bearing (2 used) (Late Model)
AB- Lubrication Fitting (Late Model)
AC- Valve Stem (Late Model)

- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fittings (E and V).
- Tighten lock nuts to specification.

Specifications

Caster Wheel Axle
Lock Nut Torque . . . . . 64 N•m (43 lb-ft)

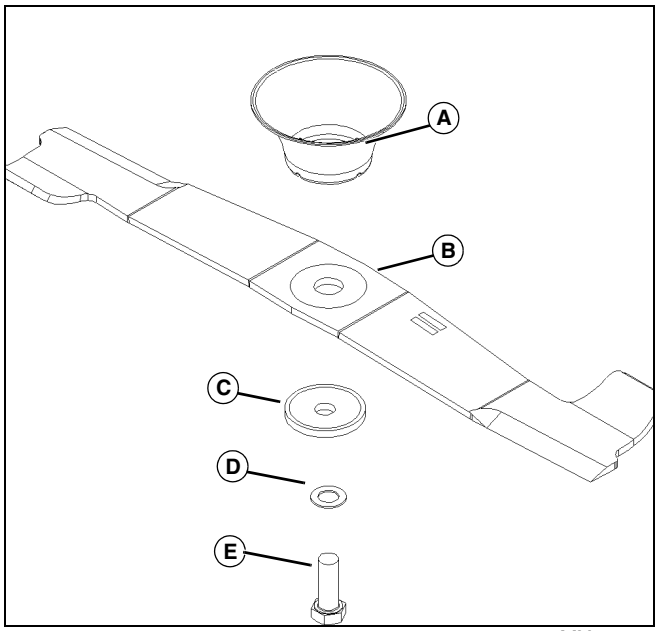
Spindle Removal and Installation

Removal

CAUTION: Avoid injury! To help prevent personal injury, wear heavy gloves or wrap the end of the blade with a rag.

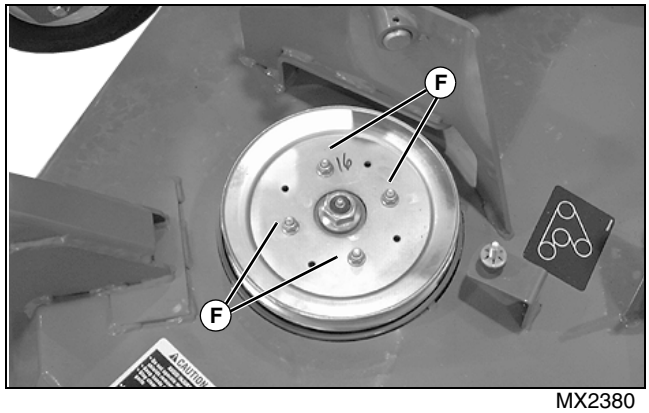
NOTE: If spindle sheave flanged nut or blade cap screw needs to be removed for any reason, loosen nut while the spindle and deck are still installed on the machine. Use a block of wood to prevent the blade from turning.

1. Remove drive belt.



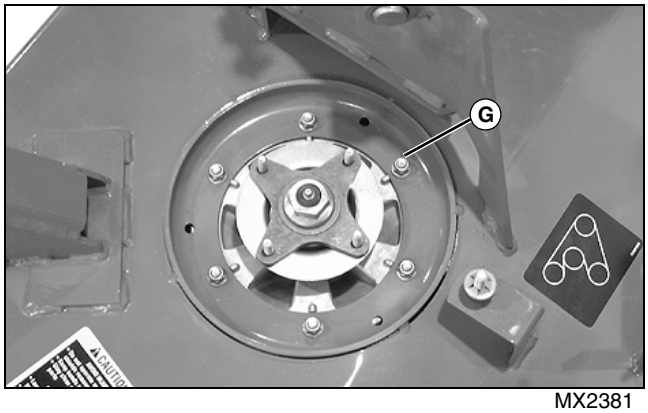
MX5731

2. Remove blade cap screw (E), flat washer (D), blade washer (C), blade (B), and deflector (A).



MX2380

3. Remove four sheave-to-hub lock nuts and cap screws (F) on spindle.



MX2381

4. Remove six mounting lock nuts (G) securing spindle housing to mower deck.

5. Remove spindle from mower deck.

6. Inspect spindle assembly for wear or damage. Replace components as necessary.

Installation

Installation is done in the reverse order of removal.

- Tighten spindle mounting lock nuts to specification.
- Tighten sheave-to-hub lock nuts to specification.

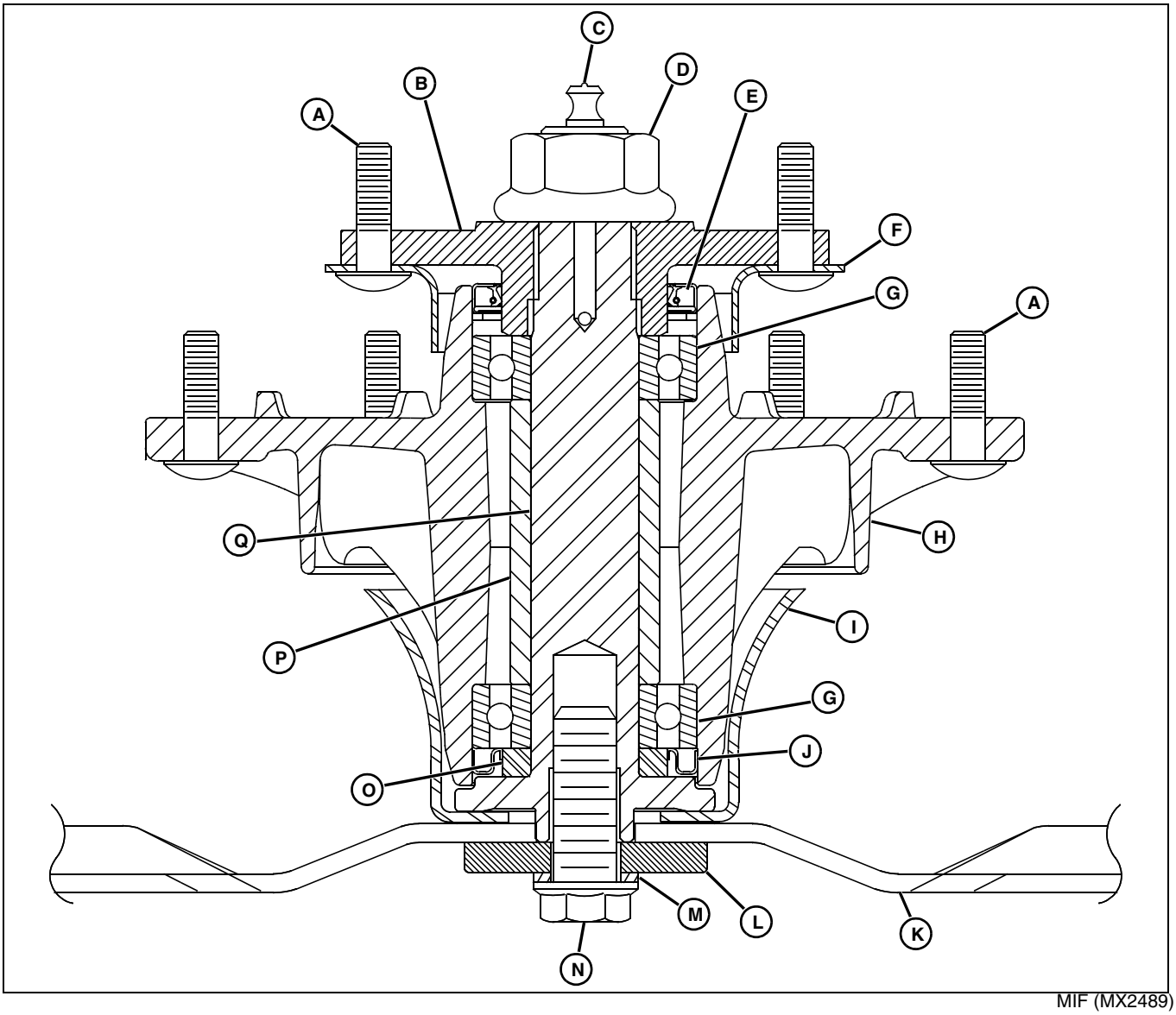
IMPORTANT: Avoid damage! Install blade with bent tips up. Install blade washer with cusp side to blade.

- Install blade and tighten cap screw to specification.
- Install drive belt.

Specifications

Blade Cap Screw Torque . . . . . 122 N•m (90 lb-ft)
Spindle Mounting Lock Nut Torque. . . . . 24 ± 4 N•m (18 ± 4 lb-ft)
Sheave-to-Hub Lock Nut Torque. . . . . 24 ± 4 N•m (18 ± 4 lb-ft)

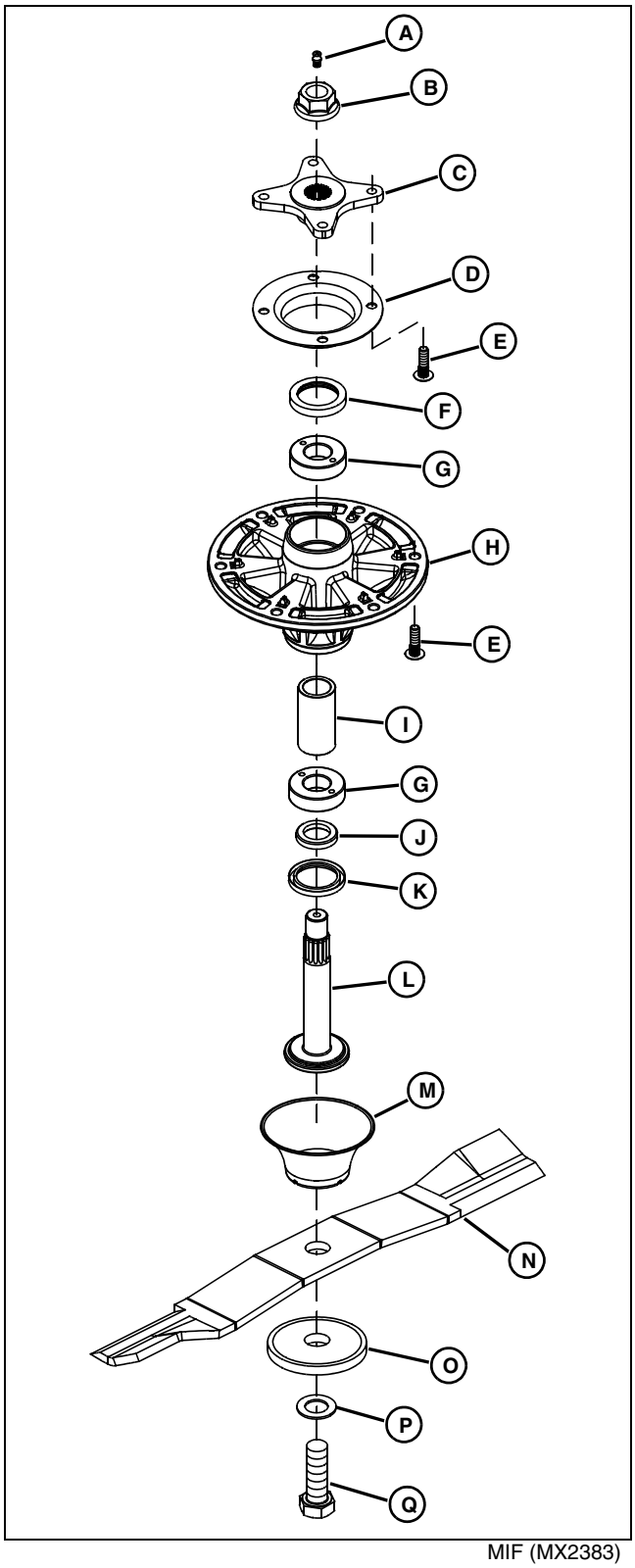
Spindle Cross Section



MIF (MX2489)

A - Cap Screw (10 used)
B - Hub
C - Lubrication Fitting (Apply Grease)
D - Flange Nut
E - Upper Seal
F - Upper Deflector
G - Ball Bearing (2 used)
H - Housing
I - Lower Deflector
J - Lower Seal
K - Blade
L - Washer
M - Washer
N - Cap Screw
O - Lower Seal Ring
P - Spacer
Q - Spindle Shaft

Spindle Disassembly and Inspection



MIF (MX2383)

A - Lubrication Fitting (Apply Grease)
B - Flanged Nut
C - Hub
D - Upper Deflector
E - Cap Screw (10 used)
F - Upper Seal
G - Ball Bearing (2 used)
H - Housing
I - Spacer
J - Lower Seal Ring
K - Lower Seal
L - Spindle Shaft
M - Lower Deflector
N - Blade
O - Washer
P - Washer
Q - Cap Screw

IMPORTANT: Avoid damage! DO NOT install hexagon end of spindle shaft in a vise to remove spindle sheave nut. The hexagon end of the spindle shaft will be damaged, resulting in improper blade operation.

NOTE: If spindle sheaved flange nut or blade cap screw need to be removed for any reason, loosen while the spindle is still installed in the deck. Use a block of wood to prevent the blade from turning.

1. Remove spindle assembly from deck.

2. If the flanged nut (B) was not loosened prior to spindle removal, install blade (N), washers (O and P), and cap screw (Q) on spindle shaft (L). Place blade in soft-jawed vise. Tighten blade cap screw to specifications.

3. Remove flanged nut.

4. Remove hub (C), upper deflector (D), and cap screws (E) as an assembly.

NOTE: Remove cap screws (E) from hub only if replacement of parts is necessary. If required, press cap screws from hub to remove upper deflector.

5. Remove cap screw (Q), washers, and blade if not already removed.

6. Remove spindle shaft from housing (H).

7. Remove lower seal ring (J) and lower seal (K).

NOTE: Remove bearings only if replacement is necessary.

8. Bearings (G) are seated against spindle hub shoulder and cannot be removed with a press. Remove upper seal (F) and bearings using a punch.

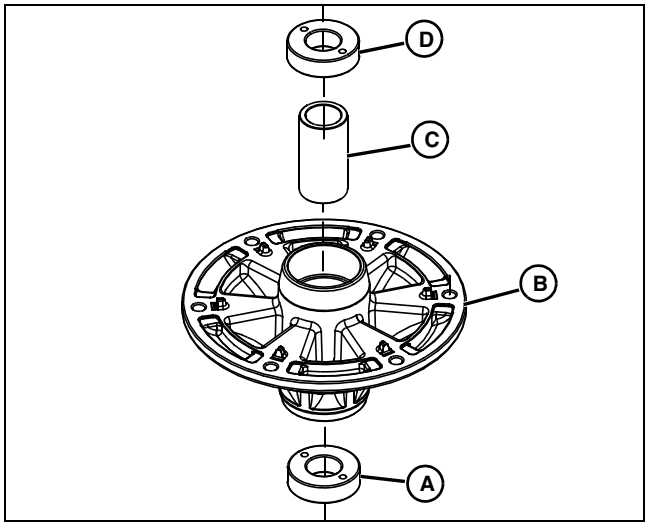
9. Remove spacer (I).

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

Specifications

Blade Cap Screw Torque (Spindle Nut Removal Only) . . . . . 320 N•m (236 lb-ft)

Spindle Assembly



MIF (MX2536)

1. Using a press and disk driver large enough to contact the bearing outer race, install lower bearing (A) until it is seated against the shoulder in the housing (B).

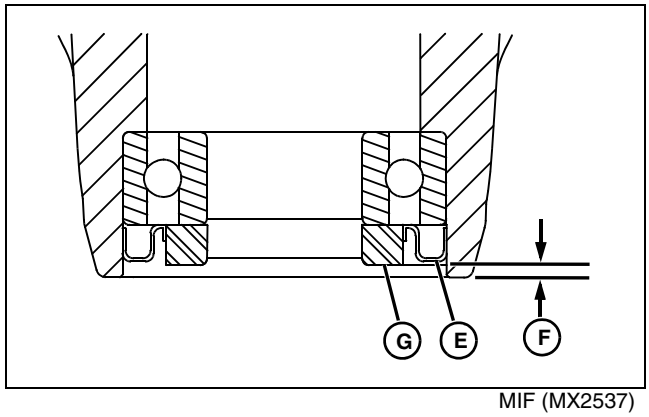
2. Turn the housing over.

3. Install spacer (C). Center the spacer over the lower bearing.

IMPORTANT: Avoid damage! Using disk drivers, support both the inner and outer races of the upper and lower bearings when installing the upper bearing. DO NOT support the housing by allowing it to rest on its end.

4. Using a press and disk driver, install upper bearing (D) until it rests against the bottom of the housing shoulder.

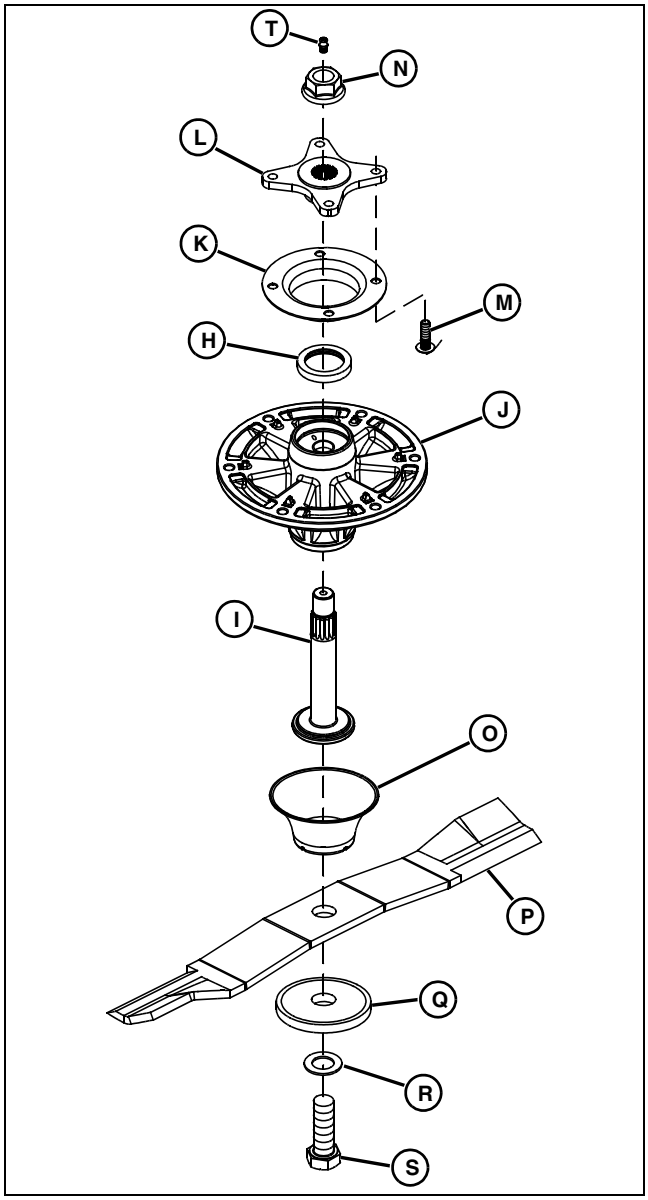
NOTE: The inner diameter chamfer of the seal ring is away from the bearing.



MIF (MX2537)

5. Using a press and disk, install lower seal (E) with open side toward bearing until the face of the seal is to specification (F) from the lower end of the housing.

6. Install lower seal ring (G) with the outer diameter chamfered edge toward bearing.



MIF (MX2538)

7. Using a press and disk, install upper seal (H) with open side toward bearing until the face of the seal is flush with the end of the housing.

8. Install spindle shaft (I) into housing (J).

9. If disassembled, assemble the upper deflector (K), hub (L) and new cap screws (M). The deflector hub must be on the same side as the long center of the hub. Press cap screws into the hub until tight against deflector.

10.Install upper deflector (K), hub (L), and cap screws (M) as an assembly.

11.Install flanged nut (N).

IMPORTANT: Avoid damage! Blade must be properly seated on the spindle, and concave side of the large washer (Q) MUST face toward blade.

12.Install lower deflector (O), blade (P), washers (Q and R), and cap screw (S).

13.Tighten cap screw (S) to specifications.

14.Place blade in a soft-jawed vise.

15.Tighten flanged nut (N) to specifications.

16.Apply chassis and mower spindle grease to lubrication fitting (T).

Specifications

Spindle Lower Seal Depth . . . . . 2.57 mm (0.10 in.)
Blade Cap Screw Torque . . . . . 122 N•m (90 lb-ft)
Spindle Flanged Nut Torque . . . . . 255 N•m (188 lb-ft)

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MISCELLANEOUS TABLE OF CONTENTS

MISCELLANEOUS SPECIFICATIONS

Specifications

Repair Specifications

Front Wheel Cap Screw Torque	**150 N•m (110 lb-ft)**
Rear Wheel Cap Screw Torque	**88 N•m (65 lb-ft)**

Repair

Console Cover Removal and Installation

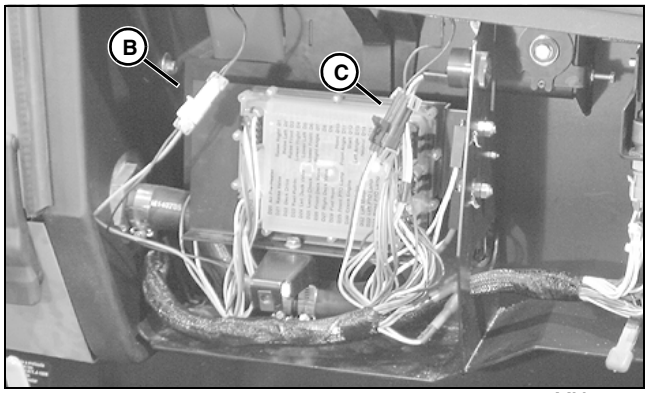
NOTE: Models 1600/1620 S.N. (010000-020000) shown. Models 1600/1620 S.N. (020001-) and Model 1600 Turbo similar except where noted.

Removal



MX2225

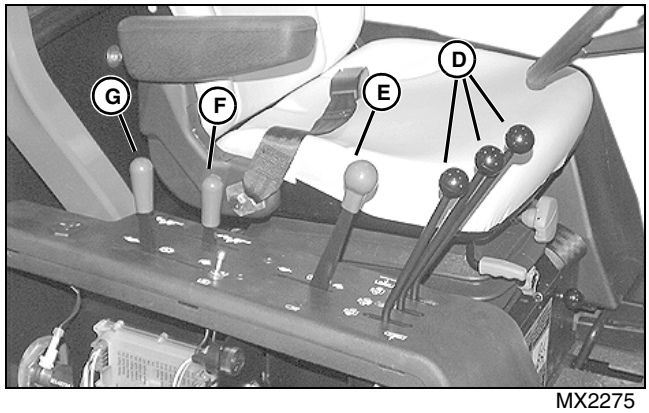
1. Remove access panel (A).



MX2274

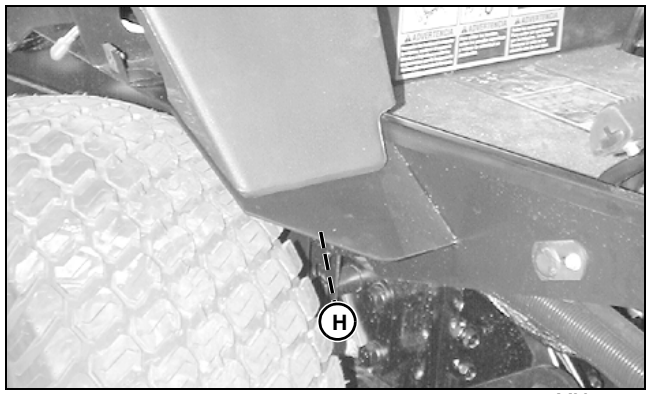
2. Disconnect hour meter wiring connector (B).
3. Disconnect PTO switch wiring connector (C).

NOTE: S.N. (-030000): Lift/lower knobs are threaded onto the levers; all other knobs are pushed on.



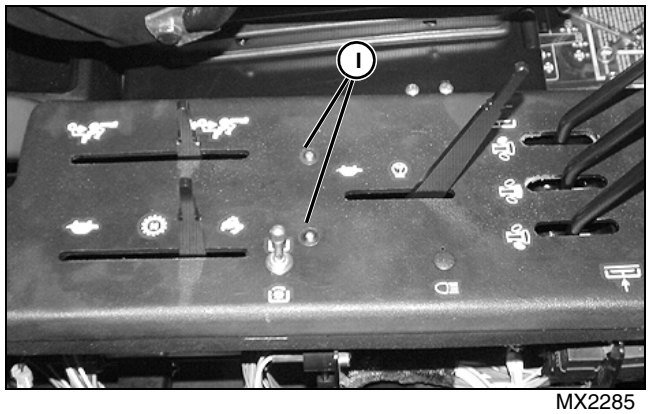
MX2275

4. **On Models 1600/1620:** Remove mower deck lift/lower lever knobs (D).
5. **On Model 1600 Turbo:** Label lift switch and PTO switch connectors and disconnect. Remove switch panel.
6. Remove throttle lever knob (E).
7. Remove high/low range lever knob (F).
8. Remove four wheel drive lever knob (G).



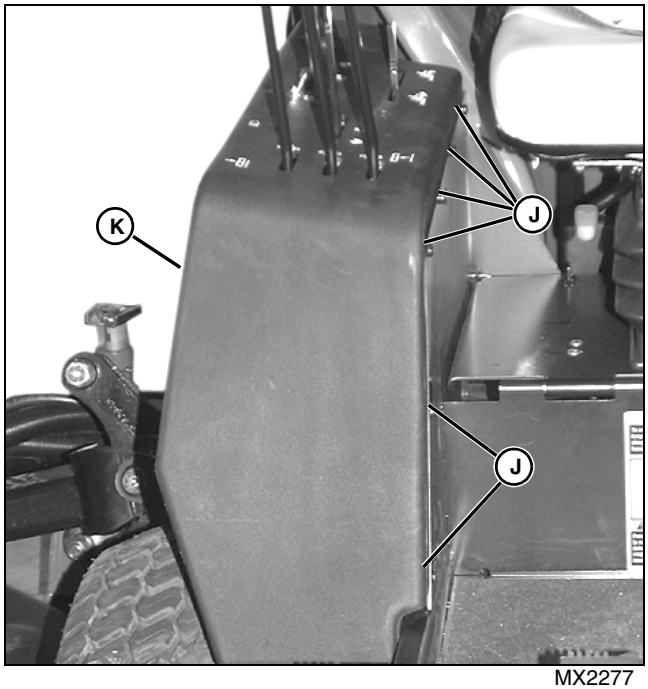
MX2276

9. Remove screw (H) at the bottom of console.



MX2285

10. Remove two socket-head screws and nuts (I).



MX2277

11.Remove six screws (J) along the side of the console.

12.Remove console cover (K).

Installation

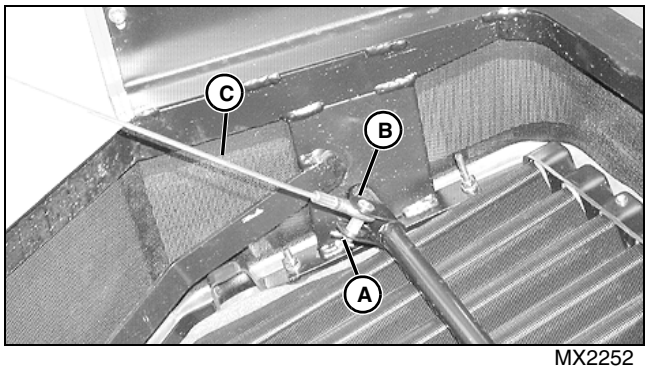
Installation is done in the reverse order of removal.

Hood Removal and Installation - Models 1600 and 1620 S.N. (010000-020000)

Removal

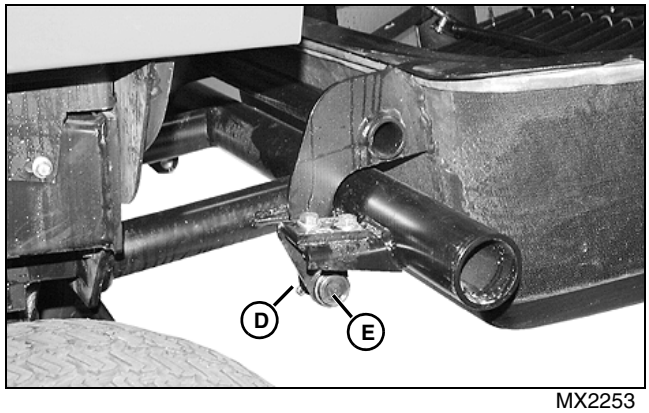
1. Raise hood.

IMPORTANT: Avoid damage! Support hood to prevent it from falling back when cables are disconnected.



MX2252

2. Remove cotter pin (A) and anchor pin (B) and disconnect support cable (C) (both sides of machine).



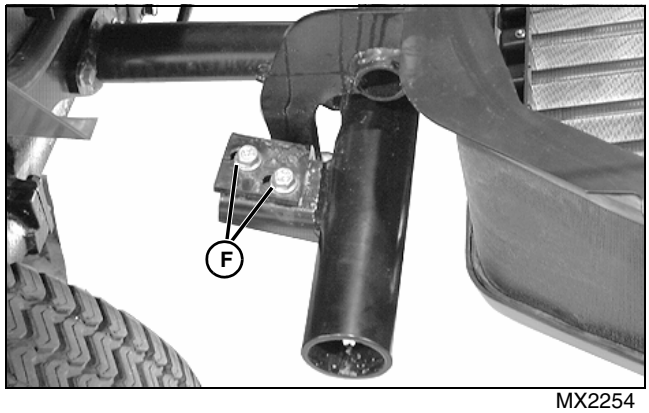
MX2253

3. Remove cotter pin (D) and pivot pin (E) (both sides of machine).

4. Remove hood.

Installation

Installation is done in the reverse order of removal.



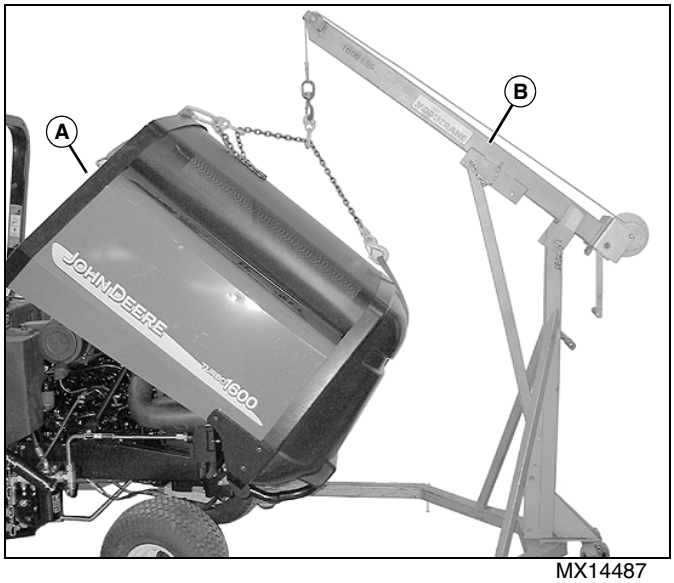
MX2254

If adjustment is required, loosen mounting bracket cap screws (F) (both sides of machine), and slide the hood forward or rearward as needed.

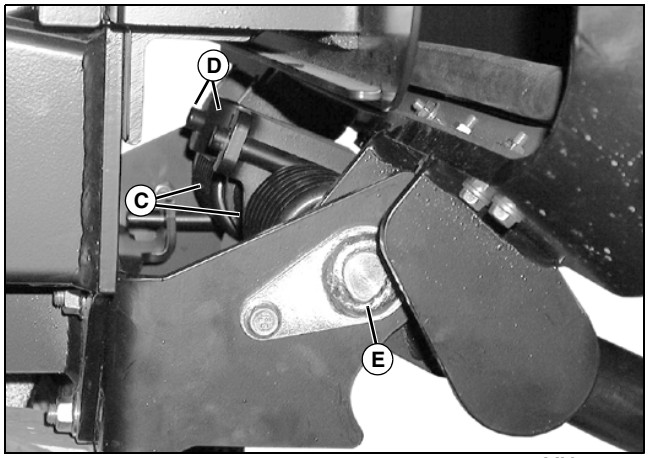
Hood Removal and Installation - Model 1600 Turbo

Removal

CAUTION: Avoid injury! Avoid personal injury. Springs MUST be in neutral "no load" position when hinge pins are removed. Check tangs (D) of hood pivot springs to ensure they are not under load.



MX14487



MX14488

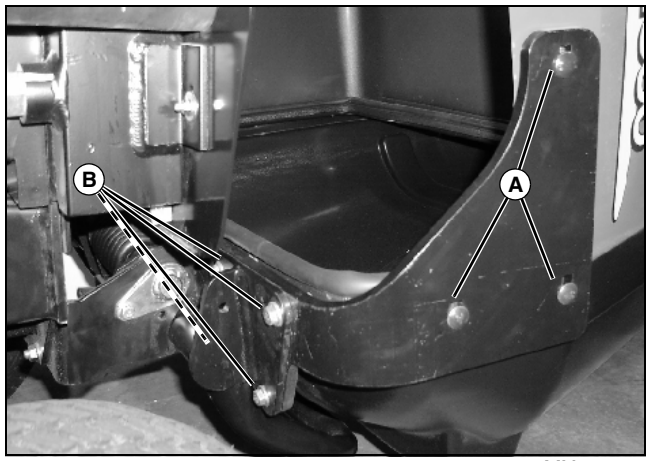
1. Secure hood (A) with hoist (B). Hood must hang in partially open position so springs (C) are in neutral "no load" position.
2. Remove hinge pins (E). Lift hood from machine.

Installation

Installation is done in the reverse order of removal.

Models S.N. (030001-): Adjust hood. (See "Adjust Hood - S.N. (030001-)" on page 664.)

Adjust Hood - S.N. (030001-)



MX18958

1. Loosen hinge-to-hood carriage bolts (A) (3 each side).
2. Loosen cap screws (B) (4 each side).
3. Close and latch hood

NOTE: If the hood can not be adjusted to fit correctly, adjust the bulkhead behind the operators seat. (See "Bulkhead Removal and Installation" on page 665.)

4. Adjust rear of hood side-to-side until it is properly fitted.
5. Tighten eight cap screws (B).

NOTE: Only two carriage bolts on each side of the hood can be accessed with the hood closed.

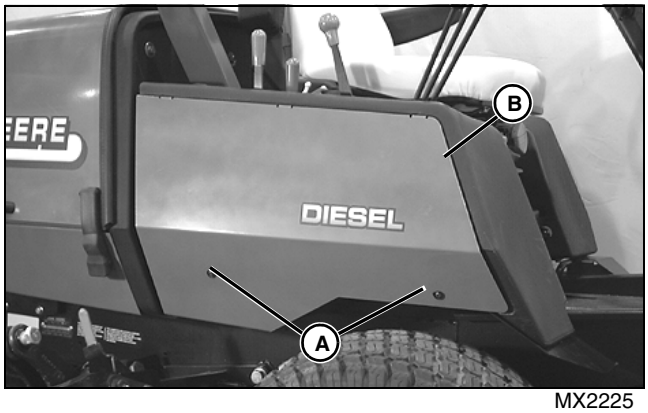
6. Tighten four (two each side) hinge-to-hood carriage bolts (A). Open hood and tighten the remaining two.

Bulkhead Removal and Installation

NOTE: Models 1600/1620 shown. Model 1600 Turbo is similar.

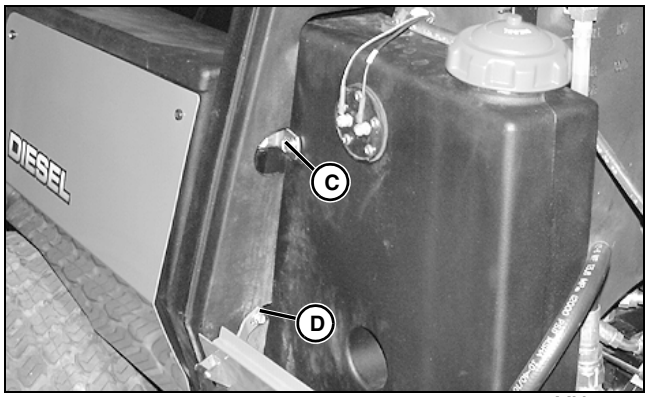
Removal

1. Raise seat platform.



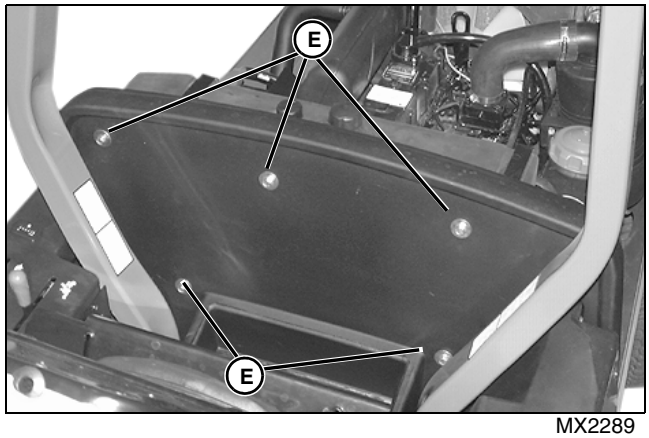
MX2225

2. Raise hood.
3. Remove screws (A).
4. Remove access panel (B).



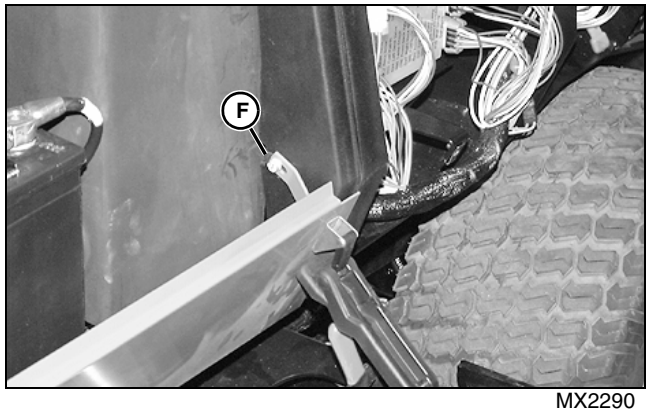
MX2288

5. Remove cap screw (C).
6. Remove cap screw (D).



MX2289

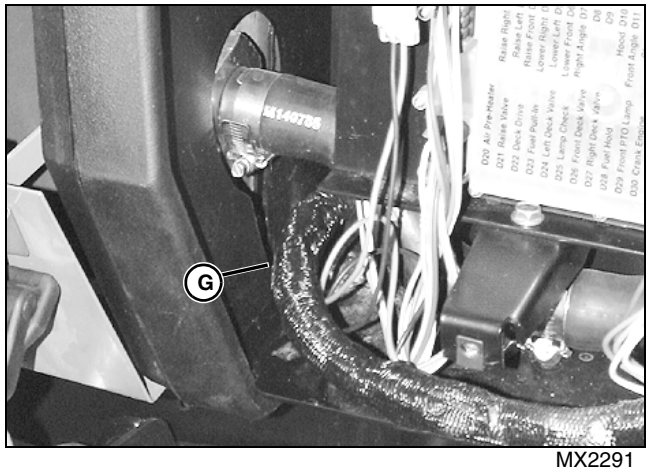
7. Remove five cap screws (E).



MX2290

8. Remove cap screw (F).

NOTE: It may be necessary to push harness (G) aside to gain clearance.



MX2291

9. Remove bulkhead by lifting it straight up.

Installation

Installation is done in the reverse order of removal.

Front Wheel Removal and Installation

Removal

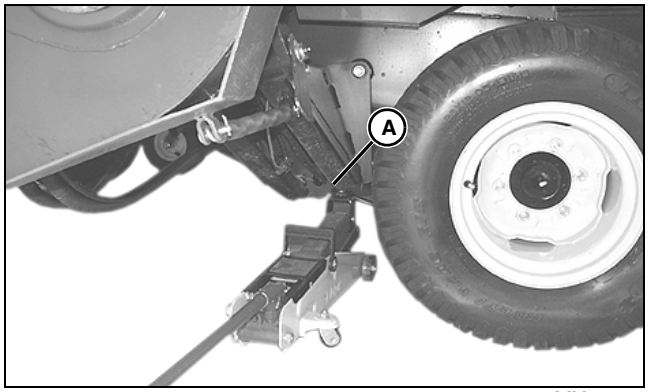
1. Park the machine safely. (See “Park Machine Safely” on page 3.)

2. Raise the wing (side) deck completely on the side of the machine requiring front wheel removal. Engage the transport lock on the raised mower deck. The other wing mower deck should be lowered to the ground.

3. Raise the front mower deck completely.

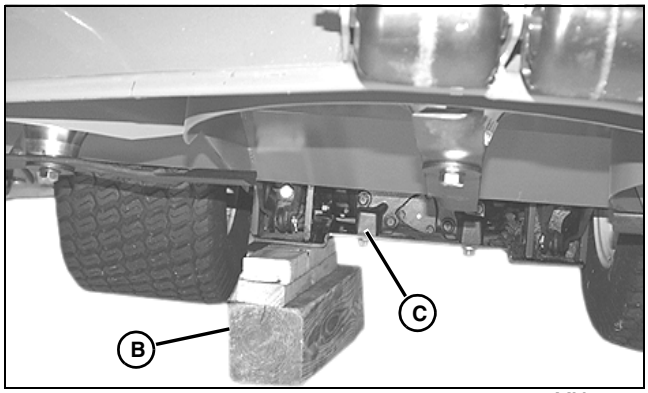
4. Rotate the front deck to SERVICE position.

IMPORTANT: Avoid damage! Use caution when placing a jack under the lift arm bracket to avoid pinching or crushing the lift cylinder hydraulic hose.



MX2316

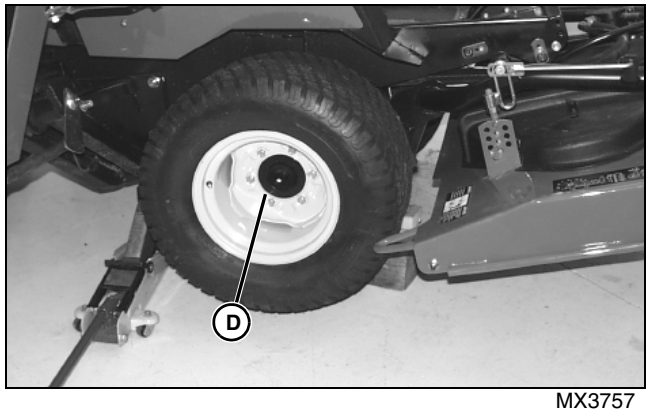
5. Place a jack under the base of the lift arm bracket (A).



MX2317

6. Place wood blocks (B) or other suitable blocking material under the front skid plate (C).

7. Lower the machine onto the wood blocks.



MX3757

8. Remove six cap screws (D).

9. Remove wheel.

Installation

Installation is done in the reverse order of removal.

- Tighten wheel cap screws in an alternating pattern to specification.

- Check wheel cap screw torque after traveling 30 m (100 ft) while changing direction, and after 3 to 10 hours of use.

Specifications

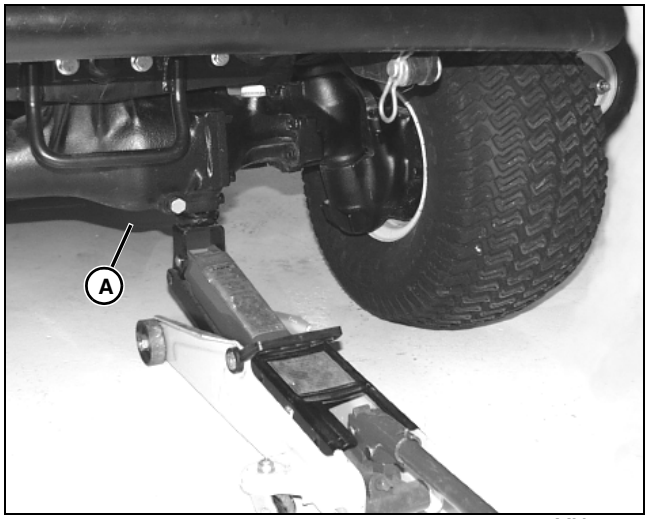
Front Wheel Cap Screw Torque . . . . 150 N•m (110 lb-ft)

Rear Wheel Removal and Installation

Removal

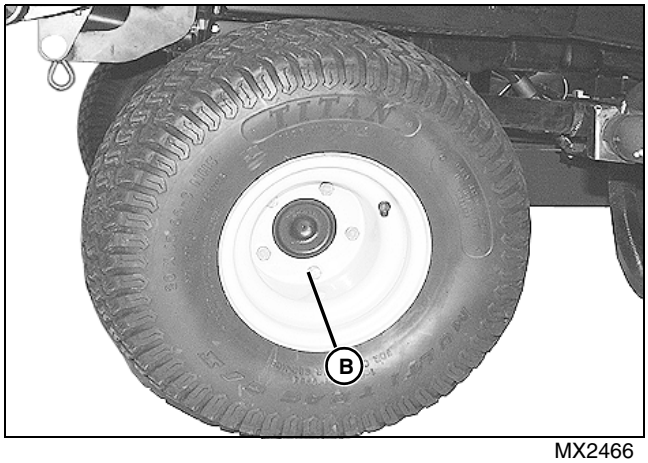
1. Park the machine safely. (See “Park Machine Safely” on page 3.)

IMPORTANT: Avoid damage! DO NOT lift or support the rear of the machine by the rear bumper, as it is not designed to support the weight of the machine.



MX3759

2. Using a safe lifting device, lift the rear of the machine under the rear axle (A) high enough to raise both wheels off the ground. Place blocks or jackstands under machine frame.



MX2466

3. Remove five cap screws (B).

4. Remove wheel.

Installation

Installation is done in the reverse order of removal.

- Tighten wheel cap screws in an alternating pattern to specification.
- Check wheel cap screw torque after traveling 30 m (100 ft) while changing direction, and after 3 to 10 hours of use.

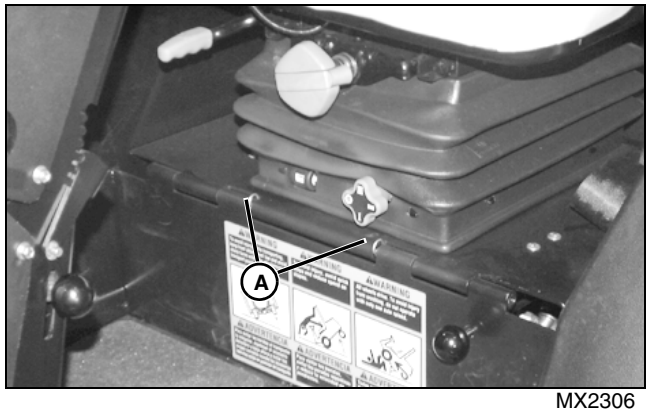
Specifications

Rear Wheel Cap Screw Torque . . . . . 88 N•m (65 lb-ft)

Seat Platform Assembly Removal and Installation - Models 1600 and 1620

Removal

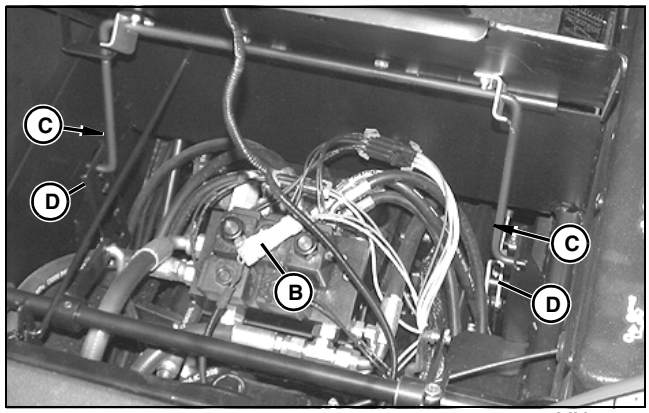
1. Park the machine safely. (See “Park Machine Safely” on page 3.)



MX2306

2. Remove spring clips (A).

3. Raise and latch seat platform.

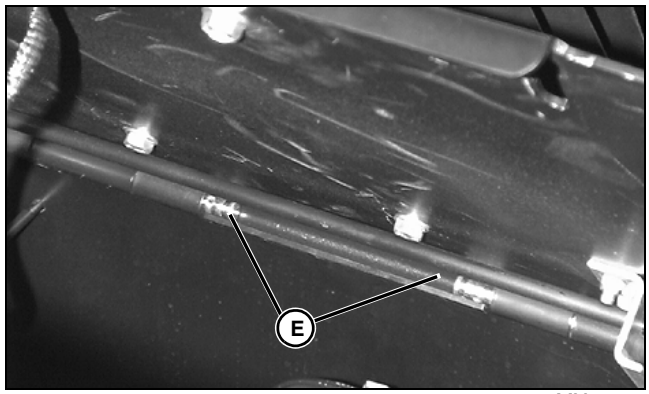


MX2307

4. Disconnect seat switch connector (B).

5. Support seat platform.

6. Carefully push support arms (C) in and move them out of the latch brackets (D).



MX2308

7. Remove pivot pins (E).
8. Remove seat platform assembly.

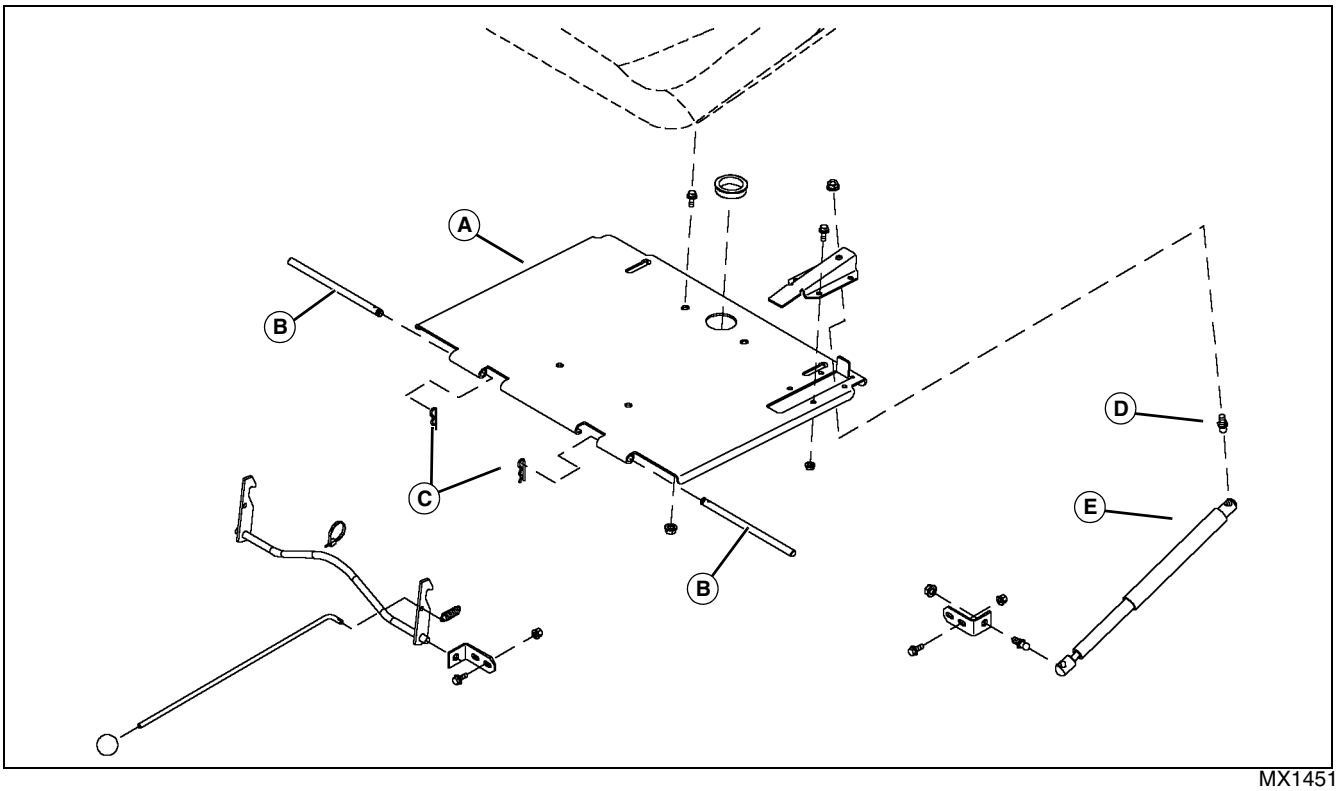
Installation

Installation is done in the reverse order of removal.

Seat Platform Assembly Removal and Installation - Model 1600 Turbo

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

Removal



MX14511

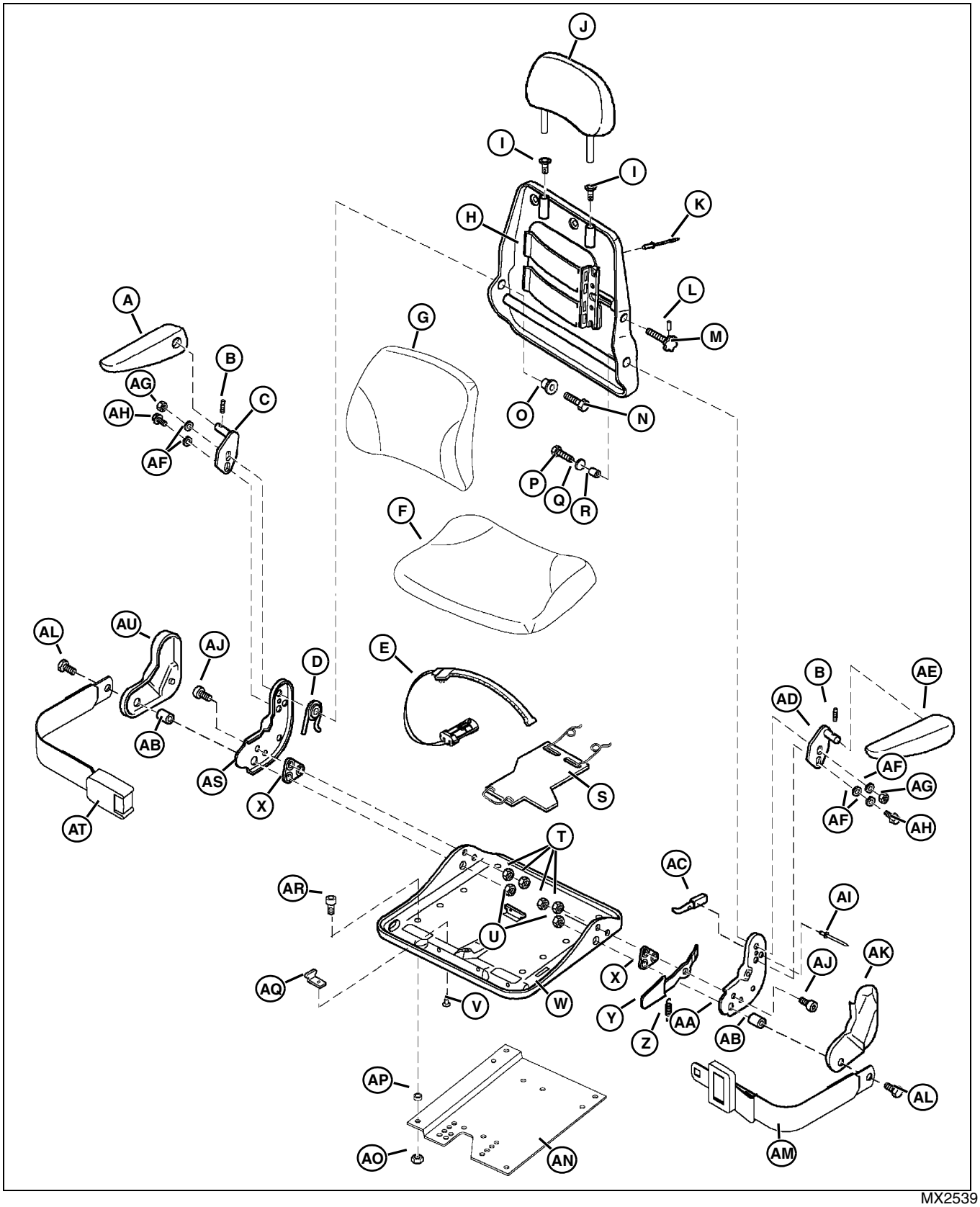
A - Seat Platform
B - Pivot Pin (2 used)
C - Spring Clip (2 used)
D - Ball Stud
E - Gas Shock

2. Remove spring clips (C).
3. Raise seat platform (A).
4. Disconnect seat switch electrical connector.
5. Disconnect gas shock (E) from ball stud (D).
6. Remove platform pivot pins (B).
7. Remove seat assembly.

Installation

Installation is done in the reverse order of removal.

Seat Repair

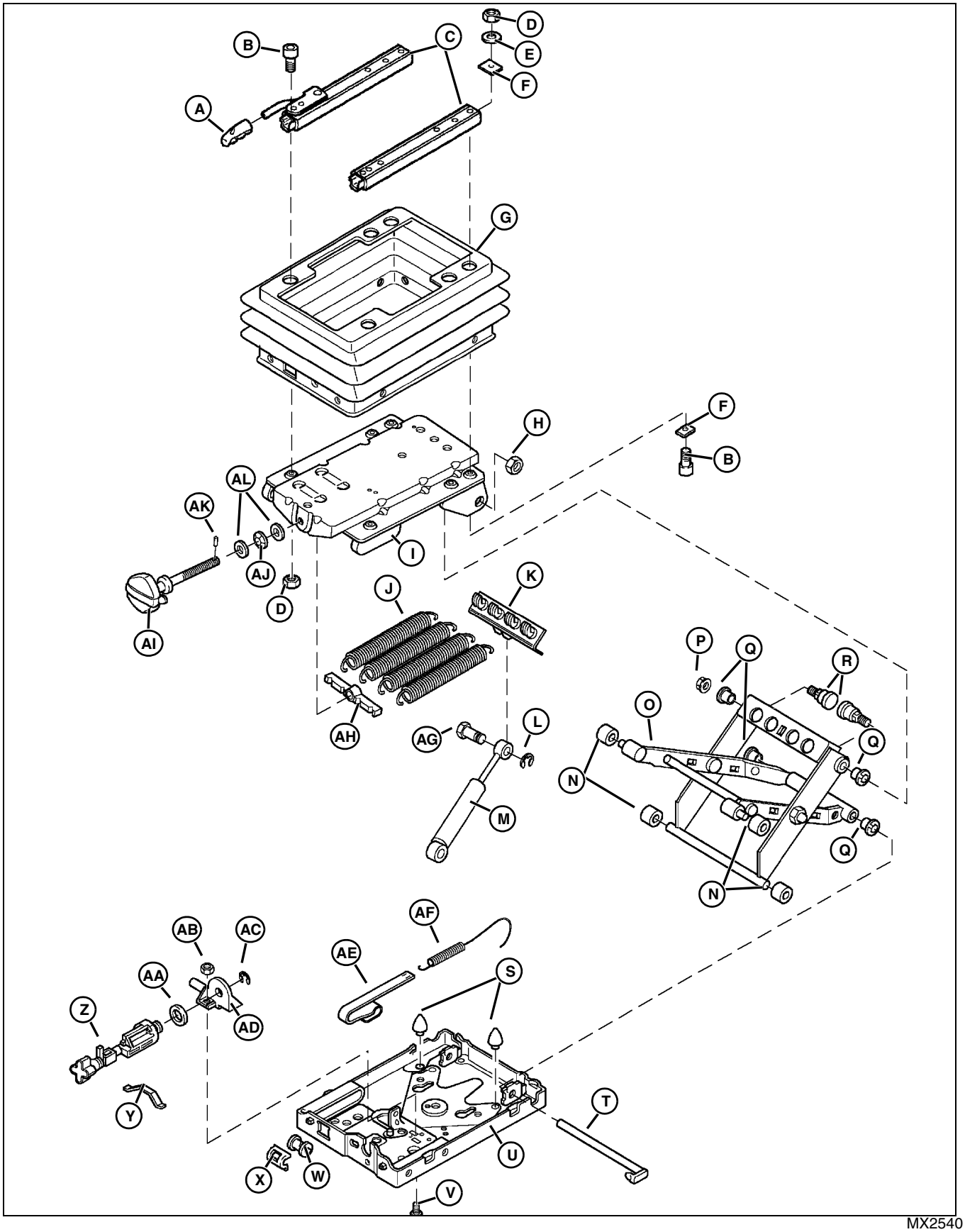


MX2539

A - Right Arm Rest
B - Washer (2 used)
C - Bracket
D - Torsion Spring
E - Switch
F - Bottom Cushion
G - Back Cushion
H - Adjustable Back Support
I - Bushing (2 used)
J - Head Rest
K - Rivet (3 used)
L - Spring Pin
M - Adjustment Knob
N - Cap Screw
O - Bushing
P - Cap Screw
Q - Washer
R - Bushing
S - Switch Actuator Plate
T - Nut (4 used)
U - Nut (2 used)
V - Rivet
W - Frame
X - Plate (2 used)
Y - Lever
Z - Spring
AA- Escutcheon
AB- Spacer (2 used)
AC- Latch
AD- Bracket
AE- Left Arm Rest
AF- Washer (5 used)
AG- Lock Nut (2 used)
AH- Cap Screw (2 used)
AI - Rivet
AJ- Socket-Head Cap Screw (2 used)
AK- Shield
AL- Cap Screw (2 used)
AM- Seal Belt
AN- Plate
AO- Nut (4 used)
AP- Spacer (4 used)
AQ- Clamp
AR- Socket-Head Screw (4 used)
AS- Escutcheon
AT- Seal Belt
AU- Shield

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

Seat Suspension Repair

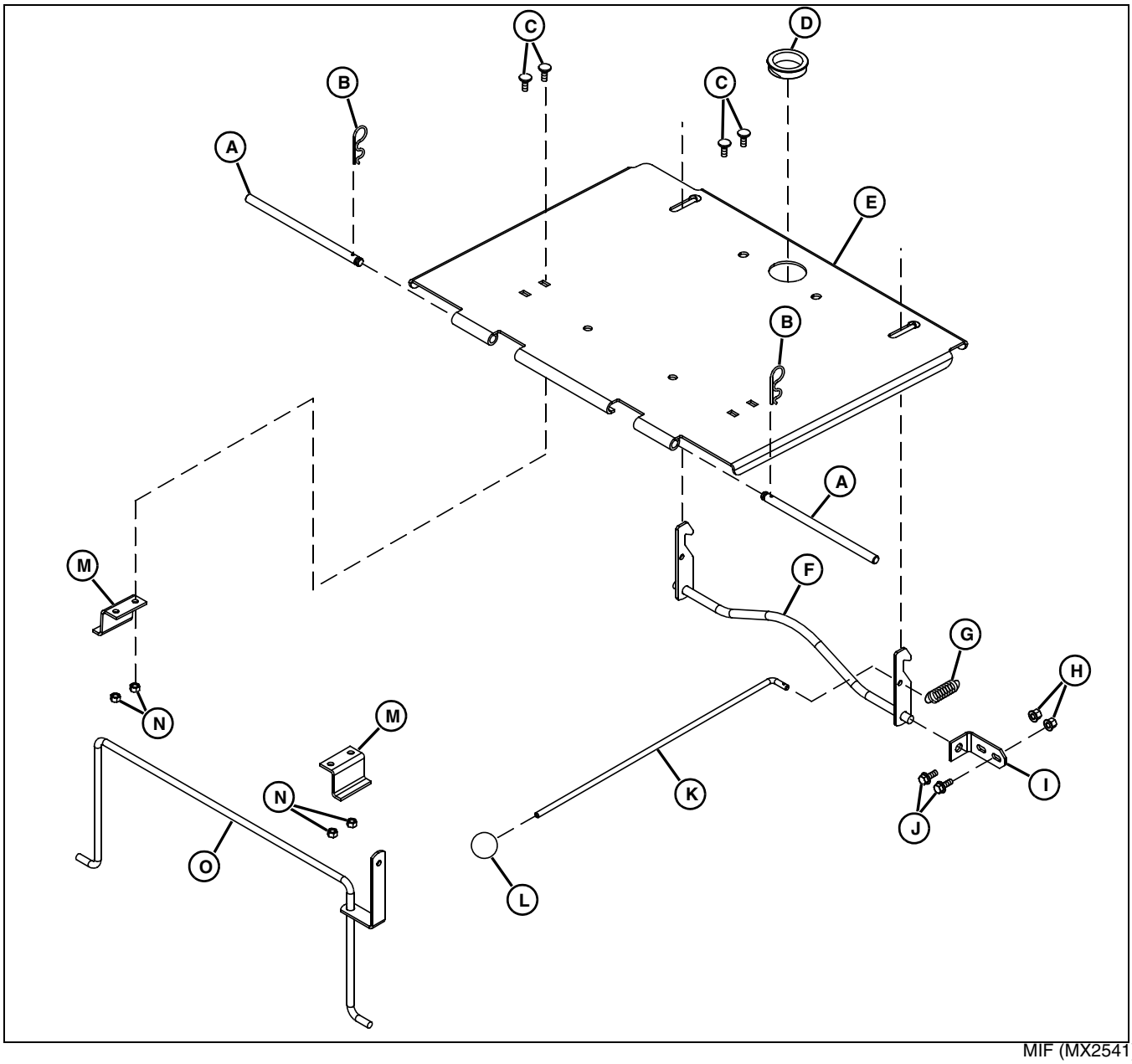


MX2540

A - Grip
B - Socket-Head Cap Screw (8 used)
C - Adjuster (2 used)
D - Nut (8 used)
E - Washer (4 used)
F - Shim (8 used)
G - Boot
H - Nut (2 used)
I - Upper Frame
J - Extension Spring (4 used)
K - Spring Anchor
L - Snap Ring
M - Shock Absorber
N - Roller (4 used)
O - Frame
P - Nut (2 used)
Q - Bearing (4 used)
R - Special Screw (2 used)
S - Bumper (2 used)
T - Rod
U - Base
V - Cap Screw
W - Roller
X - Guide
Y - Bracket
Z - Adjuster
AA- Washer
AB- Nut
AC- Snap Ring
AD- Bracket
AE- Strap
AF- Spring
AG- Cap Screw
AH- Spring Anchor
AI - Adjuster
AJ- Washer
AK- Spring Pin
AL- Washer (2 used)

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

Seat Platform Assembly Repair - Models 1600 and 1620

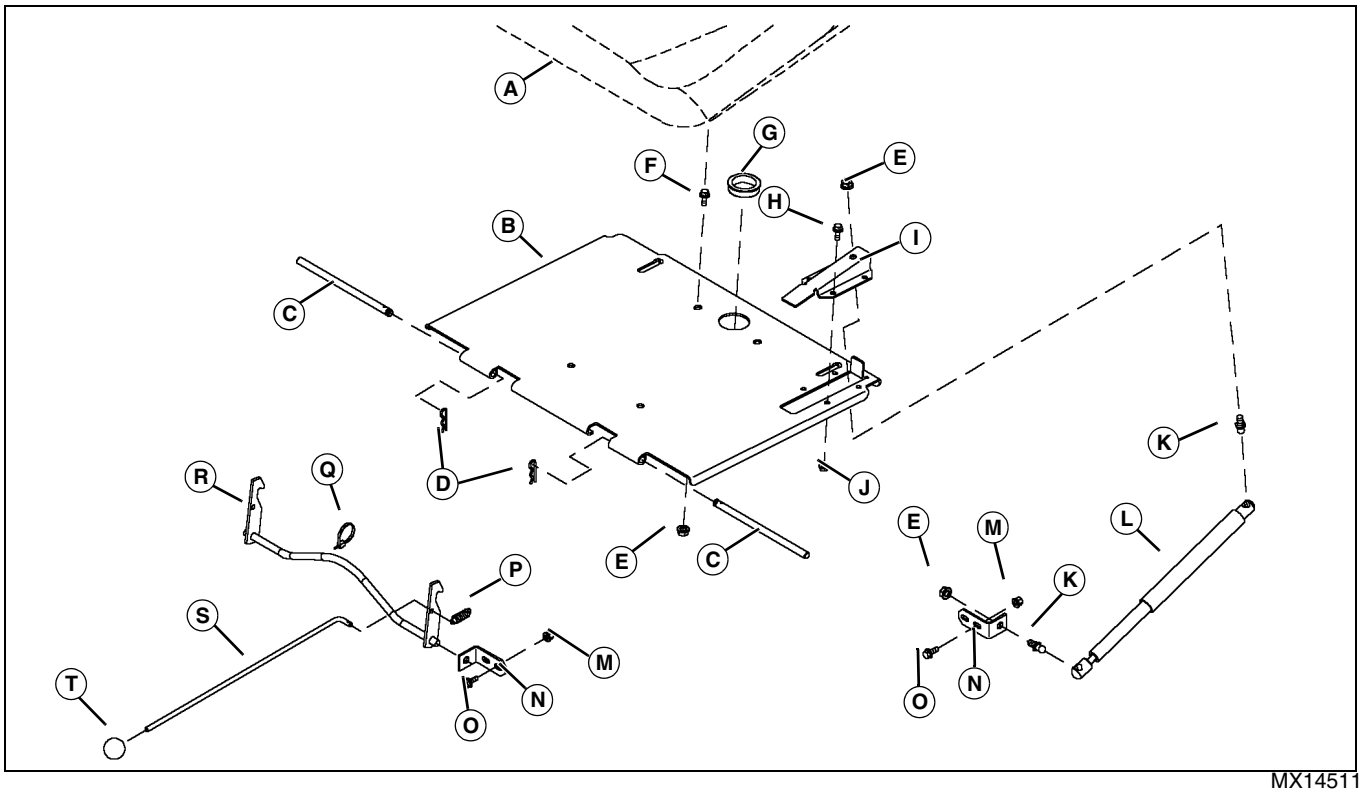


MIF (MX2541)

A - Pivot Pin (2 used)
B - Spring Locking Pin (2 used)
C - Cap Screw (4 used)
D - Grommet
E - Base
F - Latch
G - Extension Spring
H - Lock Nut (2 used)
I - Support
J - Screw (2 used)
K - Rod
L - Knob
M - Bracket (2 used)
N - Lock Nut (4 used)
O - Support Rod

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

Seat Platform Assembly Repair - Model 1600 Turbo



MX14511

A - Seat
B - Seat Platform
C - Pivot Pin (2 used)
D - Spring Clip (2 used)
E - Flange Nut (8 used)
F - Screw (4 used)
G - Grommet
H - Screw (2 used)
I - Bracket
J - Flange Nut (2 used)
K - Ball Stud (2 used)
L - Gas Strut
M - Lock Nut (4 used)
N - Bracket (2 used)
O - Screw (2 used)
P - Spring
Q - Tie Band
R - Latch
S - Rod
T - Knob

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