JACOBSEN

TEXTRON

SERVICE & REPAIR INSTRUCTIONS

HR5111™

HR5111™
Product No. 67760
with ROPS 69116
with CAB 69129

Includes Attachments

Litho in U.S.A. 3/97

Suggested Retail Price
$60.00

WARNING: If incorrectly used this machine can cause severe injury. Those who use and maintain the machine should be trained in its proper use, warned of its dangers and should read the entire manual before attempting to set up, operate, adjust or service the machine.

SECTION 1
INTRODUCTION

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SECTION 1A. GENERAL INFORMATION

CONTENTS

This manual contains repair instructions for major tractor components, attachments and options. The Table of Contents at the start of each section lists contents of that section. Sections are identified by tabs in the right hand margin.

This manual is to be used in conjunction with the Operator's Manual and Parts Catalog.

Normal maintenance, adjustment, and operating procedures are also covered in the user Operator's Manual and are only included where appropriate in this Service and Repair Manual.

Engine repair is not covered in this manual. Refer to the appropriate engine manufacturer's instructions for engine service and repair.

This manual includes all removal, disassembly, inspection, repair, reassembly, installation, adjustment, and testing procedures. If you, as user of this machine, do not consider yourself or your repair facilities capable of a given procedure, please consult your dealer or distributor.

Information, specifications, illustrations, and procedures in this manual are based on information in effect at the time this manual was published. Improvements and product changes due to continual advancements of the product design may cause changes to your product that may not be included in this manual. Each manual is reviewed and updated as required to include changes and product improvements.

Read each section completely before proceeding with specific repairs in that section. You will minimize errors by understanding what you will be doing and how the component relates to others in its system. Lists of repair tools and materials for each section of the manual are given at the start of that section.

The designations L.H. (left hand) and R.H. (right hand) used throughout this manual refer to the operator's left or right when standing in the normal operating position.

INDEX NUMBERS

Illustrations showing removal, disassembly, reassembly and installation may have index numbers to call out the sequence of procedure.

Where the sequence of procedure is not important or self-evident (eg. linkages, hoses, clamps, etc.) index numbers are not included.

Repair procedures for items not subject to wear (eg. panels, brackets, frames) are not included in this manual except for the general procedures given below.

Exercise common sense during disassembly or reassembly; remove only the items required to accomplish necessary repair or service.

REPLACEMENT PARTS

Use the appropriate Parts Catalog when ordering replacement parts. Follow installation instructions shipped with service parts or kits. When ordering parts, always give the serial number and product number of your machine as well as quantity, part number and description of the parts needed.

To eliminate error and speed delivery:

1. Write your NAME and ADDRESS on your order plainly.
2. Explain WHERE and HOW to make shipment.
3. Give PRODUCT NUMBER, NAME, and SERIAL NUMBER that is stamped on the NAME and SERIAL PLATE of your product.
4. Order by QUANTITY DESIRED, the PART NUMBER and the DESCRIPTION OF PART.
5. Send your order to or visit your nearest AUTHORIZED JACOBSEN TURF EQUIPMENT DISTRIBUTOR.
6. INSPECT ALL SHIPMENTS ON RECEIPT. If any parts are damaged or missing, file a claim with the carrier before accepting.
7. Do not return material to your AUTHORIZED JACOBSEN DISTRIBUTOR without a letter of explanation. Make a list of all returned parts, show your name and address, and include it with the shipment. TRANSPORTATION CHARGES MUST BE PREPAID.

SERIAL NUMBERS

See Figure 1A-1 for location of tractor assembly serial number.

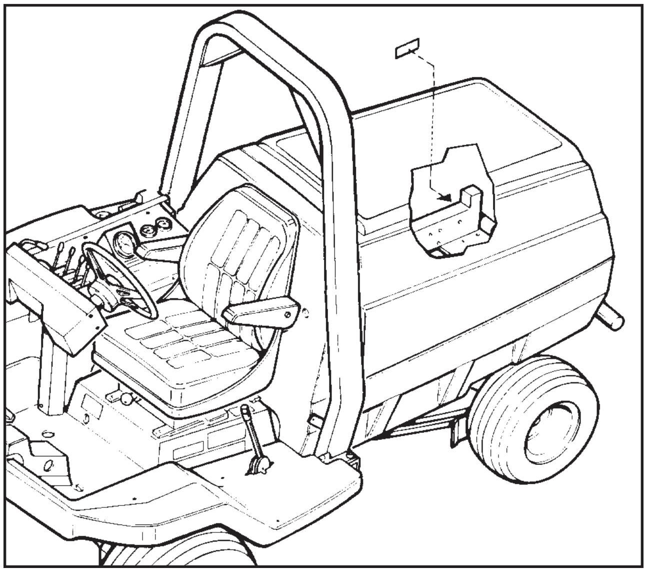


Figure 1A-1. Serial Number Location

SECTION 1A. GENERAL INFORMATION

GENERAL CLEANING

Improper cleaning and lubrication of your machine results in many equipment failures. Before any repairs are undertaken, thoroughly clean the exterior of the component to be removed.

Use a clean surface to lay out parts being removed. Keep lubricants clean and cover containers not being used. Plug or cap all hydraulic lines and ports to hydraulic components immediately after disconnecting.

SAFETY

Safety should always be the rule when working on or with machinery. Always use safe practices and common sense when using hand or power tools. Use the suggested procedures in this manual when working with the tractor.

Throughout this manual signal words will be used to highlight special procedures. The signal words and their meaning are as follows:

NOTE

Any procedure needing special care when performing a procedure.

⚠ CAUTION

Hazards or unsafe practices which *could* result in personal injury or product or property damage.

⚠ WARNING

Hazards or unsafe practices which *could* result in *severe* personal injury or death.

⚠ DANGER

Imminent hazards which *will* result in *severe* personal injury or death if precautions are not taken.

Decals on the machine denote cautions, warnings, and dangers. These cautions, warnings, and danger decals must be on the machine at all times. If they become worn, torn or painted over, new decals should be installed as shown in Section 14 of this manual.

⚠ CAUTION

Disconnect leads at alternator before electric welding is done on components in common ground with engine.

⚠ DANGER

This machine is equipped with an interlock system which is intended to protect the operator and others from injury, by preventing the engine from starting, unless the implement switch is in the “Off” position, traction pedal is in the “Neutral” position and the brake set. The system also shuts off the engine if the operator leaves the seat with the implement switch “On” and brake released. In the interest of safe operating conditions, this machine must never be operated with the interlock relays or interlock system disconnected or malfunctioning.

TORQUE VALUES

Torque values are given in the following “Torque Specification Chart”. Special torque values are called out on illustrations and text throughout this manual.

SECTION 1A. GENERAL INFORMATION

TORQUE SPECIFICATIONS

STANDARD SAE GRADE #5 SCREWS

Size	Torque Values	Size	Torque Values
8-32	27-33 in-lbs. (3-4 N.m)	½-13	67-83 ft-lbs. (90-113 N.m)
8-36	28-34 in-lbs. (3-4 N.m)	½-20	81-99 ft-lbs.(110-134 N.m)
10-24	39-47 in-lbs. (4-5 N.m)	9⁄16-12	99-121 ft-lbs. (134-164 N.m)
10-32	44-54 in-lbs. (5-6 N.m)	9⁄16-18	108-132 ft-lbs. (146-179 N.m)
¼-20	7-9 ft-lbs. (9-12 N.m)	⅝-11	135-165 ft-lbs. (183-223 N.m)
¼-28	9-11 ft-lbs. (12-15 N.m)	⅝-18	162-198 ft-lbs. (220-268 N.m)
5⁄16-18	15-18 ft-lbs. (20-24 N.m)	¾-10	234-286 ft-lbs. (317-388 N.m)
5⁄16-24	17-21 ft-lbs. (23-28 N.m)	¾-16	270-330 ft-lbs. (366-447 N.m)
⅜-16	27-33 ft-lbs. (37-45 N.m)	⅞-9	360-440 ft-lbs. (488-597 N.m)
⅜-24	31-39 ft-lbs. (42-53 N.m)	⅞-14	396-484 ft-lbs. (537-656 N.m)
7⁄16-14	45-55 ft-lbs. (61-75 N.m)	1-8	522-638 ft-lbs. (708-865 N.m)
7⁄16-20	49-61 ft-lbs. (66-83 N.m)	1-12	576-704 ft-lbs. (780-954 N.m)

NOTE: These torque values are to be used for all hardware excluding: locknuts, self-tapping screws, thread forming screws, sheet metal screws and socket head setscrews.

METRIC

Diameter — Coarse Thread	Metric Grade							
	5.6		8.8		10.9		12.9	
	N.m	ft-lbs.	N.m	ft-lbs.	N.m	ft-lbs.	N.m	ft-lbs.
M6	4.6	3.3	10.5	7.7	15	11	18	13
M7	7.8	5.6	17.5	12.9	26	18.4	29	21.3
M8	11	8.1	26	19	36	26	43	31
M10	22	16	51	37	72	53	87	64
M12	39	28	89	66	125	92	150	110
M14	62	45	141	103	198	146	240	177
M16	95	70	215	158	305	224	365	269
M18	130	95	295	217	420	309	500	368
M20	184	135	470	309	590	435	710	623

SECTION 1A. GENERAL INFORMATION

FENDERS AND HOOD REMOVAL AND INSTALLATION

Most service and repair of the HR5111 can be accomplished by opening the hood and/or seat pan. For better access, the hood, floor pan and engine compartment cowling can be removed, Figure 1A-2. Mark all attaching hardware to simplify installation.

Using a suitable device, support the platform before removing any hardware.

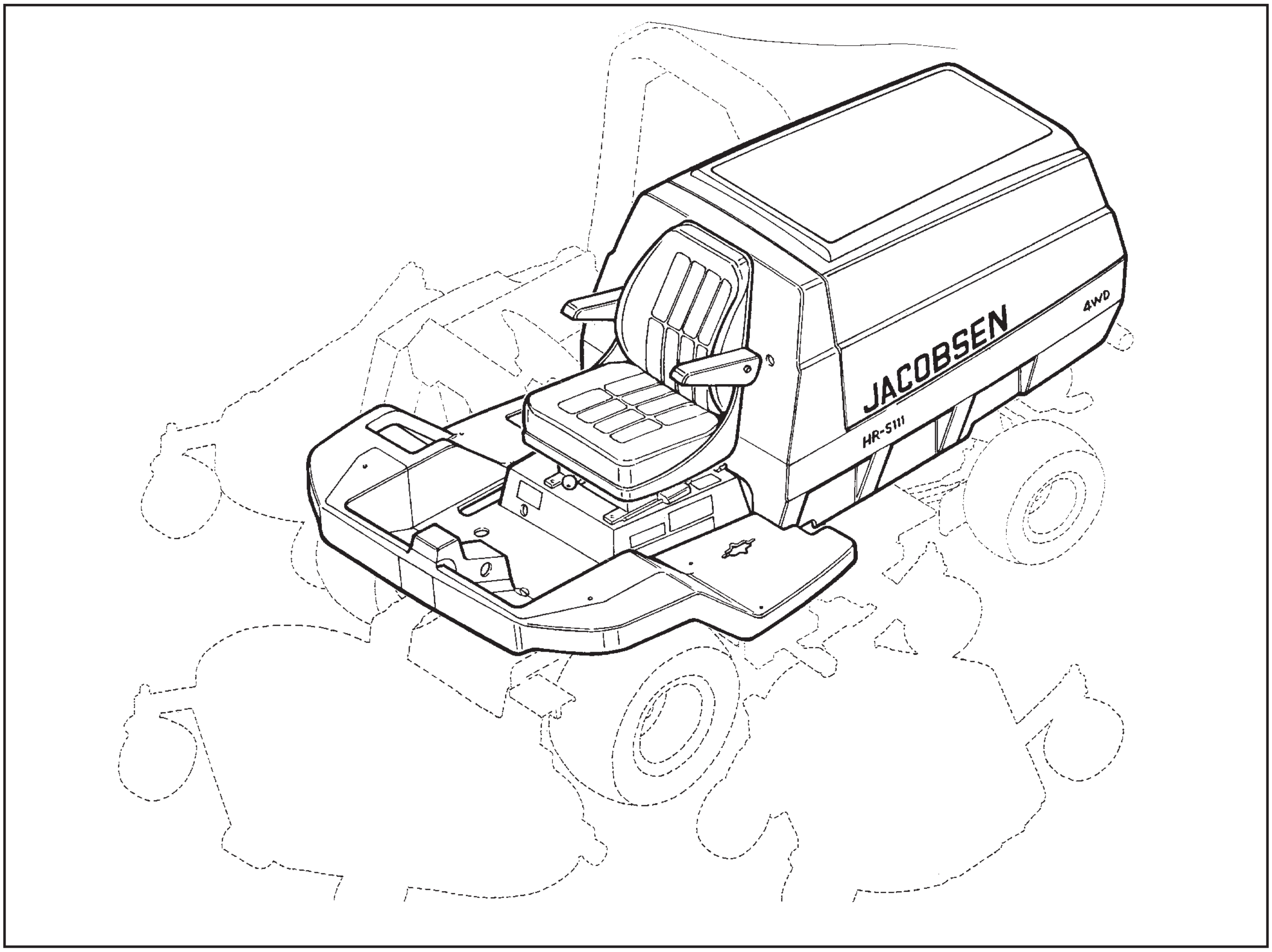


Figure 1A-2. Hood, Seat Pan and Floor Pan

SECTION 2
CONTROLS

2

SECTION 2A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools.
Cleaning materials:	Stoddard or equivalent solvent. Detergent and water.
Lubricants:	Refer to Section 11.

SECTION 2B. FAILURE ANALYSIS

GENERAL

The following table gives common problems, probable causes, and suggested remedies with page references to detailed description of remedial procedures.

PROBLEM	PROBABLE CAUSE	REMEDY
1. Engine does not turn over when ignition switch is engaged.	a. Parking brake not set.	a. Set parking brake.
	b. Implement switch ON.	b. Turn OFF.
	c. 10 amp shut-off system circuit breaker tripped.	c. Reset.
	d. 50 amp tractor circuit breaker tripped.	d. See Section 10B.
	e. Faulty electrical system.	e. See Section 10B.
2. Engine turns over but will not start.	a. Glow plugs not set.	a. Set glow plugs for 7 seconds before starting.
	b. 30 amp implement/fuel circuit breaker tripped.	b. Reset/test (Section 10J).
	c. Battery low.	c. Charge or replace (Section 10D).
	d. No fuel/obstructed fuel supply.	d. Check fuel level and/or obstruction. Purge system (Section 3D).
	e. Faulty electrical system.	e. See Section 11B.
3. Tractor creeps when traction pedal is in neutral.	a. Traction linkage centering spring not adjusted.	a. Adjust (Section 2C).
	b. Binding in the linkage.	b. Repair/lubricate (Sections 2C and 11B).
4. Parking brake does not hold.	a. Brake not adjusted.	a. Adjust (Section 2C).
	b. Worn brake shoes.	b. Replace (Section 5C).
5. Service brake spongy, fades or does not hold.	a. Master cylinder fluid level low or no fluid.	a. Check (Section 11).
	b. Air in brake system.	b. Bleed (Section 5E).
	c. Worn brake shoes.	c. Replace (Section 5C).
6. Mowers do not lift or lower properly.	a. Engine rpm too low.	a. Increase engine rpm above 2000.
	b. Faulty control valve handle linkage.	b. Repair (Section 2C).
	c. Faulty hydraulic circuit.	c. See Section 8B.
7. Slow traction speed.	a. Engine rpm too low.	a. Increase engine rpm.
	b. Traction pedal linkage not adjusted.	b. Adjust (Section 2C).
	c. Traction pedal linkage binding or damaged.	c. Repair (Section 2C).
	d. Parking brake not released.	d. Release.
	e. Faulty hydraulic circuit.	e. See Section 8B.

SECTION 2B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
8. Instrument(s) do not work.	a. Faulty wiring or bad electrical ground.	a. Test (Section 10C).
	b. 10 amp gauge/panel light circuit breaker tripped.	b. Reset/test (Section 10J).
9. No cruise control when turned ON.	a. 10 amp cruise/horn circuit breaker tripped.	a. Reset/test (Section 10J).
	b. Service brake applied.	b. Release.
	c. Service brake switch not adjusted.	c. Adjust (Section 2C).
	d. Faulty electrical circuit.	d. See Section 10B.
10. Cruise control drops OFF after being set.	a. Faulty holding relay.	a. Test/replace (Section 10H).
	b. Service brake switch not adjusted.	b. Adjust (Section 2C).
	c. Faulty cruise control switch.	c. Test (Section 10G).
	d. Weak/faulty magnet.	d. Replace.
11. Speed does not stay set (slips).	a. Cruise magnet gap too big.	a. Clean, check spring.
	b. Too steep of an incline.	b. Destroke traction pedal.
	c. Faulty cruise magnet.	c. Replace.
12. Cruise control does not shut OFF.	a. Faulty holding relay.	a. Test/replace (Section 10H).
13. No 4 wheel drive.	a. 4 wheel drive switch not ON.	a. Turn ON.
	b. Reverse sensing switch not adjusted.	b. Adjust (Section 2C).
	c. Faulty electrical circuit.	c. See Section 10B.
	d. Faulty hydraulic system.	d. See Section 8B.
14. No differential lock.	a. Differential lock switch not pushed ON.	a. Push ON.
	b. Faulty hydraulic circuit.	b. See Sections 6B and 8B.
	c. Faulty electrical circuit.	c. See Section 10B.
15. Glow plugs do not come on.	a. Parking brake not set.	a. Set brake.
	b. Implement switch not in the OFF position.	b. Push into OFF position.
	c. 50 amp tractor circuit breaker tripped.	c. Reset/test (Section 10J).
	d. 10 amp shut-off system circuit breaker tripped.	d. Reset/test (Section 10J).
	e. 50 amp glow plug/light circuit breaker tripped.	e. Test (Section 10J).
	f. Faulty glow plug switch.	f. Test (Section 10G).
	g. Faulty glow plugs.	g. Test/replace (Section 10L).
	h. Faulty glow plug relay.	h. Test/replace (Section 10H).
	i. Faulty ignition switch.	i. Test (Section 10G).

SECTION 2B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
16. Engine shuts down when implement switch is pulled to the ON position.	a. No operator in seat.	a. Set in seat.
	b. Faulty seat switch.	b. Test (Section 10G).
	c. Faulty timing delay relay.	c. Test/replace (Section 10H).
	d. Faulty implement control switch.	d. Test (Section 10G).
	e. Faulty wiring or bad electrical ground.	e. Test (Section 10C).
17. Mowers do not come on when implement switch is pulled to the ON position. Engine stays running.	a. Mowers not on the ground.	a. Lower.
	b. Direction control switches not in the CUT position.	b. Push into CUT.
	c. Faulty implement switch.	c. Test (Section 10G).
	d. Faulty hydraulic system.	d. See Section 8B.
18. Only one wing does not come on.	a. Mower not on the ground.	a. Lower.
	b. Arm interlock switch not closing.	b. Check switch (Section 10G).
	c. Check solenoid plug LED, ON — Push manual override. Mower comes ON. Faulty electrical circuit.	c. See Section 10B.
	Mower does not come ON. Faulty hydraulic circuit.	See Section 8B.
	OFF	See Section 10B.
	d. Jammed blades	d. Clean out under deck.
19. Only the front mower does not come on.	a. Mower not on the ground.	a. Lower.
	b. Direction control switch not in the CUT position.	b. Push into CUT.
	c. Arm interlock switch not closing.	c. Check switch (Section 10G).
	d. Check solenoid plug LED, ON — Push manual override. Reels come ON. Faulty electrical circuit.	d. See Section 10B.
	Mower does not come ON. Faulty hydraulic circuit.	See Section 8B.
	OFF	See Section 10B.
	e. Jammed blades.	e. Clean out under deck.
20. Engine shuts down immediately when operator leaves seat (implement switch OFF).	a. Faulty electrical circuit.	a. See Section 10B.

SECTION 2B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
21. Engine does not shut down when operator leaves seat (implement switch ON).	a. Faulty electrical circuit.	a. See Section 10B.
22. Panel lights do not come on when test switch is pushed to the ON position.	a. 10 amp gauge/panel light circuit breaker tripped. b. Battery dead. c. 50 amp tractor circuit breaker tripped. d. Faulty electrical circuit.	a. Reset/test (Section 10J). b. Charge/replace (Section 10D). c. Test (Section 10J). d. See Section 10B.

SECTION 2C. CONTROL ADJUSTMENTS

GENERAL

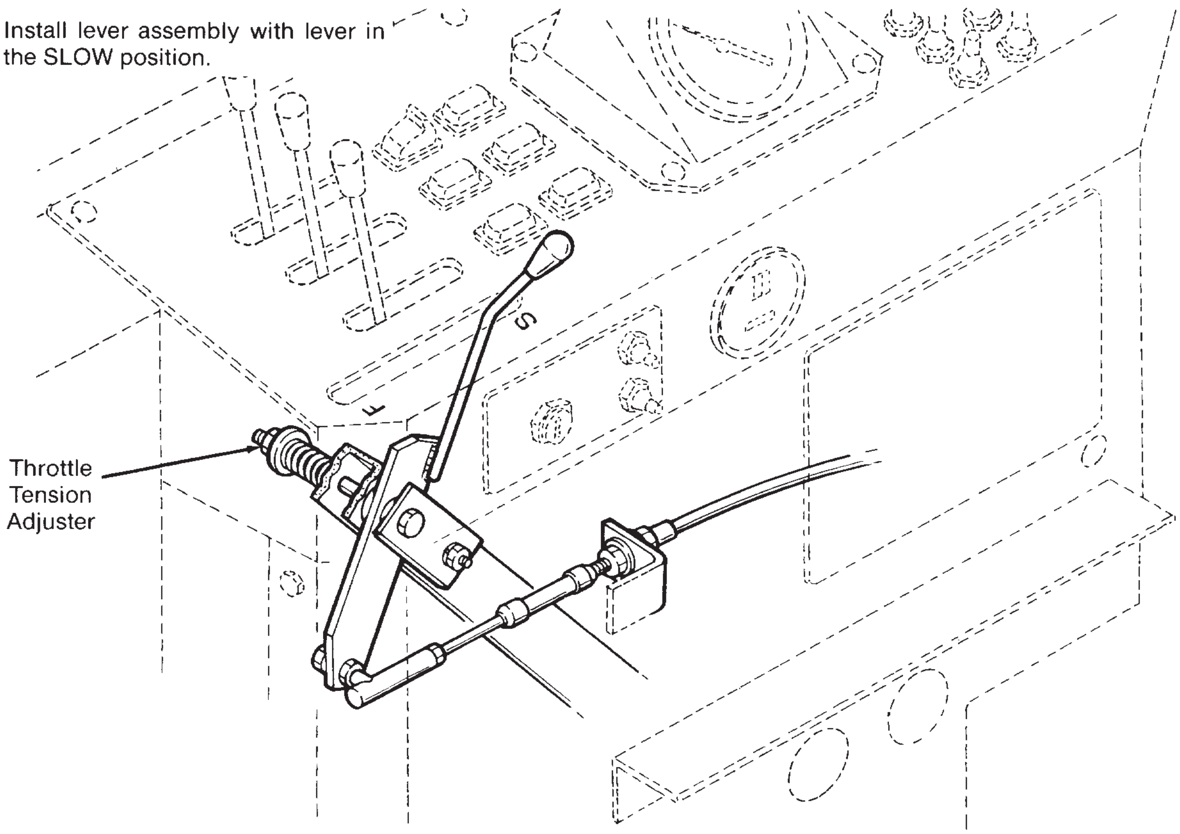
The repair of controls is limited to adjustment of linkages, straightening of bent rods or replacement of defective parts and hardware.

THROTTLE (See Figure 2C-1)

Located to the right of the operator's seat, the throttle control is used to regulate engine speed. Replace a defective throttle as shown in Figure 2C-1.

STEP 1

Install lever assembly with lever in the SLOW position.



STEP 2

Position cable in clamp so throttle is held closed. Tighten clamp.

STEP 3

Push throttle to full open position and check governor throttle lever contacts high speed stop.

STEP 4

Start engine and check idle and high speed setting. Idle 750-800 rpm, high speed 2800 rpm.

STEP 5

Adjust ball joint to obtain full governor throttle lever movement.

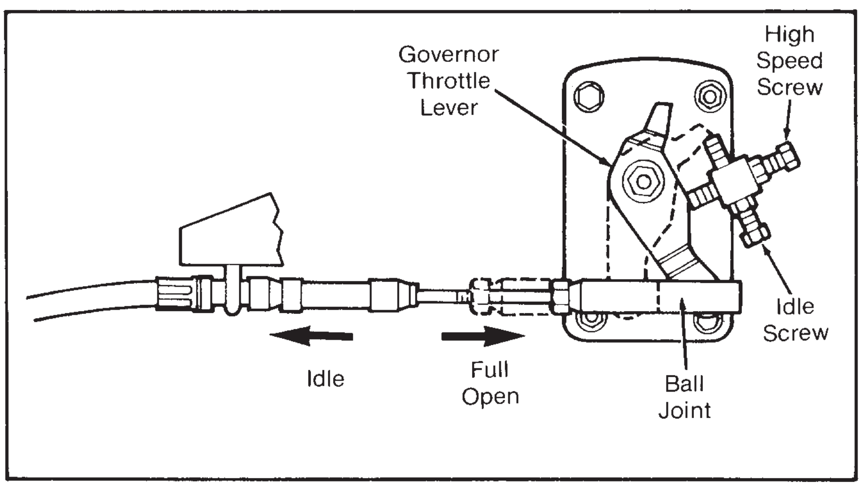


Figure 2C-1. Throttle Control Repair

SECTION 2C. CONTROL ADJUSTMENTS

TRACTION PEDAL (See Figure 2C-2)

The traction pedal controls travel direction and speed. The traction pedal is connected by linkage to the hydrostatic pump. Depending on which way the pedal is depressed, it controls “forward” or “reverse”. Repair of the traction pedal and linkage is limited to replacement of damaged or worn parts and adjustments.

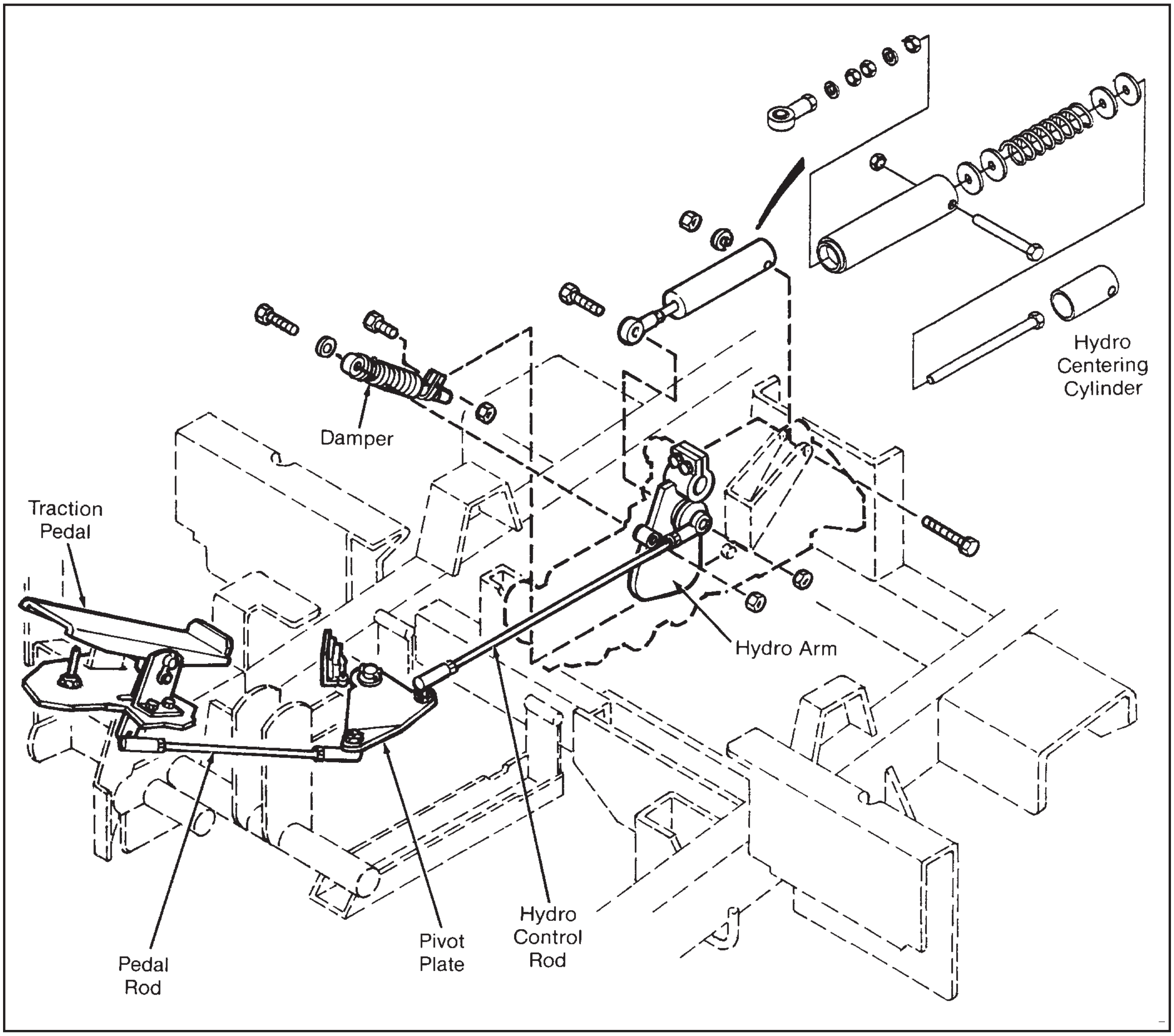


Figure 2C-2. Traction Pedal and Linkage

SECTION 2C. CONTROL ADJUSTMENTS

TRACTION PEDAL NEUTRAL ADJUSTMENT

If the tractor moves ("creeps") in either direction while the engine is running, but traction pedal is not depressed, the hydro centering cylinder may need adjusting, see Figure 2C-3 and adjust traction pedal linkage as follows:

IMPORTANT

Place a small amount of lubricating oil on pedal linkage pivot points to ease movement.

1. Raise the tractor so all four wheels are off the ground. Put jack stands under frame to prevent accidental lowering of tractor during adjustment.
2. Electrically bypass seat switch.
3. Disengage parking brake.
4. Put 4 WHD/2 WHD switch in 2 WHD position.
5. Start engine and set throttle to full speed.

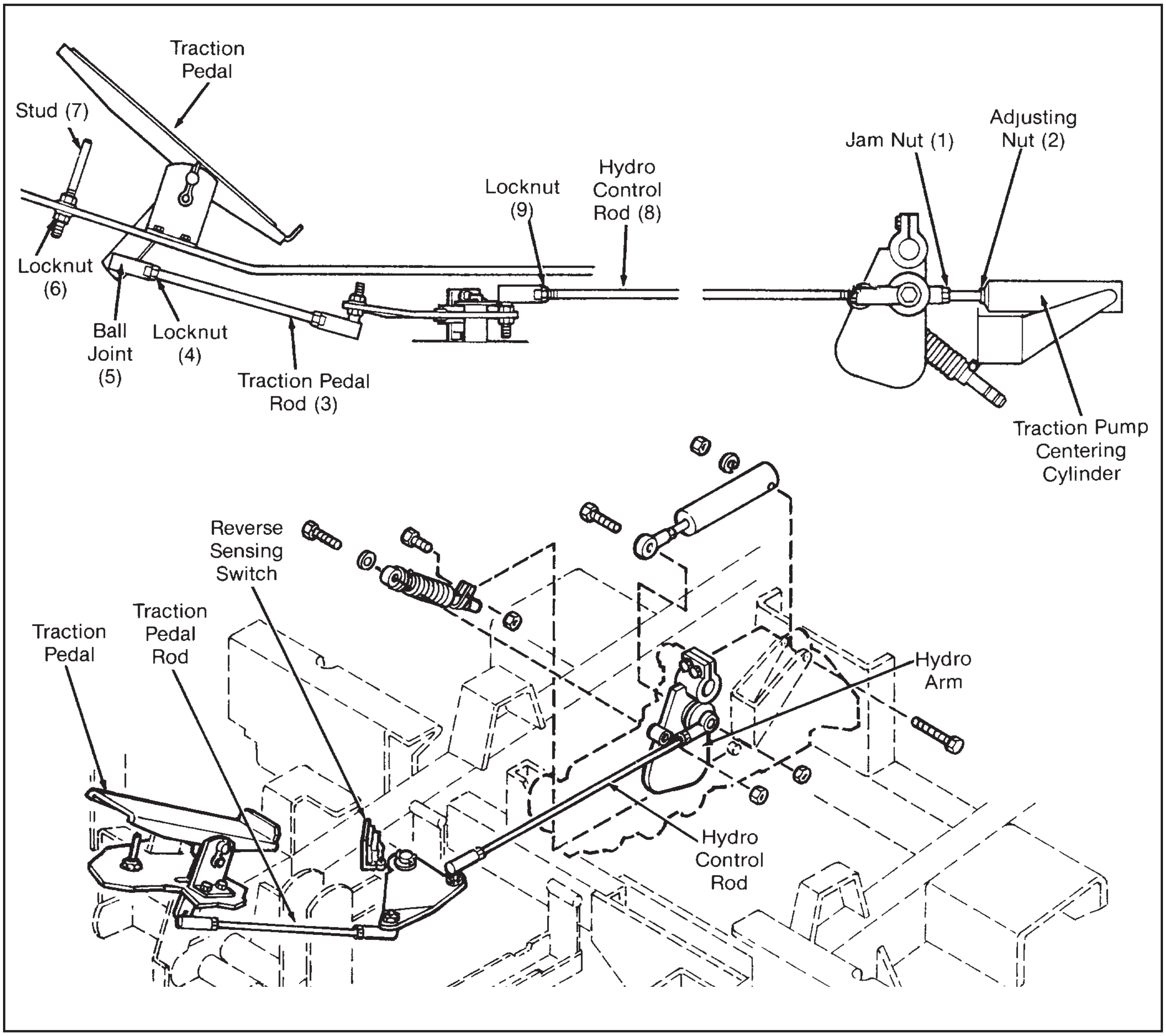


Figure 2C-3. Traction Pedal Adjustments

SECTION 2C. CONTROL ADJUSTMENTS

⚠ WARNING

Use extreme caution during the following adjustment as the drive wheels will be off the ground with the engine running. Serious personal injury can result if clothing or limbs become entangled

6. On the traction pump centering cylinder, loosen jam nut (1) and turn adjusting nut (2), moving threaded rod in or out as required to stop wheels from turning.
7. When the wheels stop turning, the traction pump is in “neutral”. Hold adjusting nut (2) in place and tighten locknut (1).

NOTE

Check the reverse brake switch adjustment and adjust as necessary.

8. Turn engine OFF.

SPEED LIMIT ADJUSTMENT

The forward and reverse transport speed limits can be set by adjusting the amount of traction pedal travel. See Figure 2C-3 and adjust pedal travel as follows:

Reverse:

“Reverse” pedal travel can be adjusted by changing the length of the traction pedal rod (3). Shortening the rod will increase reverse speed and lengthening the rod will decrease reverse speed.

1. Loosen locknut (4).
2. Remove nut (5) and adjust ball joint as required to obtain desired speed limit. Operate unit to determine when desired speed limit is obtained.
3. After adjusting the length of the rod, the pedal stop for “forward” pedal travel, must be adjusted as described below.

Forward:

1. Loosen locknut (6) and move the traction pedal to its maximum forward position. Turn stud (7) in if pedal touches bolt before reaching its maximum forward position.
2. Adjust stud (7) until the head touches the traction pedal, then turn the stud one revolution counterclockwise (out against the pedal).
3. Tighten nut (6).

REVERSE SENSING SWITCH (See Figure 2C-3)

The tractor should shift into 4 wheel drive at approximately 1.0 mph (switch closed).

1. Raise the operator’s seat to gain access to hydro control rod (8) and locknut (9).
2. Raise the tractor so all 4 wheels are off the ground and put jack stands under frame to prevent accidental lowering of tractor during adjustment.
3. Electrically bypass seat switch.
4. Disengage parking brake.
5. Put 4 WHD/2 WHD switch in 2 WHD position.
6. Put a piece of tape or mark the front tire with a white line.
7. Start engine and set throttle to full speed.
8. Put 4 WHD/2 WHD switch in 4 WHD position.
9. Slowly push the traction pedal down. The front tire should turn 7–14 rpm before 4 wheel drive energizes.

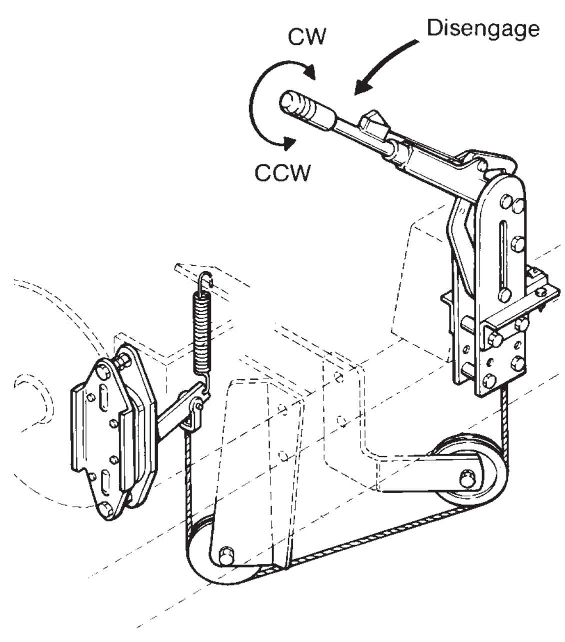


Figure 2C-4. Parking Brake

ADJUSTMENT

1. Loosen nuts (9).
2. Turn rod (8) (clockwise (CW) to increase mph engagement, counterclockwise (CCW) to decrease mph engagement).
3. Tighten nut (9) and repeat Steps 7–9.

SECTION 2C. CONTROL ADJUSTMENTS

PARKING BRAKE (See Figure 2C-4)

The adjusting knob at the end of brake lever is used to compensate for brake lining and linkage wear, or to adjust to unusual holding demands.

1. Place brake lever in the disengaged position and turn knob in a clockwise direction, apply and release brake lever every quarter turn until a definite "snap over center" action is achieved.
2. Over adjustment causes "hard" lever action, but does not increase brake efficiency. Turn knob counterclockwise until a smooth but firm action is obtained.

SERVICE BRAKE (See Figure 2C-5)

The service brake pedal should have a minimum of 1/8 (3.17 mm) free play before the plunger contacts piston in the master cylinder.

Adjust brake pedal rod as shown in Figure 2C-5.

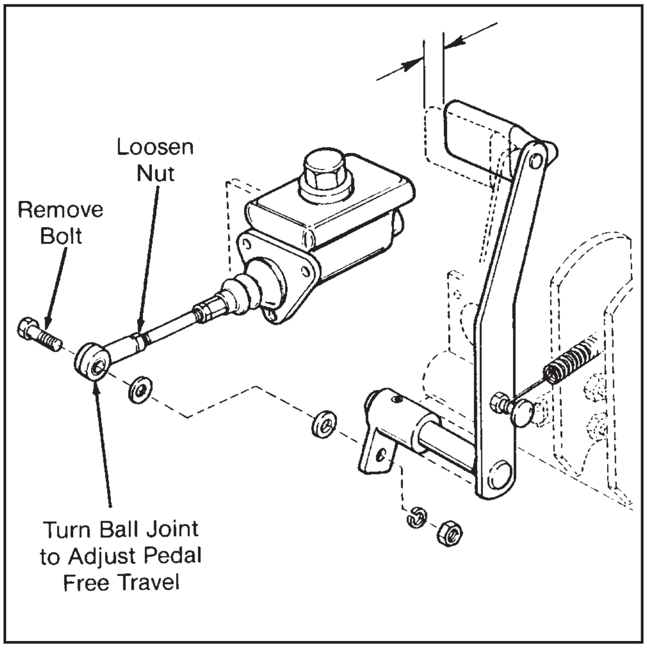


Figure 2C-5. Service Brake

CRUISE CONTROL SWITCH (See Figure 2C-6)

If the cruise control will not disengage when the pedal is pushed, proceed as follows:

1. Loosen nuts (1) and position switch so roller (2) is centered on bolt (3). Tighten nuts (1).
2. Loosen nuts (4) and extend or retract bolt (3) to activate switch. Tighten nuts (4).

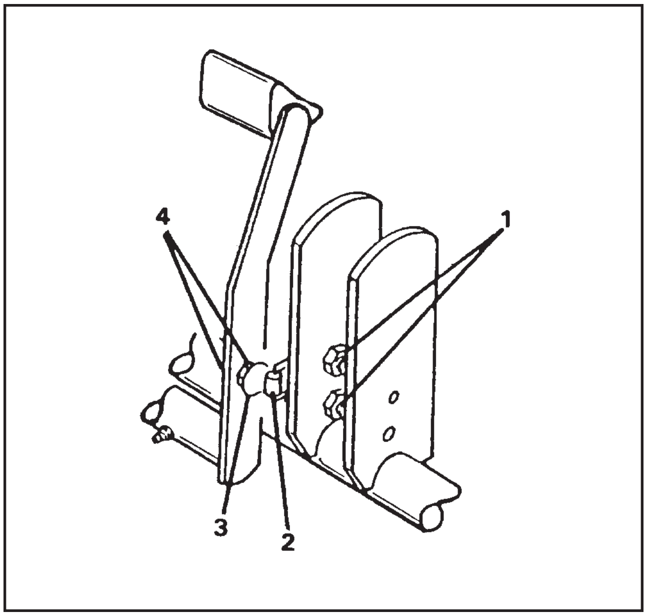


Figure 2C-6. Cruise Control Switch

SECTION 2D. GAUGES AND INSTRUMENTS

REPAIR

NOTE

Refer to Section 10G for test/repair of switches.

Repair of instruments is limited to replacement of faulty components. See Figure 2D-1 and replace faulty component as follows:

1. Remove fuel tank to gain access.
2. Disconnect battery ground (black) cable.
3. Label wires for proper identification and disconnect wiring.
4. Remove attaching hardware and replace faulty instrument.
5. Connect wiring.
6. Connect battery ground cable.

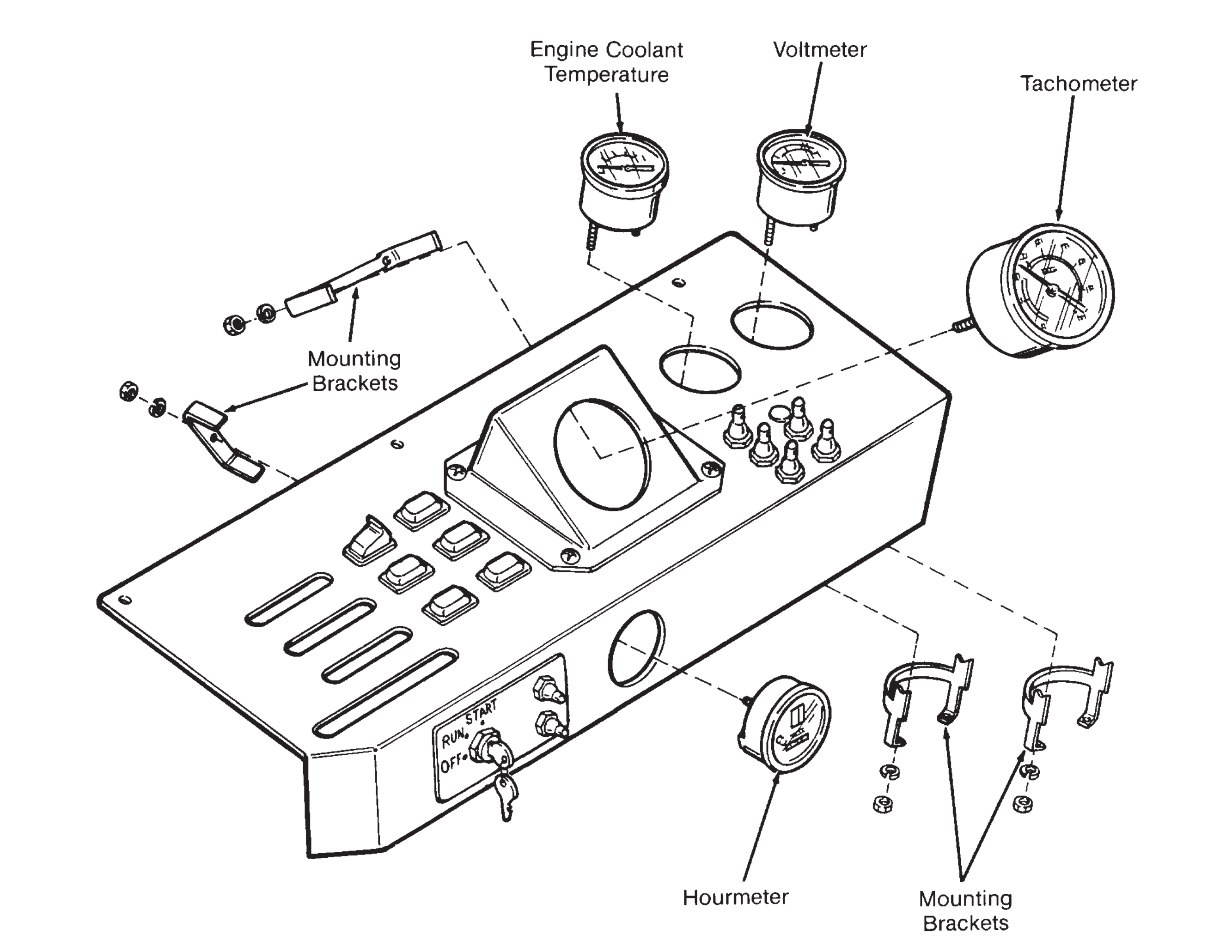


Figure 2D-1. Gauges and Instruments Removal and Replacement

SECTION 3
ENGINE

3

SECTION 3A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools.
Cleaning materials:	Stoddard or equivalent solvent. Detergent and water. Anti-rust Never-Seize.
Lubricants:	Refer to Section 11.
Other service items:	Compressed Air Source, Engine Hoist. Loctite 242 (Blue). Engine Service Manual can be obtained from your Jacobsen Dealer or Distributor. Anti-freeze, 50-50 mix water and ethylene glycol.

SECTION 3B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Engine cranks but does not start.	a. Fuel tank empty. b. Fuel petcock at filter closed. c. Air in fuel line. d. Electrical system malfunctioning. e. Fuel filter dirty/clogged. f. Faulty engine.	a. Check fuel level. b. Open petcocks. c. Purge air (Section 3D). d. See Section 10. e. Clean and/or replace filter (Section 3D). f. See Engine Manufacturer's Service Manual.
2. Engine not running smoothly.	a. Dirty fuel filter. b. Faulty engine component.	a. Clean and/or replace filter (Section 3D). b. See Engine Manufacturer's Service Manual.
3. Engine dies down under load.	a. Throttle adjustment. b. Binding in governor linkage. c. Partially blocked fuel line or filter. d. Load heavier than engine can handle.	a. Adjust (Section 3D). b. Inspect/repair. See Engine Manufacturer's Service Manual. c. Check fuel line and filter for blockage. d. Increase engine throttle full open position. Adjust maximum engine RPM (Section 2C). Reduce load.
4. Engine overheats.	a. Radiator clogged. b. Radiator clean out trap door open. c. Instruments faulty. d. Sending units faulty.	a. Clean out. b. Close. c. See Section 2D. d. See Section 10J.

SECTION 3C. GENERAL INSTRUCTIONS

CONTENTS

The engine used in the HR5111 Tractor is a Kubota V-2203, 4 cylinder in-line, liquid cooled diesel engine.

This section covers repairs to the engine associated components (eg. exhaust system, air cleaners, radiators). Removal and installation of the engine is also covered, but engine repair is not included in this manual. Refer to the engine manufacturer's instructions for engine service and repair. The engine manual is available from your Jacobsen Dealer or Distributor.

NOTE

Tests for alternators, starters, and regulator are included in Section 10 of this manual. If these components are found faulty, refer to the engine manufacturer's manual for repair instructions.

CLEANING AND LUBRICATION

Thoroughly clean each component after removal from the machine. Follow instructions for lubrication of engine in Section 11.

SECTION 3D. DIESEL ENGINE

GENERAL

A separate engine operator's manual, prepared by the engine manufacturer is supplied with your tractor. Study the manual carefully until you are familiar with the maintenance, operation and adjustment of your equipment. Proper attention to the engine manufacturer's directions will assure maximum service life of the engine and highest operating efficiency.

AIR CLEANER (See Figure 3D-1)

Perform Step 1 daily or as needed. Perform Steps 2–5 when the "Air Filter" light on the monitor panel comes on.

1. Loosen the retaining clamp (1) and slide the cover (2) off of the air cleaner assembly. Remove the baffle (3) and empty dust from the cover. Wipe clean with a clean damp cloth.

NOTE

It is not recommended to remove element to clean. If element is to be removed, replace with a new one.

2. Remove the swing nut and gasket (4), and slide the element (5) out of assembly.

NOTE

If a new element is installed, use a new gasket (4).

3. Install the element (5). Install the wing nut and gasket (4).
4. Install the baffle (3) in cover (2) making sure opening is up.
5. Secure cover (2) with retaining clamp (1).

⚠ WARNING

DO NOT USE STARTING ASSIST FLUIDS. Use of starting assist fluids in the air intake system may be potentially explosive or cause a "RUN-AWAY" engine condition. This could result in serious engine damage and/or personal injury.

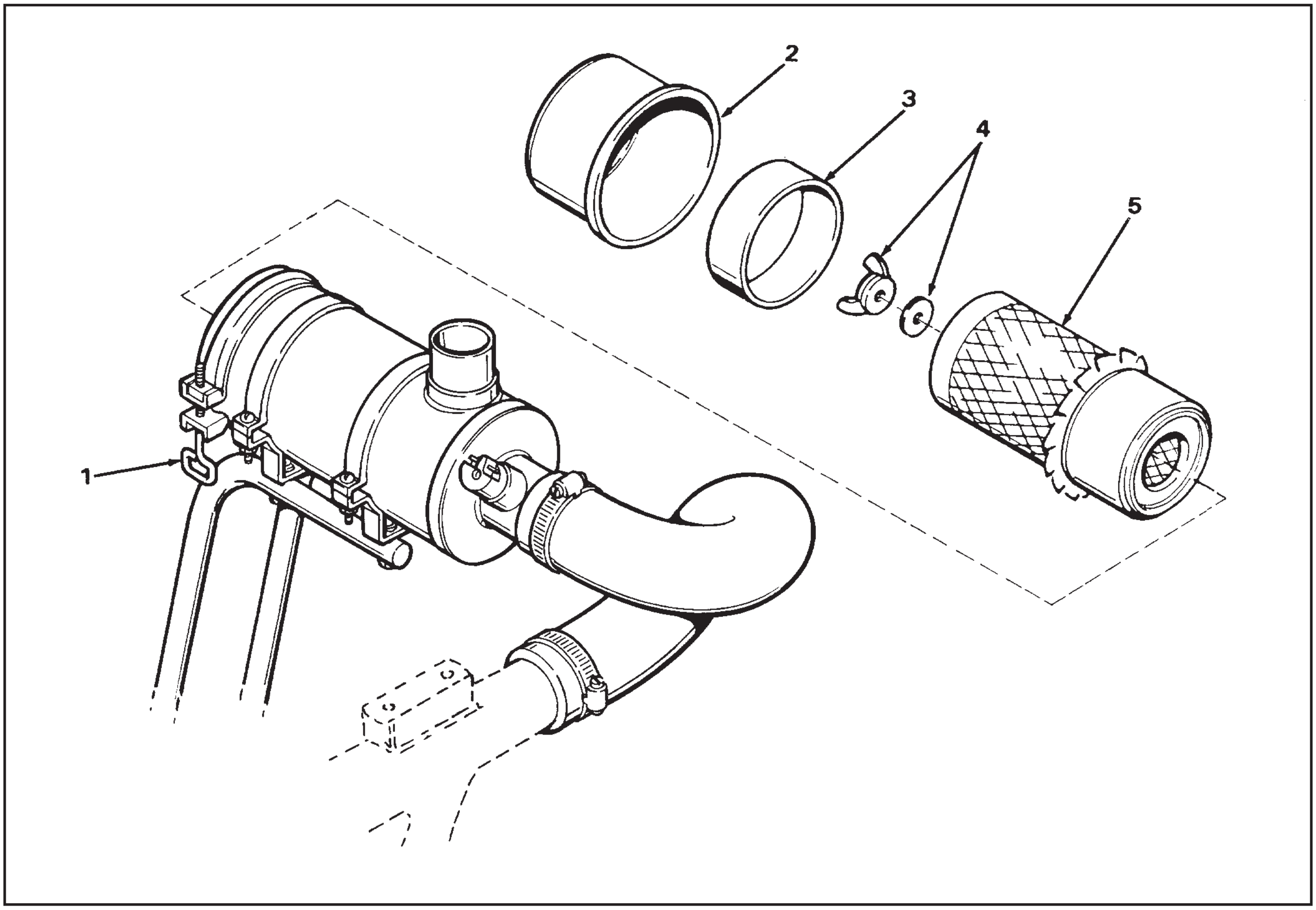


Figure 3D-1. Air Cleaner Service

SECTION 3D. DIESEL ENGINE

RADIATOR (See Figure 3D-2)

⚠ CAUTION

Never open radiator cap (2) while engine is running or soon after it stops. Hot water sometimes shoots out if the radiator cap is opened while the engine is hot.

CHANGING COOLANT

1. Open drain cock (1) and radiator cap (2) and drain coolant into a clean container.
2. Flush the inside of the radiator (3) with clean water.

NOTE

Always mix anti-freeze with the cooling water. Mixture ratios differ with the anti-freeze manufacturer and temperature. Follow the instructions of each manufacturer. However, do not exceed a 50/50 mixture of anti-freeze to water.

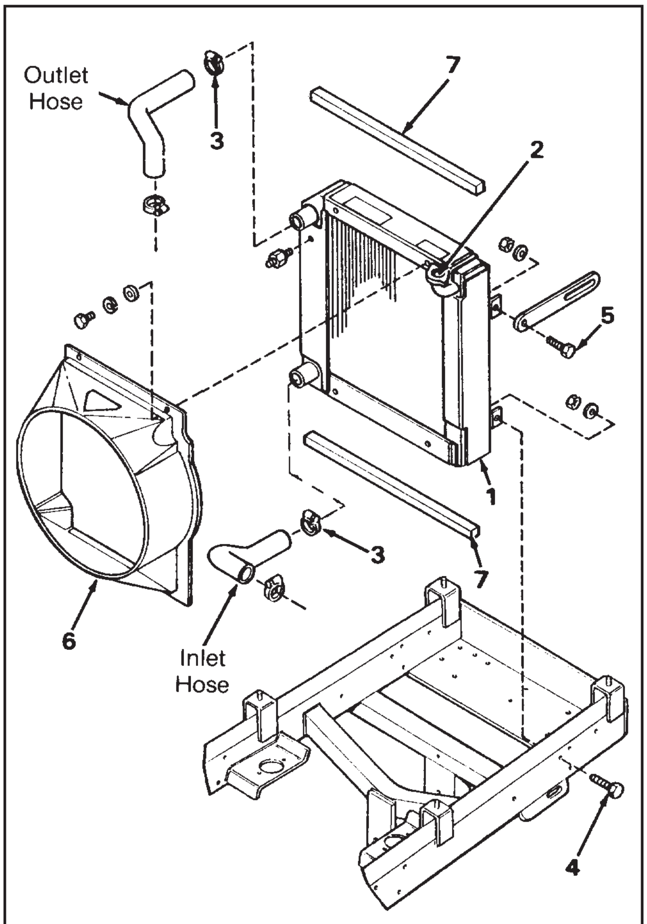


Figure 3D-2. Radiator Service

CLEANING RADIATOR CORE

When dust enters between fins and tubes, blow out with air, then wash with tap water under pressure.

NOTE

Never use a screwdriver or other pointed tool for cleaning. It may damage the core tubes of the radiator.

Open access door at bottom of radiator to allow trash to fall out during cleaning.

REMOVAL (See Figure 3D-2)

1. Loosen wing nuts holding oil cooler in place and tilt oil cooler out of the way.
2. Remove hardware securing fan shroud to radiator and move shroud back over fan.
3 Open drain cock (1), remove radiator cap (2) and drain the coolant.
4. Disconnect the inlet and outlet hoses by loosening hose clamps (3).
5. Disconnect overflow tube at radiator cap.
6 Remove attaching hardware (4 and 5).
7. Inspect weatherstrip (7). Replace if damaged.

INSTALLATION (See Figure 3D-2)

1. Install weatherstrip (6) if removed.
2. Place the radiator (3) on frame and secure with attaching hardware (4 and 5).
3. Connect overflow coolant tube.
4. Connect the inlet and outlet hoses; tighten hose clamps (3).
5. Close drain cock (1) and fill the radiator with clean distilled water/anti-freeze mixture.

NOTE

Always mix anti-freeze with the cooling water. Mixture ratios differ with the anti-freeze manufacturer and temperature. Follow the instructions of each manufacturer. However, do not exceed a 50/50 mixture of antifreeze to water.

6. Secure fan shroud to radiator with attaching hardware.
7. Secure oil cooler in place with wing nuts and washers.

SECTION 3D. DIESEL ENGINE

MUFFLER REMOVAL AND INSTALLATION

Remove and install the muffler and engine as shown on Figure 3D-3.

CAUTION

Do not attempt to service muffler while engine is hot from operation.

EXHAUST SYSTEM INSPECTION

1. Clean all sections of the exhaust system of dirt, dust or other foreign material.
2. Inspect exhaust system for cracks, holes, distortion or deformation.

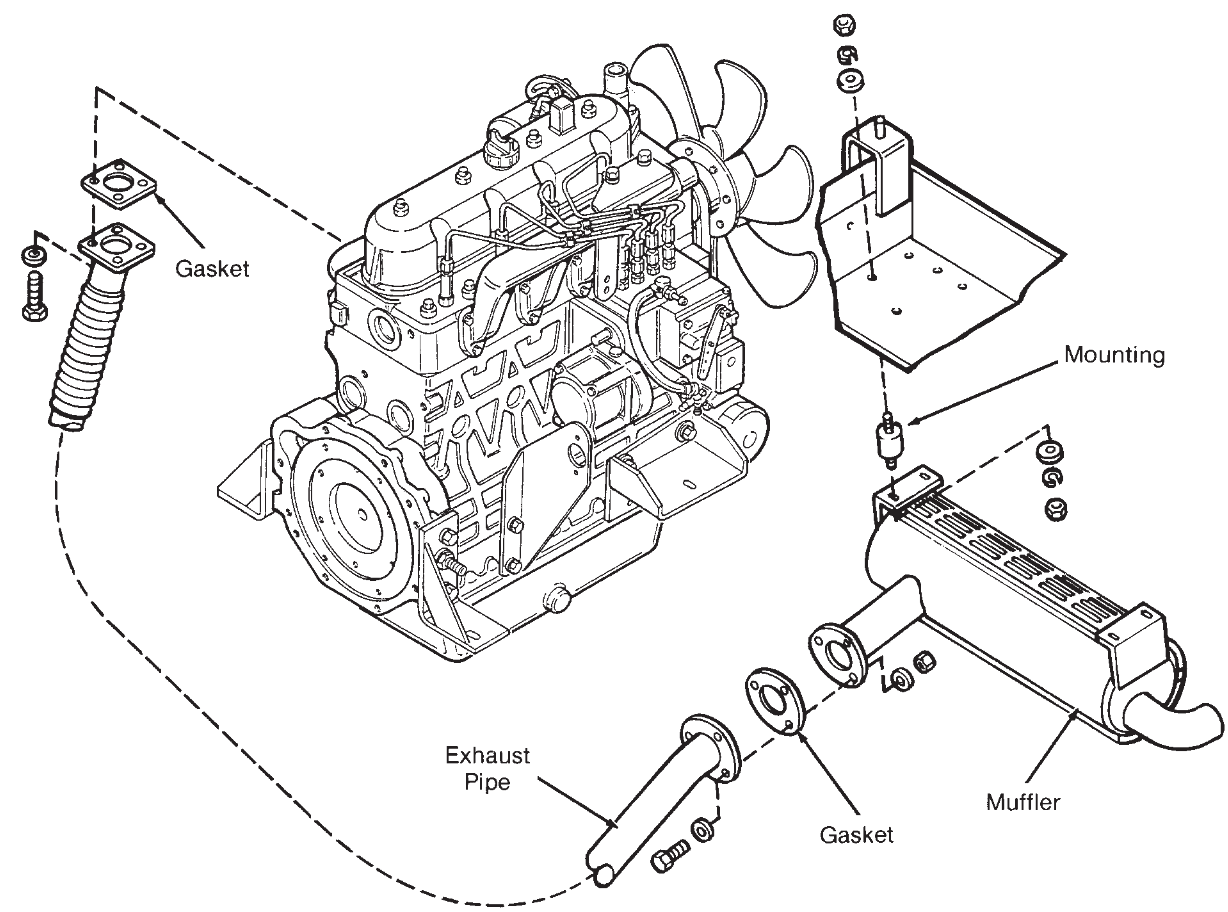


Figure 3D-3. Muffler Removal and Installation

SECTION 3D. DIESEL ENGINE

FUEL FILTER SERVICE (See Figure 3D-4)

The fuel filter is mounted on the left front of engine on the frame. Moisture and other foreign matter accumulate in the fuel filter. Periodically clean and replace the filter element. (Refer to Section 11.)

Purge air from the fuel system after new filter has been installed.

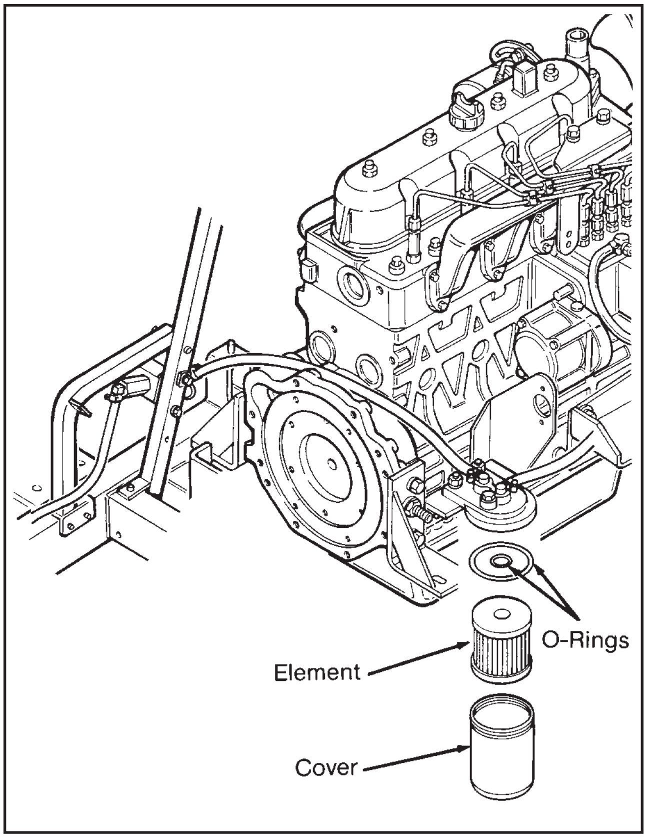


Figure 3D-4. Fuel Filter Service

PURGING THE FUEL SYSTEM (See Figure 3D-5)

⚠ CAUTION

Do not perform purging when the engine is hot.

Whenever the fuel filter or fuel piping are removed, the fuel tank is completely emptied, or the engine has not been used for an extended time, purge the system of air as follows:

1. Fill the fuel tank with fuel.

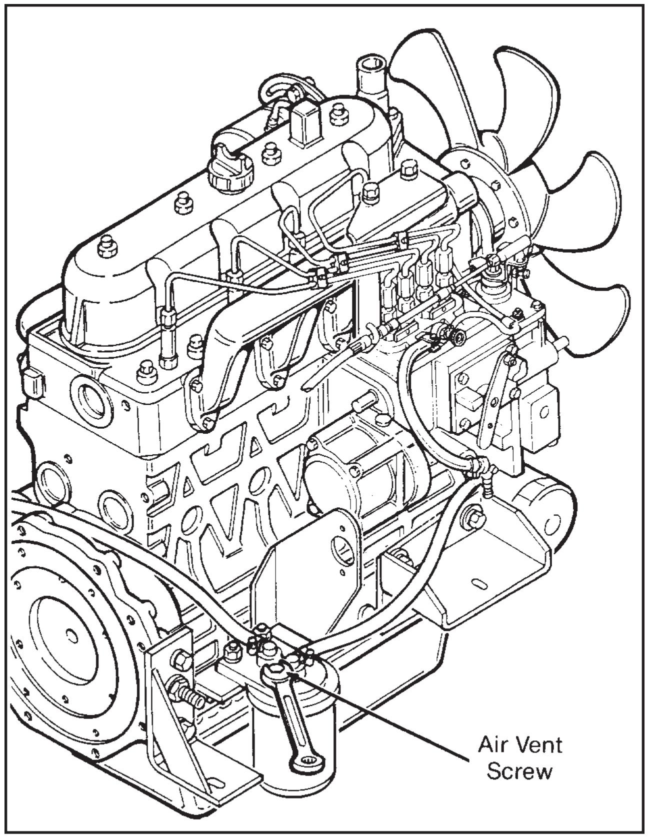


Figure 3D-5. Purging the Fuel System

2. Loosen the air vent screw at the top of the filter by turning it counterclockwise two turns. Use a suitable container to catch fuel which will flow from screw hole.
3. Turn ignition switch ON to allow electric fuel pump to operate.
4. When bubbles disappear from fuel coming out of the air vent screw hole, turn the screw back in and turn ignition switch OFF.
5. Open the air vent plug on the fuel injection pump.
6. Turn ignition switch ON to allow electric fuel pump to operate.
7. Close the air vent plug when air bubbles disappear from the fuel flow and turn ignition switch OFF.

⚠ WARNING

The engine may start during this process. Be careful of injury due to moving components. If the engine starts, continue purging the remaining fuel injector lines.

8. One at a time, loosen the high pressure fuel injector line nuts at the injector while cranking the engine.
9. When bubbles disappear, tighten the fuel line nuts. Repeat Steps 6 and 7 for the remaining fuel injection lines.
10. When all the lines have been purged and the engine is running, listen to the engine. If it sounds like it's missing, repeat Steps 6 and 7 for all the injection lines.

ENGINE REMOVAL (See Figures 3D-6 to 3D-8)

1. Disconnect and tag all electrical connections at the engine.
2. Remove the fuel line from engine.
3. Disconnect air cleaner and support rods (see Figure 3D-6).
4. Disconnect the throttle cable at the fuel injection pump (Figure 3D-7).

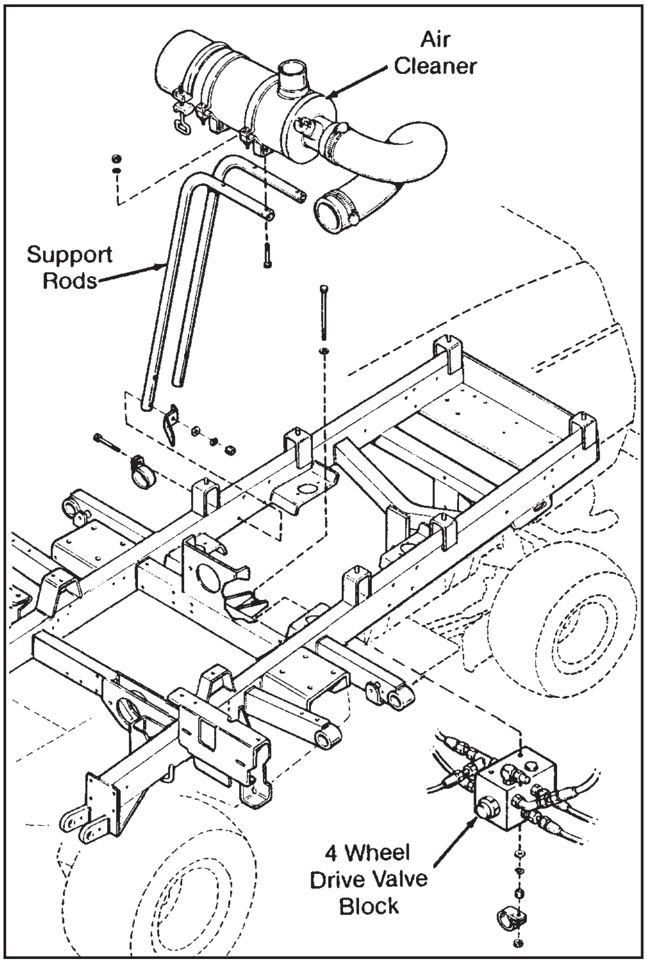


Figure 3D-6. Component Removal

5. Remove the exhaust pipe and radiator shroud described in preceding paragraphs (see Figure 3D-2 and 3D-3).

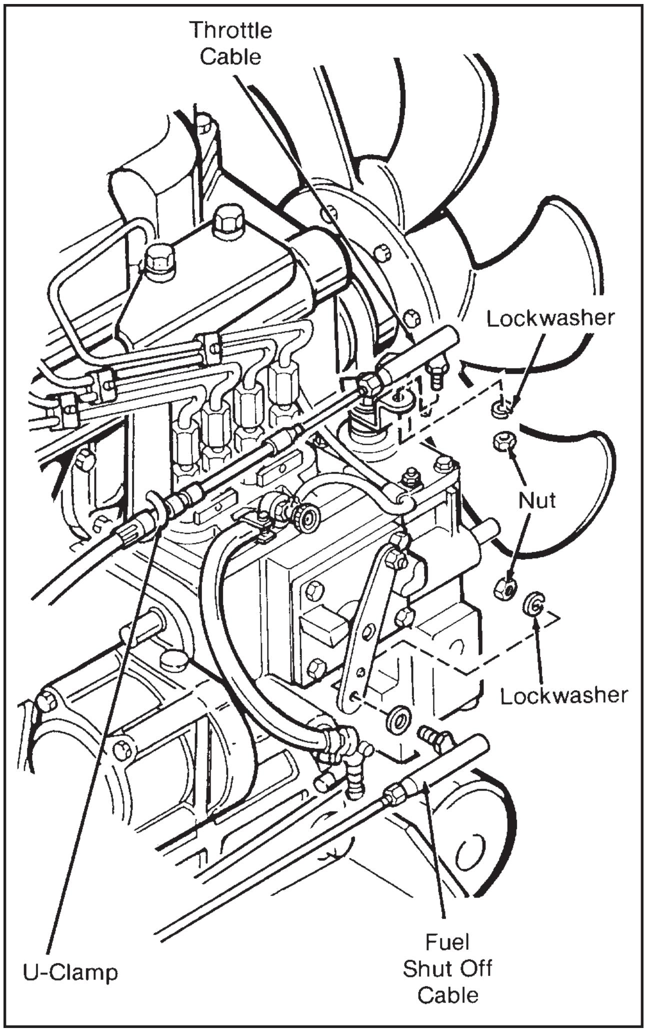


Figure 3D-7. Fuel Shut-Off Solenoid and Throttle Cable Connections

6. Tag and remove hydraulic lines from 4 wheel drive valve block (see Figure 3D-6).
7. Remove 4 wheel drive valve block.
8. Remove the bolts (1) and lockwashers (2) that mount the hydrostatic pump drive plate (3) to the engine (see Figure 3D-8).
9. Attach a chain hoist to the engine (the engine weighs approximately 400 lbs.).
10. Remove all bolts (4), lockwashers (5) and flat washers (6) that hold the engine to the machine frame.
11. Carefully lift the engine out of the machine.

3D

SECTION 3D. DIESEL ENGINE

ENGINE INSTALLATION (See Figures 3D-6 to 3D-8)

1. Move the engine onto its approximate mounting position using a chain hoist.
2. Line up holes in hydrostatic pump drive plate with engine flywheel. Install bolts (1) and lockwashers (2). Torque to 37 ft-lbs. (51 N.m).
3. Slide engine forward, align and loosely attach all bolts (4), lockwashers (5) and flat washers (6) that secure the engine to the frame.
4. Install the radiator shroud and exhaust pipe as described in preceding paragraphs of this section.
5. Tighten mounting bolts (4) after all have been installed.
6. Connect and adjust the throttle control (see Section 2 of this manual and Figure 3D-6).
7. Connect all electrical connections to the engine (see Section 10 for location and testing).
8. Install air cleaner and support rods.

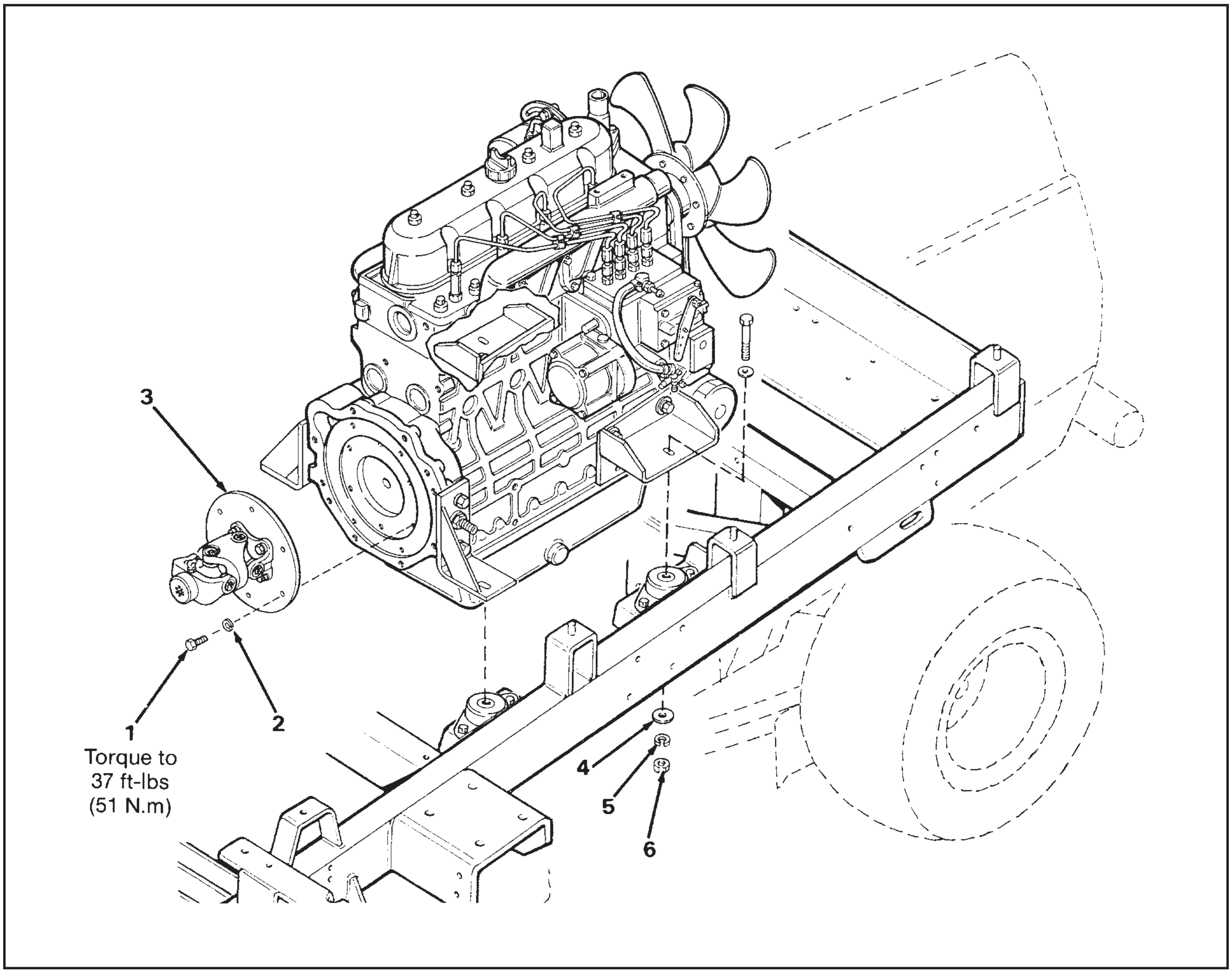


Figure 3D-8. Engine Installation

SECTION 4
DRIVE TRAIN

SECTION 4A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard Automotive hand tools. Metric tools.
Cleaning materials:	Stoddard solvent or equivalent. Loctite "chisel" gasket remover or equivalent.
Lubricants:	Refer to Section 11.
Special tools:	* Bucher-Guyer AG CH-8166 Niederweningen FAX: 01-857-26-55 * Adjusting tool 150-10511-0. * Special circlip pliers 150-16789-0. Loctite® "Master Gasket Sealant" or equivalent. Loctite® "Locquic Primer N" or equivalent. Loctite® "Threadlock 242 Blue".

SECTION 4B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Differential lock does not disengage.	a. Torque on drive line. b. Differential lock collar jammed. c. Faulty differential lock piston. d. Tractor in a turn. e. Differential switch faulty. f. Differential solenoid valve cartridge faulty.	a. Stop tractor. b. Repair (Section 4E). c. Repair (Section 4E). d. Stop tractor. e. Test (Section 10G). f. Replace (Section 8K).
2. No differential lock. Check LED at solenoid: ON — See b, d, e. OFF — See a and c.	a. Differential lock solenoid faulty. b. Differential lock solenoid valve cartridge faulty. c. Differential switch faulty. d. Faulty differential lock. e. Differential lock collar jammed.	a. Check LED at solenoid. ON — Faulty solenoid. OFF — (Electrical, Section 10B). b. Replace (Section 8K). c. Test (Section 10G). d. Repair (Section 4E). e. Repair (Section 4E).
3. Wheel scuffs turf on turns.	a. Differential lock engaged. b. Differential not disengaging.	a. Release. b. See #1 above.
4. Noisy when tractor moving forward or reverse.	a. Excessive gear backlash. b. Faulty U-joints.	a. Adjust (Section 4E). b. Repair (Section 4D).
5. Tractor does not go forward or reverse when traction pedal is pushed. Does drive shaft turn? NO — See a, c, d, e. YES — See b, f.	a. Faulty traction pedal linkage. b. Axle input shaft spline stripped. c. Hydro traction motor shaft spline stripped. d. Parking brake applied. e. Parking brake not releasing. f. Internal gear failure in axle.	a. Repair/adjust (Section 2C). b. Repair (Section 4E). c. Repair (Section 8I). d. Release (Section 2C). e. Repair/adjust (Sections 5C/2C). f. Repair (Section 4E).
6. Clunking sound when changing direction.	a. Axle drive U-joint faulty. b. Excessive axle gear backlash.	a. Repair (Section 4D). b. Adjust (Section 4E).

4B

SECTION 4C. HYDROSTAT DRIVE U-JOINT

GENERAL

The hydrostatic transmission is driven by a telescoping universal joint type drive shaft connected directly between the hydro and engine flywheel plate.

REPAIR

Repairs are limited to renewing the cross and bearings.

SERVICE

DISASSEMBLY (See Figure 4C-1)

1. Position the joint in a vise as shown.
2. Remove the four snap rings.
3. Using a driver slightly smaller than the outside diameter of the bearing, drive the bearing in forcing the bearing on the opposite side out.
4. Turn the drive shaft around and driving on the cross, push opposite bearing out.
5. Repeat Steps 3 and 4 for the remaining bearings.

ASSEMBLY (See Figure 4C-1)

NOTE

During reassembly be sure all the parts are clean and free of dirt.

1. Start one bearing in yoke ear and position center cross through yoke.
2. Drive the first bearing flush with outside surface of ear.

NOTE

Do not bend ear of yoke.

3. Support the ear and using a mandrel the same diameter as the bearing, drive the bushing slightly past the snap ring groove.
4. Install the snap ring.
5. Repeat Steps 3 and 4 for the other bearings.
6. After assembly, ensure proper seating by striking the forged surfaces of the yoke ear one sharp blow with a soft mallet.
7. Lubricate the joint as described in Section 11.

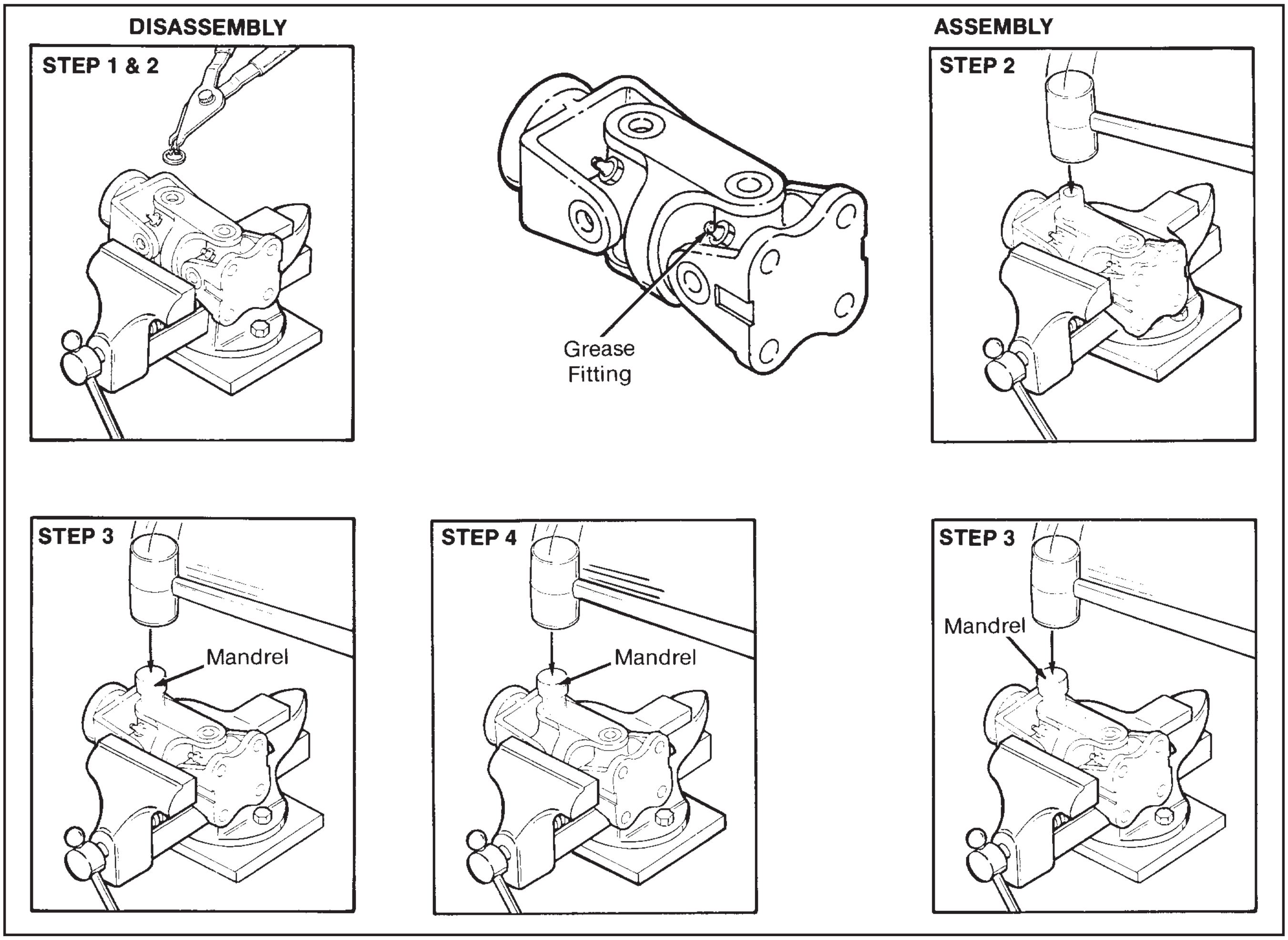


Figure 4C-1. Drive Shaft

SECTION 4D. AXLE DRIVE U-JOINT

GENERAL

The drive axle is driven by a telescoping universal joint type drive shaft connected directly between the hydro motor and axle.

NOTE

When removing, do not bend or damage the disc plate surface.

SERVICE

DISASSEMBLY (See Figure 4D-1)

1. Remove drive shaft assembly from tractor.
2. Position the joint in a vise as shown.
3. Remove the four snap rings.
4. With a soft face hammer, strike the top ear of the yoke. This will drive the top bushing outward 3/8".
5. Grip the loose bushing in the vise and drive the yoke off the bushing.
6. Repeat Steps 3 and 4 for the remaining bushings.

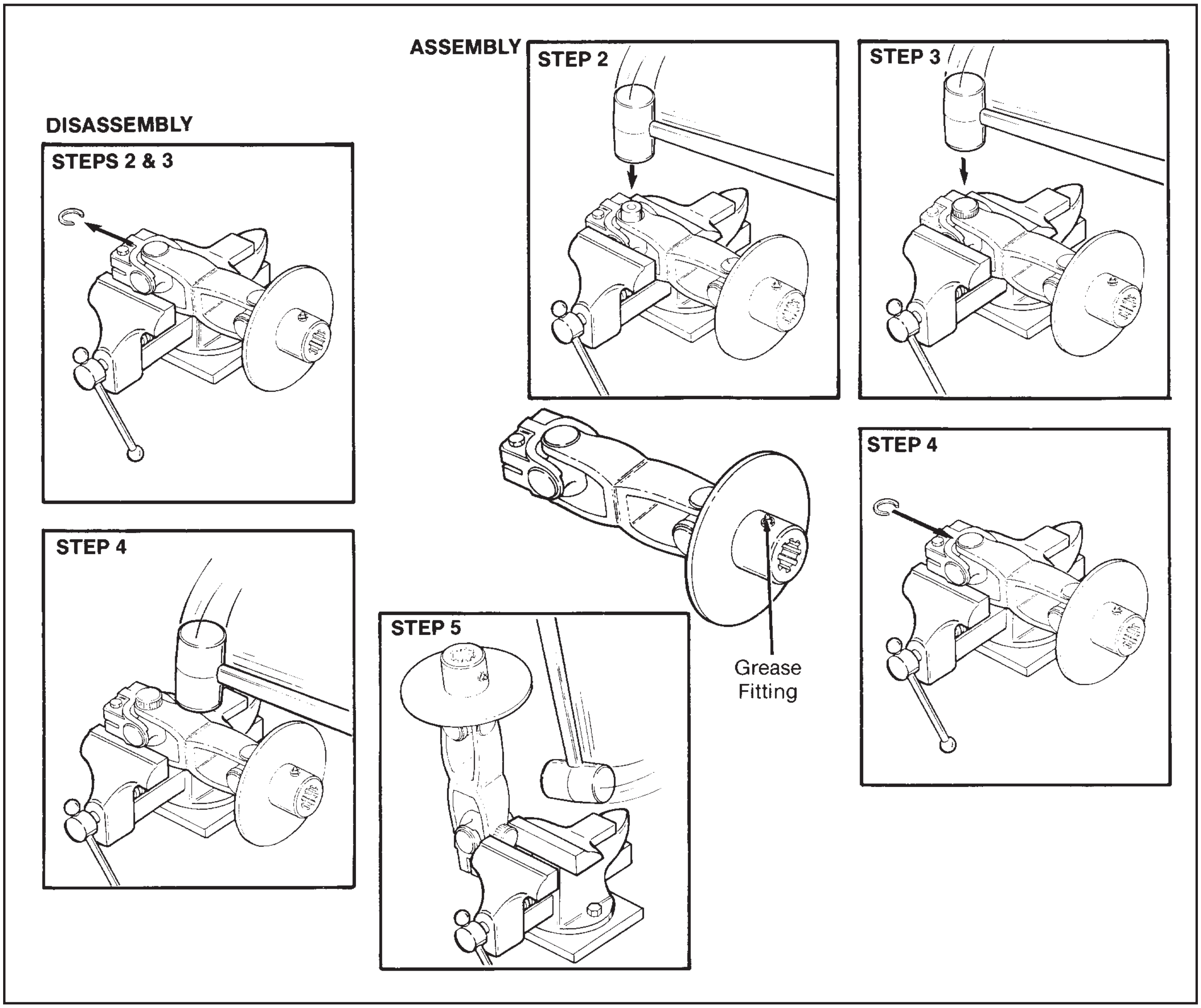


Figure 4D-1. Drive Shaft

SECTION 4D. AXLE DRIVE U-JOINT

ASSEMBLY (See Figure 4D-1)

NOTE

During reassembly be sure all the parts are clean and free of dirt.

1. Start one bushing in yoke ear and position center cross through yoke.
2. Drive the first bushing flush with outside surface of ear.

NOTE

Do not bend ear of yoke.

3. Support the ear and using a socket or mandrel the same diameter as the bushing, drive the bushing slightly past the snap ring groove.
4. Install the snap ring.
5. Repeat Steps 3 and 4 for the other bushings.
6. After assembly, ensure proper seating by striking the forged surfaces of the yoke ear one sharp blow with a soft mallet.
7. Lubricate the joint as described in Section 11.
8. Install assembly in tractor.
9. Adjust parking brake pad calipers (see Section 5C).

SECTION 4E. AXLE

GENERAL (See Figure 4E-1)

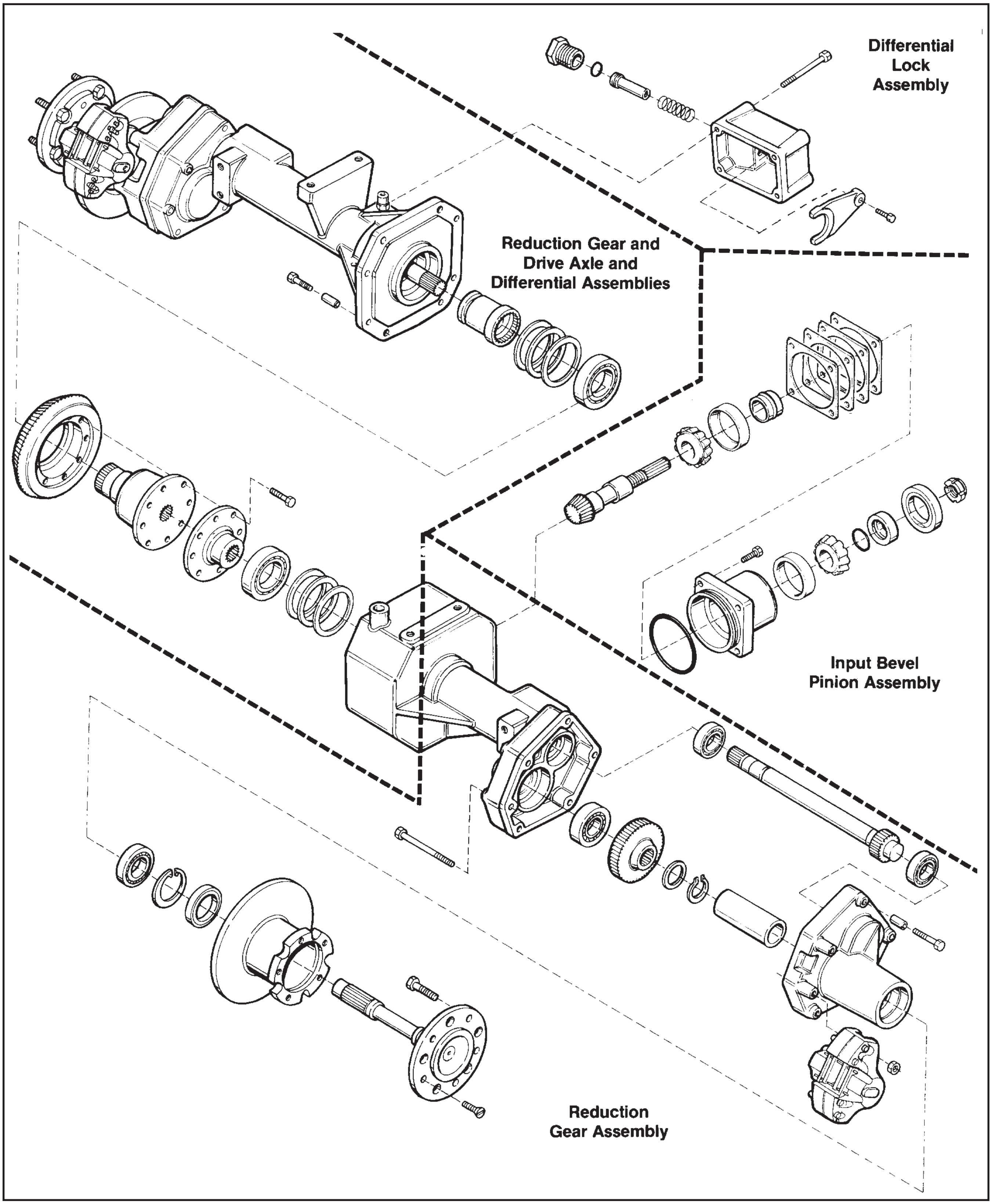


Figure 4E-1. Axle Assembly

SECTION 4E. AXLE

This section is divided into four subsections; Differential Lock Assembly, Input Bevel Pinion, Reduction Gear and Drive Axle and Differential.

For information on brake repair, refer to Sections 5D and 5E.

In most cases the entire axle assembly will not be disassembled. Refer only to the section the failure occurred.

If it becomes necessary to disassemble the entire axle, follow the steps in each subsection.

DIFFERENTIAL LOCK ASSEMBLY (See Figure 4E-2)

Repairs to the differential lock assembly is limited to renewing worn or broken parts.

To repair the sliding differential lock collar, refer to Differential, Disassembly for removal and Reassembly for installation.

INPUT BEVEL PINION

GENERAL

The input bevel pinion and ring gear are a matched set and should be replaced as a set.

Replace all O-rings with new ones.

If the input bevel pinion is to be serviced and the original pinion shaft and ring gear used, proceed with Steps 1 through 5.

If the input bevel pinion and ring gear are to be replaced, proceed as follows:

For the input bevel pinion, perform Steps 1, 2, 4 and 5, omitting Step 3.

For the ring gear, subsection Differential Disassembly, Reassembly and Pinion Gear Backlash Adjustment.

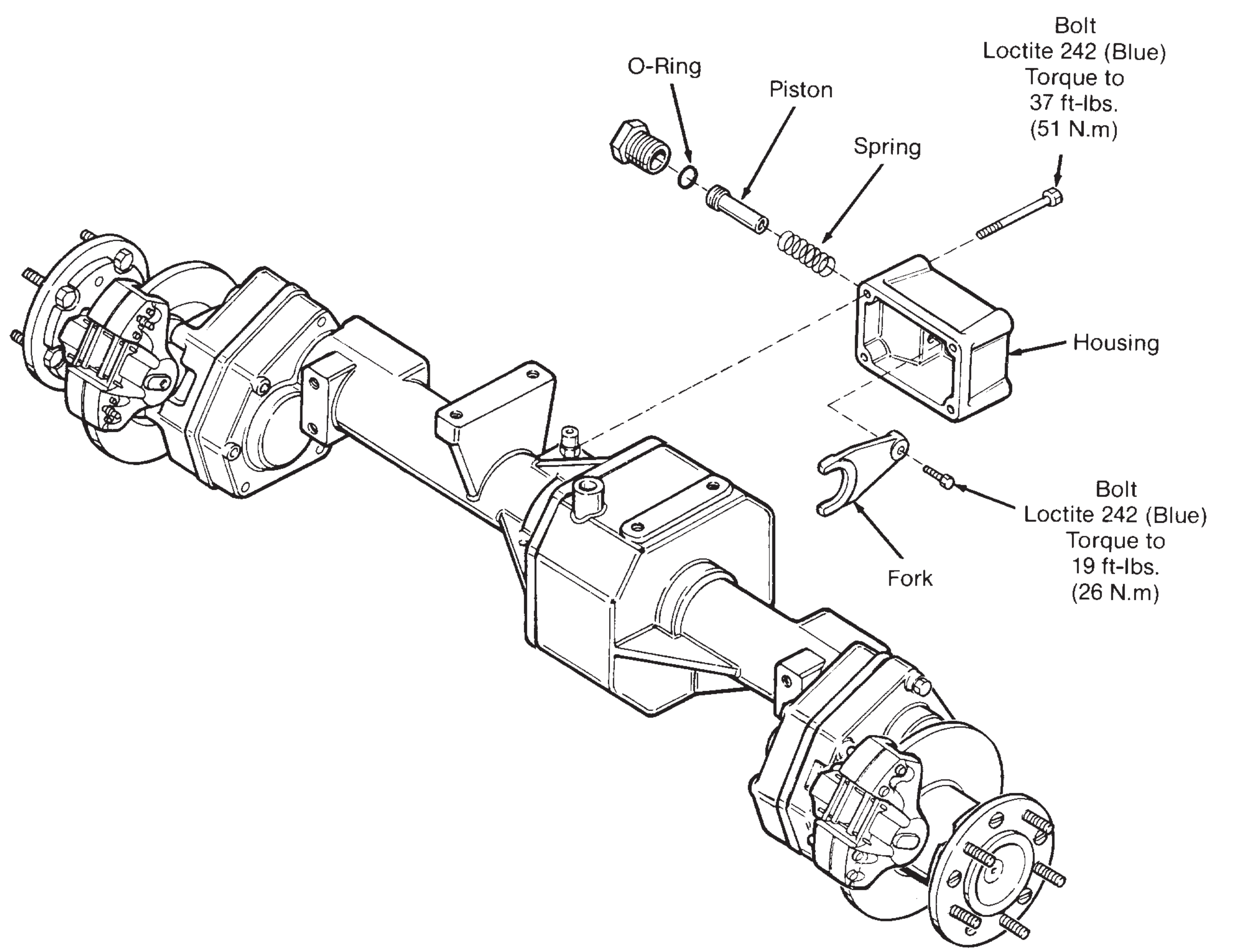


Figure 4E-2. Differential Lock Assembly

SECTION 4E. AXLE

DISASSEMBLY (See Figure 4E-3)

NOTE

Before removing the input bevel pinion assembly from the axle, complete Step 1.

1. Remove the elastic nut.

NOTE

Once the elastic stop nut is loosened a new collapsible spacer must be installed.

2. Remove input bevel pinion assembly from axle.
3. If the original pinion shaft is to be used, remove the shim pack, tag and mark it for reassembly. If the shims are damaged, replace them with shims equal to the thickness of the shims removed.
4. Support the pinion housing and bearing, press pinion shaft from bearings.
5. Remove spacer, seal, taper bearings and collapsible spacer.

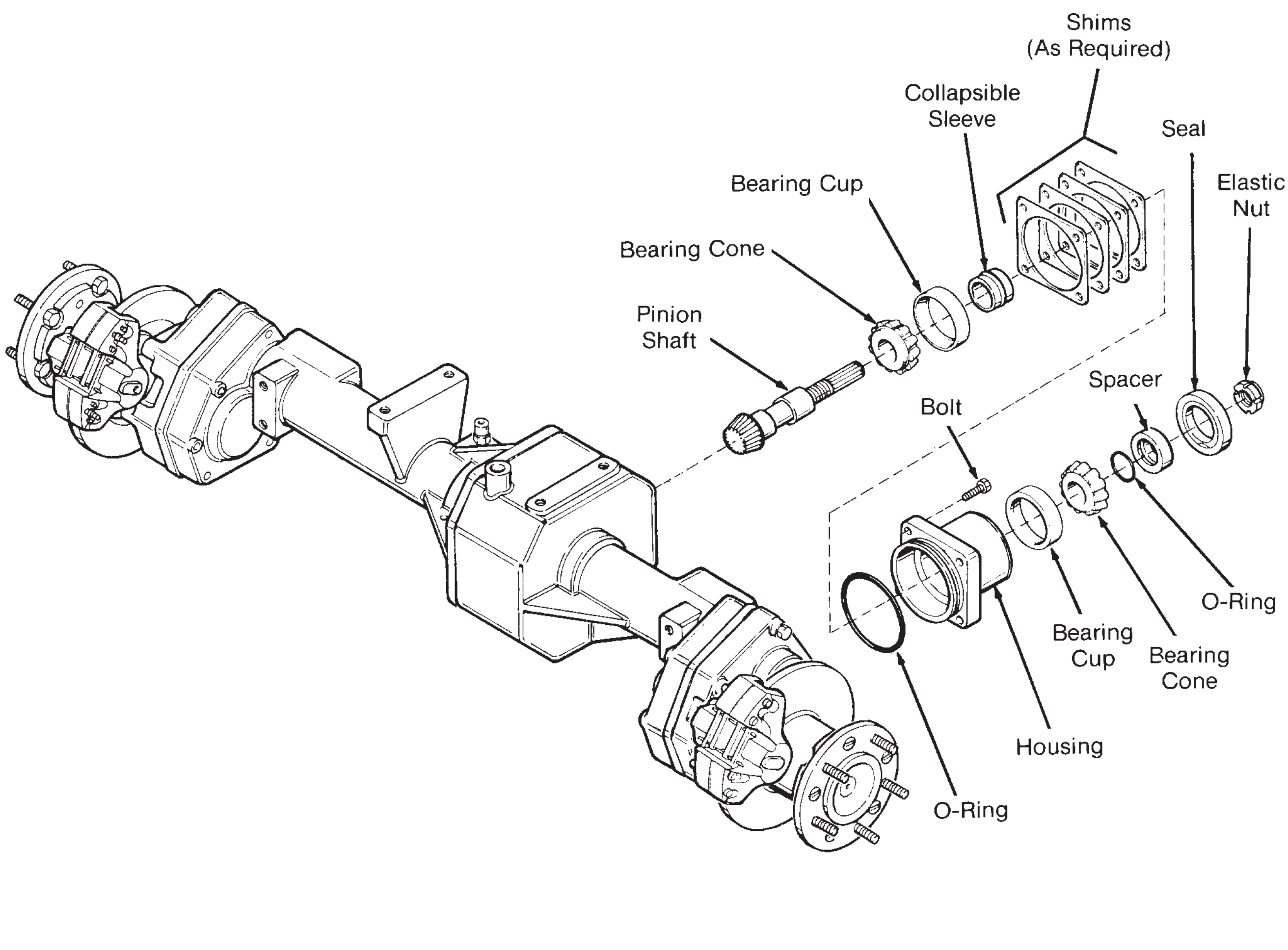


Figure 4E-3. Input Bevel Pinion Disassembly

SECTION 4E. AXLE

REASSEMBLY (See Figure 4E-4)

1. Support the inner race of the bearing cone. Press input shaft into bearing cone, taper toward the inside.
2. Press bearing cups, tapers to the outside, into housing.
3. Install input shaft and bearing into housing.
4. Install collapsible sleeve and press bearing cone against sleeve.
5. With the bearing inner race supported, press outer bearing cone into housing until it just contacts the collapsible sleeve, be careful not to collapse the sleeve.
6. Install O-ring in spacer. Install spacer, O-ring goes against bearing, on the shaft.
7. Install elastic nut, do not tighten. Proceed with Break-Away Torque Adjustment, Steps 1 and 2.

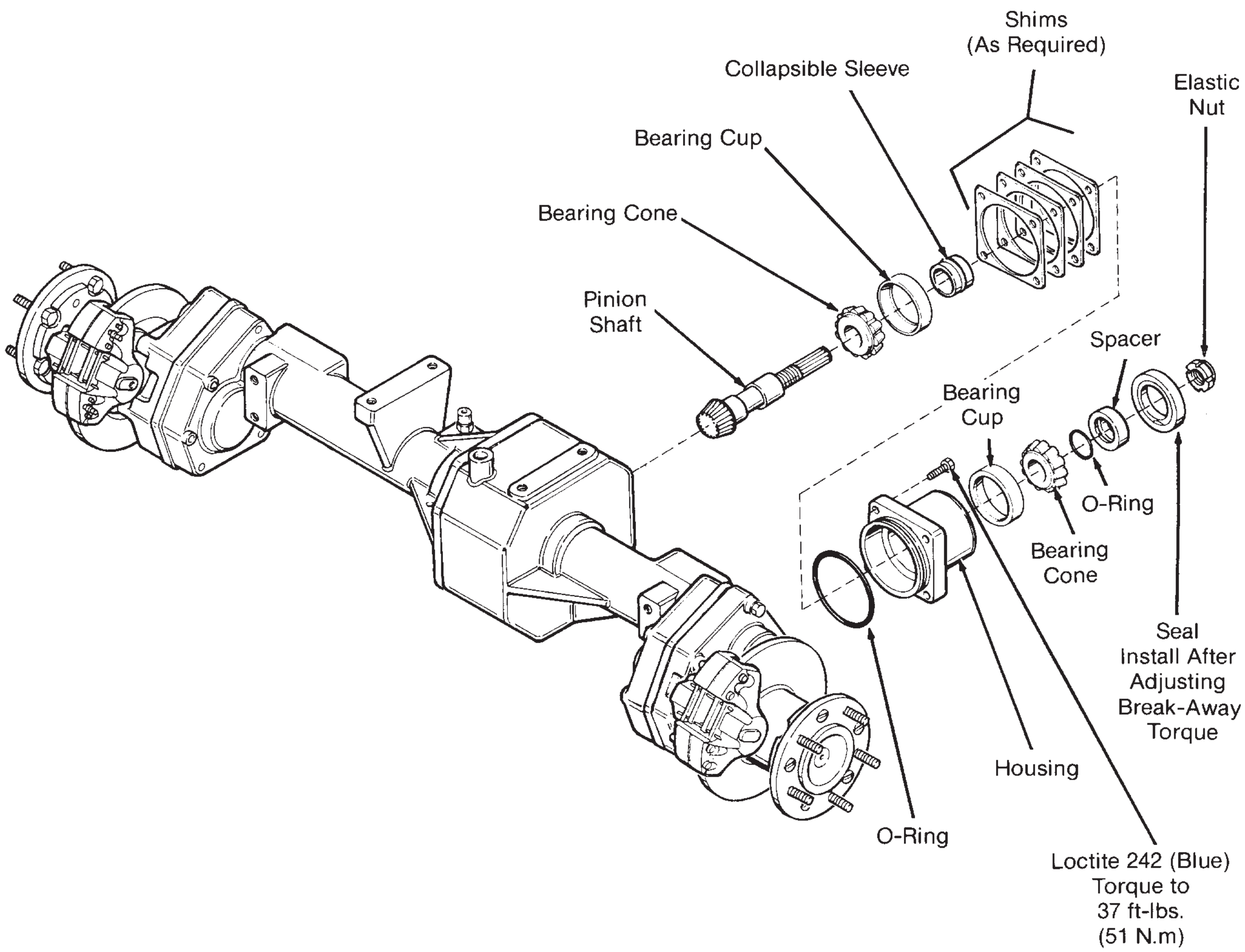


Figure 4E-4. Input Bevel Pinion Reassembly

SECTION 4E. AXLE

BREAK-AWAY TORQUE ADJUSTMENT (See Figure 4E-5)

NOTE

The following adjustment is made with no seal installed in the pinion housing.

1. Tighten the elastic nut until a break-away torque of 4.5–6.3 in-lbs. (0.5–0.7 N.m) is obtained.

NOTE

Apply a slow steady increasing pressure on the torque wrench.

2. Install the seal in the pinion housing.
3. Install O-ring and shims pack on pinion housing.

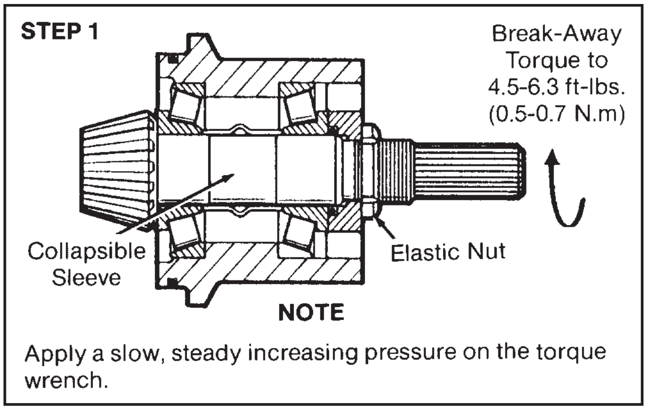


Figure 4E-5. Break-Away Torque Adjustment

REDUCTION GEAR AND DRIVE AXLE

GENERAL

Bearings in the reduction gear case are press fitted. The large gear is splined to the shaft. The axle pinion gear is part of the axle shaft.

DISASSEMBLY (See Figure 4E-6)

NOTE

Remove the drive axle only if necessary.

When removing the right axle shaft the differential collar will slide off the end.

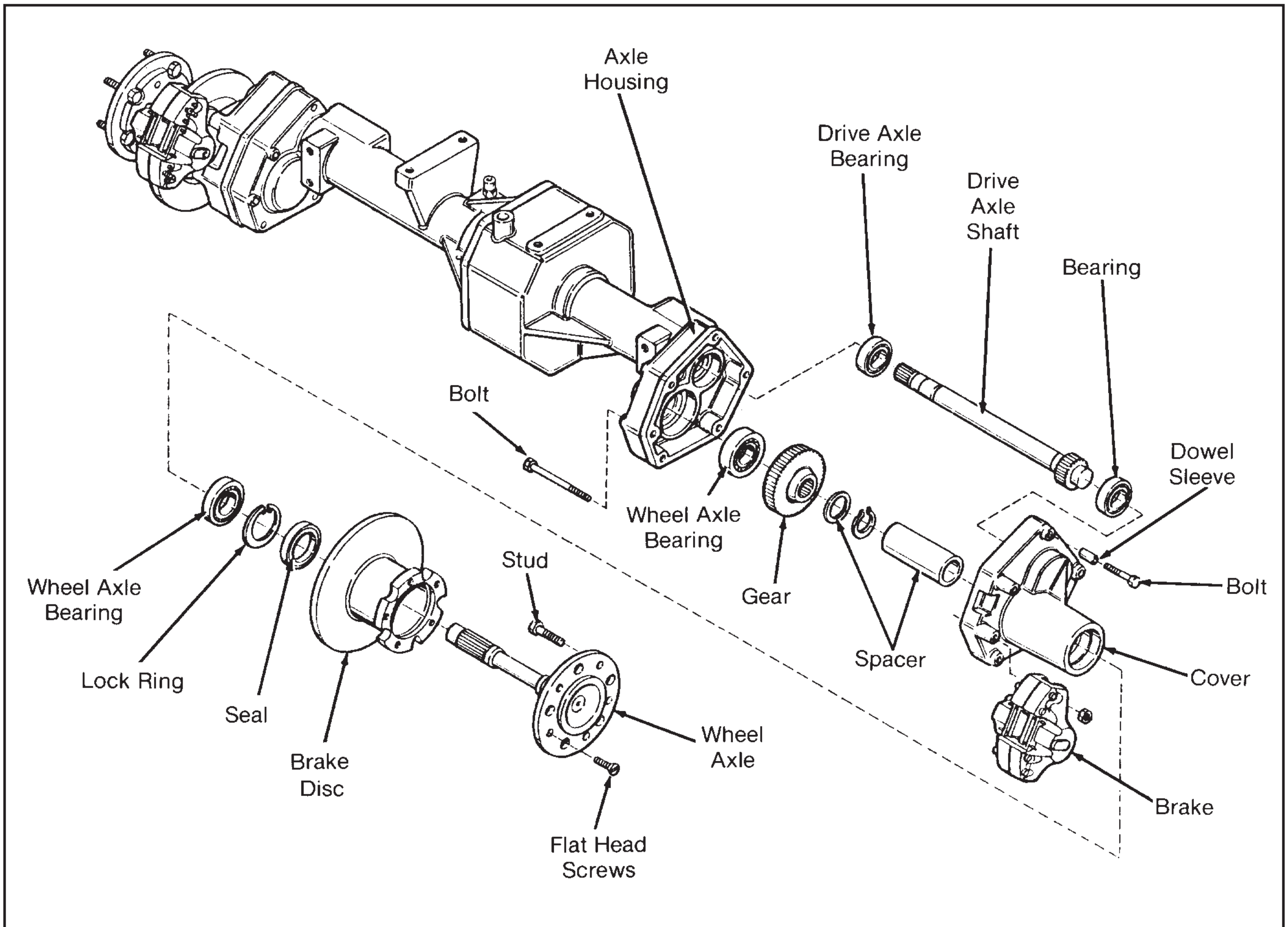


Figure 4E-6. Reduction Gear and Drive Axle Disassembly

SECTION 4E. AXLE

REASSEMBLY (See Figure 4E-7)

If the axle shaft(s) were not removed, proceed with Step 5.

1. Press wheel axle bearing into axle housing.
2. Support the inner race of the bearing and press drive axle shaft into bearing.

(Step 3 for right axle ONLY)

3. Remove the differential lock assembly housing.
4. Press drive axle with bearing into axle housing, (right axle ONLY) sliding the axle shaft through the differential lock collar.

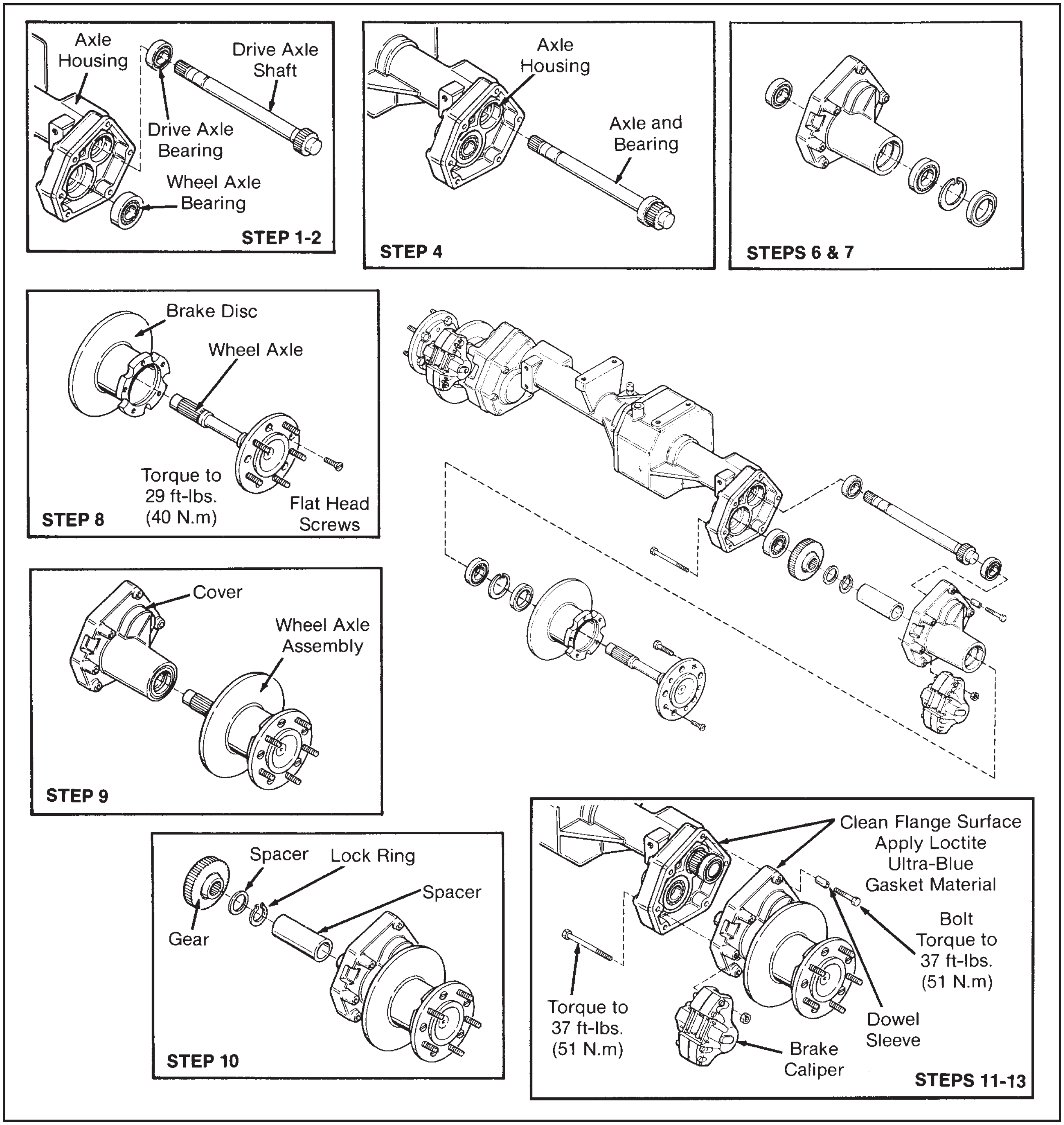


Figure 4E-7. Reduction Gear and Drive Axle Reassembly

SECTION 4E. AXLE

(Step 5 for right axle ONLY)

5. Install differential lock assembly cover.
6. Press drive axle bearing and wheel axle outer bearing into cover.
7. Install outer cover bearing, lock ring and seal into reduction gear cover.
8. Fasten wheel axle shaft to brake disc with flat head screws. Torque to 29 ft-lbs. (40 N.m).
9. Press wheel axle assembly into cover bearing.
10. Install spacer, lock ring, spacer and gear.
11. Be sure gasket flange surface is clean and dry. Apply Loctite® Ultra Blue gasket material in a thin continuous bead and around all holes.
12. Install reduction gear cover onto axle aligning dowel sleeves.
13. Position caliper brake assembly on cover. Torque cover bolts to 37 ft-lbs. (51 N.m).

DIFFERENTIAL

GENERAL

Separate the axle housing only if bearings, pinion gear, ring gear, differential lock collar, and/or differential are worn or damaged.

If the differential and/or bearings are replaced, see Pinion and Ring Gear Backlash Adjustment in this section.

Separate the axle housing only if bearings, pinion gear, ring gear, differential lock collar, and/or differential are worn or damaged.

If the differential and/or bearings are replaced, see Pinion and Ring Gear Backlash Adjustment in this section.

If the ring gear or differential lock collar are to be replaced, reinstall the original shim packs removed at disassembly.

REPAIR

Refer to Figure 4E-8 for disassembly and Figure 4E-9 for reassembly procedures. Be sure to follow all the steps and special notes.

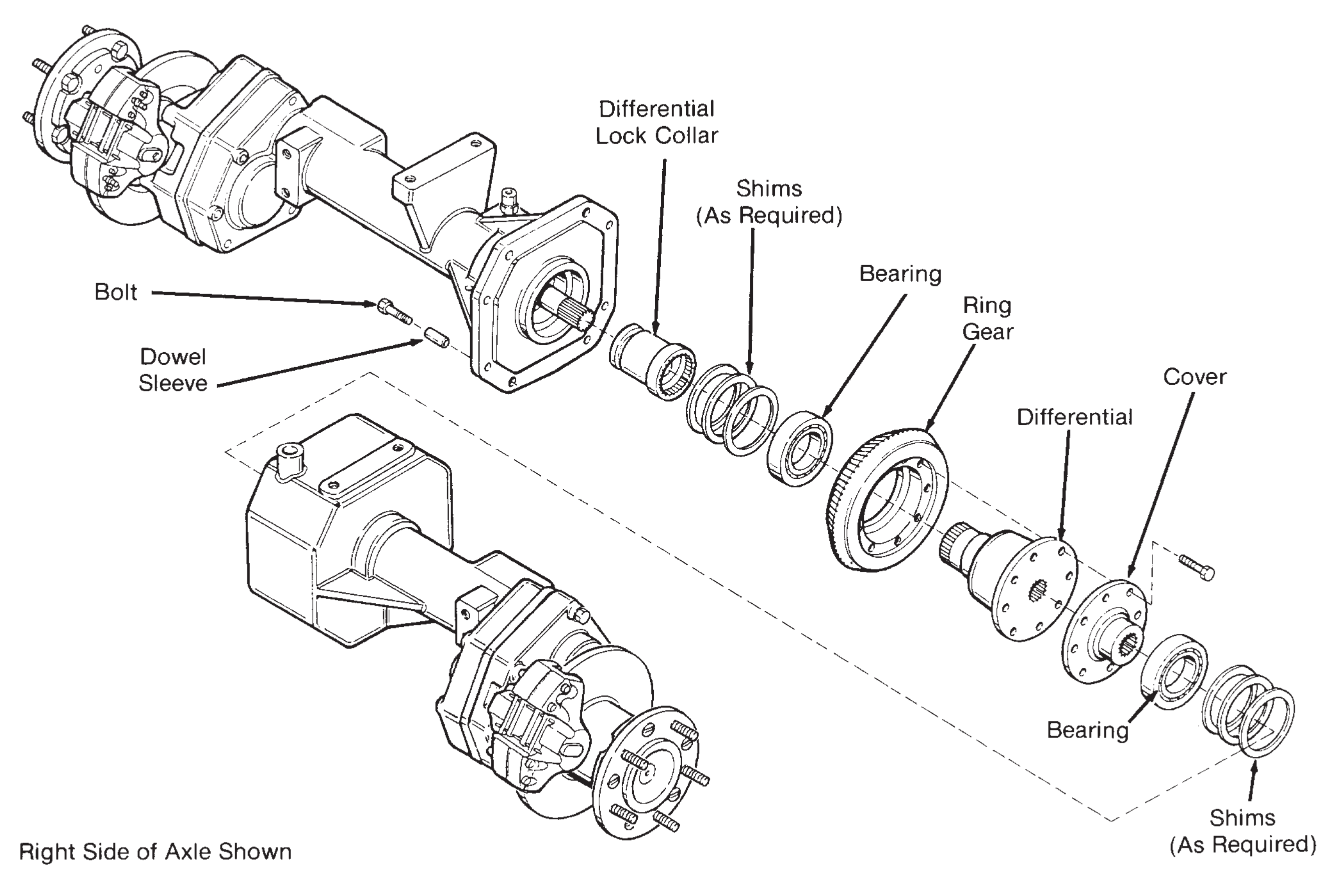


Figure 4E-8. Differential Disassembly

SECTION 4E. AXLE

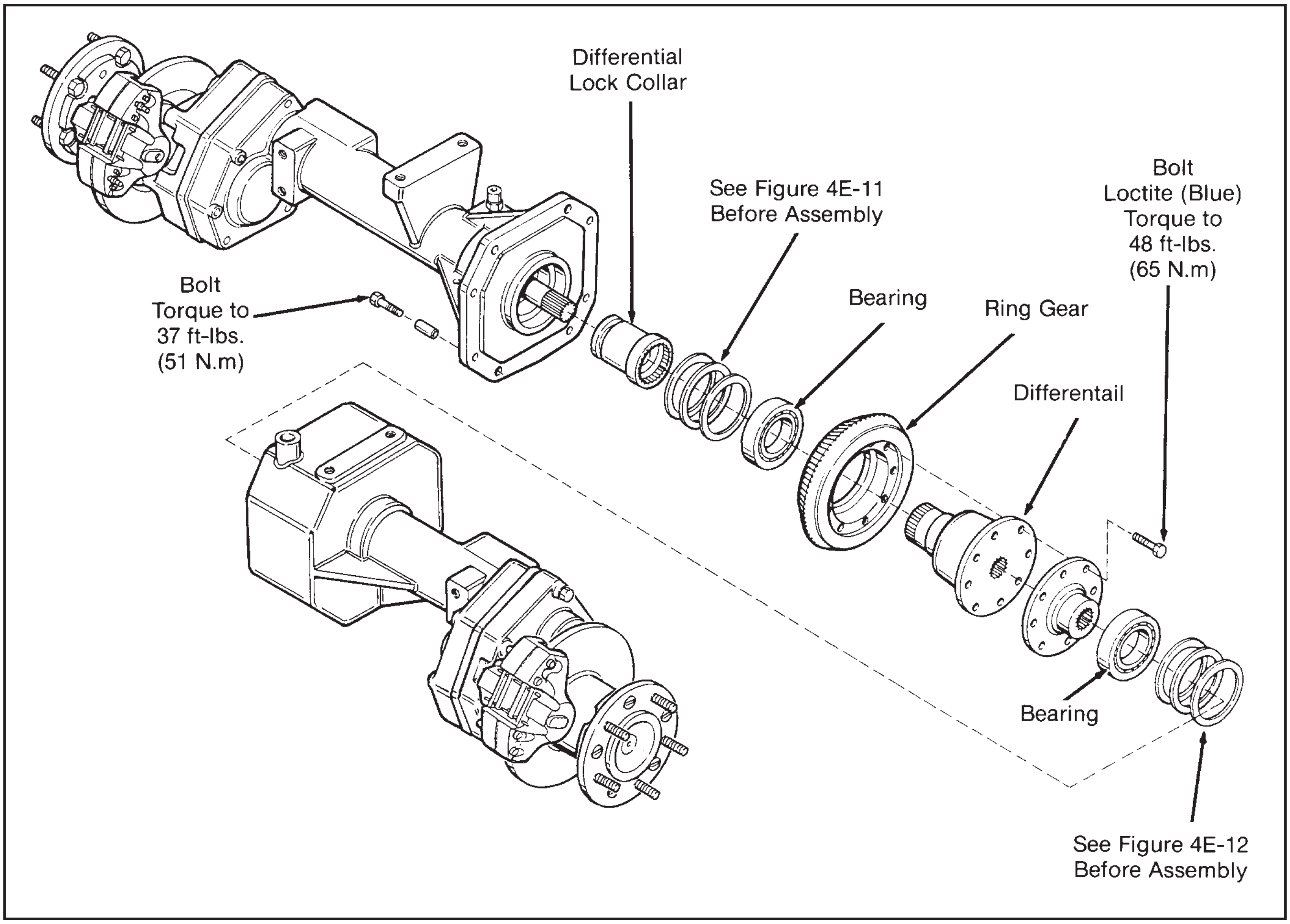


Figure 4E9. Differential Reassembly

INPUT BEVEL PINION AND RING GEAR CLEARANCE (See Figure 4E-10)

NOTE

Proceed with the following steps if a new matched input bevel pinion and ring gear are to be installed.

1. Install input bevel pinion assembly with no shims and torque it to 37 ft-lbs. (51 N.m).
2. Install special tool into bearing bore of gear case.
3. Measure the distance between the special tool and end of pinion.
4. Subtract this dimension from 0.689" (17.5 mm).
5. Build a shim pack equal to the final dimension obtained in Step 4.
6. Remove and install shim pack to the input bevel pinion housing.
7. Remove special tool and proceed with Differential, Pinion and Ring Gear Backlash Adjustment.

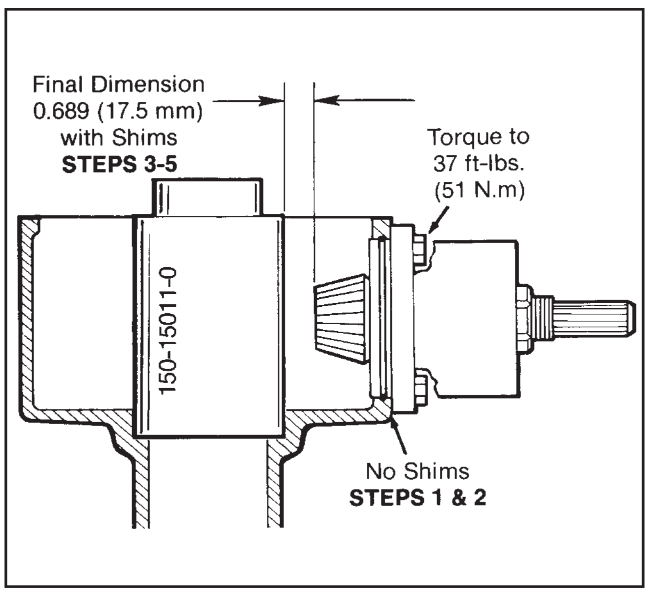


Figure 4E-10. Input Bevel Pinion and Ring Gear Clearance

SECTION 4E. AXLE

PINION AND RING GEAR BACKLASH ADJUSTMENT

General

There are two methods described to adjust backlash. Method “A” and “B” should be reviewed prior to performing the adjustment to determine which will be used.

Method “A” (See Figure 4E-11)

1. Press bearings onto the differential assembly.
2. Install the differential assembly with no shims into the gear case. Make sure bearing is seated in the bearing bore.
3. Install input bevel pinion with shim pack and torque to 37 ft-lbs. (51 N.m).
4. Using a dial indicator against a pinion tooth, check the gear backlash.
5. Subtract backlash of 0.008" (0.2 mm) from the measurement obtained. Build a shim pack equal to the final dimension.
6. Remove the differential assembly, place the shim pack in the bearing bore of the gear case.

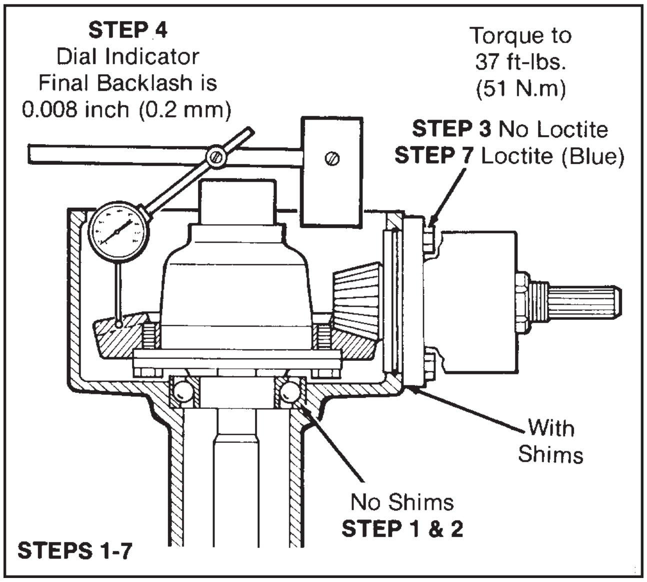


Figure 4E-11. Pinion and Ring Gear Backlash Adjustment

(See Figure 4E-12)

7. Install differential and input bevel pinion. Apply Loctite® 242 (Blue) to the pinion housing bolts and torque them to 37 ft-lbs. (51 N.m).
8. Measure the distance from the side of the differential bearing to the gear case flange surface.
9. In the axle housing, measure the distance from the flange to the bottom of the bearing seat.

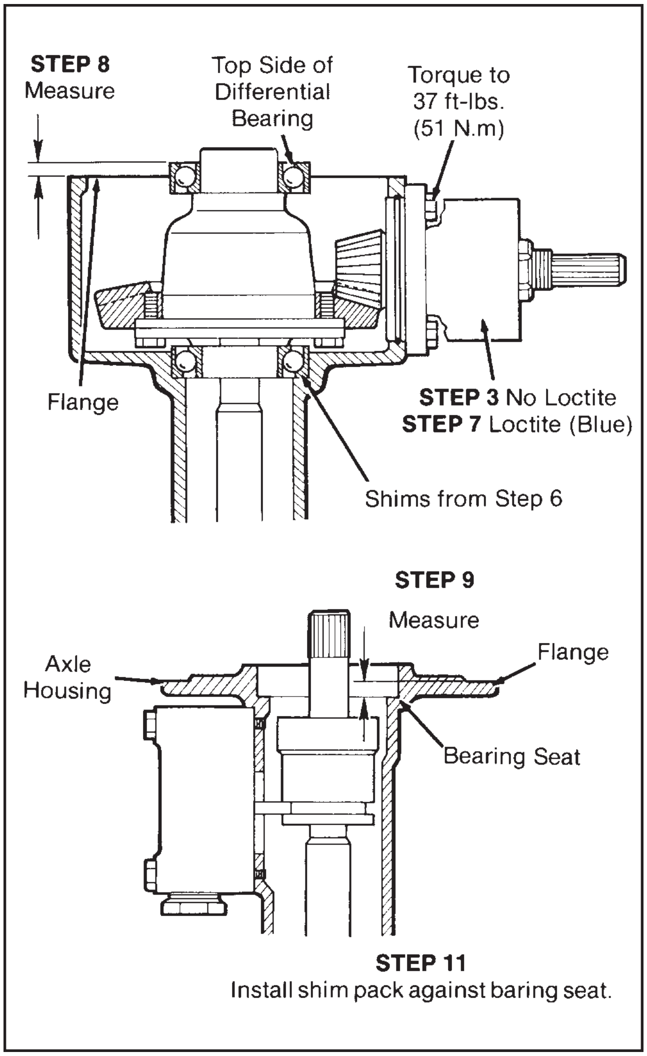


Figure 4E-12. Pinion and Ring Gear Backlash Adjustment

10. Subtract the two measurements. From the answer add 0.004" (0.1 mm). This is the thickness of the shim pack.
11. Build a shim pack equal to the thickness obtained in Step 10 and install it against the bearing seat of the axle housing.
12. Continue to assemble axle as in Figure 4E-9.

Method “B” (See Figure 4E-11)

1. Press bearings onto the differential assembly.
2. Install the differential assembly with no shims into the gear case. Make sure bearing is seated in the bearing bore.
3. Install input bevel pinion with shim pack and torque to 37 ft-lbs. (51 N.m).

SECTION 4E. AXLE

4. Using a dial indicator against a pinion tooth, check the gear backlash.
5. Subtract backlash of 0.008" (0.2 mm) from the measurement obtained. Build a shim pack equal to the final dimension.
6. Remove the differential assembly, place the shim pack in the bearing bore of the gear case.
7. Install differential and input bevel pinion. Apply Loctite® 242 (Blue) to the pinion housing bolts and torque them to 37 ft-lbs. (51 N.m).

(See Figure 4E-13)

8. Build a shim pack equal to 0.030" (0.76 mm) and install it in the bearing bore of the right axle.
9. Assemble both axle halves together.
10. Snug the bolts evenly, do not tighten.
11. Using a feeler gauge, measure the gap between the two axle halves.
12. To this dimension subtract 0.004" (0.1 mm), then subtract the total from the 0.030" (0.76 mm). This is the thickness of the shim pack needed.
13. Separate the axle housing halves.
14. Replace the 0.030" (0.76 mm) shim pack with the correct shim pack.
15. Continue to assemble axle as in Figure 4E-9.

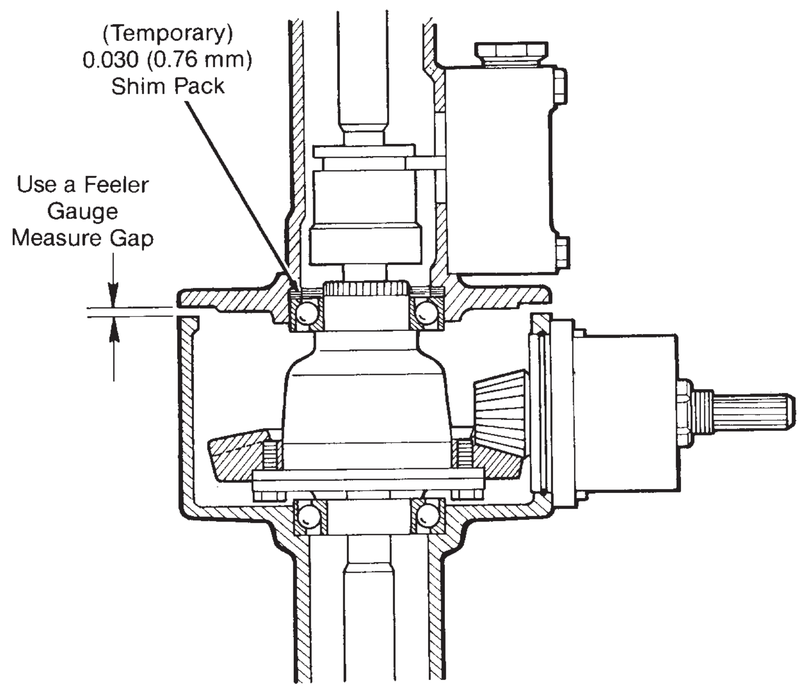


Figure 4E-13. Pinion and Ring Gear Backlash Adjustment (Optional Method)

SECTION 5
BRAKE SYSTEM

SECTION 5A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools. Metric tools.
Cleaning materials:	Stoddard solvent or equivalent.
Lubricants:	Refer to Section 11.
Other service items:	Brake repair parts. Brake linings.

SECTION 5B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Parking brake does not hold tractor in position.	a. Brake is not adjusted. b. Worn brake linings. c. Broken or worn cable.	a. Adjust brake (Section 2C). b. Replace lining (Section 5C). c. Replace (Section 5C).
2. Service brake does not hold tractor in position.	a. Low fluid level. b. Leaking master cylinder. c. Worn brake linings.	a. Check (Section 11). b. Repair (Section 5E). c. Replace (Section 5D).
3. Service brake pedal fades when pushed.	a. Worn brake pads. b. Brake line leaks. c. Air in line.	a. Replace (Section 5D). b. Repair. c. Bleed.
4. Service brake does not release.	a. Binding pedal. b. Faulty master cylinder.	a. Free and lubricate. b. Repair (Section 5E).
5. Service brakes leak fluid externally.	a. Faulty seals.	a. Reseal (Section 5D).
6. Service brakes squeal.	a. Glazed pads.	a. Deglaze.
7. Parking brake does not release completely.	a. Brake misadjusted. b. Binding in brake linkage. c. Broken return spring. d. Binding in brake cable.	a. Adjust (Section 2C). b. Clean and lubricate (Section 11). c. Repair (Section 5C). d. Repair (Section 5C).

SECTION 5C. PARKING BRAKE

REPAIR

Repairs to the parking brake are limited to changing worn brake linings and renewing worn or damaged parts. Refer to Figure 5C-1.

ADJUSTMENT (See Figure 5C-2)

1. Place brake lever in the disengaged position and turn knob in a clockwise direction, apply and release brake lever every quarter turn until a definite “snap over center” action is achieved.
2. Over adjustment causes “hard” lever action, but does not increase brake efficiency. Turn knob counterclockwise until a smooth but firm action is obtained.

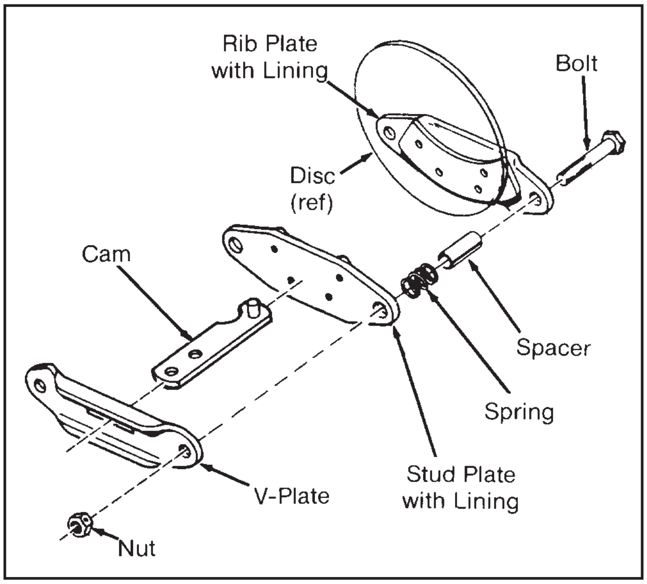


Figure 5C-1. Parking Brake

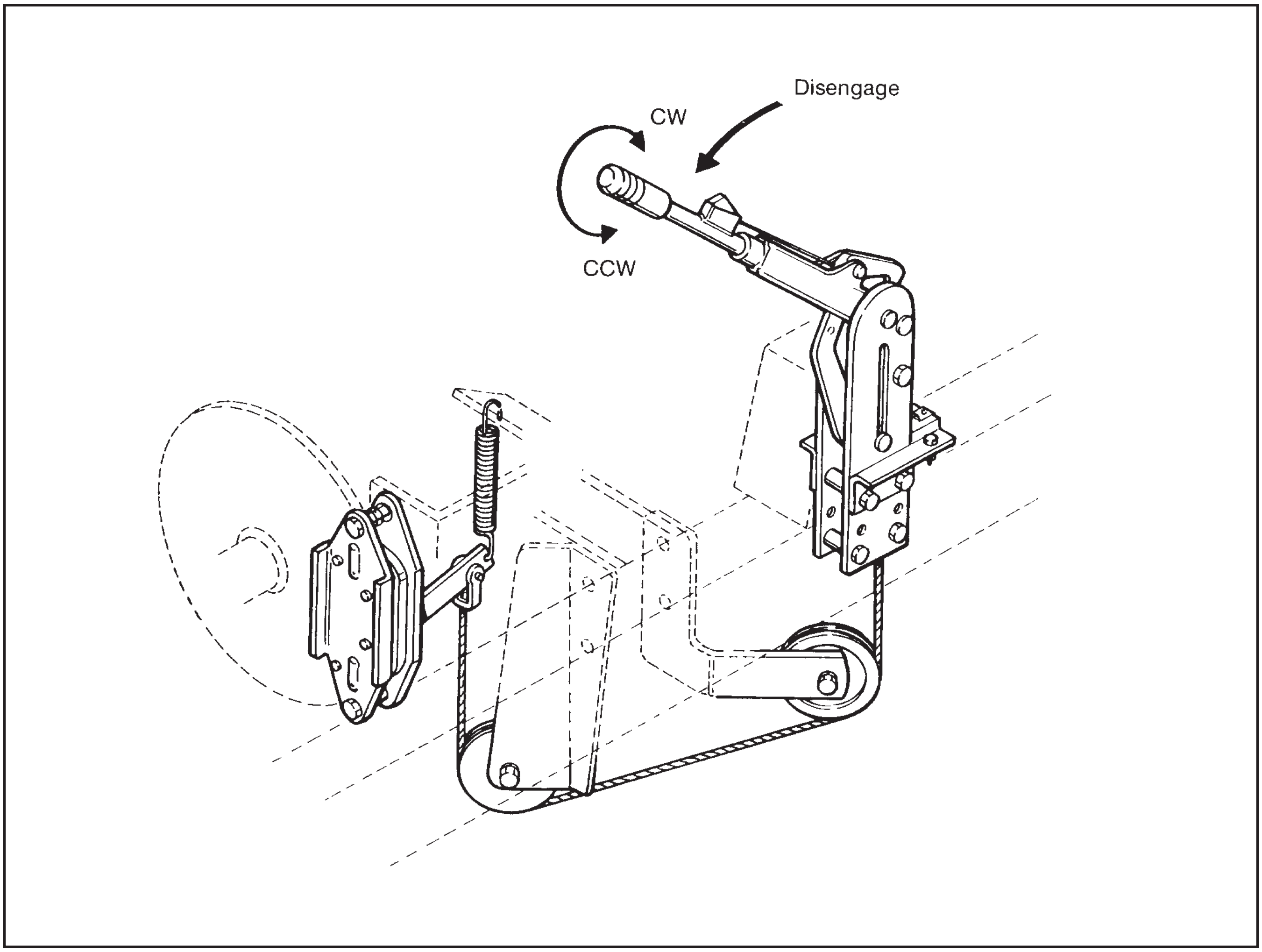


Figure 5C-2. Parking Brake Adjustment

SECTION 5D. SERVICE BRAKE

REPAIR

Repair of the service brake calipers is shown in Figure 5D-1. To service the calipers, a repair kit can be ordered from your local Jacobsen distributor. Refer to the parts catalog for the kit part number.

BLEEDING SYSTEM (See Figure 5D-2)

1. Fill master cylinder with approved brake fluid (see Section 11).
2. At the brake calipers, open both bleed screws.
3. Slowly push the brake pedal several times until all the air has been bled from the brake lines.

NOTE

At the end of each pedal downward stroke, close the bleed screws, then open for the next stroke.

4. Check the brake fluid level often during bleeding.
5. Repeat Steps 2 through 4 at the opposite brake caliper.

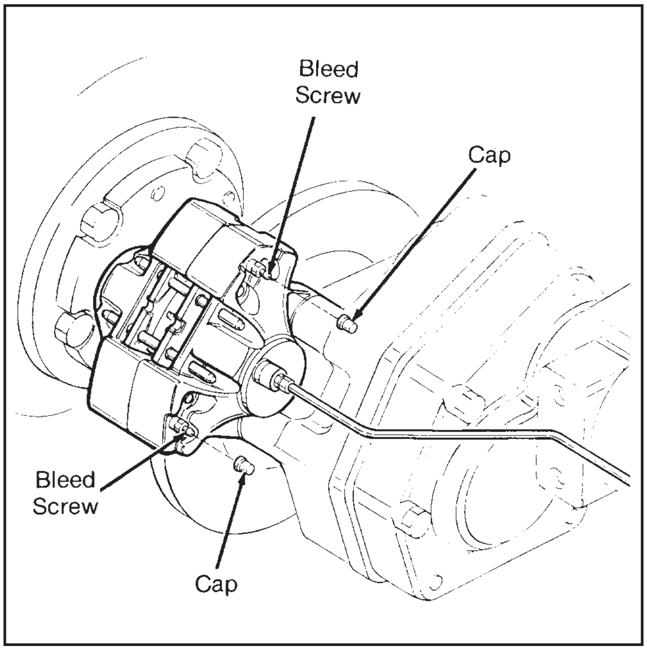


Figure 5D-2. Bleeding Brake System

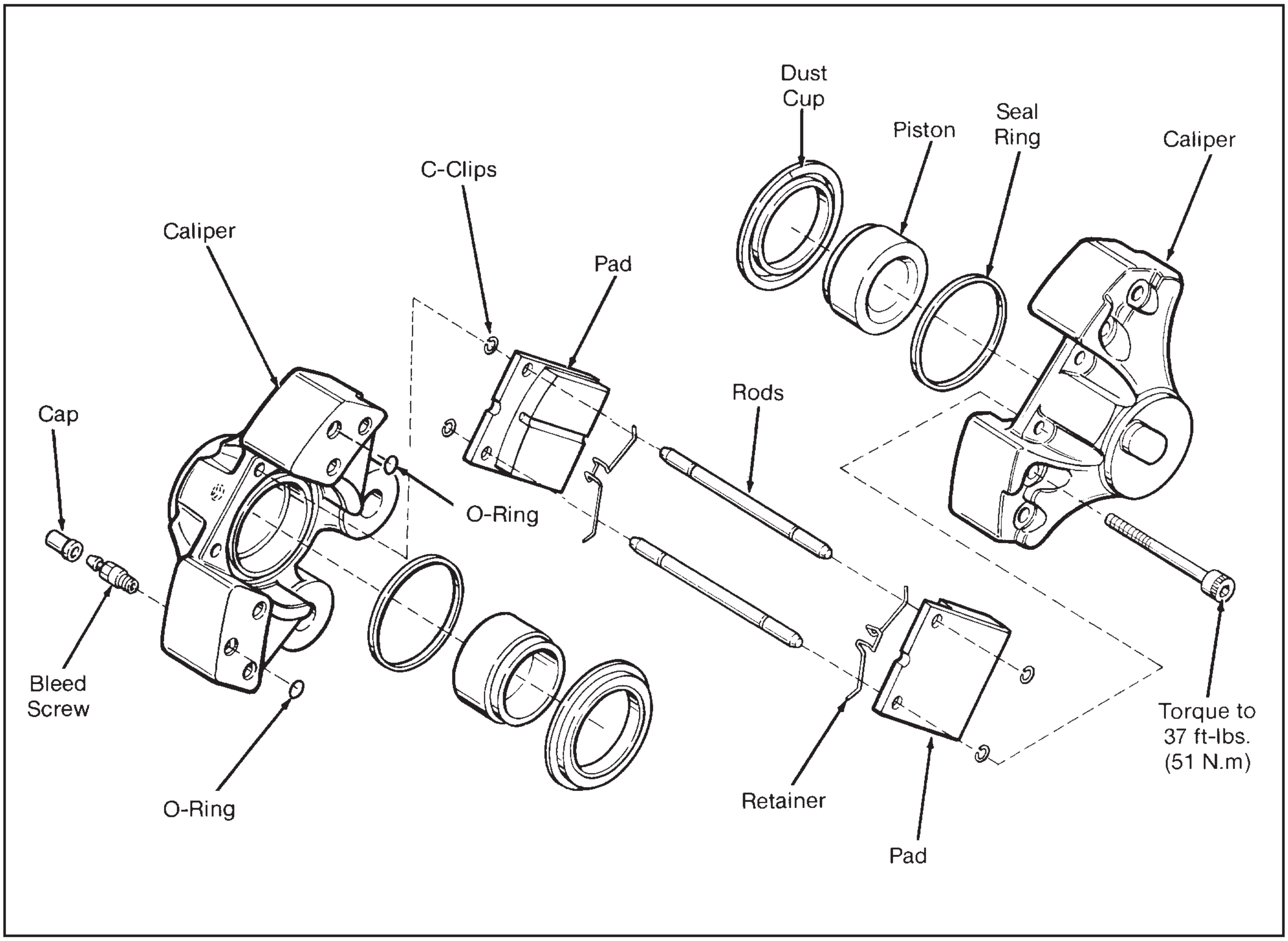


Figure 5D-1. Service Brake Caliper

SECTION 5E. MASTER CYLINDER

REPAIR

Repair of the master cylinder is shown in Figure 5E-1. To service the master cylinders, a repair kit can be ordered from your local Jacobsen distributor. Refer to the parts catalog for the kit part number.

BLEEDING SYSTEM (See Figure 5E-2)

1. Fill master cylinder with approved brake fluid (see Section 11).
2. At the brake calipers, open both bleed screws.
3. Slowly push the brake pedal several times until all the air has been bled from the brake lines.

NOTE

At the end of each pedal downward stroke, close the bleed screws, then open for the next stroke.

4. Check the brake fluid level often during bleeding.
5. Repeat Steps 2 through 4 at the opposite brake caliper.

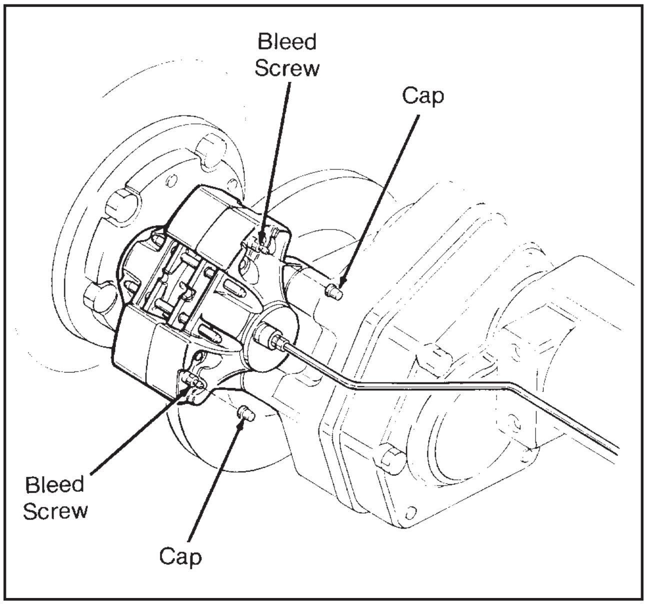


Figure 5E-2. Bleeding Brake System

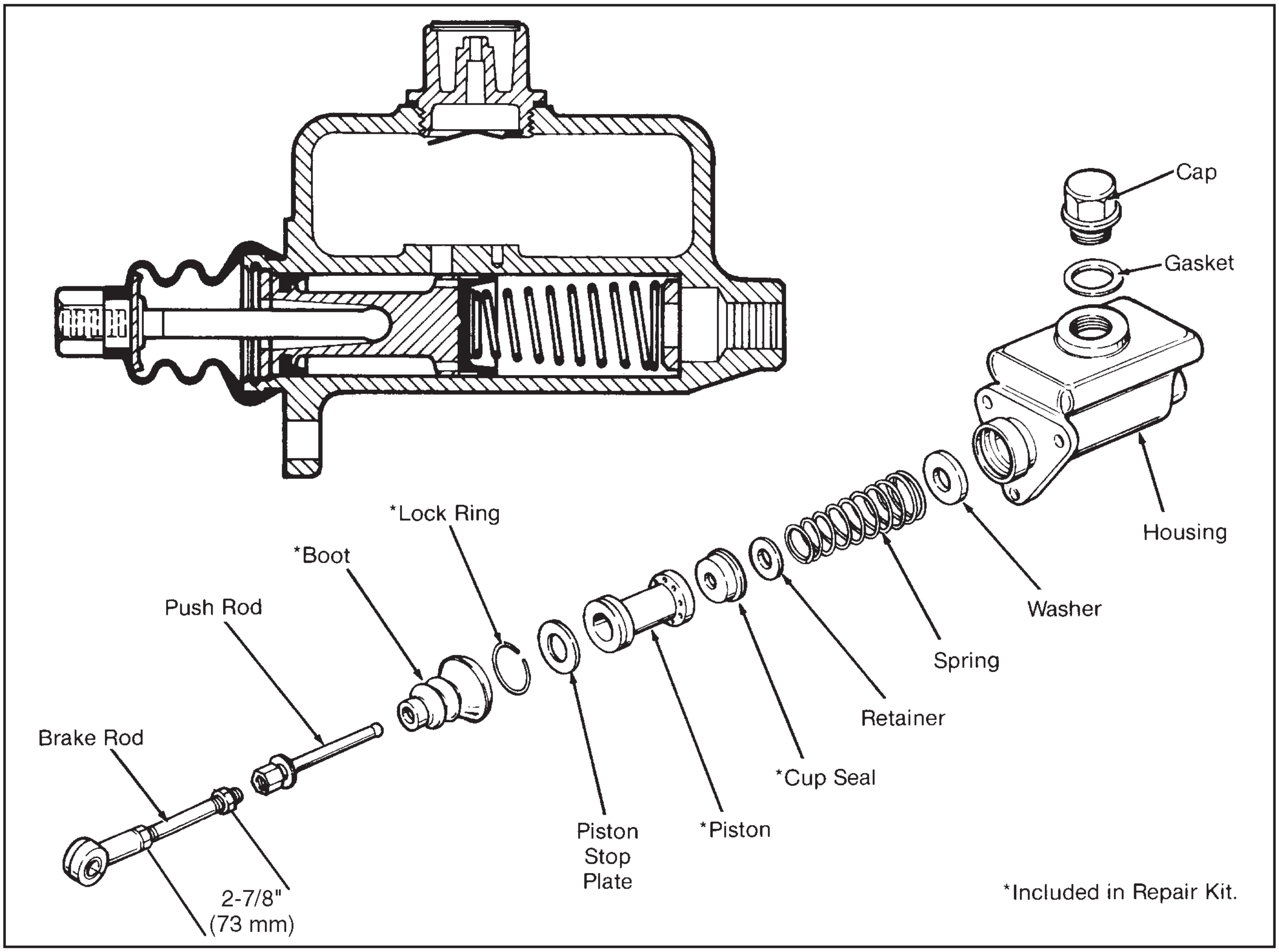


Figure 5E-1. Master Cylinder

SECTION 6
STEERING

SECTION 6A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required: Standard automotive hand tools.
6 mm hexagon socket wrench.
8 mm hexagon socket wrench.

Cleaning materials: Stoddard solvent or equivalent.

Other service items: O-ring and kin ring tool SJ 150-9000-11.
Cardan shaft tool SJ 150-9000-3.

Above tool can be purchased from:

Danfoss, Inc.
1696 Northrock Court
Rockford, IL 61103
(815) 654-0005

SECTION 6B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. No turning of steering wheel.	a. Insufficient oil supply.	a. Check oil supply.
	b. Insufficient oil pressure or no oil pressure.	b. Check (Section 8R).
	c. Steering relief valve sticking open or valve set too low.	c. Repair, clean and reset the relief valve (Sections 6C and 8R).
	d. Mechanical parts binding.	d. Grease/repair if required.
	e. Tire pressure too low.	e. Check (Sections 7 and/or 11).
2. Steering wanders.	a. Tire pressure incorrect.	a. Properly inflate tires (Section 7C).
	b. Loose or worn steering cylinder.	b. Tighten or repair (Section 6F).
	c. Steering cylinder internal leakage.	c. Repair (Section 6F).
	d. Steer wheels out of adjustment.	d. Adjust (Section 6D).
	e. Improper toe-in adjustment.	e. Adjust toe-in (Section 6D).
	f. Steering unit leaf springs broken or weak.	f. Replace (Section 6C).
3. Impossible to make the steering go to neutral position.	a. Leaf springs.	a. Replace leaf springs (Section 6C).
4. Backlash.	a. Splines of cardan shaft worn or broken.	a. Cardan shaft to be replaced (Section 6C).
	b. Leaf springs.	b. Replace worn spring (Section 6C).
5. Shimmy.	a. Tire mounting nuts loose.	a. Tighten (Section 7C).
	b. Loose or worn steering linkage.	b. Tighten or replace (Section 6F).
	c. Steer wheels out of adjustment.	c. Adjust (Section 6D).
	d. Air accumulator in steering cylinder.	d. Bleed the cylinder.
	e. Leaky dual shock valves and suction valves or broken springs.	e. Repair or replace (Section 6C).
6. Lost motion at steering wheel.	a. Steering wheel loose.	a. Tighten (Section 6C).
	b. No oil in the tank.	b. Change with clean oil and bleed the system.
	c. Loosen or worn steering linkage.	c. Tighten or repair (Section 6F).
	d. Steering cylinder internal leakage.	d. Repair (Section 6F).
	e. Steering unit internal leakage.	e. Repair (Section 6C).
	f. Excessive heat. Hot oil.	f. Check oil cooler and clean if necessary.
7. Hard impacts in steering wheel in both directions.	a. Incorrect setting of cardan shaft and gear wheel set.	a. Setting to be adjusted (Section 6C).

SECTION 6C. STEERING UNIT

GENERAL

The power steering unit is supplied with oil from the pump, Section 3. Power steering is provided as long as the engine is running. If an engine failure occurs, the steering unit provides manual steering.

REMOVAL (See Figure 6C-1)

1. Remove steering wheel cap (1), nut (2), flat washer (3) and steering wheel (4).

NOTE

Insert (5) should come off with steering wheel.

2. Remove steering unit cover (6).
3. Label and remove hydraulic lines from steering unit.
4. Remove steering unit attaching hardware and steering unit.

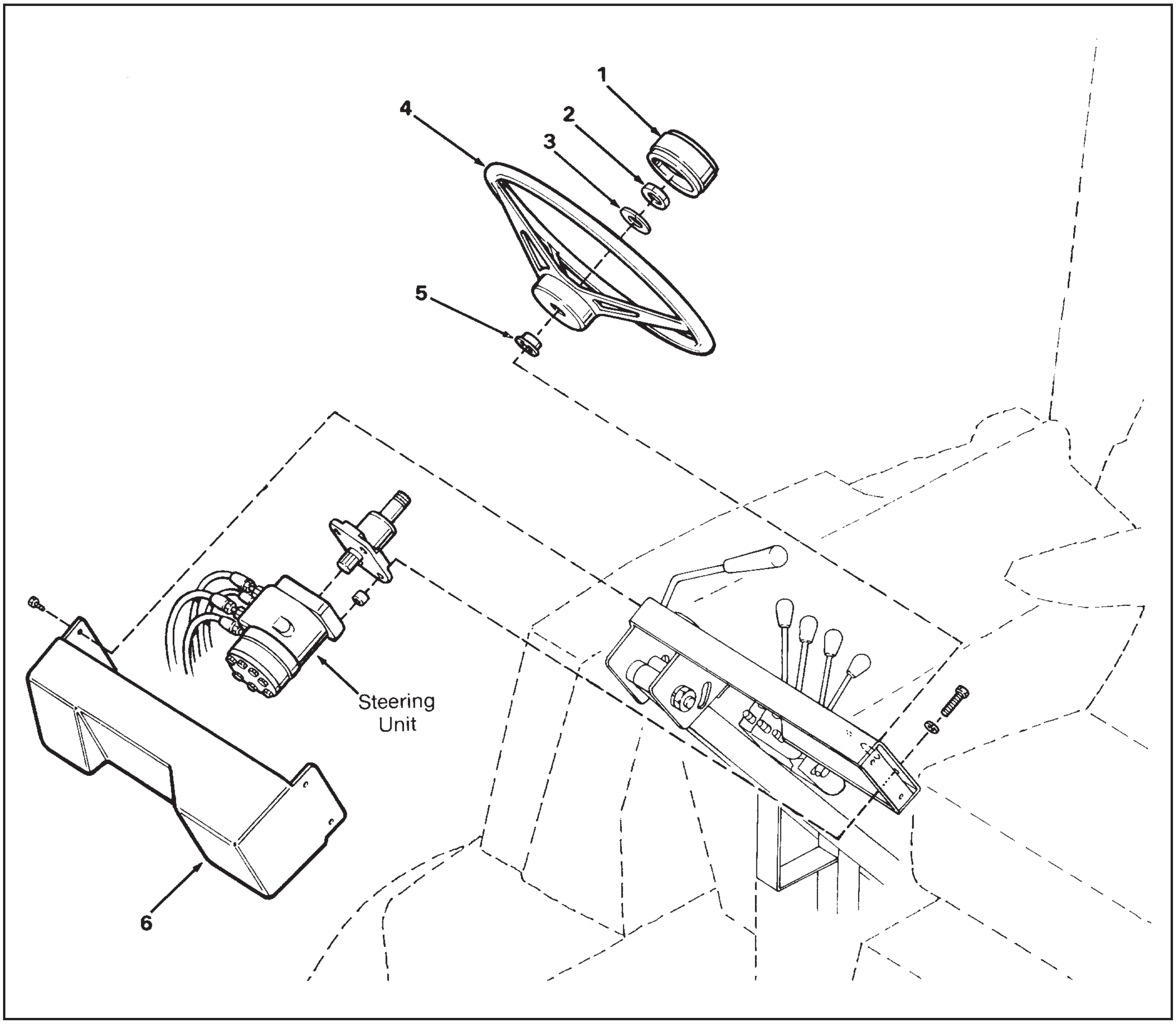


Figure 6C-1. Steering Unit Removal and Installation

SECTION 6C. STEERING UNIT

DISASSEMBLY
(See Figures 6C-2 through 6C-6)

NOTE

Before disassembly, scribe a line from top to bottom of steering unit housing. This line can be used to determine proper orientation of sections for assembly (see Figure 6C-13).

1. Securely place the power steering fixture in a vise.
2. Remove end cover screws (1) and washers (2).

NOTE

There are seven screws, one is a special screw — note its position.

3. Slide cover (3) sideways from gear wheel set (4).
4. Lift gear wheel set (4) off housing.
5. Remove cardan shaft (9) and distributor plate (7).
6. Remove O-rings (5, 6 and 8).

(See Figure 6C-3)

7. Remove threaded bushing (10).

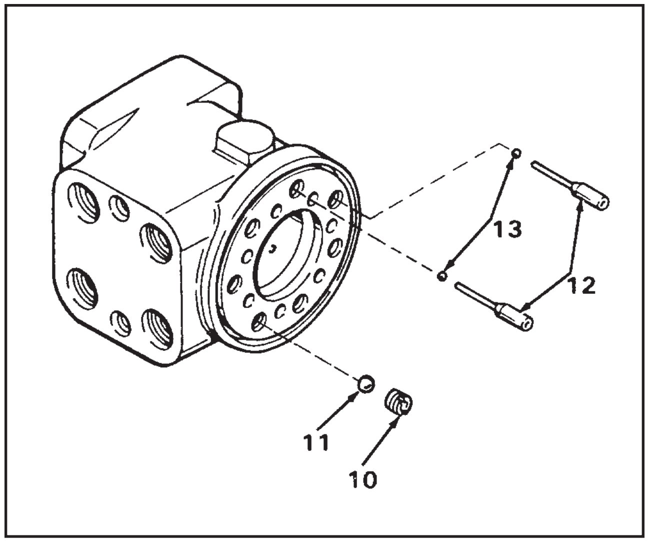


Figure 6C-3.

8. To remove check ball (11), two suction valve pins (12) and two 13/16" check valve balls (13), turn steering unit over.

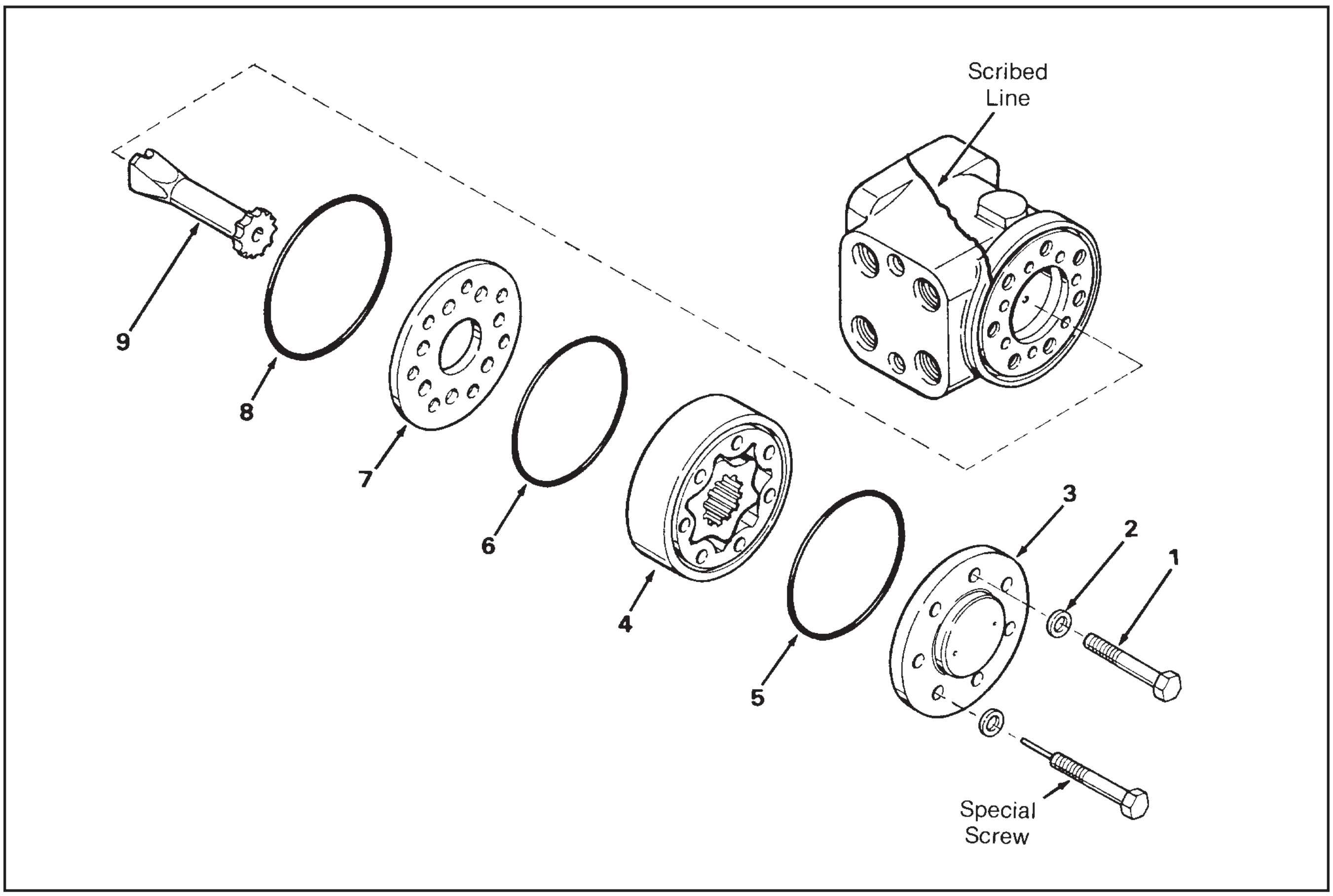


Figure 6C-2.

SECTION 6C. STEERING UNIT

(See Figure 6C-4)

9. Place steering unit on its side. Keeping cross pin horizontal, carefully push sleeve (14) from steering unit housing.

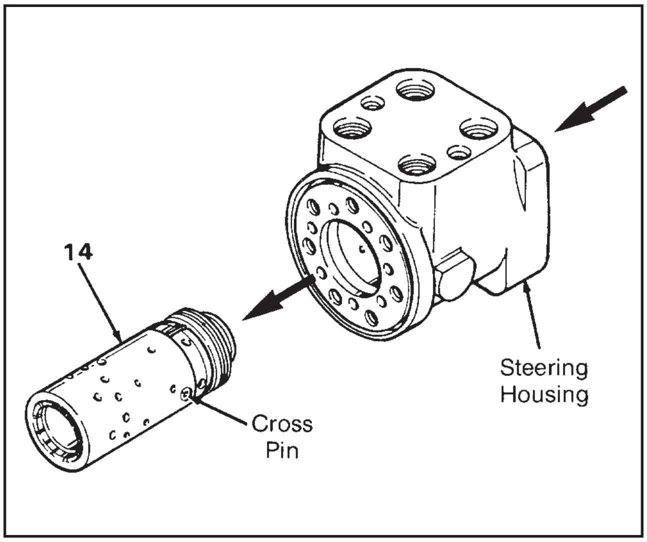


Figure 6C-4.

(See Figure 6C-5)

10. Remove O-ring (22), kin ring (21), thrust bearing and washers (20), ring (19) and dust ring (23).
11. Push cross pin (15) out of sleeve (16).
12. Carefully push spool (17) from sleeve (16).
13. Push neutral positioning springs from spool (17).

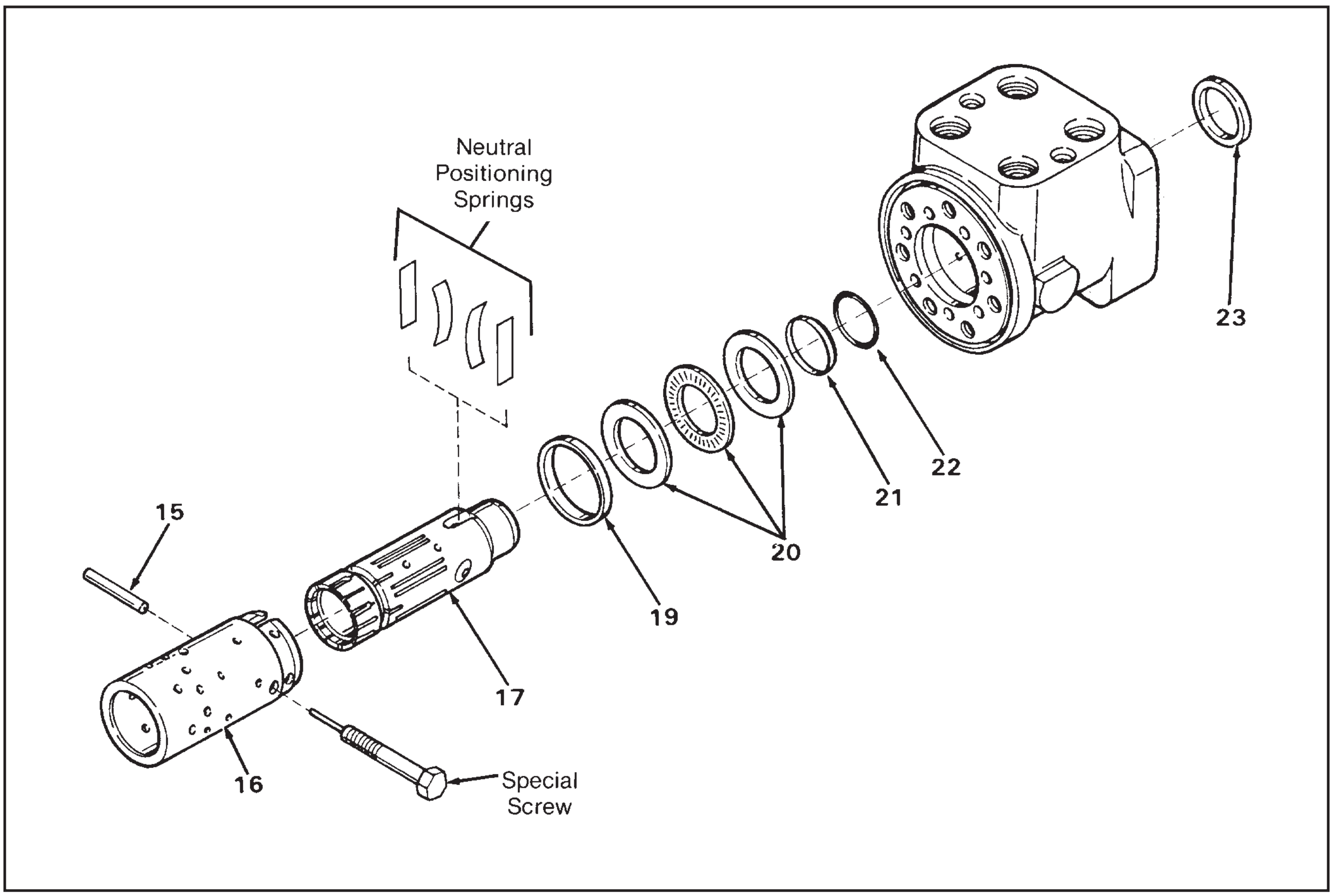


Figure 6C-5.

SECTION 6C. STEERING UNIT

(See Figure 6C-6)

NOTE

If either shock valve plugs (26) in Step 15 and/or the relief valve plug (32) in Step 17 are removed, the relief setting will be destroyed.

If it is not necessary to remove these items, skip Steps 14–17.

14. Use a 6 mm hex socket wrench. Remove shock valve plug (24) and washer (25).
15. Remove plug (26), spring (27), valve cone (28) and ball (29).

NOTE

Steps 14 and 15 describe the removal of one of two shock valve assemblies. Repeat Steps 14 and 15 for the other shock valve.

16. Using a 8 mm hex socket wrench, remove pressure relief valve plug (30) and washer (31).
17. Remove plug (32), spring (33) and valve spool (34).

INSPECTION

1. Clean all parts being careful not to scratch or nick parts. After cleaning, coat parts with a thin film of oil.
2. Inspect parts for signs of wear or damage. Discard all seals and O-rings.
3. Replace any damaged or worn parts.

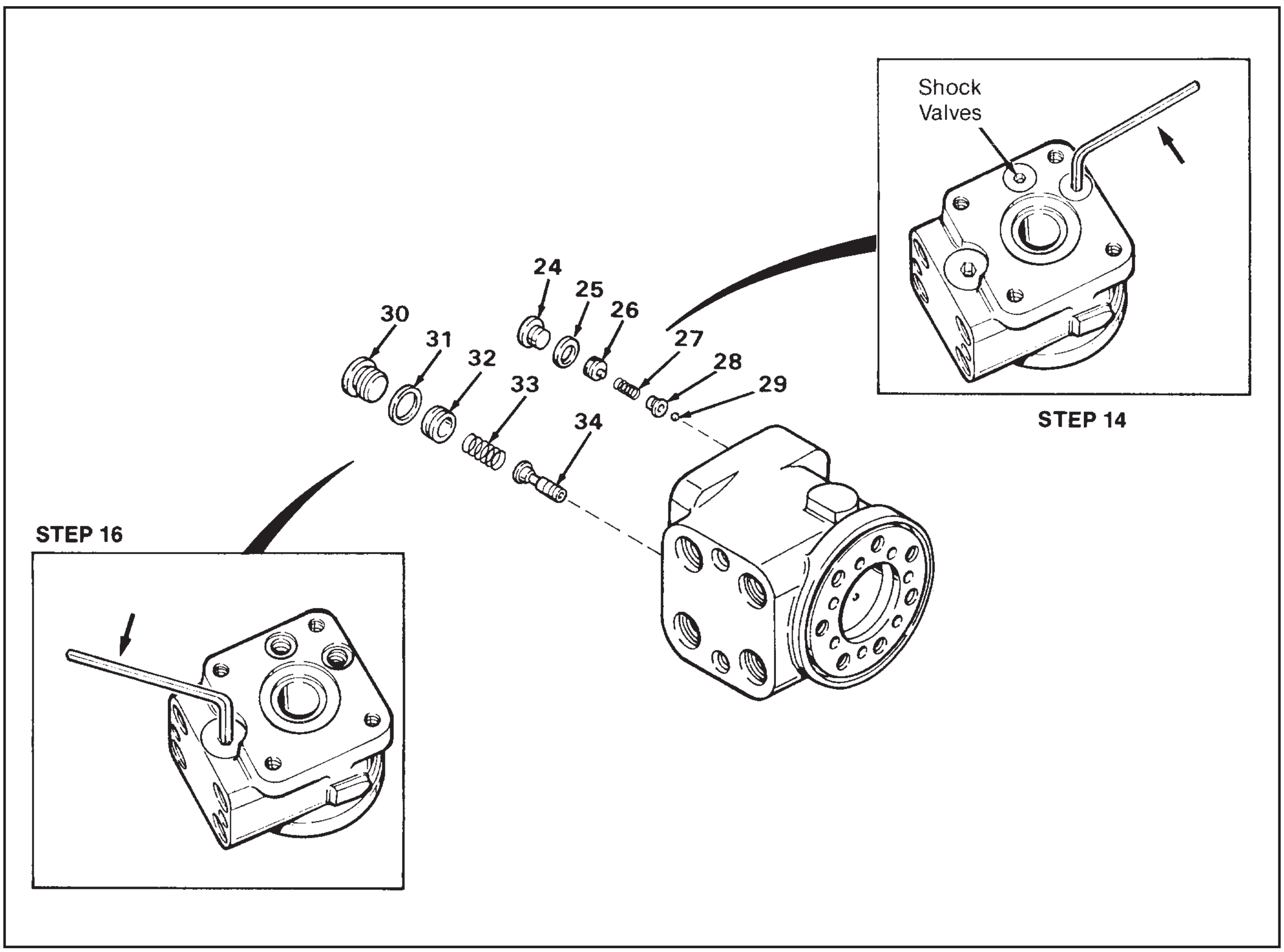


Figure 6C-6.

SECTION 6C. STEERING UNIT

ASSEMBLY (See Figures 6C-7 through 6C-12)

1. Coat all parts with oil. Make sure parts are clean.
2. Insert spool (17) into sleeve (16), guide in carefully.

⚠ CAUTION

DO NOT force these parts together. They are closely fitted and require careful handling.

3. Install two flat neutral position springs (18) into slot of spool (17).
4. Slide two curved springs (18) between the flat springs.
5. Press springs together and push into slots of sleeve (16).
6. Line up springs (18) and center them.

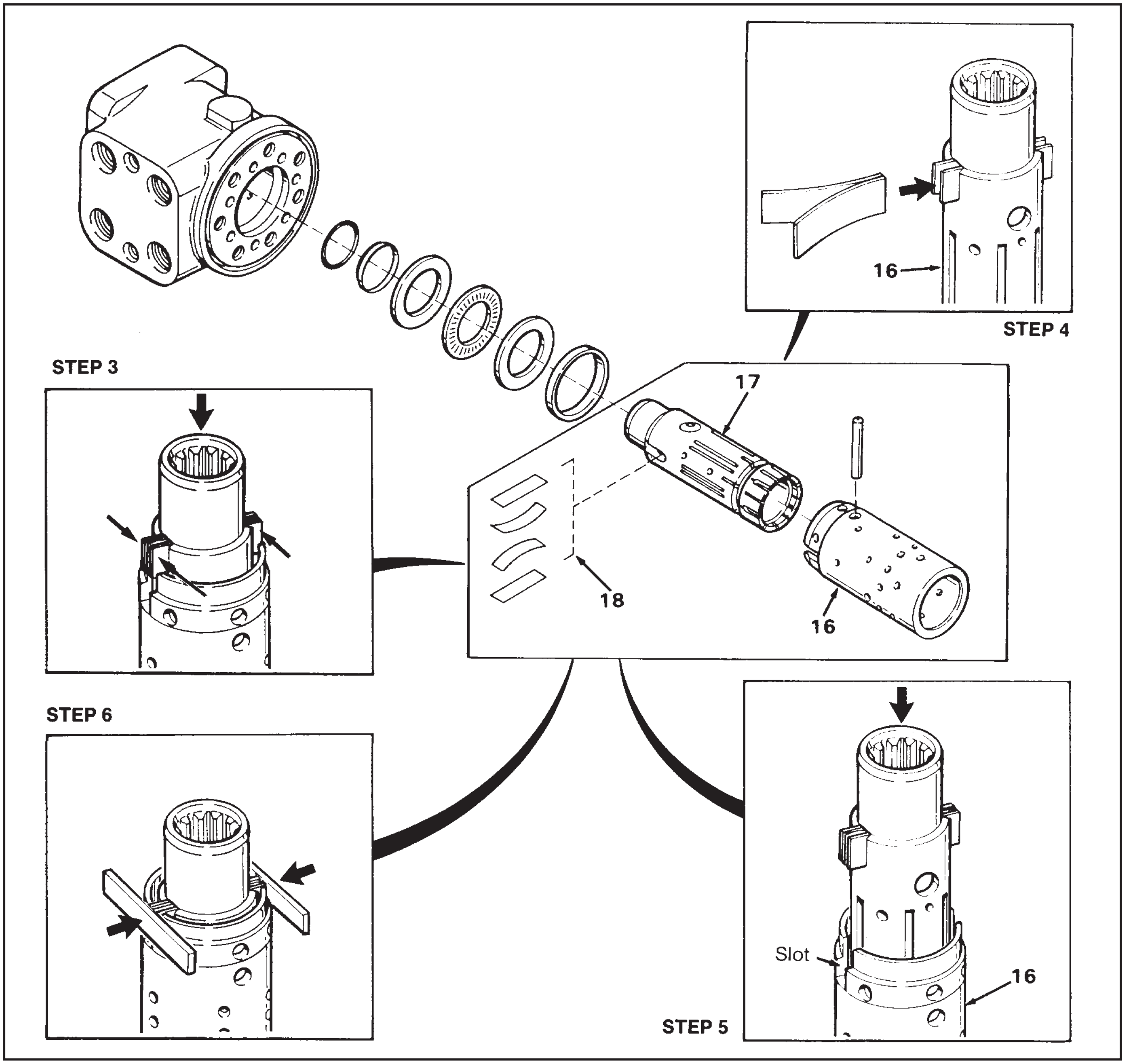


Figure 6C-7.

SECTION 6C. STEERING UNIT

(See Figure 6C-8)

7. Install ring (19) over sleeve (16).

NOTE

Ring (19) should rotate free of springs (18).

8. Install cross pin (15) through sleeve and spool.
9. Install thrust bearing and washers (20) being sure inside chamber of heavy washer goes on spool first.

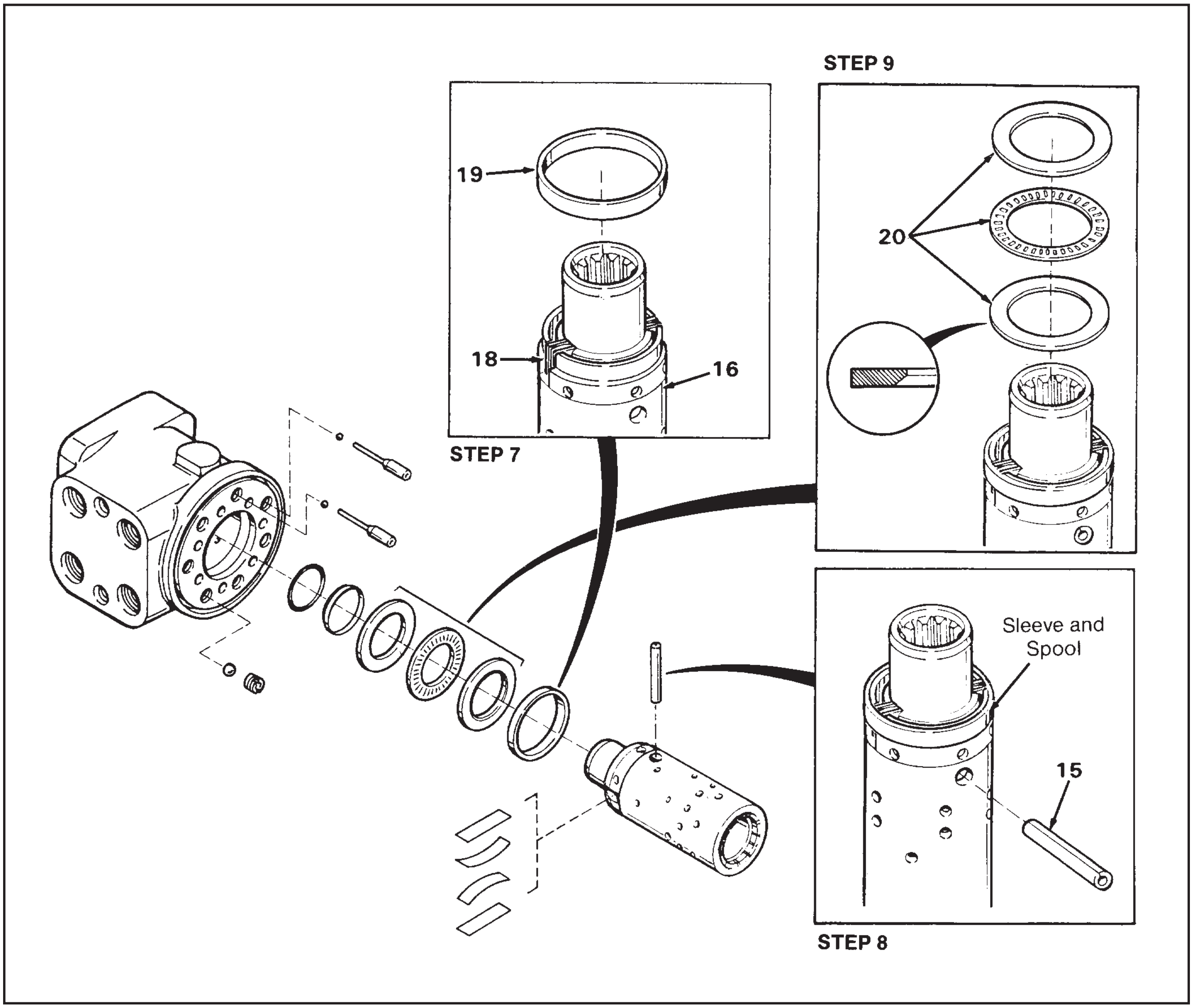


Figure 6C-8.

SECTION 6C. STEERING UNIT

(See Figure 6C-9)

10. Place the steering unit on its side. Insert the outer sleeve of tool SJ 150-9000-11 into the sleeve bore.
11. Lubricate O-ring (22) and kin ring (21). Place them on the guide tool as shown.
12. Using the inner tool, push and turn the guide through the outer tool sleeve until O-ring (22) and kin ring (21) properly seat in the housing.
13. Pull both the inner and outer tool from the housing, leaving the guide in the housing.

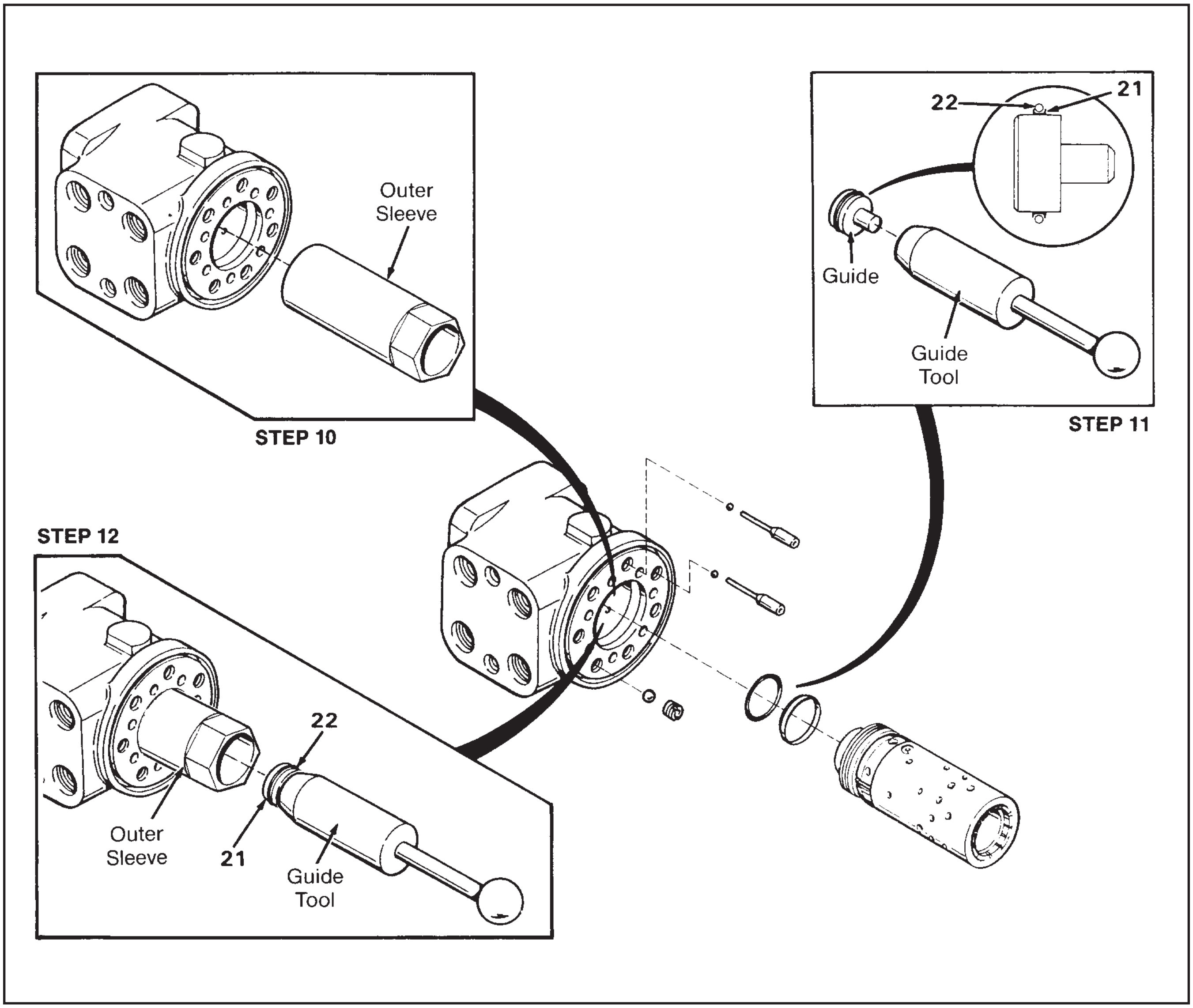


Figure 6C-9.

SECTION 6C. STEERING UNIT

(See Figure 6C-10)

14. Place the housing down on a flat surface. Hold sleeve assembly (14) so cross pin (15) is horizontal.
15. Carefully insert sleeve assembly (14).

NOTE

Sleeve to housing fit is very close. Do not force together.

16. Push sleeve (14) into housing, pushing out the O-ring and kin ring guide tool.
17. Insert ball (11) into hole as shown.
18. Screw bushing into housing until it is just below the surface of the housing.

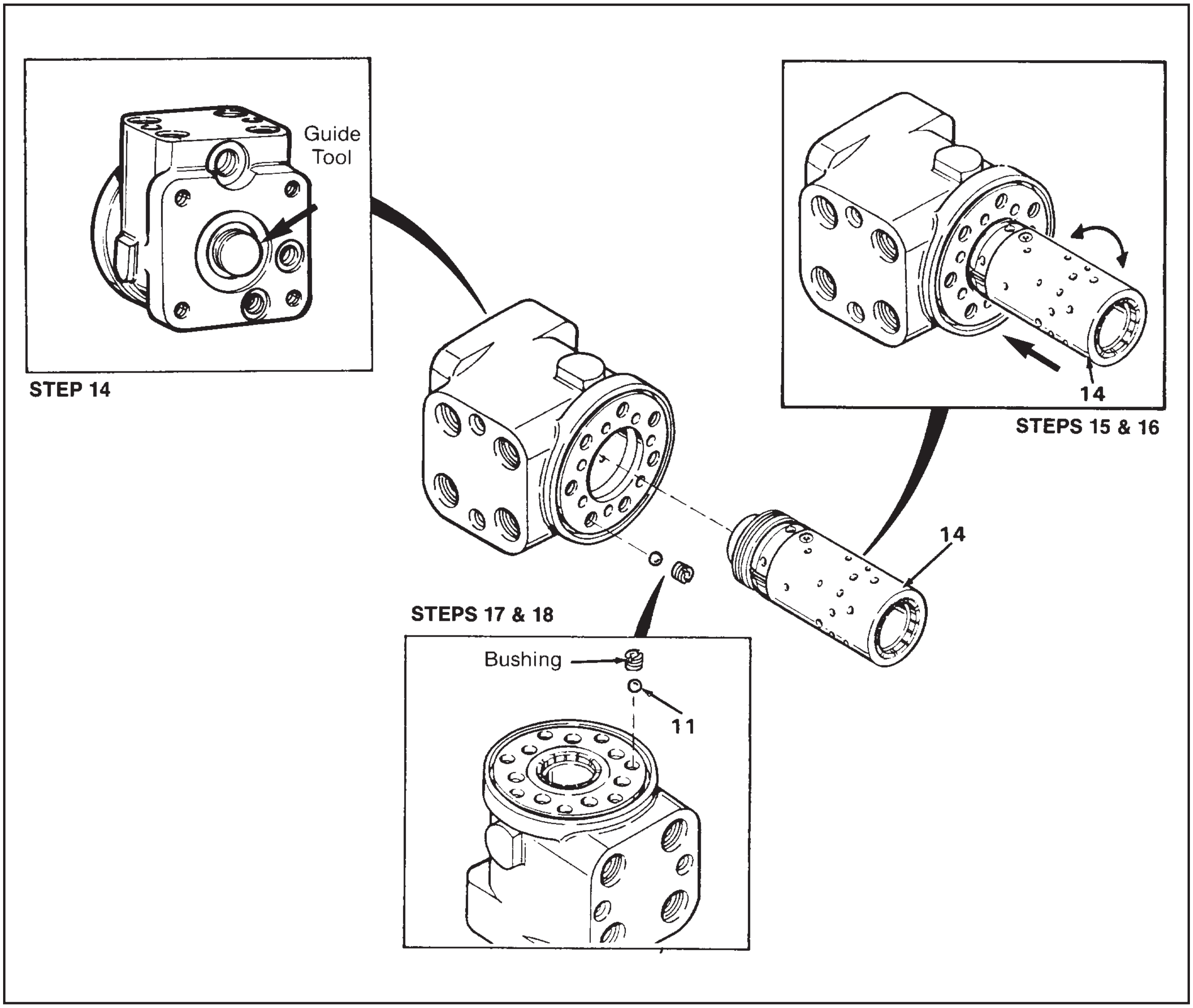


Figure 6C-10.

SECTION 6C. STEERING UNIT

(See Figure 6C-11)

19. Install 3/16" suction valve balls (13) as shown.
20. Install suction valve pins (12) as shown.
21. Install O-ring (8) and distributor plate (7).
22. Install cardan shaft (9) and hold in position with tool SJ 150-9000-3.
23. Install O-rings (4 and 6) to gear wheel set (5).
24. Install gear wheel set (5). Engage the splines so the valley of the inner rotor is in line with the pin slot of the cardan shaft as shown.
25. Install cover (3), flat washers (2) and screws (1).

NOTE

Be sure to place the special screw in the correct hole as shown.

26. Remove cardan shaft tool. Torque screws to 22 ft-lbs. (30 N.m).
27. Install shock valve ball (29), valve cone (28), spring (27) and using a 6 mm hex socket wrench, plug (26).

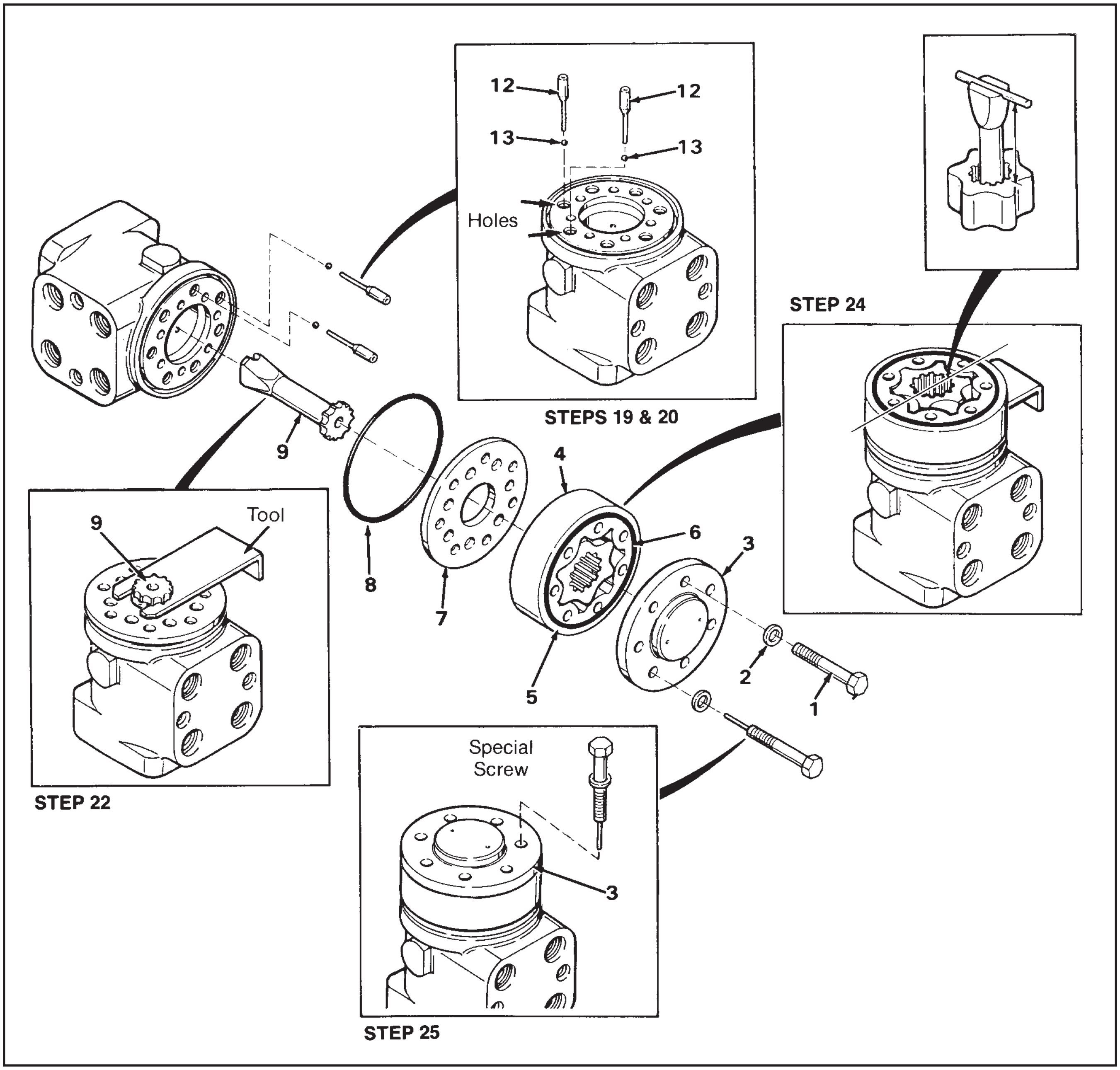


Figure 6C-11.

SECTION 6C. STEERING UNIT

NOTE

There are two shock valve assemblies. Installation of both are the same, see Step 27.

NOTE

The pressure setting of this valve must be adjusted. Use the tractor hydraulics and adjust as described in Section 8S.

28. Install relief valve spool (34), spring (33), and using an 8 mm hex socket wrench, plug (32).
29. Install washer (31) and plugs (30) snug.

    After adjusting pressure, (see Section 8S) reinstall plug (30) and torque to 37 ft-lbs. (50 N.m).

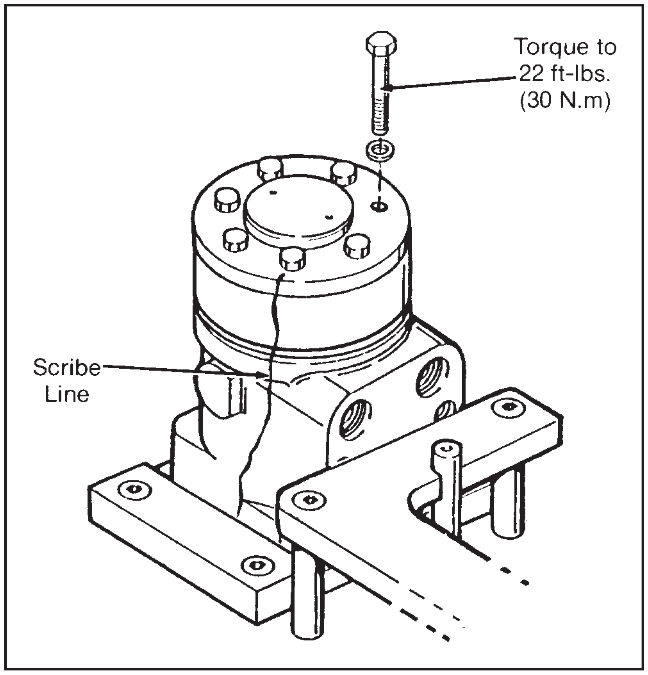


Figure 6C-13. Alignment Mark

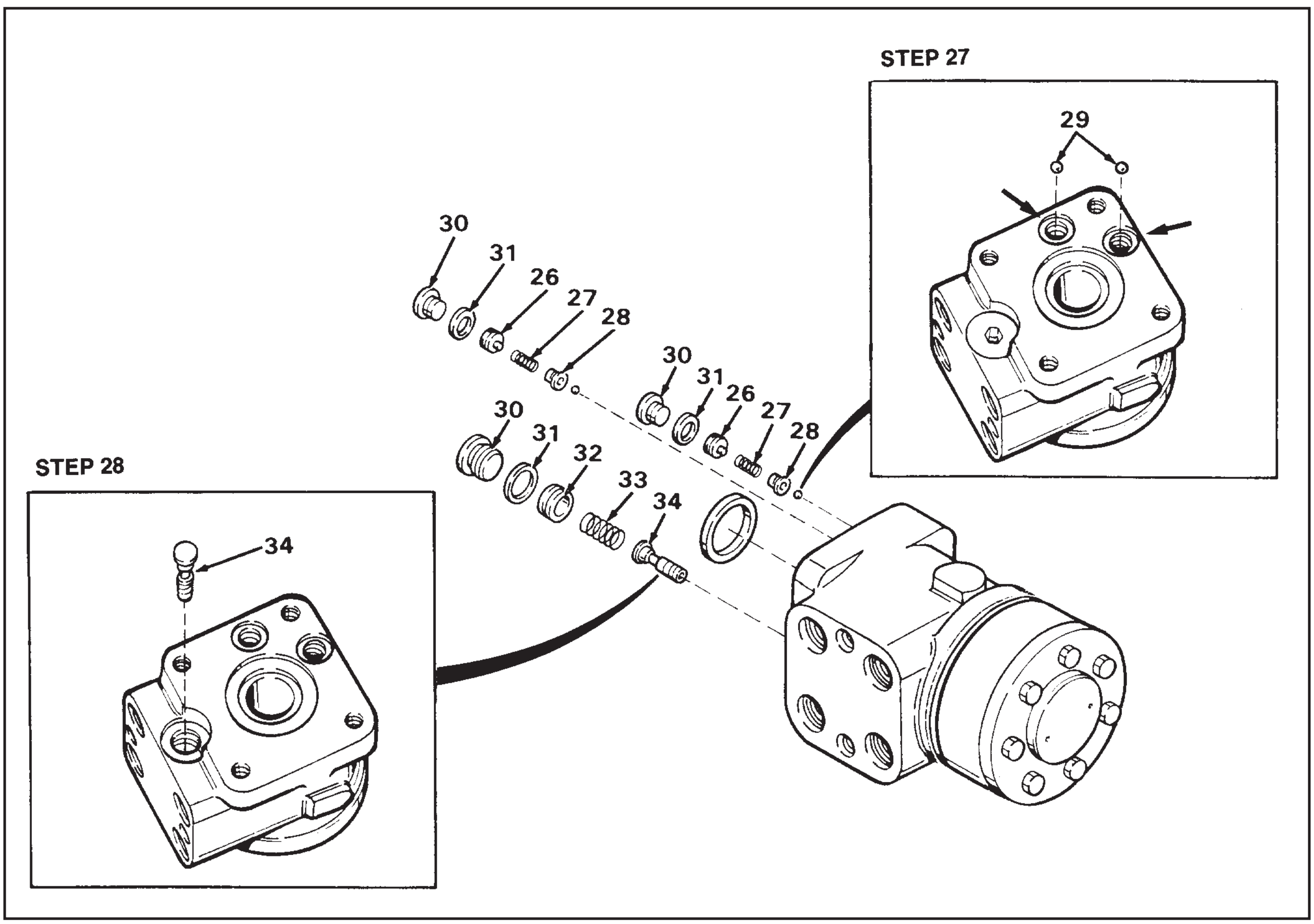


Figure 6C-12.

SECTION 6C. STEERING UNIT

INSTALLATION (See Figures 6C-1 and 6C-14)

1. Position and attach steering unit to tractor.
2. Connect hydraulic lines, see Figure 6C-14.
3. Install insert (5), flat washer (3), steering wheel (4) and nut (1). Torque nuts to 25–30 ft-lbs. (34–41 N.m).
4. If steering unit was disassembled, adjust shock valve and relief valve pressure settings as described in Section 8R.
5. Install steering unit cover (6).

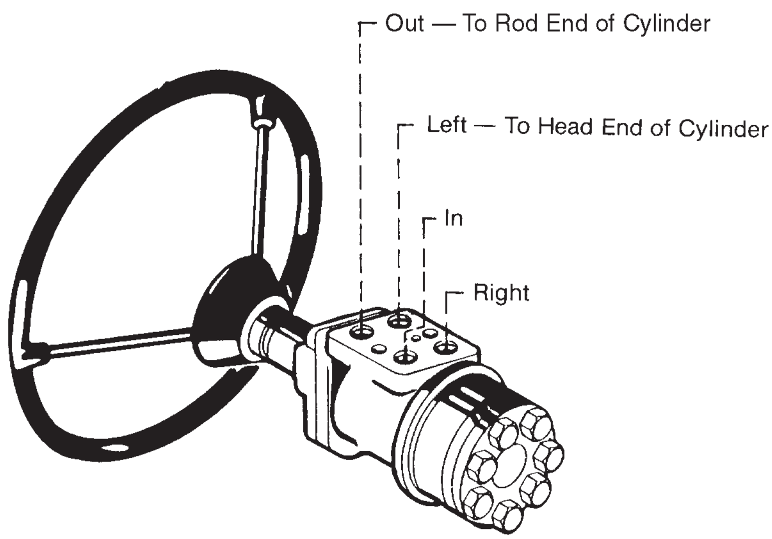


Figure 6C-14. Hydraulic Hose Connection

SECTION 6D. STEER WHEEL ADJUSTMENTS

TOE-IN (See Figure 6D-1)

1. Turn steer wheels to straight ahead position.
2. Remove the cylinder rod end ball joint.
3. Loosen the rod jam nuts.
4. Turn tie rod so wheels toe-in 1/16" (1.6 mm).
5. Loosen cylinder clamp on rod end of cylinder.
6. Lengthen or shorten rod end ball joint to line up with hole in steering arm.
7. Install rod end ball joint in steering arm and torque to 45 ft-lbs. (61 N.m).

NOTE

After making this adjustment, check the turn stop and adjust if necessary.

TURN STOP (See Figure 6D-1)

1. Loosen jam nuts on stop bolts and turn stop bolts in completely.
2. Turn the steering wheel completely to the right and left.
3. In each direction, the steering arms should connect the stop bolts. If they do not, proceed with Step a.
   a. Remove the cylinder.
   b. Loosen the cylinder clamps on each end of the cylinder.
   c. Lengthen or shorten cylinder by turning ball joints.
   d. Reattach cylinder and torque ball joint nuts to 45 ft-lbs. (61 N.m).
4. In each direction, the steering arms should control the stop bolts. If they do not, proceed with Step a.
   a. Remove the cylinder.
   b. Loosen the cylinder clamps on each end of the cylinder.
   c. Lengthen or shorten cylinder by turning ball joints.
   d. Reattach cylinder and torque ball joint nuts to 45 ft-lbs. (61 N.m).
5. Turn stop bolts out 1/2 turn and lock in position.

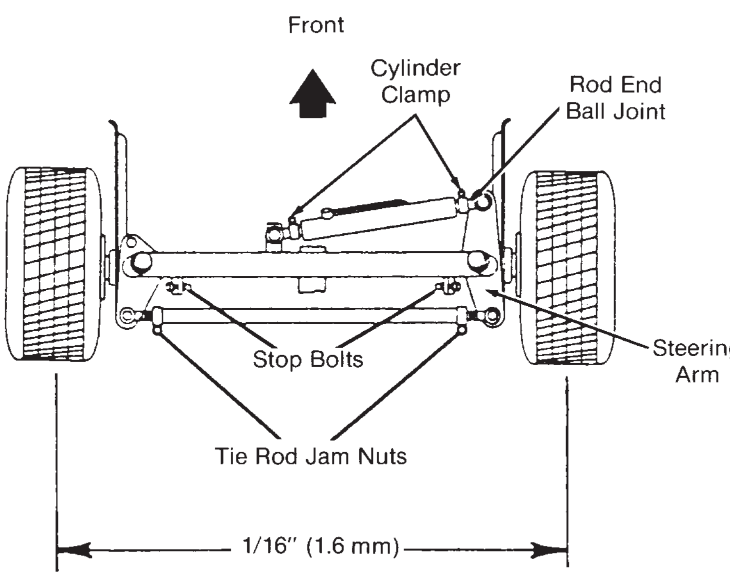


Figure 6D-1. Steer Wheel Adjustments

SECTION 6E. STEERING CYLINDER

REMOVAL (See Figure 6E-1)

1. Block the wheel and set the parking brake.
2. Tag and remove hydraulic lines. Cap the cylinder ports and plug the lines.
3. Remove attaching hardware and remove cylinder.

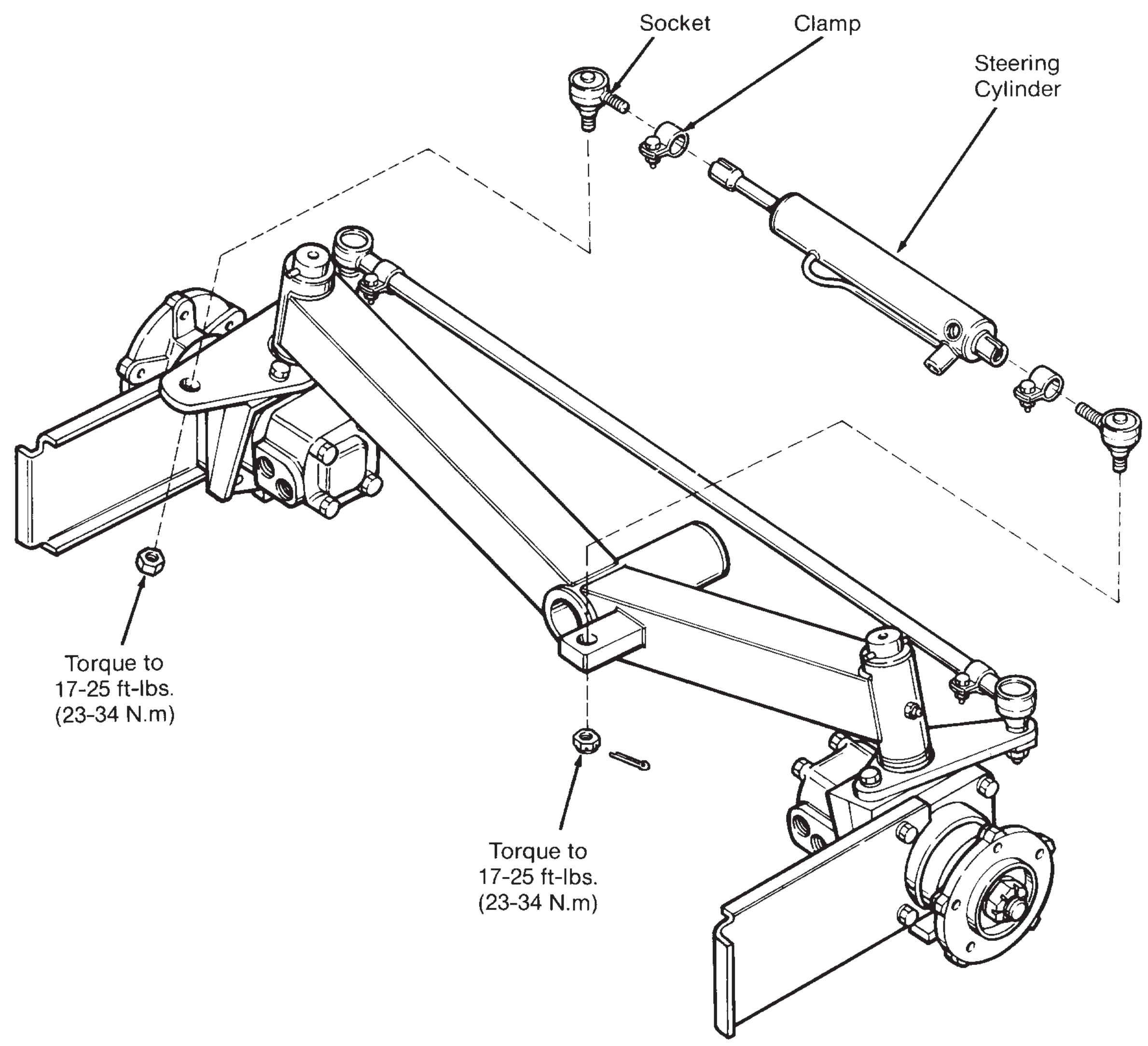


Figure 6E-1. Steering Cylinder Removal and Installation

SECTION 6E. STEERING CYLINDER

DISASSEMBLY (See Figure 6E-2)

Clean and air dry exterior of cylinder. Drain all the oil from the cylinder. Disassemble following the steps as illustrated.

INSPECTION

- Inspect all parts for excessive wear, cracks and broken parts.
- Discard all O-rings, seals and backup rings.

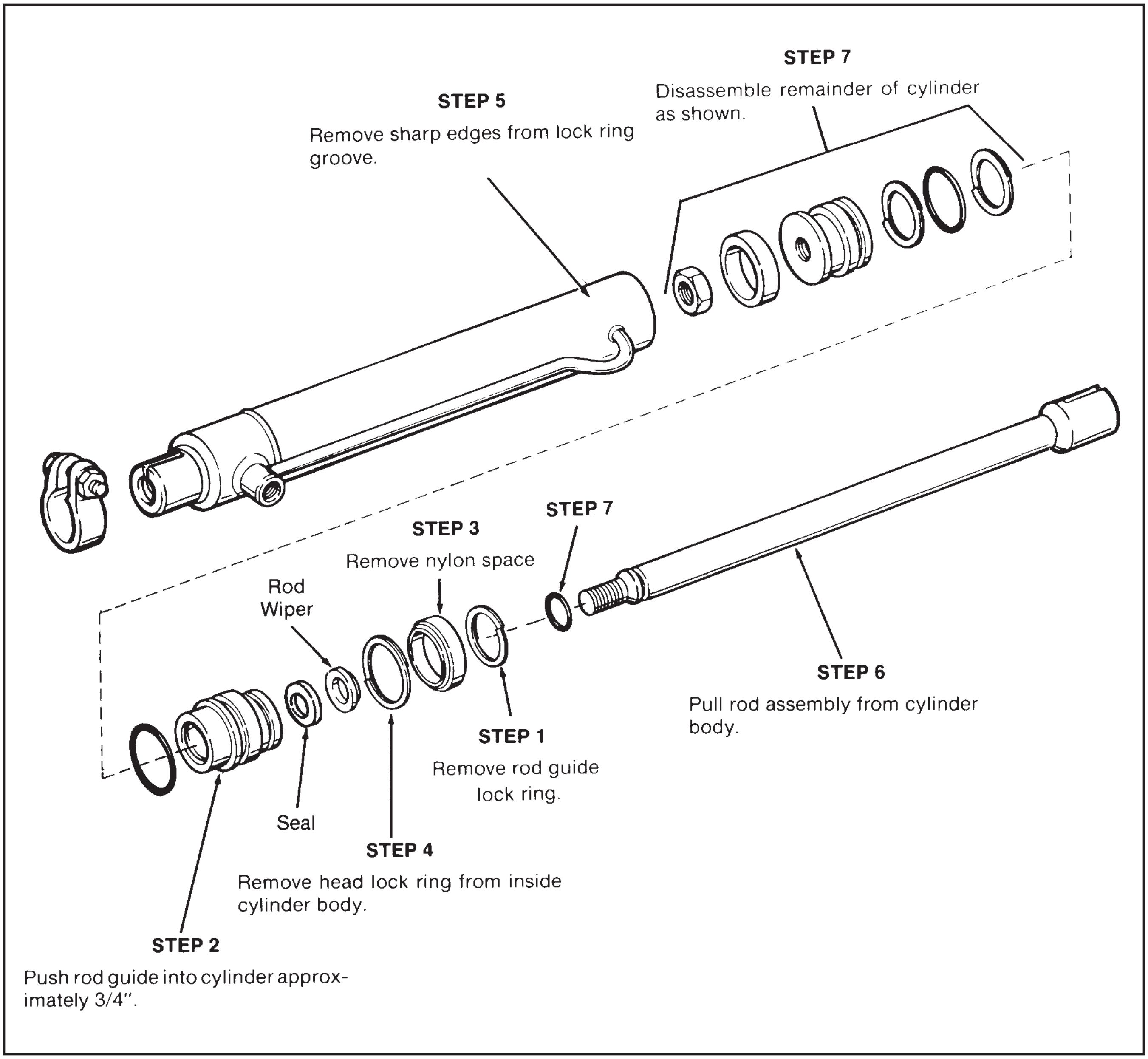


Figure 6E-2. Steering Cylinder Disassembly

SECTION 6E. STEERING CYLINDER

REASSEMBLY

1. Lightly lubricate O-rings, backup rings and seals.
2. Install seal kit as shown in Figure 6E-3.
3. Lubricate all parts before assembly.
4. Follow the steps as illustrated in Figure 6E-4 and reassembly.

INSTALLATION (See Figure 6E-1)

1. Install cylinder and secure with attaching hardware.
2. Connect hydraulic hoses.
3. Start tractor and check for leaks. Repair as necessary.

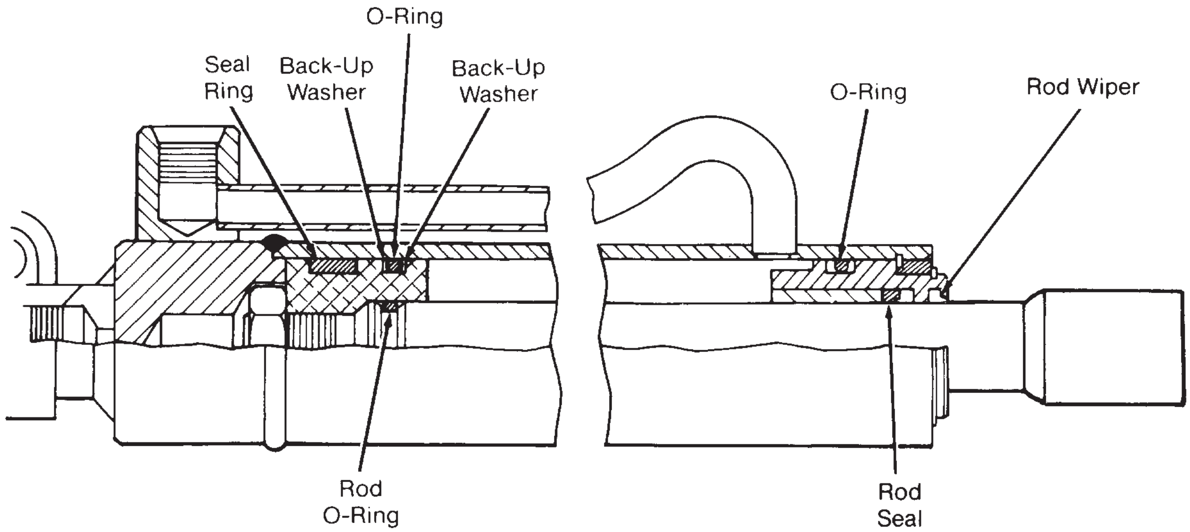


Figure 6E-3. Seal Kit Installation

SECTION 6E. STEERING CYLINDER

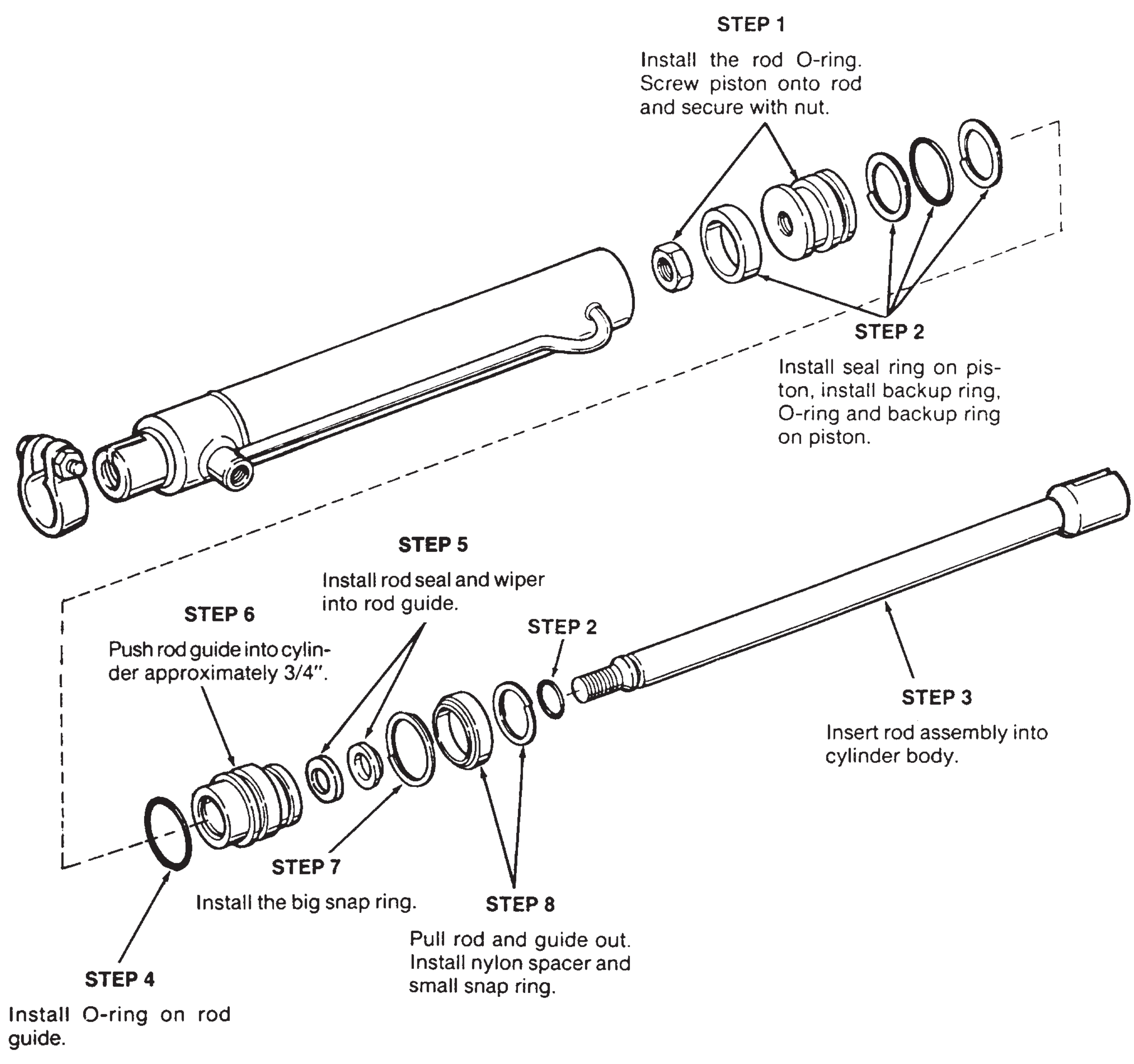


Figure 6E-4. Steering Cylinder Assembly

SECTION 7
WHEELS AND TIRES

7

SECTION 7A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools.
Cleaning materials:	Stoddard solvent or equivalent.
Other service items:	Commercially available tire sealant. Non-hardening.
	Tire pressure gauge.
	Compressed air with tire valve fitting.

SECTION 7B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Tractor rides hard.	a. Over inflated tires.	a. Reduce tire pressure 20 to 24 psi (1.4 to 1.6 bars) front and 6 to 10 psi (.41 to .68 bars) rear.
2. Tractor wanders.	a. Under inflated tires.	a. Inflate tires to 20 to 24 psi (1.4 to 1.6 bars) front and 6 to 10 psi (.41 to .68 bars) rear.
	b. Steering malfunctioning.	b. Steering test. Refer to Sections 8M, 8N.
	c. Wheel nuts loose.	c. Tighten nuts to 40-50 ft-lbs. (54–68 N.m) front.
	d. Steer wheels out of adjustment.	d. Adjust. Refer to Section 6E.
3. Poor traction.	a. Over inflated tires.	a. Reduce tire pressure 20 to 24 psi (1.4 to 1.6 bars) front and 6 to 10 psi (.41 to .68 bars) rear.

SECTION 7C. TIRE SERVICE

GENERAL

Tires are subject to damage from sharp objects. If large punctures or tears occur, it is advisable to take the tire (installed on the wheel) to a qualified tire repair shop.

The front drive wheels are bolted directly to the wheel hub which is part of the front axle assembly. See Section 4 for bearing repair.

The rear drive wheels are bolted directly to the wheel hub mounted to the motor. There are no wheel bearings to repair or service.

SERVICE

Tires are inflated to 20 to 24 psi (1.4 to 1.6 bars) front, and 6 to 10 psi (.41 to .68 bars) rear. This pressure gives the best results for average use. Tire pressure should be equal for each set of tires.

If a tire is removed from the rim it should be inflated to approximately 30 to 35 psi (2.0 to 2.4 bars), when it is replaced. This assures proper seating of the tire bead to the rim. Then reduce the pressure to the desired level before using.

NOTE

Never use grease or oil on the rim when mounting a tire.

Bead sealing of the tires may be repaired by using tire sealants available from tire repair shops. Always use non-hardening tire sealant. Hardening type tire sealants eliminate the cushioning effect from the pneumatic tire and can result in axle, differential, hydraulic motor and frame failure. To apply sealant:

1. Break one bead from seal on rim and pull out past rim flange at bottom or install through valve stem.
2. Pour sealant into tire cavity.
3. Reseat bead on rim by inflating the tire to 20 to 24 psi (1.4 to 1.6 bars).
4. Rotate tire slowly to spread compound.
5. Reduce tire pressure to specified pressure.
6. Torque front wheel nuts to 100–120 ft-lbs. (135–162 N.m). Check torque daily until torque is maintained.

SECTION 8
HYDRAULICS

SECTION 8A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools, including torque wrench, seal drivers, snap ring pliers, bearing driver.
	Tachometer. Hydra sleuth or in-line tester equipped with load valve. Pressure test kit.
Cleaning materials:	Stoddard or equivalent solvent. Detergent and water. Loctite “Locquic” Primer “T”.
Lubricants:	Refer to Section 11.
	Grease: Sunray DX671 or Gulf Supreme No. 0.
Other service items:	Seal and Repair Kits (available from Jacobsen Distributors)
	Liquid Gasket, Loctite Superflex Ultra-BLUE™ (Blue)
	Petroleum Jelly
	Wheel Restraint (See Figure 8A-1)
	Straps, 3" wide, 12' long

SECTION 8A. REPAIR AND SERVICE TOOLS AND MATERIALS

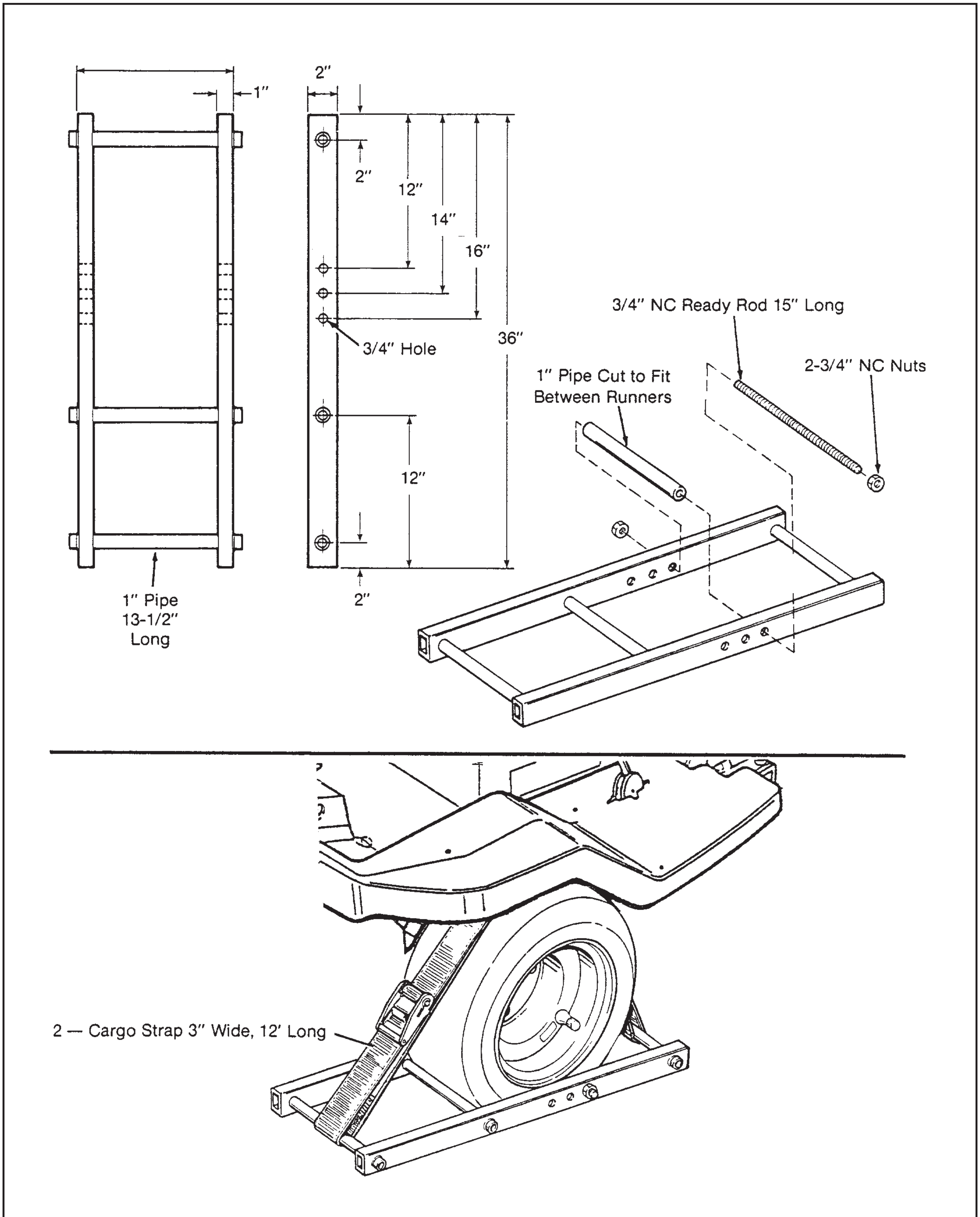


Figure 8A-1. Wheel Restraint

SECTION 8B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
TRACTION SYSTEM		
1. Forward and reverse slow (2 WHD).	a. Dump valve not closed. b. Parking brake applied. c. Traction linkage damaged or out of adjustment. d. No or little charge pressure. e. Faulty traction pump. f. Faulty traction motor. g. Faulty traction loop relief valve(s).	a. Close valve. b. Release. c. Adjust/repair (Section 2C). d. Test (Section 8R). e. Test (Section 8R). f. Test (Section 8R). g. Test (Section 8R).
2. No forward or reverse (2 WHD).	a. Dump valve not closed. b. Traction linkage damaged. c. No or little charge pressure. d. Faulty traction pump. e. Faulty traction motor.	a. Close dump valve. b. Repair/adjust (Section 2C). c. Test (Section 8R). d. Test (Section 8R). e. Test (Section 8R).
3. No forward or slow, reverse OK.	a. Traction linkage damaged or out of adjustment. b. Faulty traction loop relief valve(s).	a. Repair/adjust (Section 2C). b. Test (Section 8R).
4. No reverse or slow, forward OK.	a. Traction linkage damaged or out of adjustment. b. Faulty traction loop relief valve(s).	a. Repair/adjust (Section 2C). b. Test (Section 8R).
5. No charge pressure.	a. No hydraulic fluid in tank. b. Faulty pump Section 4. c. Faulty charge relief valve.	a. Check (Section 11). b. Test (Section 8R). c. Test (Section 8R).
6. No 4 wheel drive. Check LED in 4 wheel drive solenoid plug: ON — Switch solenoid with differential lock solenoid. Still no 4 wheel drive, see a to f. OFF — See g.	a. Faulty cartridge valve. b. Faulty pilot valve in 4 wheel drive valve. c. Faulty 4 wheel drive control valve spool. d. Insufficient charge pressure to activate 4 wheel drive valve. e. Faulty 4 wheel drive pilot valve spool. f. Rear traction motor(s) excessive internal leakage. g. Faulty electrical circuit.	a. Replace (Section 8K). b. Replace (Section 8F). c. Repair/replace (Section 8F). d. Test (Section 8R). e. Replace (Section 8F). f. Test (Section 8R). g. See Section 10B.

SECTION 8B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
7. No differential lock. Check LED in differential lock solenoid plug: ON — Switch solenoid with 4 wheel drive solenoid. Still no differential lock, see a to e. OFF — See f,	a. Faulty cartridge valve.	a. Replace (Section 8K).
	b. Faulty 4 wheel drive control valve spool.	b. Repair/replace (Section 8F).
	c. Insufficient charge pressure to activate 4 wheel drive valve.	c. Test (Section 8R).
	d. Faulty differential lock valve spool.	d. Replace (Section 8K).
	e. Faulty differential lock cylinder.	e. Repair (Section 4E).
	f. Faulty electrical circuit.	f. See Section 10B.
8. Differential lock not disengaging.	a. Differential collar sticks in axle.	a. Let up on traction pedal. Tractor should not be in a turn.
	b. Differential solenoid valve spool sticks.	b. Replace (Section 8K).
	c. Differential solenoid does not de-energize.	c. See Section 10B.
	d. Insufficient charge pressure to activate differential lock.	d. Test (Section 8R).
	e. Differential collar return spring broken.	e. Repair (Section 4E).
LIFT SYSTEM		
1. Mowers will not lower.	a. Engine RPM must be 2000 or greater.	a. Increase engine RPM to 2000.
	b. Valve detent spool sticks.	b. Repair (Section 8H).
	c. Faulty lift valve main relief.	c. Test/adjust (Section 8R).
	d. Insufficient oil supply, priority valve.	d. Test (Section 8R).
	e. Mechanical binding of lift arm.	e. Lubricate/repair (Sections 11B, 9F).
	f. Faulty pump.	f. Test (Section 8R).
2. Mowers lower too slow.	a. Flotation control set too high.	a. Adjust (see Operator's Manual.
	b. Restriction in oil return line.	b. Check (Section 8S).
3. Right wing will not lower.	a. Mechanical binding of lift arm.	a. Lubricate/repair (Sections 11B, 9F).
	b. Valve detent spool sticks.	b. Repair (Section 8H).
	c. Restriction in oil return line.	c. Test (Section 8R).
4. Left wing will not lower.	a. Mechanical binding of lift arm.	a. Lubricate/repair (Sections 11B, 9F).
	b. Valve detent spool sticks.	b. Repair (Section 8H).
	c. Restriction in oil return line.	c. Test (Section 8R).

SECTION 8B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
5. Front mower will not lower.	a. Valve detent spool sticks. b. Restriction in oil return line.	a. Repair (Section 8H). b. Test (Section 8R).
6. Mower stops lowering when handle is released.	a. Detent spool not locking in detent position.	a. Repair (Section 8H).
7. Mowers will not raise.	a. Engine RPM must be 2000 or greater. b. Cylinder leaking internally. c. Faulty lift valve main relief. d. Insufficient oil supply, priority valve. e. Faulty pump.	a. Increase engine RPM to 2000. b. Test (Section 8R). c. Test (Section 8R). d. Test (Section 8R). e. Test (Section 8R).
8. Mower(s) will stay in the raised position when control handle is released.	a. Cylinder leaking internally. b. Valve detent poppet not seating or leaking. c. Detent spool not retracting completely, sticking.	a. Repair (Section 8L). b. Repair (Section 8H). c. Repair (Section 8H).
9. Mower(s) slowly lower by themselves.	a. Cylinder leaking internally. b. Valve detent poppet not seating or leaking. c. Detent spool not retracting completely, sticking.	a. Repair (Section 8L). b. Repair (Section 8H). c. Repair (Section 8H).
10. Mower(s) do not float.	a. Valve plunger not holding detent spool. b. Valve detent spool sticking, not going into detent. c. Valve detent plunger spring broken. d. Valve detent plunger worn out.	a. Repair (Section 8H). b. Repair (Section 8H). c. Repair (Section 8H). d. Repair (Section 8H).
11. Mowers down pressure too heavy or too tight.	a. Adjust flotation control.	a. See Operator's Manual.
12. Mower lowers hard (fast), raises slow.	a. Flotation control set heavy.	a. See Operator's Manual.
IMPLEMENT SYSTEM		
1. Front mower runs slow. Push manual override: Mowers still run slow, see a, c and d. Mowers run normal, see b.	a. Engine RPM too low. b. Faulty motor control valve. c. Faulty relief valve. d. Faulty pump section.	a. Increase engine RPM. b. Test (Section 8R). c. Test (Section 8R). d. Test (Section 8R).
2. Right wing runs slow.	a. Reel-to-bedknife too tight. b. Faulty reel or drive. c. Faulty reel motor.	a. Adjust (Section 12E). b. Repair (Section 12D). c. Test (Section 8R).

SECTION 8B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
3. Left wing runs slow.	a. Reel-to-bedknife too tight. b. Faulty reel or drive. c. Faulty reel motor. d. Right wing motor excessive internal leakage.	a. Adjust (Section 12E). b. Repair (Section 12D). c. Test (Section 8R). d. Test (Section 8R).
4. Front motor doesn't run. Check LED in motor control valve plug: ON — Check voltage, 12VDC NO, see a. YES, see c–e. OFF — See a.	a. Faulty electrical circuit. b. Faulty motor control valve. c. Faulty motor control valve solenoid. d. Faulty relief valve. e. Faulty pump section.	a. See Section 10B. b. Test (Section 8R). c. Test (Section 10I). d. Test (Section 8R). e. Test (Section 8R).
5. Right wing mower doesn't run. Check LED in motor control valve plug: ON — Check voltage, 12VDC NO, see a. YES, see c–e. OFF — See a.	a. Faulty electrical circuit. b. Faulty motor control valve solenoid. c. Faulty relief valve. d. Faulty motor control valve. e. Faulty pump section.	a. See Section 10B. b. Test (Section 10I). c. Test (Section 8R). d. Test (Section 8R). e. Test (Section 8R).
6. Left wing mower doesn't run. Check LED in motor control valve plug: ON — Check voltage, 12VDC NO, see a. YES, see c–e. OFF — See a.	a. Faulty electrical circuit. b. Faulty motor control valve solenoid. c. Faulty relief valve. d. Faulty motor control valve. e. Faulty pump section.	a. See Section 10B. b. Test (Section 10I). c. Test (Section 8R). d. Test (Section 8R). e. Test (Section 8R).

SECTION 8C. GENERAL INSTRUCTIONS

GENERAL

NOTE

Component location illustrations and hydraulic diagrams are located at the end of this section.

The following general instructions apply to all hydraulic system service procedures. Carefully read and adhere to each precaution.

- Dirt in the hydraulic system will cause damage to system components and reduce the life of the machine. Clean all dirt from around fittings and components *before* disconnecting any hydraulic lines or removing components.
- Relieve system pressure at components or hydraulic lines by slightly loosening the line fitting before removing.
- Immediately after disconnecting a hydraulic line, cap the line fitting and plug the port of the removed component from the machine. This not only prevents the entry of dirt into the system but also eliminates the loss of hydraulic fluid.
- Identify and label all linkages, hydraulic lines and component parts. Mark the pump and valve sections before removal and disassembly. This will ensure the correct order of parts during reassembly and installation.
- Drain hydraulic fluid from components before disassembly.
- Discard all seals and O-rings as they are removed. Install new seals and O-rings during reassembly. Most seals are available in component kit form from your Jacobsen Distributor.

⚠ CAUTION

Do not use steam or high pressure washers to clean hydraulic components.

- All parts should be thoroughly cleaned in a suitable non-flammable solvent and air blown dried before beginning repair or reassembly.
- Perform repair procedures in a clean work area using clean tools.
- Do not force or pry components apart or together. Light tapping with a plastic mallet is recommended unless otherwise specified in the repair instruction.
- Unless otherwise indicated, apply a light coat of clean hydraulic fluid to parts as each is reassembled. Apply clean grease to O-rings, if necessary, to hold them in position during reassembly.
- Hydraulic hose and tube lines should be inspected daily to check for loose connections, kinks, worn or cut hoses, etc. Be sure tubes and hoses do not contact other frame parts which could cause abrasive wear. Always replace worn hose or tube assemblies before operating machine.

⚠ CAUTION

If, during the disassembly of any hydraulic component metal chips or damage is found the hydraulic system must be drained, thoroughly flushed with clean oil and then refilled.

⚠ WARNING

Always check hydraulic tank level after removing and installing a hydraulic component or line. Severe damage to system components can result if they are allowed to run dry.

HYDRAULIC TUBE AND HOSE FITTING

⚠ WARNING

To avoid serious bodily injury, always lower mowers fully, place all controls in neutral and shut off engine before inspecting hydraulic lines or hoses. Never run hands across tubes, hoses or fittings to check for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate skin and may cause infection in a minor cut or opening in the skin.

37° FLARE FITTINGS

Torque Recommendations

1. Assemble tube nut adapter to fitting with minimum torque (finger tight) until flare contacts seat on fitting body.
2. For tightening reference, mark a line lengthwise on the flats of both the nut and adapter fitting with a marker as shown in Figure 8C-1.

SECTION 8C. GENERAL INSTRUCTIONS

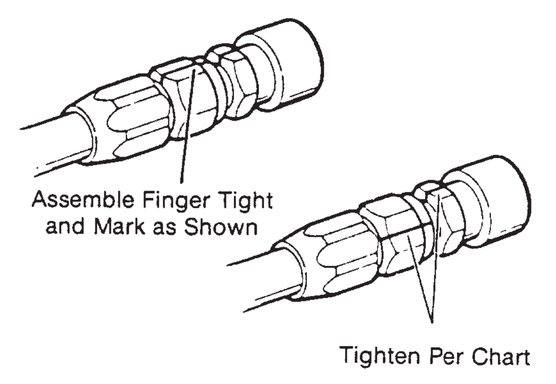


FIgure 8C-1. Reference Marking

3. Using a wrench, tighten the nut the amount shown in the chart below. The line will show which fittings have been tightened correctly and also indicates if a fitting is becoming loose.

37° Flare Torque Recommendations

SAE Dash Size	Thread Size	Tube O.D.	Torque In-Lbs.	# of Flat Rotations
3	⅜-24	0.188	95-105	1½:1¾
4	7⁄16-20	0.250	135-145	2¼:2¾
5	½-20	0.312	170-190	3¼:3¾
6	9⁄16-18	0.375	215-245	2¼:2¾
8	¾-16	0.500	430-470	2¼:2¾
10	⅞-14	0.625	680-750	2:2½
12	1 1⁄16-12	0.750	950-1050	2:2½
14	1⅜-12	0.875	1000-1100	1:1½
16	1 5⁄16-12	1.000	1300-1360	2¼:2¾
20	1⅝-12	1.250	1520-1600	1¼:1¾
24	1⅞-12	1.500	1900-2000	¾:1¼

Tube O.D. or Hose I.D.	Rotate No. of Hex Flats
3/8"	2
1/2"	2
5/8"	1½–2
1"	¾–1

Special Hose Installation Instructions

1. Hold the fixed portion of the hose coupling with one wrench; use a second wrench to tighten or loosen the hose nut. This will avoid damaging the fitting seal. When tightening a hose, do not permit it to twist; hold it in a normal straight position.
2. When installing mower hoses, place fittings at angles to avoid contact with fixed parts when turning. Make sure hoses are assembled to proper “A” and “B” ports on components.

O-RING BOSS FITTINGS

On hoses with O-ring fittings, make sure O-rings are clean and hose fittings are properly seated before tightening. Always install new O-rings. See Figure 8C-2.

Replacement O-rings for O-Ring Boss Fittings

A	B	O-Ring
Tubing O.D. or Hose I.D.	Thread Size	Jacobsen Part No.
⅛	5⁄16-24	459290
3⁄16	⅜-24	459291
¼	7⁄16-20	339896
5⁄16	½-20	459293
⅜	9⁄16-18	339897
½	¾-16	339898
⅝	⅞-14	339899
¾	1 1⁄16-12	339900
⅞	1 3⁄16-12	459296
1	1 5⁄16-12	339901
1¼	1⅝-12	339902
1½	1⅞-12	339903
2	2½-12	459300

NOTE

O-rings should be lubricated with the fluid to be used in the system prior to assembly.

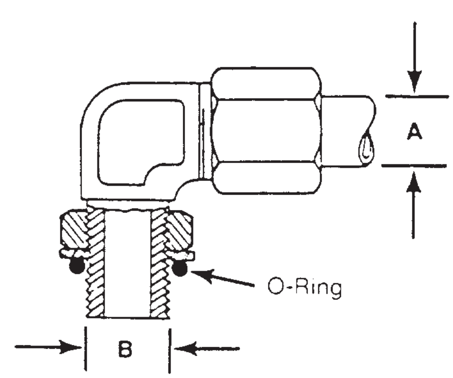


Figure 8C-2. Boss Fitting O-Ring Installation

SECTION 8C. GENERAL INSTRUCTIONS

O-Ring Boss Torque Recommendations

SAE Dash Size	Thread Size	Tube O.D.	Torque In-Lbs.
3	3/8-24	0.188	96-120
4	7/16-20	0.250	168-192
5	1/2-20	0.312	216-240
6	9/16-18	0.375	288-312
8	3/4-16	0.500	600-720
10	7/8-14	0.625	864-960
12	1 1/16-12	0.750	1500-1620
14	1 3/8-12	0.875	1920-2160
16	1 5/16-12	1.000	2400-2640
20	1 5/8-12	1.250	2520-3360
24	1 7/8-12	1.500	3240-4320

ORS (Face Seal) FITTINGS (See Figure 8C-3)

Face seal fittings have O-ring grooves machined into the flat male face. This O-ring and flat surface mate against the mating fittings machined face.

The swivel nut can be retracted to inspect the O-ring and fitting face without removal of tubes or components.

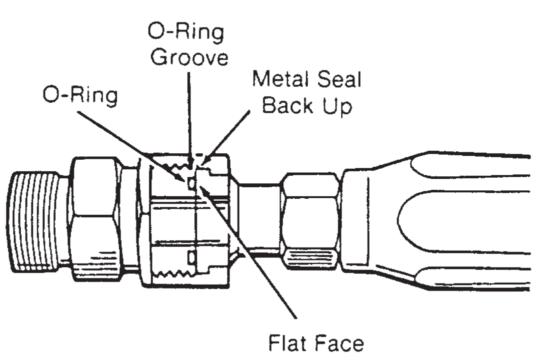


Figure 8C-3. ORS (Face Seal) Fitting

Replacement O-Ring for ORS (Face Seal) Fittings

ORS (Face Seal) Tube Size	ORS (Face Seal) O-Ring Size	Jacobsen Part No.
4	11	339908
6	12	339909
8	14	339910
10	16	339911
12	18	339912
16	21	339913
20	25	339914
24	29	339915

O-Ring Face Seal Torque Recommendations

SAE Dash Size	Thread Size	Tube O.D.	Torque In-Lbs.
3		N/A	N/A
4	9/16-18	0.250	120-144
5		N/A	N/A
6	11/16-16	0.375	216-240
8	13/16-16	0.500	384-420
10	1-14	0.625	552-600
12	1 3/16-12	0.750	780-840
16	1 7/16-12	1.000	1104-1200
20	1 11/16-12	1.250	1500-1680
24	2-12	1.500	1800-3960

SECTION 8D. TRACTION PUMP

GENERAL (See Figure 8D-1)

The traction pump supplies oil to the traction system of the tractor. The pump is engine driven through a drive shaft. It is a variable output pump.

When disassembling pump, ONLY disassemble the necessary components for repair. In some cases it is not necessary to completely disassemble the pump.

REMOVAL

NOTE

Do not attempt to remove or disassemble hydro for repair until a hydro pump test described in Section 8Q and/or 8R is performed.

1. Remove the seat and seat pan.
2. Thoroughly clean area around entire pump with a suitable cleaning solvent. Do not use material that could damage paint, gaskets or seals.
3. Label all hydraulic lines and remove. Plug or cap all lines and parts of pumps.
4. Disconnect all control linkage from pump.
5. Remove mounting hardware from both the implement pump and traction pump.
6. Support the pump and pull forward sliding pump shaft from drive shaft.

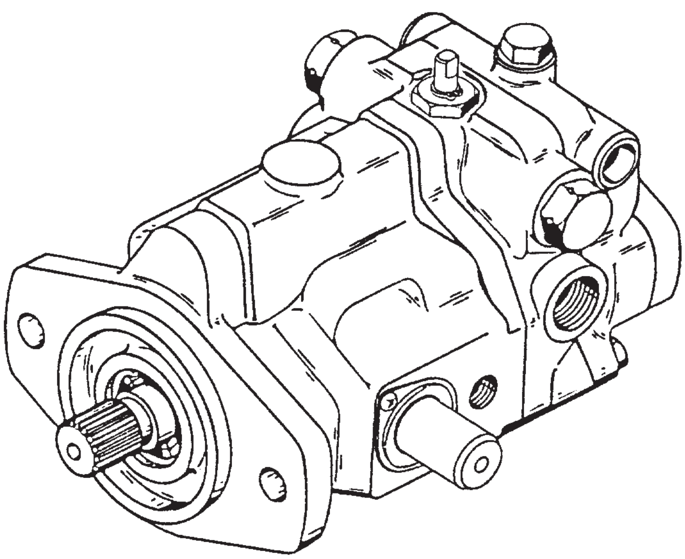


Figure 8D-1. Traction Pump Removal

SECTION 8D. TRACTION PUMP

REPAIR (See Figure 8D-2)

Refer to Figure 8D-2 for disassembly and reassembly of the traction pump.

INSPECTION

1. Inspect bronze surface of valve plate for scratches or gouged marks.
2. Inspect piston shoes for excessive wear, cracks or shoes that fall off pistons.
3. Inspect shaft for excessive wear or damage.

CAUTION

DO NOT lap valve plate bronze surface, piston block or piston shoes.

4. If any component condition is questionable, replace hydrostatic transmission.

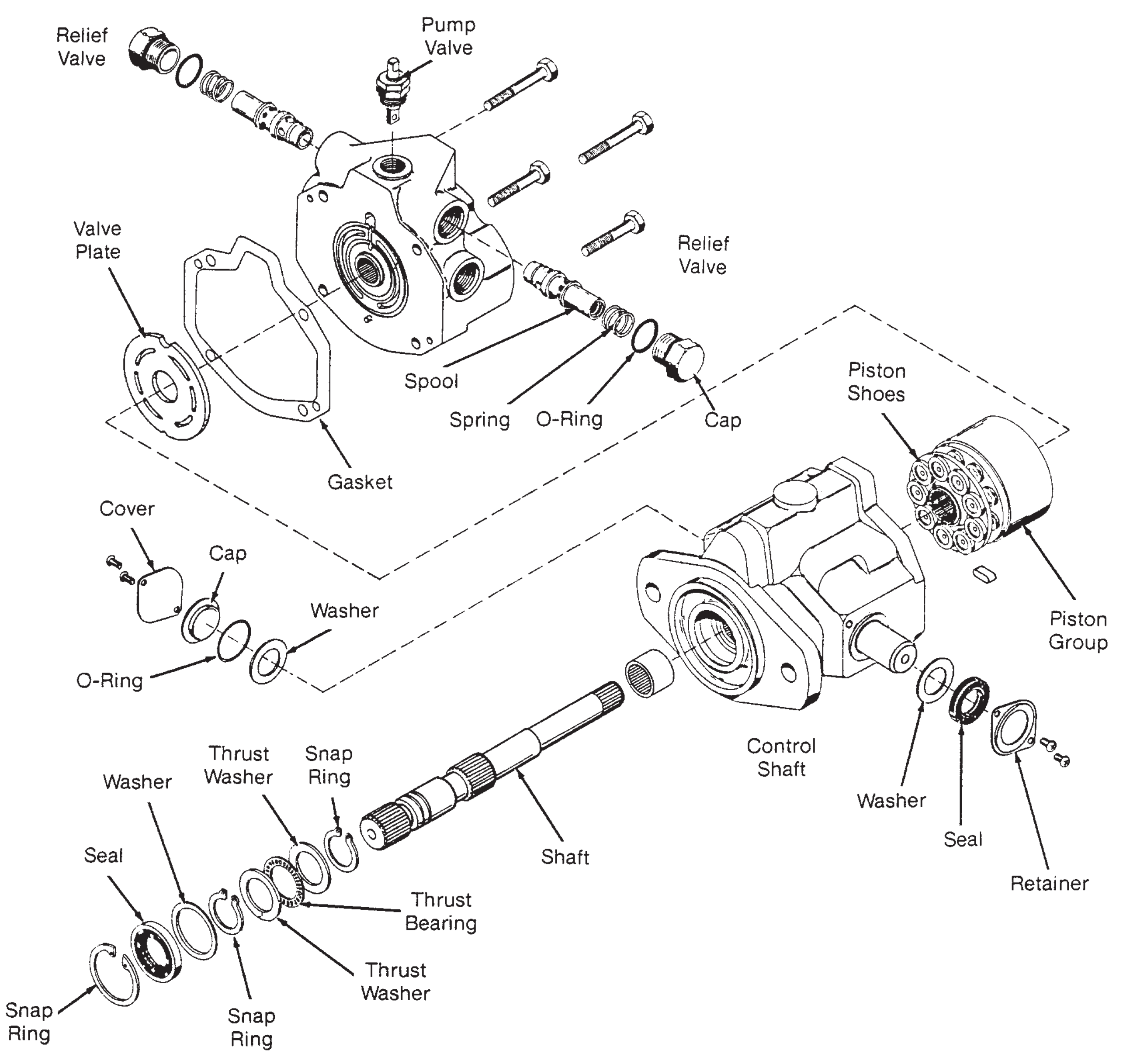


Figure 8D-2. Traction Pump Repair

SECTION 8D. TRACTION PUMP

INSTALLATION (See Figure 8D-1)

1. Install the pump, rotating it back and forth to engage the splines, fasten the mounting plate.
2. Connect all control linkage. See Section 2 for proper adjustments.
3. Install the implement pump.
4. Connect all hydraulic hoses and tubes.
5. Install seat and seat pan.
6. Start the tractor and inspect for leaks, repair as necessary.

SECTION 8E. IMPLEMENT PUMP

GENERAL

The implement pump has four positive displacement gear pump sections. Pump sections are numbered from the shaft end. Pump section 1 supplies oil to the right wing mower. Pump section 2 supplies oil to the left wing mower. Pump section 3 supplies oil to the front mower. Pump section 4 supplies oil for steering, lift and lower, charge oil for the traction pump, differential lock and the 4 wheel drive valve.

REMOVAL (See Figure 8E-1)

1. Using a suitable solution, clean the pump and surrounding area.
2. Tag and mark the location of hydraulic lines.
3. Remove hydraulic lines.
4. Remove pump mounting hardware and remove pump from tractor.
5. Plug all hydraulic lines and pump ports.

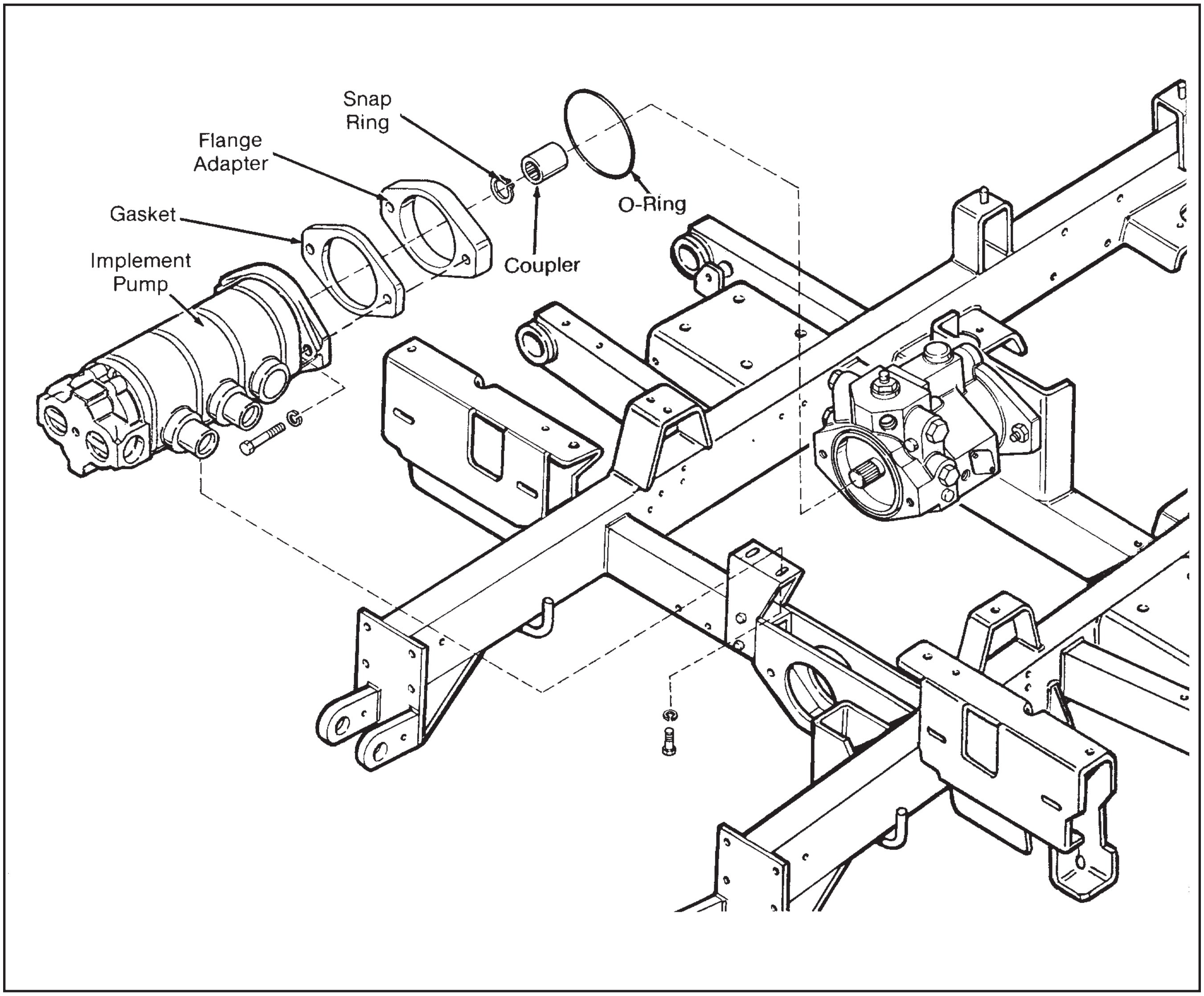


Figure 8E-1. Implement Pump Removal

SECTION 8E. IMPLEMENT PUMP

REPAIR

DISASSEMBLY (See Figure 8E-2)

1. Before disassembly mark pump sections, starting at drive shaft end, to ensure correct order of part reassembly. Recommended method of marking body sections is to use a fine point metal punch, making one indentation in line on each section.

⚠ CAUTION

Never pry pump sections apart as damage to sealing areas can result. Use of a soft face hammer to tap sections apart is recommended.

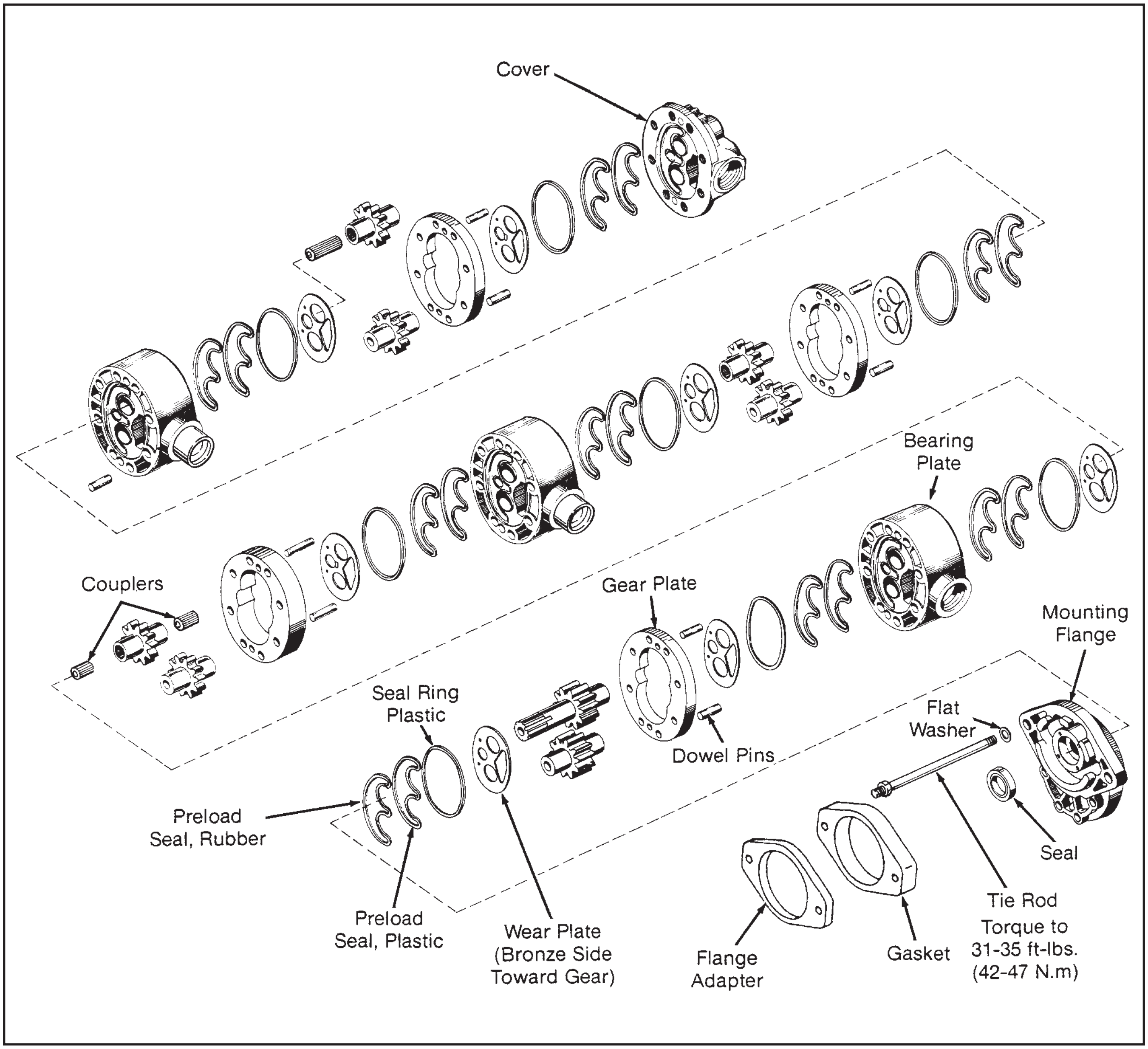


Figure 8E-2. Implement Pump Disassembly

SECTION 8E. IMPLEMENT PUMP

2. After removing tie bolts, disassemble pump one section at a time. Before removing gear sets, mark a line across meshing teeth to ensure that gears are reassembled in the same position (see Figure 8E-3).
3. Place parts in assembly order, on a clean work area as they are removed.
4. Discard seals and gaskets as they are removed.

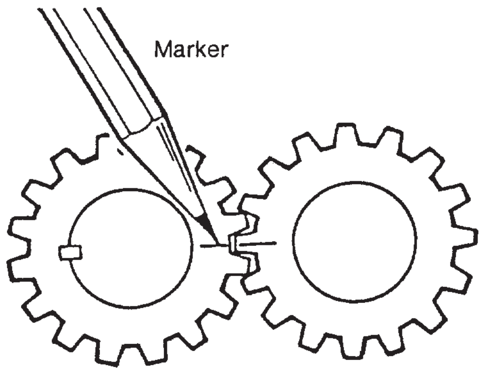


Figure 8E-3. Marking Gear Teeth

INSPECTION

1. Keeping parts in assembly order, clean and air dry each for inspection. Look for metal chips or slivers during cleaning (an indication of damage to pump or other hydraulic components).
2. Inspect all parts for cracks, nicks, burrs and excessive wear. Replace all damaged parts. Gears must be replaced in sets.
3. Inspect wear plates, replace if worn or damaged.

REASSEMBLY (See Figure 8E-2)

1. Apply a coat of clean hydraulic oil to all parts to ease assembly.
2. Assemble pump one section at a time, building up from cover section.
3. Use a new seal kit during assembly. Use clean grease to keep seals in position.
4. Remove alignment mark from gear sets after they have been installed with teeth in mesh.
5. Rotate drive shaft after assembling each section to make sure there is no binding between parts.
6. Use extreme care when installing shaft seal. It must seat squarely in seal bore with metal casing facing out. Use clean grease on shaft and put tape over keyway to avoid cutting seal during assembly.
7. Install the bolts finger tight and rotate drive shaft to make sure it turns. Tighten tie bolts evenly and in steps to a final torque of 31–35 ft-lbs. (42–47 N.m).
8. Apply permatex 2 to both sides of gasket surface of flange.
9. Install gasket and flange.

INSTALLATION (See Figure 8E-1)

1. Position the pump on the hydrostatic pump.
2. Turn pump slightly to engage spline of pump coupler.
3. Securely fasten in place with attaching hardware.
4. Connect hydraulic lines.

SECTION 8F. 4 WHEEL DRIVE CONTROL VALVE

REPAIR

Repairs are limited to replacing the 4 wheel drive pilot cartridge or changing O-rings.

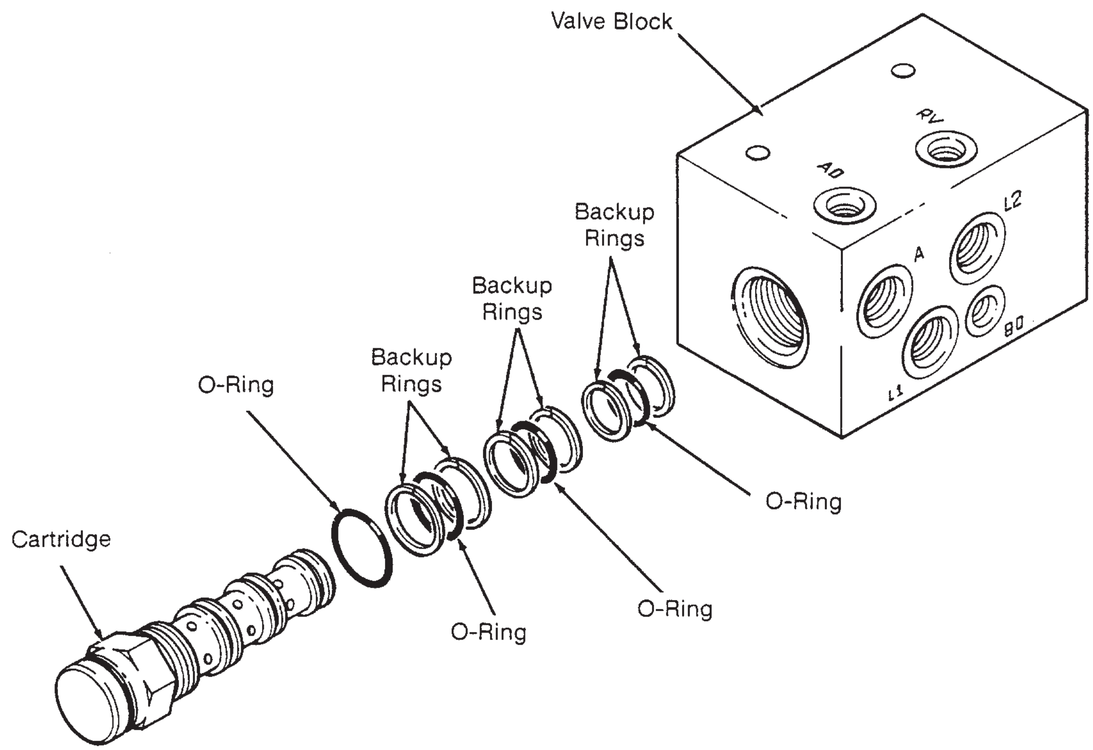


Figure 8F-1. 4 Wheel Drive Control Valve

8F

SECTION 8G. ANTI-SIPHON VALVE

REPAIR

Repair is limited to cleaning only. Use a punch, manually push poppet off its seat and flush with cleaning solvent. If the problem still exists, replace valve.

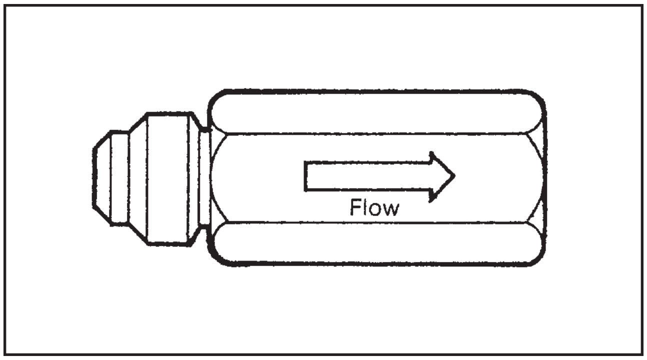


Figure 8G-1. Anti-Siphon Valve

SECTION 8H. LIFT AND LOWER CONTROL VALVE

GENERAL

The lift and lower control valve is used to raise and lower the cutting units. Left control is for the left wing. Right control is for the right wing. Center control is for the three front cutting units.

REMOVAL

1. Drain and remove the fuel line.
2. Tag and mark hydraulic lines on valve.
3. Remove hydraulic lines.
4. Disconnect lever linkage and remove.
5. Remove valve.

DISASSEMBLY

See Figures 8H-2 to 8H-4.

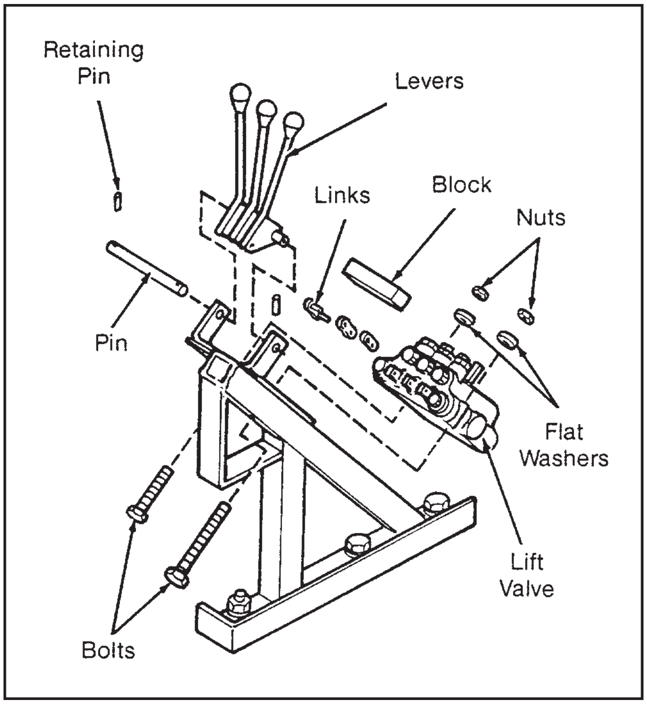


Figure 8H-1. Lift and Lower Valve Removal

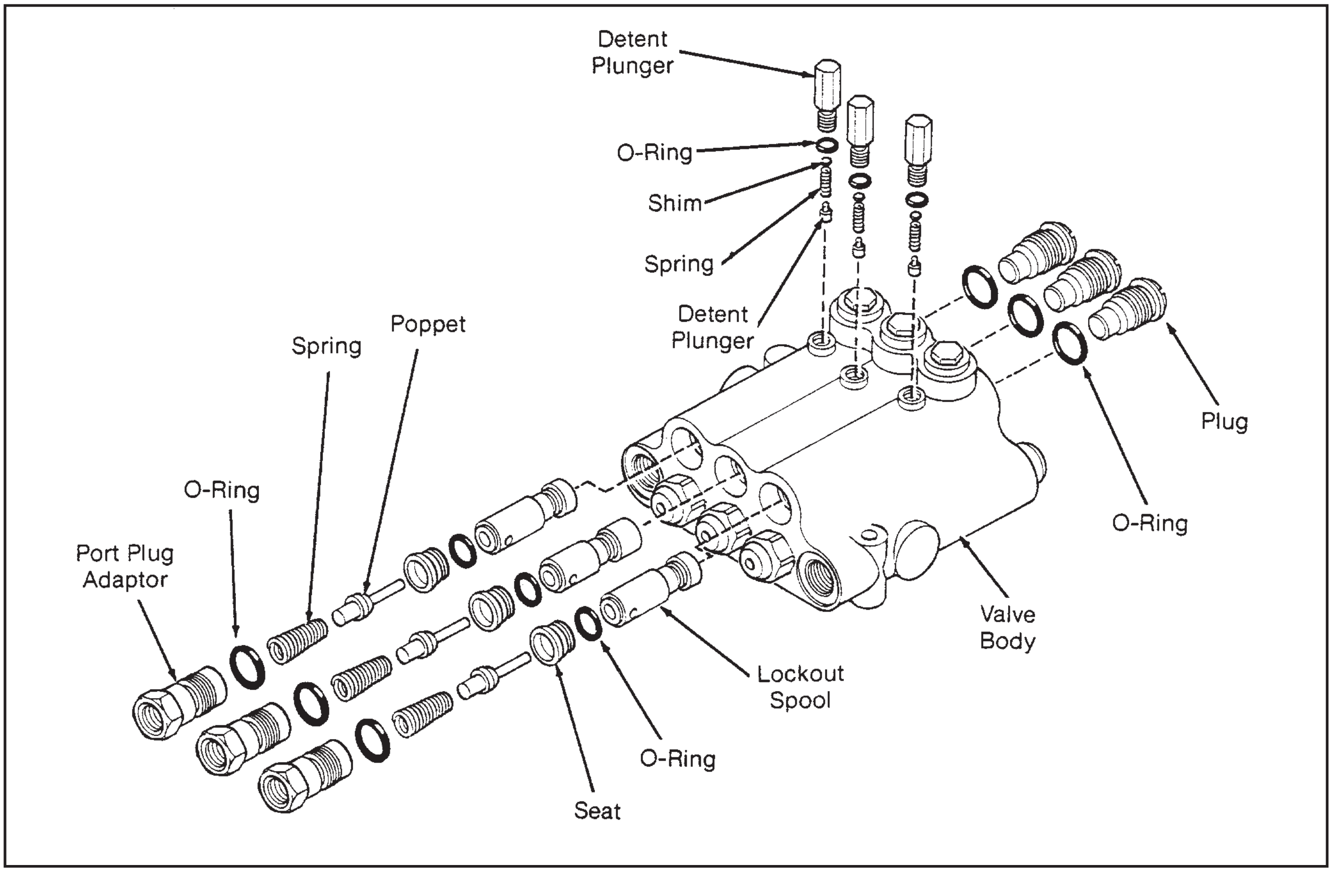


Figure 8H-2. Detent and Lockout Assembly Removal

SECTION 8H. LIFT AND LOWER CONTROL VALVE

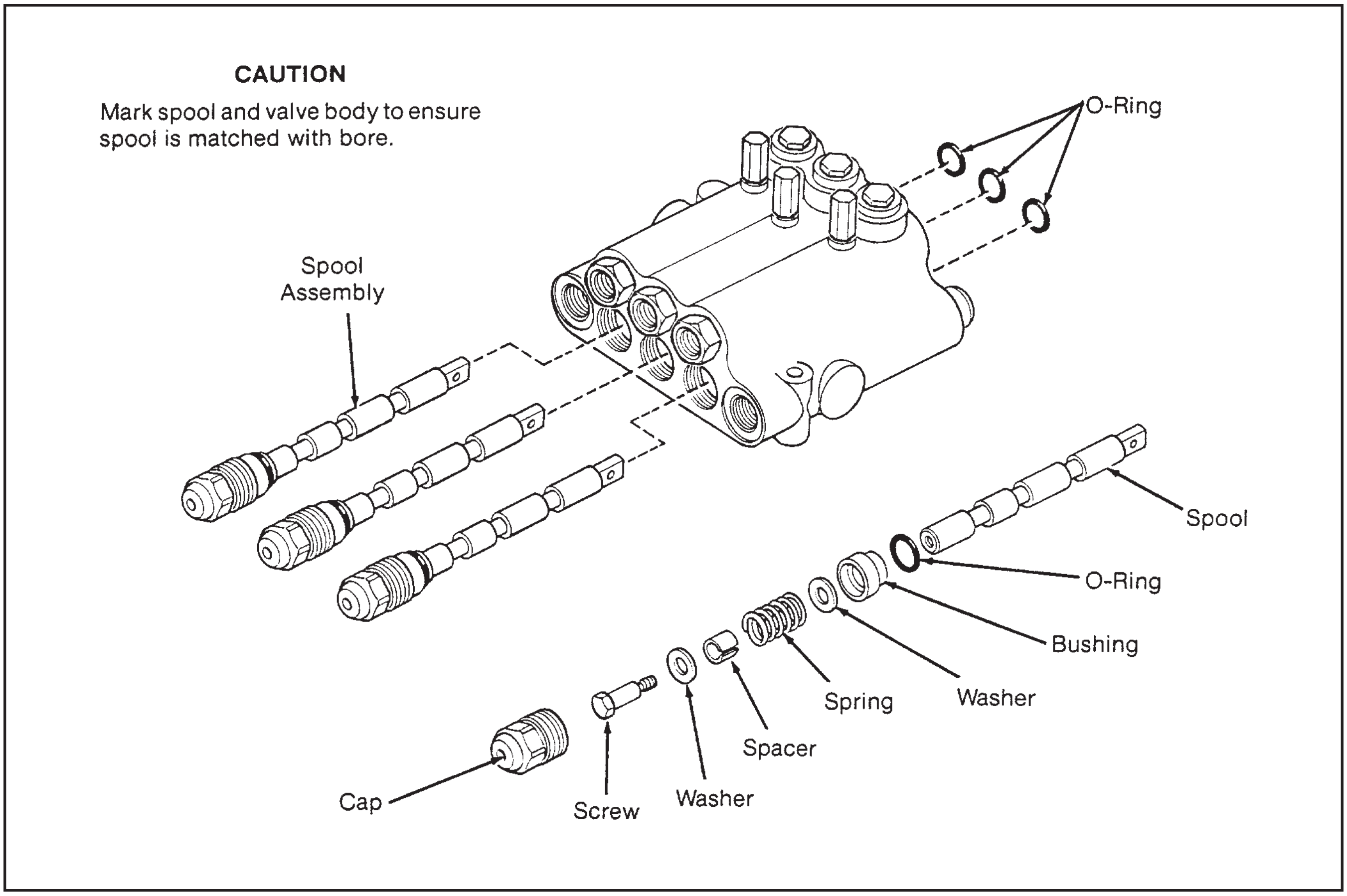


Figure 8H-3. Spool Assembly Removal

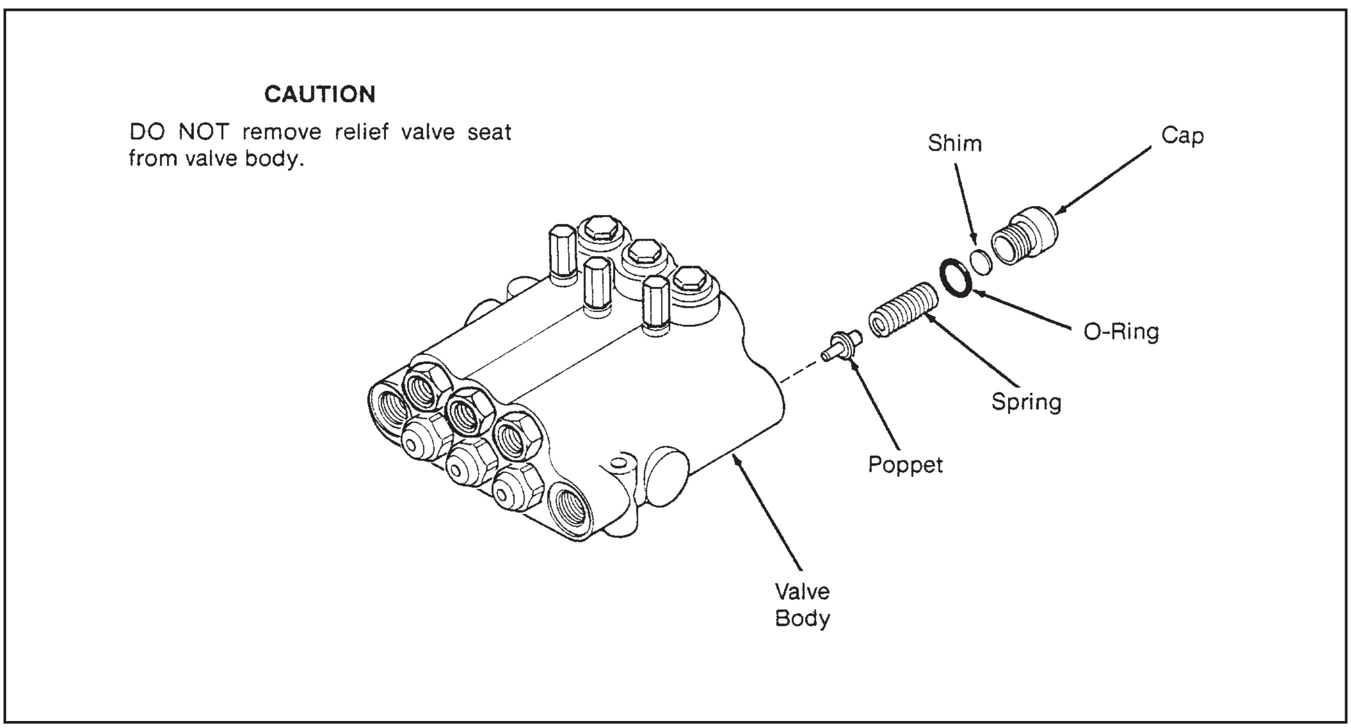


Figure 8H-4. Relief Valve Removal

SECTION 8H. LIFT AND LOWER CONTROL VALVE

INSPECTION

1. Remove all nicks and burrs from parts.
2. Inspect parts for excessive wear or damage, replace parts as necessary.
3. Inspect poppet seats for burrs or roughness.
4. Discard old O-rings and replace with new ones.

CAUTION

Do not remove relief valve seat.

REASSEMBLY

See Figures 8H-5 to 8H-7.

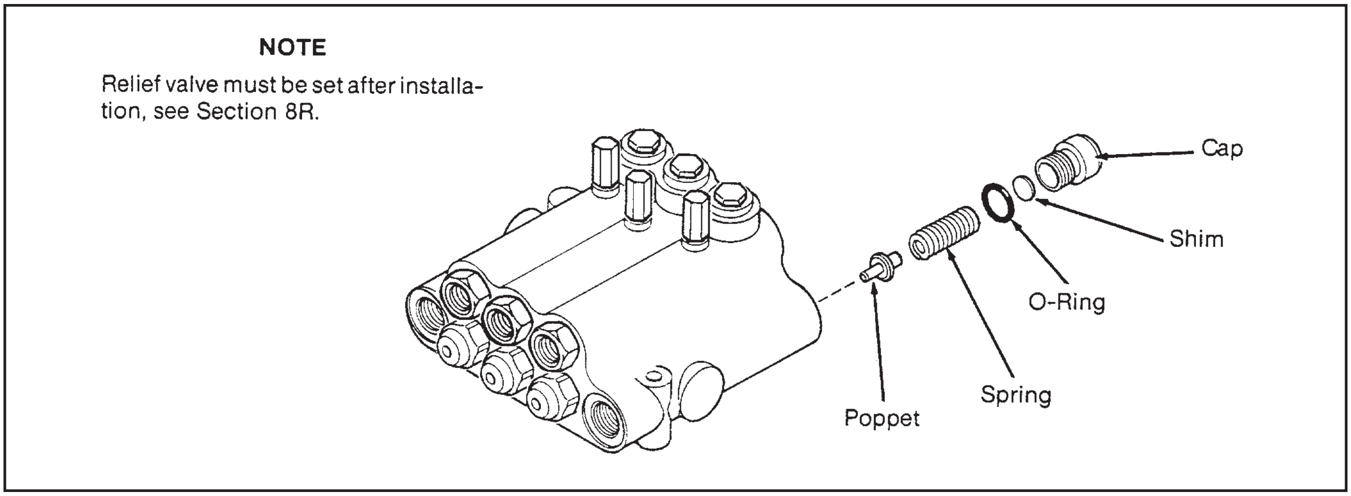


Figure 8H-5. Relief Valve Assembly

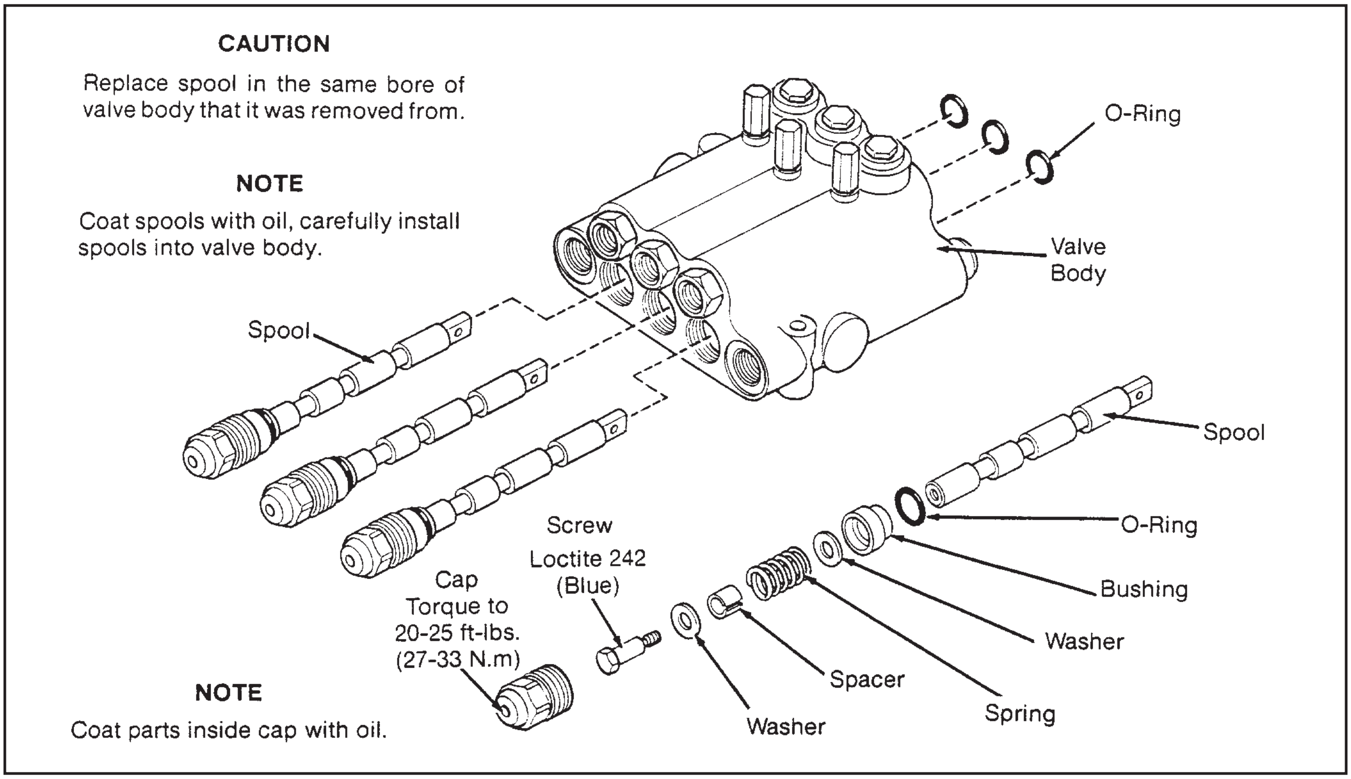


Figure 8H-6. Spool Assembly

SECTION 8H. LIFT AND LOWER CONTROL VALVE

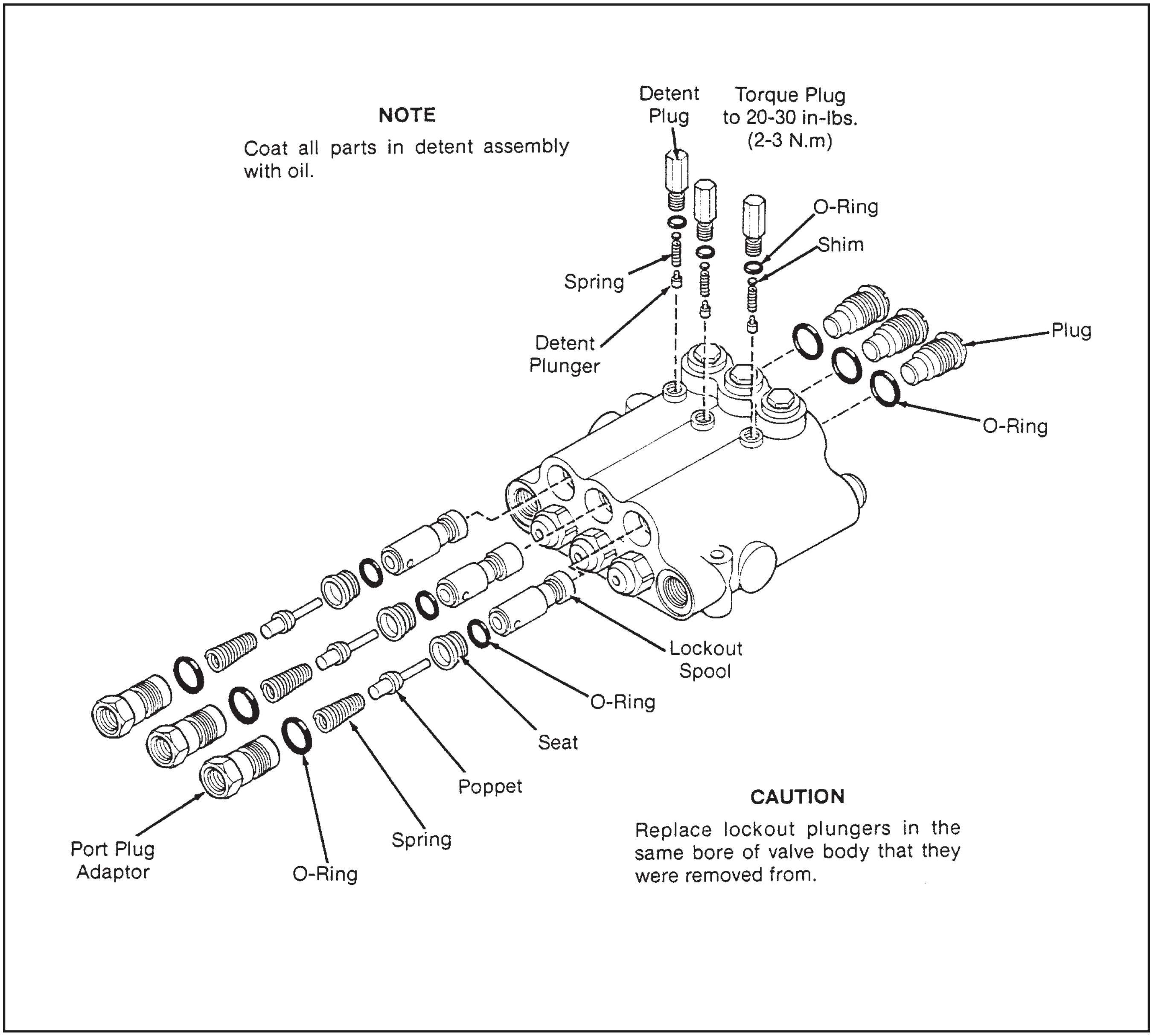


Figure 8H-7. Detent and Lockout Reassembly

SECTION 8I. TRACTION MOTOR

REPAIR

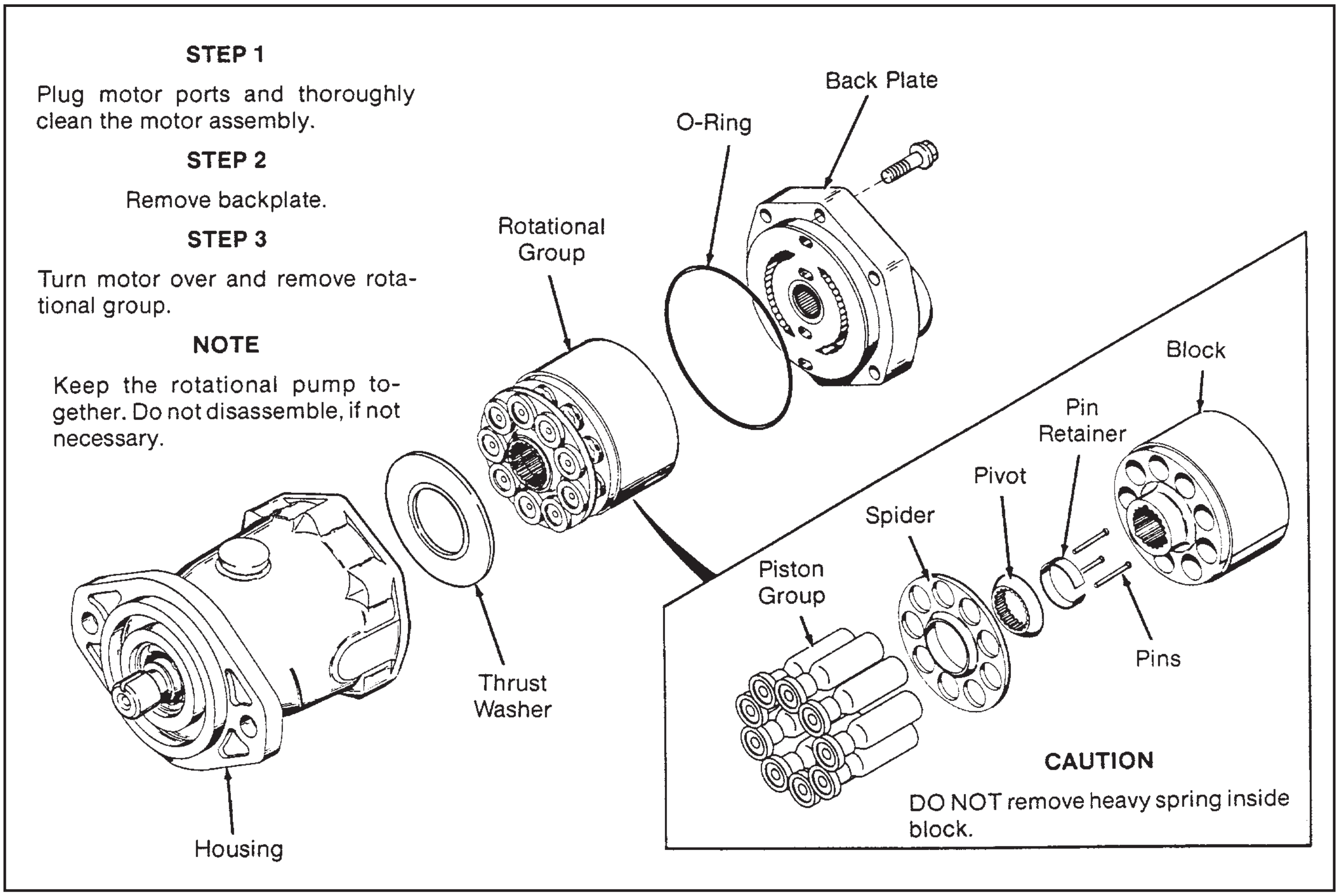


Figure 8I-1. Traction Motor Disassembly

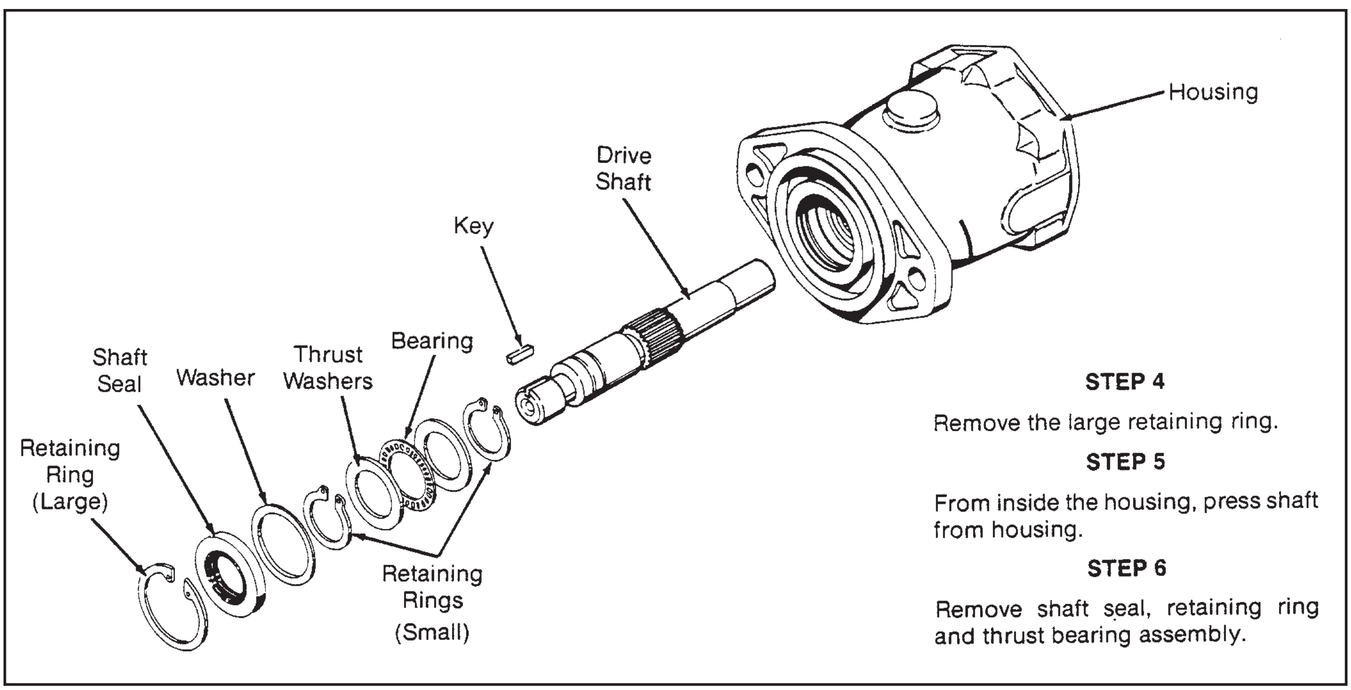


Figure 8I-2. Drive Shaft Disassembly

SECTION 8I. TRACTION MOTOR

INSPECTION

1. Inspect all parts for signs of wear or damage.
2. Inspect needle bearing in housing and lock plate. Needles should be free of excess play and remain in the bearing cage.
3. Inspect pistons and shoes. Pistons should be snug and shoes should be flat and have no signs of flaking.

NOTE

Do not tap piston shoes.

4. Inspect piston block. Make sure the flat surface is free of score marks.

NOTE

Do not lap piston block.

5. Inspect flat surface of back plate. It should be free of score marks and metal build up.

NOTE

Do not lap back plate.

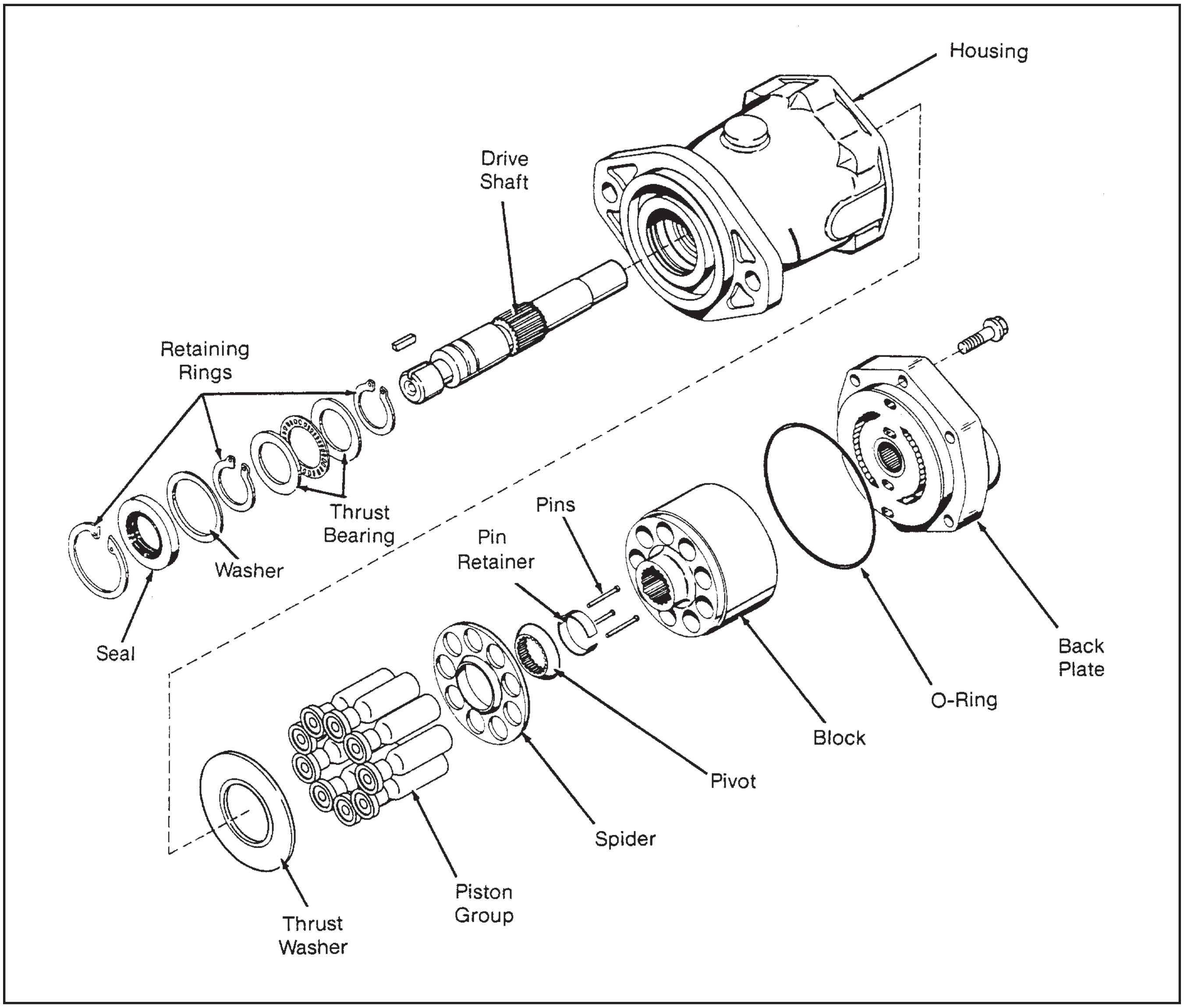


Figure 8I-3. Inspection

SECTION 8I. TRACTION MOTOR

STEP 7

Install small retaining ring, thrust washer, thrust bearing, thrust washer and small retaining ring.

STEP 8

Press shaft and bearing into housing.

NOTE

Do not press on bearing.

STEP 9

Install washer.

STEP 10

Press shaft seal into housing until it is approximately 7/32" (5.5 mm) below the surface.

STEP 11

Install large retaining ring against shaft seal.

STEP 12

Continue to press large retaining ring and shaft seal into housing until the retaining ring snaps into its groove.

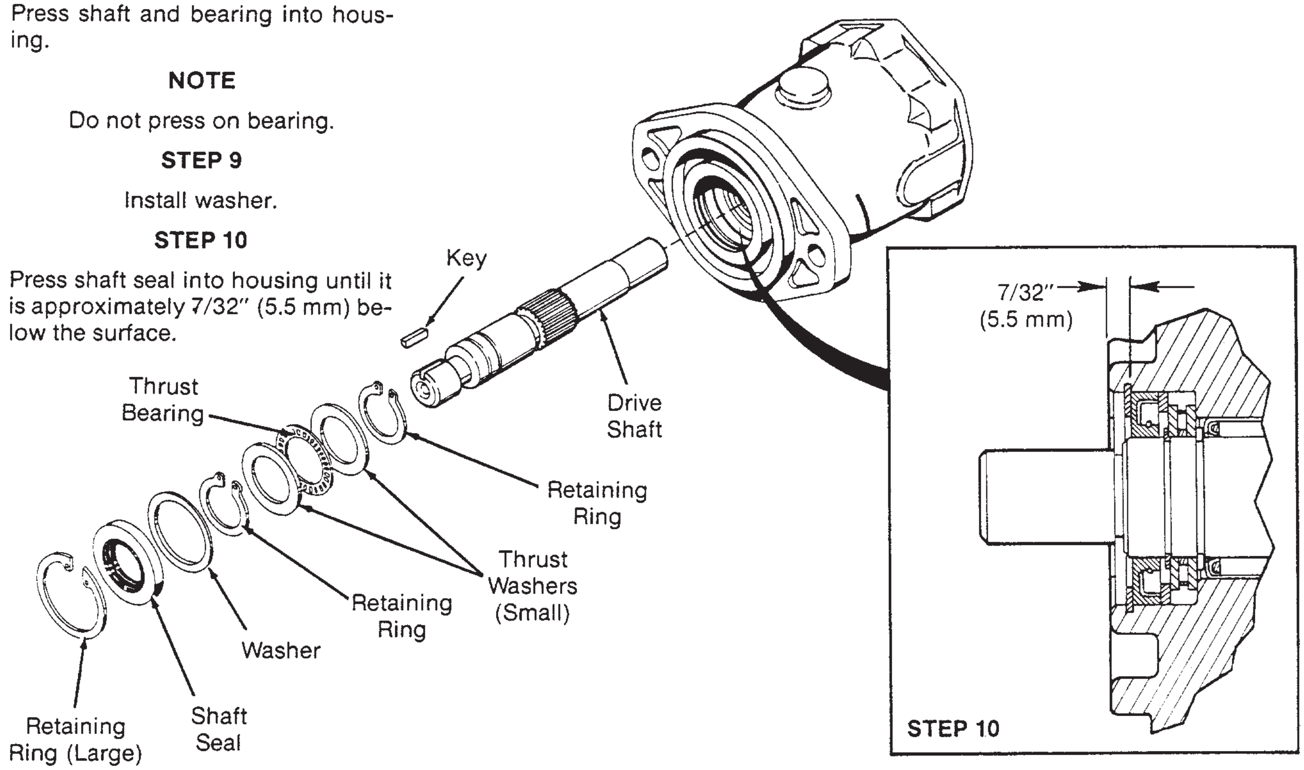


Figure 8I-4. Drive Shaft Reassembly

STEP 13

Install thrust washer making sure lettering is against the housing.

STEP 14

Install rotational group, keeping pistons together.

STEP 15

Install O-ring and back plate, torque back plate capscrews to 15-18 ft-lbs. (20-24 N.m).

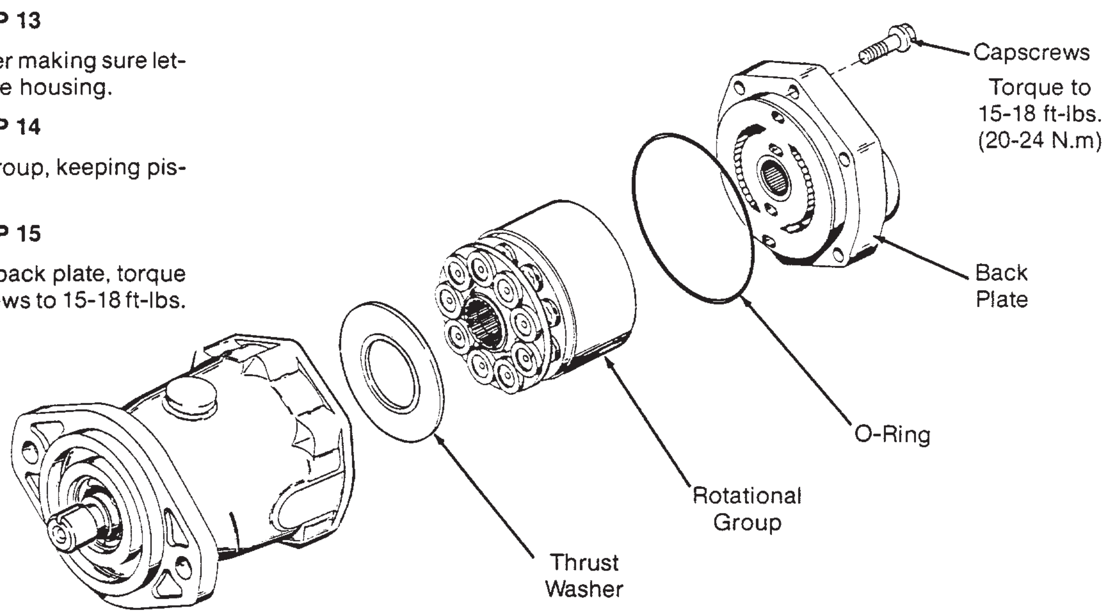
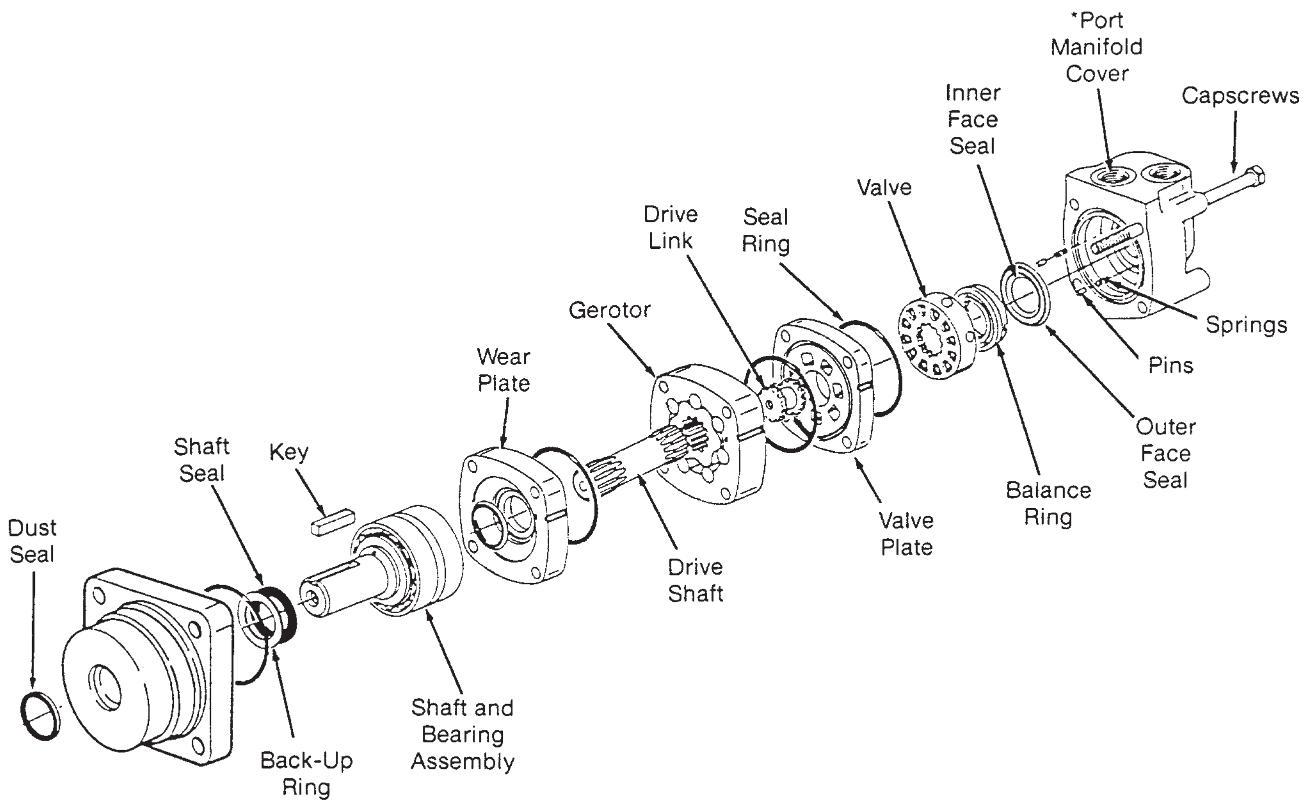


Figure 8I-5. Traction Motor Reassembly

8I

SECTION 8J. REAR TRACTION MOTOR

REPAIR



STEP 1

Disassemble motor as shown in this illustration.

***NOTE**

When removing the port manifold cover, be careful not to lose the two pins and springs between balance ring and cover.

STEP 2

Press the shaft and bearing assembly from the mounting flange end.

STEP 3

Remove and discard all seals, back-up ring and seal rings.

STEP 4

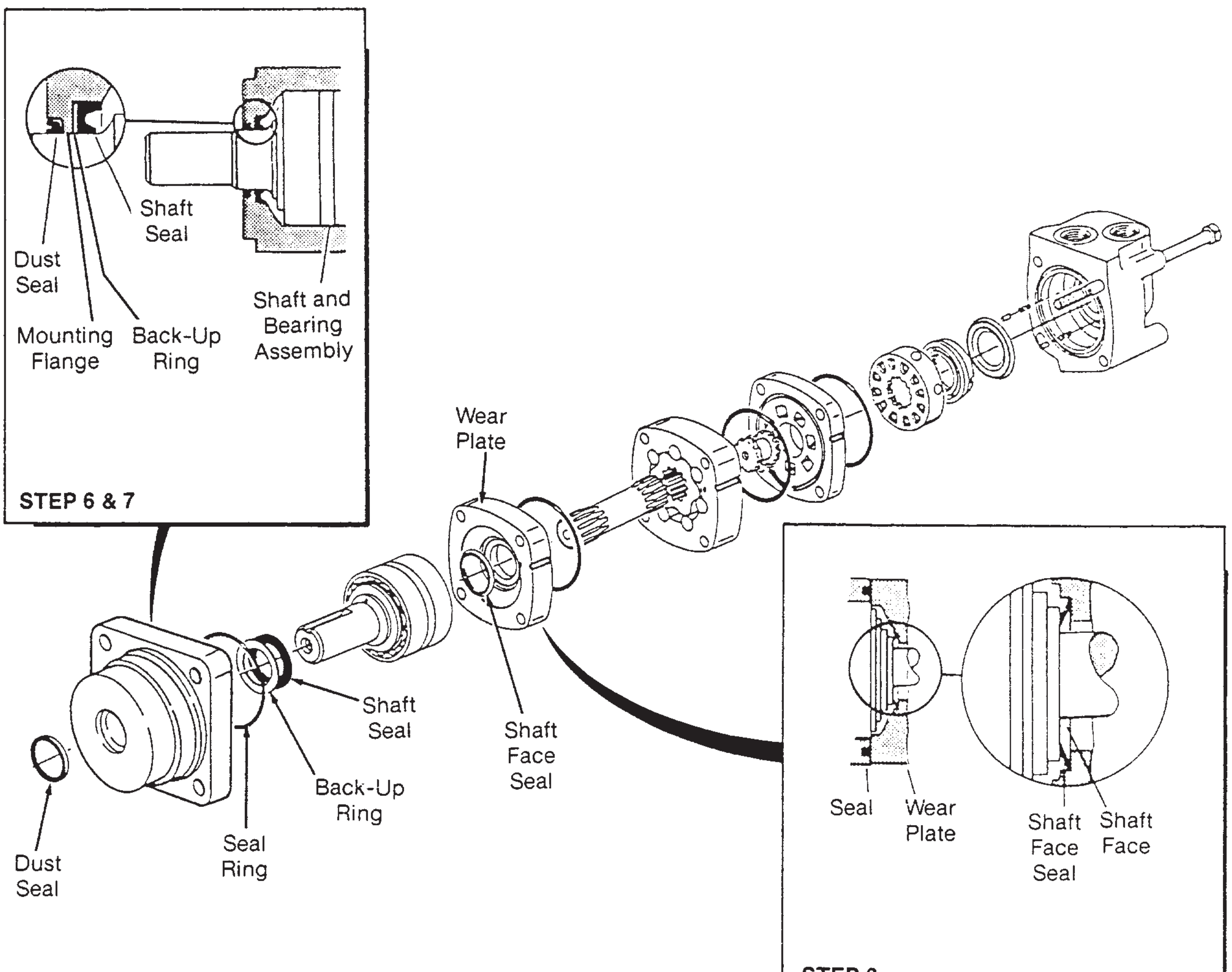
Clean all parts in a suitable solvent.

STEP 5

Inspect parts for wear or damage. The only serviceable items are the shaft and bearing assembly, shaft nut, key, bolts and a seal kit.

Figure 8J-1. Rear Traction Motor

SECTION 8J. REAR TRACTION MOTOR



NOTE

When reassembling the motor, be very careful to position seals, seal rings and back-up washer properly.

STEP 6

Install seals and back-up ring in flange end as shown.

STEP 7

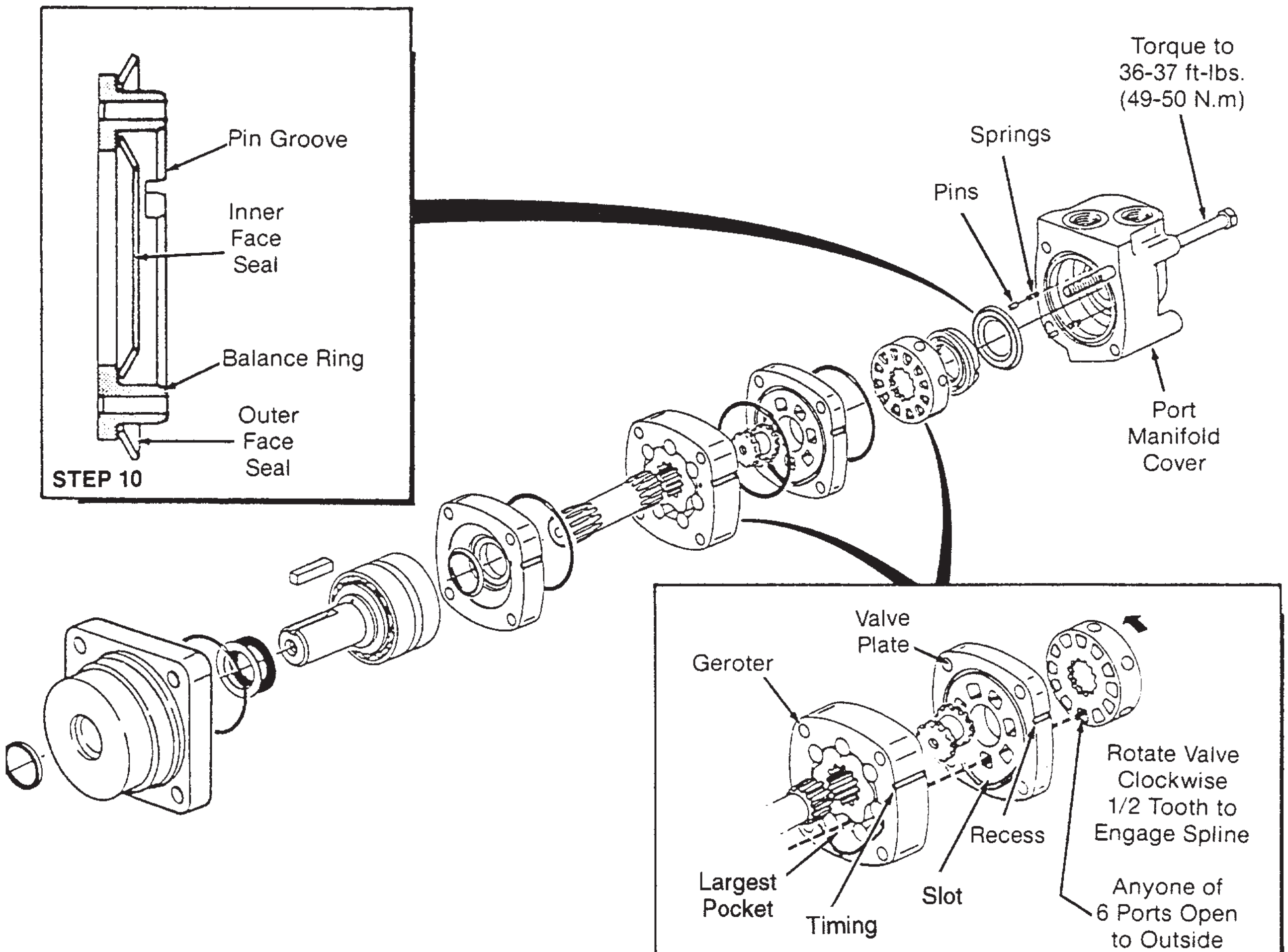
Press bearing and shaft assembly into flange end of motor.

STEP 8

Install shaft face seal as shown. Place wear plate on flange end.

Figure 8J-2. Seal Assembly

SECTION 8J. REAR TRACTION MOTOR



STEP 9

Continue to assemble as shown.

NOTE

Be sure the gerotor, valve plate and valve are timed, see inset.

STEP 10

Install inner and outer face seal, as shown, to balance ring.

STEP 11

Install balance ring on valve with pin groove facing up.

STEP 12

Coat springs and pins with petroleum jelly. Install both springs and pins in holes of manifold cover.

STEP 13

Carefully install manifold cover onto valve plate.

Center manifold cover and balance ring. When they are centered and aligned you should be able to push down on cover until it contacts the valve plate.

NOTE

The manifold cover will have a slight spring load to it, this is normal.

STEP 14

Install four capscrews and torque to 36-37 ft-lbs. (49-50 N.m).

Figure 8J-3. O-Rings and Seals

8J

SECTION 8K. CONTROL VALVE

REPAIR

Repair of the control valve is limited to changing cartridges or renewing O-ring on each cartridge.

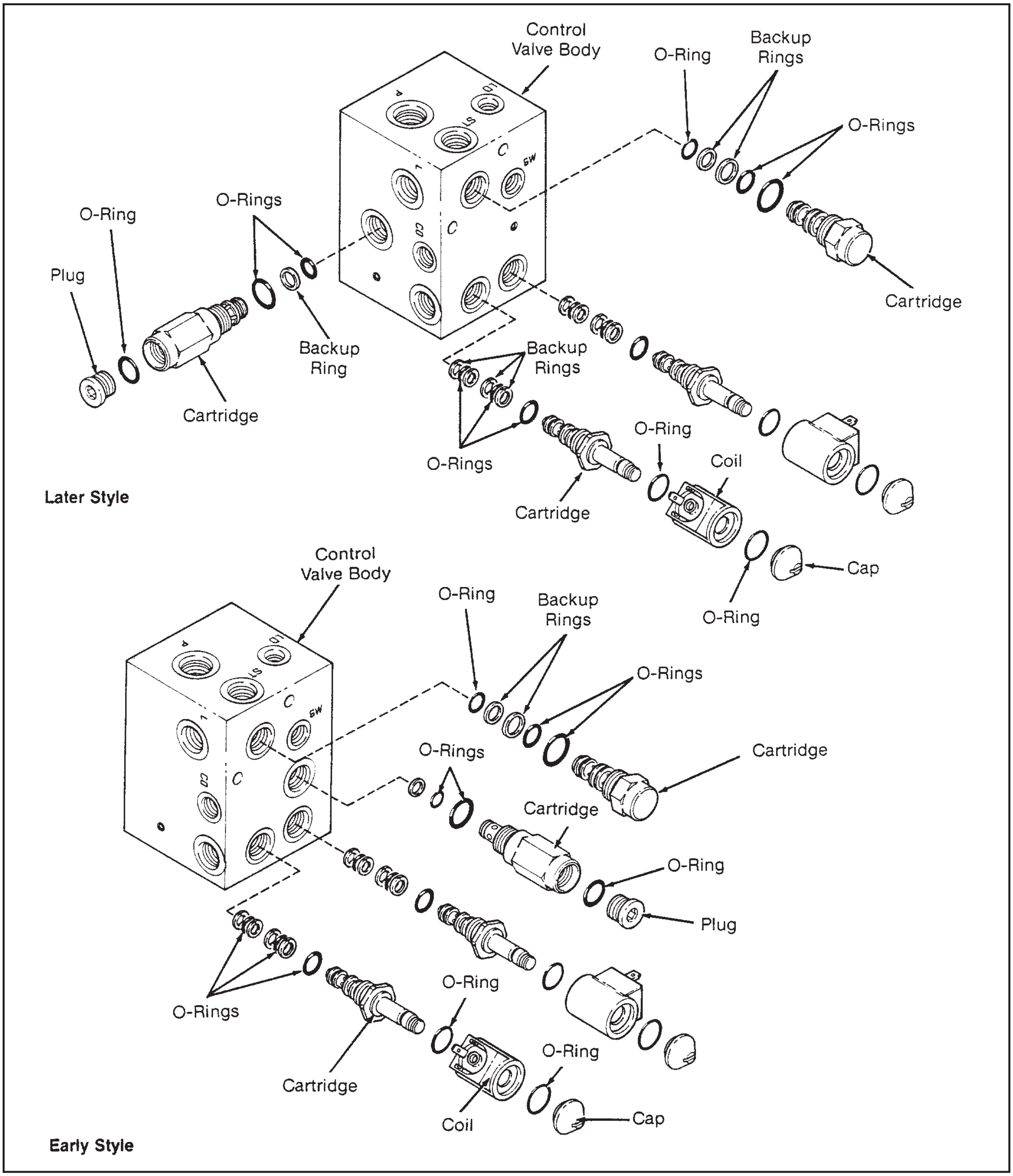


Figure 8K-1. Control Valve

SECTION 8L. LIFT CYLINDER

GENERAL

The HR5111 tractor uses four hydraulic cylinders to raise and lower the cutting units. The two wing cylinders are the same and are different from the two cylinders which are the same.

CAUTION

During repair of cylinder, use extreme care not to damage the body, rod or sealing surfaces of the cylinder.

FRONT CYLINDERS

DISASSEMBLY (See Figure 8L-1)

1. Clean and air dry exterior of cylinder.
2. Drain all the oil from the cylinder.
3. Disassemble, following the steps in Figure 8L-1.

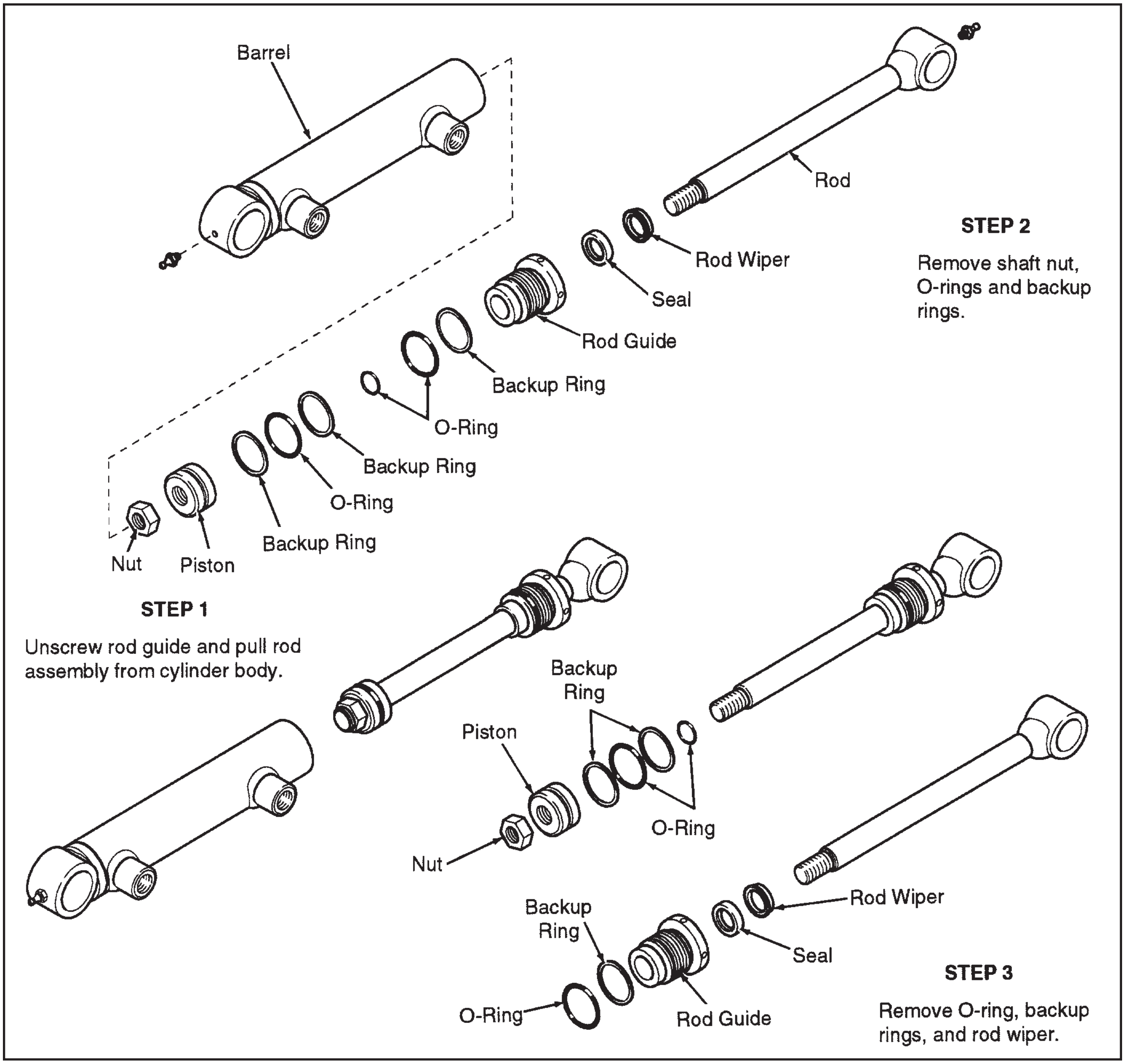


Figure 8L-1. Lift Cylinder Disassembly

SECTION 8L. LIFT CYLINDER

INSPECTION

1. Inspect all parts for excessive wear, cracks and broken parts.
2. Discard all O-rings, seals and seal ring.

REASSEMBLY

1. Lightly lubricate O-rings, seal ring and seals.
2. Install seal kit as shown in Figure 8L-2.
3. Lubricate all parts before assembly.
4. Follow the steps as illustrated in Figure 8L-3 for reassembly.

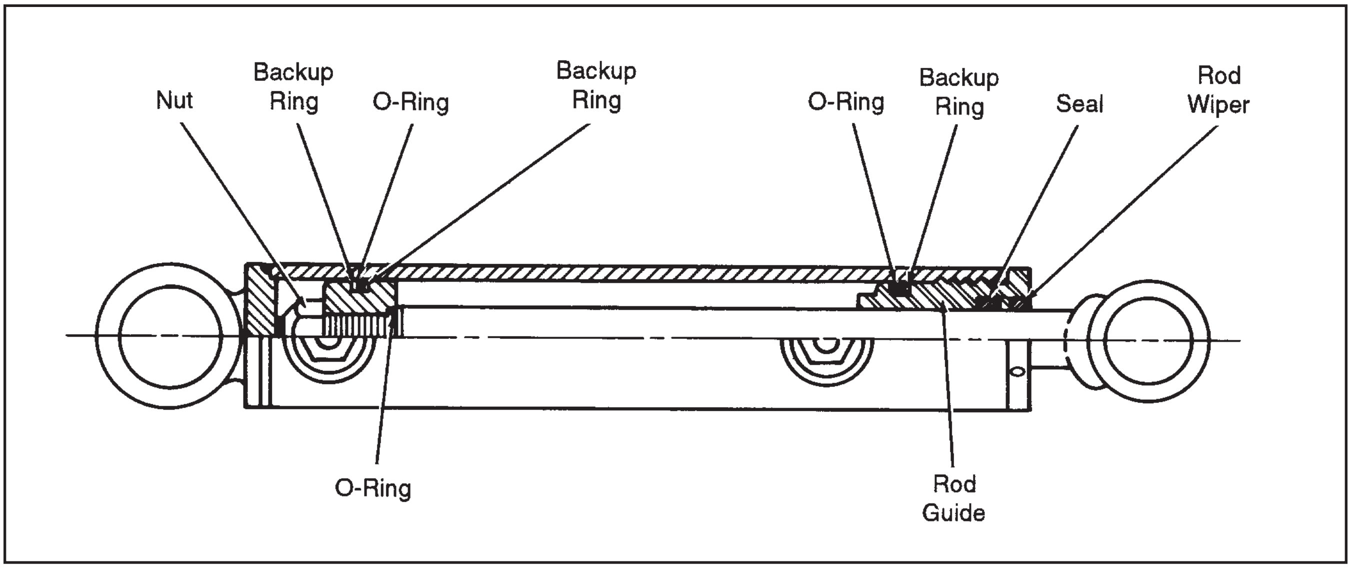


Figure 8L-2. Seal Kit Installation

SECTION 8L. LIFT CYLINDER

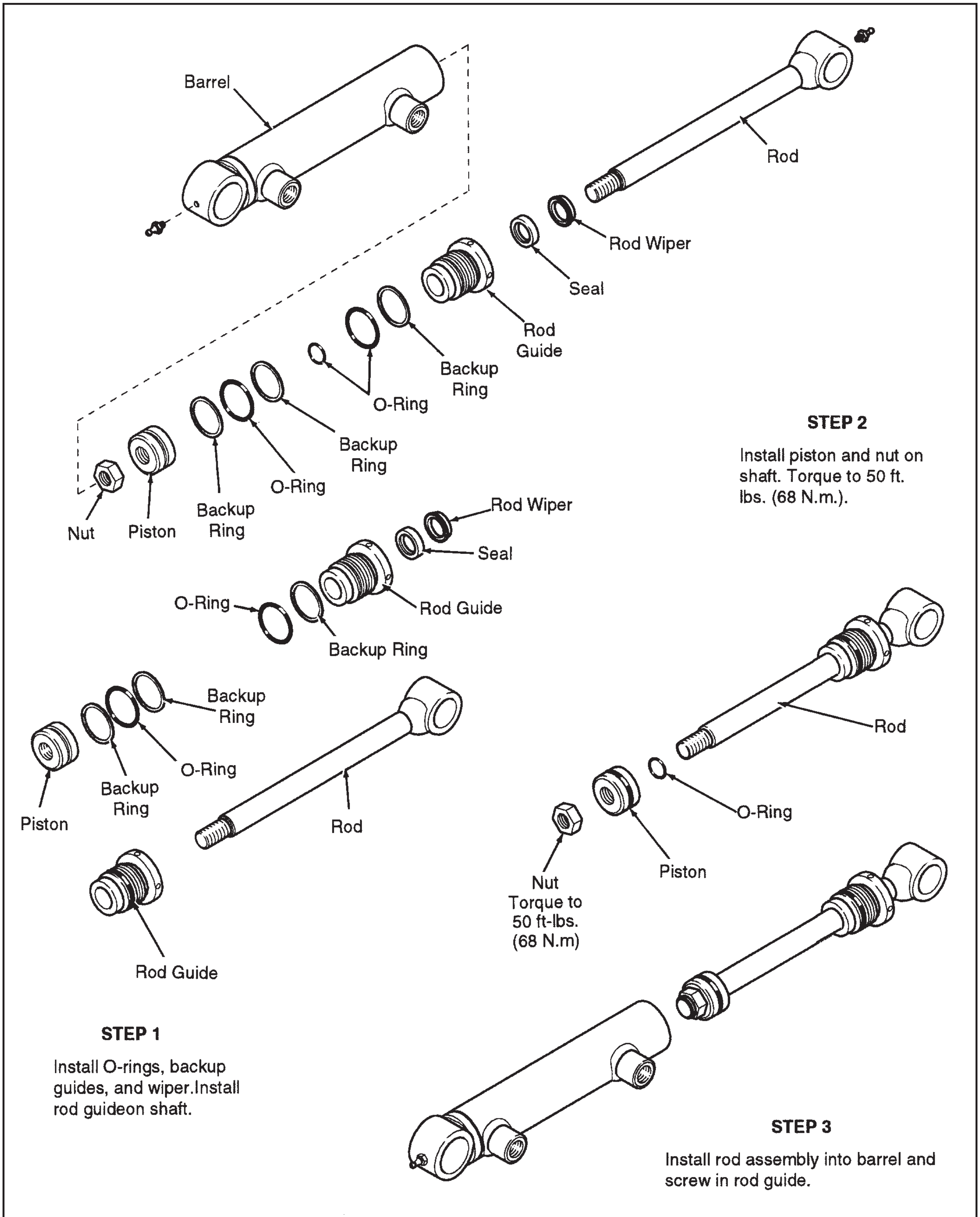


Figure 8L-3. Lift Cylinder Assembly

SECTION 8L. LIFT CYLINDER

WIRING CYLINDERS

DISASSEMBLY (See Figure 8L-4)

1. Clean and air dry exterior of cylinder.
2. Drain all the oil from the cylinder.
3. Disassemble following the steps in Figure 8L-4.
4. Disassemble remainder of cylinder as shown in Figure 8L-4.

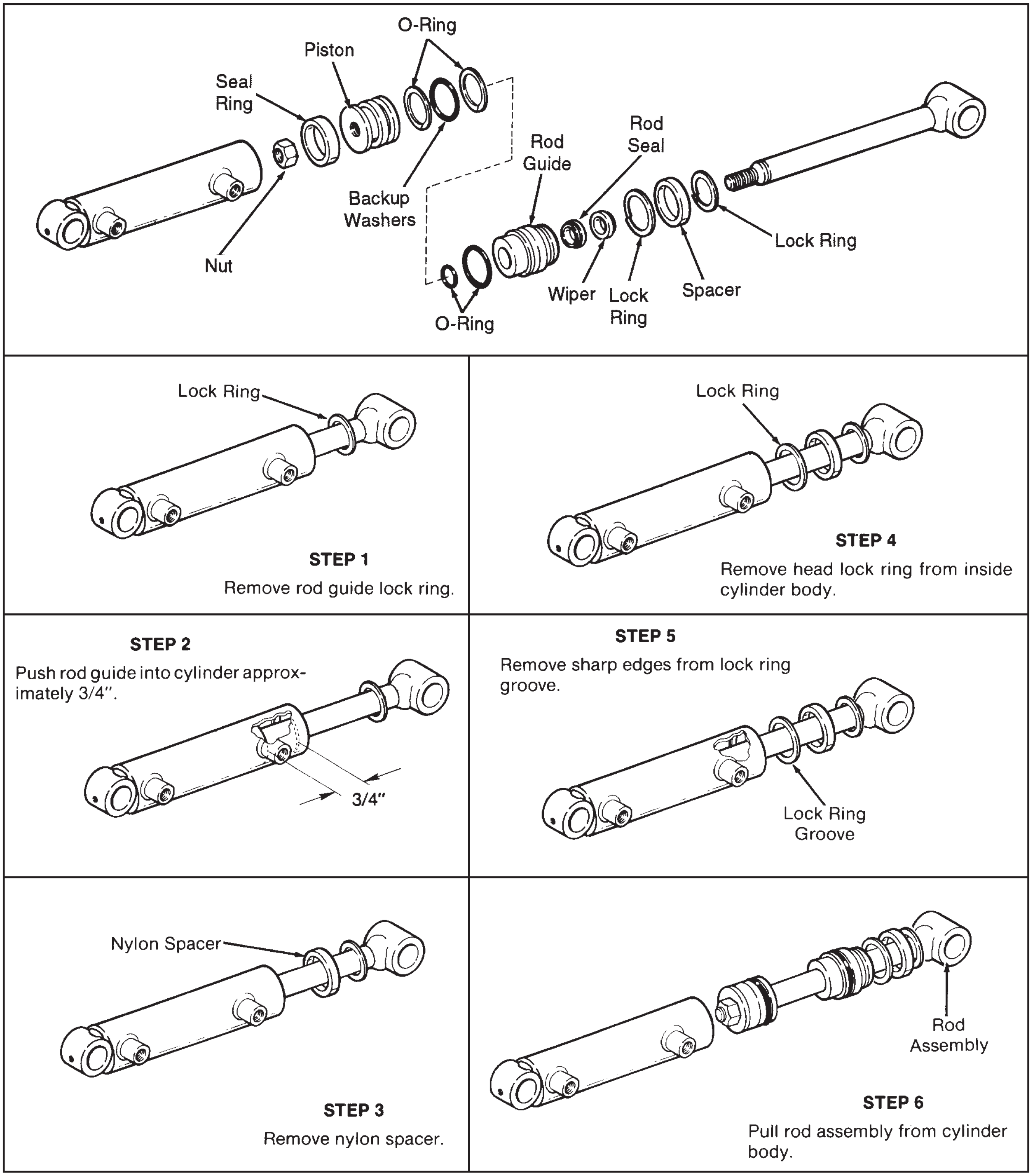


Figure 8L-4. Wing Cylinder Disassembly

SECTION 8L. LIFT CYLINDER

INSPECTION

1. Inspect all parts for excessive wear, cracks and broken parts.
2. Discard all O-rings, seals and backup rings.

REASSEMBLY

1. Lightly lubricate O-rings, backup rings and seals.
2. Install seal kit as shown in Figure 8L-5..

NOTE

Do not install rod O-ring at this time.

3. Lubricate all parts before assembly.
4. Follow the steps as illustrated in Figure 8L-5 for reassembly.

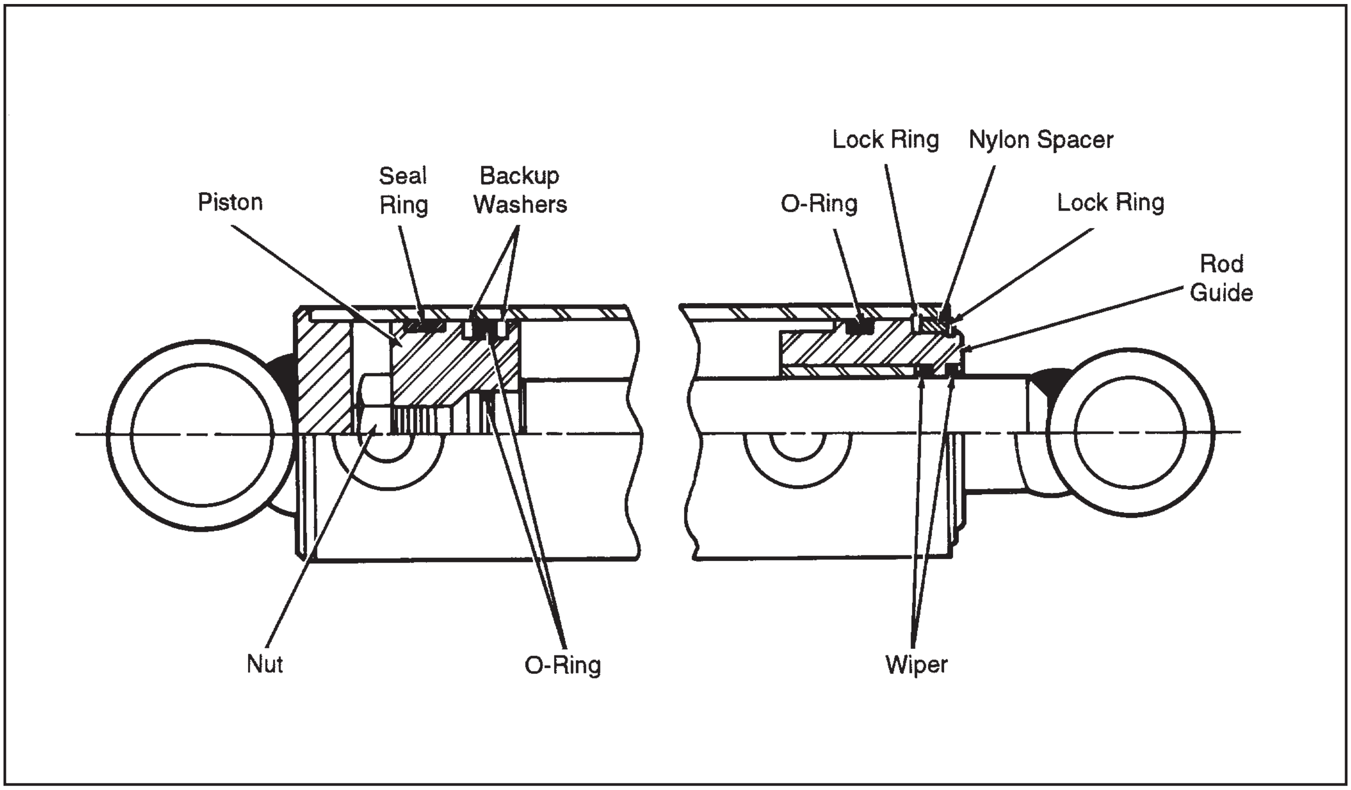
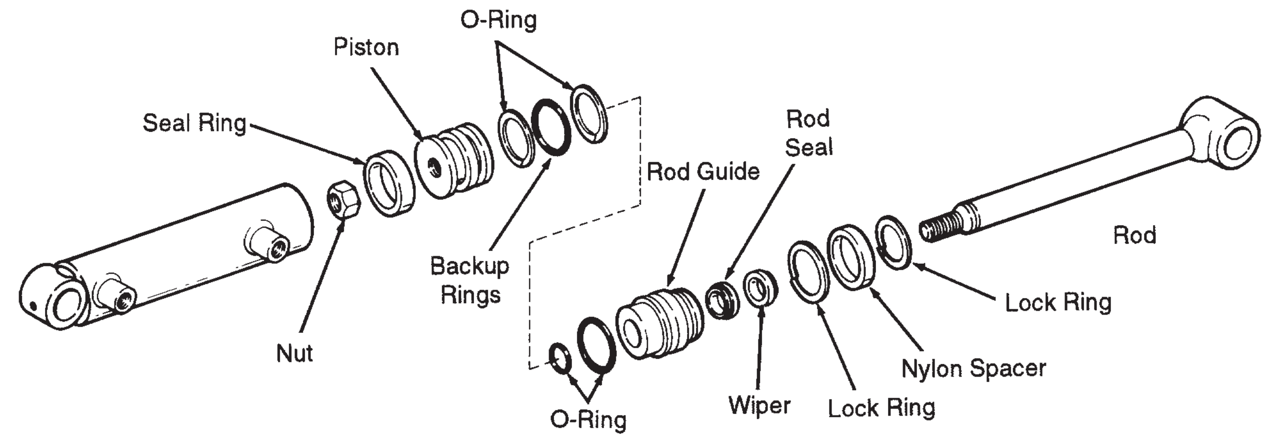
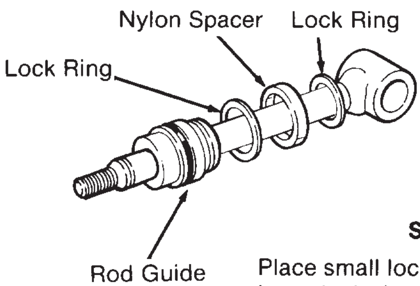


Figure 8L-5. Seal Kit Installation

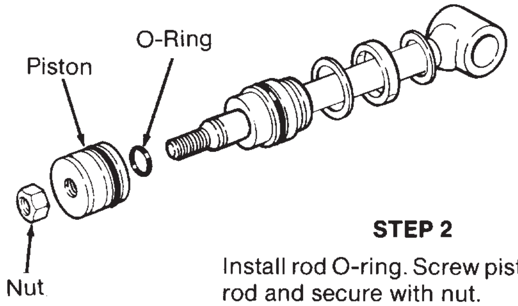
SECTION 8L. LIFT CYLINDER





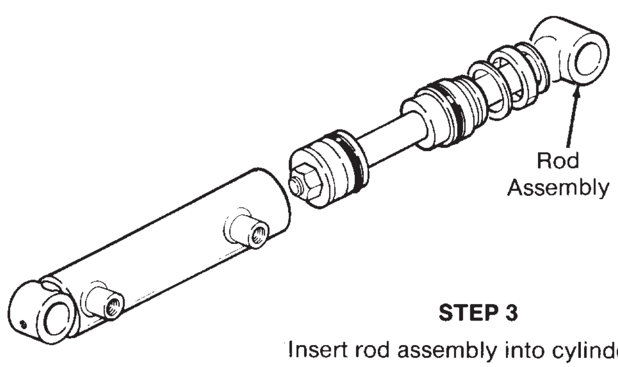
STEP 1

Place small lock ring, nylon spacer, large lock ring and rod guide onto rod.



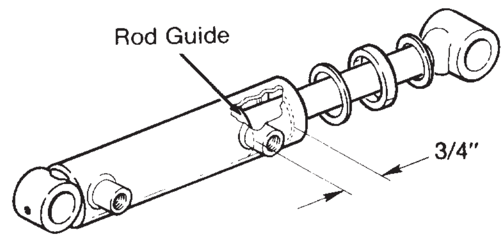
STEP 2

Install rod O-ring. Screw piston onto rod and secure with nut.



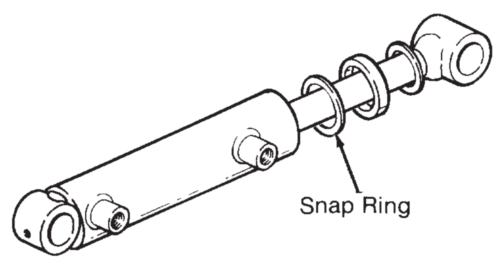
STEP 3

Insert rod assembly into cylinder body.



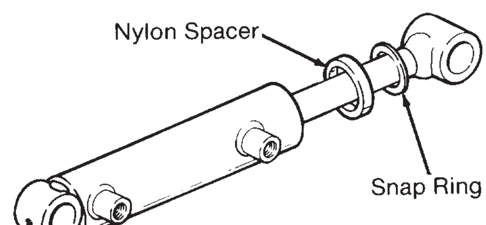
STEP 4

Push rod guide into cylinder approximately 3/4".



STEP 5

Install the large snap ring.



STEP 6

Pull rod and guide out. Install spacer and small snap ring.

Figure 8L-6. Wing Cylinder Assembly

SECTION 8M. MOWER MOTOR CONTROL VALVE

GENERAL

The mower motor control valves control oil flow to the mower motors. It is a 2 position, 4 way open center valve. The valve is solenoid operated. See Section 10I for solenoid test.

The following illustration shows one of the three valves.

REPAIR (See Figure 8M-1)

Repair of the valve consists of installing a new O-ring kit for changing a coil.

1. Follow the sequence as illustrated to disassemble the solenoid valve.
2. Keep all parts in proper order.
3. Wash and air dry parts.

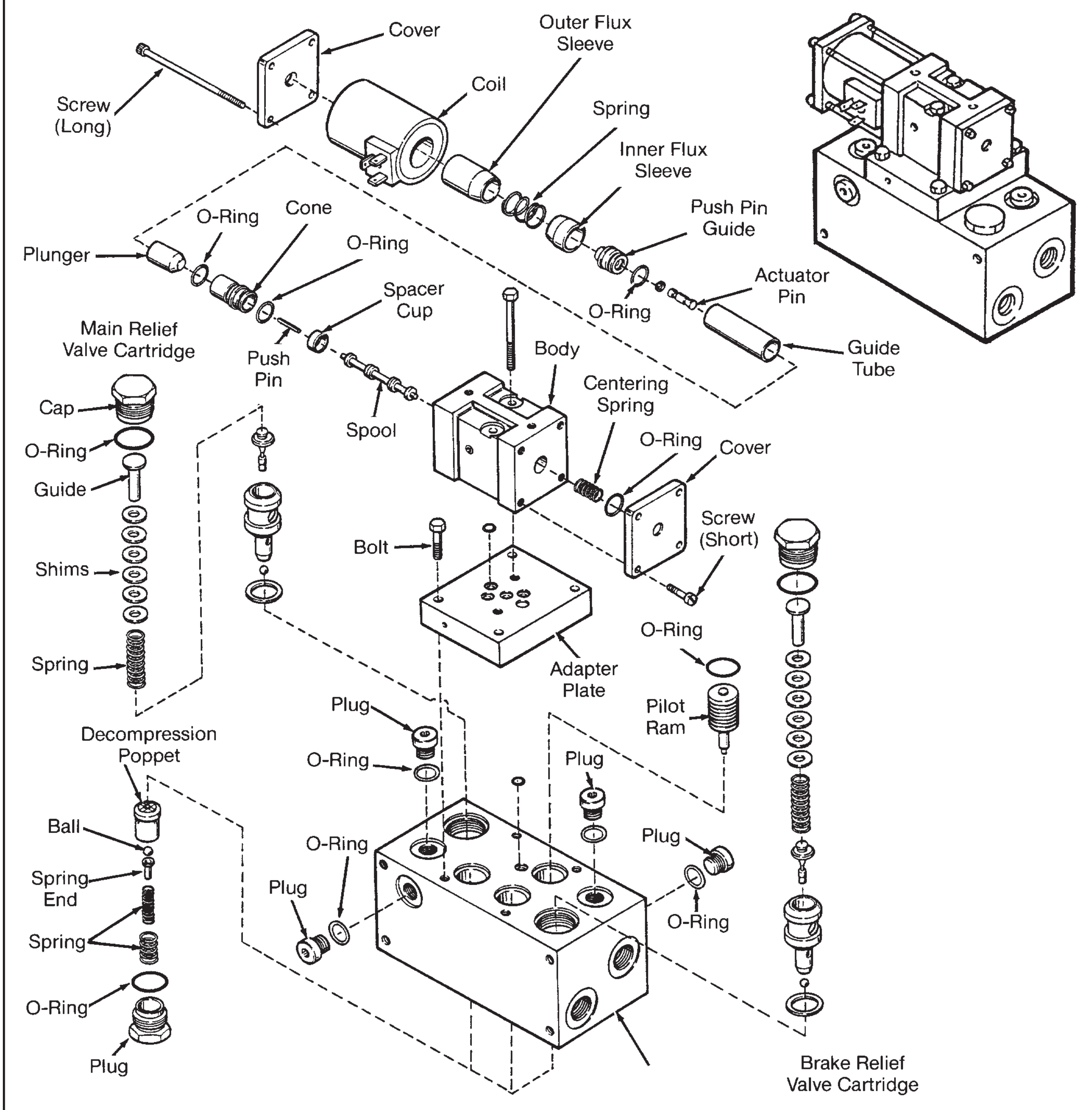


Figure 8M-1. Mower Motor Control Valve

8M

SECTION 8M. MOWER MOTOR CONTROL VALVE

INSPECTION

1. Inspect all parts for signs of excessive wear or damage.
2. O-rings should be discarded and a new kit O-ring installed.
3. Check spool making sure it slides smoothly in valve body.
4. Check plunger making sure it slides easily in the outer flux sleeve.
5. Check for broken or cracked return spring.

INSTALLATION

Install control valve to frame with attaching hardware.

SOLENOID COIL REPLACEMENT

Refer to Section 10I for test procedures on the solenoid coil.

The coil can be easily changed as illustrated (see Figure 8M-2).

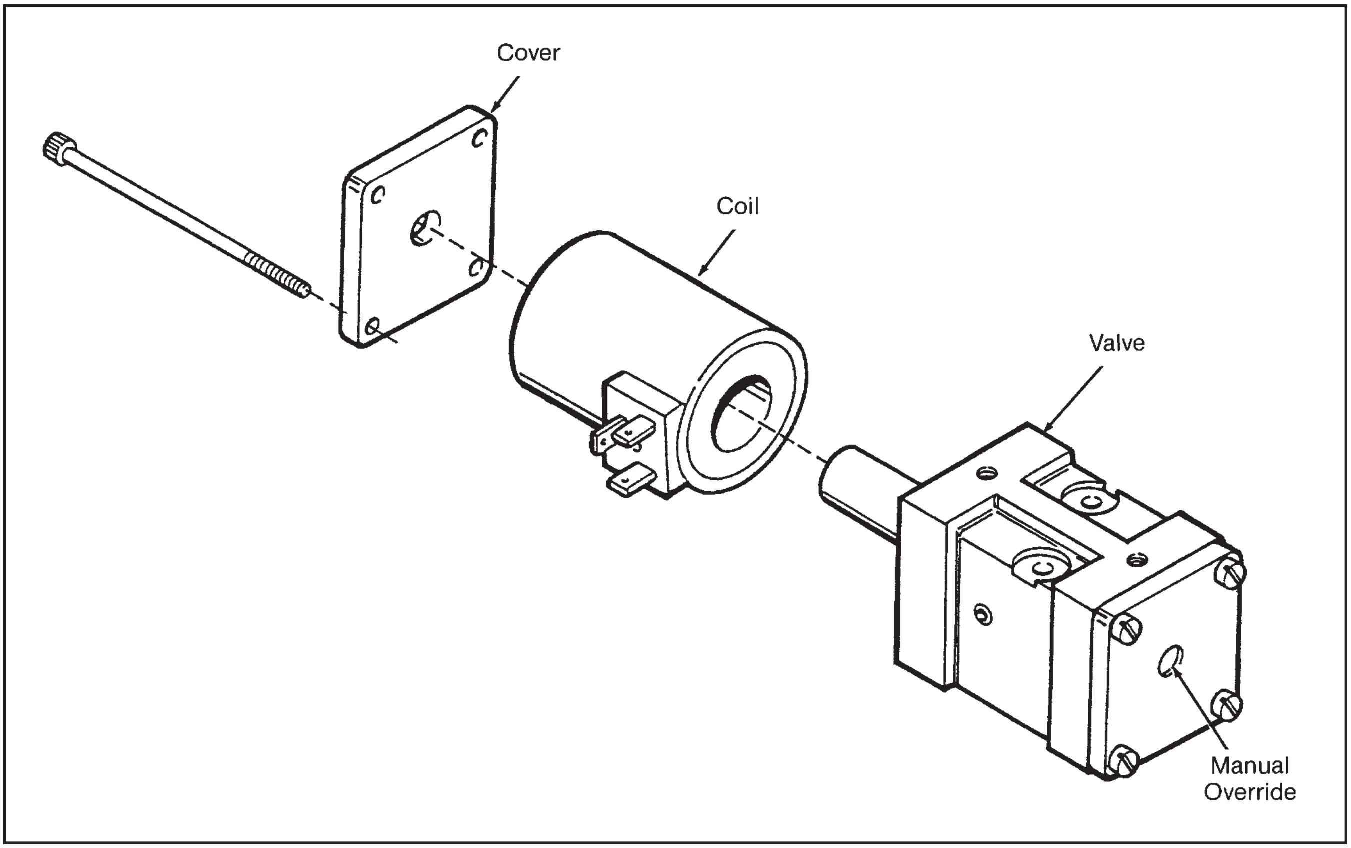


Figure 8M-2. Solenoid, Mower Motor Control Valve

SECTION 8N. MOWER MOTOR

GENERAL (See Figure 8N-1)

The motors used on the HR5111 are uni-directional and positioned according to their rotation. Viewed from the shaft end, clockwise (CW) rotating motors have the letter C stamped on the motor housing. Motors that are counterclockwise (CCW) rotating have the letter A stamped on the motor housing.

Prior to disassembly, mark the position of the check valve in the cover to motor housing.

REPAIR (See Figure 8N-2)

Repair of the motor is limited to the replacement of seals and O-rings.

Disassemble as illustrated in Figure 8N-2 adhering to important instructions.

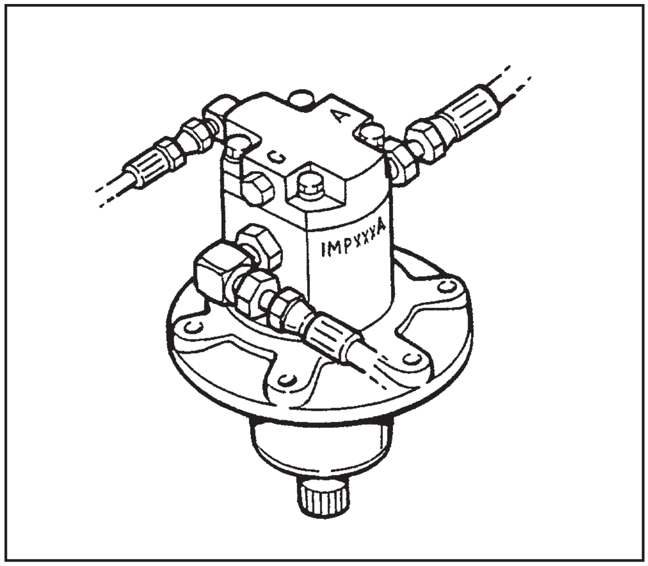


Figure 8N-1. Motor Identification

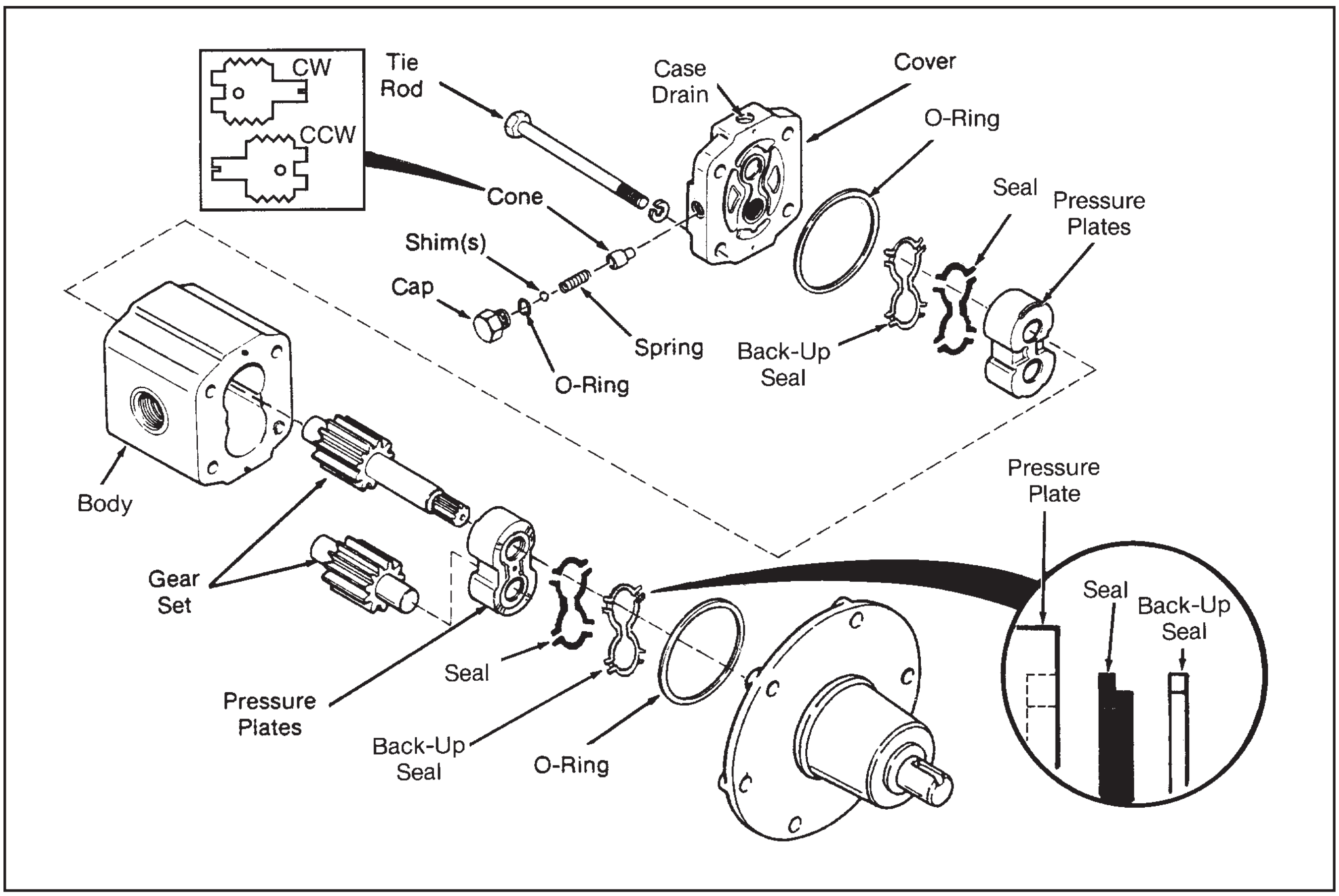


Figure 8N-2. Implement Motor Repair

SECTION 8N. MOWER MOTOR

DISASSEMBLY

1. Clean exterior of motor with suitable solvent before removing the bolts.
2. Before disassembly mark motor sections, starting at drive shaft end, to ensure correct order and position of parts when reassembling. Recommended method of marking body sections is to use a fine point metal punch, making one indentation for section #1, two indentations for section #2, etc.

⚠ CAUTION

Never pry motor sections apart as damage to sealing areas can result. Use of a soft face hammer to tap sections apart is recommended.

3. After removing the bolts and cover, mark a line across meshing teeth to ensure that gears are reassembled in the same position (see Figure 8N-3).
4. Remove gear set.
5. Place parts in assembly order, on a clean work area, as they are removed.
6. Discard seals as they are removed.

INSPECTION

1. Keeping parts in assembly order, clean and air dry each for inspection. Look for metal chips or slivers during cleaning (an indication of damage to motor or other hydraulic component).
2. Inspect all parts for cracks, nicks, burrs and excessive wear. Replace entire motor if found damaged or worn.

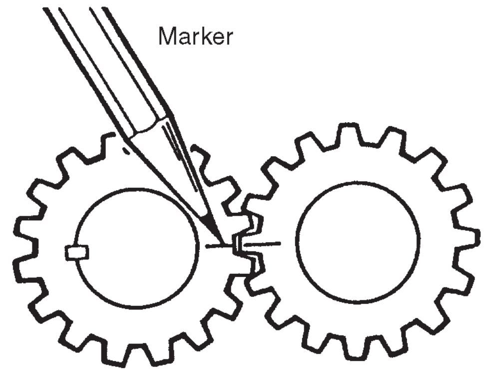


Figure 8N-3. Marking Gear Teeth

REASSEMBLY (See Figure 8N-2)

1. Apply a coat of clean hydraulic oil to all parts to ease assembly.
2. Assemble motor one section at a time, building up from flange section.
3. Use a new seal kit during assembly. Use clean grease to keep seals in position.
4. Remove alignment mark from gear sets after they have been installed with teeth in mesh.
5. Rotate gear set after assembling to make sure there is no binding between parts.
6. Install the bolts, finger tight and rotate gear set to make sure it turns freely. Tighten tie bolts evenly and in steps to a final torque of 26–30 ft-lbs. (35–41 N.m).

SECTION 8O. OIL COOLER COLD OIL BYPASS

REPAIR

The bypass is located at the bottom left side of the hydraulic tank.

Repair is limited to cleaning only. Disassemble and flush with a cleaning solvent.

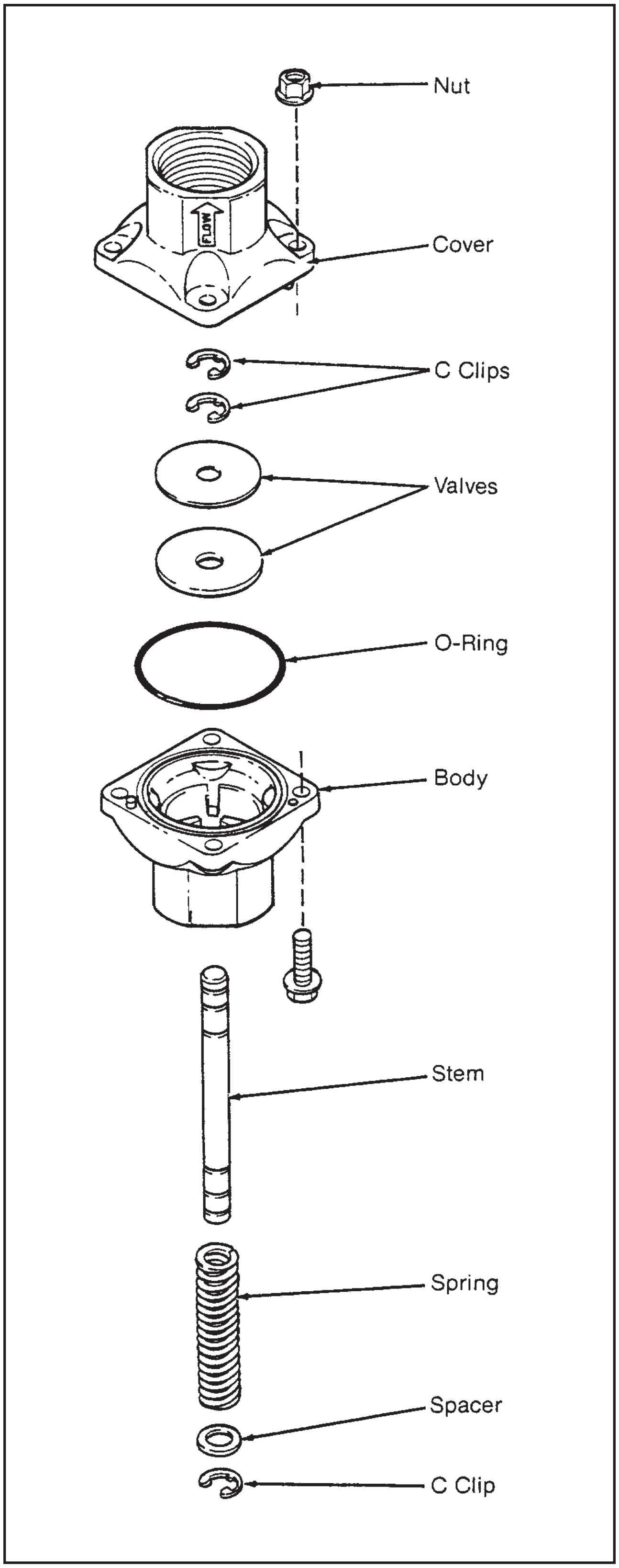


Figure 8O-1. Bypass

SECTION 8P. FLOTATION CONTROL

REPAIR

Repair of the flotation control is renewing O-ring or replacing the control cartridge.

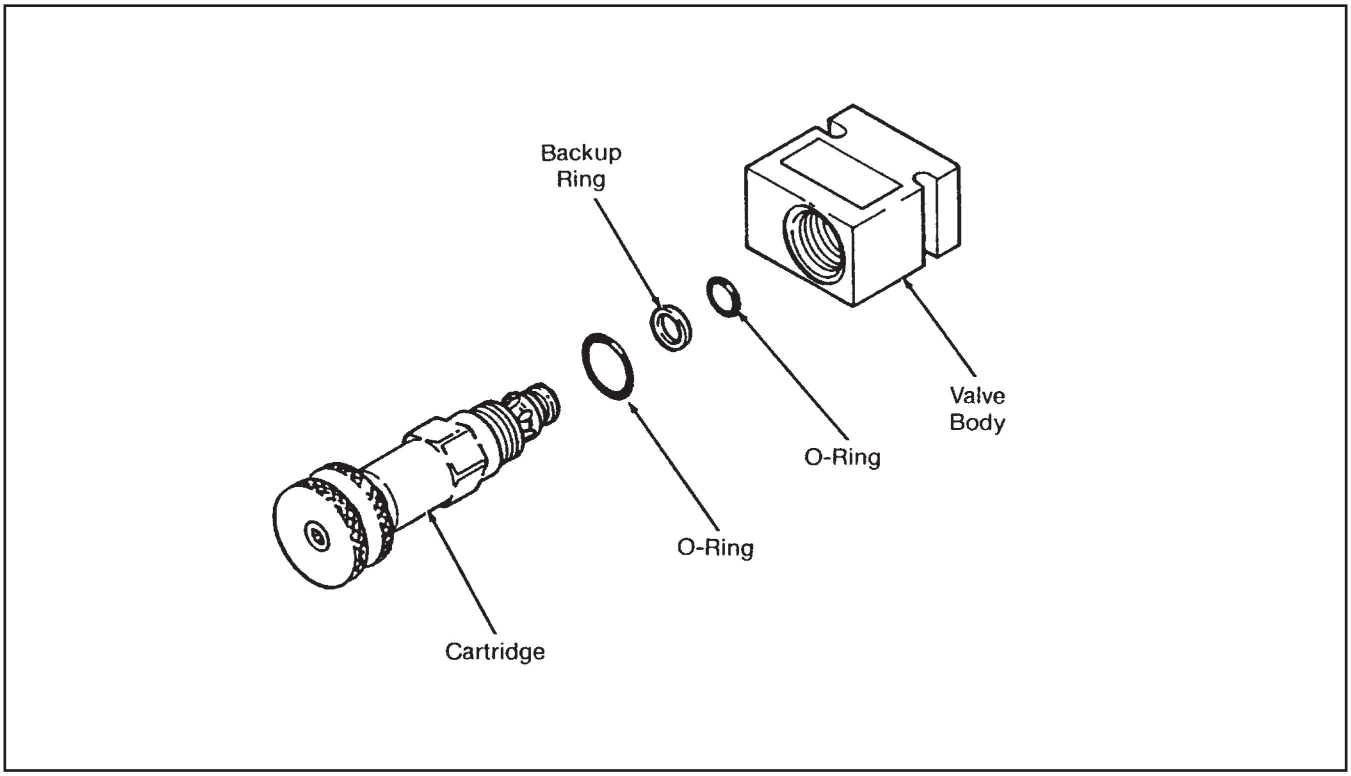


Figure 8P-1. Back Pressure Control Valve

SECTION 8Q. HYDRAULIC FIELD TEST PROCEDURES

GENERAL

The purpose of this section is to provide a guide for field testing the hydraulic system. More extensive test procedures, using test instruments, are presented in Section 8R. Component location illustrations, hydraulic schematics and diagrams are presented in Section 8S. Before performing any tests see "Preliminary Checks" below.

AS A SAFETY REMINDER

- Follow the procedures one step at a time.
- Observe all NOTES, CAUTIONS and WARNINGS.
- Pay attention to what you are doing. Work with a safety conscious attitude.
- Use care working with HOT oil.
- Wear safety glasses at all times.
- Keep hands and feet away from the moving parts.
- Engine must be shut off and attachments lowered to ground when making adjustments or hydraulic connections unless otherwise specified in the test instructions.

PRELIMINARY CHECKS

The following preliminary checks should be made before performing any tests.

1. The reservoir should be checked for proper level, the presence of water (noted by a cloudy or milky appearance), air (noted by a foaming appearance), or a rancid odor indicating excessive heat.

   If any of the above symptoms appear, or if the hydraulic oil becomes contaminated, or after a major component failure, the oil should be changed and system flushed.

   NOTE

   Use only the recommended hydraulic oil (see Section 11 — Preventive Maintenance). Always change the filter when changing the oil.

   The filter should be changed after the initial 25 hours of operation. Thereafter, the filter should be changed approximately every 250 hours.

2. Check all lines and fittings for leakage and tighten as necessary (see Section 8C).
3. To eliminate all possible mechanical problems first, complete the steps presented in block form below before starting the hydraulic tests.

FIELD TESTS

When a hydraulic failure occurs, some simple, effective tests can be performed prior to using a test instrument. The results of these tests can lead you to the suspected component failure. If further testing is necessary, proceed to INSTRUMENT TESTS.

CHARGE PUMP

The charge pump (section #4 implement pump) supplies oil for the power steering unit, lift and lower, differential lock, 4 wheel drive valve and for charging the hydrostat for traction.

If a fault affects all the systems, proceed with an instrument test for the charge pump.

TRACTION PUMP (See Figure 8Q-2)

NOTE

Before performing any tests, be sure dump valve located on top of the traction pump is closed (see Figure 8Q-1).

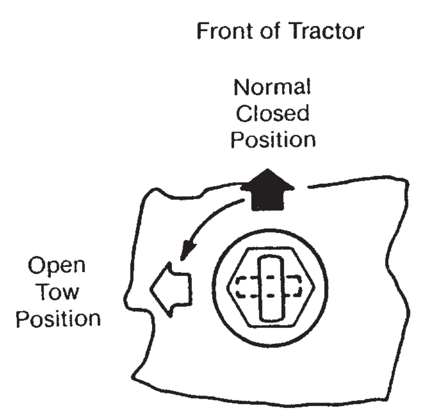


Figure 8Q-1. Dump Valve

1. Remove left hydraulic lines from traction pump. Cap line and plug motor port.
2. Be sure the oil is at operating temperature.
3. With the engine throttle wide open, slowly step on the "forward" traction pedal.
   - If the engine stalls or labors the pump is okay. A fault may exist in the main traction motor or 4 wheel drive assembly.

8Q

SECTION 8Q. HYDRAULIC FIELD TEST PROCEDURES

- If the engine does not labor, a fault exists in the traction pump.

4. Reconnect hydraulic lines to the traction pump.
5. Remove both hydraulic lines from the 4 wheel valve. Plug the hoses and cap the valve ports.
6. With the tractor on asphalt or concrete, chain the tractor to an unmovable object such as a pole or tree.
7. With the engine throttle wide open, 2 wheel drive and cutting units lowered, slowly step on the traction pedal.

- If the engine labors or the tractor drive tires brake traction the traction motor is okay, proceed with Step 8.
- If the engine does not labor, the fault may be the traction motor.

8. Reconnect hydraulic lines to 4 wheel drive valve. A probable cause may be in the 4 wheel drive system. Perform an instrument test, Section 8R.

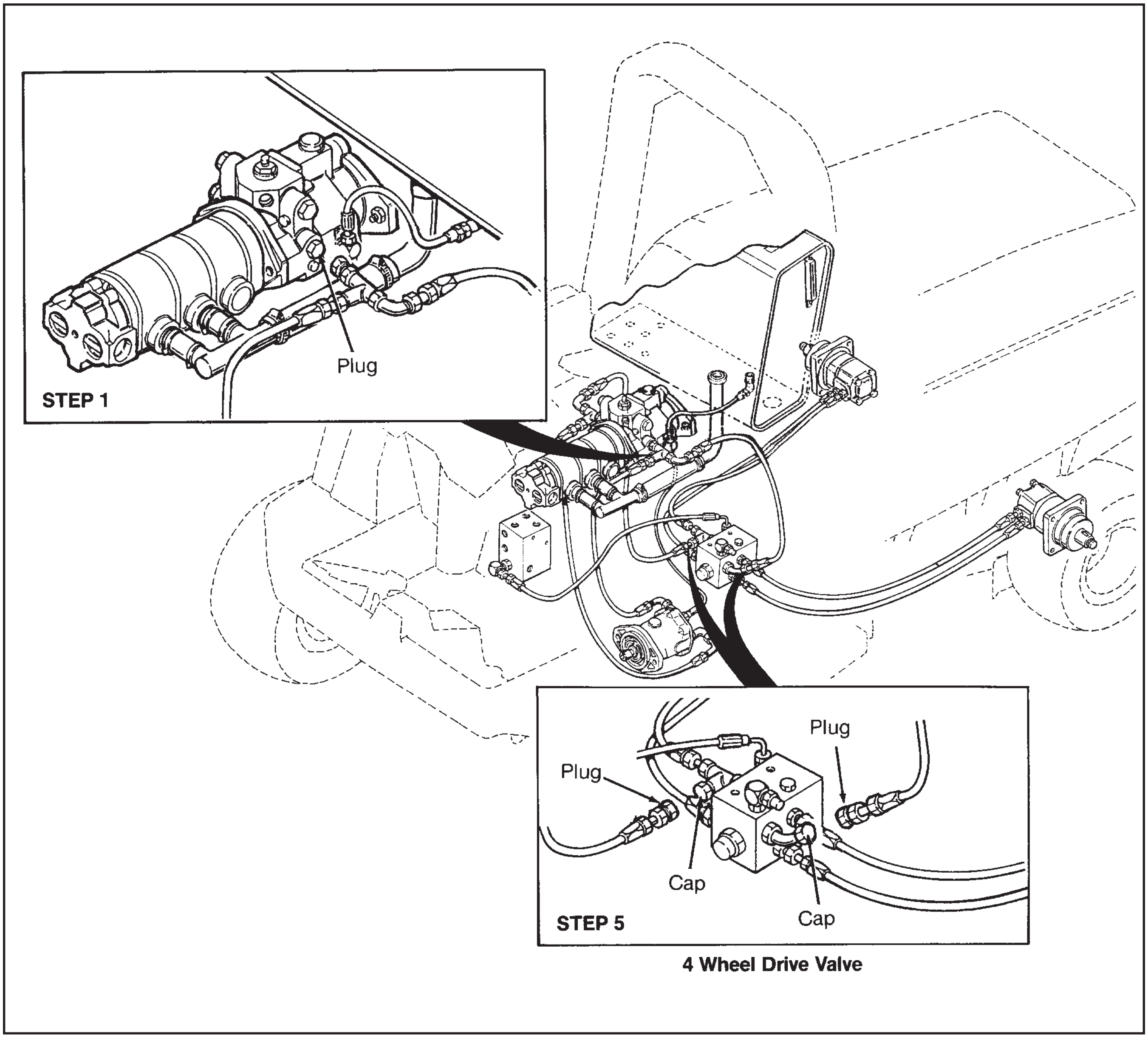


Figure 8Q-2. Traction System

SECTION 8Q. HYDRAULIC FIELD TEST PROCEDURES

POWER STEERING SYSTEM (See Figure 8Q-3)

NOTE

Before performing the following test, check the steering system for mechanical binding and/or damage that may affect the steering effort.

1. Turn the steering wheel completely to the right, then to the left.
   - If the steering wheel becomes hard or stops turning and a hissing sound is heard after steering the maximum right and/or left, the steering unit is okay.
   - If the steering wheel continues to turn, proceed to Step 2.
2. Remove both hydraulic lines from the steering cylinder, plug the lines, cap the cylinder ports.
3. Turn the steering wheel to the right, then to the left.
   - If the steering wheel becomes hard or stops turning the cylinder is at fault and should be rebuilt, see Section 6E.
4. Reconnect lines to the steering cylinder.

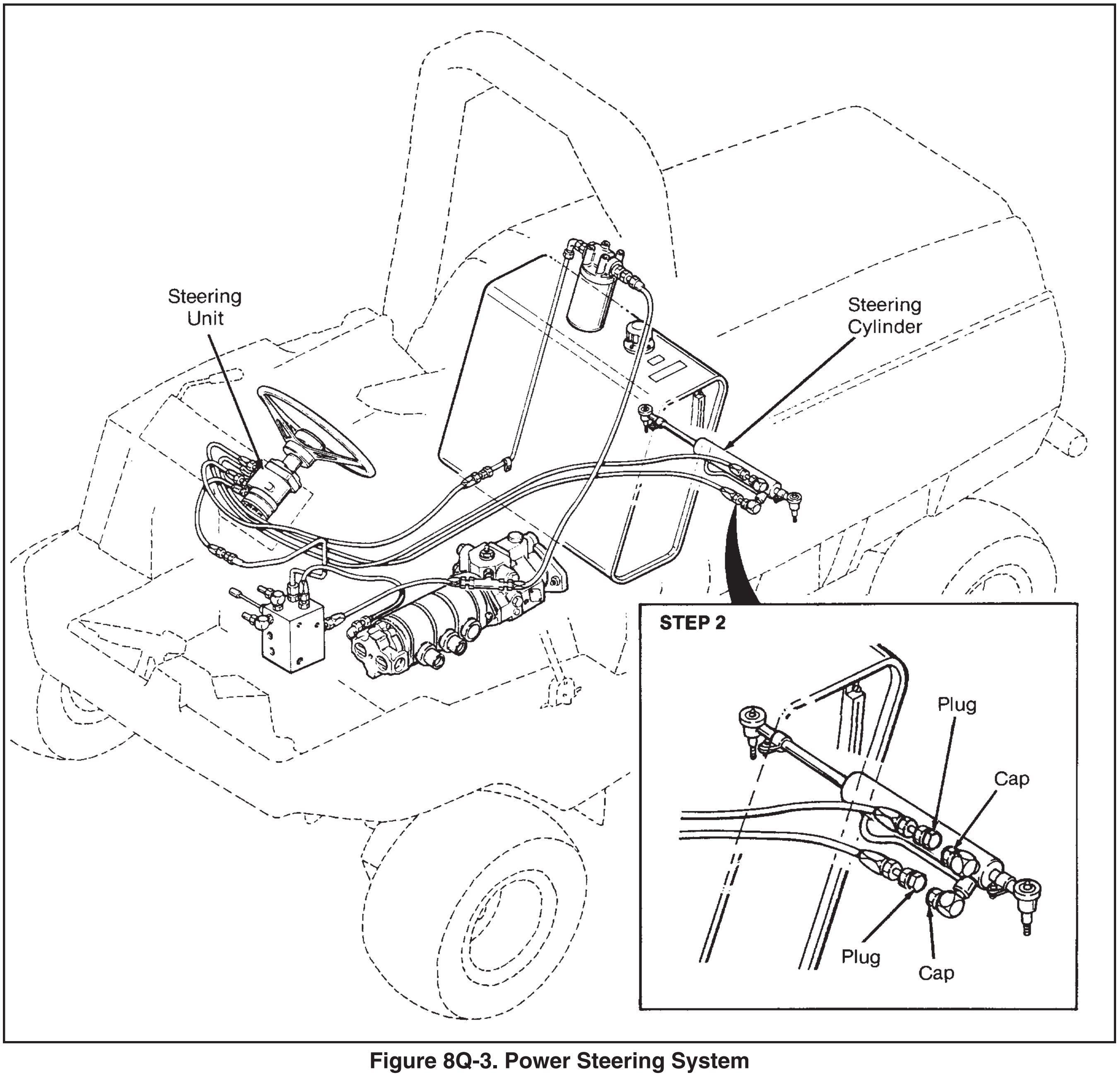
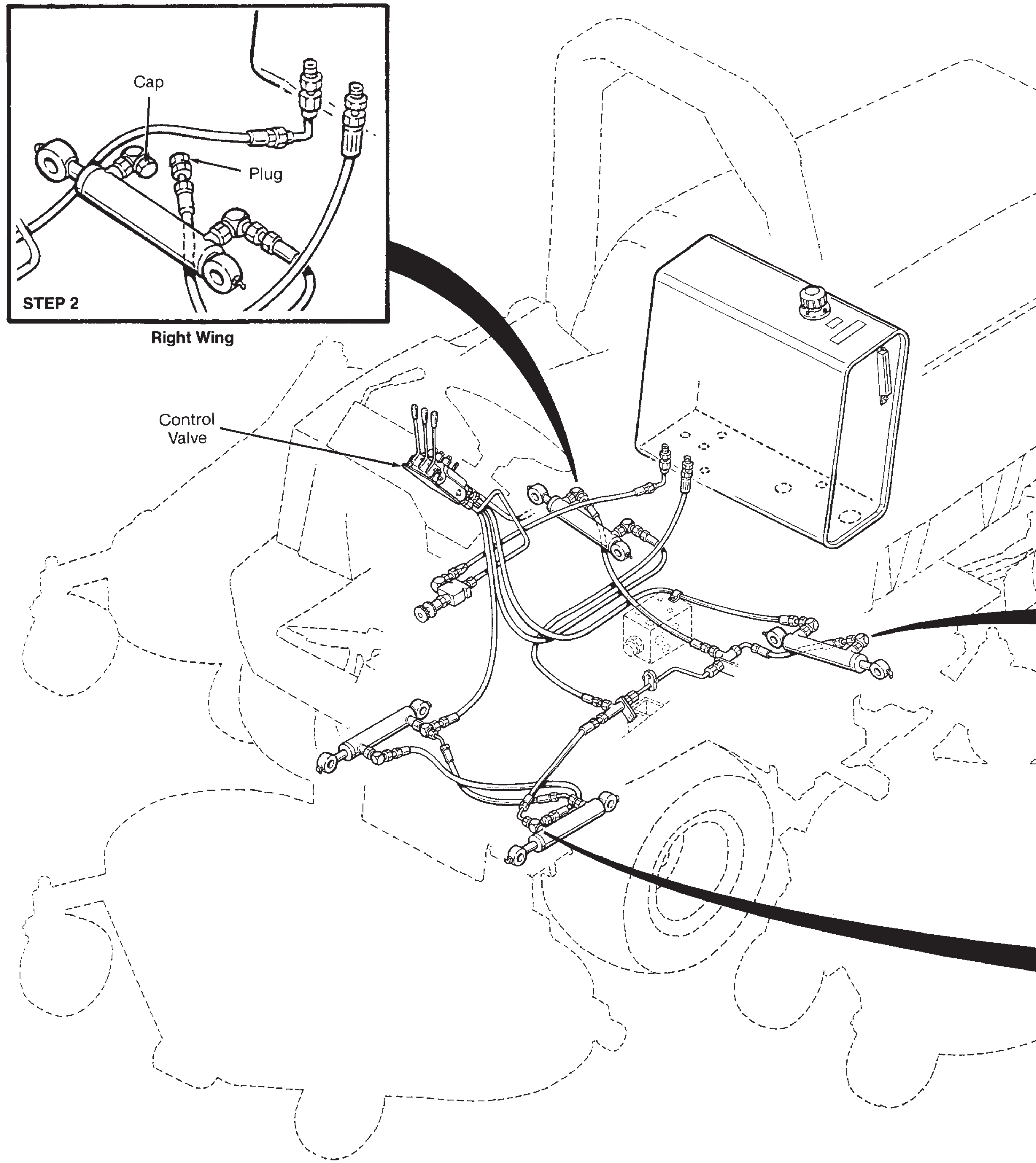


Figure 8Q-3. Power Steering System

SECTION 8Q. HYDRAULIC FIELD TEST PROCEDURES



SECTION 8Q. HYDRAULIC FIELD TEST PROCEDURES

LIFT AND LOWER CONTROL (See Figure 8Q-4)

NOTE

Be sure engine is above 2000 rpm.

1. Isolate the circuit at fault by operating each handle of the control valve separately.

NOTE

If all circuits are affected, perform an instrument test, see Section 8R.

2. Lower all mowers, follow the procedure under the circuit being affected.

   Center

   Remove hydraulic lines as shown in Figure 8Q-4. Plug line and cap port.

   Right Wing

   Remove hydraulic lines as shown in Figure 8Q-4. Plug line and cap port.

   Left Wing

   Remove hydraulic lines as shown in Figure 8Q-4. Plug line and cap port.

3. Pull lift control lever, raising the mower(s) and hold.
   - If the engine labors slightly and a hissing sound is heard, the valve is okay, proceed with Step 4.
   - If the engine is not affected or no hissing sound is heard, valve may be at fault, proceed with an instrument test, see Section 8R.
4. Reconnect hydraulic line removed in Step 2.
5. Pull lift control lever raising the mower(s) and hold.
6. Feel return line(s) of the cylinder(s). If the hydraulic cylinder return line feels warm the cylinder may have excessive internal leakage and should be rebuilt.

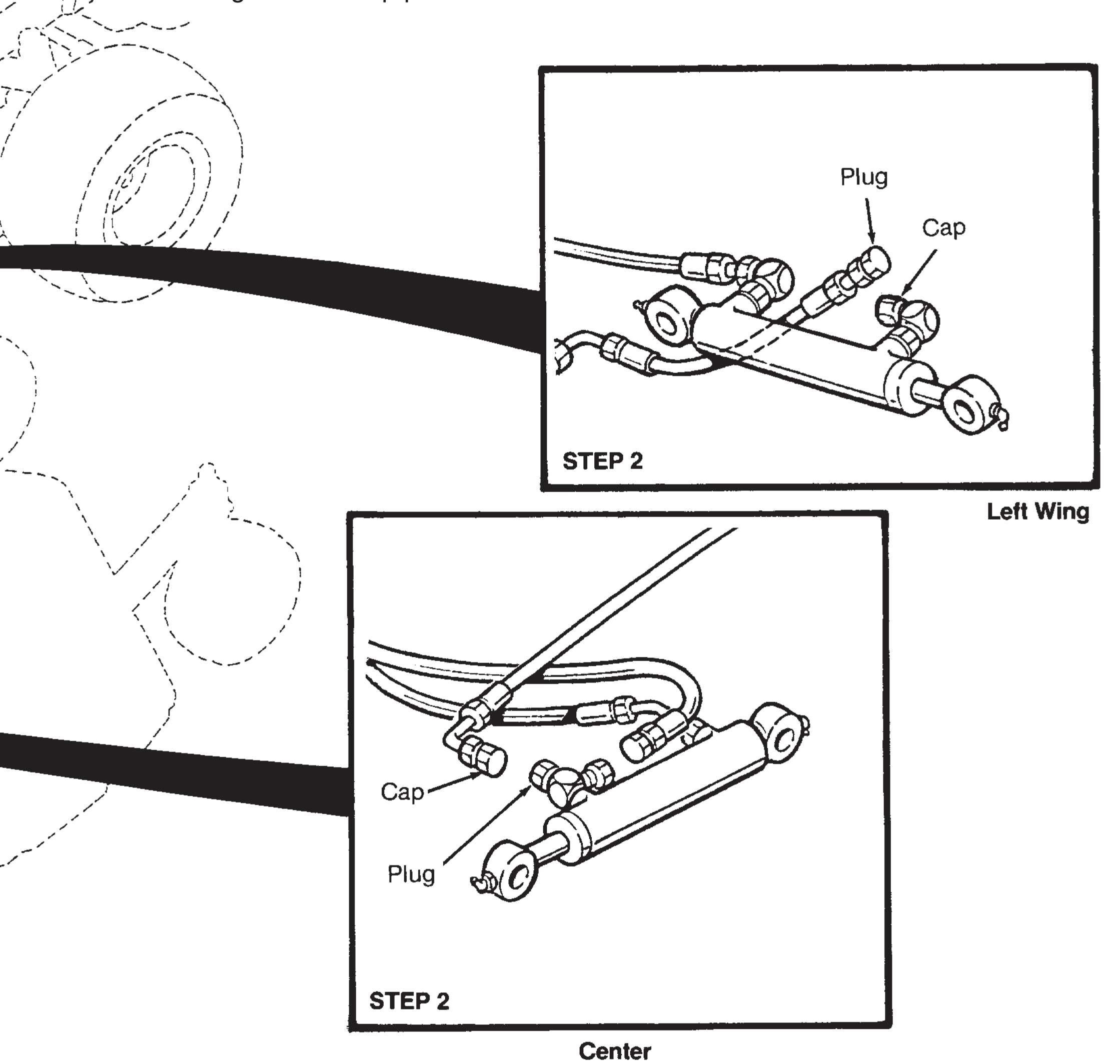


Figure 8Q-4. Lift and Lower Control

SECTION 8Q. HYDRAULIC FIELD TEST PROCEDURES

MOWER SYSTEM (See Figure 8Q-5)

The mower circuits can be divided into three separate circuits. Mower pump section 1 supplies oil to motor control valve. Then to right wing motors.

Mower pump section 2 supplies oil to a motor control valve. The motor control valve controls the left wing.

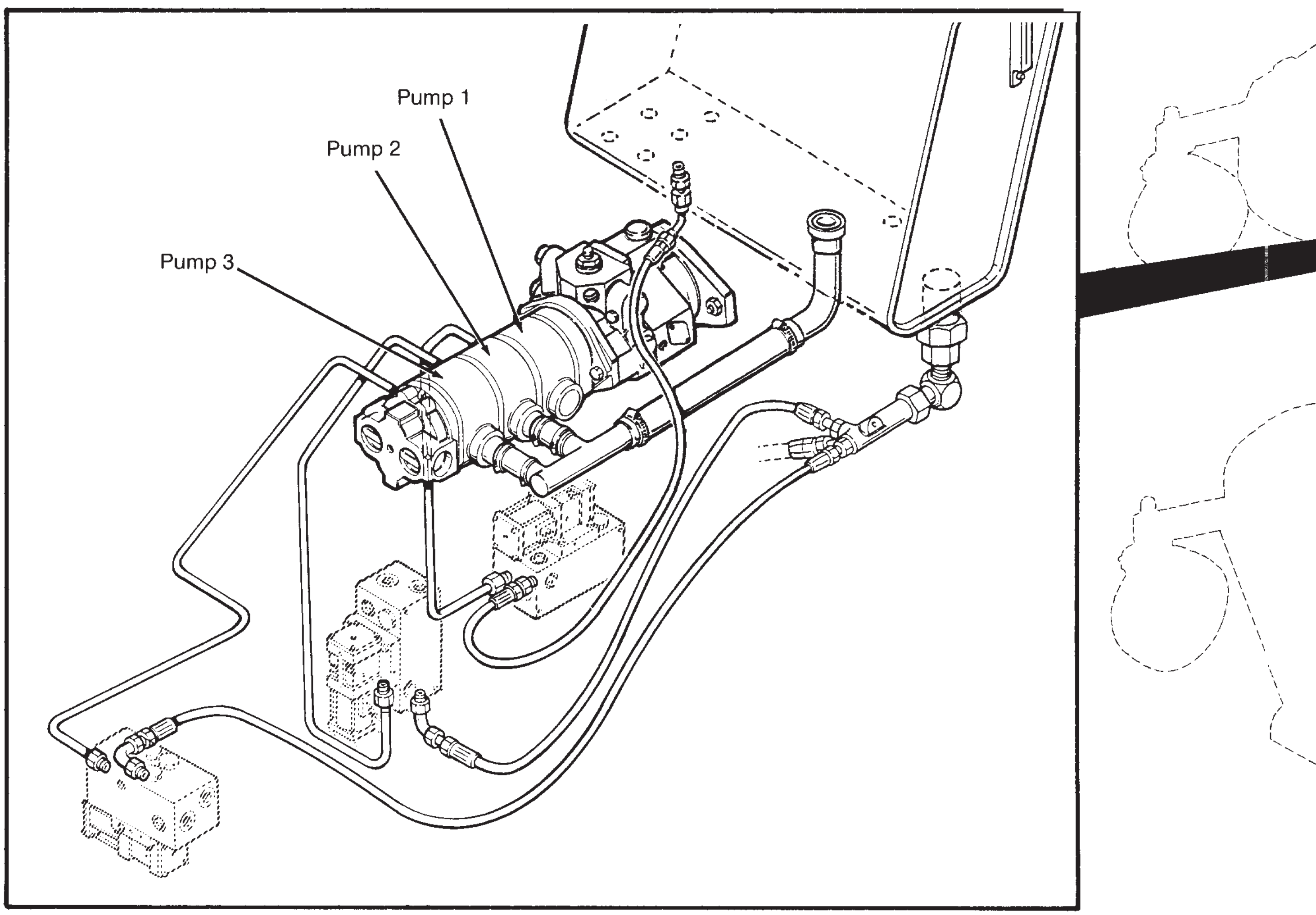
Mower pump section 3 supplies oil to the front motor control valve. Then to the front three motors.

1. Isolate which circuit, front, right wing, or left wing, having the problem.
2. With the ignition and implement (mower) switches ON, engine not running, and the reel directional switch in CUT, check the plastic connector on the motor control valve, the red LED should be on.
   - If the red LED is on, proceed with Step 3.
   - If the red LED is not on an electrical problem may exist, see Section 10.

⚠ DANGER

KEEP CLEAR OF REELS.

3. With the tractor running push the manual override button on the inside of the solenoid valve.
   - If the mower comes on and runs at a normal speed the solenoid may be faulty.
   - If the mowers do not come on, a pump may be faulty, perform an instrument test, see Section 8S.
   - If the mower or mowers run slow, proceed with Step 4.



SECTION 8Q. HYDRAULIC FIELD TEST PROCEDURES

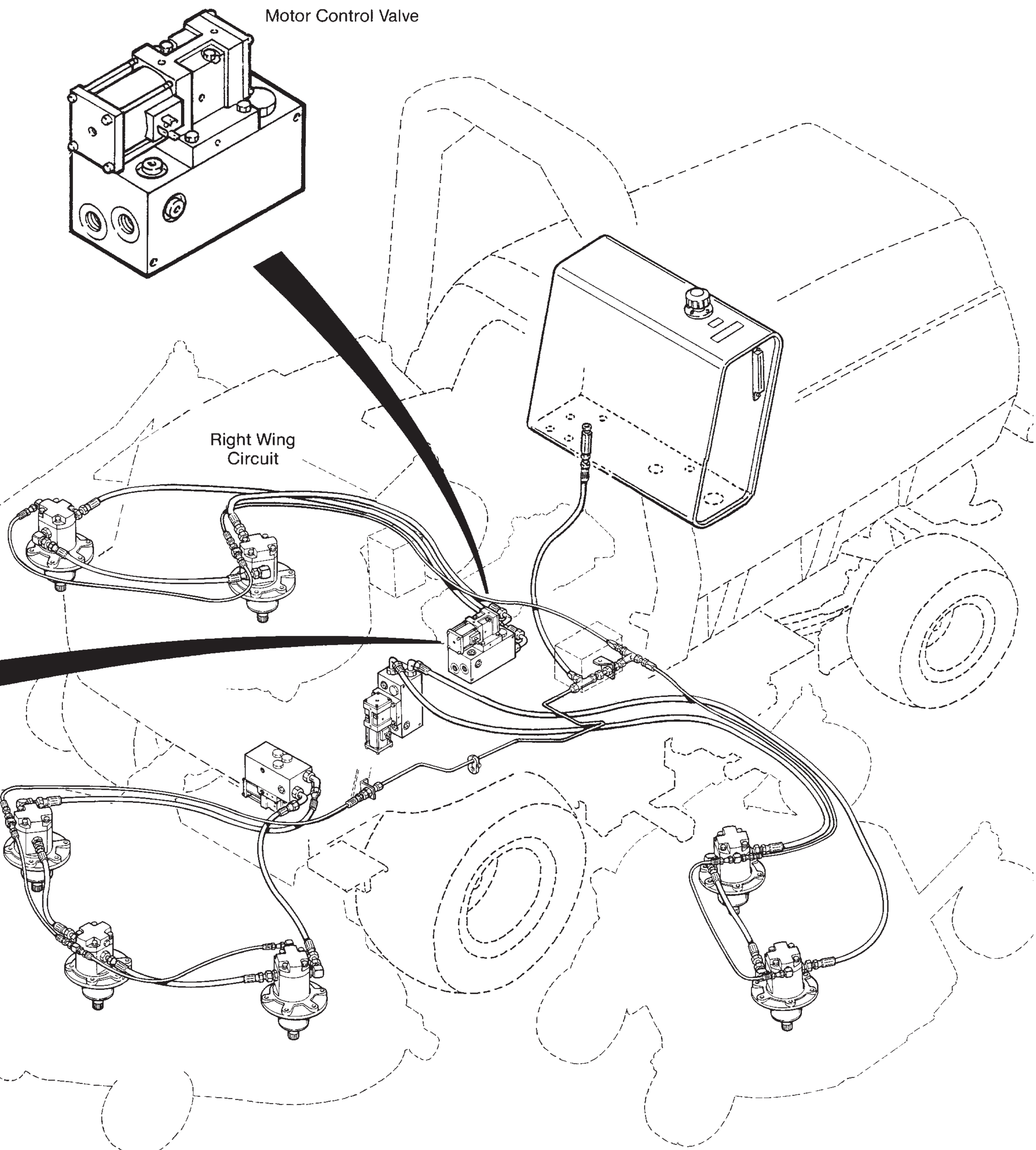


Figure 8Q-5. Reel System

SECTION 8Q. HYDRAULIC FIELD TEST PROCEDURES

4. Follow the procedure listed under the circuit having the problem.

   Front Mowers

   If all motors are affected, check the case drain line on the left motor. If the case drain line feels warmer than the two remaining motors, it may have excessive internal leakage, see Section 8N.

   If only the right and center are affected, check the case drain line on the center motor. If the case drain line feels warmer than the remaining motor, it may have excessive internal leakage, see Section 8N.

   If only the right motor is affected, check its case drain line. If the case drain line feels warmer than the two remaining motors, it may have excessive internal leakage, see Section 8N.

   Wings

   If both motors are affected, check the case drain line on the inner motor. If the case drain line feels warmer than the outer motor, it may have excessive internal leakage, see Section 8N.

SECTION 8R. INSTRUMENT TEST

GENERAL

The tests in this section are provided as a means of isolating a problem in the hydraulic system.

This section consists of two test methods. The first; Relief Valve Tests, using pressure gauges only. Using this method results in some test conclusions not being final. Second; Starting with the Traction System Test, an in-line hydraulic flow/pressure instrument is used (see Figure 8R-1). This method is more complete and will result in a final conclusion of the failure.

Make sure the tractor is secured and cannot roll. If interlock systems are bypassed, exercise caution when performing each test — do so in a safe manner.

⚠ CAUTION

Make sure interlock system is reconnected after test has been completed.

It is important to follow the instructions accurately and completely. Make sure to plug lines and cap ports when so instructed. Also, read and follow the Preliminary Checks provided in Section 8Q before proceeding with the instrument tests.

IMPORTANT

All of the tests in this section use an in-line tester as shown in Figure 8R-1. When using tester with variable gpm settings, make sure tester is set for the proper flow range to avoid damage to the test instrument. It is recommended that you record all readings obtained during these tests. It is important that you accurately run all tests at the same engine rpm and oil at operating temperature.

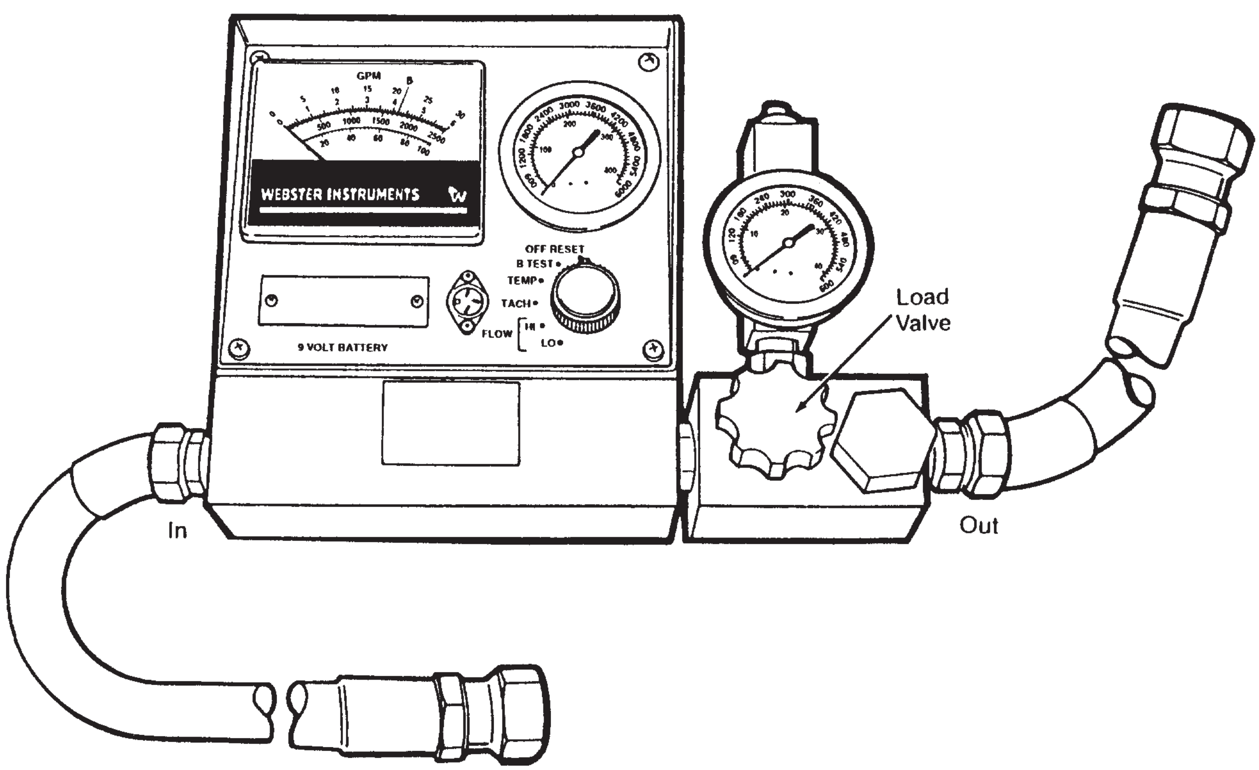


Figure 8R-1. In-Line Tester

SECTION 8R. INSTRUMENT TEST

RELIEF VALVE TEST

CHARGE RELIEF TEST (See Figure 8R-2)

1. Use a 0–500 psi gauge with test adapter P/N 551433.
2. Plug gauge into test port CD located on the control valve block.
3. Set the brake, start the engine and advance throttle to 2800 engine rpm.

- Charge relief should read 190–250 psi.

NOTE

The charge relief cartridge should not be adjusted.

- If the charge relief pressure is higher or lower than 190–250 psi, adjust the charge relief valve.
- If after adjusting, the pressure reading does not change, perform an instrument test as described in this section.

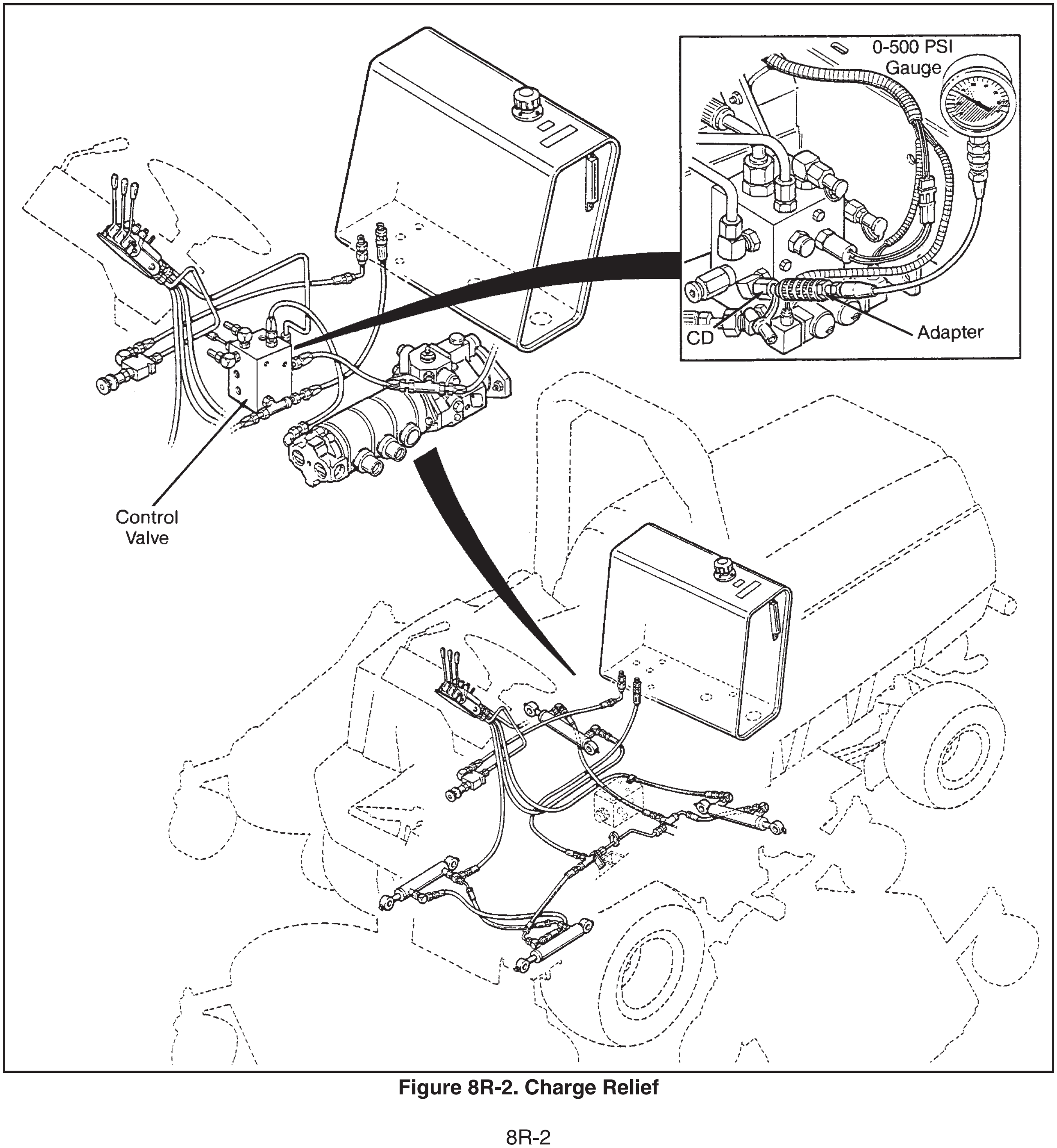


Figure 8R-2. Charge Relief

STEERING SYSTEM RELIEF (See Figure 8R-3)

1. Use a 0–2000 psi gauge with test adapter P/N 551433.
2. Plug gauge into test port SD located on the control valve block.
3. Set the brake, start the engine and advance throttle to 2800 engine rpm.
4. Turn the steering wheel completely to the left or right and hold.
   - If 1500 psi is obtained, relief valve is okay.
   - If 1500 psi cannot be obtained, proceed with relief valve adjustment.

Adjustment (See Figure 8R-3)

1. Shut the engine down before making the adjustment.
2. Remove the steering shaft.
3. Using an 8 mm hex socket wrench, remove the large plug located on the top of the steering unit.
4. Turn the adjusting screw inside:

   Clockwise (CW) increases pressure.
   Counterclockwise (CCW) decreases pressure.
5. Repeat Steps 3 and 4 under Steering System Relief.

NOTE

If after making an adjustment, the pressure does not change, perform an instrument test as described in this section.

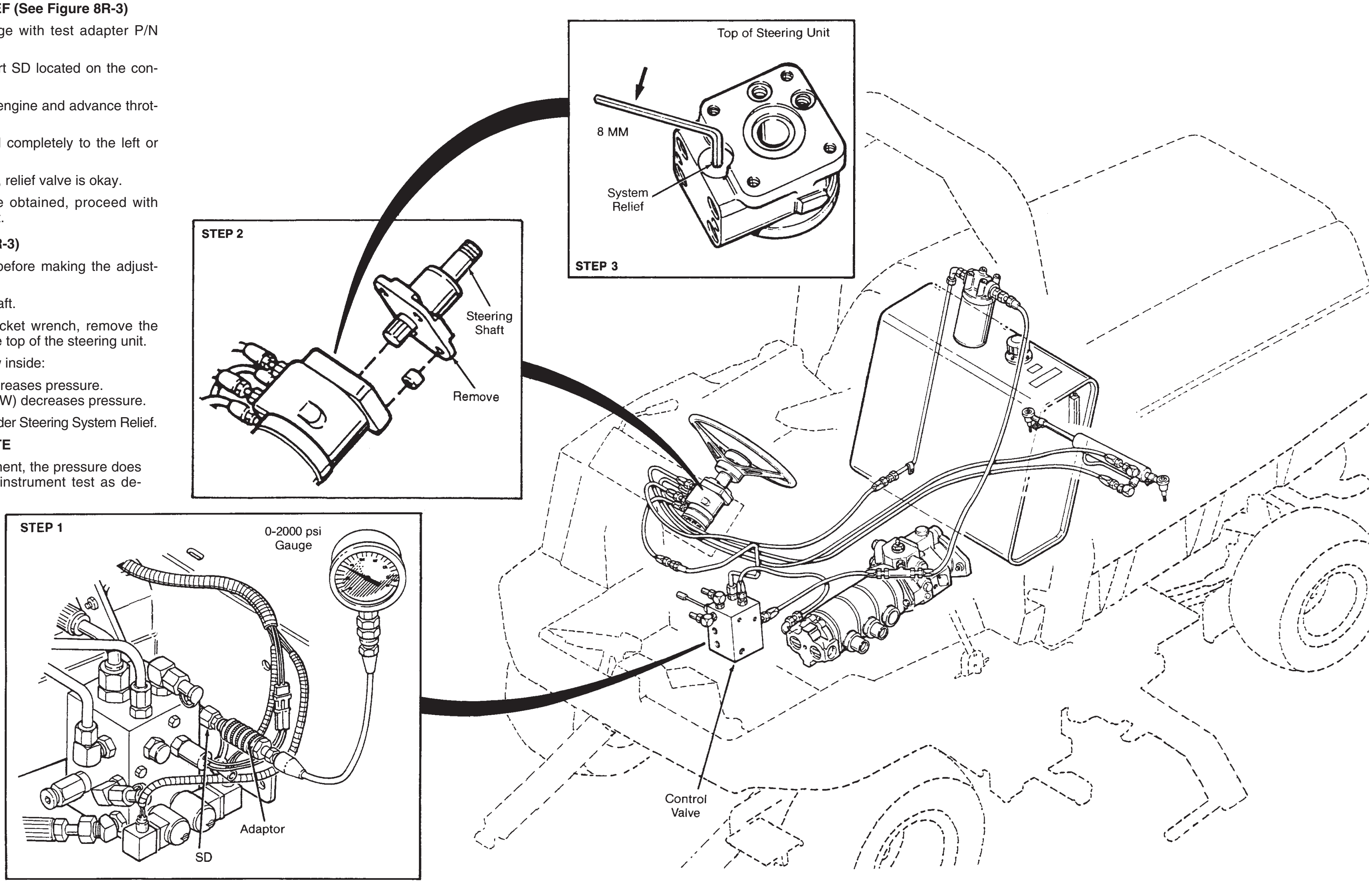


Figure 8R-3. Steering System Relief

LIFT SYSTEM RELIEF (See Figure 8R-4)

1. Use a 0–2000 psi gauge with test adapter P/N 551433.
2. Plug gauge into test port LD located on the control valve block.
3. Set the brake, start the engine and advance throttle to 2800 engine rpm.
4. Raise cutting units and hold the control lever in RAISE position.
   - If 1500 psi is obtained, relief valve is okay.
   - If 1500 psi cannot be obtained, proceed with relief valve adjustment.

Adjustment (See Figure 8R-4)

1. Be sure engine is shut down.
2. Remove relief valve cap from lift valve.
3. Shims are used to adjust the pressure setting:

   Adding shim(s) increases pressure.
   Removing shim(s) decreases pressure.

   NOTE

   Always start with the smallest shim. Then increase size as necessary.

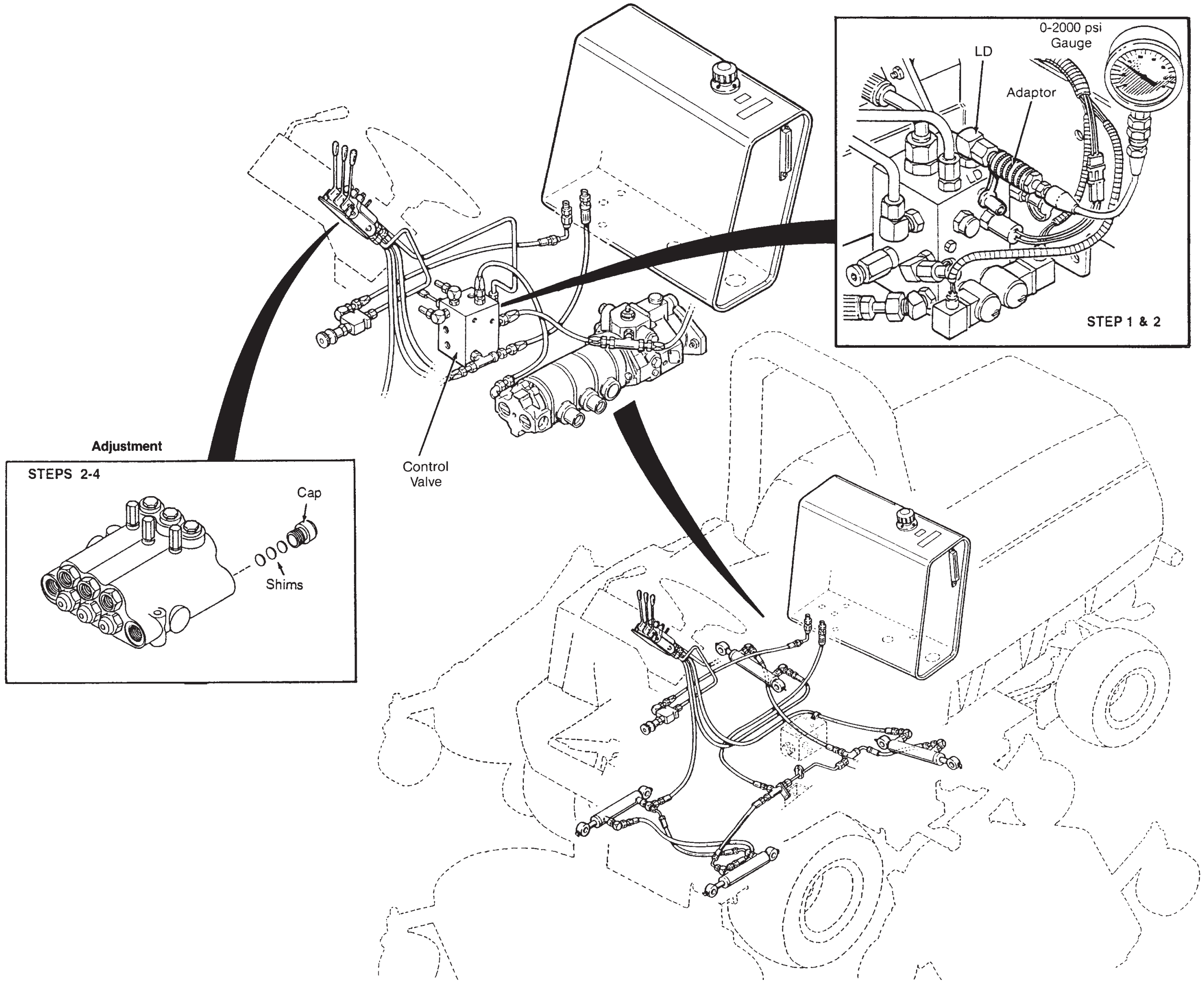
   Shims come in three thicknesses:

   0.010" (0.25 mm)
   0.015" (0.38 mm)
   0.035" (0.89 mm)

4. Reinstall relief valve cap.
5. Repeat Steps 3 and 4 under Lift System Relief.

NOTE

If pressure does not change after making an adjustment, perform an instrument test described in this section.



TRACTION SYSTEM RELIEF

Forward (See Figure 8R-5)

1. Use a 0–5000 psi gauge with test adapter P/N 551433.
2. Plug gauge into test port AD located on the top left of the 4 wheel drive valve.
3. Set the parking brake, start the engine, advance throttle to 2800 engine rpm, and push on the service brake.

NOTE

Be sure dump valve is in the FORWARD position (see Figure 8R-5).

4. Slowly push on the forward traction pedal.
   - The engine should labor and 3500 psi should be obtained, relief valve is okay.
   - If 3500 psi cannot be obtained, proceed with REVERSE pressure test.

Reverse (See Figure 8R-5)

1. Use a 0–5000 psi gauge with test adapter P/N 551433.
2. Plug gauge into port BD located on the top of the 4 wheel drive valve.
3. Set the parking brake, start the engine, advance throttle to 2800 engine rpm, and push on the service brake.

NOTE

Be sure dump valve is in the FORWARD position (see Figure 8R-5).

4. Slowly push on the reverse traction pedal.
   - The engine should labor and 3500 psi should be obtained, relief valve is okay.
   - If the forward relief valve test failed and the reverse relief valve test was okay, replace spring and/or relief spool on the left side of traction pump (see Figure 8R-5, Forward).
   - If only the reverse relief valve test failed, replace spring and/or relief spool on the right side of traction pump (see Figure 8R-5, Reverse).
   - If both forward and reverse relief valve tests fail, perform an instrument test as described in this section.

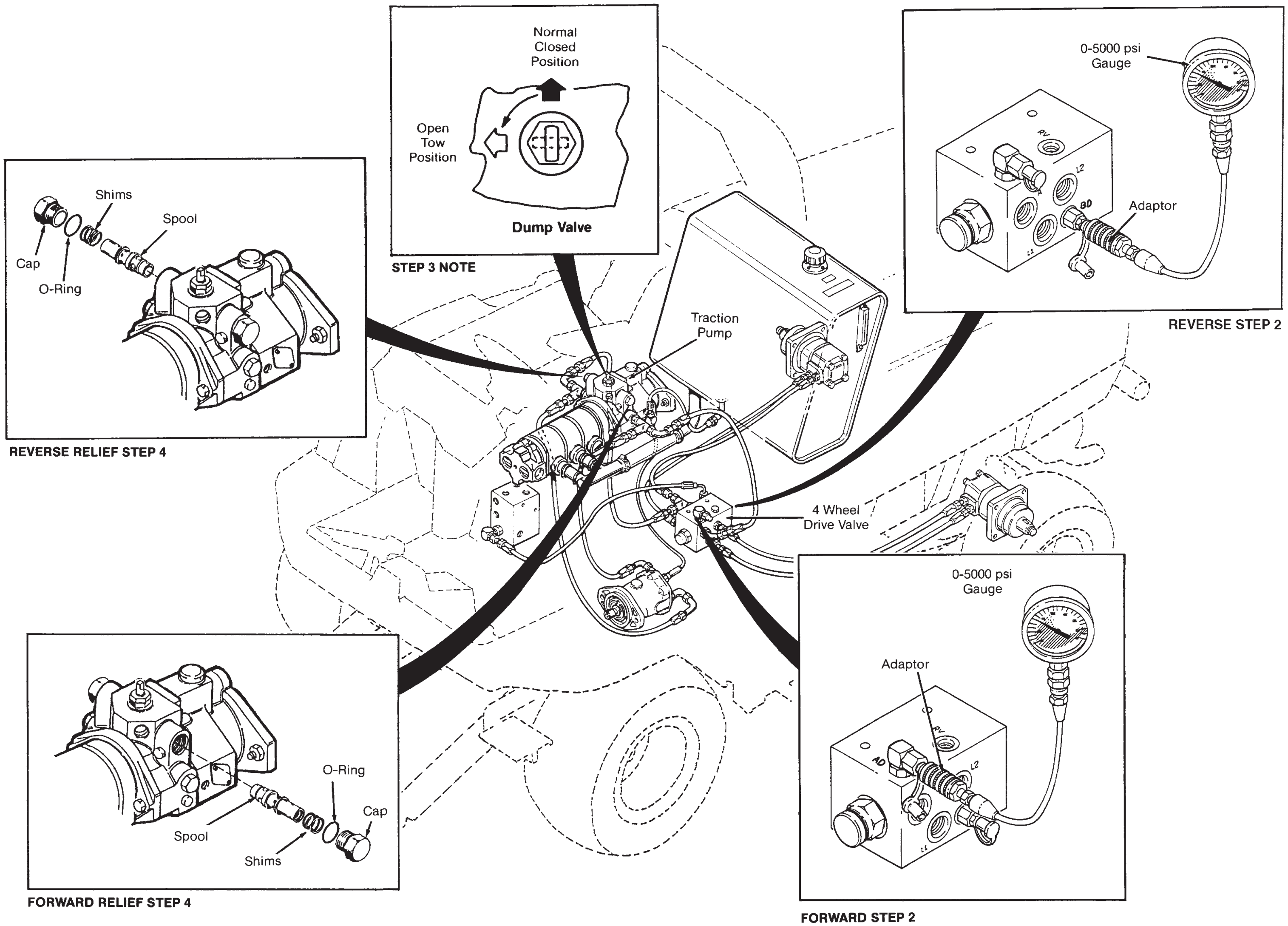


Figure 8R-5. Traction System Relief

MOWER SYSTEM RELIEF

There are three relief valves, one located under the coil on each motor control valve.

The procedure below is the same for each circuit, front, right or left wings. Identify which circuit has the fault, then proceed as follows.

Relief Valve Test (See Figure 8R-6)

1. Use a 0–5000 psi gauge with test adapter P/N 551433.
2. Plug gauge into test port on front motor control valve.
3. Remove hydraulic line from the A port of the left motor. Plug line cap motor port.
4. Set the brake, start the engine, advance the throttle to 2800 engine rpm. Engage the front motor circuit.
   - If 3000 psi is obtained, relief valve is okay.
   - If 3000 psi cannot be obtained, proceed with relief valve adjustment.

Adjustment (See Figure 8R-6)

1. Be sure the engine is shut down.
2. Remove coil from valve.
3. Remove relief valve plug guide.

Adding shim(s) increases pressure.
Removing shim(s) decreases pressure.

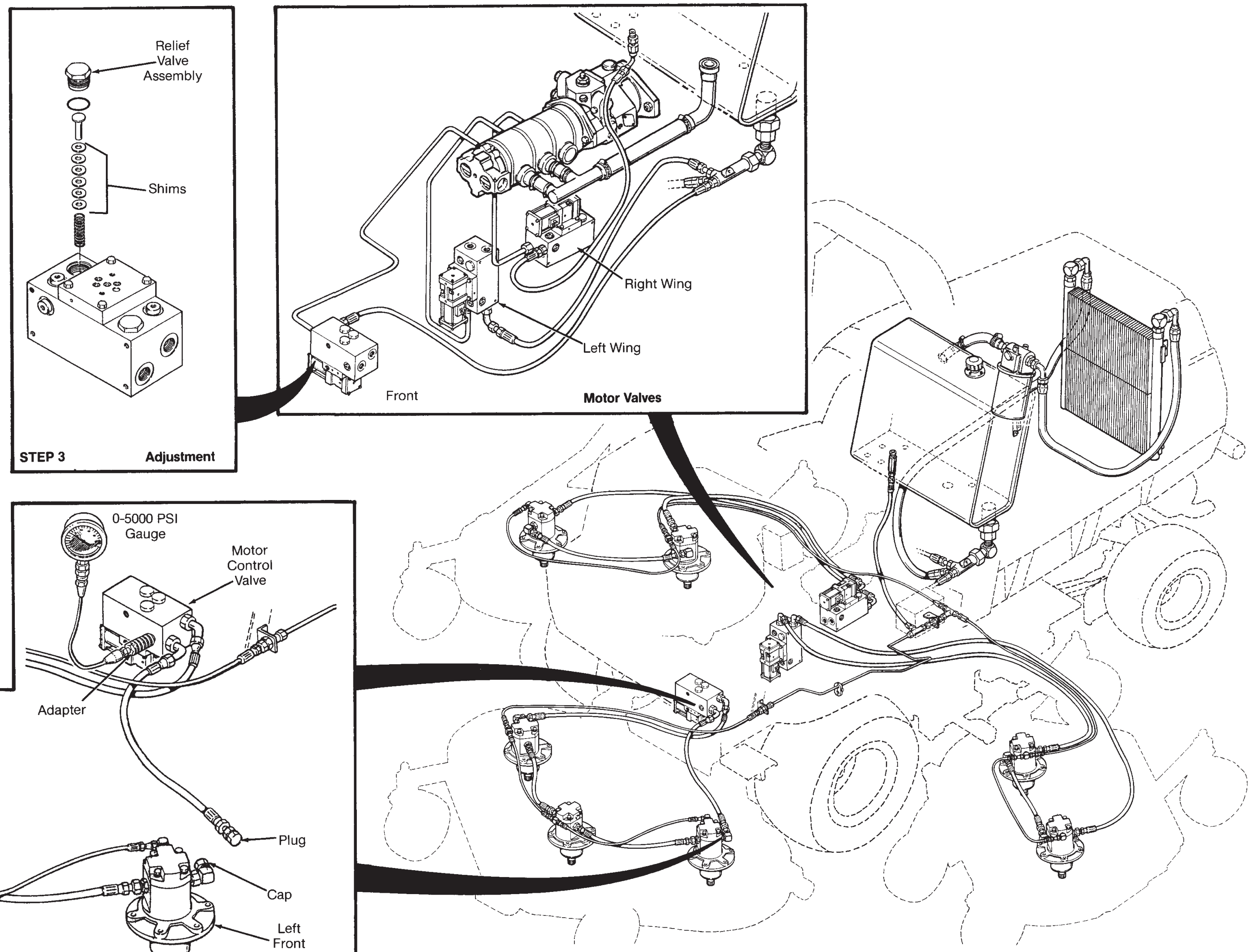
NOTE

Always add or remove one shim at a time.

4. Reinstall relief valve guide and plug.
5. Reinstall coil.
6. Repeat Steps 4 under Relief Valve Test.

NOTE

If relief pressure does not change after making adjustment, perform an instrument test described in this section.



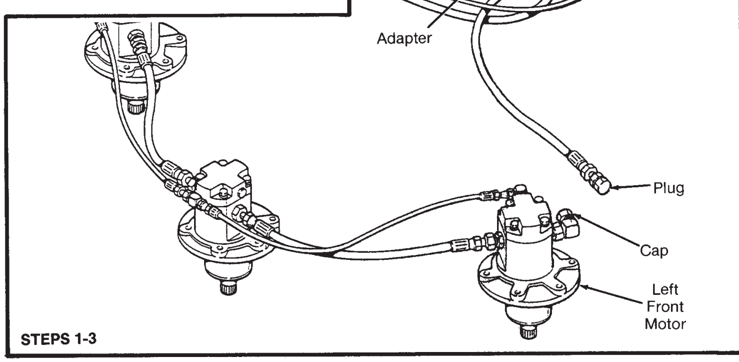


Figure 8R-6. Mower System Relief Front Motors

CHARGE PUMP TEST (See Figure 8R-7)

1. Remove outlet line from pump section 4 (pump section closest to the front axle).
2. Connect the IN port of the tester to the pump outlet port.
3. Connect hose from the OUT port of tester to the pump outlet line.
4. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
5. Read/record no load flow. It should be 7.5 gpm.
6. Slowly close tester load valve until 1500 psi is obtained and allow oil to heat up to 150°F.

⚠ CAUTION

Do not exceed 1500 psi.

7. Read/record gpm flow and engine rpm.
   - If flow drops 1/2 gpm or less, pump is okay.
   - If flow drop is 1/2–1 gpm, pump is marginal.
   - If flow drops more than 1 gpm, pump has excessive internal leakage.
8. Reconnect outlet line to pump section 4.

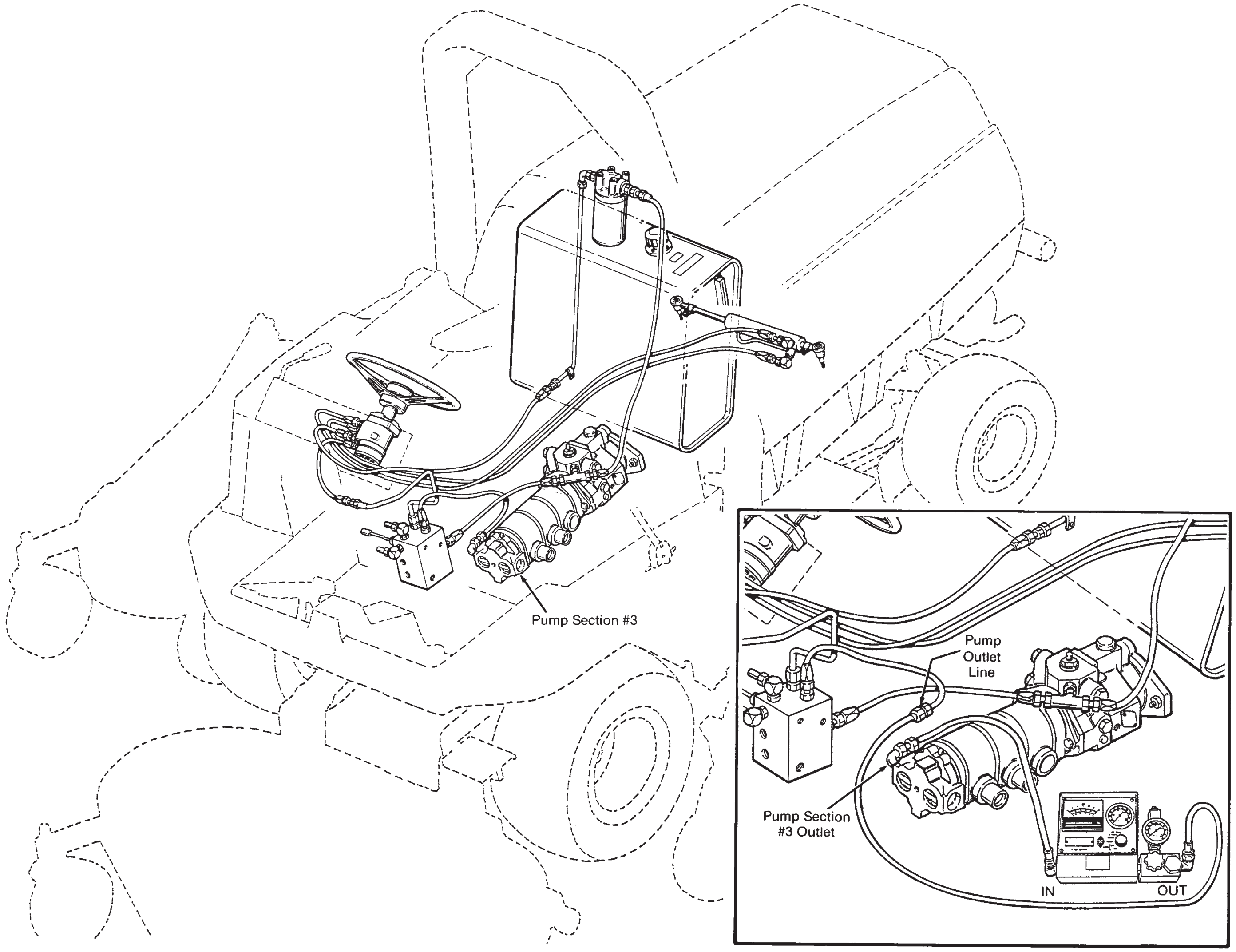


Figure 8R-7. Charge Pump Test

PRIORITY VALVE TEST (See Figure 8R-8)

NOTE

A charge pump test must be performed before proceeding with this test.

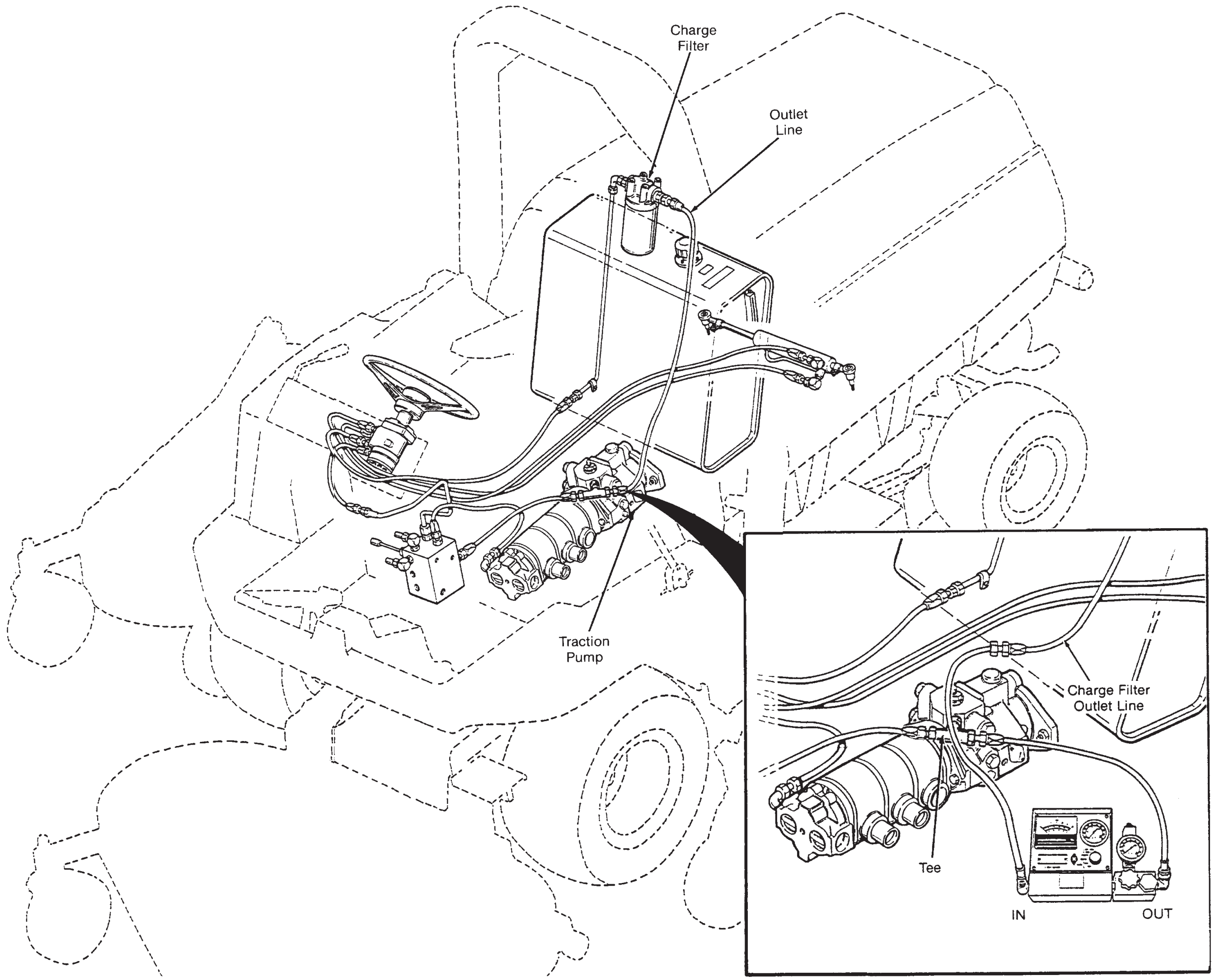
9. At the top of the traction pump, remove the outlet line of the charge filter from the fitting.
10. Connect the IN port of the tester to the charge filter outlet line.
11. Completely open tester load valve.
12. Connect the OUT port of the tester to the tee.
13. Start the engine, slowly advance the throttle.

⚠ CAUTION

DO NOT close tester load valve.

Flow should increase to approximately 4.5–5.0 gpm at approximately 1900–2000 engine rpm. At this point flow should stop increasing as engine rpm continues to be installed.

- If flow stops at 4.5–5.0 gpm as engine rpm continues to increase, priority valve is okay.
- If flow does not increase to 4.5–5.0 gpm, priority valve may be faulty. Continue with Lift System Test, Step 15 for Front or Wing mowers.
- If flow continues to increase above 4.5–5.0 gpm, priority valve may be faulty. Continue with Lift System Test, Step 15 for Front or Wing mowers.



LIFT SYSTEM TEST (See Figure 8R-9)

FRONT MOWER CYLINDERS AND LIFT VALVE ISOLATION TEST

15. Raise the front mower and block it in the up position.

> **⚠ CAUTION**
>
> Be certain the area beneath the mower is clear.

16. Disconnect the two return hoses (rod end port) from the front left cylinder.
17. Remove the blocking from the front mower.

NOTE

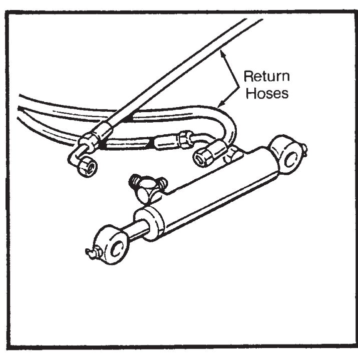
DO NOT start engine.

- If mower(s) come down and no oil leaks from disconnected tee, the lift valve may be faulty, repair valve, see Section 8H.

NOTE

A small amount of static oil may leak from open port of the tee.

- If oil leaks from the rod end port tee of a left cylinder or the removed hose of the right cylinder, that cylinder leaking is faulty, repair cylinder, see Section 8L.



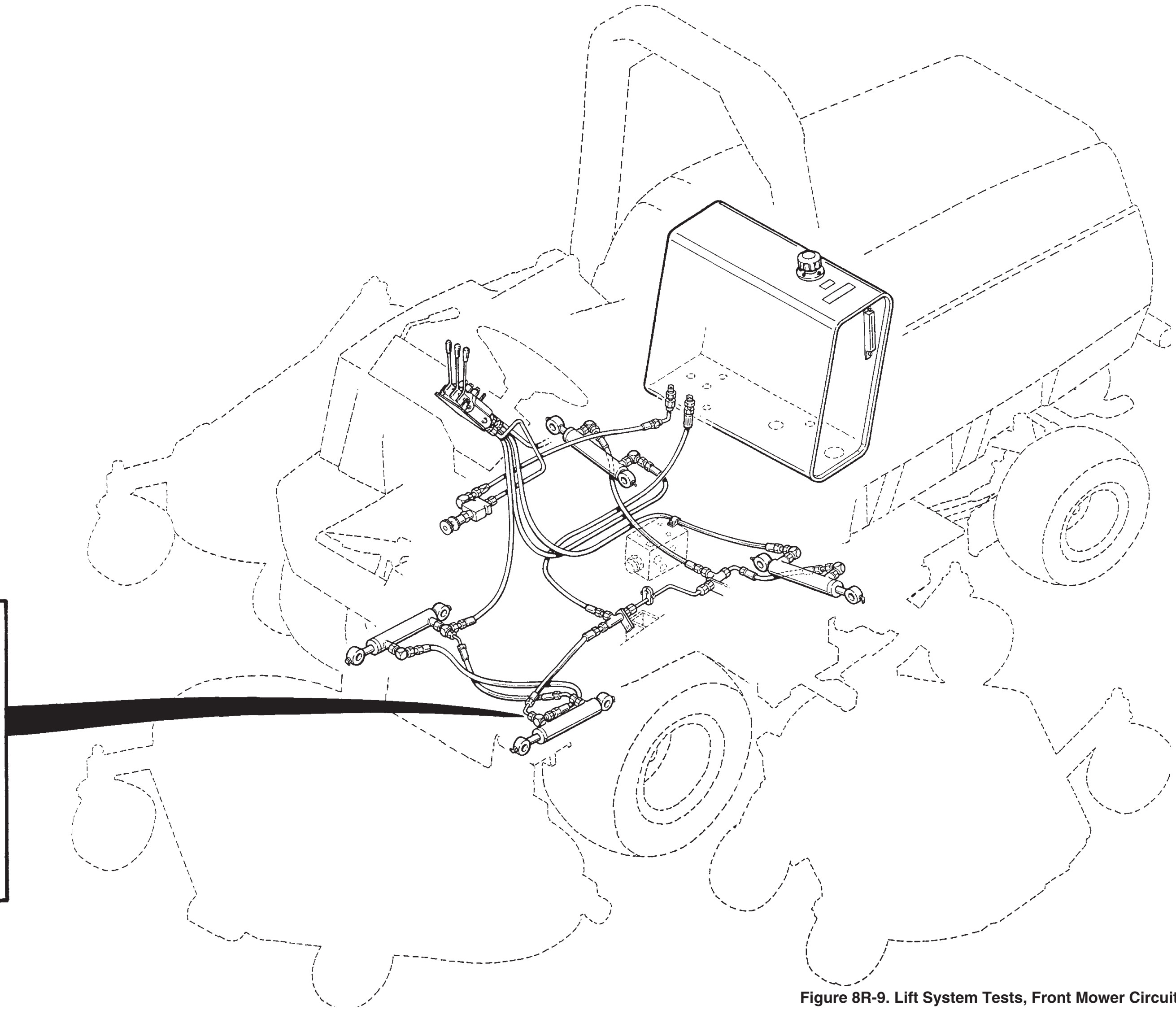


Figure 8R-9. Lift System Tests, Front Mower Circuit

LEFT WING CYLINDER AND LIFT VALVE ISOLATION TEST (See Figure 8R-10)

15. Raise left wing mower and lock in transport position.
16. At the left cylinder, remove return line from the rod end of cylinder.
17. Release transport lock.

⚠ CAUTION

Be certain the area beneath the mowers is clear.

NOTE

DO NOT start engine.

- If left wing mower comes down and no oil leaks from disconnected cylinder port, the lift valve may be faulty, repair valve, see Section 8H.

NOTE

A small amount of static oil may leak from open port and/or line.

- If left wing mower comes down and oil continues to leak from cylinder port, cylinder is faulty, repair cylinder, see Section 8L.

RIGHT WING CYLINDER AND LIFT VALVE ISOLATION EST (See Figure 8R-10)

15. Raise right wing mower and lock in transport position.
16. At the right cylinder, remove the return line from the rod end of cylinder.
17. Release transport lock.

⚠ CAUTION

Be certain the area beneath the mowers is clear.

NOTE

DO NOT start engine.

- If right wing mower comes down and no oil leaks from disconnected cylinder port, the lift valve may be faulty, repair valve.

NOTE

A small amount of static oil may leak from open port and/or line.

- If right wing mower comes down and oil continues to leak from cylinder port, cylinder is faulty, see Section 8L.

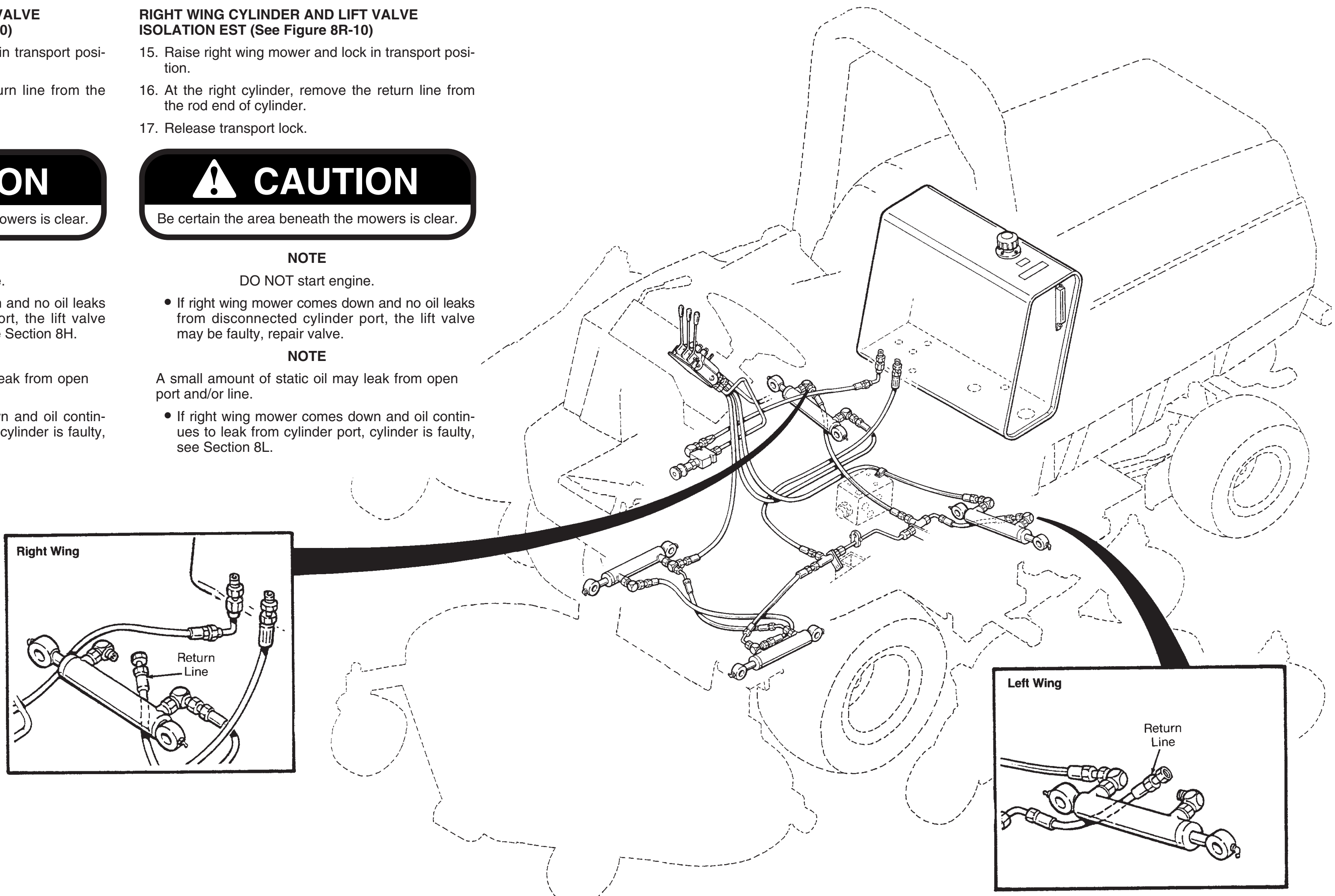


Figure 8R-10. Lift System Test, Wing Mower Circuit

TRACTION SYSTEM

TRACTION PUMP TEST (See Figure 8R-11)

1. Raise front wheels off the ground.
2. Remove 4 wheel drive hose from the left side of the traction pump, cap tee and plug line.
3. Remove front traction motor hose from left side of traction pump.
4. Remove front traction motor hose from right side of traction pump.
5. Plug front motor hoses.
6. Install tee fittings to each side of traction pump.
7. Connect IN port of tester to left side of traction pump, cap tee.
8. Connect OUT port of tester to right side of traction pump, cap tee.
9. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
10. Read/record charge pressure.
    - If the charge pressure is not within 190–250 psi, replace the charge relief valve cartridge (see Section 8K).
    - If charge pressure is not affected after changing the charge relief cartridge, proceed with an instrument test, implement pump section 4.
11. Slowly close tester load valve until 3000 psi is obtained and allow oil to heat up to 150°F.
12. Open tester load valve.
13. Push traction pedal to obtain 10 gpm. Record no load gpm flow.
14. Slowly close tester load valve until 3000 psi is obtained.
15. Read/record gpm flow. Record engine rpm. Subtract gpm flow from 10 gpm NO LOAD flow.
    - If flow drops 1 gpm or less, pump is okay.
    - If flow drop is 1-1/2 gpm, pump is marginal.
    - If flow drops more than 1-1/2 gpm pump has excessive internal leakage.
16. Continue closing load valve, read/record psi when flow drops off. This is the forward traction loop relief valve setting.

⚠ CAUTION

DO NOT exceed 4000 psi during this test.

- If the relief valve opens at 3500 psi, relief is okay.
- If relief pressure is above or below 3500 psi, replace the relief valve on the left side of the hydrostatic pump.

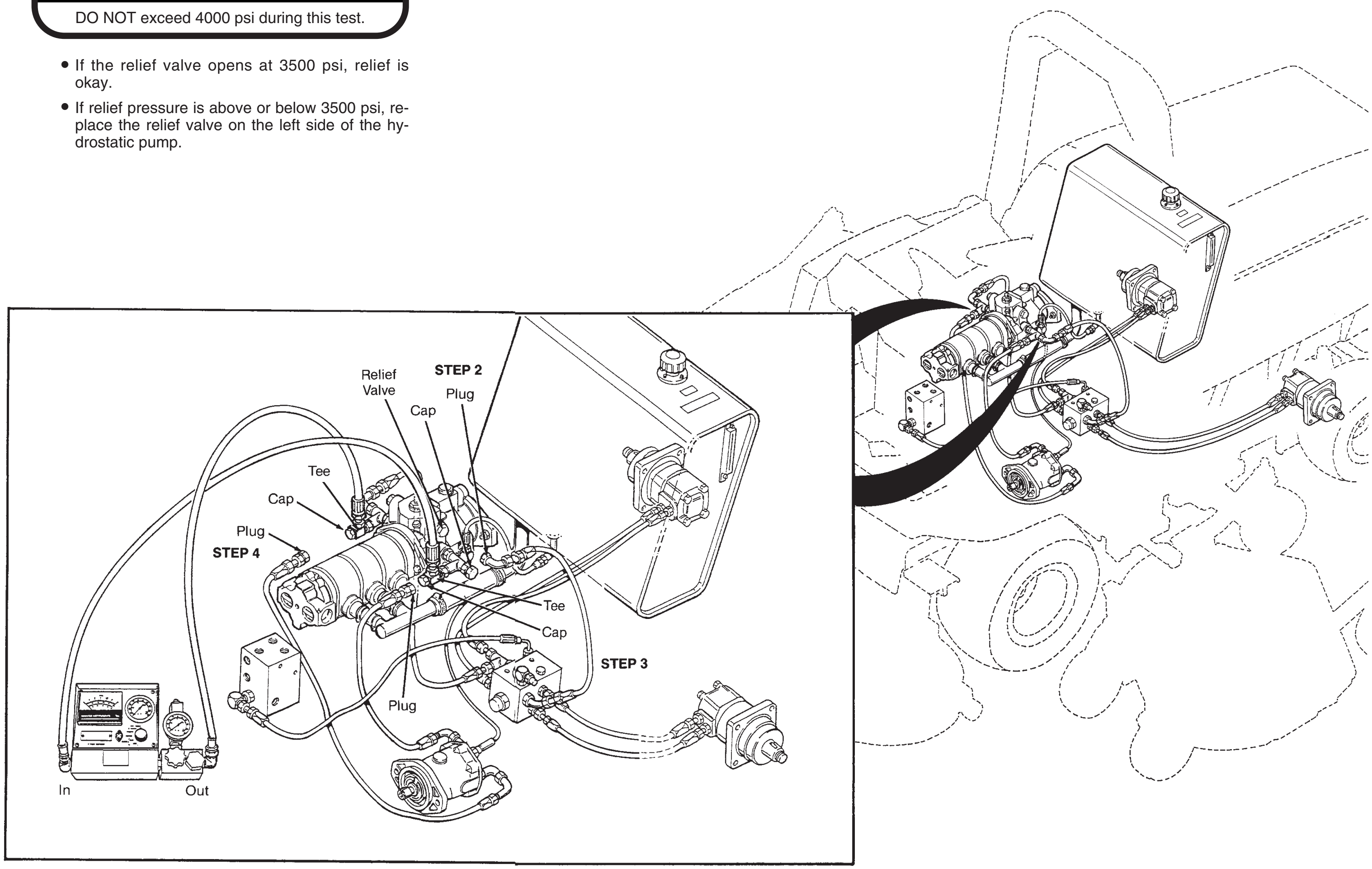


Figure 8R-11. Traction Pump Test

8R

FRONT TRACTION MOTOR TEST
(See Figure 8R-12)

NOTE

A traction pump test must be performed before proceeding with this test.

17. Connect both front traction motor hoses to the left and right side tees on pump.
18. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
19. Set parking brake, apply and hold foot brake.
20. Slowly close tester load valve until 3000 psi is obtained and allow oil to heat up to 150°F.
21. Read/record gpm flow. Subtract from flow obtained in TRACTION PUMP TEST. Record engine rpm.
    - If flow drops 1/2 gpm or less, traction motor is okay.
    - If flow drop is 1/2–1 gpm, traction motor is marginal.
    - If flow drops more than 1 gpm, traction motor has excessive internal leakage.

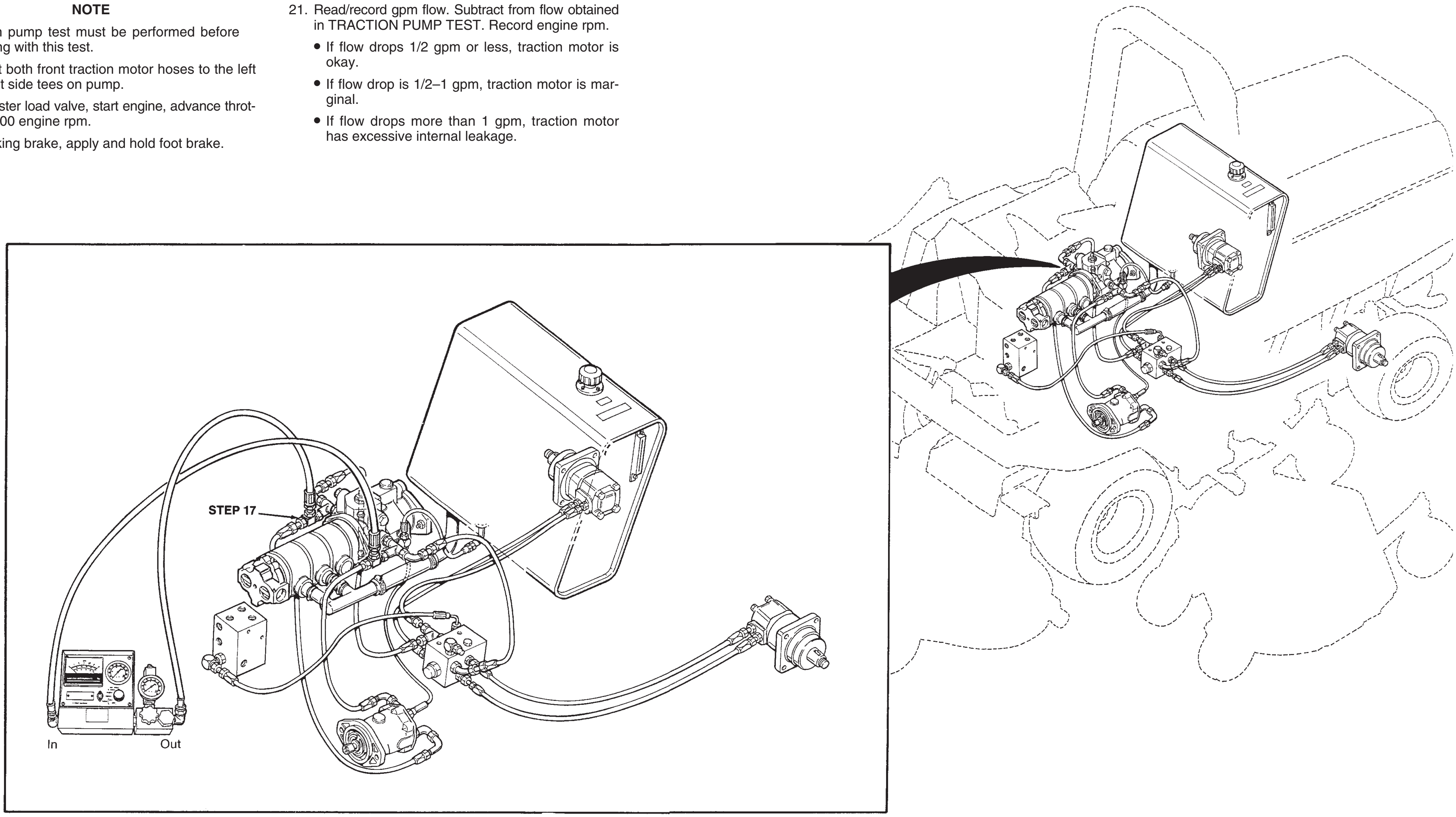


Figure 8R-12. Front Hydrostatic Motor Test

4 WHEEL DRIVE VALVE TEST
(See Figure 8R-13)

NOTE

A traction pump and front motor test must be performed before proceeding with this test.

22. Connect 4 wheel drive hose to left side of traction pump.
23. At the 4 wheel drive valve, remove hoses from L1 and R1 ports. Cap ports and plug hoses.
24. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
25. Engage 4 wheel drive switch.
26. Set parking brake, apply and hold foot brake.
27. Slowly close tester load valve until 3000 psi is obtained and allow oil to heat up to 150°F.
28. Read/record gpm flow. Subtract from flow obtained in TRACTION MOTOR TEST. Record engine rpm.
    - If flow drops 1/2 gpm or less, valve is okay.
    - If flow drop is 1/2–1 gpm, valve is marginal.
    - If flow drops more than 1 gpm, valve has excessive internal leakage.

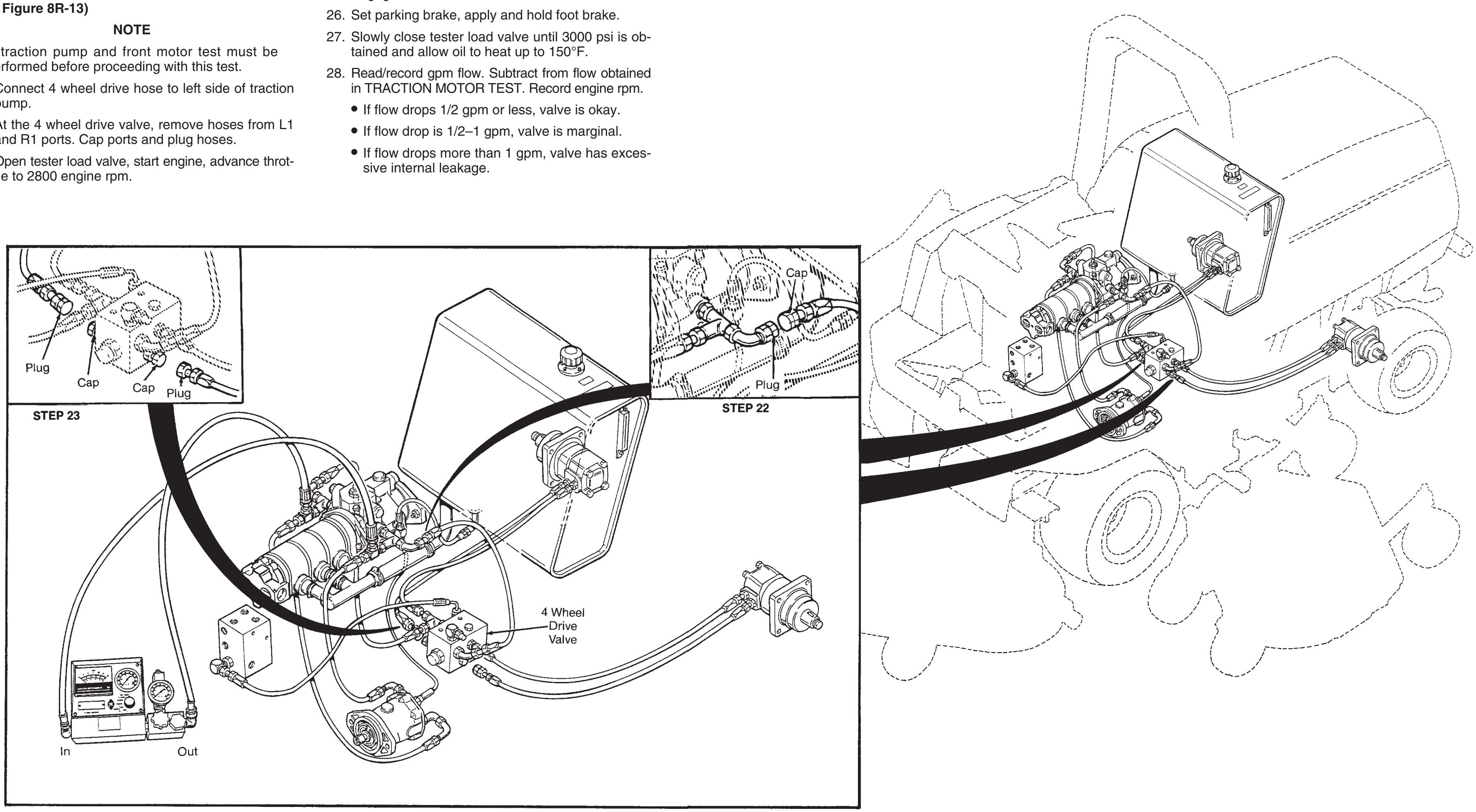


Figure 8R-13. 4 Wheel Drive Valve Test

REAR TRACTION MOTOR TEST

Left Motor Test (See Figure 8R-14)

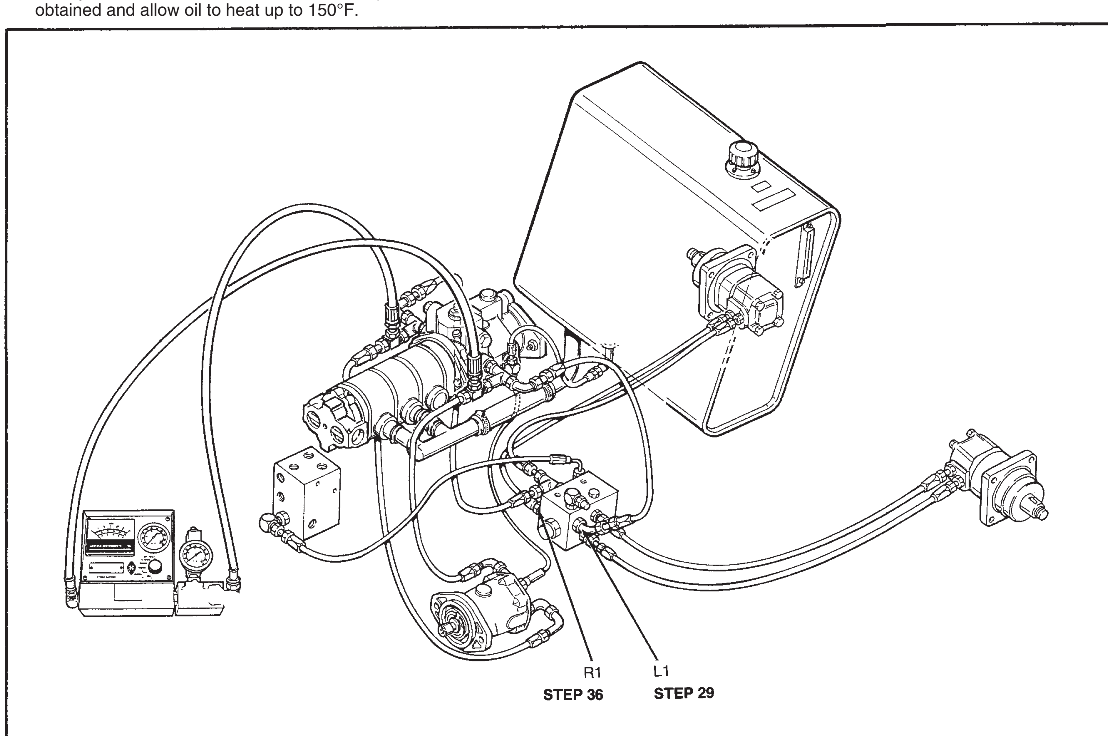
NOTE

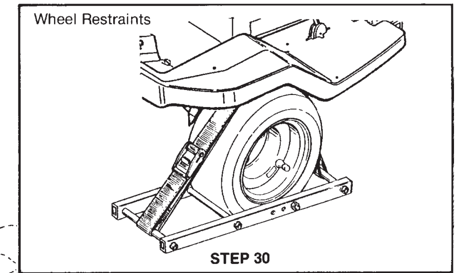
A traction pump, traction motor and a 4 wheel drive valve test must be performed before proceeding with this test.

29. At the 4 wheel drive valve, connect left motor hose to L1 port.
30. Install rear wheel restraints to the right and left rear wheels.
31. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
32. Engage 4 wheel drive switch.
33. Set parking brake, apply and hold foot brake.
34. Slowly close tester load valve until 3000 psi is obtained and allow oil to heat up to 150°F.
35. Read/record gpm flow. Subtract from flow obtained in 4 wheel drive valve test. Record engine rpm.
    - If flow drops 1/2 gpm or less, left rear motor is okay.
    - If flow drop is 1/2–1 gpm, left rear motor is marginal.
    - If flow drops more than 1 gpm, left rear motor has excessive internal leakage.

Right Motor Test

36. At the 4 wheel drive valve, connect right motor hose to R1 port.
37. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
38. Engage 4 wheel drive switch.
39. Set parking brake, apply and hold foot brake.
40. Slowly close tester load valve until 3000 psi is obtained and allow oil to heat up to 150°F.
41. Read/record gpm flow. Subtract from flow obtained for the left rear motor test. Record engine rpm.
    - If flow drops 1/2 gpm or less, valve is okay.
    - If flow drop is 1/2–1 gpm, valve is marginal.
    - If flow drops more than 1 gpm, valve has excessive internal leakage.





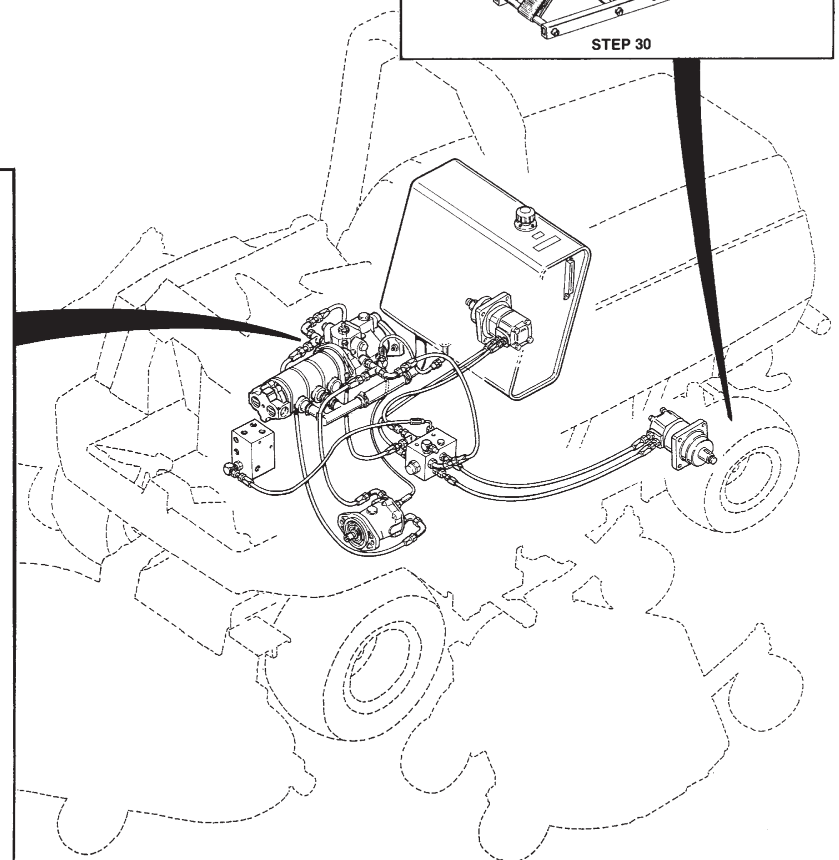


Figure 8R-14. Rear Traction Motor Test

MOWER SYSTEM

FRONT MOWER

Pump Test (See Figure 8R-15)

1. Remove outlet line from pump section 3.
2. Connect the IN port of the tester to the pump outlet port, plug pump outlet line.
3. Put the hose from the OUT port of tester into the hydraulic tank.
4. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
5. Read/record no load flow. It should be 10.0 gpm.
6. Slowly close tester load valve until 2300 psi is obtained and allow oil to heat up to 150°F.
7. Read/record gpm flow and engine rpm. Subtract gpm flow from NO LOAD gpm flow.
   - If flow drops 1/2 gpm or less, pump is okay, proceed with Step 8.
   - If flow drop is 1/2–1 gpm, pump is marginal.
   - If flow drops more than 1 gpm, pump has excessive internal leakage.

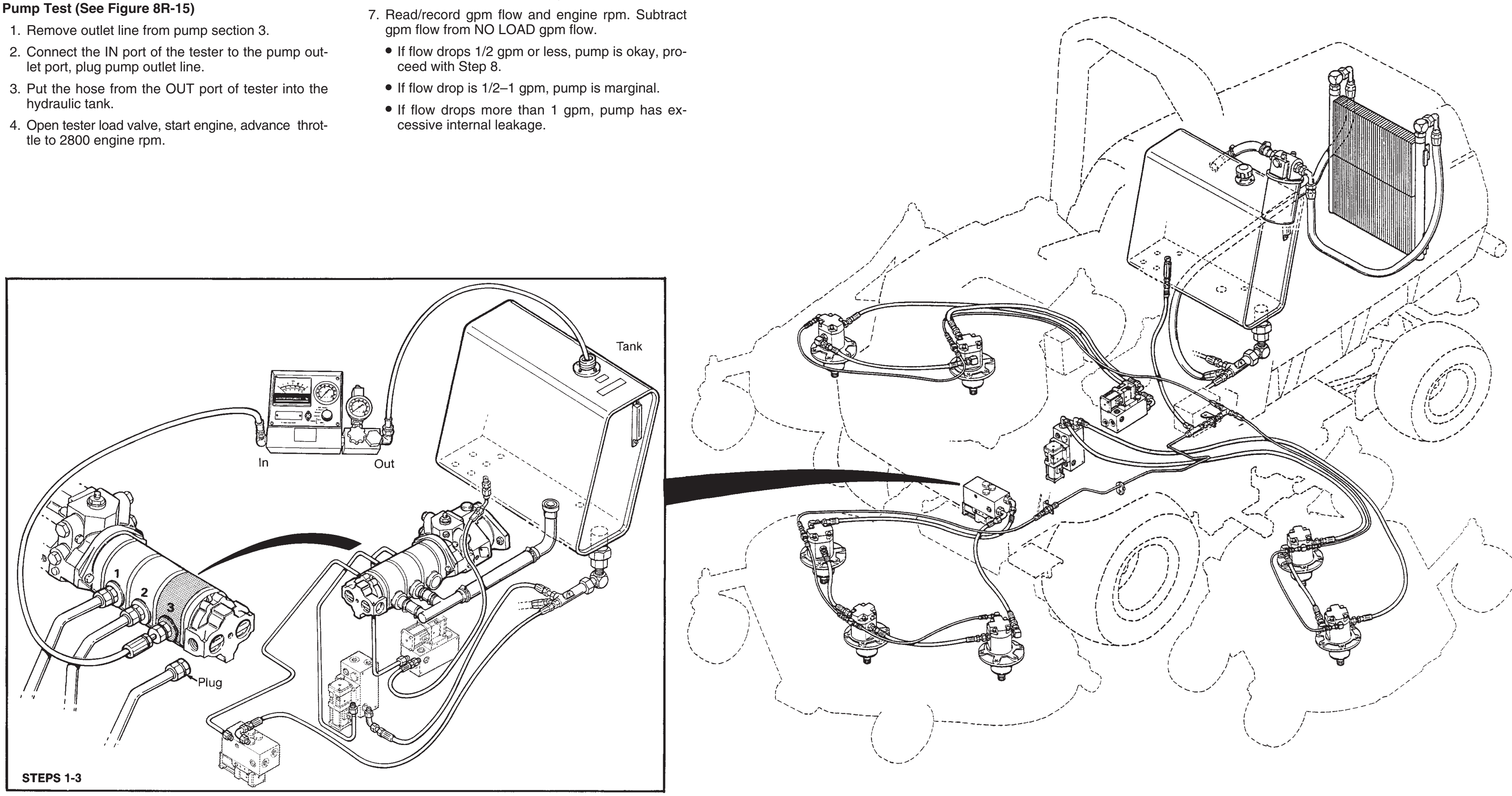


Figure 8R-15. Pump Test Front Mowers

Motor Valve Test (See Figure 8R-16)

NOTE

A pump test must be performed before proceeding with this test.

8. Reconnect outlet line to pump.
9. Remove hydraulic line from the A port of the left motor and install a tee to hose. Cap motor port.
10. Connect IN port of tester to tee in hydraulic line.
11. Put the hose from the OUT port of tester into the hydraulic tank.
12. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
13. Push center mower reel switch into CUT and pull implement switch ON.
14. Read/record no load flow. It should be the same as the pump test.
15. Slowly close tester load valve until 2300 psi is obtained and allow oil to heat up to 150°F.
16. Continue to close load valve until flow drops off and pressure no longer increases.
17. Read/record pressure at the point where flow drops off. This is the relief valve setting for the motor valve.

⚠ CAUTION

DO NOT exceed 3100 psi for this test.

- If relief valve opens between 2950–3050 relief is okay, proceed with Step 18.
- If relief opens lower than 2950 or more than 3050 the relief is faulty. Readjust, see relief valve adjustment, reel system front motors, adjustment, Figure 8R-6.

18. Slowly open tester load valve until 2500 psi is obtained.
19. Read/record gpm flow. Subtract from flow obtained in PUMP test.
    - If flow drops 1/2 gpm or less, valve is okay, proceed with Step 20.
    - If flow drop is 1/2–1 gpm, valve is marginal.
    - If flow drops more than 1 gpm, valve has excessive internal leakage.

Left Motor Test

NOTE

A pump and valve test must be performed before proceeding with this test.

20. Connect a tee to A port of the left motor.
21. IN port of tester should be connected to tee.
22. Using a 2 x 6" (50.8 x 152.4 mm) wooden block, block motor blade.
23. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
24. Push center mower reel switch into CUT and pull implement switch ON.
25. Slowly close tester load valve until 2500 psi is obtained.
26. Read/record gpm flow. Subtract from flow obtained in MOTOR VALVE test.
    - If flow drops 1/2 gpm or less, left motor is okay, proceed with Step 27.
    - If flow drop is 1/2–1 gpm, left mower is marginal.
    - If flow drops more than 1 gpm, left motor has excessive internal leakage.

Center Motor Test

NOTE

A pump, valve, and left motor test must be performed before proceeding with this test.

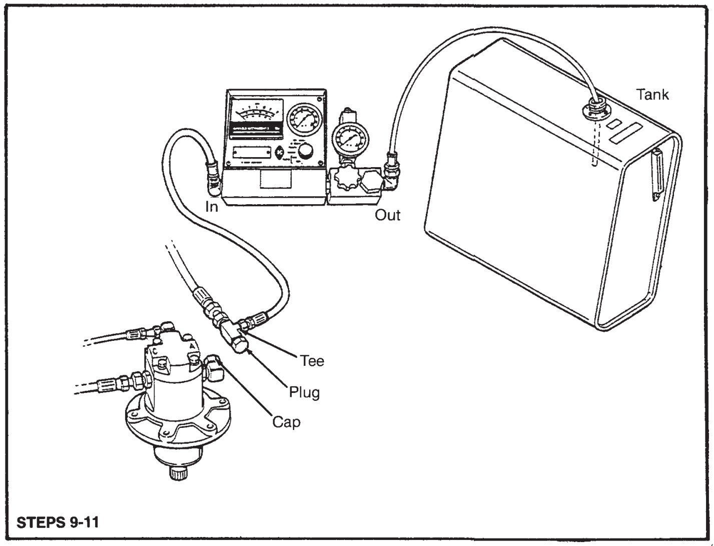
27. Move wooden block to center motor blade.
28. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
29. Push center mower reel switch into CUT and put implement switch on.
30. Slowly close tester load valve until 2500 psi is obtained.
31. Read/record gpm flow. Subtract from flow obtained in LEFT MOWER test.
    - If flow drops 1/2 gpm or less, center motor is okay, proceed with Step 32.
    - If flow drop is 1/2–1 gpm, center motor is marginal.
    - If flow drops more than 1 gpm, center motor has excessive internal leakage.

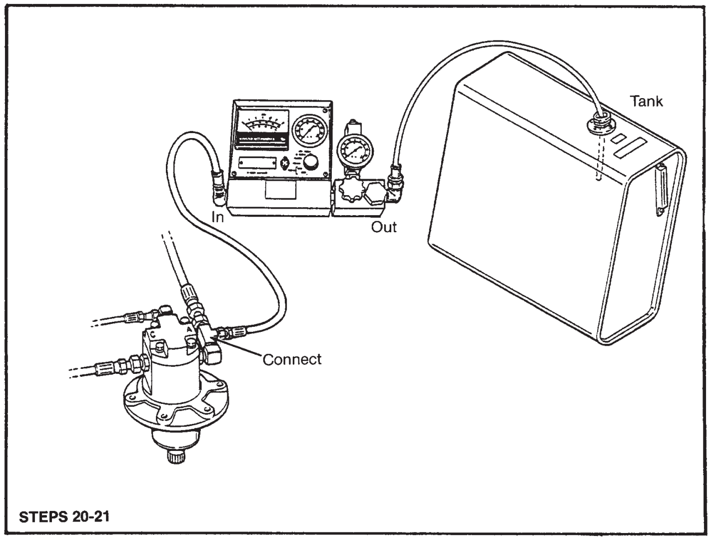
Right Motor Test

NOTE

A pump, valve, center motor and left motor test must be performed before proceeding with this test.

32. Move wooden block to right motor blade.
33. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
34. Push center mower reel switch into CUT and pull implement switch ON.
35. Slowly close tester valve until 2500 psi is obtained.
36. Read/record gpm flow. Subtract from flow obtained in CENTER MOTOR test.
    - If flow drops 1/2 gpm or less, right motor is okay.
    - If flow drop is 1/2–1 gpm, right motor is marginal.
    - If flow drops more than 1 gpm, right motor has excessive internal leakage.
37. Remove tee from left motor and connect line to motor.





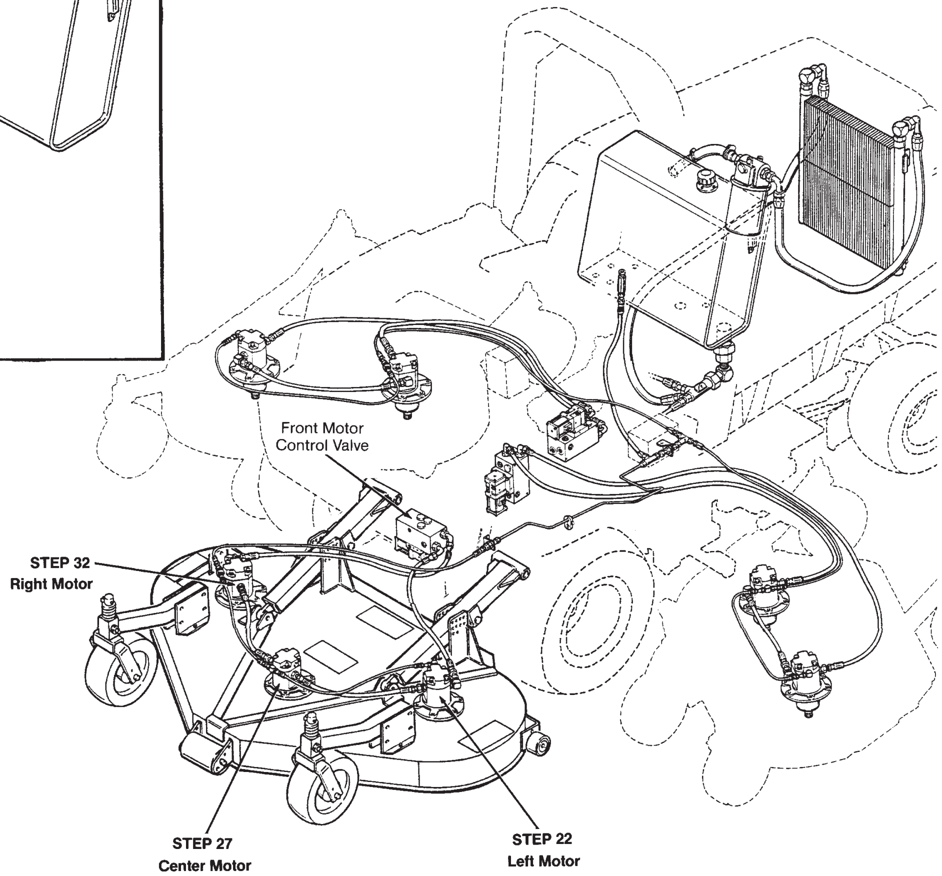


Figure 8R-16. Front Center Mower Circuit Tests

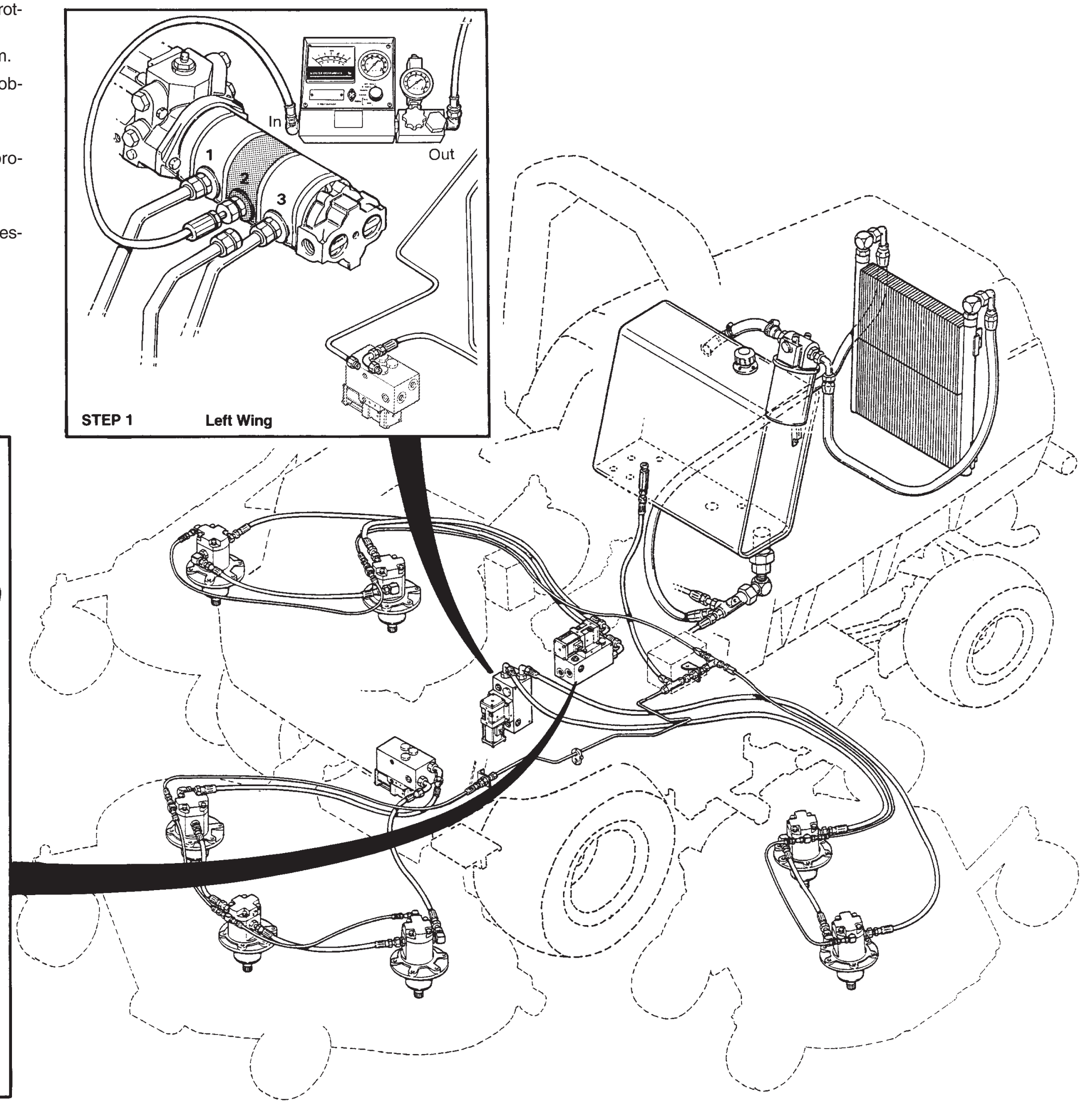
8R

WING MOWERS

Pump Test (See Figure 8R-17)

Pump section 1 supplies oil to the right wing and pump section 2 to the left wing. The test procedure is the same for both circuits. Test the circuit having the fault.

1. Remove outlet line from the pump section 1.
2. Connect the IN port of the tester to the pump outlet port and plug pump outlet line.
3. Put the hose from the OUT port of tester into the hydraulic tank.
4. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
5. Read/record no load flow. It should be 10.0 gpm.
6. Slowly close tester load valve until 2500 psi is obtained and allow oil to heat up to 150°F.
7. Read/record gpm flow and engine rpm.
   - If flow drops 1/2 gpm or less, pump is okay, proceed with Step 8.
   - If flow drop is 1/2–1 gpm, pump is marginal.
   - If flow drops more than 1 gpm, pump has excessive internal leakage.



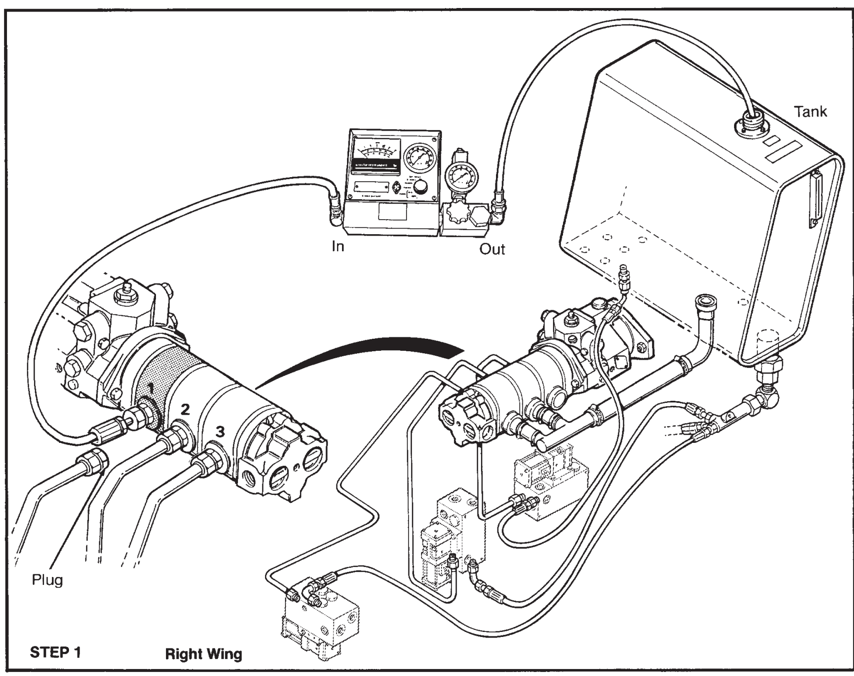


Figure 8R-17. Pump Test Wing Motor

Right Wing Motor Valve Test (See Figure 8R-18)

NOTE

A pump section 1 test must be performed before proceeding with this test.

8. Reconnect outlet line to pump, Section 1.
9. Remove hydraulic line from the A port of the inside motor and install a tee to hose. Cap motor port.
10. Connect IN port of tester to tee in hydraulic line.
11. Put the hose from the OUT port of tester into the hydraulic tank.
12. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
13. Push right wing mower reel switch into CUT and pull implement switch ON.
14. Read/record no load flow. It should be the same as the pump test.
15. Slowly close tester load valve until 2500 psi is obtained.
16. Continue to close load valve until flow drops off and pressure no longer increases.
17. Read/record pressure at the point where flow drops off. This is the relief valve setting for the motor valve.

⚠ CAUTION

DO NOT exceed 3100 psi for this test.

- If relief valve opens between 2950–3050, relief is okay, proceed with Step 18.
- If relief opens sooner than 2950 or more than 3050 the relief is faulty. Readjust, see relief valve adjustments, reel system, wing mowers, adjustment, Figure 8R-6.

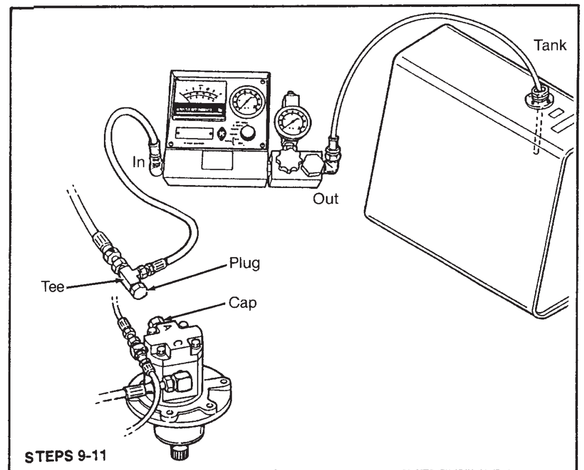
18. Slowly open tester load valve until 2500 psi is obtained.
19. Read/record gpm flow. Subtract from flow obtained in PUMP test.
    - If low drops 1/2 gpm less, motor valve is okay, proceed with Step 20.
    - If flow drop is 1/2–1 gpm, motor valve is marginal.
    - If flow drops more than 1 gpm, motor valve has excessive internal leakage.

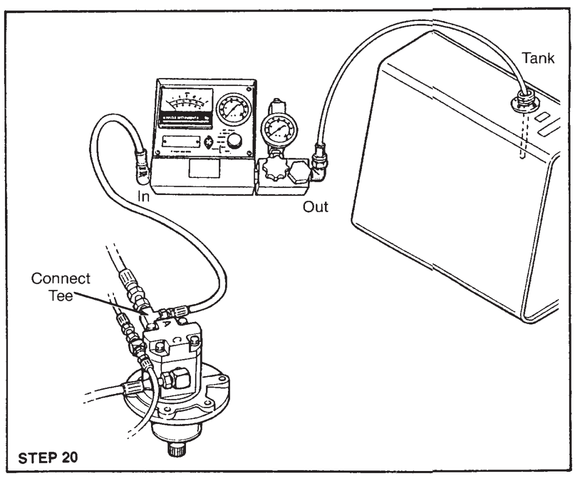
Right Wing Motor Tests

NOTE

A pump and right wing motor valve test must be performed before proceeding with this test.

20. Reconnect hydraulic line and tee to A port of inside motor.
21. Using a 2 x 6" (50.8 x 152.4 mm) wooden block, block the blade of the inside motor.
22. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
23. Push right wing reel switch into CUT and pull implement switch ON.
24. Slowly close tester load valve until 2500 psi is obtained.
25. Read/record gpm flow. Subtract from flow obtained in RIGHT WING MOTOR VALVE test.
    - If flow drops 1/2 gpm or less, right wing motor is okay.
    - If flow drop is 1/2–1 gpm, right wing motor is marginal.
    - If flow drops more than 1 gpm, right wing motor has excessive internal leakage.
26. Repeat Steps 21–25, blocking the blade of the outside motor.





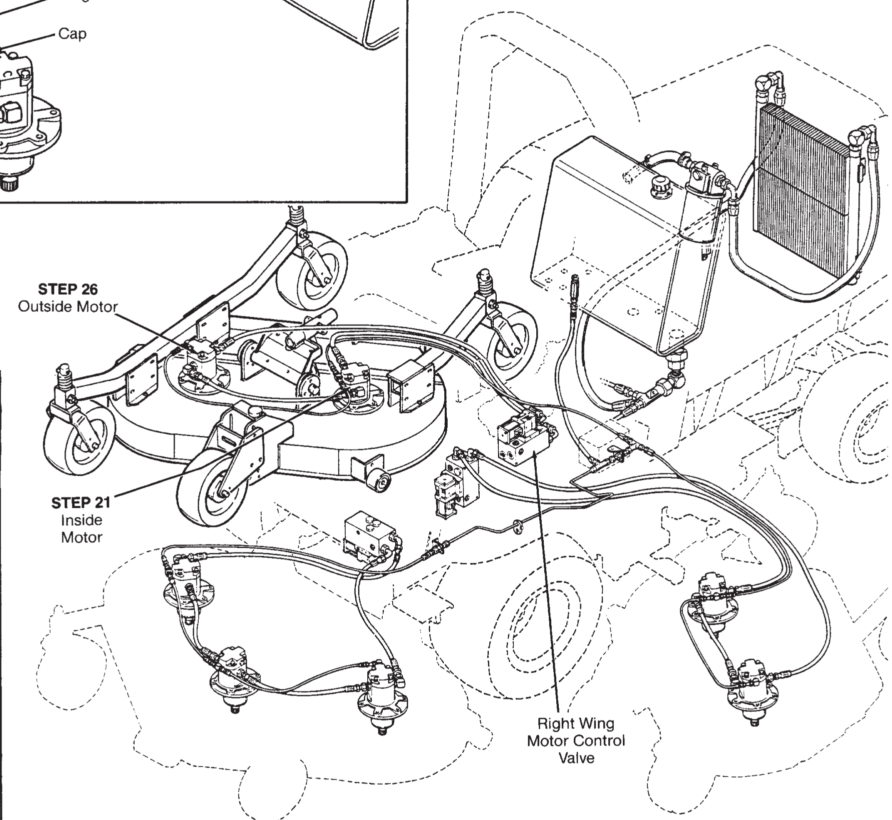


Figure 8R-18. Right Wing Motor Circuit Tests

Left Wing Motor Valve Test (See Figure 8R-19)

NOTE

A pump section 2 test must be performed before proceeding with this test.

8. Reconnect outlet line to pump, Section 2.
9. Remove hydraulic line from the port C of the left wing inside motor and install a tee to hose. Cap motor port.
10. Connect IN port of tester to tee in hydraulic line.
11. Put the hose from the OUT port of tester into the hydraulic tank.
12. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
13. Push left wing mower reel switch into CUT and pull implement switch ON.
14. Read/record no load flow. It should be the same as the pump test.
15. Slowly close tester load valve until 2500 psi is obtained.
16. Continue to close load valve until flow drops off and pressure no longer increases.
17. Read/record pressure at the point where flow drops off. This is the relief valve setting for the motor valve.

CAUTION

DO NOT exceed 3100 psi for this test.

- If relief valve opens between 2950–3050, relief is okay, proceed with Step 18.
- If relief opens sooner than 2950 or more than 3050, the relief is faulty. Readjust, see relief valve adjustments, reel system, wing mowers, adjustment, Figure 8R-6.

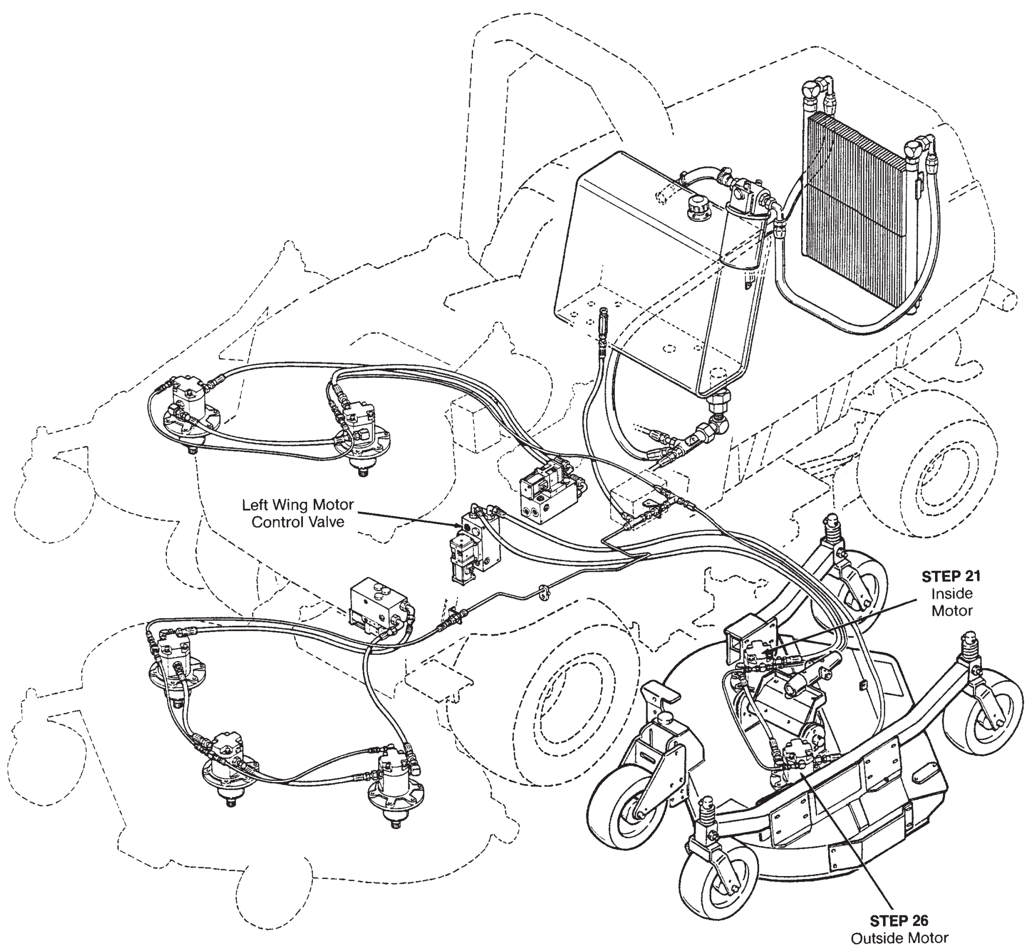
18. Slowly open tester load valve until 2500 psi is obtained.
19. Read/record gpm flow. Subtract flow obtained in PUMP test.
    - If flow drops 1/2 gpm or less, motor valve is okay, proceed with Step 20.
    - If flow drop is 1/2–1 gpm, motor valve is marginal.
    - If flow drops more than 1 gpm, motor valve has excessive internal leakage.

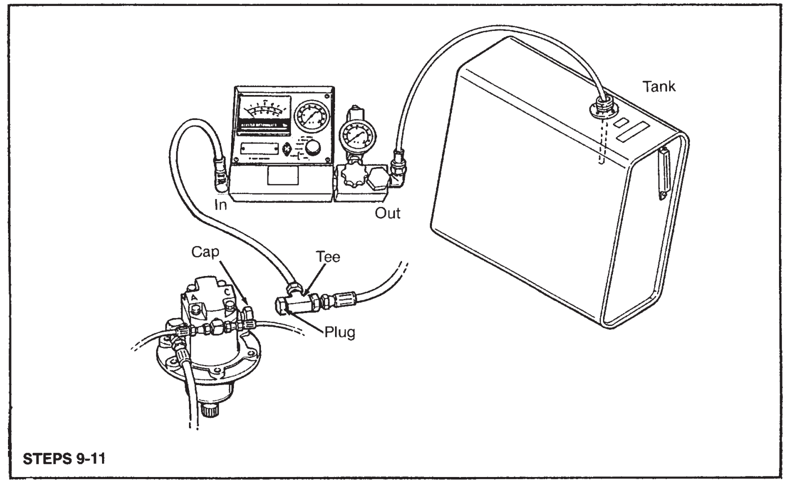
Left Wing Motor Tests

NOTE

A pump and left wing motor valve test must be performed before proceeding with this test.

20. Reconnect hydraulic line and tee to rear port of left wing motor.
21. Using a 2 x 6" (50.8 x 152.4 mm) wooden block, block the blade of the inside motor.
22. Open tester load valve, start engine, advance throttle to 2800 engine rpm.
23. Push left wing reel switch into CUT and pull implement switch ON.
24. Slowly close tester load valve until 2500 psi is obtained.
25. Read/record gpm flow. Subtract from flow obtained in LEFT WING MOTOR VALVE test.
    - If flow drop is 1/2 gpm or less, left wing motor is okay.
    - If flow drop is 1/2–1 gpm, left wing motor is marginal.
    - If flow drops more than 1 gpm, left wing motor has excessive internal leakage.
26. Repeat Steps 21–25 blocking the blade of the outside motor.





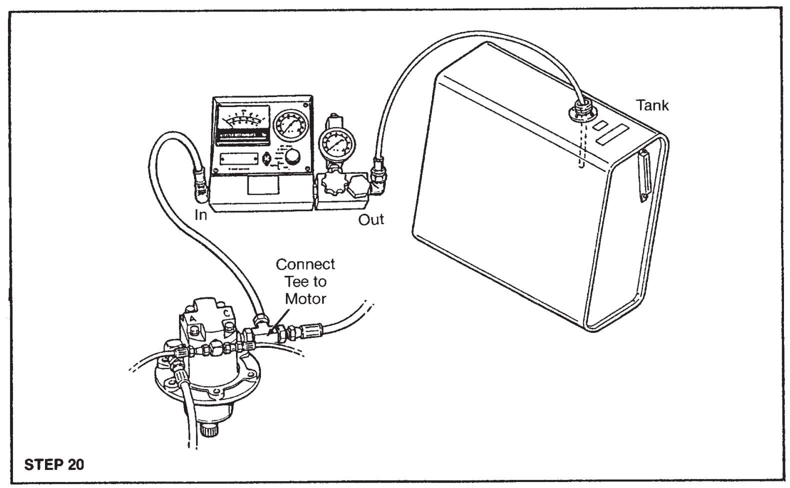


Figure 8R-19. Left Wing Motor Circuit Tests

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SECTION 8R. INSTRUMENT TEST

HYDRAULIC INSTRUMENT TEST DATA SHEET

RELIEF VALVE TESTS

	Actual	Settings
Charge Relief	_____ psi	190–250 psi
Steering Relief	_____ psi	1500 psi
Lift System Relief	_____ psi	1500 psi
Traction System Relief		
Forward	_____ psi	3500 psi
Reverse	_____ psi	3500 psi
Mower System Relief		
Front Motors	_____ psi	3000 psi
Left Wing Motors	_____ psi	3000 psi
Right Wing Motors	_____ psi	2600 psi

FLOW TESTS

Charge Pump		
NO LOAD	________ gpm	@ engine rpm ________
@ 1500 psi	________ gpm	@ engine rpm ________
Conclusion	________ gpm drop	@ engine rpm drop ________
Priority Valve		
Flow increases to	4.5 to 5.0 gpm	@ engine rpm 2800
Flow increases to	________ gpm	@ engine rpm ________
Conclusion	________ gpm drop	@ engine rpm drop ________

LIFT SYSTEM TESTS
Front Mower and Lift Valve Isolation Test (check correct Conclusion)

_____ No oil leakage, mower does not come down.
_____ No oil leakage, mower comes down.
_____ Oil leaks from tee, mower comes down.
All Steps 16–19
_____ No oil leakage.
_____ Oil leaks from left cylinder.
_____ Oil leaks from right cylinder.

Left Wing Cylinder and Lift Valve Isolation Test (check correct Conclusion)

_____ No oil leakage, mower does not come down.
_____ No oil leakage, mower comes down.
_____ Oil leaks from cylinder port, mower comes down.

Right Wing Cylinder and Lift Valve Isolation Test (check correct Conclusion)

_____ No oil leakage, mower does not come down.
_____ No oil leakage, mower comes down.
_____ Oil leaks from cylinder port, mower comes down.

SECTION 8R. INSTRUMENT TEST

FLOW TESTS (Continued)

TRACTION SYSTEM
Traction Pump

NO LOAD		________	gpm	@ engine rpm	2800
NO LOAD @		10	gpm	@ engine rpm	2800
@ 3000 psi	–	________	gpm	@ engine rpm –	________
Conclusion	=	________	gpm drop	@ engine rpm drop =	________

Front Traction Motor

NO LOAD		10	gpm	@ engine rpm	2800
Traction Pump Test		________	gpm		
@ 3000 psi	–	________	gpm	@ engine rpm –	________
Conclusion	=	________	gpm drop	@ engine rpm drop =	________

4 Wheel Drive Valve

NO LOAD		________	gpm	@ engine rpm	2800
Traction Motor Test		________	gpm		
@ 3000 psi	–	________	gpm	@ engine rpm –	________
Conclusion	=	________	gpm drop	@ engine rpm drop =	________

Rear Traction Motor Tests

Left Motor

NO LOAD		10	gpm	@ engine rpm	2800
4 Wheel Drive Test		________	gpm		
@ 3000 psi	–	________	gpm	@ engine rpm –	________
Conclusion	=	________	gpm drop	@ engine rpm drop =	________

Right Motor

NO LOAD		10	gpm	@ engine rpm	2800
Left Motor Test		________	gpm		
@ 3000 psi	–	________	gpm	@ engine rpm –	________
Conclusion	=	________	gpm drop	@ engine rpm drop =	________

MOWER SYSTEM TESTS
Front Mower Pump (Section 3)

NO LOAD		________	gpm	@ engine rpm	2800
@ 2500 psi	–	________	gpm	@ engine rpm –	________
Conclusion	=	________	gpm drop	@ engine rpm drop =	________

Mower Valve

NO LOAD		________	gpm	@ engine rpm	2800
Pump Test		________	gpm		
@ 2500 psi	–	________	gpm	@ engine rpm –	________
Conclusion	=	________	gpm drop	@ engine rpm drop =	________

Left Motor

NO LOAD		________	gpm	@ engine rpm	2800
Motor Valve Test		________	gpm		
@ 2500 psi	–	________	gpm	@ engine rpm –	________
Conclusion	=	________	gpm drop	@ engine rpm drop =	________

SECTION 8R. INSTRUMENT TEST

FLOW TESTS (Continued)

MOWER SYSTEM TESTS (Continued)
Front Mower Pump (Continued)

Center Motor

NO LOAD	________ gpm	@ engine rpm	2800
Center Motor Test	________ gpm		
@ 3000 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

Right Motor

NO LOAD	________ gpm	@ engine rpm	2800
Right Motor Test	________ gpm		
@ 3000 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

Right Wing Mower Pump (Section 1)

NO LOAD	________ gpm	@ engine rpm	2800
@ 2500 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

Right Wing Motor Valve

NO LOAD	________ gpm	@ engine rpm	2800
Pump Test	________ gpm		
@ 2500 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

Right Wing Inside Motor

NO LOAD	________ gpm	@ engine rpm	2800
Motor Valve Test	________ gpm		
@ 2500 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

Right Wing Outside Motor

NO LOAD	________ gpm	@ engine rpm	2800
Pump Test	________ gpm		
@ 2500 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

SECTION 8R. INSTRUMENT TEST

FLOW TESTS (Continued)

MOWER SYSTEM TESTS (Continued)
Front Mower Pump (Continued)

Right Wing Mower Pump (Section 1)

NO LOAD	________ gpm	@ engine rpm	2800
@ 2500 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

Left Wing Motor Valve

NO LOAD	________ gpm	@ engine rpm	2800
Pump Test	________ gpm		
@ 2500 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

Left Wing Inside Motor

NO LOAD	________ gpm	@ engine rpm	2800
Motor Valve Test	________ gpm		
@ 2500 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

Left Wing Outside Motor

NO LOAD	________ gpm	@ engine rpm	________
Pump Test	________ gpm		
@ 2500 psi	– ________ gpm	@ engine rpm –	________
Conclusion	= ________ gpm drop	@ engine rpm drop =	________

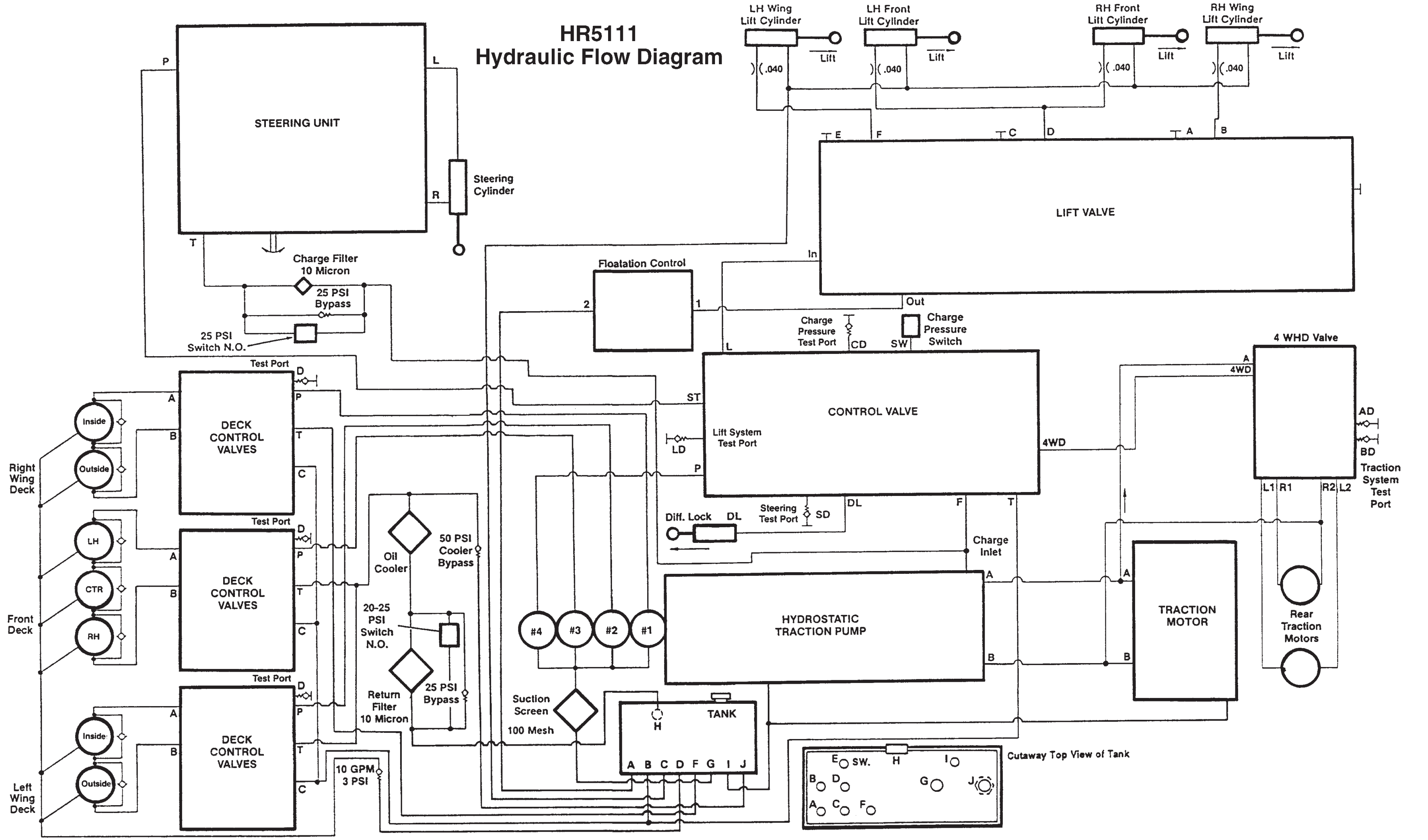


Figure 8S-1. Flow Diagram

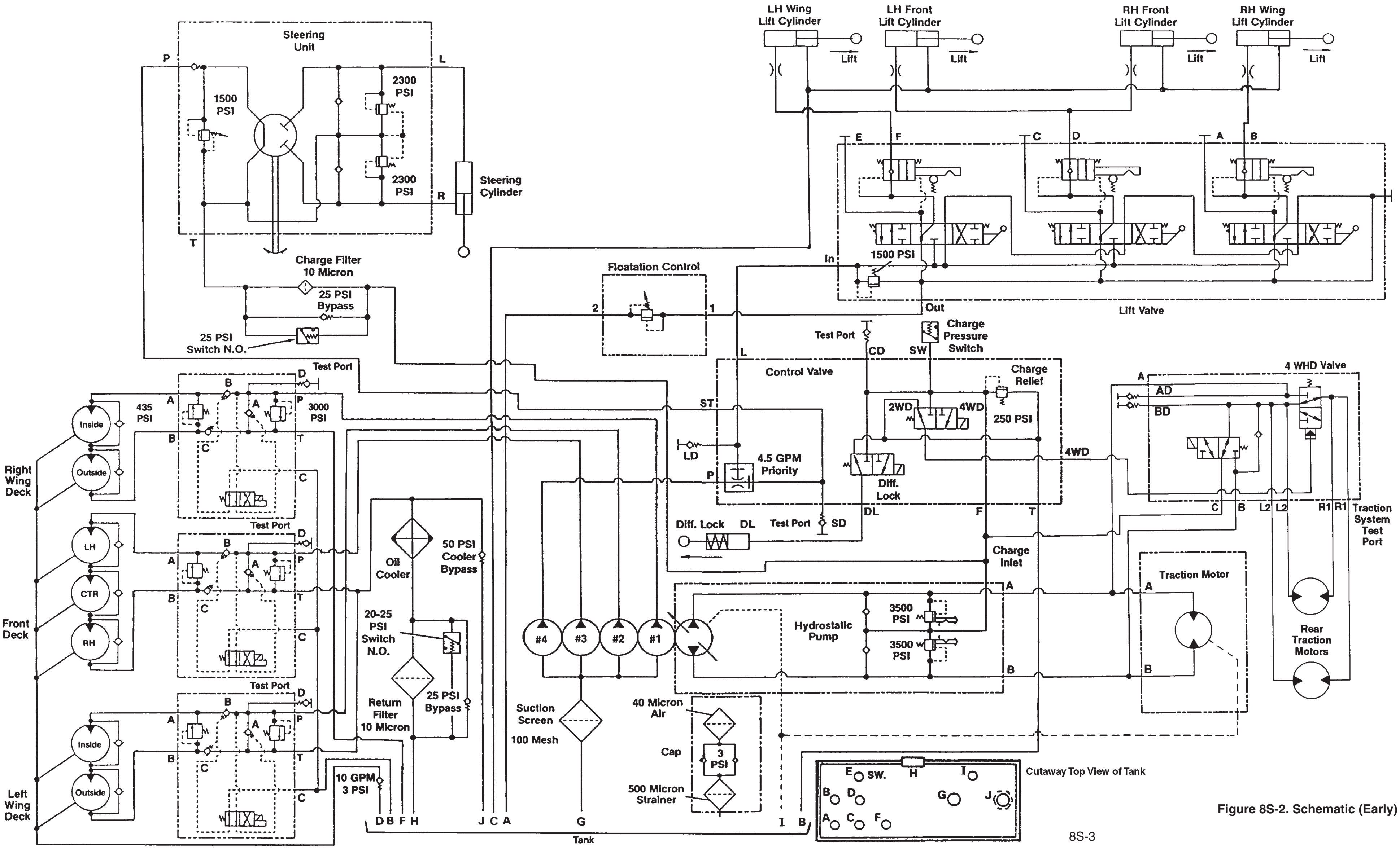


Figure 8S-2. Schematic (Early)

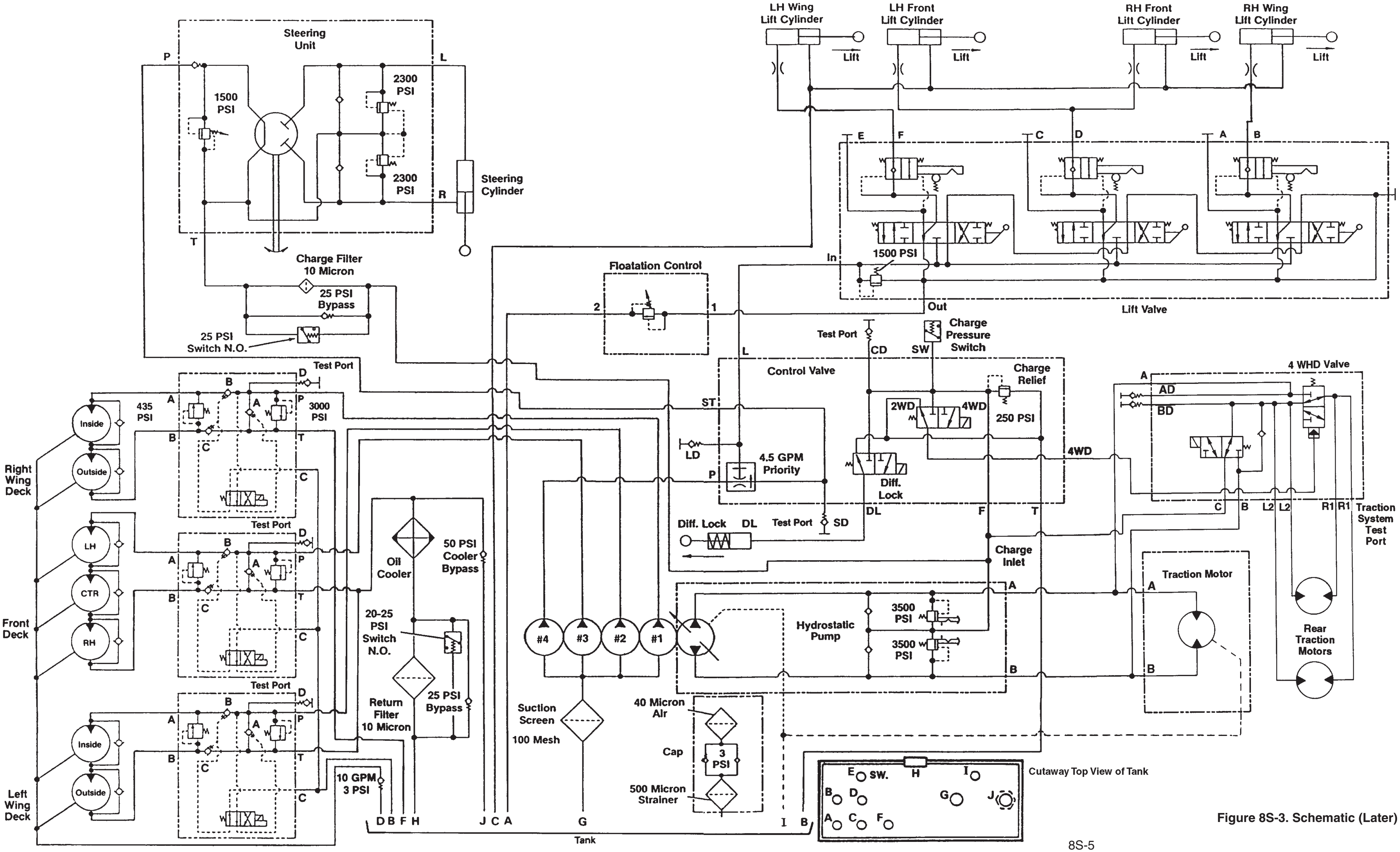
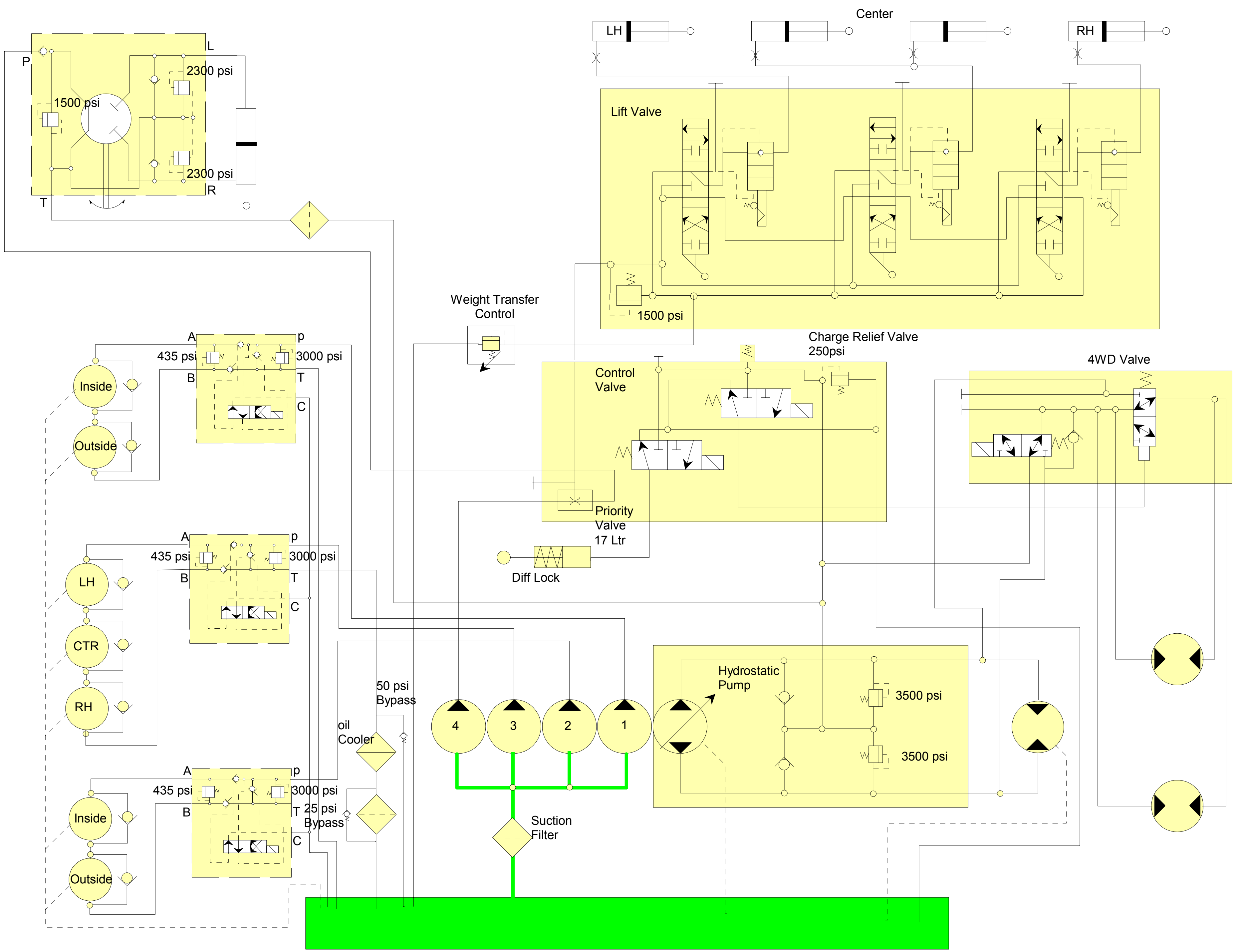
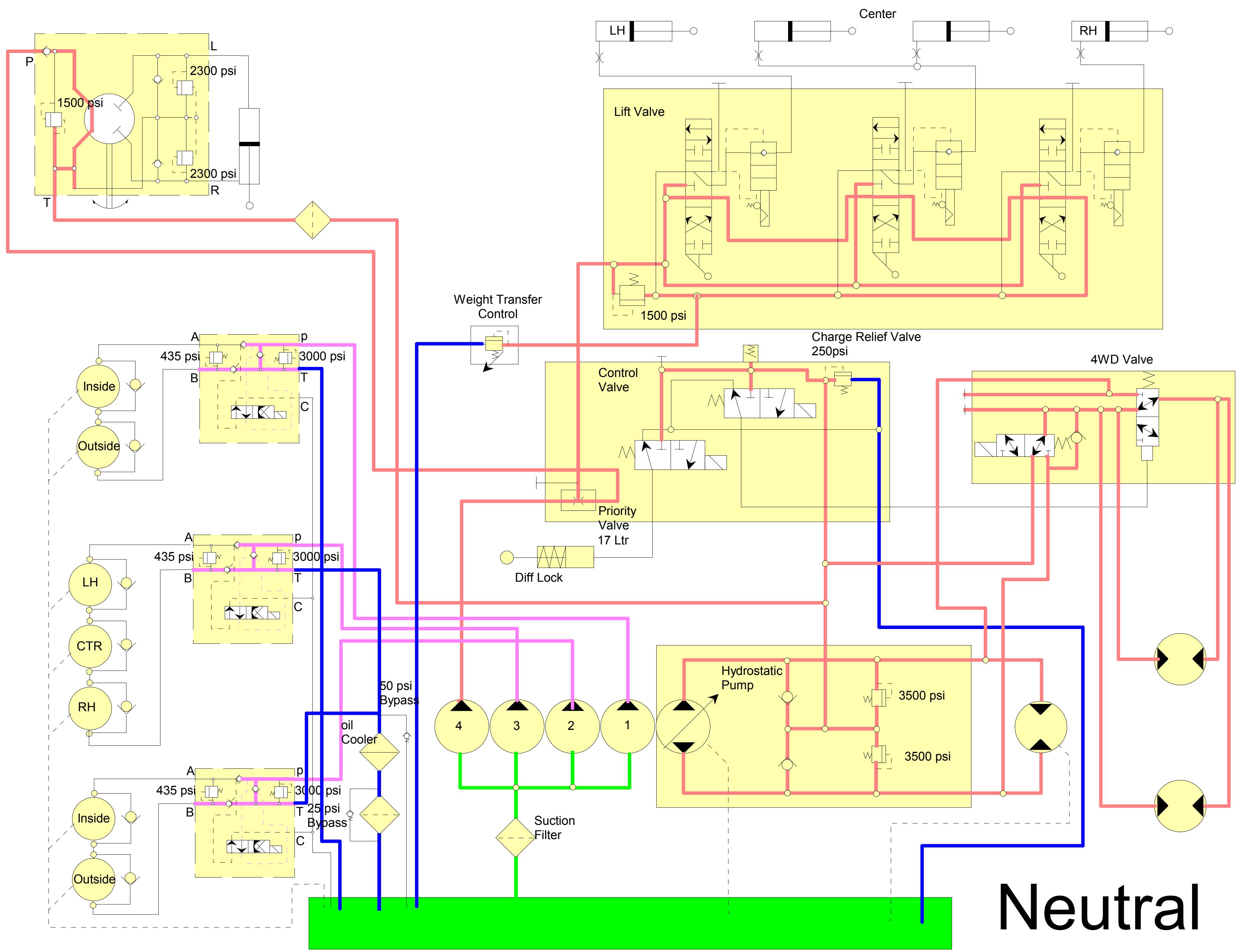


Figure 8S-3. Schematic (Later)

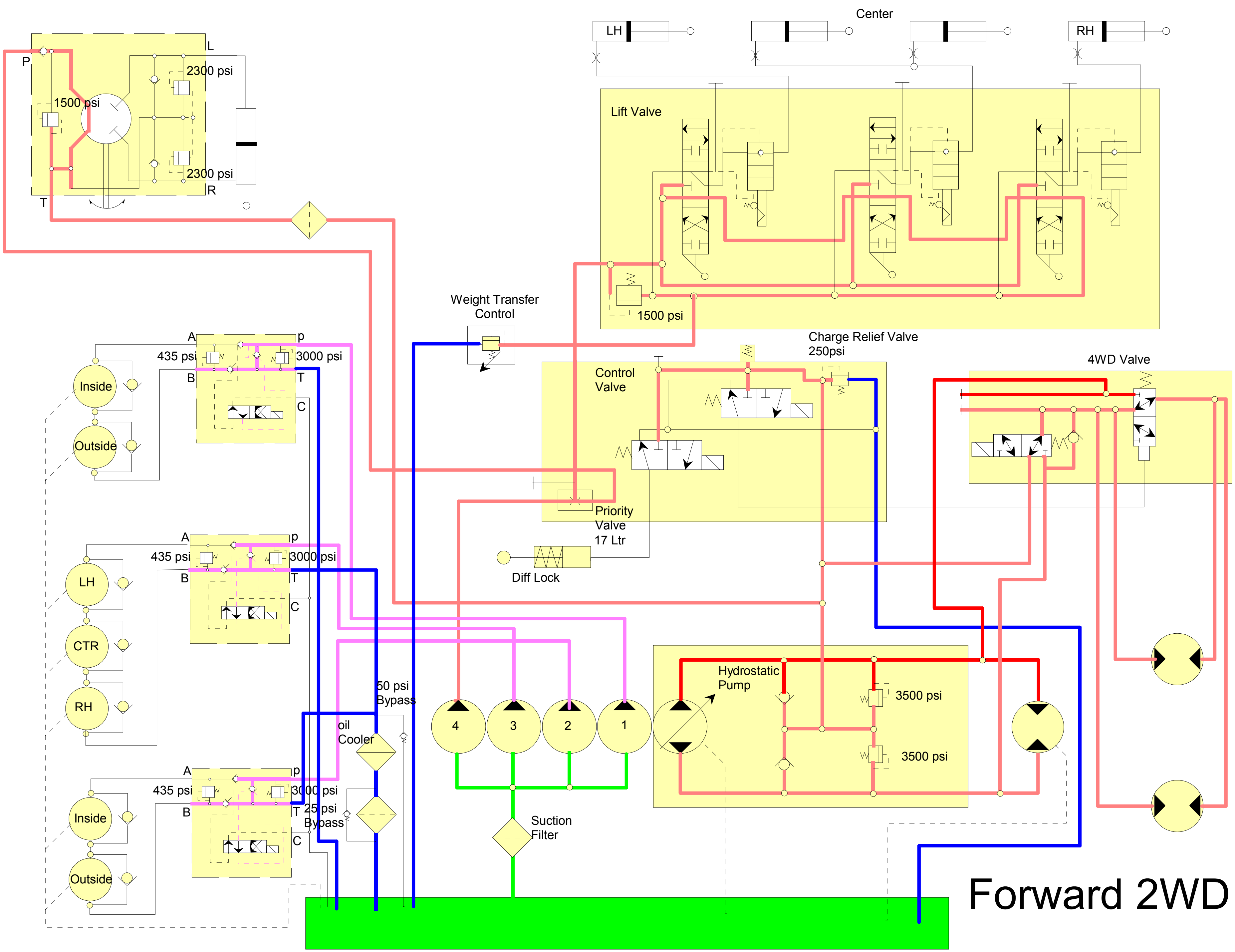


Center
LH
RH
P
L
2300 psi
1500 psi
2300 psi
T
R
Lift Valve
1500 psi
Weight Transfer Control
Charge Relief Valve 250psi
4WD Valve
Control Valve
A
p
435 psi
3000 psi
B
T
C
Inside
Outside
Priority Valve 17 Ltr
Diff Lock
LH
CTR
RH
Hydrostatic Pump
3500 psi
3500 psi
50 psi Bypass
oil Cooler
4
3
2
1
25 psi Bypass
Suction Filter

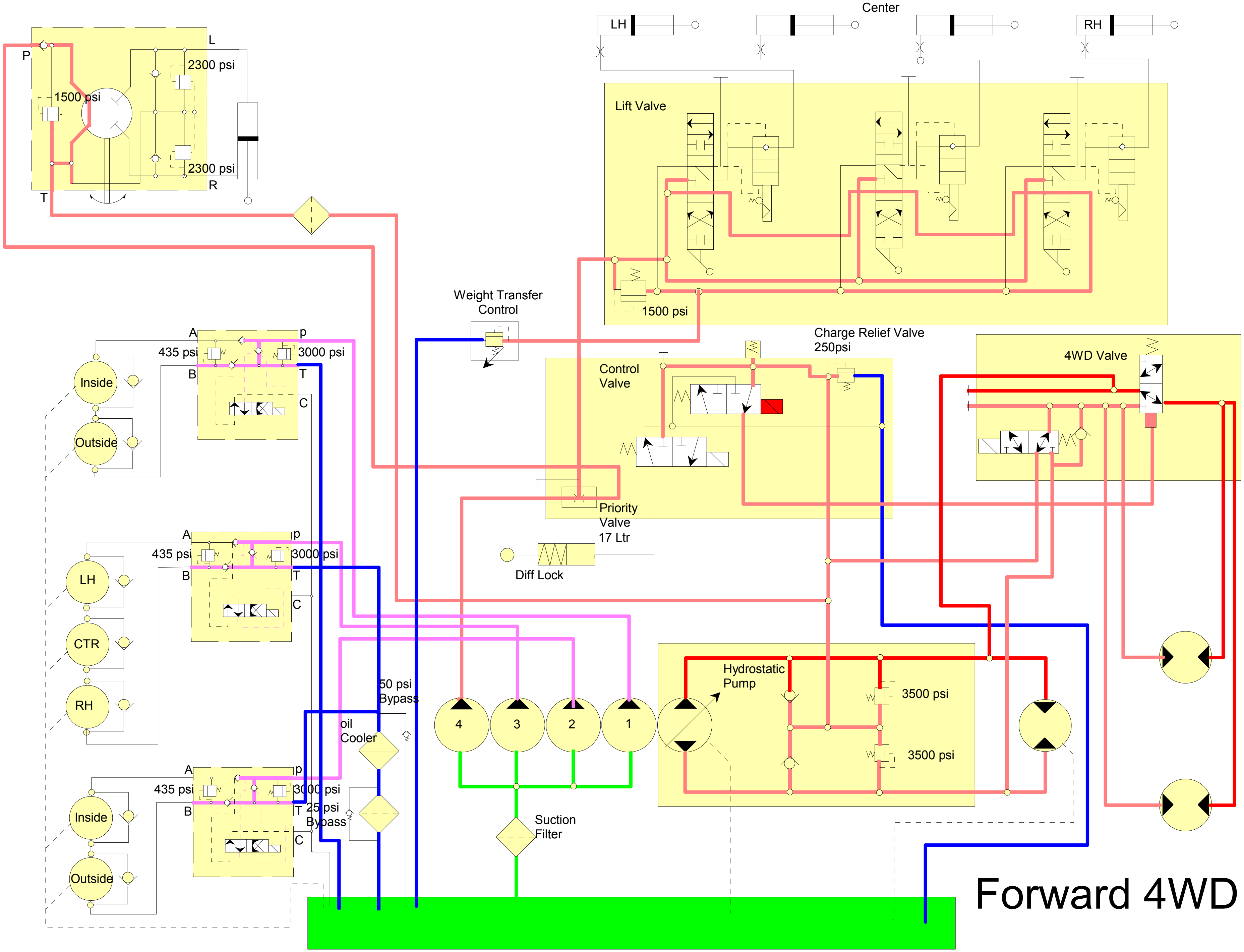


Center
LH
RH
L
P
2300 psi
1500 psi
2300 psi
T
R
Lift Valve
1500 psi
Weight Transfer
Control
Charge Relief Valve
250psi
4WD Valve
Control
Valve
Priority
Valve
17 Ltr
Diff Lock
A
p
435 psi
3000 psi
B
T
C
Inside
Outside
LH
CTR
RH
50 psi
Bypass
oil
Cooler
25 psi
Bypass
4
3
2
1
Hydrostatic
Pump
3500 psi
3500 psi
Suction
Filter
Neutral

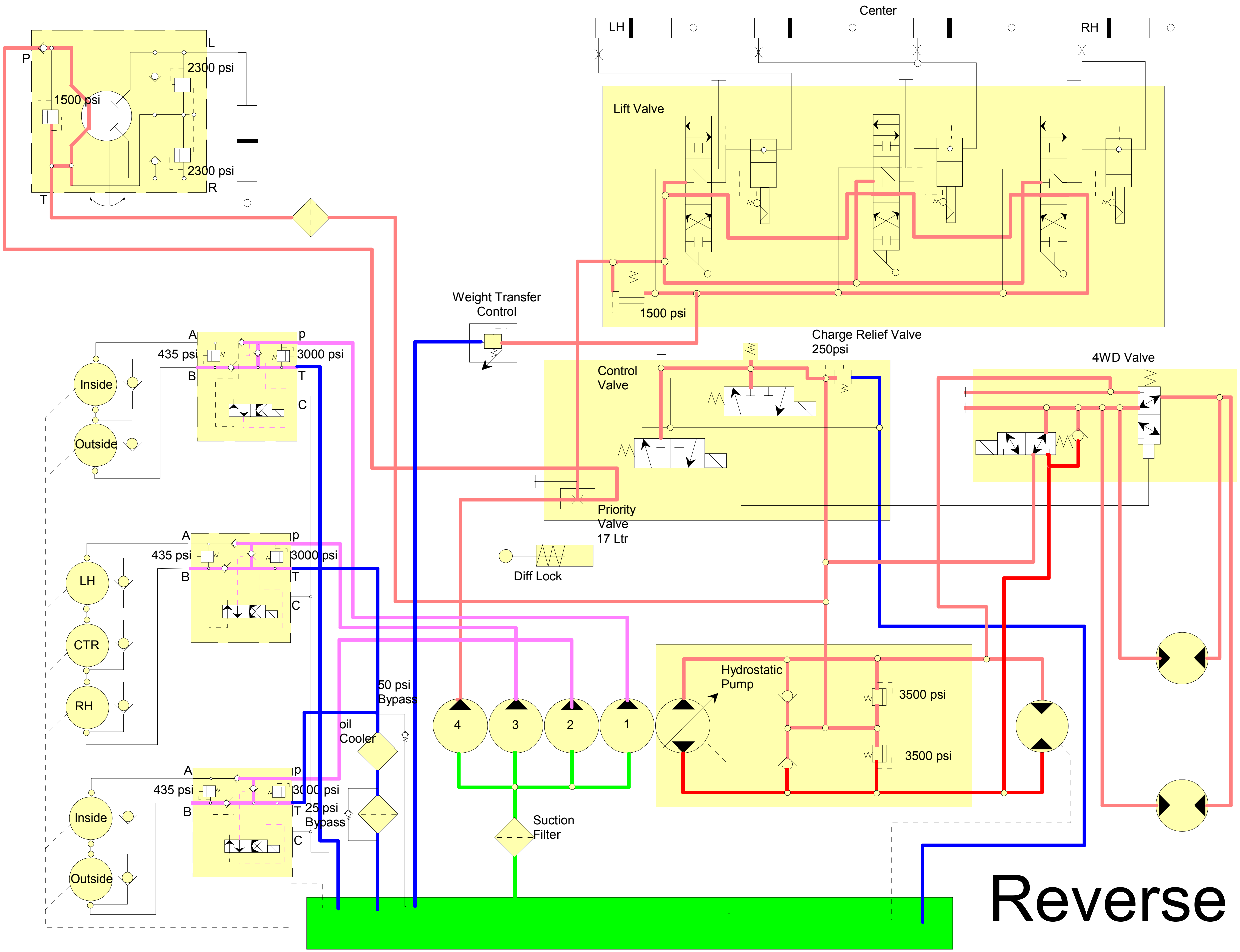
8S


Center
LH
RH
L
P
2300 psi
1500 psi
2300 psi
R
T
Lift Valve
1500 psi
Weight Transfer Control
Charge Relief Valve 250psi
4WD Valve
Control Valve
Priority Valve 17 Ltr
Diff Lock
A
p
435 psi
3000 psi
B
T
C
Inside
Outside
LH
CTR
RH
Inside
Outside
50 psi Bypass
oil Cooler
25 psi Bypass
4
3
2
1
Suction Filter
Hydrostatic Pump
3500 psi
3500 psi

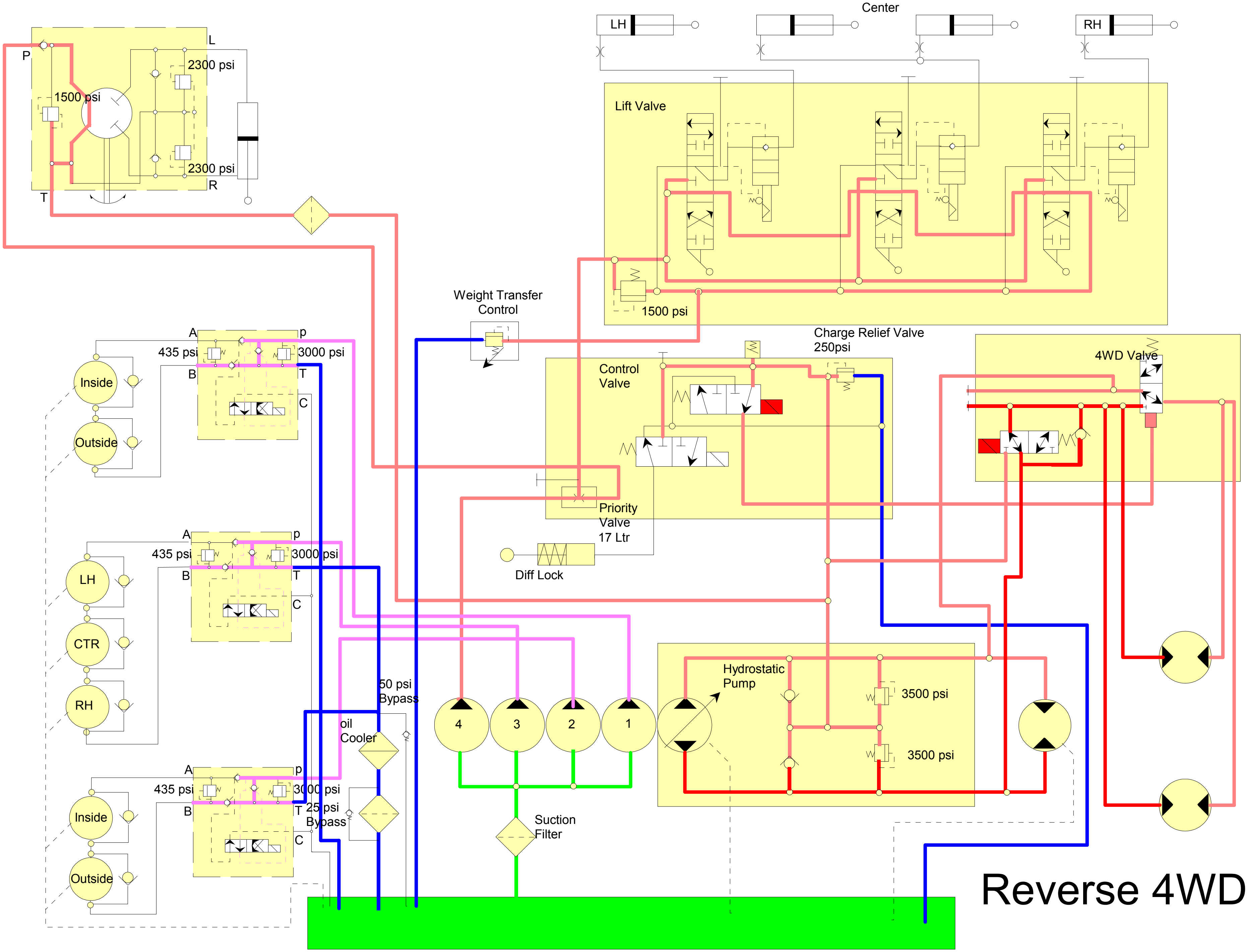
Forward 2WD


P
L
T
R
1500 psi
2300 psi
2300 psi
LH
Center
RH
Lift Valve
1500 psi
Weight Transfer Control
Charge Relief Valve 250psi
Control Valve
4WD Valve
Priority Valve 17 Ltr
Diff Lock
A
p
435 psi
3000 psi
B
T
C
Inside
Outside
LH
CTR
RH
50 psi Bypass
oil Cooler
25 psi Bypass
4
3
2
1
Hydrostatic Pump
3500 psi
3500 psi
Suction Filter

Forward 4WD

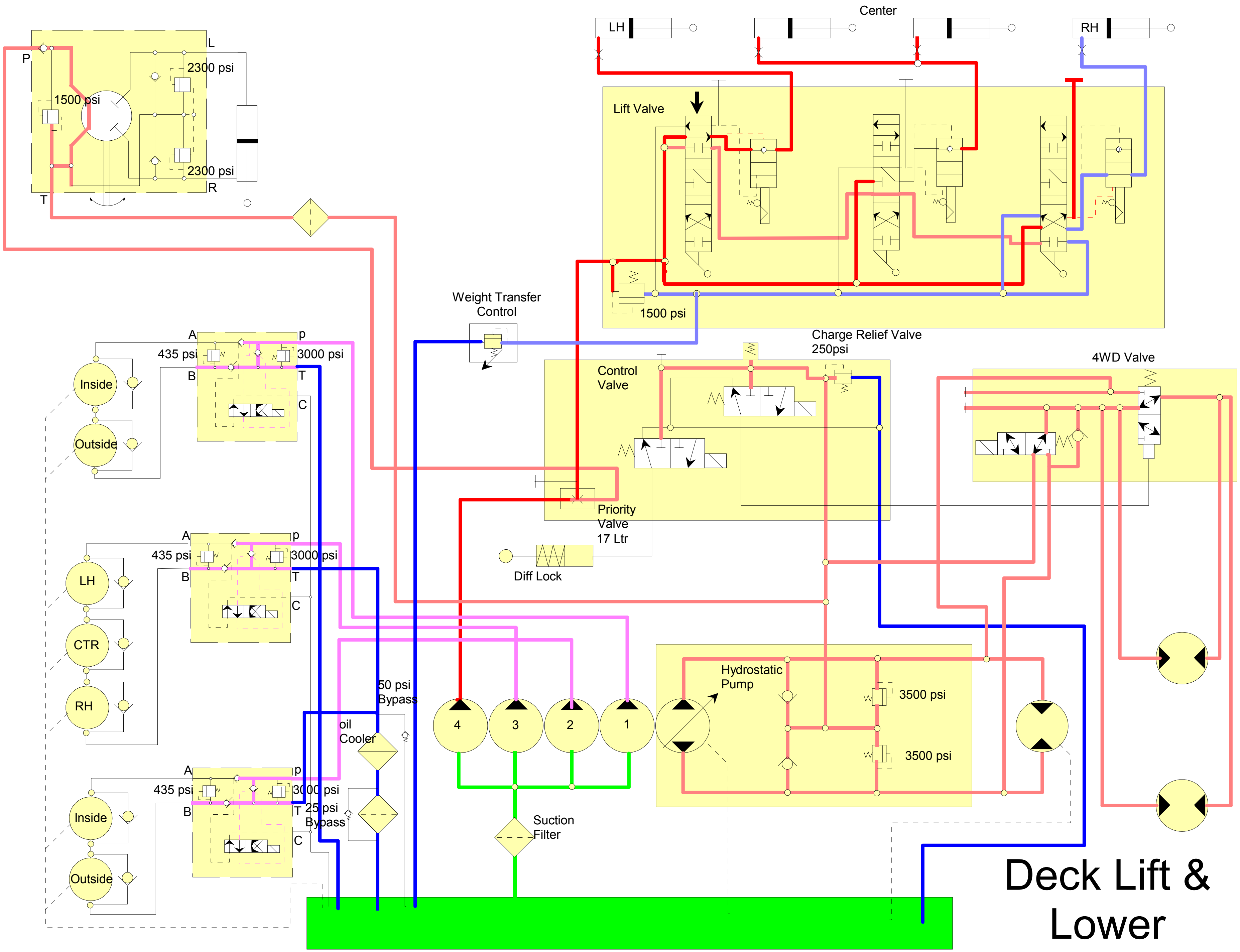

Center
LH
RH
Lift Valve
1500 psi
P
L
2300 psi
1500 psi
2300 psi
T
R
Weight Transfer Control
Charge Relief Valve 250psi
4WD Valve
Control Valve
Priority Valve 17 Ltr
Diff Lock
A
p
435 psi
3000 psi
B
T
C
Inside
Outside
LH
CTR
RH
50 psi Bypass
oil Cooler
25 psi Bypass
4
3
2
1
Suction Filter
Hydrostatic Pump
3500 psi
3500 psi

Reverse

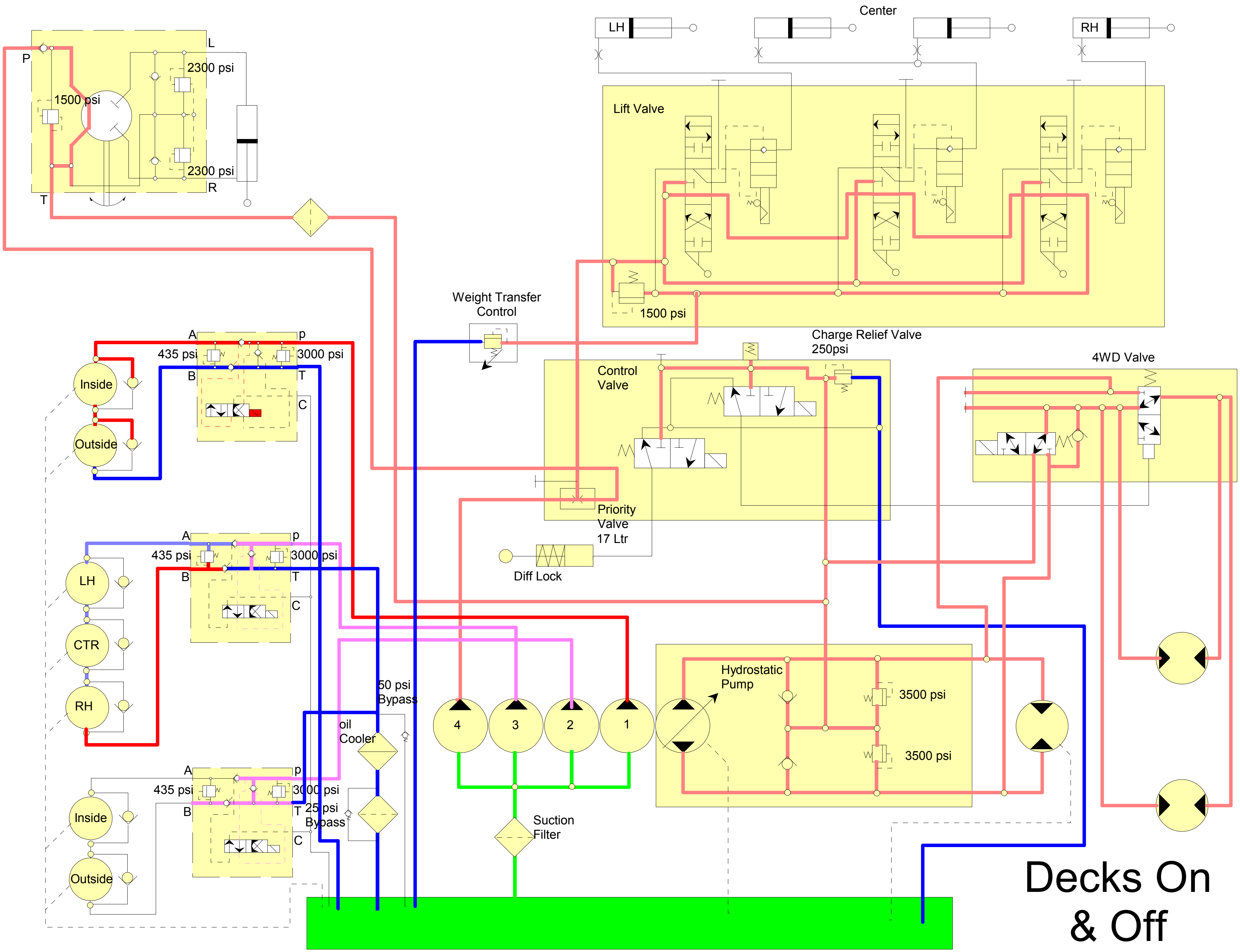


Reverse 4WD

8S



Deck Lift & Lower



Decks On & Off

8S

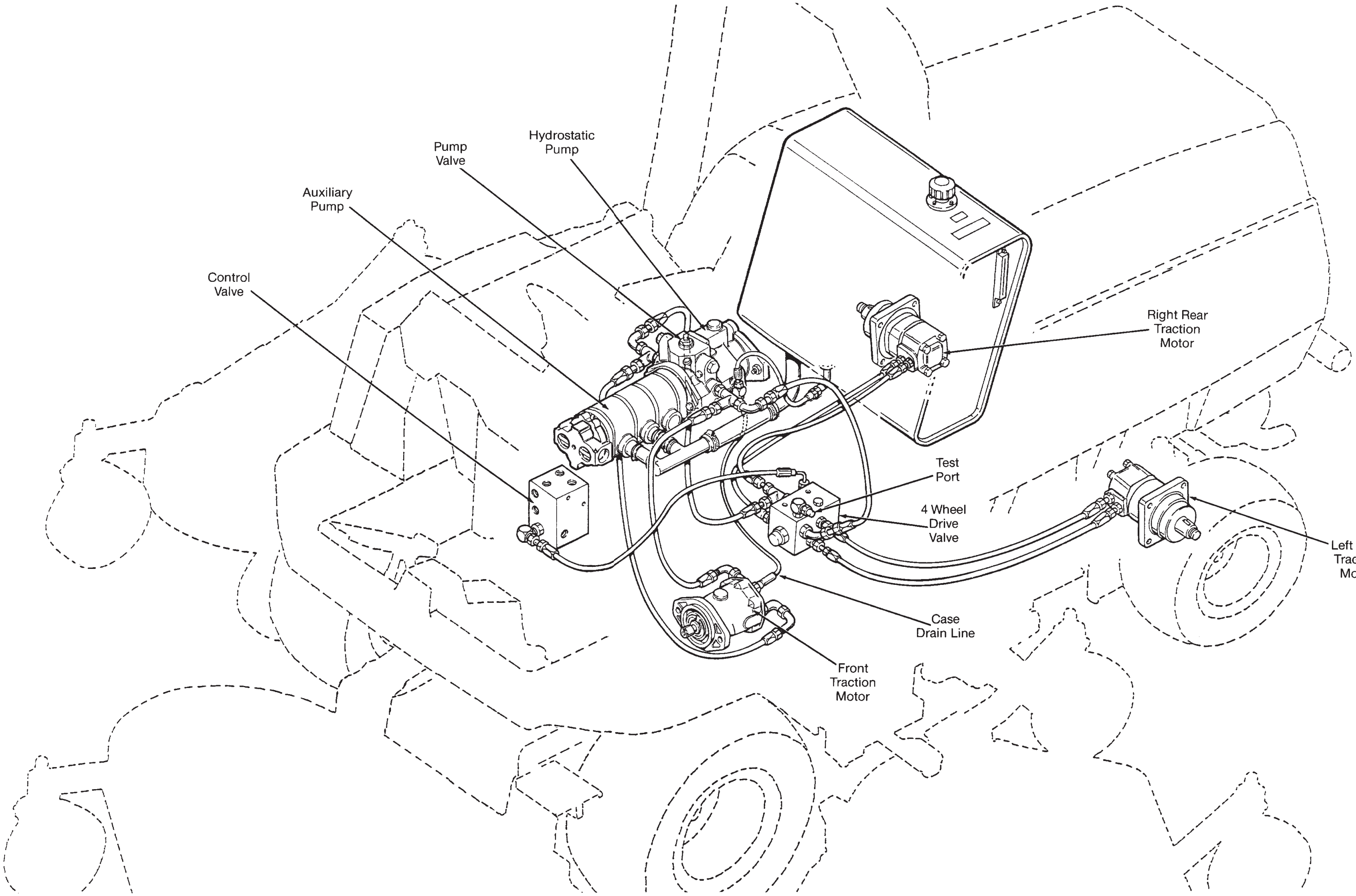


Figure 8S-4. Traction System (1 of 4)

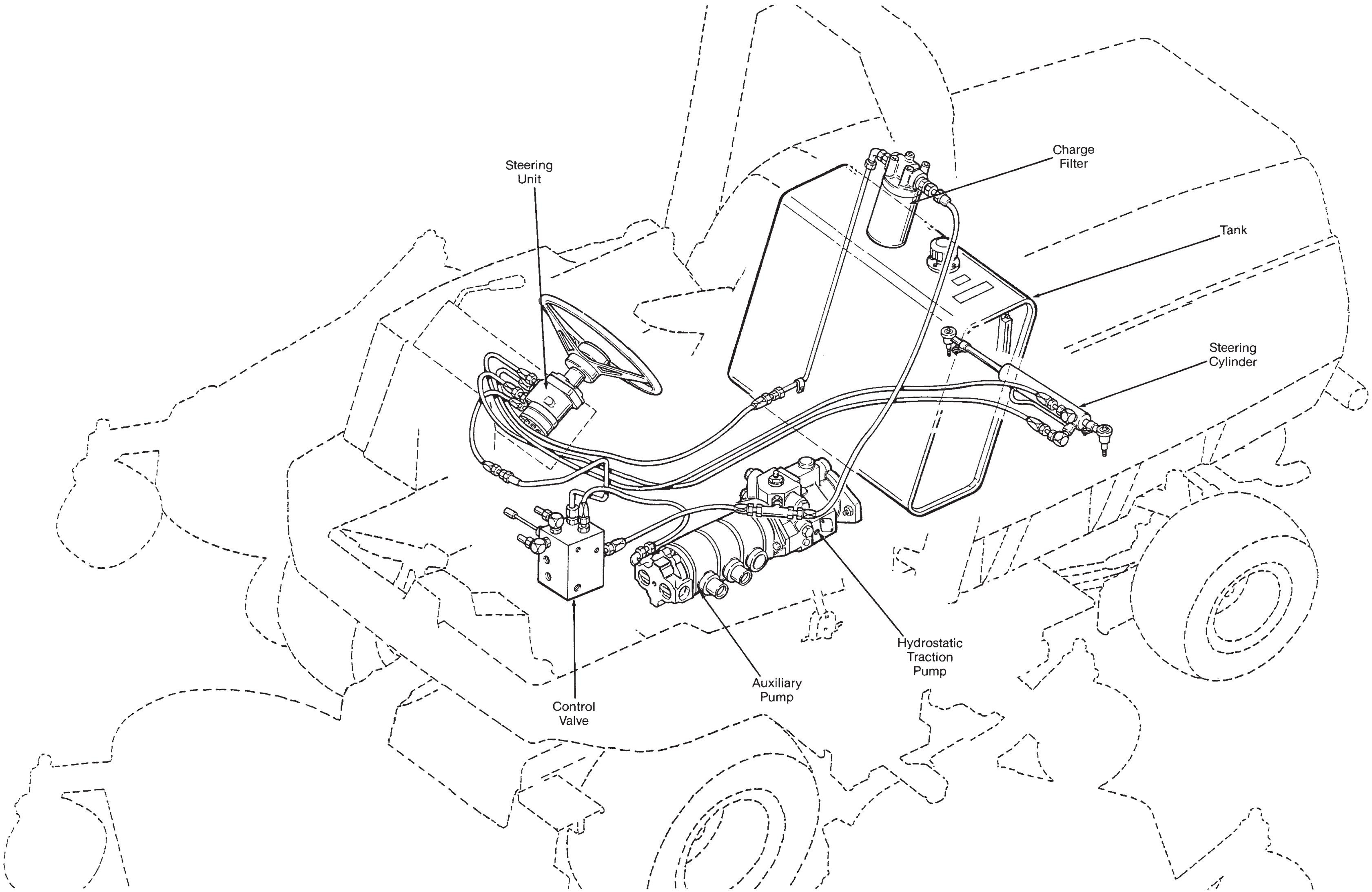


Figure 8S-5. Power Steering System (2 of 4)

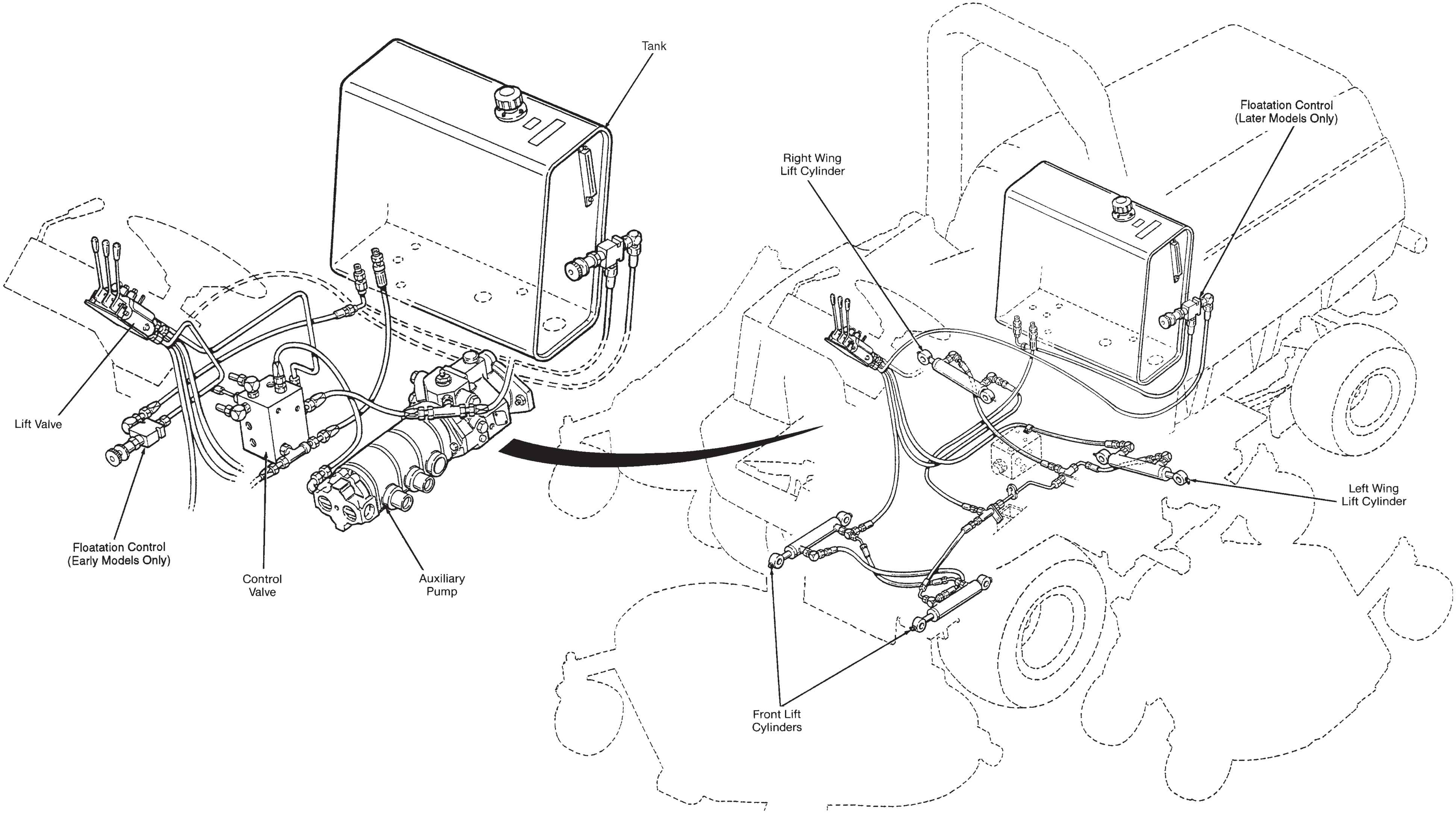
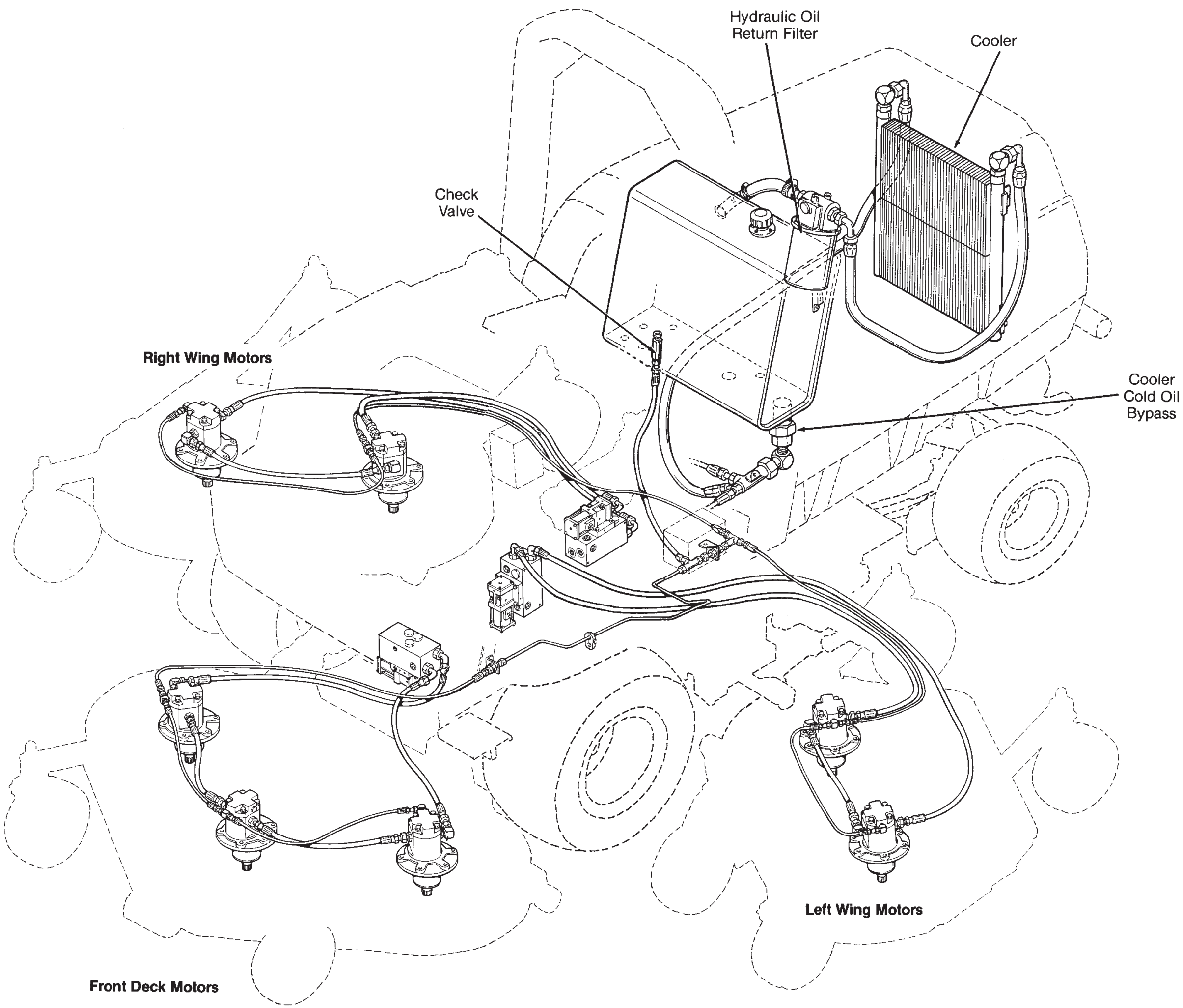


Figure 8S-6. Lift System (3 of 4)



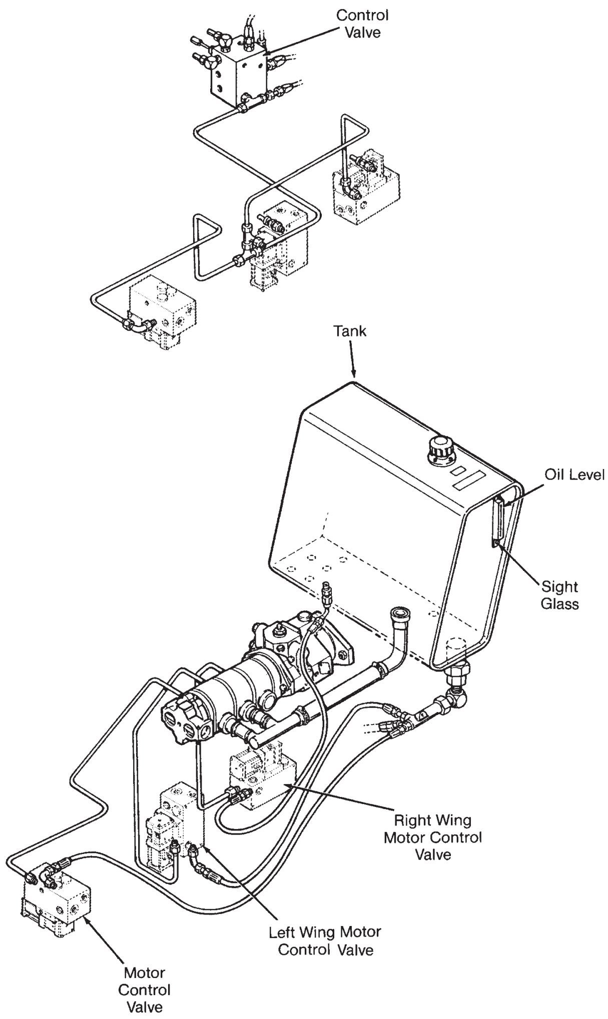


Figure 8S-7. Mower System (4 of 4)

SECTION 9
CHASSIS

SECTION 9A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools including bearing pullers.
Cleaning and refinishing materials:	Stoddard or equivalent solvent.
	Detergent and water.
	Paint, Jacobsen orange.
	Paint, Jacobsen black.
	Anti-rust Never-Seize.
Lubricants:	Grease gun grease (eg. Sunray DX671 or Gulf Supreme No. 0).
	Lithium based grease.
Other oil options:	Jacobsen Part No. 502693, 5 gal. (19 liter).
	Jacobsen Part No. 502696, 2.5 gal. (9.5 liter).
	Sunoco H.P. Engine Oil SAE 10W-30.
	Mobil Delvac (Special) SAE 10W-30.

SECTION 9B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Lift/lower functions do not occur when lever is actuated.	a. Engine rpm not above 2000.	a. Increase engine rpm.
	b. Lever linkage is worn.	b. Repair or replace linkage (Section 2C).
	c. Mechanical binding.	c. Lubricate/repair.
	d. Hydraulics faulty.	d. Test (Section 8B).
2. Slow or noisy lift/lower operation.	a. Mechanical binding.	a. Lubricate/repair.
	b. Hydraulics faulty.	b. Test (Section 8B).

SECTION 9C. FUEL TANK

GENERAL

The fuel tank is a single piece tank which should require no servicing unless punctured or otherwise accidentally damaged. The fuel tank should be drained whenever the machine is to be stored.

NOTE

The cap used on the tank is a vented cap.

REMOVAL AND INSTALLATION (See Figure 9C-1)

1. Place a suitable container under tank and open tank drain valve.
2. Remove fuel vent, outlet and return lines from tank.
3. Remove tank mounting hardware and tank.
4. Remove fuel lever indicator.
5. Position tank on tractor, do not fasten.
6. Connect fuel vent, outlet and return lines.
7. Fasten tank with mounting hardware.
8. Install fuel line indicator.

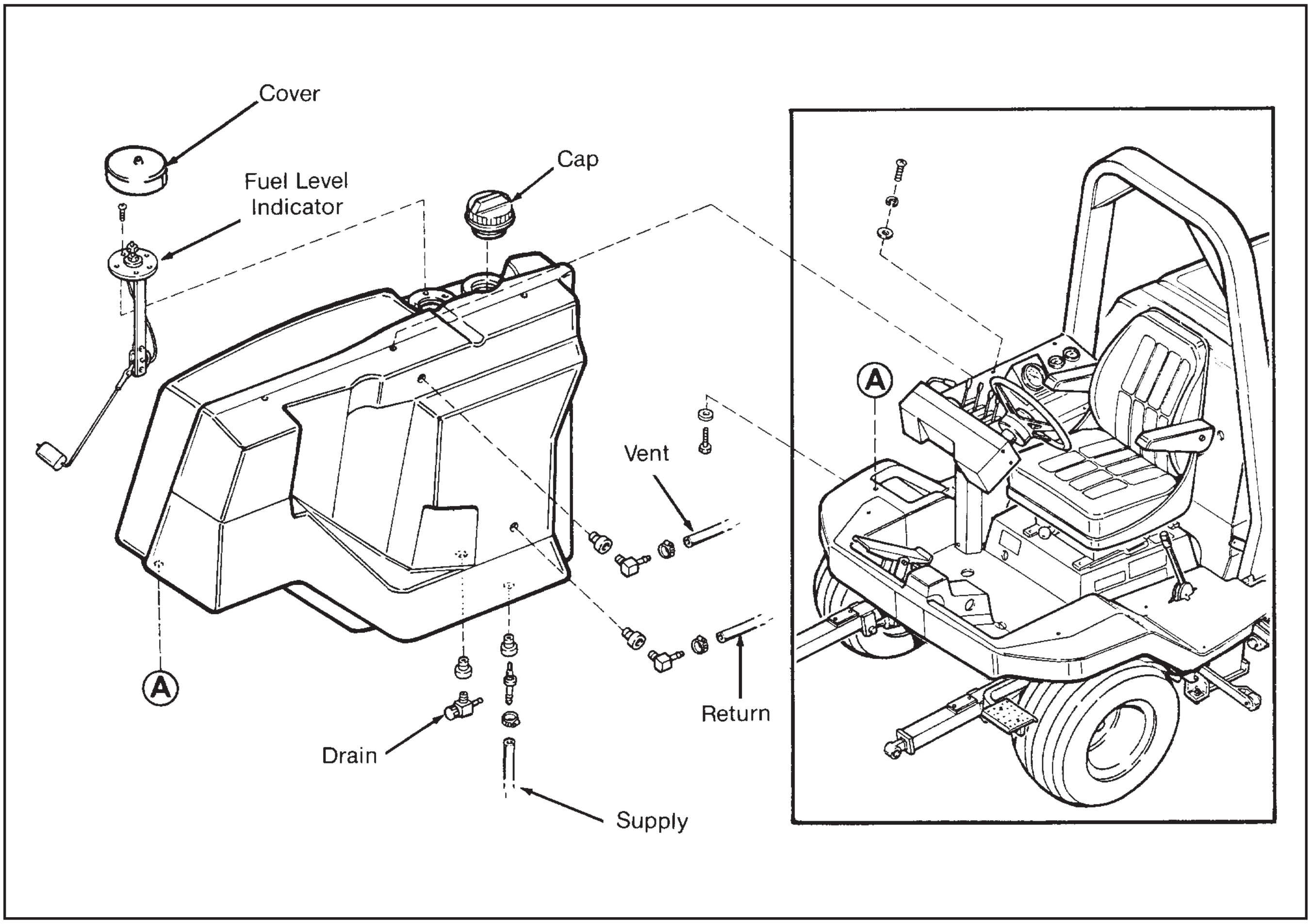


Figure 9C-1. Fuel Tank Removal and Installation

SECTION 9D. HYDRAULIC TANK

GENERAL

The hydraulic tank requires little or no service other than adding hydraulic oil when indicated by checking the sight gauge and periodically cleaning the screen in the outlet of the tank.

The hydraulic oil level should be checked daily for proper level. Use extreme care when adding oil to prevent the entry of contaminants.

Do not check oil level when oil is hot.

Overfilling tank could result in oil coming out cap (breather).

If you notice the presence of water (noted by a cloudy or milky appearance), or air (noted by a foamy appearance) or other contaminants, a rancid odor (indicating excessive heat), or after a major component failure, the hydraulic fluid should be changed.

NOTE

The cap on the hydraulic tank is a pressure cap.

If water, air, or contamination is indicated, locate the source of the problem and take corrective action.

REMOVAL AND INSTALLATION (See Figure 9D-1)

If it is necessary to remove the hydraulic tank, drain the fluid into a suitable container, disconnect all hoses at the tank.

When installing the hydraulic tank, secure the tank with mounting clamps, connect hydraulic hoses to the tank.

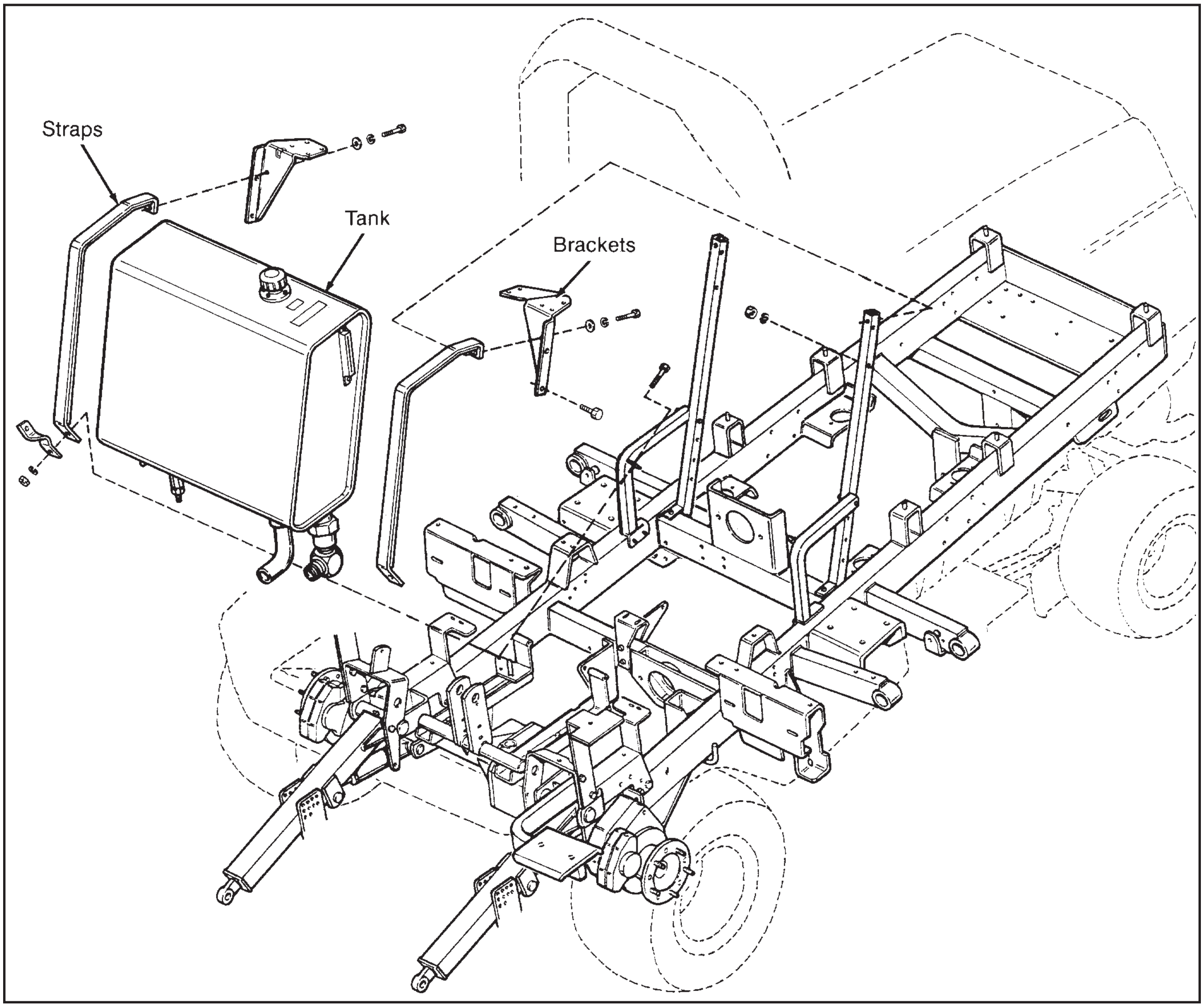


Figure 9D-1. Hydraulic Tank Removal and Installation

SECTION 9E. SEAT

REMOVAL AND INSTALLATION (See Figure 9E-1)

1. Remove the attaching hardware from the slide mounting brackets.
2. Lift the seat and slide mounts off seat pan.

To install the seat, secure the seat assembly with attaching hardware. Lubricate as described in Section 11.

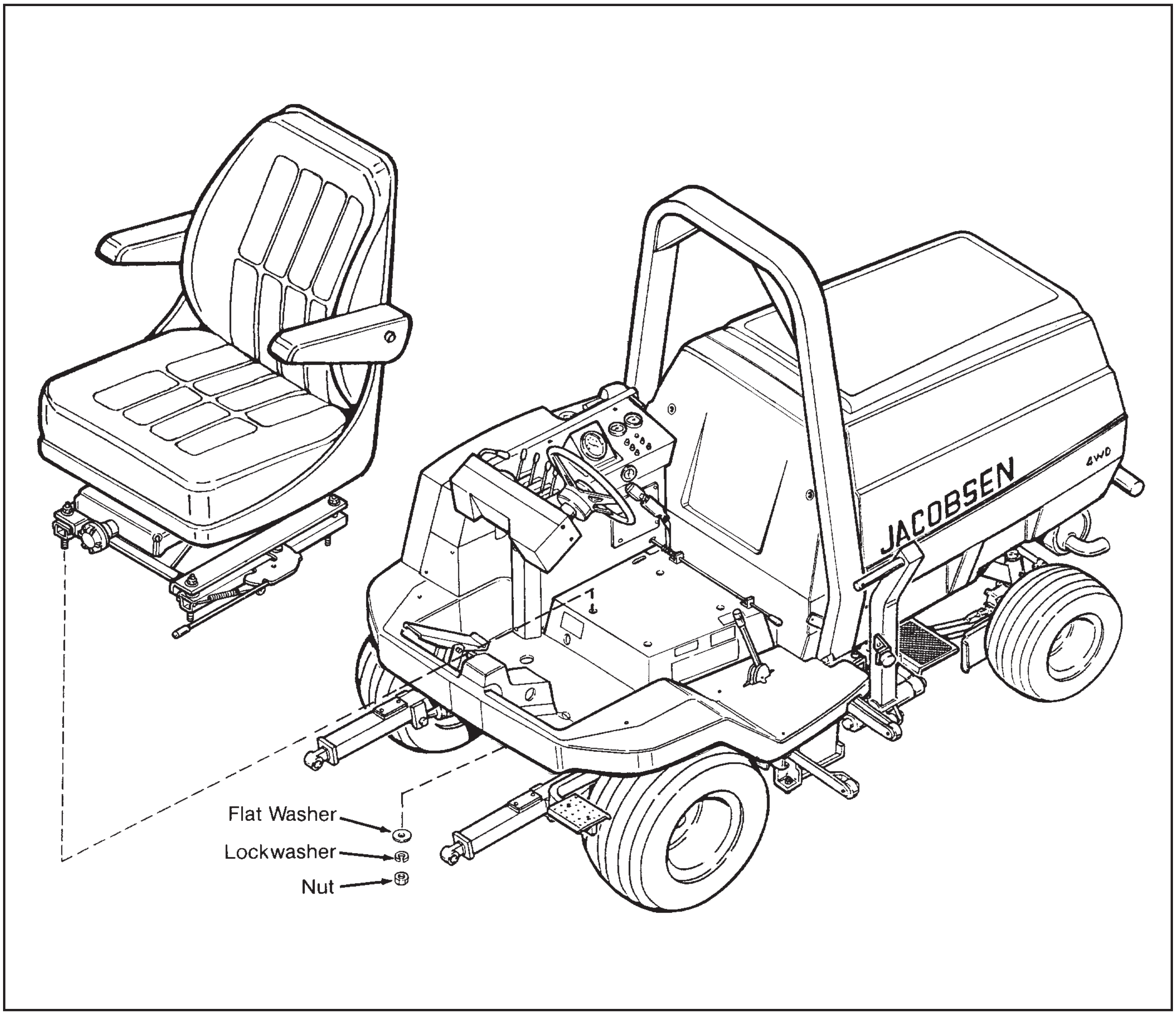


Figure 9E-1. Seat Assembly Removal and Installation

LIFT ASSEMBLY
(See Figure 9F-1)

1. Lower implement to ground.

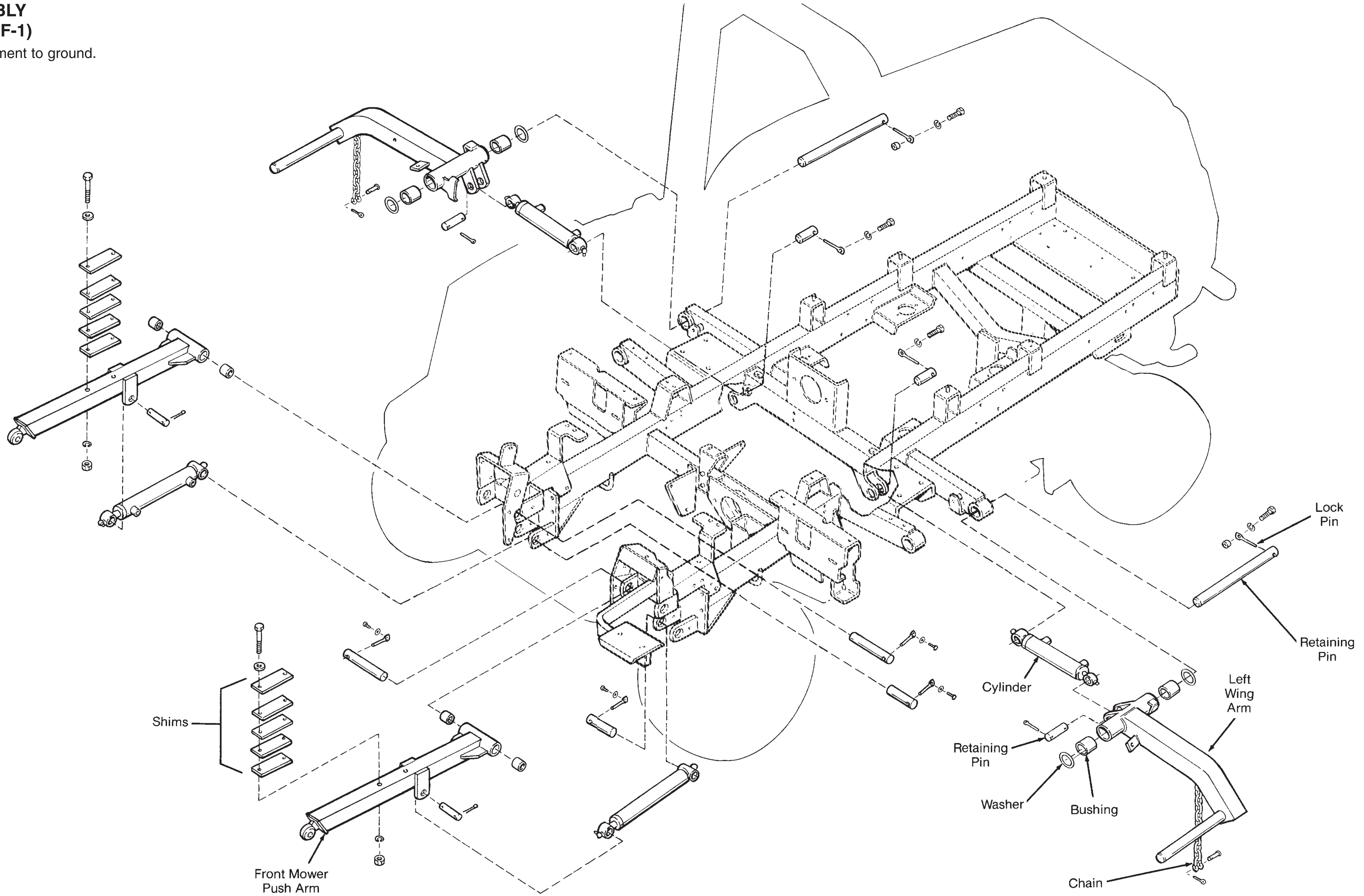


Figure 9F-1. Lift Assembly

SECTION 9F. DECK LIFT ASSEMBLY

TRANSPORT LOCK MECHANISM (See Figure 9F-2)

The wing transport lock mechanism should not require adjustments unless the arms have been disassembled.

Repair is limited to replacing damaged or worn parts.

NOTE

When installing the center lock nut, do not tighten against latch hook. Latch hook must move freely.

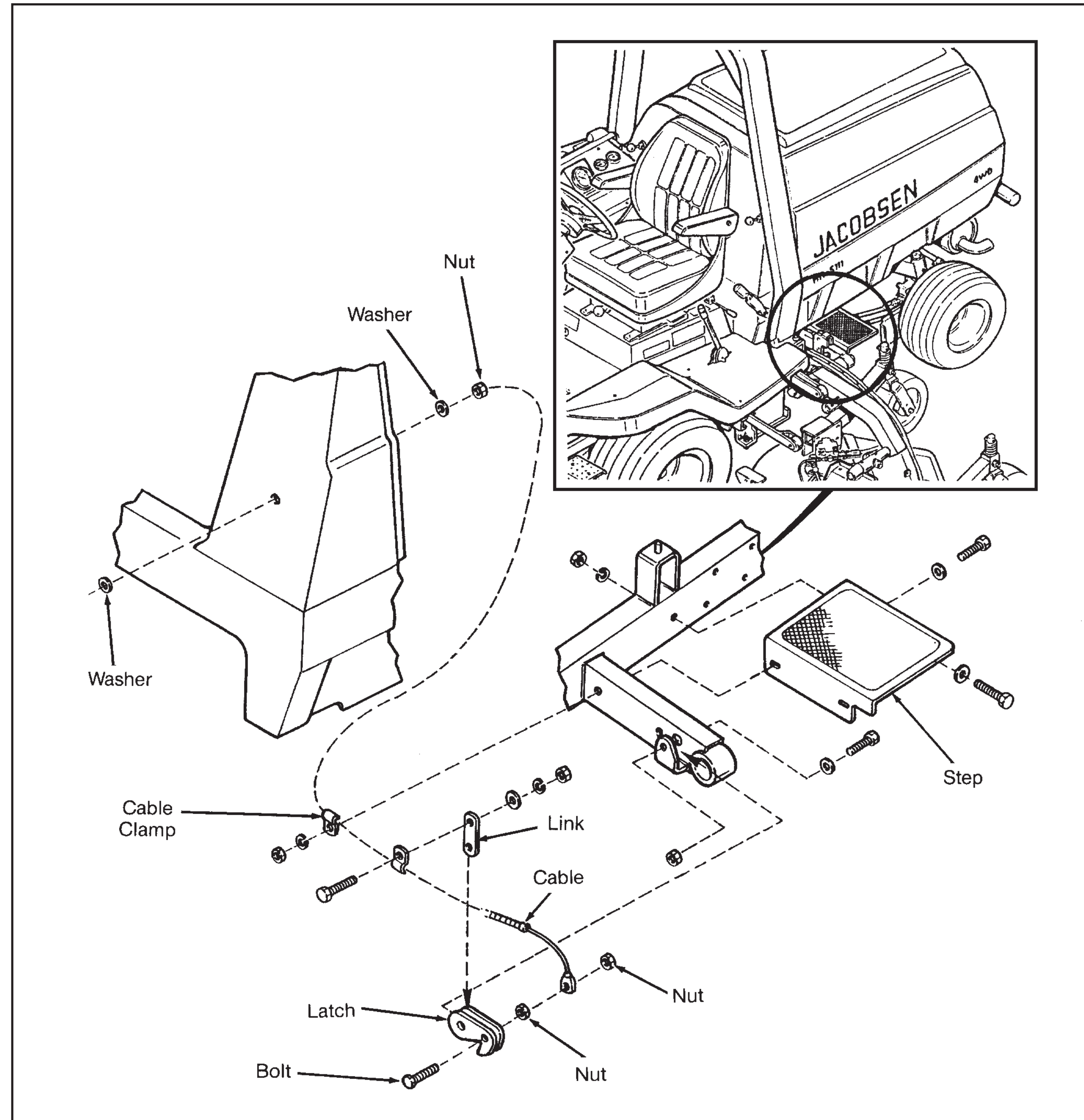


Figure 9F-2. Wings Transport Lock Mechanism

SECTION 9G. REAR AXLE

GENERAL

Repair of the rear axle is limited to replacement of broken parts and servicing bushings and bearings. (See Steer Cylinder Service Section 6F and Adjustments Section 6D.)

REMOVAL AND INSTALLATION (See Figure 9G-1)

1. Block front wheels to prevent tractor movement.
2. Raise the rear of the tractor. Do not attach lifting device to axle or any component connected to axle assembly.
3. Disconnect hydraulic lines to steering cylinder and hydraulic motors. Cap or plug all fittings.
4. Remove cotter pin and slotted nut.
5. Remove capscrew.
6. Making sure tractor and axle are well supported, remove pivot shaft and thrust washer to free axle from tractor frame.
7. Remove pivot pin bushings.
8. Inspect all parts for damage or excessive wear. Replace if necessary.
9. Reassemble axle.
10. Install bushings and position axle under tractor frame.
11. Install pivot pin, thrust washer, slotted nut and a new cotter pin.
12. Install capscrew and torque to 15–18 ft-lbs. (20–24 N.m).

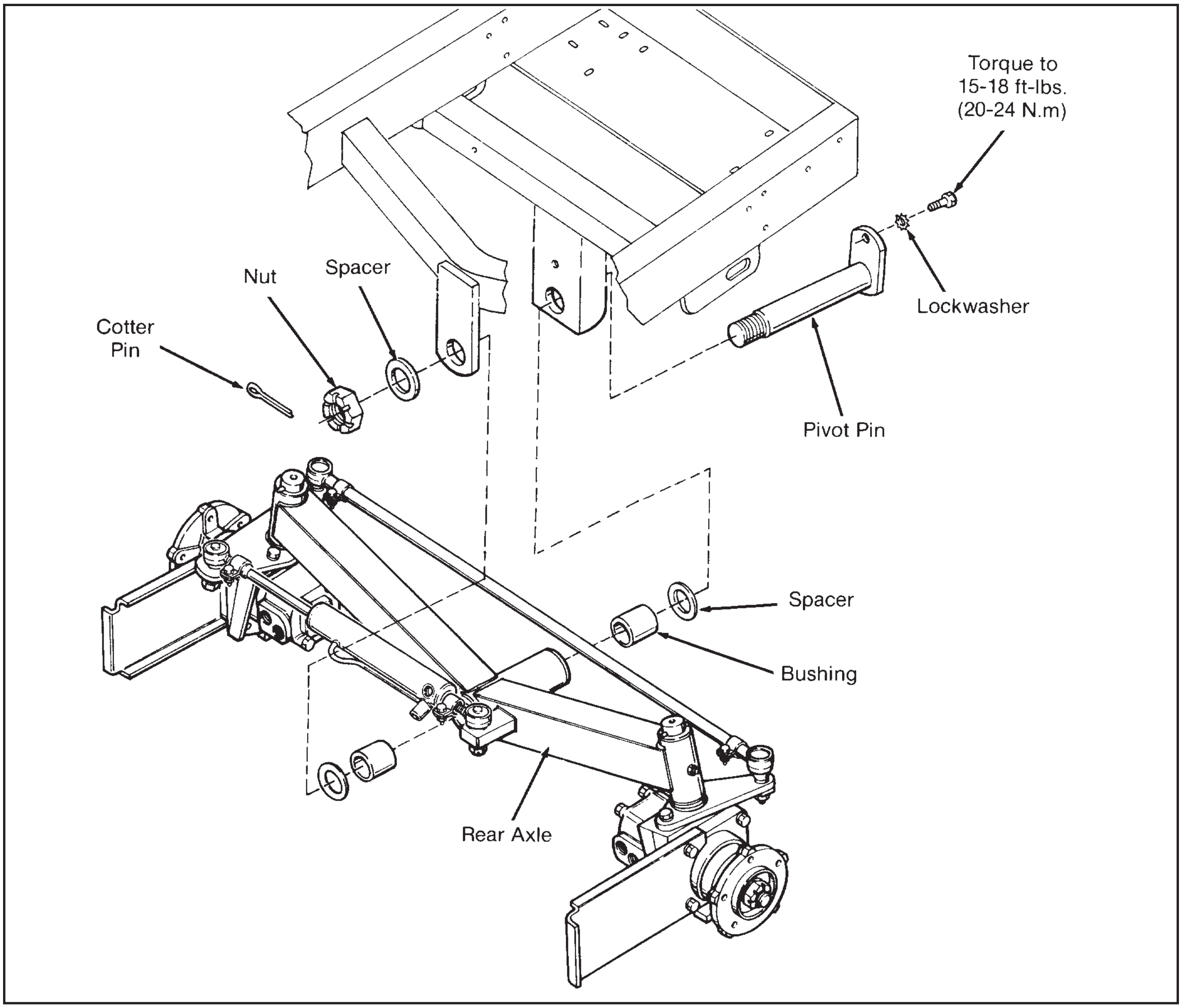


Figure 9G-1. Removal and Installation

SECTION 9G. REAR AXLE

SPINDLE REMOVAL AND INSTALLATION (See Figure 9G-1)

1. Disconnect tie rod and head end of the steering cylinder from the right hand steering assembly and tie rod from the left steering assembly.
2. Remove hydraulic lines from motor. Cap and plug all fittings.
3. Remove hydraulic motors.
4. Remove the groove pin from the top of the spindle shaft and remove the spindle assemblies.
5. Inspect steering assembly components for signs of wear and replace as necessary.
6. Replace lower thrust bearing and thrust washers and spindle bushings as needed.
7. Install thrust bearings and thrust washers on spindle assembly.
8. Install spindle assembly into axle and lock in place by installing flat washer and new groove pin.
9. Reconnect tie rods and steering cylinder.
10. Mount motors and connect hydraulic lines.
11. Perform toe-in and steering stop adjustments as described in Section 6D.

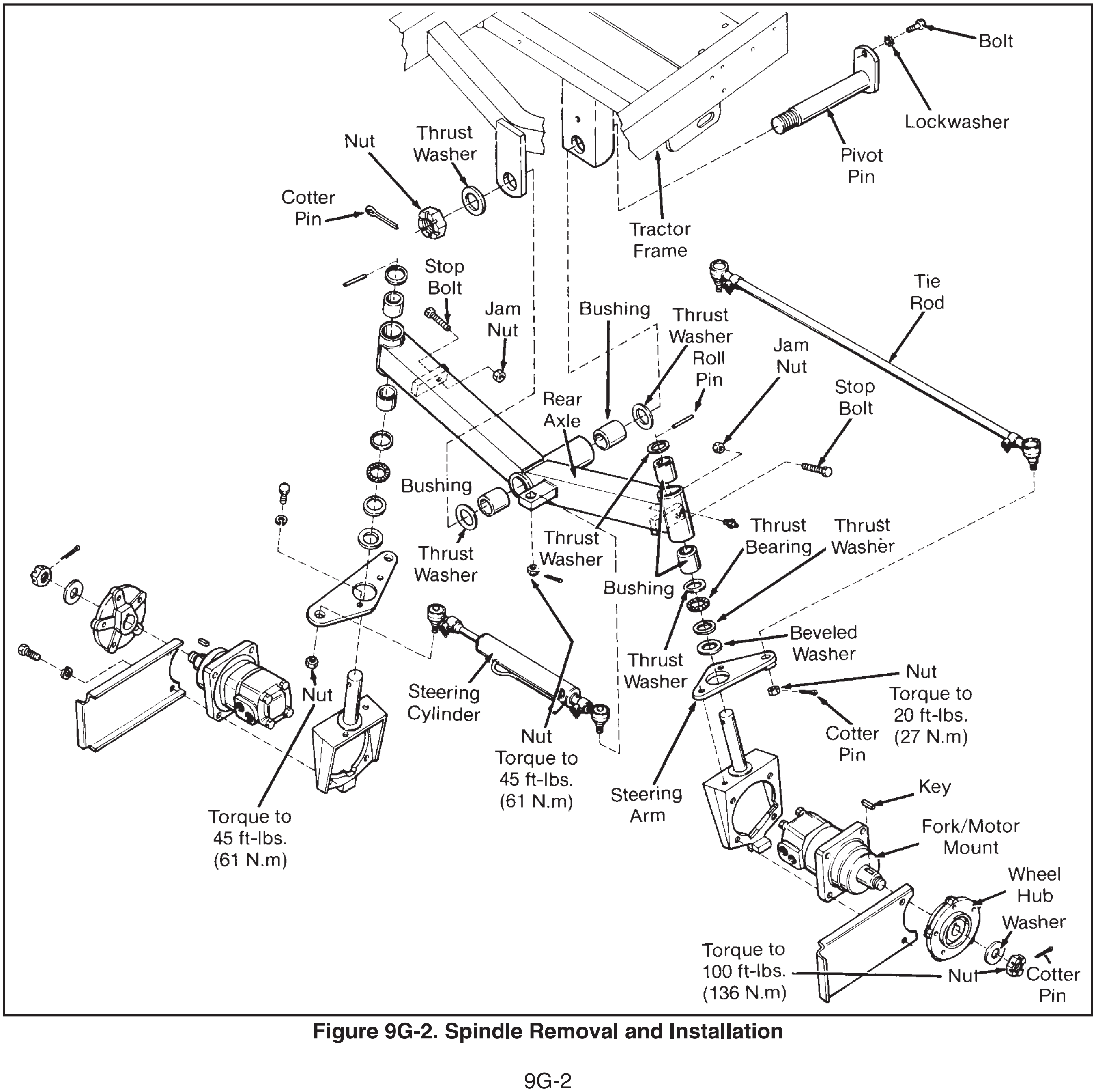


Figure 9G-2. Spindle Removal and Installation

SECTION 10
ELECTRICAL SYSTEM

SECTION 10A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Multimeter. Jumper wires. 60 amp ammeter.
Cleaning materials:	Baking soda and water.
Other service items:	Electrical insulation compound P/N 365422.

SECTION 10B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Engine will not turn over when ignition switch is engaged.	a. Battery dead.	a. Charge or replace (Section 10D).
	b. Parking brake not set.	b. Set brake.
	c. Implement switch not in the OFF position.	c. Push into OFF position.
	d. 10 amp shut-off system circuit breaker tripped.	d. Reset/test (Section 10J).
	e. 50 amp tractor circuit breaker tripped.	e. Reset/test (Section 10J).
	f. Faulty starter solenoid.	f. Test (Section 10F).
	g. Faulty ignition switch.	g. Test (Section 10G).
	h. Faulty starter.	h. Test (Section 10F).
	i. Faulty wiring or bad electrical ground.	i. Test (Section 10C).
2. Engine turns over, but will not start.	a. Battery low.	a. Charge or replace (Section 10D).
	b. Glow plugs not set.	b. Set glow plugs for 7 seconds before starting. Test/replace (Section 10L).
	c. Faulty glow plug switch.	c. Test (Section 10G).
	d. 30 amp implement/fuel circuit breaker tripped.	d. Reset/test (Section 10J).
	e. Faulty fuel solenoid relay.	e. Test/replace (Section 10H).
	f. Faulty fuel solenoid.	f. Test/replace (Section 10I).
	g. No fuel/obstructed fuel supply.	g. Check fuel level and/or obstruction. Purge system (Section 3D).
	h. Internal engine problem.	h. Refer to Engine Manufacturer's Manual.
	i. Faulty glow plug relay.	i. Test/replace (Section 10H).
3. Engine starts, but shuts down when ignition switch is released.	a. Faulty fuel solenoid.	a. Test/replace (Section 10I).
	b. Faulty ignition switch.	b. Test/replace (Section 10G).
	c. Fuel solenoid linkage misadjusted.	c. Adjust (Section 10I).
4. Battery does not charge.	a. Bad battery.	a. Replace.
	b. 50 amp glow plug/light circuit breaker tripped.	b. Test (Section 10J).
	c. No alternator output.	c. Test (Section 10E).
	d. Faulty regulator.	d. Test (Section 10E).
	e. Faulty time delay relay.	e. Test/replace (Section 10H).
5. Battery over charges.	a. Bad battery.	a. Replace.
	b. Faulty regulator.	b. Test (Section 10E).

SECTION 10B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
GLOW PLUG CIRCUIT		
1. Glow plugs do not come on.	a. Parking brake not set.	a. Set brake.
	b. Implement switch not in the OFF position.	b. Push into OFF position.
	c. 50 amp tractor circuit breaker tripped.	c. Reset/test (Section 10J).
	d. 10 amp shut-off system circuit breaker tripped.	d. Reset/test (Section 10J).
	e. 50 amp glow plug/light circuit breaker tripped.	e. Test (Section 10J).
	f. Faulty glow plug switch.	f. Test (Section 10G).
	g. Faulty glow plugs.	g. Test/replace (Section 10L).
	h. Faulty glow plug relay.	h. Test/replace (Section 10H).
	i. Faulty ignition switch.	i. Test (Section 10G).
TRACTOR CIRCUITS		
1. No 4 wheel drive.	a. 4 wheel drive switch not ON.	a. Turn ON.
	b. Faulty solenoid.	b. Check solenoid plug LED. ON: Check voltage, 12 VDC. NO — Check wiring (Section 10C). YES — Change coil. OUT: Check wiring (Section 10C).
	c. Reverse sensing switch not adjusted.	c. Adjust (Section 2C).
	d. Faulty reverse sensing switch.	d. Test (Section 10G).
	e. Faulty 4 wheel drive switch.	e. Test (Section 10G).
	f. Faulty 4 wheel drive valve.	f. See Section 8B.
2. No differential lock.	a. Differential switch not pushed.	a. Push ON.
	b. Faulty solenoid.	b. Check solenoid plug LED. ON: Check voltage, 12 VDC. NO — Check wiring (Section 10C). YES — Change coil. OUT: Check wiring (Section 10C).
	c. Faulty differential lock cylinder.	c. See Section 4E.
IMPLEMENT CIRCUITS		
1. Engine shuts down when implement switch is pulled to the ON position.	a. No operator in seat.	a. Sit in seat.
	b. Faulty seat switch.	b. Test (Section 10G).
	c. Faulty time delay relay.	c. Test/replace (Section 10H).
	d. Faulty implement control switch.	d. Test (Section 10G).
	e. Faulty wiring or bad electrical ground.	e. Test (Section 10C).
2. Mowers do not come on when implement switch is pulled to the ON position. Engine stays running.	a. Mowers not on the ground.	a. Lower.
	b. Direction control switches not in the CUT position.	b. Push into CUT.
	c. Faulty implement switch.	c. Test (Section 10G).

SECTION 10B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
IMPLEMENT CIRCUITS (Continued)		
3. Only one wing does not come on.	a. Arm interlock switch not closing. b. Faulty arm interlock switch. c. Faulty motor valve solenoid.	a. Check switch/adjust (Section 2C). b. Test switch (Section 10G). c. Check solenoid plug LED. ON — Push manual override. Mower comes on, test solenoid (Section 10I). Mower does not come on, hydraulic problem (Section 8B). OFF — Check switches and wiring (Section 10C).
4. Only the front mower does not come on.	a. Arm interlock switch not closing. b. Faulty arm interlock switch. c. Faulty motor valve solenoid.	a. Check switch/adjust (Section 2C). b. Test switch (Section 10G). c. Check solenoid plug LED. ON — Push manual override. Mower comes on, test solenoid (Section 10I). Mower does not come on, hydraulic problem (Section 8B). OFF — Check switches and wiring (Section 10C).
5. Engine shuts down immediately when operator leaves seat. (Implement switch ON.)	a. Faulty time delay relay. b. Faulty wiring or bad electrical ground.	a. Test/replace (Section 10H). b. Test (Section 10C).
6. Engine does not shut down when operator leaves.	a. Faulty time delay relay. b. Faulty wiring or bad electrical ground. c. Interlock circuit electrically bypassed.	a. Test/replace (Section 10H). b. Test (Section 10C). c. Reconnect to manufacturer's specifications.
GAUGES AND PANEL LIGHTS		
1. Engine oil pressure light does not come on when ignition switch is turned ON. Ground BLU wire at sending unit; light does not come ON, see a. Light comes ON, see b.	a. Bulb burned out. b. Faulty sending unit. c. Faulty wiring or bad electrical ground. d. 10 amp gauge/panel light circuit breaker tripped.	a. Replace. b. Replace. c. Test (Section 10C). d. Reset/test (Section 10J).
2. Engine oil pressure light does not come on when ignition switch is turned ON. Ground GRY/WHT wire at sending unit; light does not come ON, see a.	a. Bulb burned out. b. Faulty sending unit. c. Faulty wiring or bad electrical ground. d. 10 amp gauge/panel light circuit breaker tripped.	a. Replace. b. Replace. c. Test (Section 10C). d. Reset/test (Section 10J).

10B

SECTION 10B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
GAUGES AND PANEL LIGHTS (Continued)		
3. Panel light does not come on when test switch is pushed to the ON position.	a. 10 amp gauge/panel light circuit breaker tripped. b. Battery dead. c. 50 amp tractor circuit breaker tripped. d. Faulty ignition switch contacts X-Y.	a. Reset/test (Section 10J). b. Charge/replace (Section 10D). c. Test (Section 10J). d. Test (Section 10G).
4. Engine water temperature gauge does not work or is erratic. Ground LT GRN wire at sending unit; gauge does not register, see b. Gauge registers, needle moves to the high side of scale.	a. 10 amp gauge/panel light circuit breaker tripped. b. Faulty gauge. c. Faulty sending unit. d. Faulty wiring or bad electrical ground. e. Faulty wiring or bad electrical ground.	a. Reset/test (Section 10J). b. Replace (Section 10K). c. Replace (Section 10K). d. Test (Section 10C). e. Test (Section 10C).
5. Tachometer does not work or erratic.	a. 10 amp gauge/panel light circuit breaker tripped. b. Sending unit not adjusted. c. Faulty sending unit. d. Faulty tachometer. e. Faulty wiring or bad electrical ground.	a. Reset/test (Section 10J). b. Adjust. c. Replace. d. Replace. e. Test (Section 10C).
6. Hourmeter does not work.	a. 10 amp gauge/panel light circuit breaker tripped. b. Faulty hourmeter. c. Faulty wiring or bad electrical ground.	a. Reset/test (Section 10J). b. Replace. c. Test (Section 10C).
7. Fuel gauge does not work or erratic. Ground TAN wire at sending unit; gauge does not register, see b. Gauge registers, needle moves to the high side of scale.	a. 10 amp gauge/panel light circuit breaker tripped. b. Faulty gauge. c. Faulty sending unit. d. Faulty wiring or bad electrical ground.	a. Reset/test (Section 10J). b. Replace (Section 10K). c. Replace (Section 10K). d. Test (Section 10C).
8. Engine oil pressure light does not go OFF when engine is started. Remove BLU wire at sending unit; light goes OFF, see b and c. Light stays ON, see d.	a. No engine crankcase oil. b. Faulty sending unit. c. Internal engine problem. d. Faulty wiring or bad electrical ground.	a. Check (Section 11C). b. Replace. c. Refer to Engine Manufacturer's Manual. d. Test (Section 10C).
9. Engine oil pressure light does not go OFF when engine is started. Remove GRY/RED wire at sending unit; light goes OFF, see b and c. Light stays ON, see d.	a. No hydraulic oil. b. Faulty sending unit. c. Hydraulic system problem. d. Faulty wiring or bad electrical ground.	a. Check (Section 11B). b. Replace. c. See Section 8C. d. Test (Section 10C).

SECTION 10B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
GAUGES AND PANEL LIGHTS (Continued)		
10. Horn does not sound when test switch is pushed to the ON position.	a. 10 amp cruise/horn circuit breaker tripped. b. Faulty horn relay. c. Faulty horn. d. Faulty wiring or bad electrical ground.	a. Reset/test (Section 10J). b. Test/replace (Section 10H). c. Test. d. Test (Section 10C).
CRUISE CONTROL CIRCUITS		
1. No cruise control when turned ON.	a. 10 amp cruise/horn circuit breaker tripped. b. Service brake applied. c. Faulty cruise relay. d. Faulty holding relay. e. Service brake switch not adjusted. f. Faulty service brake switch. g. Faulty cruise magnet. h. Faulty cruise control switch. i. Faulty wiring or bad electrical ground.	a. Reset/test (Section 10J). b. Release. c. Test/replace (Section 10H). d. Test/replace (Section 10H). e. Adjust (Section 2C). f. Test (Section 10G). g. Replace. h. Test (Section 10G). i. Test (Section 10C).
2. Cruise control drops off after being set.	a. Faulty holding relay. b. Service brake switch not adjusted. c. Faulty cruise control switch.	a. Test/replace (Section 10H). b. Adjust (Section 2C). c. Test (Section 10G).
3. Speed does not stay set (slips).	a. Cruise magnet gap too big. b. Faulty cruise magnet.	a. Clean, check spring. b. Replace.
4. Cruise control does not shut OFF.	a. Faulty holding relay. b. Faulty cruise control switch.	a. Test/replace (Section 10H). b. Test (Section 10G).
CAB CIRCUITS		
1. Lights (all) do not work.	a. 30 amp light/cab circuit breaker tripped. b. 50 amp glow plug/light circuit breaker tripped. c. Faulty light switch. d. Faulty wiring or bad electrical ground.	a. Reset/test (Section 10J). b. Test (Section 10J). c. Test (Section 10G). d. Test (Section 10C).
2. Fender work lights do not work.	a. Bulb burned out. b. Faulty wiring or bad electrical ground. c. Faulty light switch.	a. Replace. b. Test (Section 10C). c. Test (Section 10G).
3. Cab road lights do not work.	a. Bulb burned out. b. Faulty wiring or bad electrical ground. c. Faulty light switch.	a. Replace. b. Test (Section 10C). c. Test (Section 10G).

SECTION 10B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
CAB CIRCUITS (Continued)		
4. Cab work lights do not work.	a. Bulb burned out. b. Faulty wiring or bad electrical ground. c. Faulty light switch.	a. Replace. b. Test (Section 10C). c. Test (Section 10G).
5. Tail light does not work.	a. Bulb burned out. b. Faulty wiring or bad electrical ground. c. Faulty light switch.	a. Replace. b. Test (Section 10C). c. Test (Section 10G).
6. Turn signals (both) do not work.	a. Bulb burned out. b. Faulty flasher. c. Faulty wiring or bad electrical. ground.	a. Replace. b. Replace. c. Test (Section 10C).
7. One turn signal does not work.	a. Bulb burned out. b. Faulty flasher. c. Faulty wiring or bad electrical ground.	a. Replace. b. Replace. c. Test (Section 10C).
8. Cab heater and wipers do not work.	a. Ignition switch OFF. b. Faulty cab relay. c. Faulty wiring or bad electrical ground.	a. Turn ON. b. Test (Section 10H). c. Test (Section 10C).
9. Heater fan does not work.	a. Ignition switch OFF. b. 20 amp fan circuit breaker tripped. c. Glow plug/light circuit breaker tripped. d. Faulty cab relay. e. Faulty heater fan switch. f. Faulty heater fan motor. g. Faulty wiring or bad electrical ground.	a. Turn ON. b. Reset/test (Section 10J). c. Reset/test (Section 10J). d. Test (Section 10H). e. Test (Section 10C). f. Replace. g. Test (Section 10C).
10. Wipers do not work.	a. Ignition switch OFF. b. 10 amp wiper breaker tripped. c. Glow plug/light circuit breaker tripped. d. Faulty cab relay. e. Faulty heater fan switch. f. Faulty heater fan motor. g. Faulty wiring or bad electrical ground.	a. Turn ON. b. Reset/test (Section 10J). c. Reset/test (Section 10J). d. Test (Section 10H). e. Test (Section 10C). f. Replace. g. Test (Section 10C).

SECTION 10C. GENERAL INSTRUCTIONS

GENERAL

Repair of the electrical system, for the most part, is limited to the replacement of faulty components or wiring. Wiring diagrams and Component Location illustrations are provided in Section 10N for troubleshooting and/or testing the electrical system. Specific repair and replacement instructions, where applicable, are also provided in this section.

NOTE

The test instrument shown in the illustrations for this section is a digital multimeter (DMM). However, any test instrument capable of measuring voltage, current resistance, and continuity values specified for each test is acceptable.

NOTE

See Engine Manufacturer's Service Manual for information on engine electrical components not covered in this section.

In addition to testing a suspected faulty component it may be necessary to check for shorts or breaks in the wiring to the component. A common method of testing wires or circuits is to perform a continuity check as described below.

NOTE

Before performing any component or wiring test, check for corrosion and loose or missing connections.

If a component (switch, relay, etc.) is removed for test or replacement make sure to identify and label wires so that the component can be installed correctly.

WIRE CONTINUITY TEST (See Figure 10C-1)

1. Identify and locate the wire to be checked on the appropriate "Electrical System" illustration, located in Section 10N.
2. Set multimeter to Ω (ohms) ♪ scale and touch leads to end of wire.
   - There should be a reading (continuity) on the multimeter. If not, proceed to 3.
3. Perform a second check by using a jumper wire to bypass the wiring being tested. If the component in question now functions normally, replace the original wire.

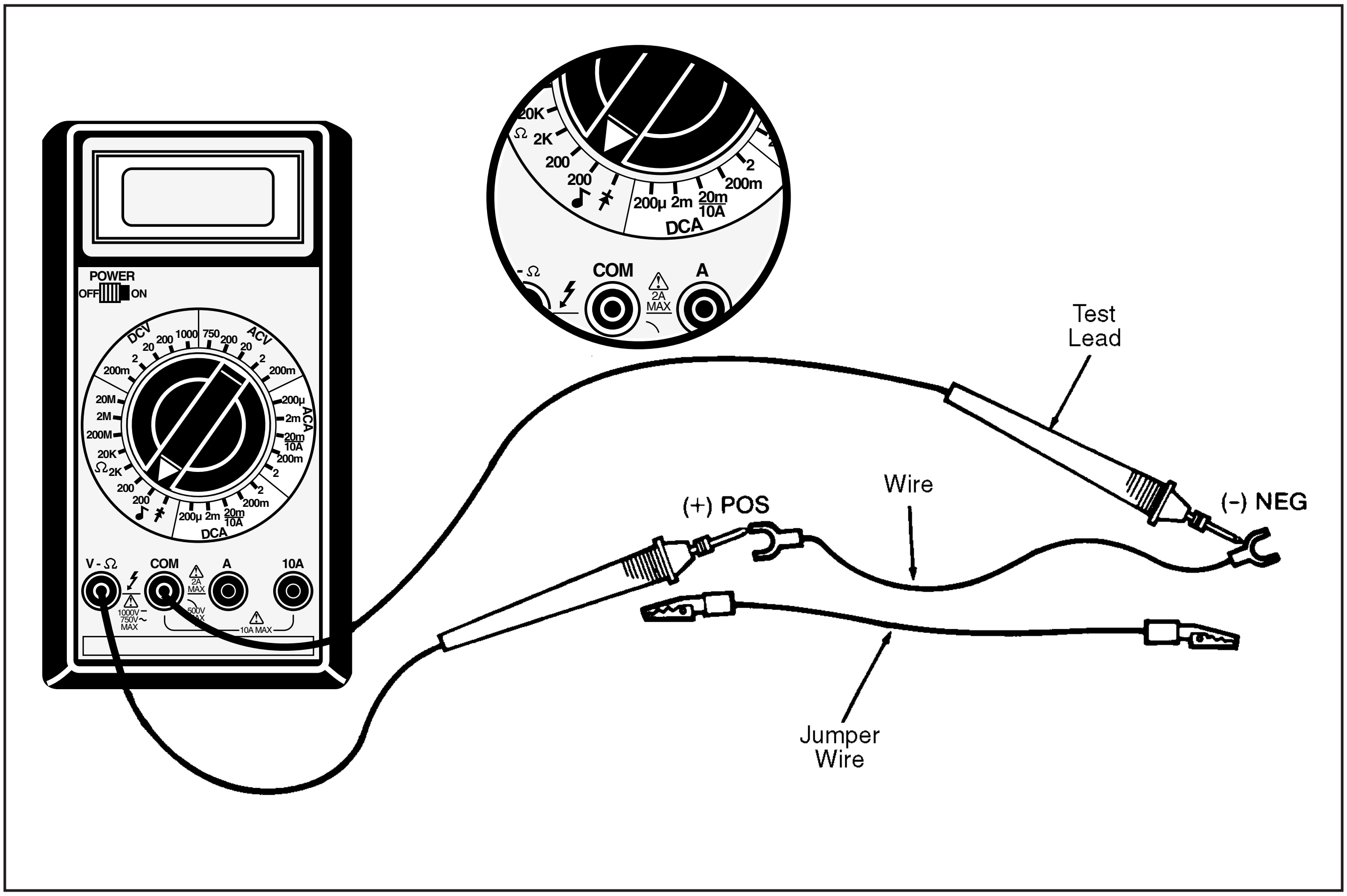


Figure 10C-1. Wire Continuity Test

10C

SECTION 10C. GENERAL INSTRUCTIONS

RESISTANCE TEST (See Figure 10C-2)

1. Set the multimeter to an Ω (ohms) scale.
2. Touch the leads to the terminals on the wire or switch.
3. Read the Ω (ohms) on the multimeter.
   - Contacts of a switch or a wire should have less than 0.5 Ω (ohms) reading.
   - If Ω (ohms) readings are above 0.5 the switch or wire is questionable.

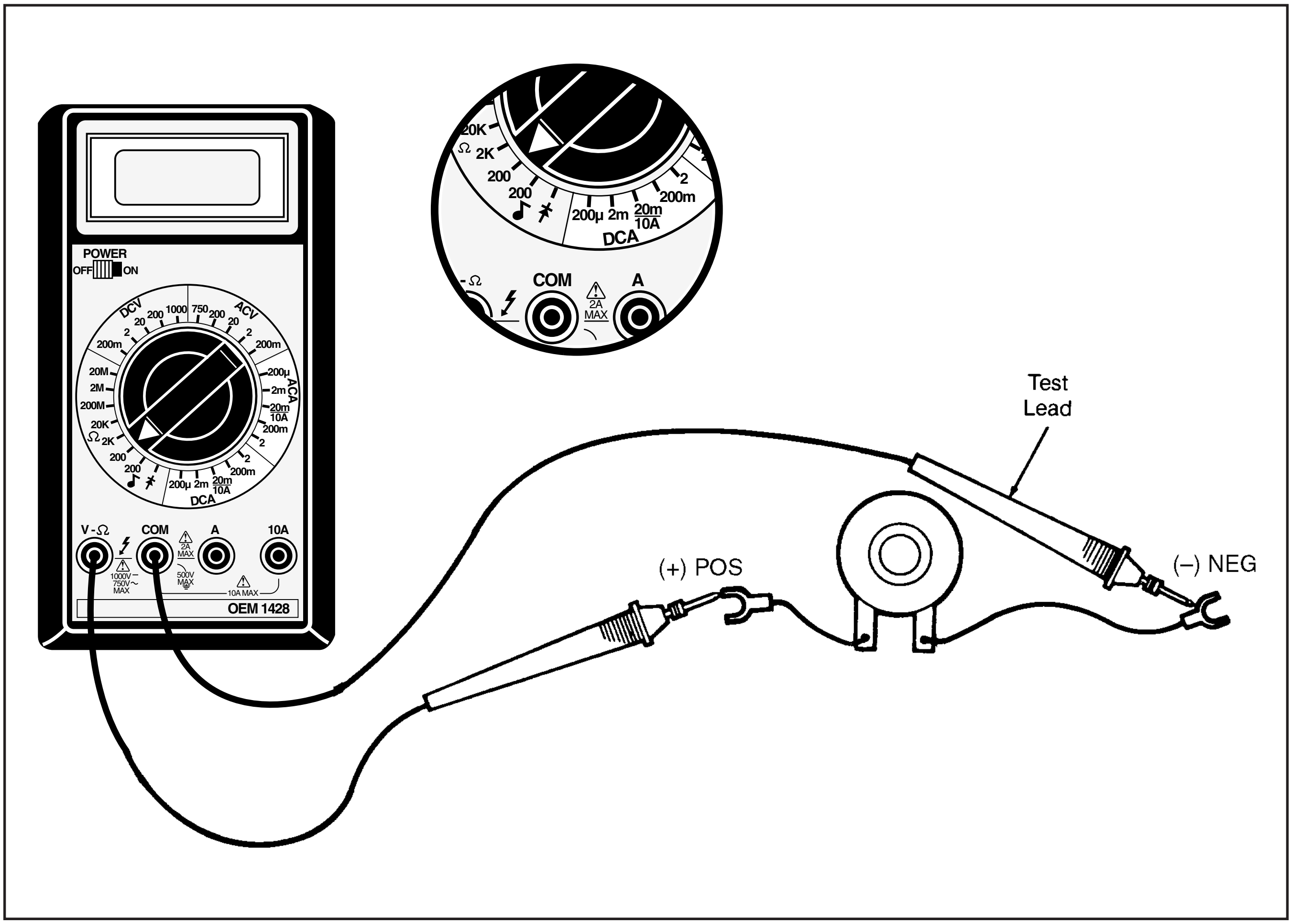


Figure 10C-2. Resistance Test, Ω (Ohms)

SECTION 10D. BATTERY

GENERAL

For normal service, use a battery rated 12V, 770 cold cranking amps at 0°F (–18°C) AABM Group #78NF.

⚠ WARNING

Batteries contain sulfuric acid and generate explosive mixtures of hydrogen and oxygen gases. Keep any device which may cause sparks or flames away from the battery to prevent explosion.

⚠ WARNING

Always wear protective glasses or goggles and protective clothing when working with batteries.

You must follow the battery manufacturer's instructions on safety, maintenance and installa-tion procedures.

⚠ CAUTION

Always connect the "ground" (black) cable last and remove it first whenever performing any battery maintenance. When the battery is being removed or reinstalled, make sure the positive and negative terminals do not contact metal tractor parts at the same time or arcing will result. Battery connections must be kept clean and tight at all times. Loose cables will cause arcing and pitting of the connections and cause eventual failure. Keep positive terminal cover in place.

CHARGING A MAINTENANCE FREE BATTERY

NOTE

Remove battery from tractor.

1. Be sure charger is "Off".
2. Connect charger leads to battery. Connect the positive (+) connector from the charger to the positive battery terminal. Connect the negative (–) connector of the charger to the negative battery terminal.

⚠ WARNING

To avoid possible injury, stand away from battery when the charger is turned on. A damaged battery or a battery with an internal short could explode.

3. Charge the battery using one of the methods shown below. Follow the manufacturer's instructions on the charger.

Slow Charge	Fast Charge
10 hours @ 5 amps 5 hours @ 10 amps	2½ hours @ 20 amps 1½ hours @ 30 amps 1 hour @ 45 amps

4. If, when charging the battery, violent gassing or spewing of electrolyte occurs, or the battery case feels hot, 125°F (52°C), reduce or temporarily halt charging to avoid damaging the battery.
5. Always turn charger to "Off" before removing a charger lead from the battery.

MAINTENANCE/CLEANING

A buildup of corrosive acid across the top of the battery can cause the battery to self-discharge. Even a light coating of this grayish-white substance can complete a circuit to drain and exhaust the energy in the battery. This is especially bad when moisture is present.

To maintain a battery in top condition, check and perform the following services at frequent intervals:

1. Regularly check level of electrolyte — add water as necessary to maintain level above plates — do not overfill as this can cause poor performance or early failure due to loss of electrolyte.
2. Keep terminals and top of battery clean. Wash with baking soda and rinse with clear water. Do not allow soda solution to enter cells as this will destroy the electrolyte.
3. Make sure battery terminals are tight and cables are in good condition.

SECTION 10D. BATTERY

TESTING (See Figure 10D-1)

Test battery voltage as follows:

1. Connect DC multimeter to battery terminals.
2. Set voltmeter to 20 VDC.
3. Crank the engine — if battery voltage falls below 9 volts while cranking, the battery is run-down or faulty. Charge and perform test again.

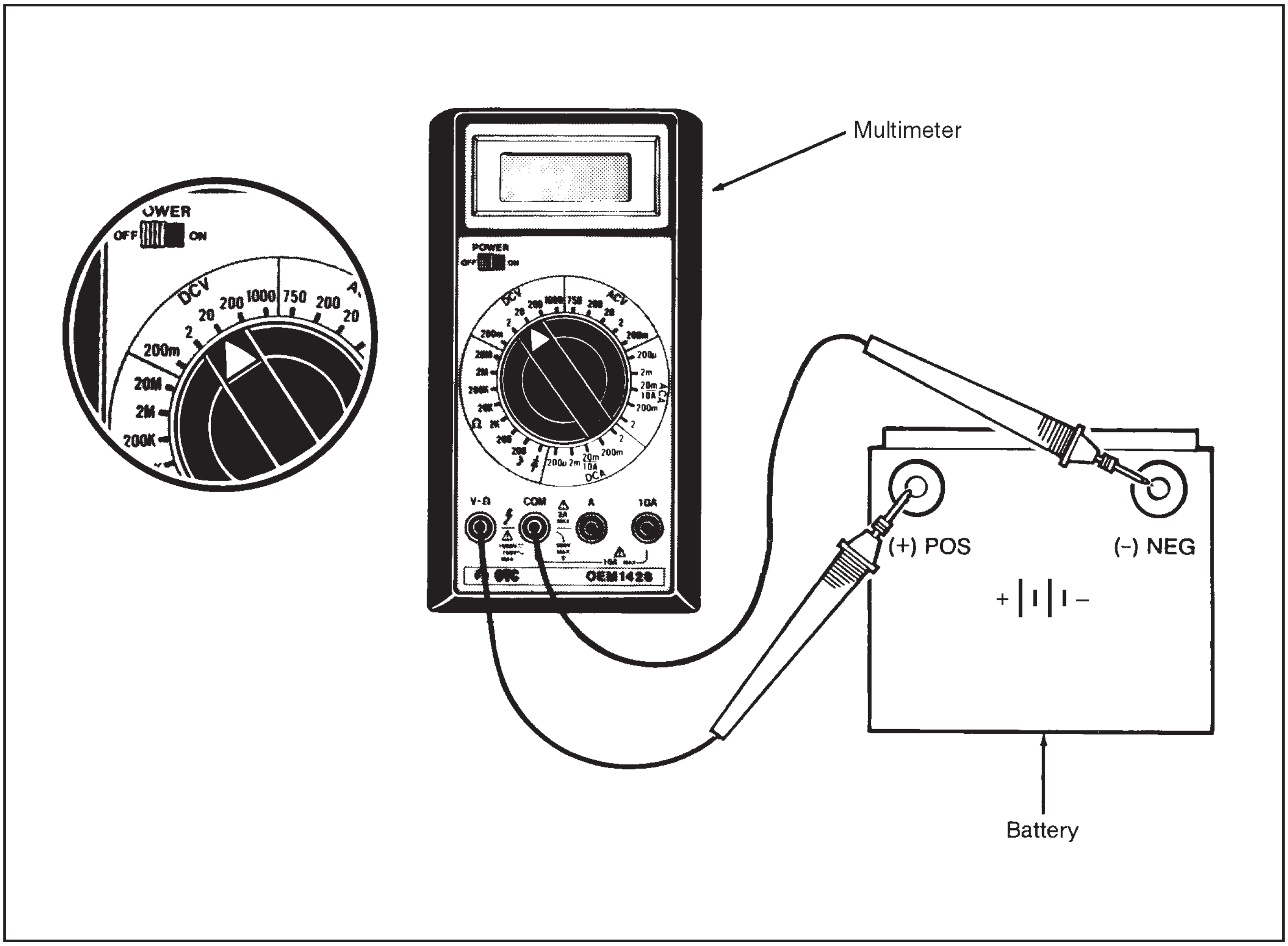


Figure 10D-1. Battery Test

SECTION 10E. CHARGING SYSTEM

GENERAL

The 35 amp charging system consists of an alternator and separate regulator.

See the Engine Manufacturer's Service Manual for detailed repairs of the alternator.

ALTERNATOR FIELD TEST

OUTPUT CURRENT (See Figure 10E-1)

⚠ WARNING

Before installing test instruments, disconnect the negative battery cable from the battery.

1. Remove the red wire from terminal B of the alternator.
2. Connect an ammeter and voltmeter as shown.

⚠ WARNING

Use an ammeter rated at 40 or more amps.

3. Start the engine.
   - As engine rpm increases, voltage should increase to a maximum 14V at 1500 engine rpm.
   - Current output should also increase to a maximum 35 amps at 2500 engine rpm.

NOTE

Charge condition of battery will affect current (amp) output. As the battery begins to charge, the current output will slowly decrease.

- If no voltage and/or current is measured, the alternator is faulty.

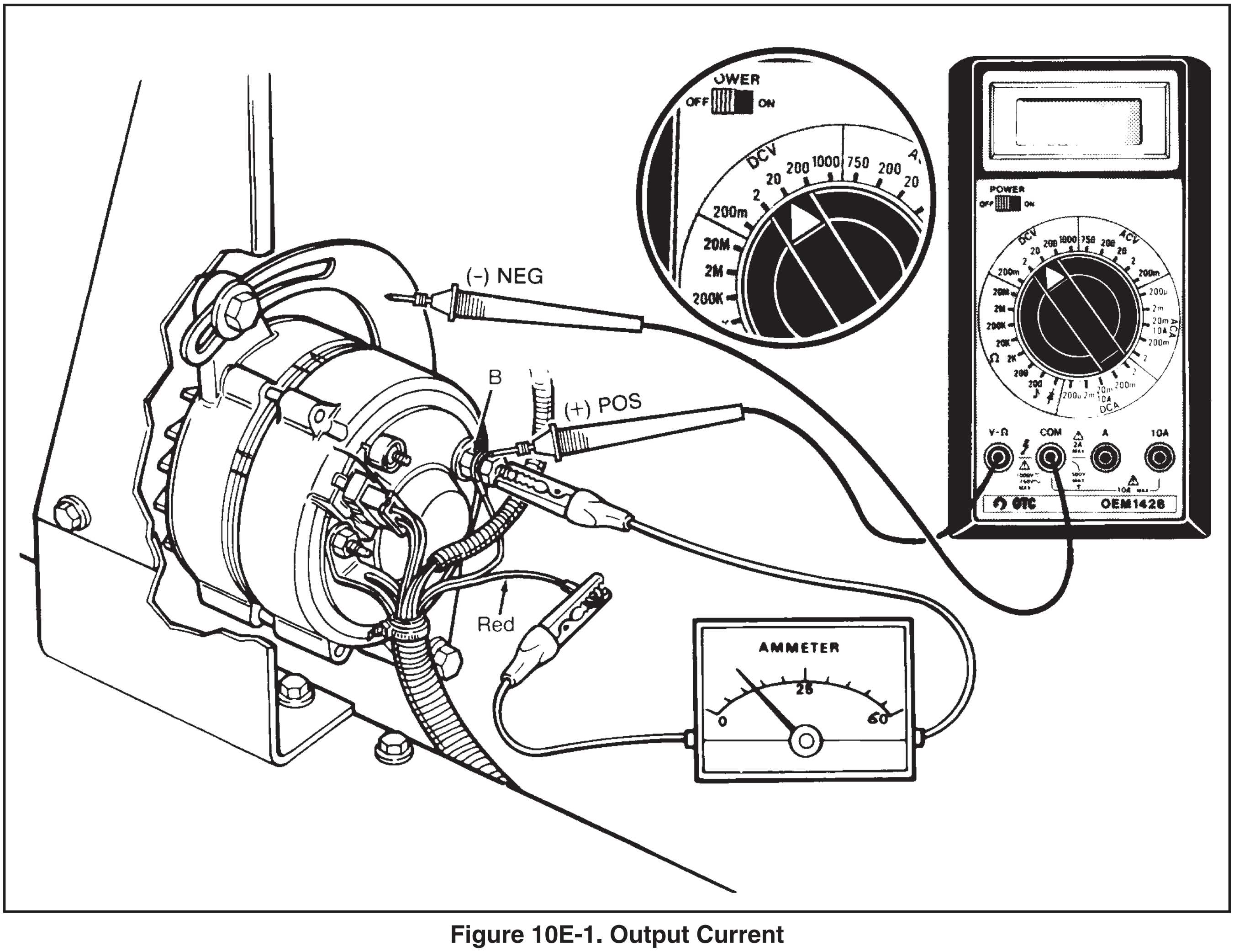


Figure 10E-1. Output Current

10E

SECTION 10E. CHARGING SYSTEM

ALTERNATOR INPUT VOLTAGE
(See Figure 10E-2)

1. Remove the alternator plug.
2. Set the multimeter to 20 VDC and connect POS (+) lead to terminal F and NEG (–) to terminal E.
3. Turn on the ignition switch.
   - The multimeter should read battery voltage.
   - If no voltage registers, continue with voltage regulator test.

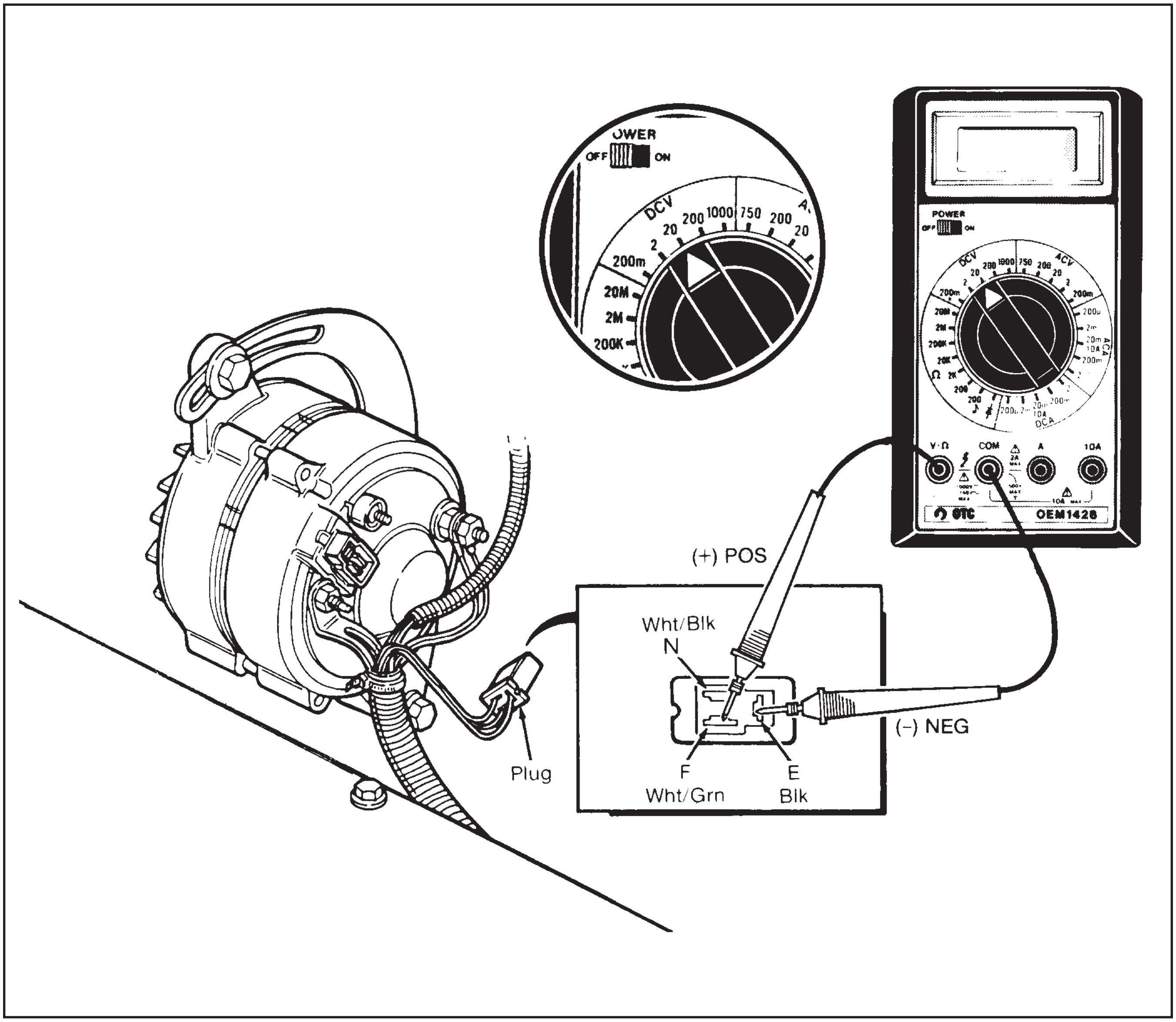


Figure 10E-2. Input Voltage

SECTION 10E. CHARGING SYSTEM

NO LOAD TEST (See Figure 10E-3)

1. Remove the electrical plug from the alternator.
2. Using a jumper wire, connect the F terminal to the B terminal.
3. Ground the E terminal.
4. Set the multimeter to 200 VDC.
5. Start and run engine at approximately 1500 rpm.
6. Disconnect the battery NEG (–) cable.
   - Voltage should be about 17 VDC.
   - Voltage should increase to 32 VDC as the engine rpm is increased.
   - If no voltage is recorded the alternator is faulty.

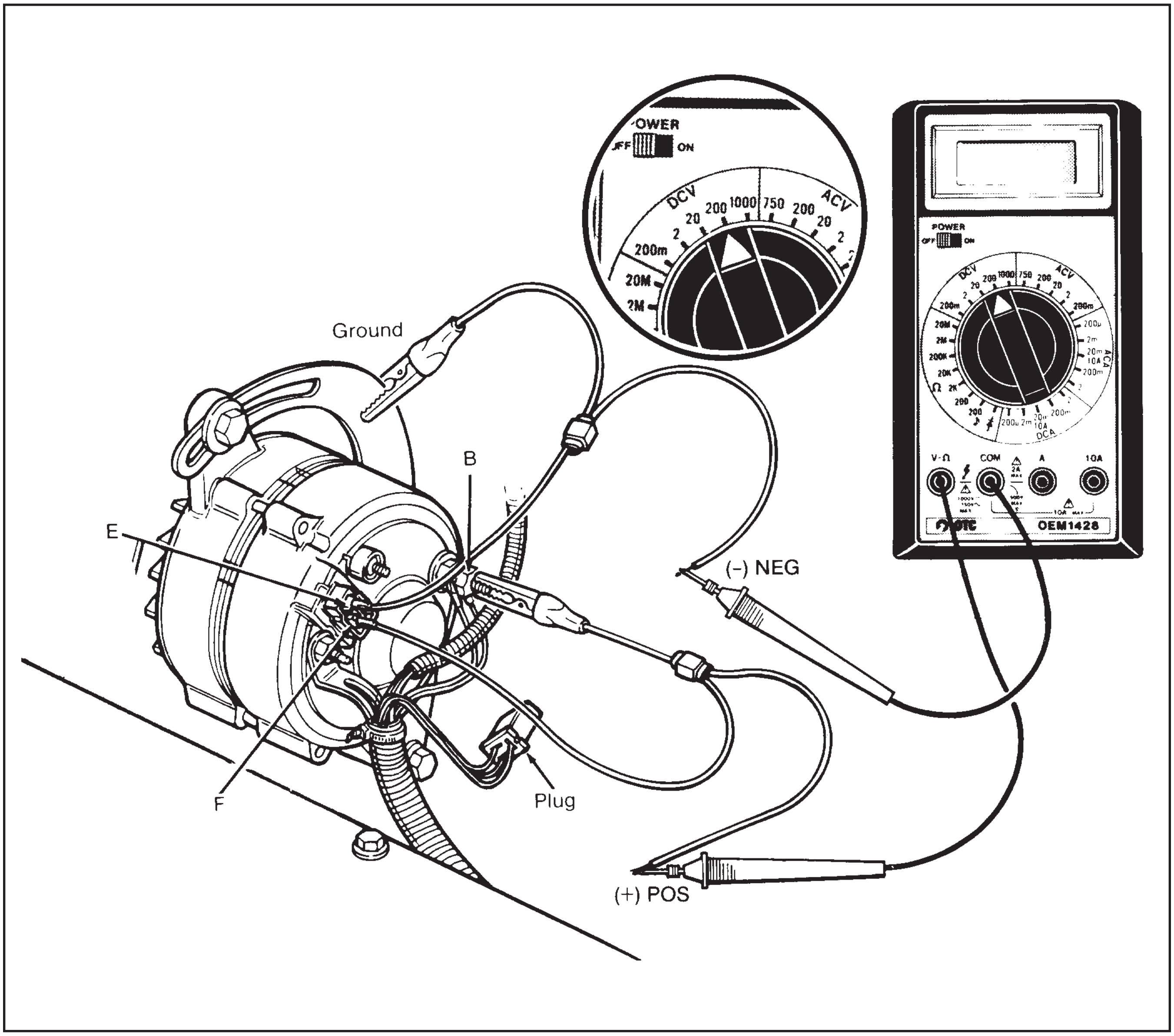


Figure 10E-3. Alternator No-Load Test

SECTION 10E. CHARGING SYSTEM

ROTOR COIL, SLIP RING AND BRUSH TEST (See Figure 10E-4)

1. Remove the plug from the alternator.
2. Set the multimeter to 200 ♪ Ω (ohms) range.
3. Connect the multimeter POS (+) lead to terminal F and the NEG (–) lead to terminal E.
   - The resistance should be approximately 6.5–10 Ω (ohms).

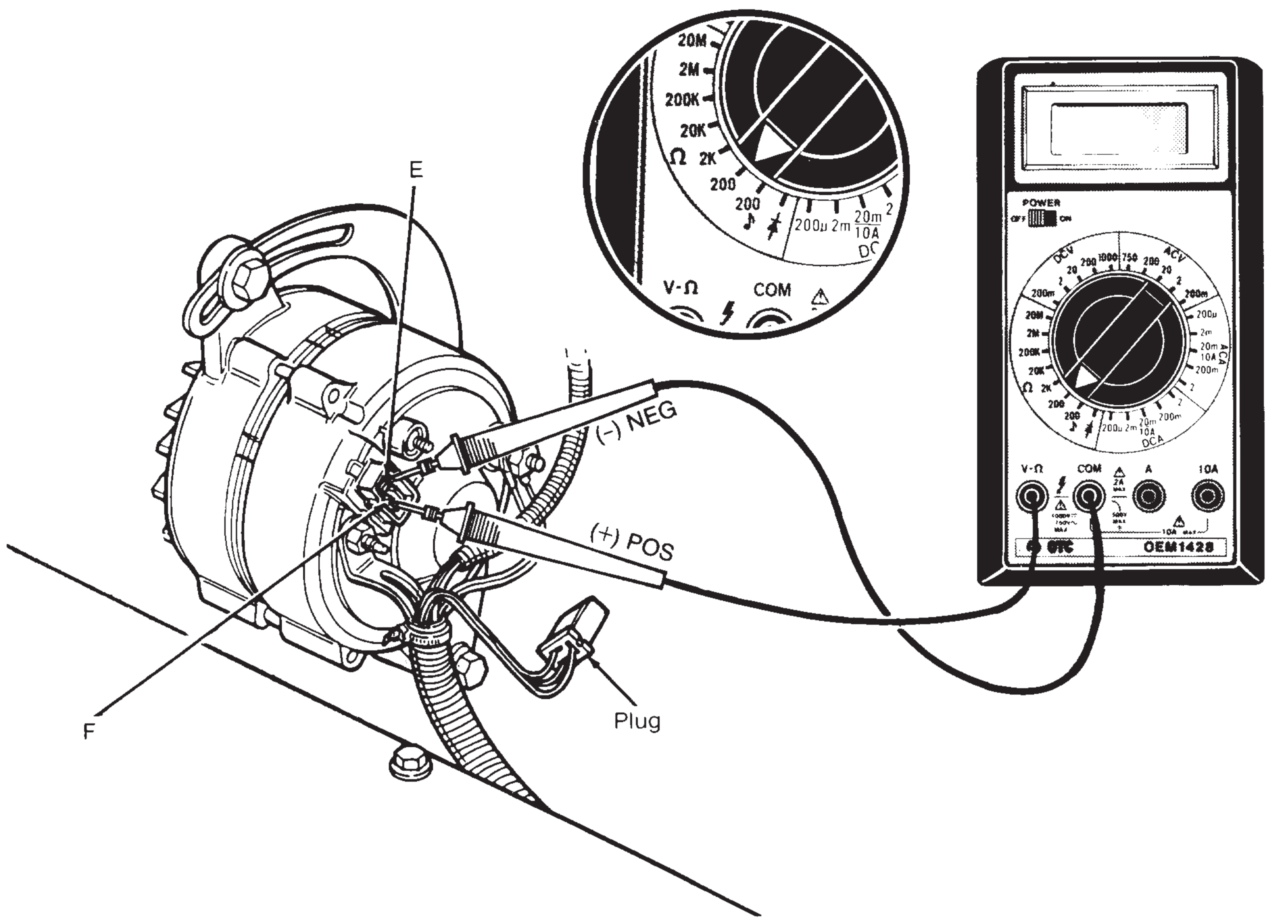


Figure 10E-4. Rotor Coil, Slip Ring and Brush Test

SECTION 10E. CHARGING SYSTEM

NO LOAD REGULATING VOLTAGE TEST (See Figure 10E-5)

1. Set the multimeter to the 20 VDC range.
2. Connect the multimeter POS (+) lead to the B terminal and the NEG (–) lead to the ground.
3. Start and run the engine at idle.
4. Remove the NEG (–) battery cable.
5. Gradually accelerate the engine and watch the multimeter.
   - Voltage should rise as engine rpm increases. Voltage should read 13.8 to 14.8 VDC.
   - If voltage does not increase with increased engine rpm, proceed with regulator test.
   - If regulator tests okay, alternator may need to be repaired.

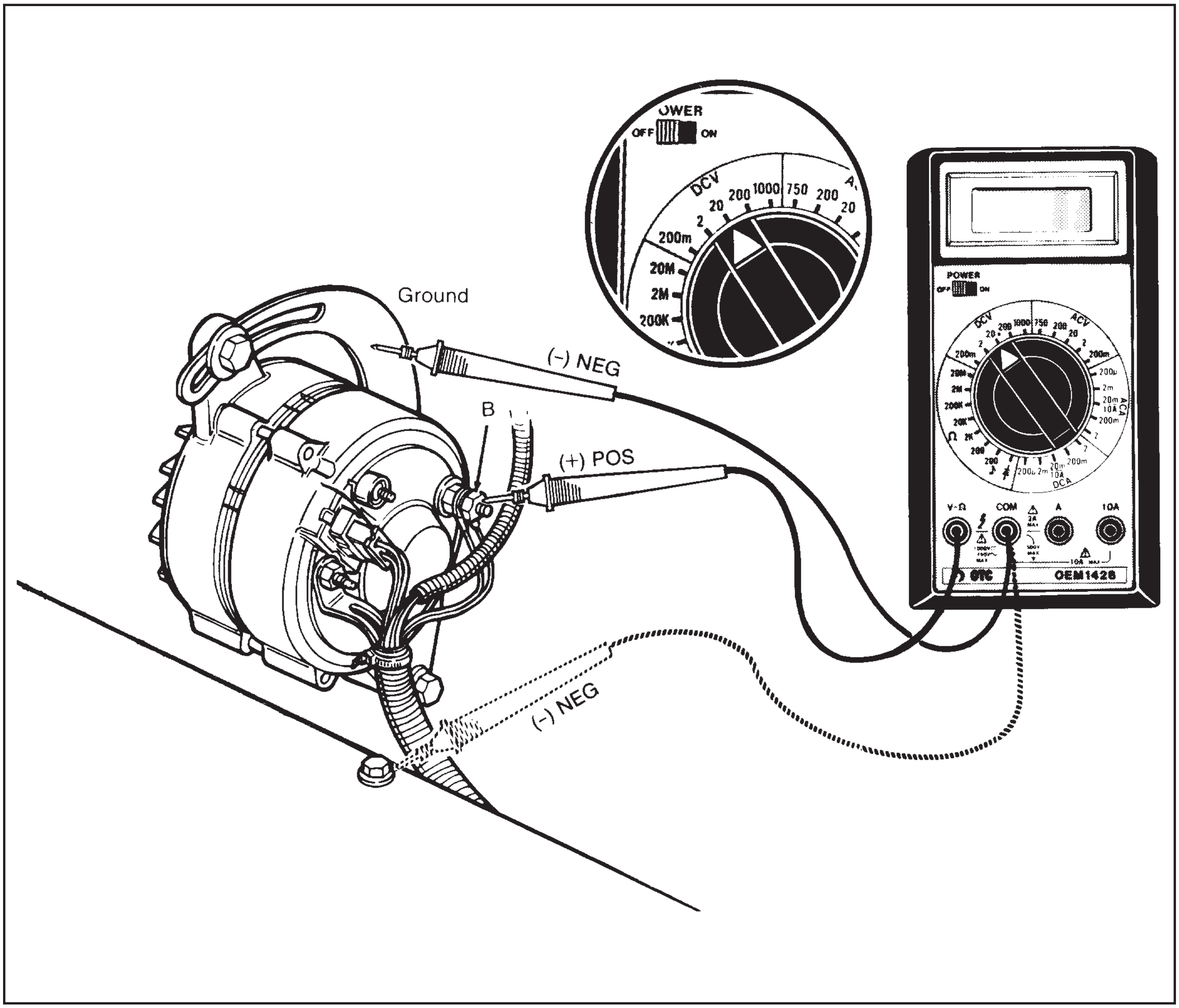


Figure 10E-5. No-Load Regulating Voltage Test

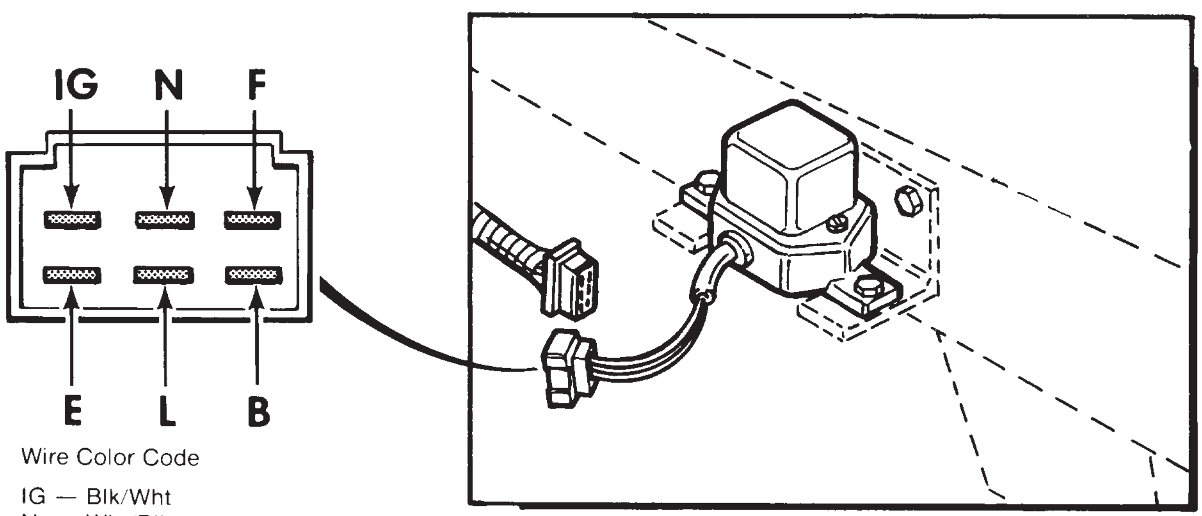
SECTION 10E. CHARGING SYSTEM

REGULATOR TEST (See Figure 10E-6)

The regulator regulates the output voltage and current according to the electrical demand.

Terminals and Color Codes		Voltage Relay Points	Resistance Ω (ohms)	Failure and Probable Causes
IG Black/White	F White/Green	OPEN	0	If reading is above 0 Ω, low speed side is faulty.
		CLOSED*	11 Ω (ohms)	If reading is infinity, control resistor is faulty.
L White/Red	E Black	OPEN	0	If reading is over 0, bad contact on voltage relay.
		CLOSED*	approx. 100 Ω (ohms)	If reading is 0 voltage, relay contacts are bad. If reading is ∞, voltage coil is broken.
N White	E Black		approx. 23 Ω (ohms)	If reading is 0, relay coil shorted. If reading is ∞, pressure coil is broken.
B White	E Black	OPEN	∞ (open circuit)	If reading is not ∞, voltage relay points melted and/or burned.
B White	L White/Red	CLOSED*	0	If reading is over 0, bad contacts on voltage relay points.

* Push contact closed with finger.



Wire Color Code

IG — Blk/Wht
N — Wht/Blk
F — Wht/Grn
E — Blk
L — Wht/Red
B — Wht

Figure 10E-6. Regulator Test

SECTION 10F. STARTER

GENERAL

The repair of the starter is covered in the Engine Manufacturer's Service Manual which can be obtained through your local Jacobsen Distributor.

FIELD TEST

PULL IN SOLENOID (See Figure 10F-1)

1. Disconnect the NEG (–) battery cable.
2. Disconnect the RED and BRN leads from the coil and tape the ends together to ensure good contact.
3. Connect the NEG battery cable and turn the ignition switch to the START position.
   - Each time the ignition switch is turned to the start position, a "click" should be heard from the coil.
   - If no click is heard the coil or electrical supply may be defective. Continue with the next step.
4. Remove the PUR/WHT solenoid wire.
5. Set the multimeter to 20 VDC and connect the POS (+) lead to the solenoid wire. Connect the NEG (–) lead to a good ground.
6. Turn and hold the ignition switch in the start position.
   - The multimeter should read battery voltage.
   - If no voltage is measured, an open interlock switch (Section 10G), faulty wire (Section 10C) or ignition switch (Section 10G), could be at fault.

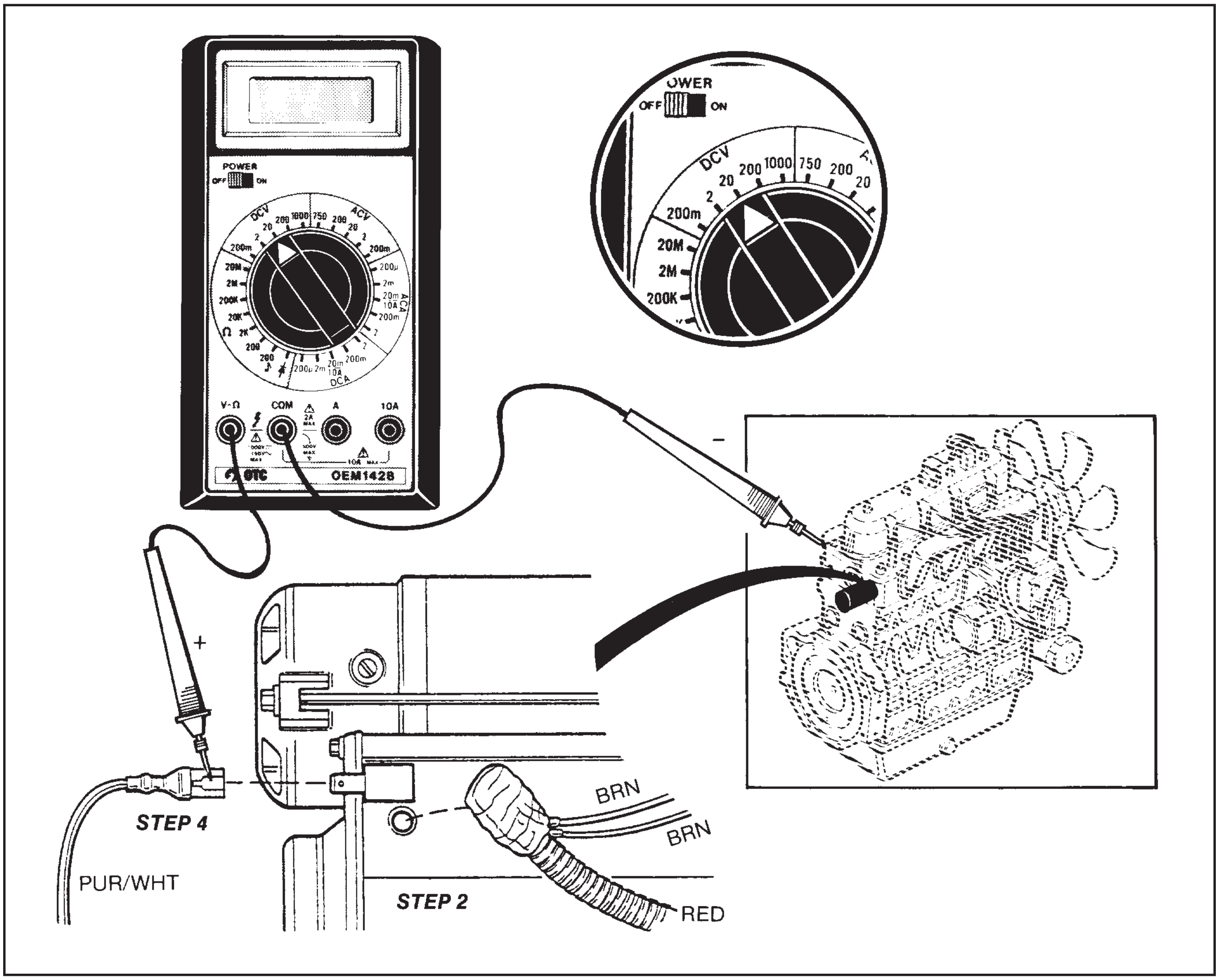


Figure 10F-1. Pull In Coil Test

SECTION 10F. STARTER

STARTER MOTOR (See Figure 10F-2)

1. Disconnect the NEG (–) battery cable.
2. Disconnect the PUR/WHT solenoid wire from the starter solenoid.
3. Remove starter.
4. Connect the cable to starter as shown.
5. Connect cable to POS (+) terminal of battery.
6. Touch the NEG (–) cable to the NEG (–) terminal on the battery.
   - The starter motor should turn.
   - If the starter does not turn or turns slow, connect a multimeter set at 20 VDC to the battery and repeat Step 4. Voltage should not drop below 10.5 volts.
   - If voltage is correct, starter may be faulty.

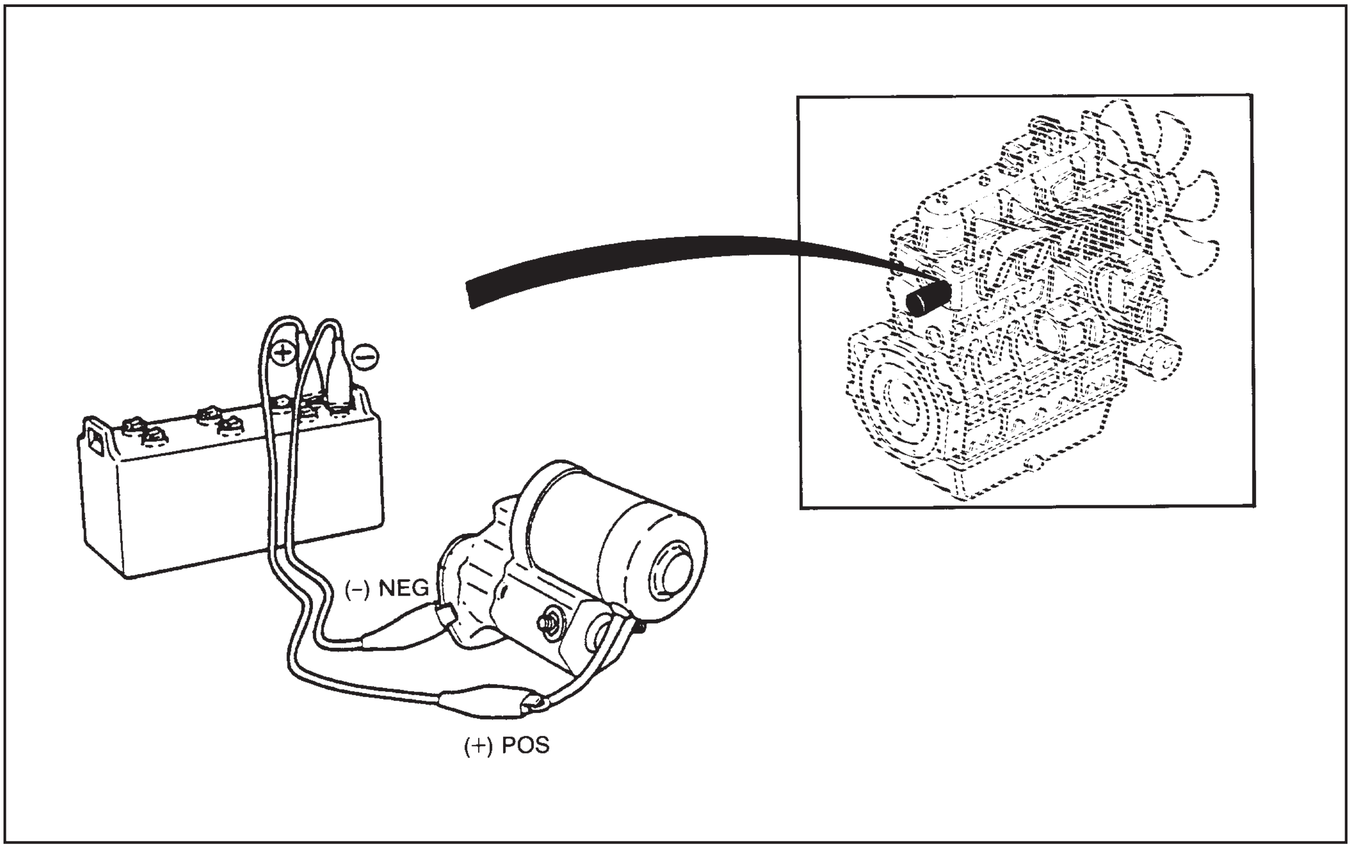


Figure 10F-2. Starter Motor Test

SECTION 10G. SWITCHES

GENERAL

This section provides instructions for testing the various switches that are part of the electrical system. Repair is limited to replacement of components found faulty during testing. See Figure 10N for location of components.

SEAT SWITCH TEST (See Figure 10G-1)

1. Disconnect seat switch connector.
2. Set VOM to 200 ♪ Ω (ohms) scale.
3. Connect meter leads to connector terminals.
   - There should be no reading (no continuity) on VOM.
4. Depress seat switch.
   - There should be a reading (continuity) on VOM.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

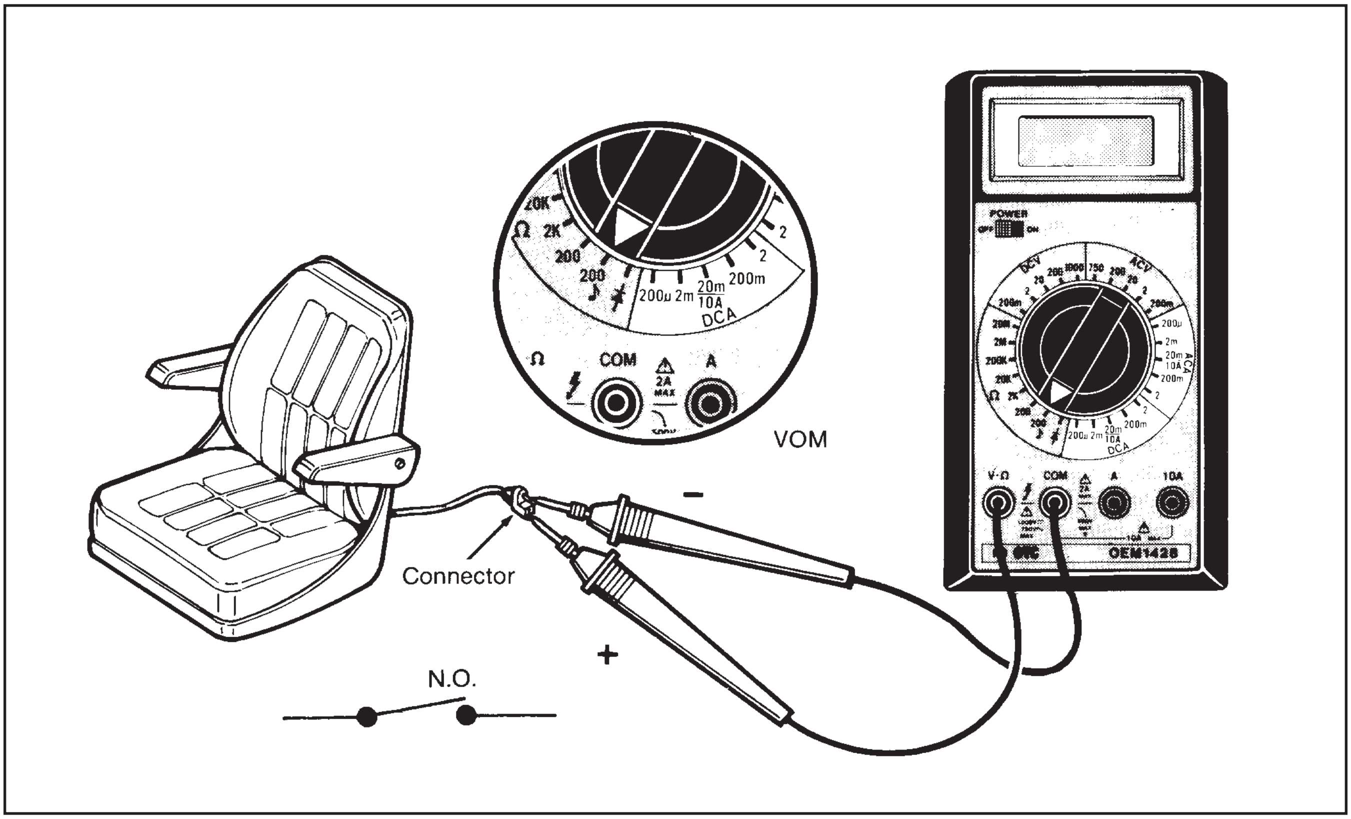


Figure 10G-1. Seat Switch Test

SECTION 10G. SWITCHES

IGNITION SWITCH TEST (EARLY) (See Figure 10G-2)

1. Disconnect ground (black) NEG (–) cable at battery.
2. Disconnect wiring connector at switch.
3. Set multimeter to 200 ♪ Ω (ohms) scale.
4. See Figure 10I-3 and check all switch positions as follows:

   a. With key switch in OFF position connect test leads to any two terminals — check all five.

   - There should be no reading on multimeter.

   NOTE

   If there is a reading of more than 0.5 Ω (ohms) in any of the following tests the switch is faulty and must be replaced.

   b. With key switch in RUN position, connect black NEG (–) test lead to terminal B and red POS (+) lead to terminal I.

   - There should be a reading of 0–0.5 Ω (ohms) on the multimeter.

   c. Move red POS (+) lead to terminal A.

   - There should be a reading of 0–0.5 Ω (ohms) on the multimeter.

   d. Connect black NEG (–) lead to terminal X and red POS (+) lead to terminal Y.

   - There should be a reading of 0–0.5 Ω (ohms) on the multimeter.

   e. Hold switch in START position. Connect black NEG (–) lead to terminal B and red POS (+) lead to terminal I.

   - There should be a reading of 0–0.5 Ω (ohms) on multimeter.

   f. Move red POS (+) lead to terminal S.

   - There should be a reading of 0–0.5 Ω (ohms) on multimeter.

Replace a switch that does not meet all of the above test results or has resistance of 0.5 Ω (ohms) or more.

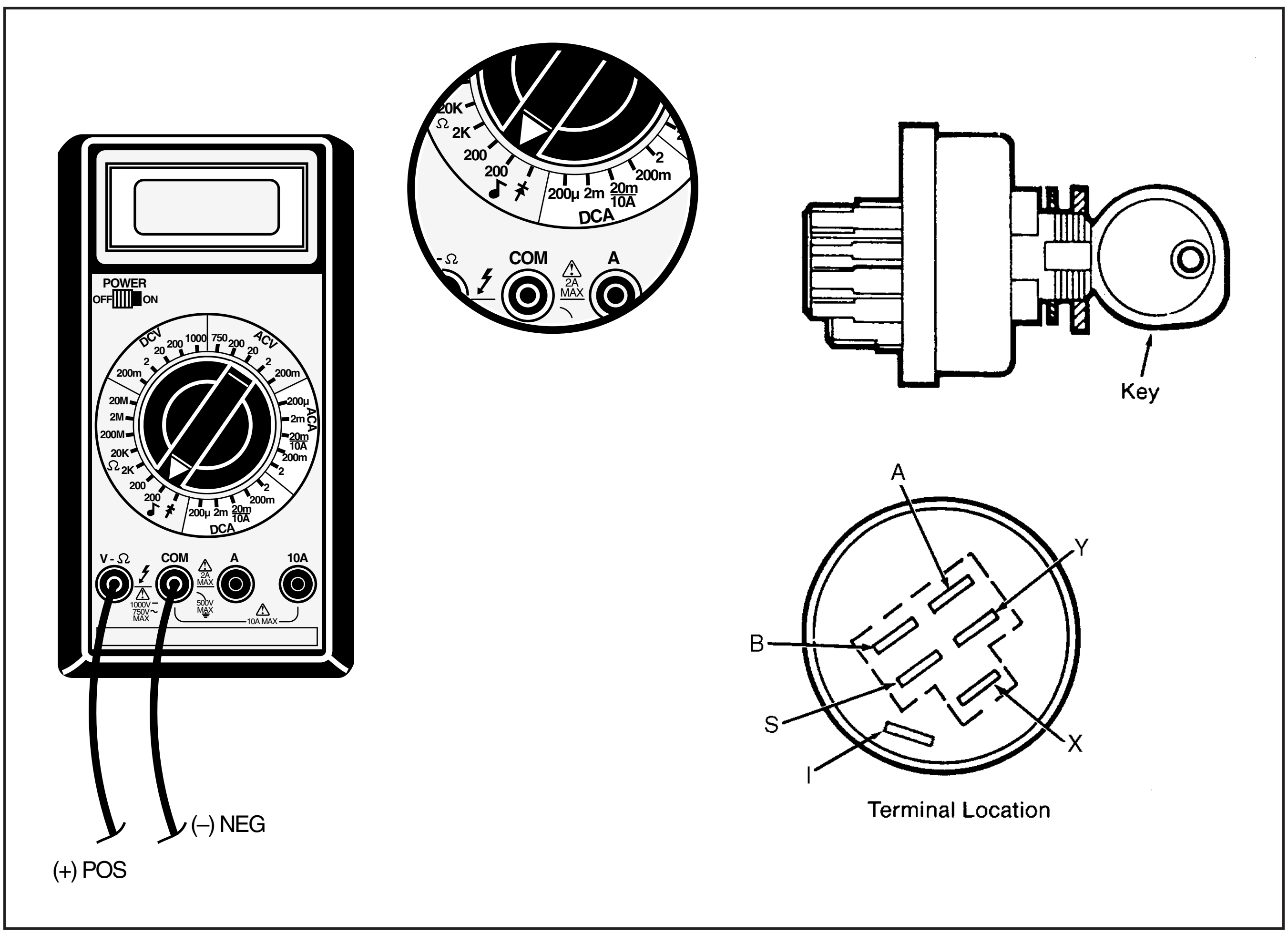
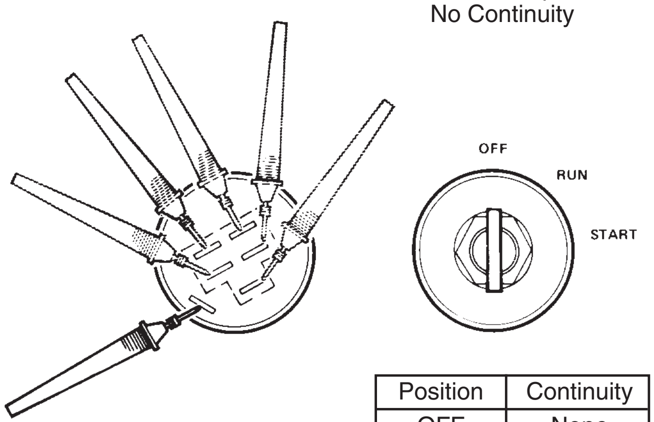


Figure 10G-2. Ignition Switch Test

SECTION 10G. SWITCHES

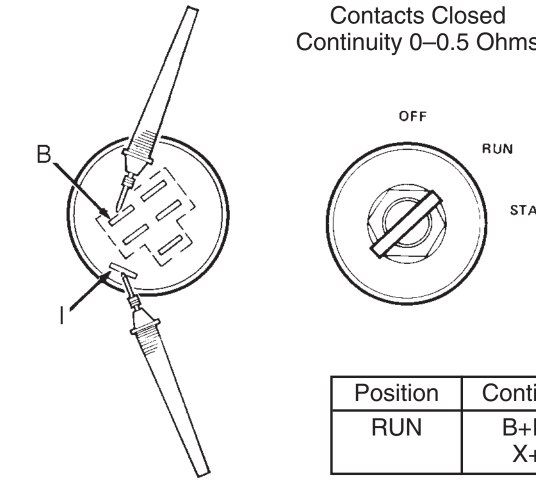
Contacts Open
No Continuity



Position	Continuity
OFF	None

STEP 4A

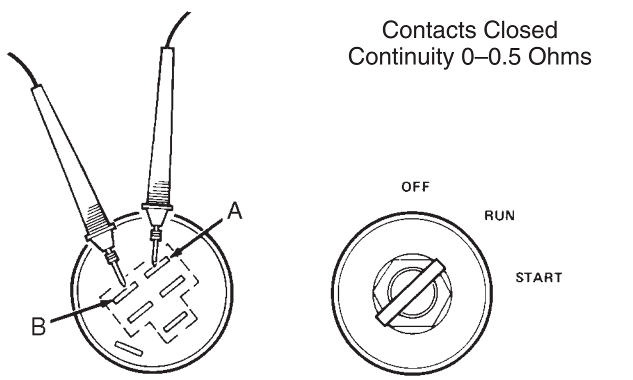
Contacts Closed
Continuity 0–0.5 Ohms



Position	Continuity
RUN	B+I+A X+Y

STEP 4B

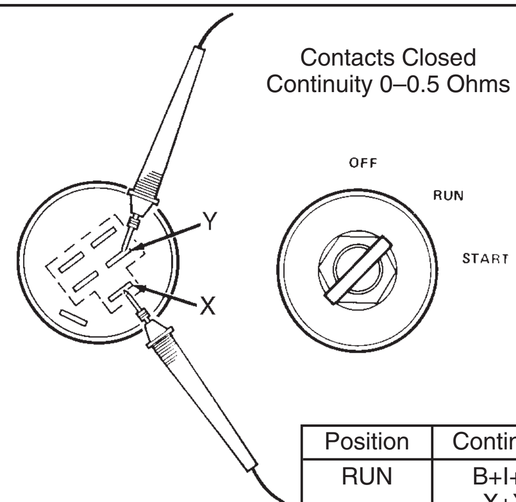
Contacts Closed
Continuity 0–0.5 Ohms



Position	Continuity
RUN	B+I+A X+Y

STEP 4C

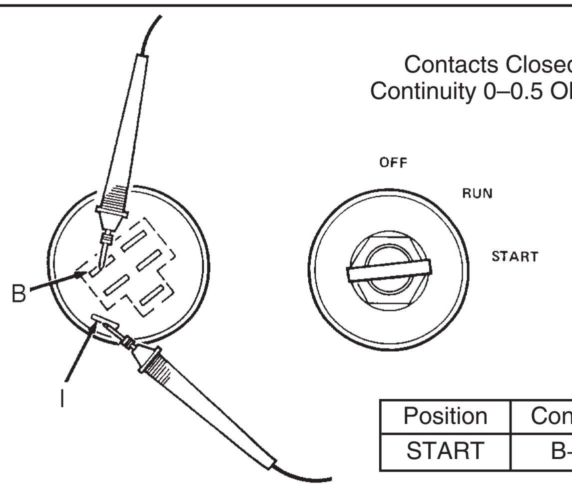
Contacts Closed
Continuity 0–0.5 Ohms



Position	Continuity
RUN	B+I+A X+Y

STEP 4D

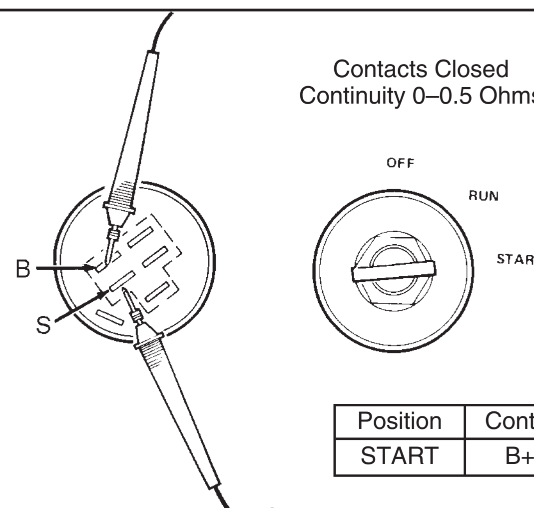
Contacts Closed
Continuity 0–0.5 Ohms



Position	Continuity
START	B+I+S

STEP 4E

Contacts Closed
Continuity 0–0.5 Ohms



Position	Continuity
START	B+I+S

STEP 4F

Figure 10G-3. Ignition Switch Test Step 4

SECTION 10G. SWITCHES

IGNITION SWITCH TEST (LATER) (See Figure 10G-4)

1. Disconnect ground (black) NEG (–) cable at battery.
2. Disconnect wiring connector at switch.
3. Set multimeter to 200 ♪ Ω (ohms) scale.
4. See Figure 10G-5 and check all switch positions as follows:
   a. With key switch in OFF position connect test leads to any two terminals — check all three.
      - There should be no reading on multimeter.

NOTE

If there is a reading of more than 0.5 Ω (ohms) in any of the following tests the switch is faulty and must be replaced.

   b. With key switch in RUN position, connect black NEG (–) test lead to terminal B and red POS (+) lead to terminal I.
      - There should be a reading not to exceed 2.0 Ω (ohms) on the multimeter.

   c. Hold switch in START position. Connect black NEG (–) lead to terminal B and red POS (+) lead to terminal S.
      - There should be a reading not to exceed 0.5 Ω (ohms) on multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

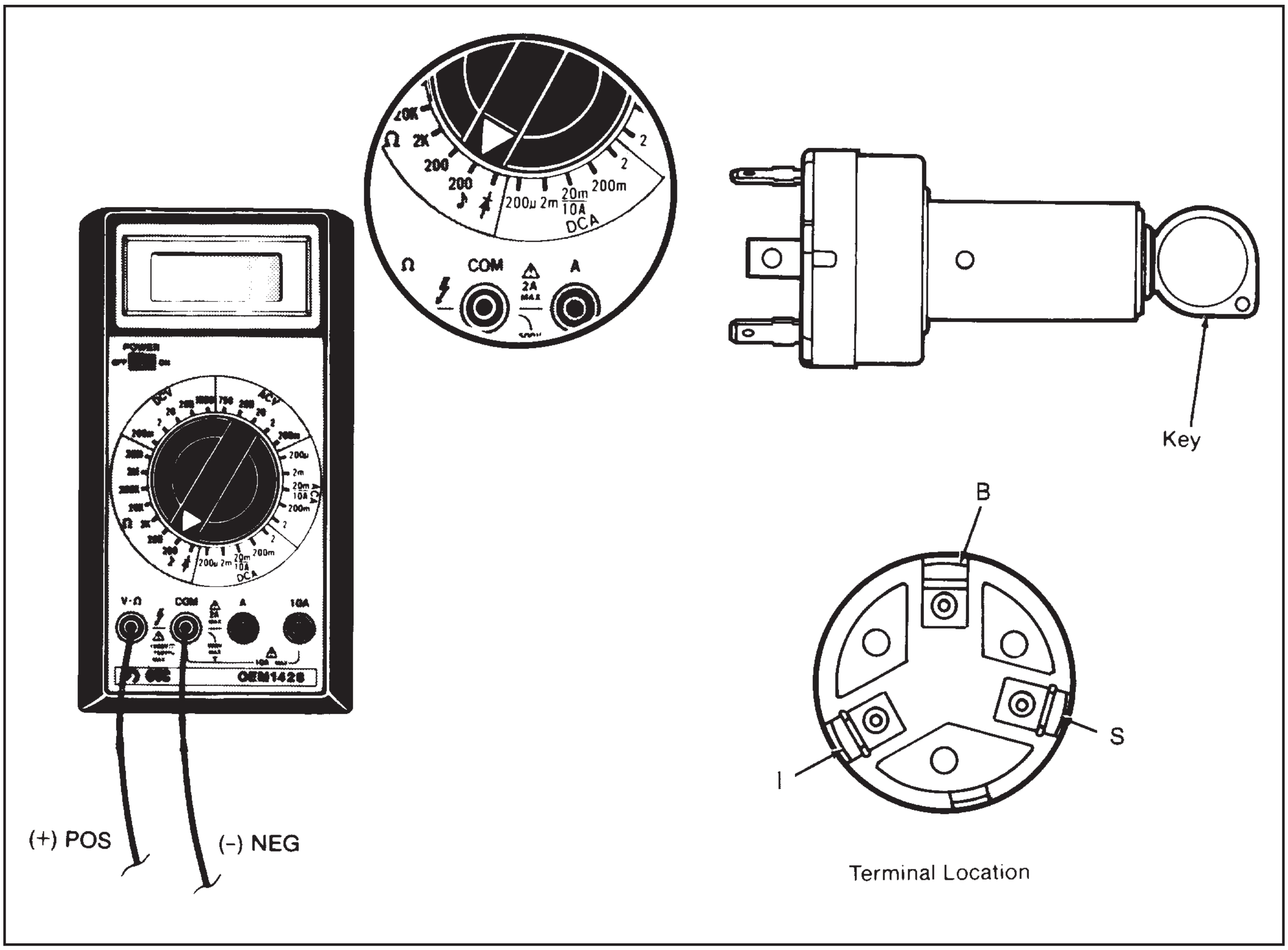


Figure 10G-4. Ignition Switch Test

SECTION 10G. SWITCHES

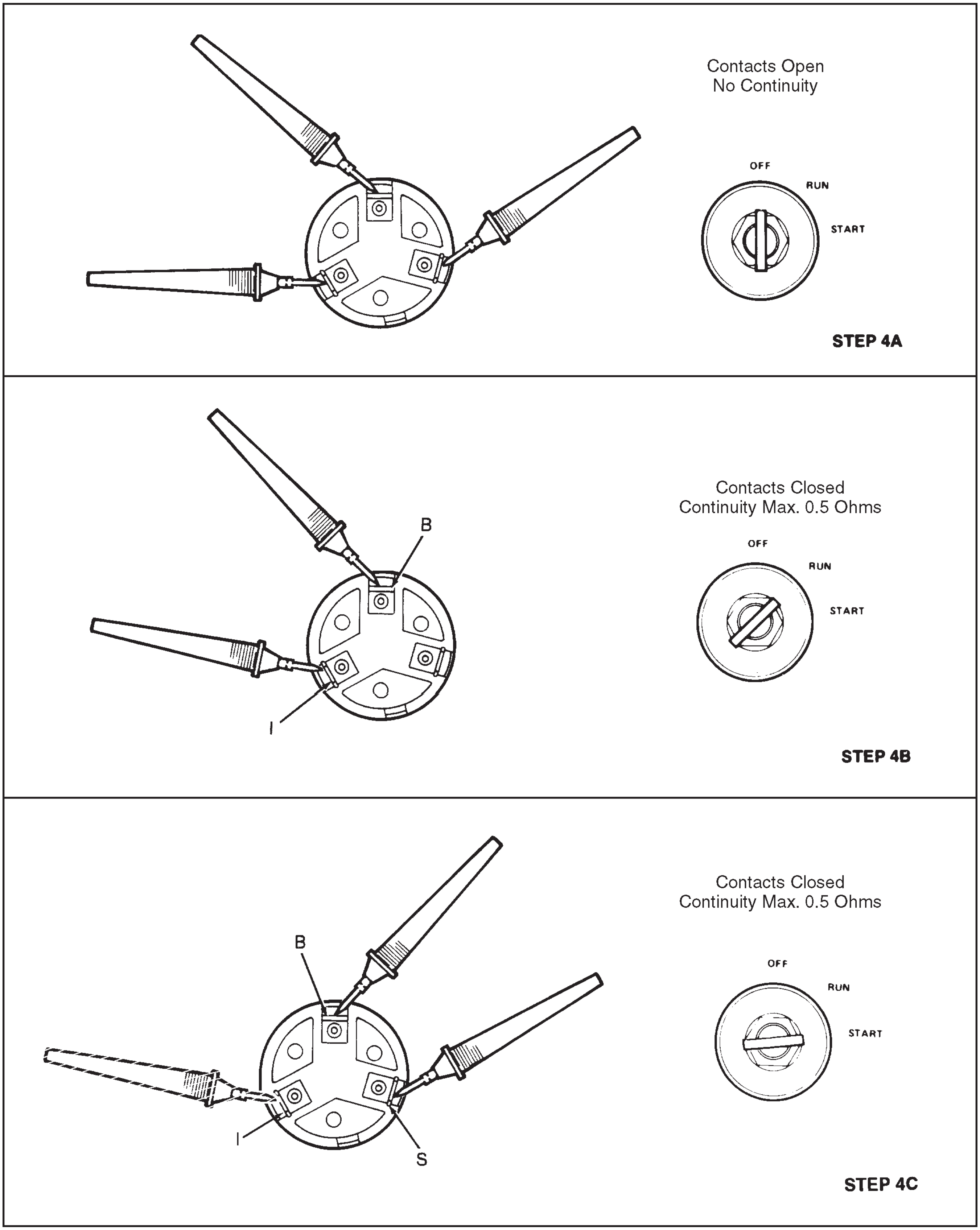


Figure 10G-5. Ignition Switch Test Step 4

SECTION 10G. SWITCHES

IMPLEMENT (MOWER) SWITCH TEST (EARLY) (See Figure 10G-6)

NOTE

See page 10G-23 for later switch.

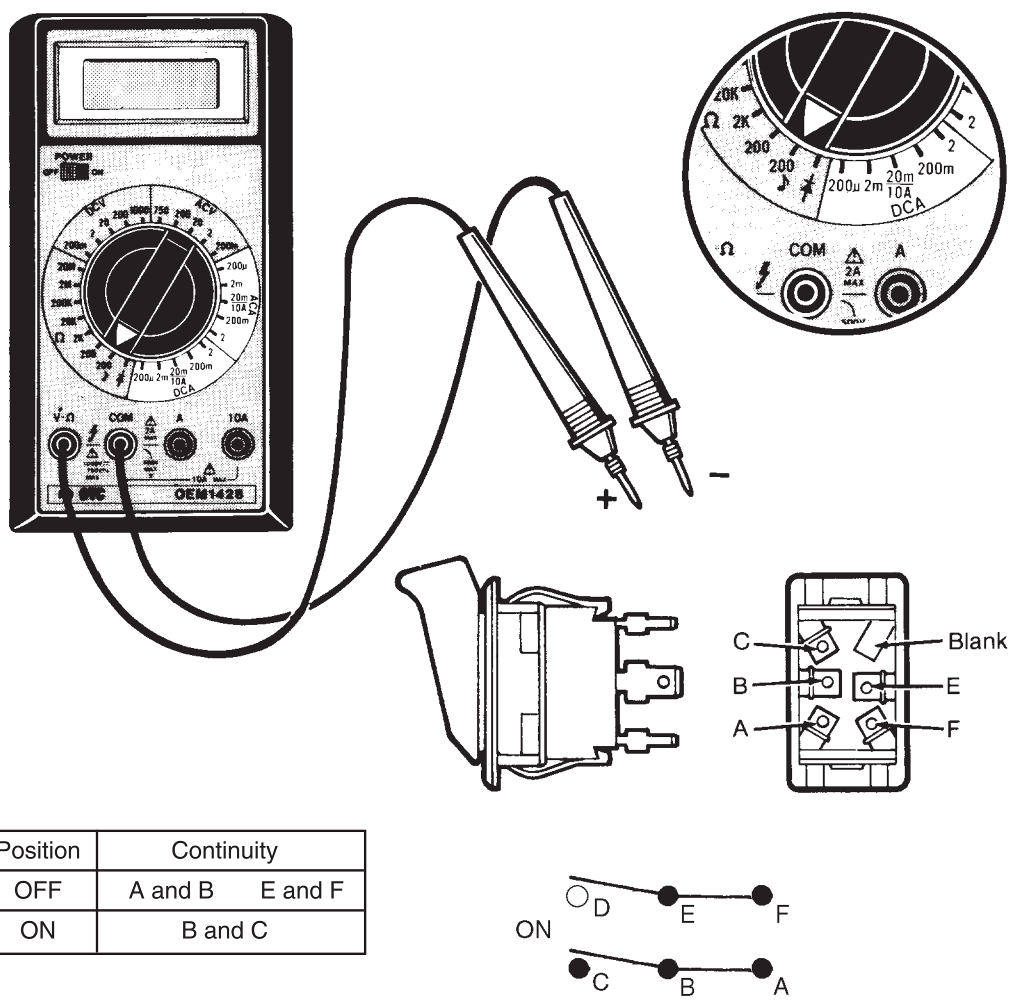
1. Disconnect switch connectors.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. With switch in OFF position, test as follows:
   a. Connect one multimeter test lead to terminal A and the other lead to B.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Connect one multimeter test lead to terminal E and the other to terminal F.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   c. Check for continuity across all remaining combinations of terminals (with switch in the OFF position).
      - There should be no reading on the multimeter.
4. Place switch in ON position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal C.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Check for continuity across all remaining combinations of terminals (with switch in the ON position).
      - There should be no reading on the multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.



Position	Continuity	
OFF	A and B	E and F
ON	B and C	

Figure 10G-6. Implement (Mower) Switch Test

SECTION 10G. SWITCHES

WING MOWER CONTROL AND LIGHTING SWITCH TEST (See Figure 10G-7)

1. Disconnect switch connectors.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. With switch in OFF position, test as follows:
   a. Check for continuity across all remaining combinations of terminals (with switch in the OFF position).
      - There should be no reading on the multimeter.
4. Place switch in ON (1) position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal A.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

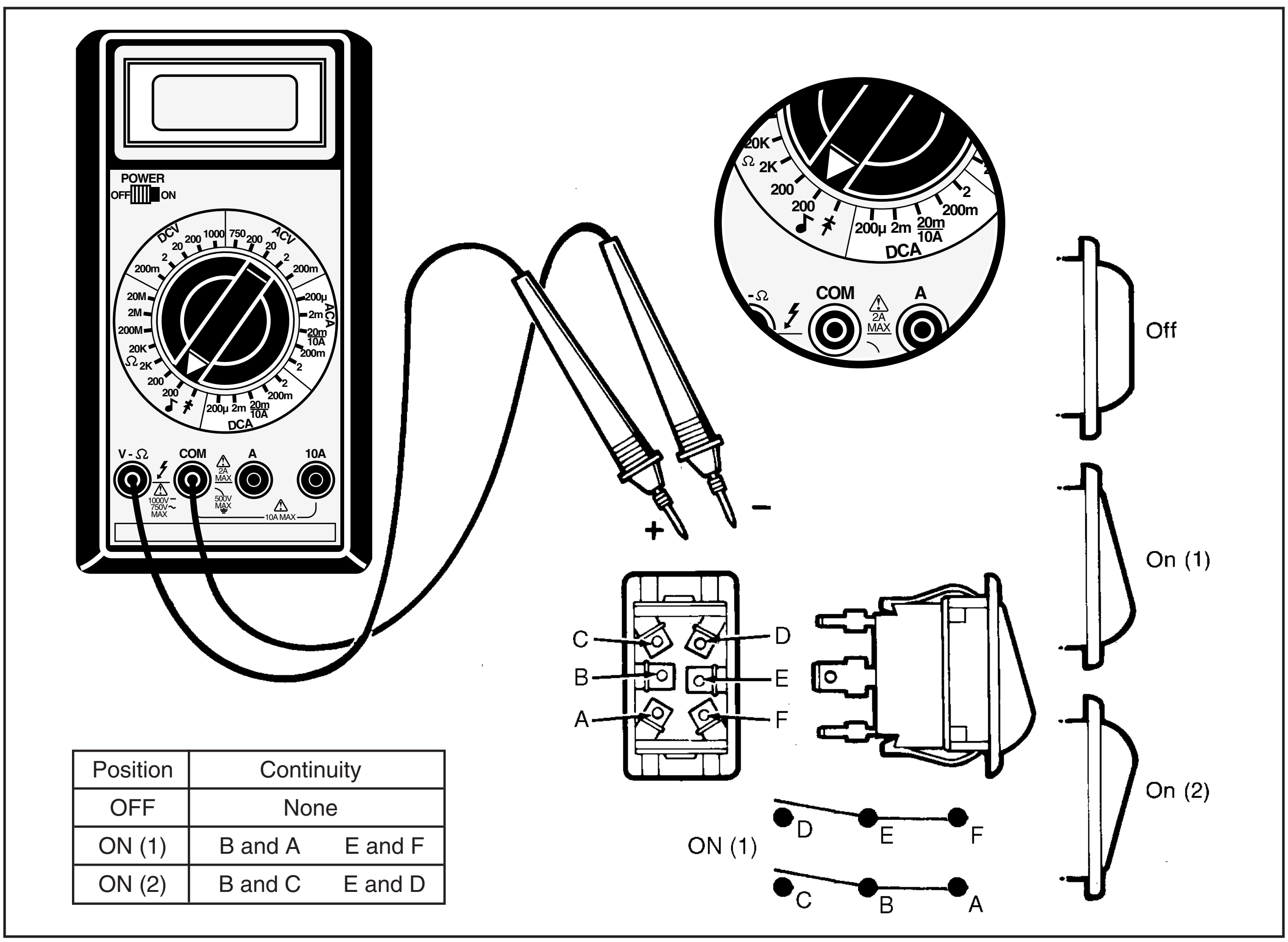
   b. Connect one multimeter test lead to terminal E and the other to terminal F.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   c. Check for continuity across all remaining combinations of terminals (with switch in the ON (1) position).
      - There should be no reading on the multimeter.
5. Place switch in ON (2) position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal C.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Connect one multimeter test lead to terminal E and the other to terminal D.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   c. Check for continuity across all remaining combinations of terminals (with switch in the ON (2) position).
      - There should be no reading on the multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.



Position	Continuity	
OFF	None	
ON (1)	B and A	E and F
ON (2)	B and C	E and D

Figure 10G-7. Wing Reel Control Lighting Switch Test

SECTION 10G. SWITCHES

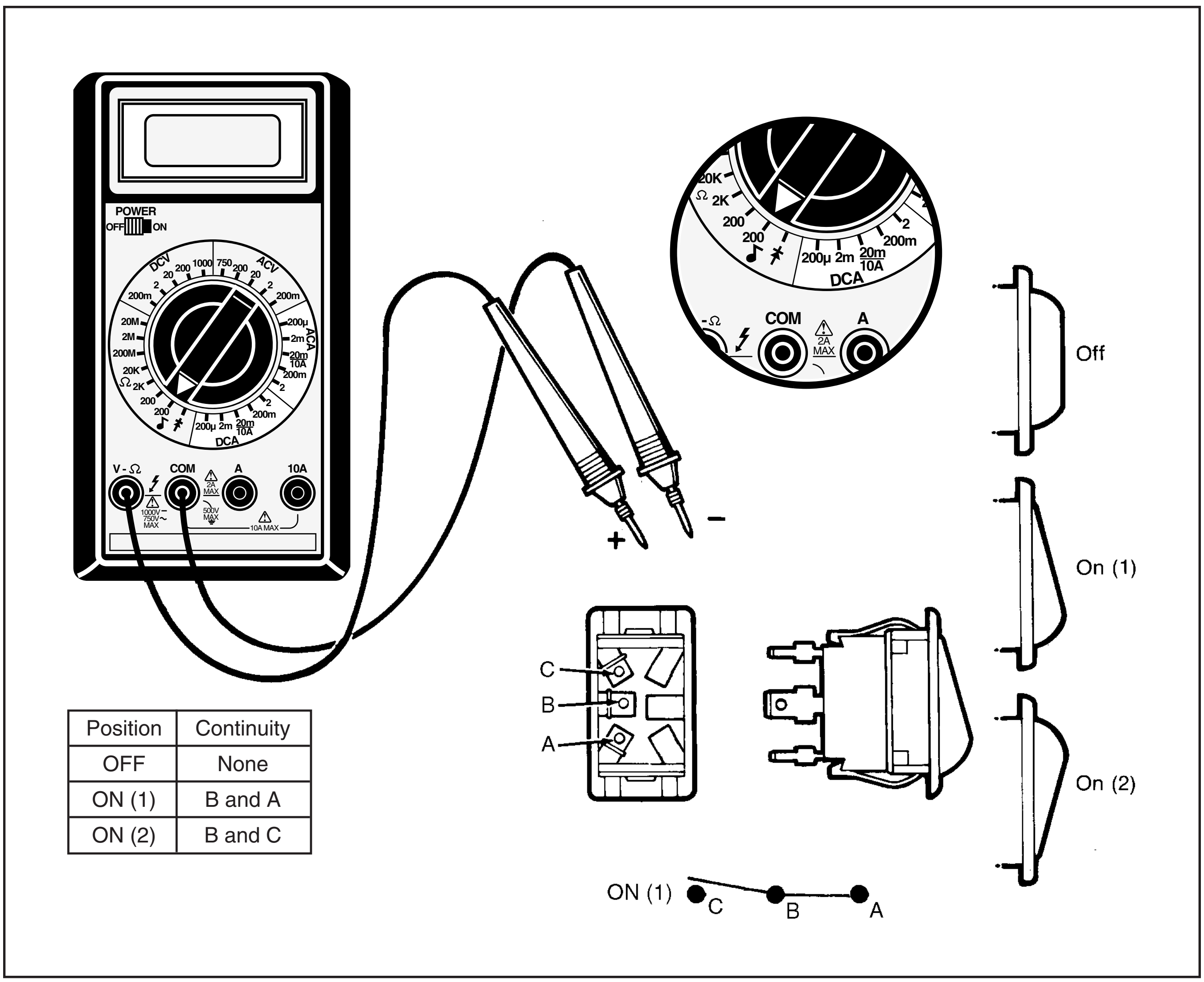
FRONT MOWER CONTROL SWITCH TEST (See Figure 10G-8)

1. Disconnect switch connectors.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. With switch in OFF position, test as follows:
   a. Check for continuity across all combinations of terminals (with switch in the OFF position).
      - There should be no reading on the multimeter.
4. Place switch in ON (1) position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal A.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Check for continuity across remaining terminal (with switch in the ON (1) position).
      - There should be no reading on the multimeter.
5. Place switch in ON (2) position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal C.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Check for continuity across remaining terminal (with switch in the ON (2) position).
      - There should be no reading on the multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.



Position	Continuity
OFF	None
ON (1)	B and A
ON (2)	B and C

Figure 10G-8. Front Reel Control Switch Test

SECTION 10G. SWITCHES

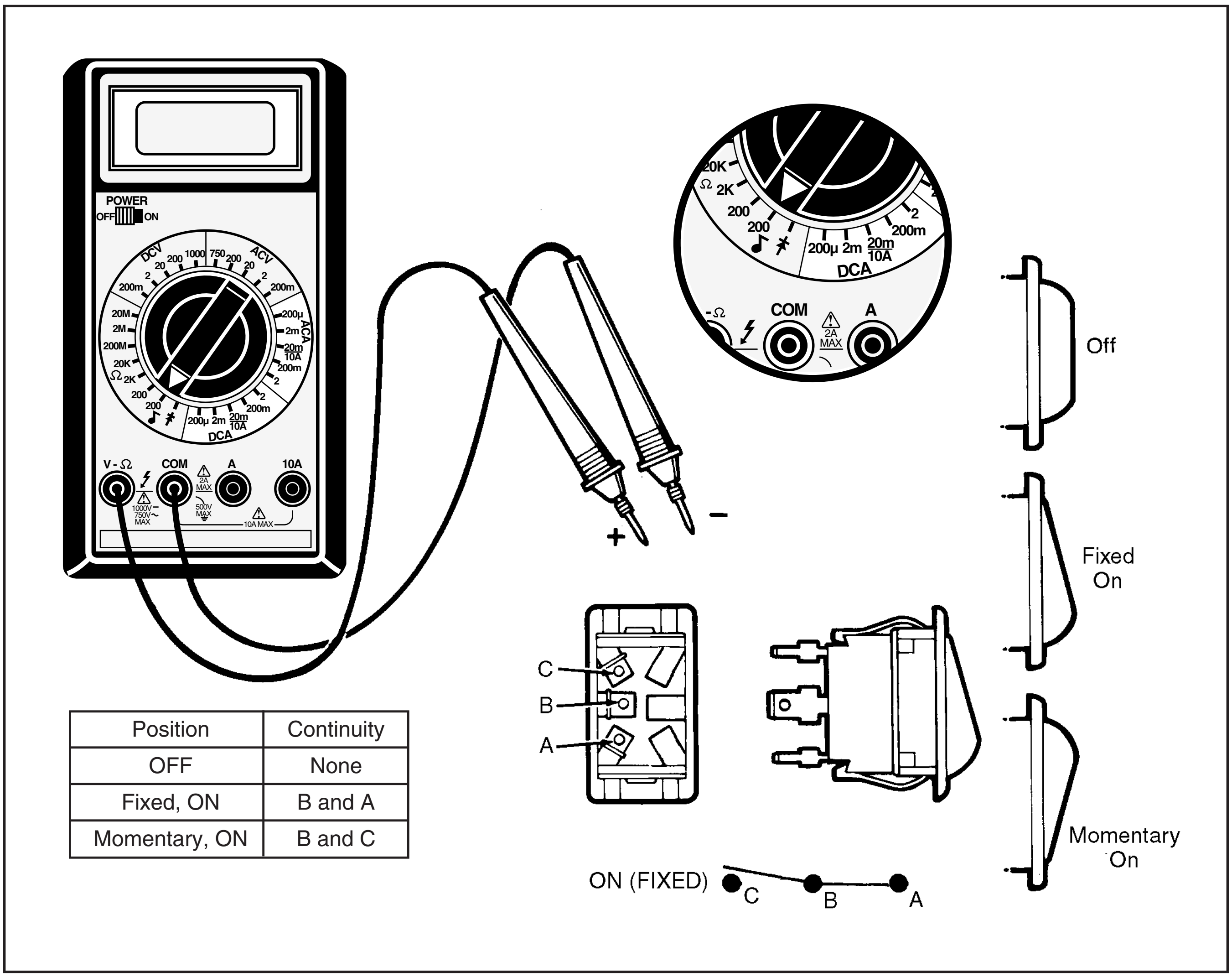
4 WHEEL DRIVE SWITCH TEST (See Figure 10G-9)

1. Disconnect switch connectors.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. With switch in OFF position, test as follows:
   a. Check for continuity across all combinations of terminals (with switch in the OFF position).
      - There should be no reading on the multimeter.
4. Place switch in ON (fixed) position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal A.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Check for continuity across remaining terminal (with switch in the ON (fixed) position).
      - There should be no reading on the multimeter.
5. Place switch in ON (momentary) position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal C.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Check for continuity across remaining terminal (with switch in the ON (momentary) position).
      - There should be no reading on the multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.



Position	Continuity
OFF	None
Fixed, ON	B and A
Momentary, ON	B and C

Figure 10G-9. 4 Wheel Drive Switch Test

SECTION 10G. SWITCHES

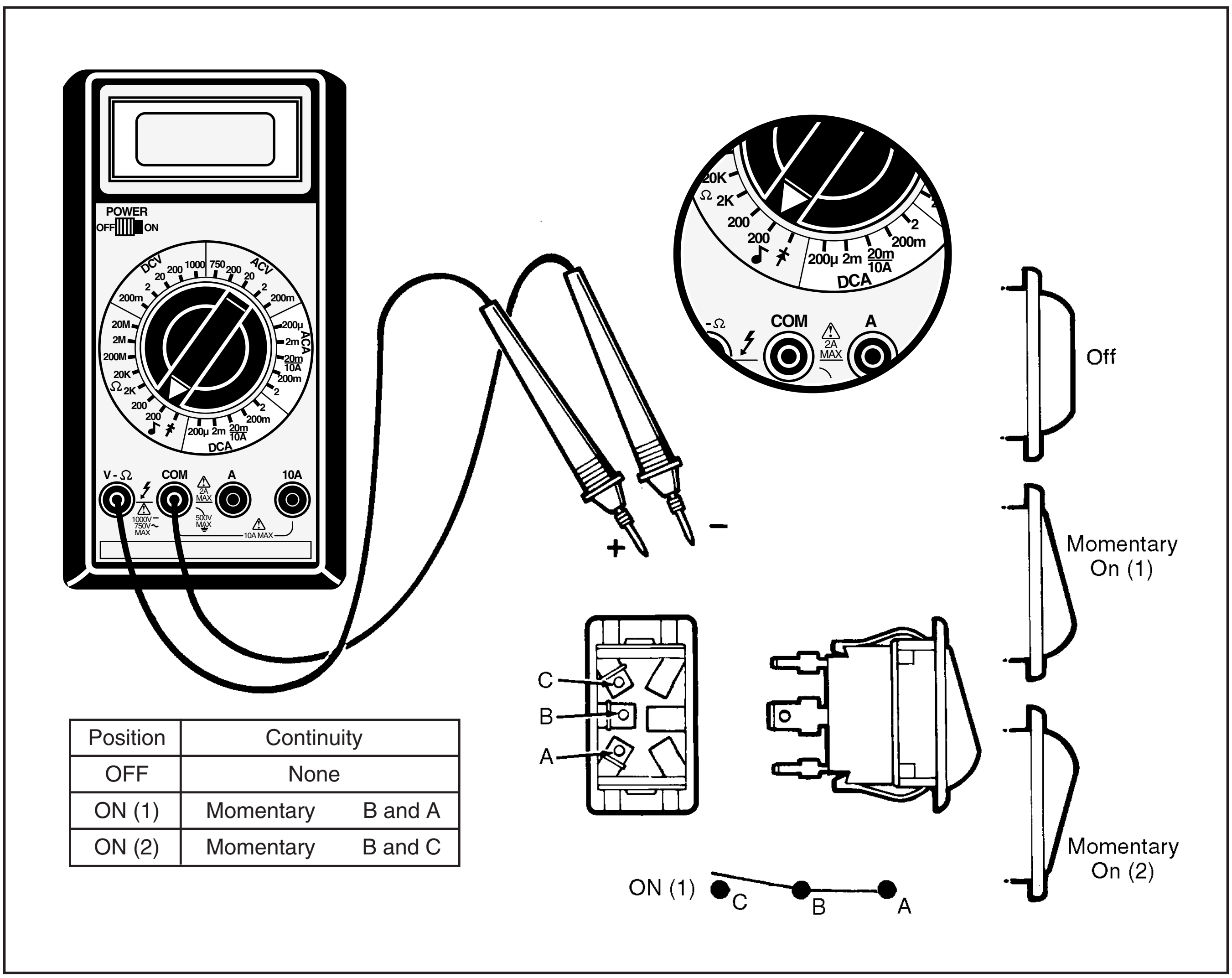
CRUISE CONTROL SWITCH TEST (See Figure 10G-10)

1. Disconnect switch connectors.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. With switch in OFF position, test as follows:
   a. Check for continuity across terminals (with switch in the OFF position).
      - There should be no reading on the multimeter.
4. Place switch in ON (1) (momentary) position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal A.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Check for continuity across remaining terminal (with switch in the ON (1) (momentary) position).
   - There should be no reading on the multimeter.
5. Place switch in ON (2) (momentary) position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal B and the other to terminal A.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Check for continuity across remaining terminal (with switch in the ON (2) (momentary) position).
      - There should be no reading on the multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.



Position	Continuity	
OFF	None	
ON (1)	Momentary	B and A
ON (2)	Momentary	B and C

Figure 10G-10. Cruise Control Switch Test

SECTION 10G. SWITCHES

GLOW PLUG SWITCH TEST
TEST SWITCH TEST (See Figure 10G-11)

The glow plug switch is pushed by the operator to allow current flow to the glow plugs, prior to starting the machine.

See Figure 10G-11 and test switch as follows:

1. Disconnect leads at switch.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. Connect multimeter test leads to switch terminals with the switch in the OFF position.
   - There should be no reading on the multimeter.
4. Hold switch in the ON position.
   - There should be a reading of 0–0.5 Ω (ohms) on the multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

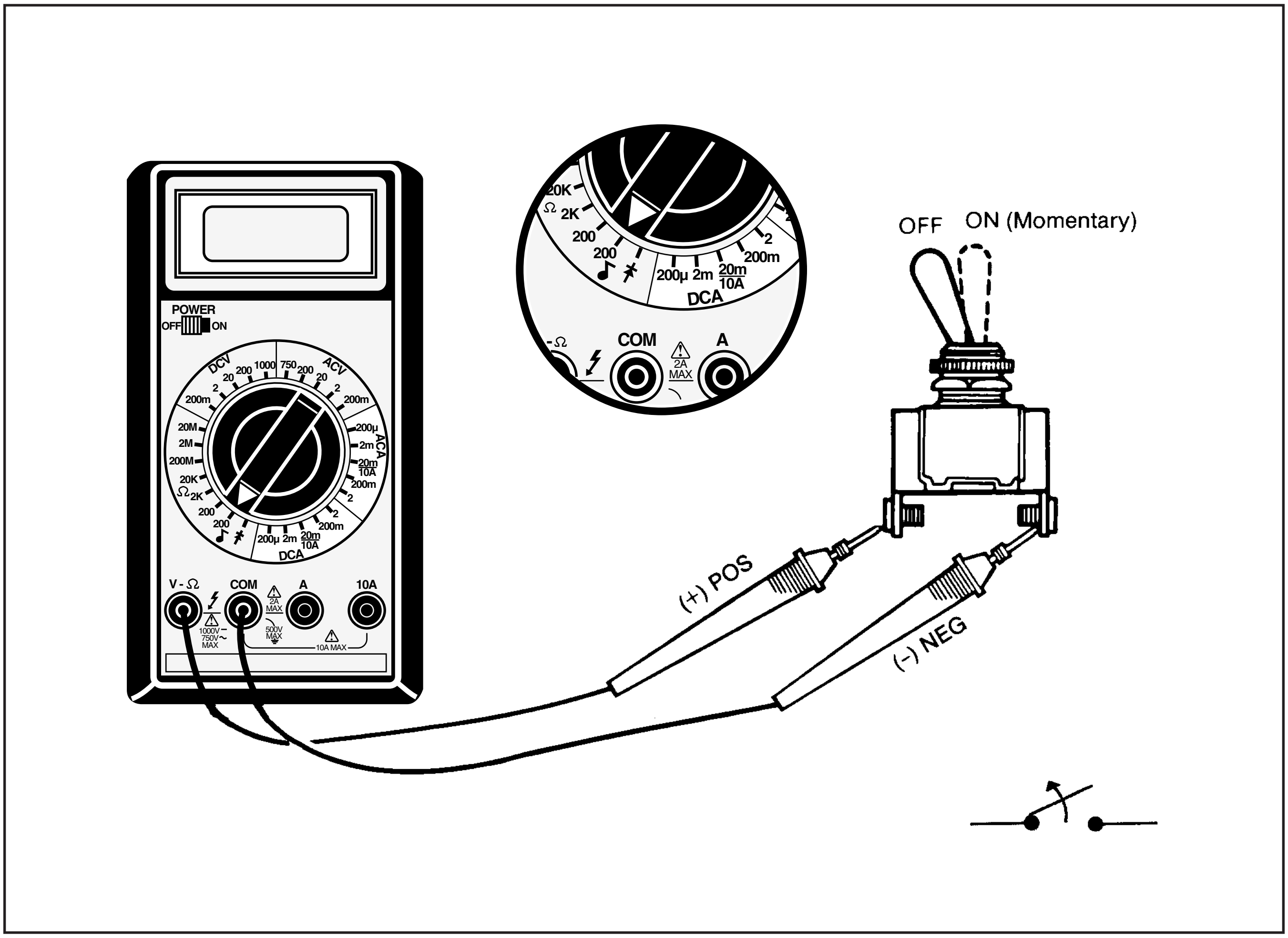


Figure 10G-11. Glow Plug Switch Test and Test Switch Test

SECTION 10G. SWITCHES

FRONT MOWER SHUT-OFF SWITCH (See Figure 10G-12)

The switch prevents operation of the mower when it is in the raised position.

1. Lower mower reels to the ground.
2. Disconnect wire connector at switch.
3. Set multimeter to 200 ♪ Ω (ohms) scale.
4. Connect multimeter test leads to switch terminals.
   - There should be a reading of 0–0.5 Ω (ohms) on the multimeter.
5. Lift and hold switch lever up in OFF position.
   - There should be no reading on the multimeter.

NOTE

Switch must be installed so that lever is engaged when mower arms are raised.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

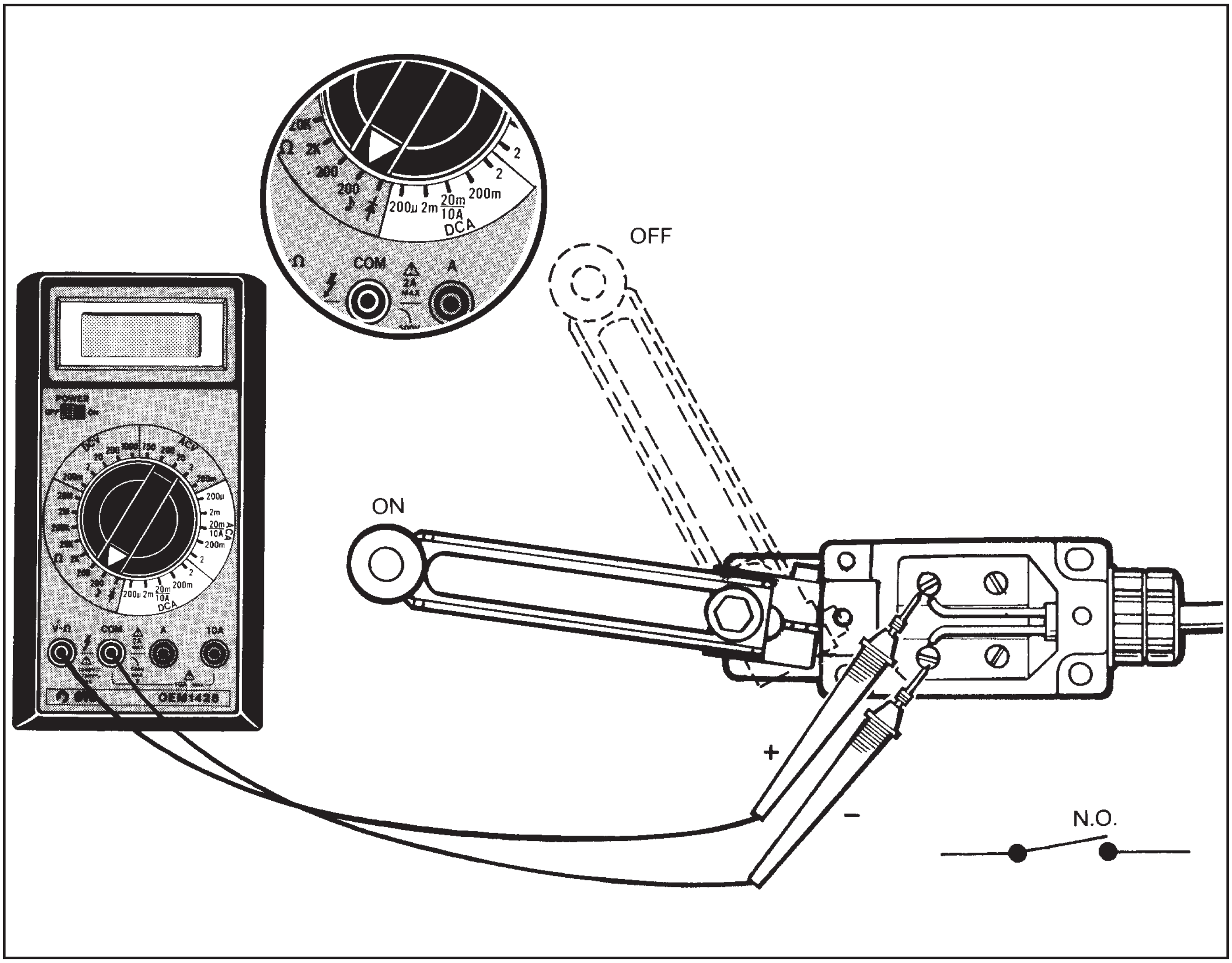


Figure 10G-12. Front Mower Shut-Off Switch

SECTION 10G. SWITCHES

BRAKE SWITCH TEST
WING MOWER SHUT-OFF SWITCH TEST
PARKING BRAKE SWITCH TEST
REVERSE SENSING SWITCH TEST (LATER) (See Figure 10G-13)

NOTE

Before testing, check to see if the switch is just out of adjustment. See Section 2C for adjustment procedures.

1. Remove the wires from the switch.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. Connect leads to switch as shown.
   - There should be no continuity through the switch.
4. Actuate switch (push button down).
   - There should be a reading of 0–0.5 Ω (ohms) at multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

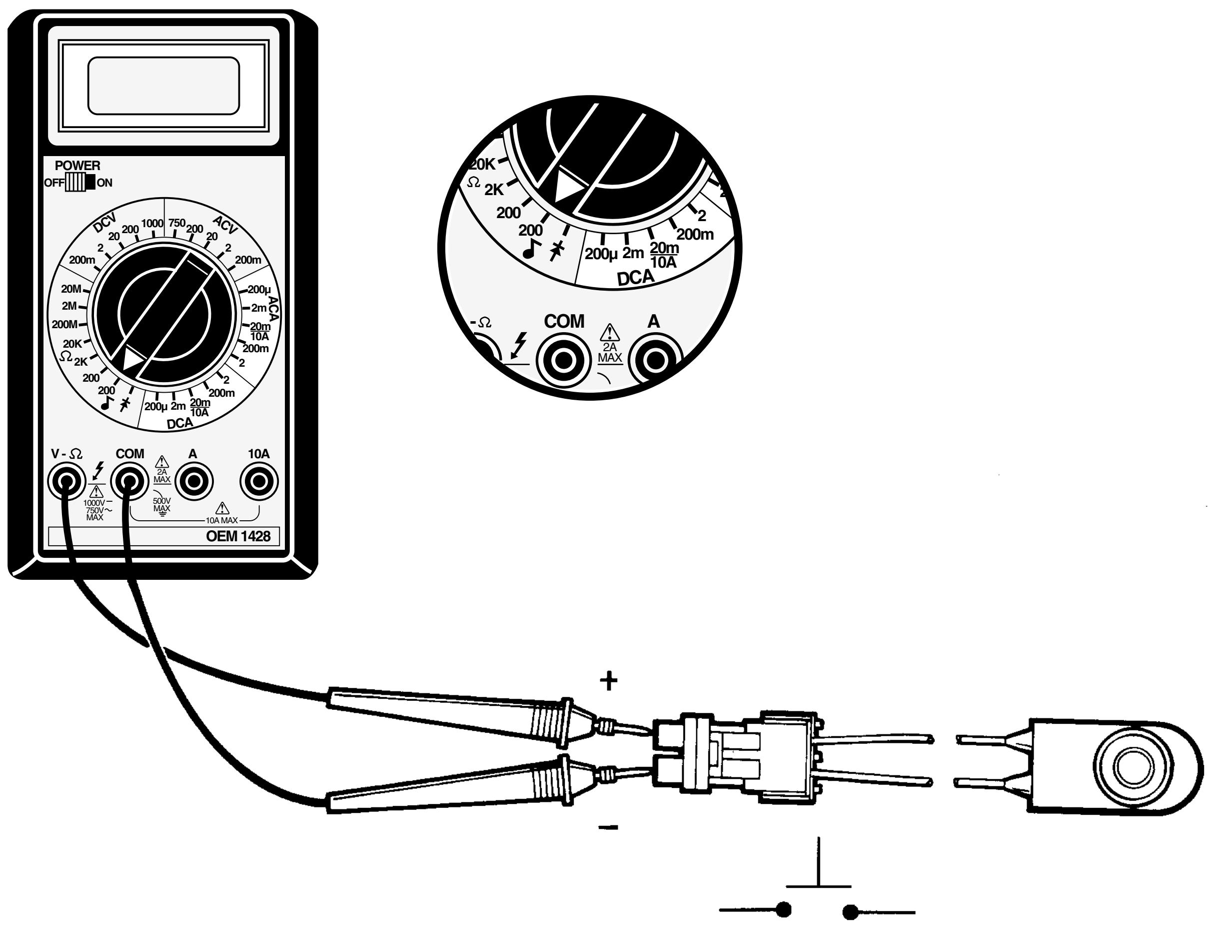


Figure 10G-13. Brake, Mower Shut-Off and Parking Brake Switch Test

SECTION 10G. SWITCHES

NEUTRAL AND REVERSE SENSING SWITCH TEST (See Figure 10G-14)

1. Disconnect ground cable at battery.
2. Identify (label) and disconnect electrical leads at switch.
3. Set multimeter to 200 ♪ Ω (ohms) scale.
4. Connect leads as shown.
   - There should be a reading on multimeter (continuity).
5. Depress switch lever.
   - There should be no reading at multimeter (no continuity).
6. Move test lead from NC to NO.
   - There should be no reading on the multimeter (no continuity).
7. Depress switch lever.
   - There should be a reading on multimeter (continuity).

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

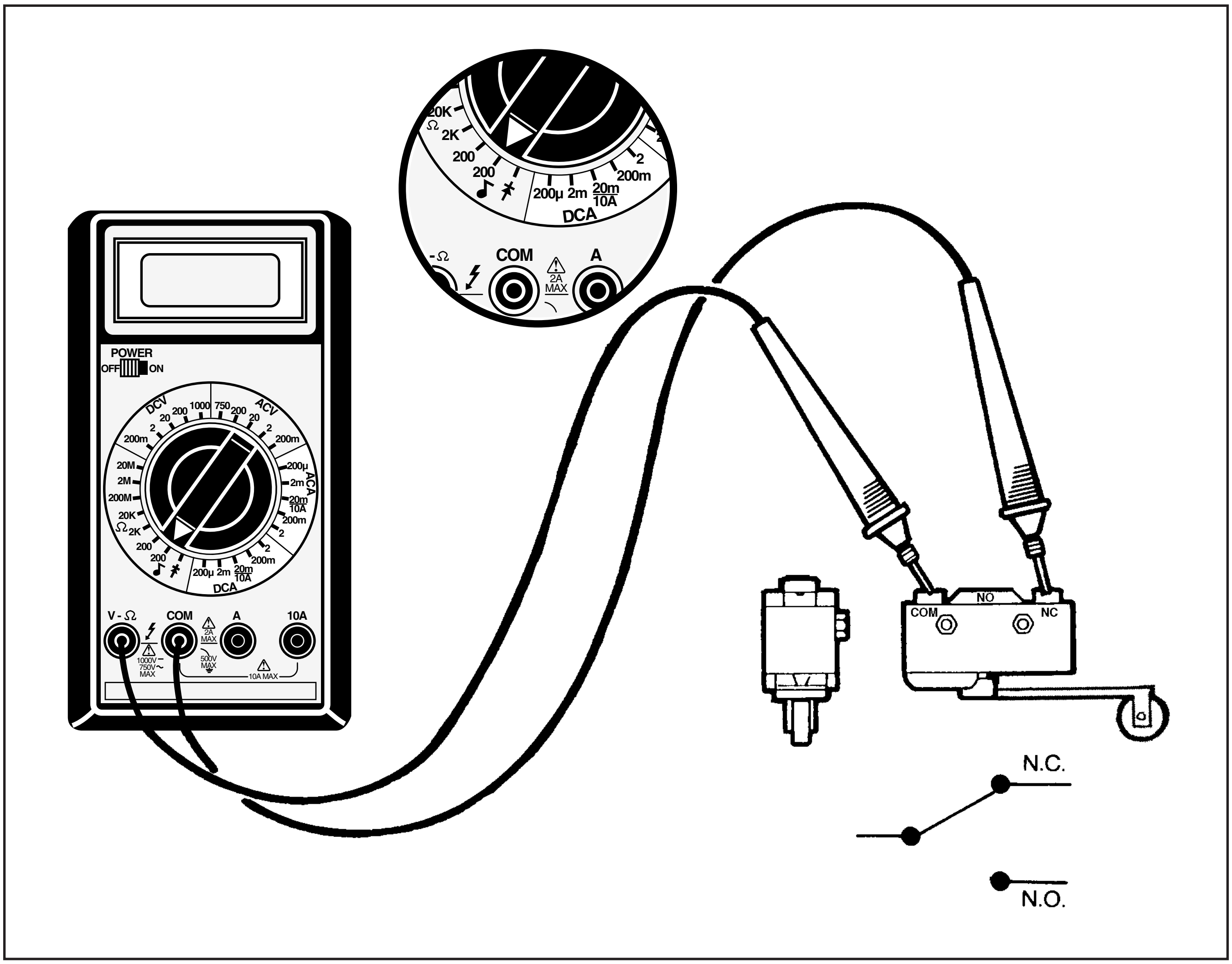


Figure 10G-14. Neutral and Reverse Switch Test

SECTION 10G. SWITCHES

HORN SWITCH TEST (See Figure 10G-15)

The horn switch sounds the tractor horn when the operator pushes on the switch. It also can be used to test the lights on the monitor panel.

1. Remove the plug from the switch.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. Connect leads to switch as shown.
   - There should be no continuity through the switch.
4. Depress switch.
   - There should be a reading of 0–0.5 Ω (ohms) at multimeter.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

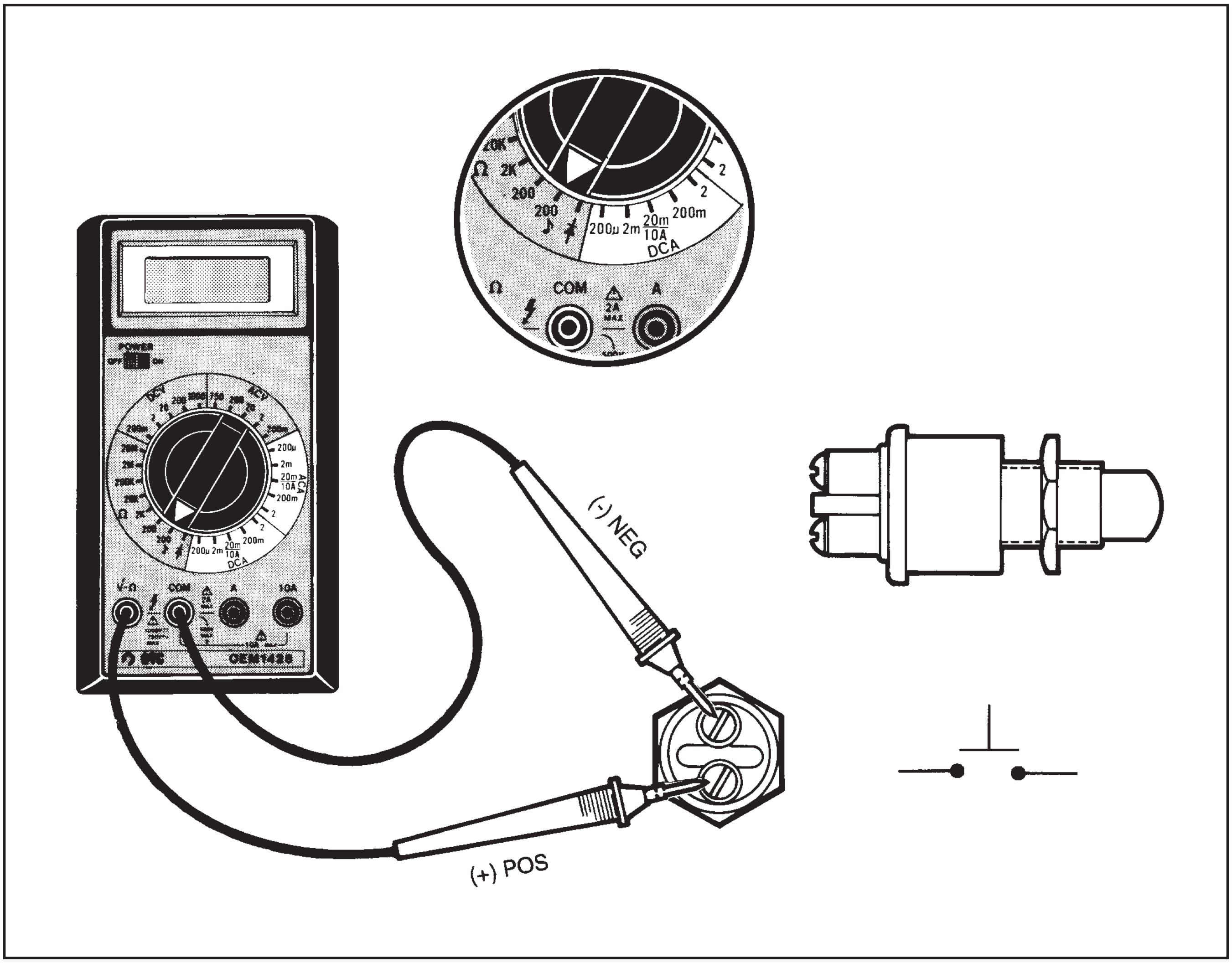


Figure 10G-15. Neutral Start Switch Test

SECTION 10G. SWITCHES

DIFFERENTIAL LOCK SWITCH TEST (See Figure 10G-16)

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect leads to switch plug as shown.
   - There should be no continuity through the switch.
3. Actuate switch (push switch in).
   - There should be a reading of 0–0.5 Ω (ohms) at multimeter.

NOTE

RED switch lead is not used.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

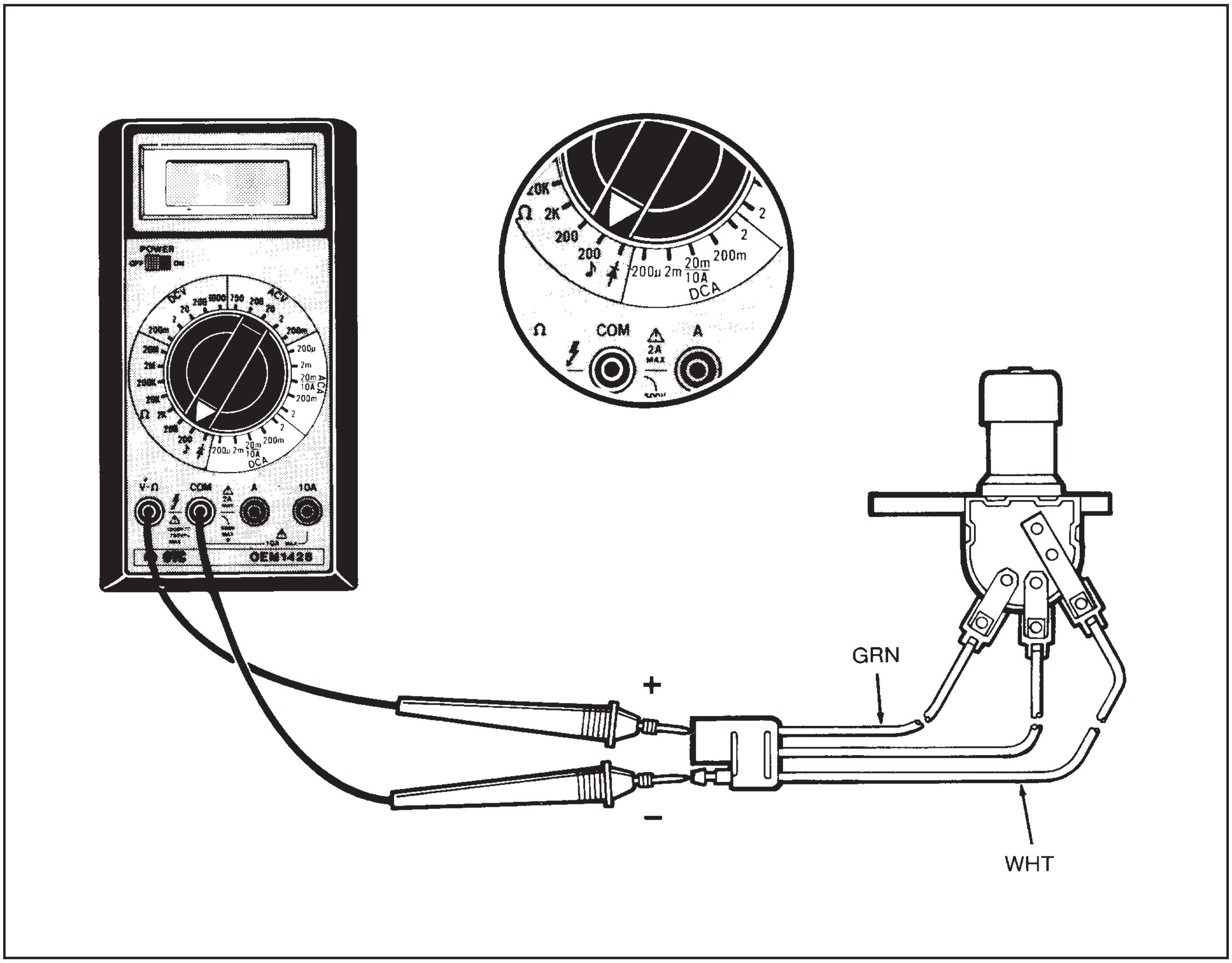


Figure 10G-16. Differential Lock Switch Test

SECTION 10G. SWITCHES

HYDRAULIC CHARGE PRESSURE SWITCH TEST (See Figure 10G-17)

The charge pressure switch is a normally CLOSED (NC) switch. When the ignition key is turned ON the hydraulic charge pressure light comes ON. When the engine is started and hydraulic charge pressure increases to 118–132 psi, the switch OPENS and the hydraulic charge pressure light goes OFF.

FIELD TEST

Hydraulic charge pressure light does not come on when ignition switch is turned ON.

At the switch, disconnect the plug. Using a jumper wire, jump across the contacts of the plug.

- Light comes on, proceed with switch test, Step 1.
- Light does not come on, check circuit wiring and/or bulb.

Hydraulic charge pressure light does not go off when engine is started.

At the switch, disconnect the plug.

- Light goes off, proceed with switch test, Step 1.
- Light does not go off, check circuit wiring ground.

SWITCH TEST

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect test leads as shown.
   - There should be continuity and the meter should read 0–0.5 Ω (ohms).
3. Increase pressure to 118–132 psi.
   - Switch contacts should open.

NOTE

If switch tests okay and the hydraulic charge pressure light still does not go out, hydraulic system charge pressure may be too low.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

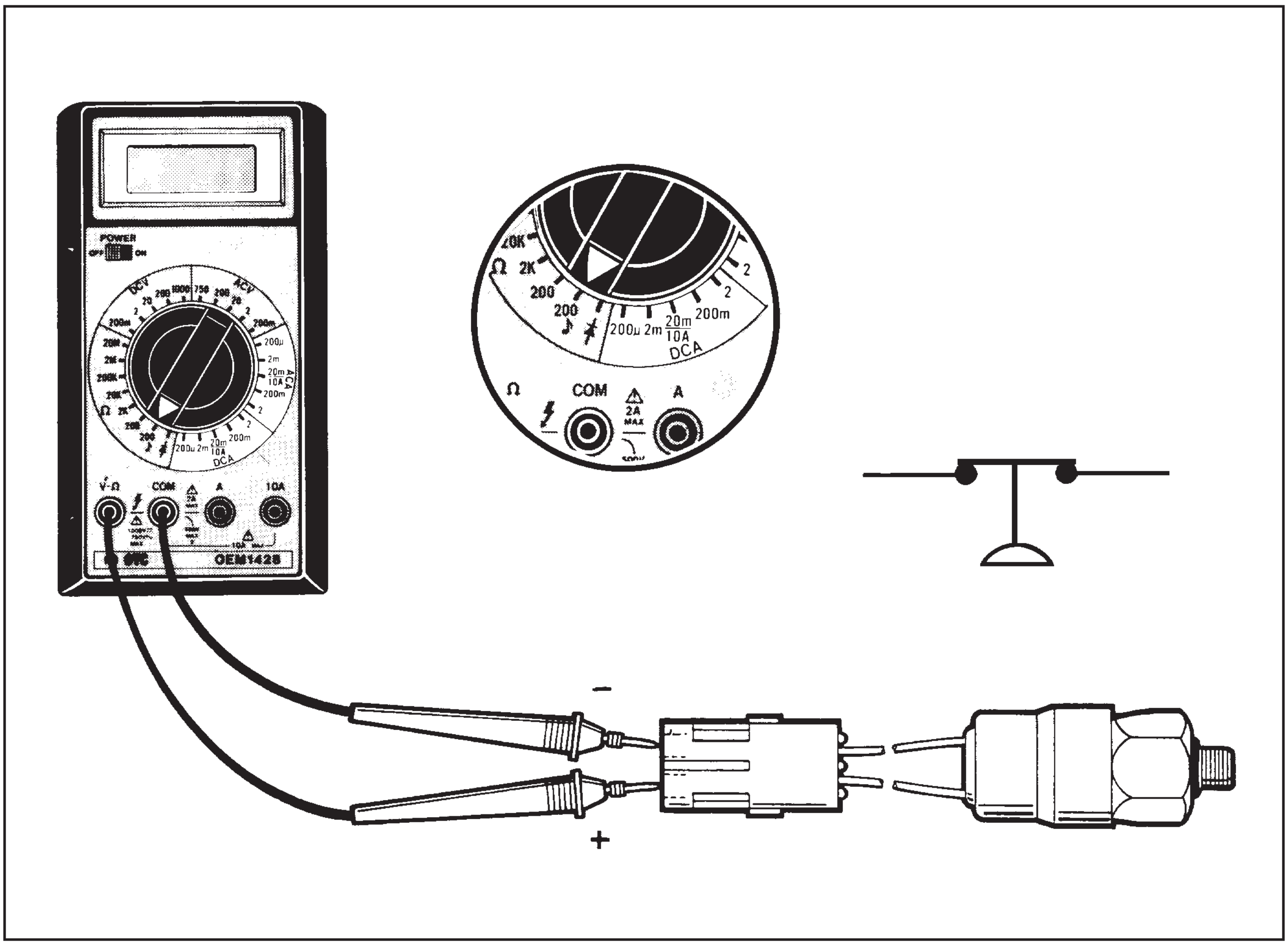


Figure 10G-17. Hydraulic Charge Pressure Switch Test

SECTION 10G. SWITCHES

HYDRAULIC CHARGE FILTER SWITCH TEST (See Figure 10G-18)

The charge filter switch is a normally OPEN (NO) switch. When the hydraulic oil pressure at the inlet of the charge oil filter increases above 20 psi the switch CLOSES and the hydraulic charge filter light comes ON.

FIELD TEST

At the switch, remove both wires from switch and connect together.

- Light comes on, proceed with switch test, Step 1.
- Light does not come on, check circuit wiring and/or bulb.

Charge filter light comes ON when ignition switch is turned on and stays ON when engine is started.

Remove BLU wire from switch terminal.

- Light goes off, proceed with switch test, Step 1.
- Light does not go off, check circuit wiring for ground.

SWITCH TEST

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect test leads as shown.
   - There should be no continuity and the meter should read 0–0.5 Ω (ohms).
3. Increase pressure above 20 psi.
   - Switch contacts should close.

NOTE

If switch tests okay and the charge filter light still does not go out, charge filter should be changed.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

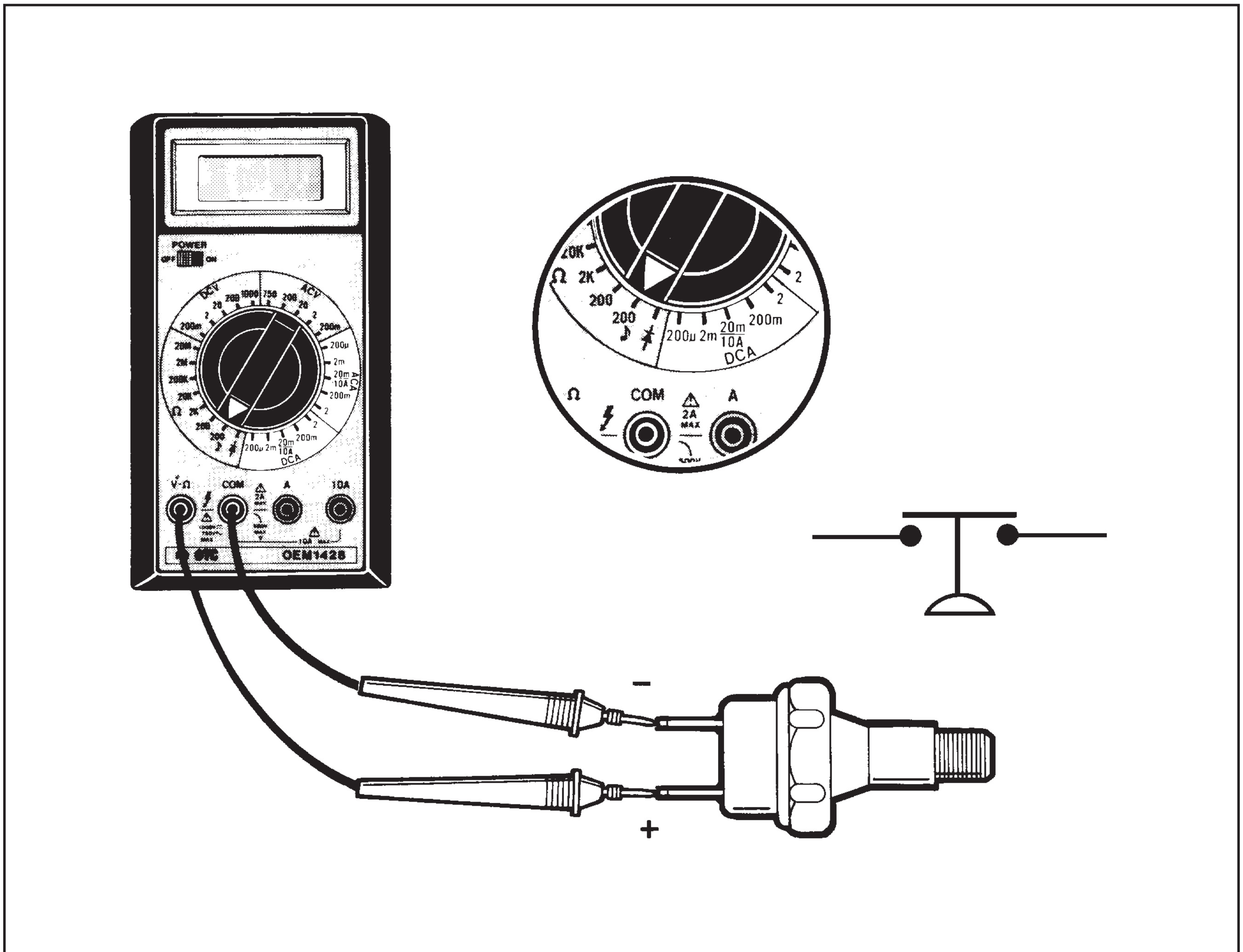


Figure 10G-18. Hydraulic Charge Filter Switch Test

SECTION 10G. SWITCHES

HYDRAULIC RETURN OIL FILTER SWITCH TEST (See Figure 10G-19)

The hydraulic return oil filter switch is a normally OPEN (NO) switch. When the hydraulic oil pressure at the inlet of the filter increases above 20–25 psi the switch CLOSES and the hydraulic oil filter light comes ON.

FIELD TEST

At the switch, remove both wires from switch and connect together.

- Light comes on, proceed with switch test, Step 1.
- Light does not come on, check circuit wiring and/or bulb.

Hydraulic oil filter light comes ON when ignition switch is turned on and stays ON when engine is started.

Remove TAN wire from switch terminal.

- Light goes off, proceed with switch test, Step 1.
- Light does not go off, check circuit wiring for ground.

SWITCH TEST

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect test leads as shown.
   - There should be no continuity and the meter should read 0–0.5 Ω (ohms).
3. Increase pressure above 20–25 psi.
   - Switch contacts should close.

NOTE

If switch tests okay and the hydraulic return oil filter light still does not go out, hydraulic filter should be changed.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

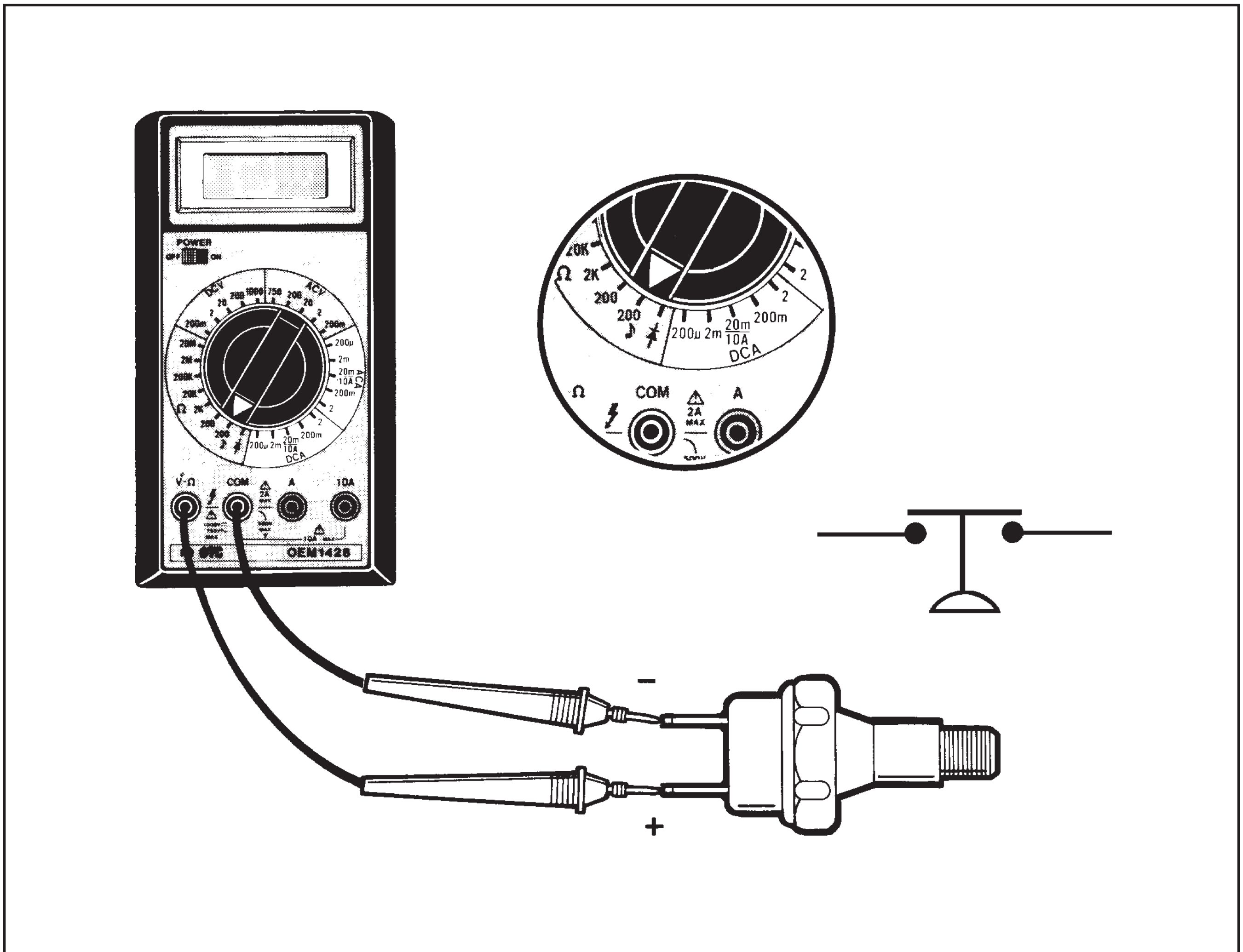


Figure 10G-19. Hydraulic Return Oil Filter Switch Test

SECTION 10G. SWITCHES

ENGINE OIL PRESSURE SWITCH TEST (See Figure 10G-20)

The engine oil pressure switch is a normally CLOSED (NC) switch. When the ignition key is turned ON the engine oil pressure light comes on. When the engine is started and oil pressure increases above 10 psi, the switch OPENS and the engine oil pressure light goes OFF.

FIELD TEST

Engine oil pressure light does not come on when ignition switch is turned ON.

Using a jumper wire, ground the switch terminal.

- Light comes on, proceed with switch test, Step 1.
- Light does not come on, check circuit wiring and/or bulb.

Engine oil pressure light does not go off when engine is started.

Remove BLU wire from switch terminal.

- Light goes off, proceed with switch test, Step 1.
- Light does not go off, check circuit wiring for ground.

SWITCH TEST

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect test leads as shown.
   - There should be no continuity and the meter should read 0–0.5 Ω (ohms).
3. Increase pressure above 10 psi.
   - Switch contacts should close.

NOTE

If switch tests okay and the engine oil pressure light still does not go out, engine oil pressure may be too low.

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

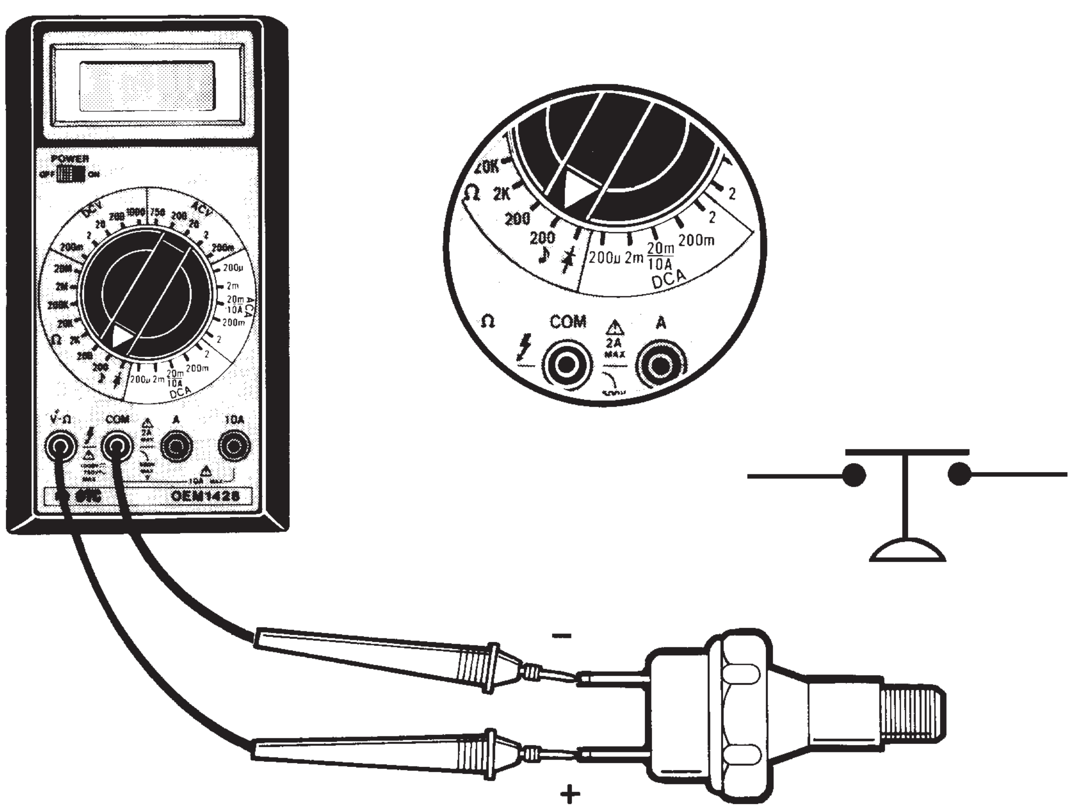


Figure 10G-20. Engine Oil Pressure Switch Test

SECTION 10G. SWITCHES

HYDRAULIC OIL TEMPERATURE ENGINE COOLING WATER TEMPERATURE SWITCH TEST (See Figure 10G-21)

The temperature switch is a normally OPEN (NO) switch. When the cooling water reaches 230°F (110°C) the switch will close.

FIELD TEST

Using a jumper wire, remove the GRN wire and ground it. Turn the ignition switch ON.

- An audible horn and the engine water temperature light comes on, proceed with switch test, Step 1.
- Horn and/or engine water temperature light does not come on. Check circuit wiring and/or bulb.

SWITCH TEST

1. Using a suitable container, fill it with engine or hydraulic oil.
2. Heat the oil to 230°F (110°C).
3. Set multimeter to 200 ♪ Ω (ohms) scale.
4. Connect test leads as shown.
   - There should be no continuity through switch.
5. Slowly emerge switch into the heated oil.
   - Switch contacts should close, there should be a reading of 0–0.5 Ω (ohms).

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

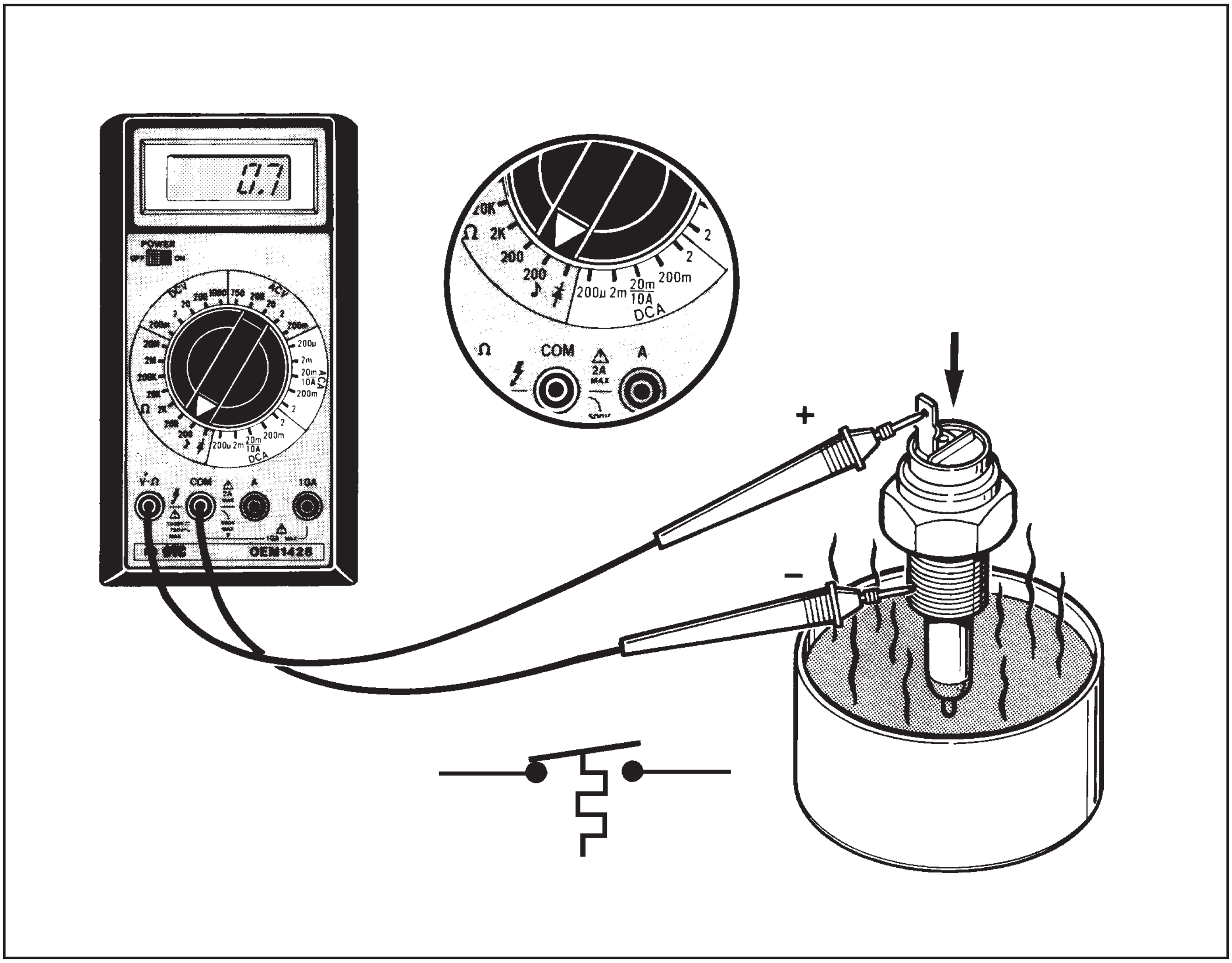


Figure 10G-21. Engine Cooling Water Temperature Switch Test

SECTION 10G. SWITCHES

AIR CLEANER SERVICE INDICATOR SWITCH TEST (See Figure 10G-22)

The air cleaner service indicator switch is a normally OPEN (NO) switch. When the air filter becomes restricted and 25" H_2O of vacuum is reached, the switch will close.

FIELD TEST

Using a jumper wire, remove both the BLU/WHT and BLK wire and connect them together.

- Air filter light comes ON, proceed with switch test, Step 1.
- Air filter light does not come on, check circuit wiring and/or bulb.

SWITCH TEST

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect test leads as shown.
   - There should be no continuity through switch.
3. Draw 25" H_2O vacuum on switch, switch contacts should close, there should be a reading of 0–0.5 Ω (ohms).

Replace a switch that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

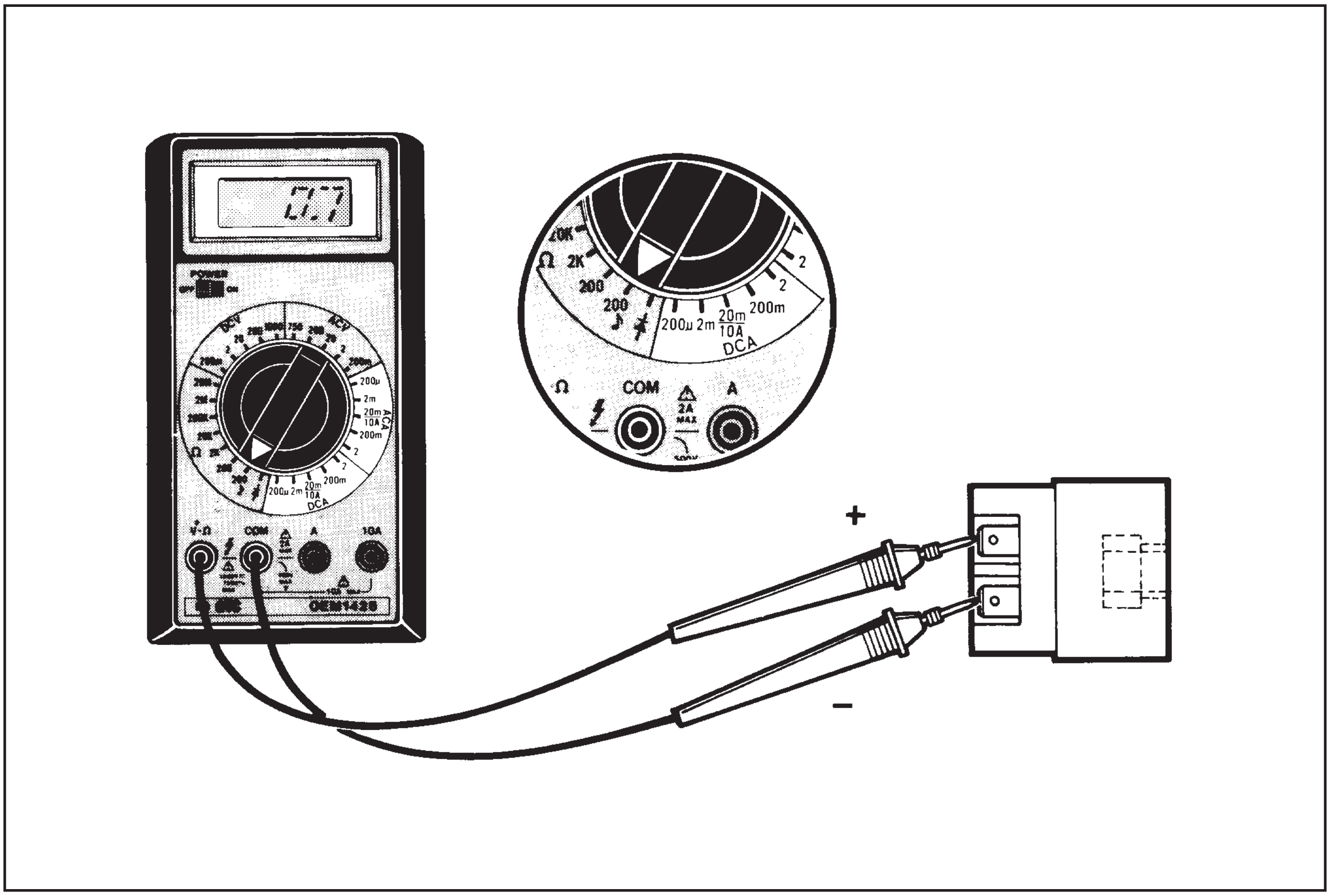


Figure 10G-22. Air Cleaner Service Indicator Switch Test

SECTION 10G. SWITCHES

IMPLEMENT (MOWER) SWITCH TEST (See Figure 10G-23)

1. Disconnect switch connectors.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. With switch in OFF position, test as follows:
   a. Connect one multimeter test lead to terminal 4 and the other lead to 5.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

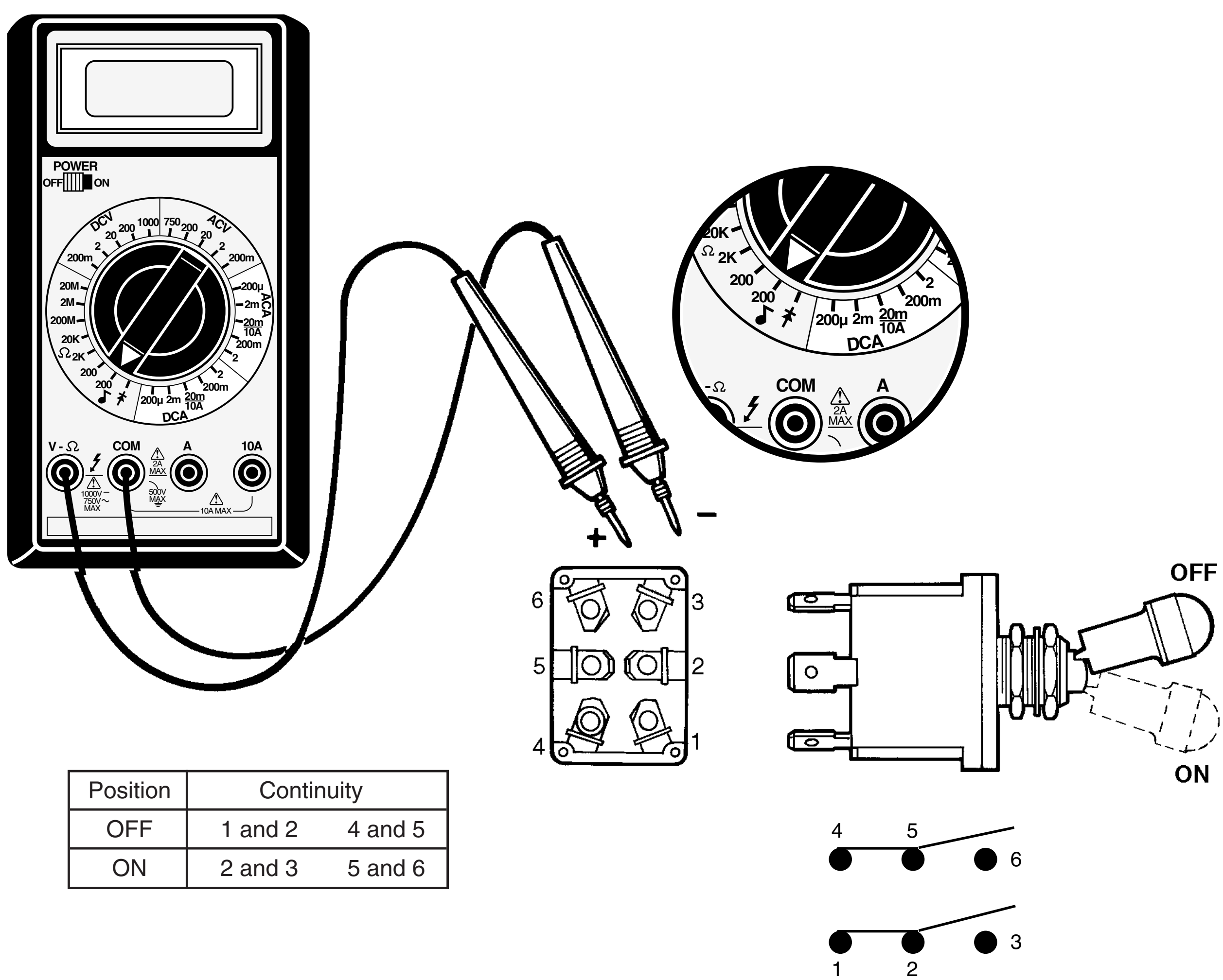
   b. Connect one multimeter test lead to terminal 2 and the other to terminal 1.
      - There should be 0–0.5 on the multimeter.

   c. Check for continuity across all remaining combinations of terminals (with switch in the OFF position).
      - There should be no reading on the multimeter.
4. Place switch in ON position and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal 5 and the other to terminal 6.
      - There should be 0–0.5 Ω (ohms) on the multimeter.

   b. Connect one multimeter test lead to terminal 2 and the other lead to terminal 3.

   c. Check for continuity across all remaining combinations of terminals (with switch in the ON position).
      - There should be no reading on the multimeter.

Replace a switch that does not meet all the above tests.



Position	Continuity	
OFF	1 and 2	4 and 5
ON	2 and 3	5 and 6

Figure 10G-23. Implement (Mower) Switch Test

SECTION 10H. RELAY

ENGINE (FUEL) SOLENOID
HORN
CRUISE ENGAGE
CAB (See Figure 10H-1)

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect red POS (+) lead to one of the terminals 87, then to the second terminal 87.
3. Connect black NEG (–) lead from multimeter to terminal 30.
   - There should be no continuity on both terminals 87. If there is continuity, replace relay.
4. Connect 12V across terminals 85 and 86. There should be an audible “click”.
5. Connect black NEG (–) lead from the multimeter to terminal 30.
6. Connect red POS (+) lead from the multimeter to one of the terminals 87, then to the second terminal 87.
   - There should be continuity on both terminals 87. If there is no continuity, replace relay.

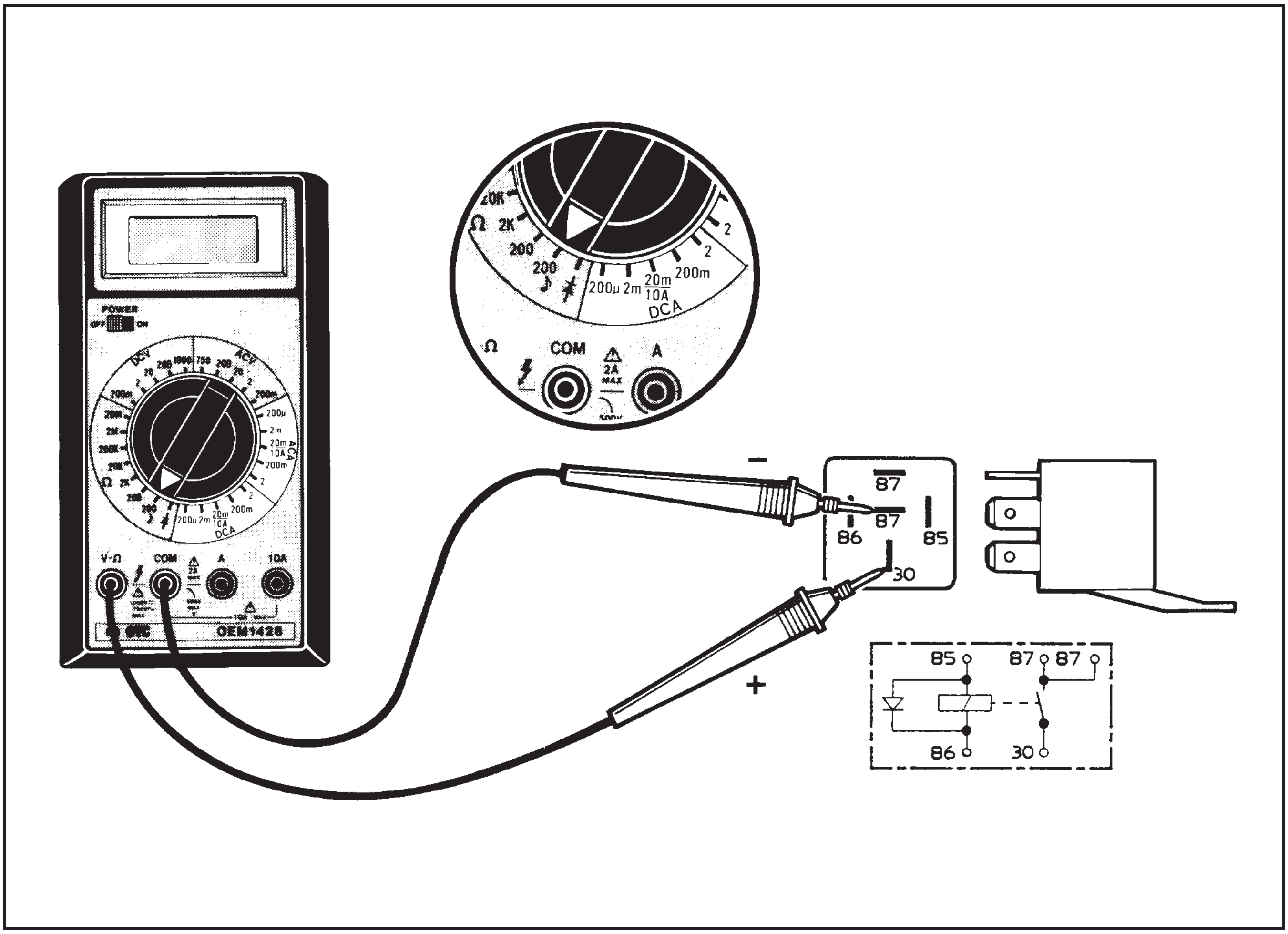


Figure 10H-1. Relay Test

10H

SECTION 10H. RELAY

CRUISE DISENGAGE (BRAKE RELAY) (See Figure 10H-2)

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect black NEG (–) lead from multimeter to terminal 30.
3. Connect red POS (+) lead from multimeter to terminal 87a.
   - There should be continuity. If there is no continuity, replace relay.
4. Move the red lead to terminal 87.
   - There should be no reading on multimeter (no continuity). If there is a reading, replace relay.
5. Connect 12V across terminals 85 and 86. There should be an audible “click”.
6. Connect black NEG (–) lead from multimeter to terminal 30.
7. Connect red POS (+) lead from multimeter to terminal 87a.
   - Open when coil is energized.
8. Move red lead to terminal 87.
   - Closed when coil is energized.

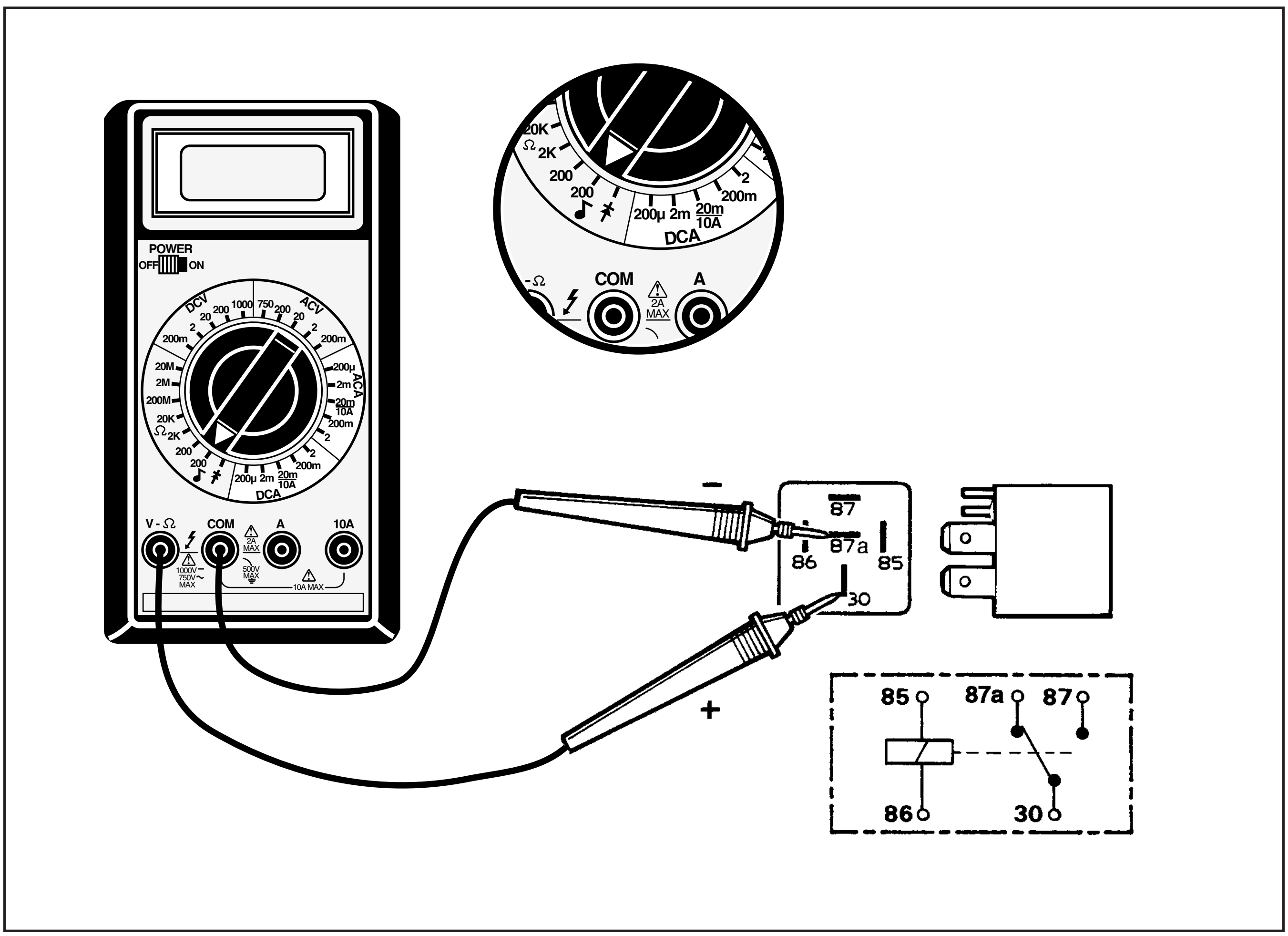


Figure 10H-2. Brake Relay Test

SECTION 10H. RELAY

SEAT DELAY RELAY TEST (See Figure 10H-3)

1. Connect white and brown wires to +12 VDC (Bat).
2. Leave black wire grounded or connect to BAT NEG (–) terminal, if relay is removed from machine.
3. Set DMM to 20 VDC.
4. Connect red lead from DMM to yellow wire and black lead to ground NEG (–) terminal at battery.
   - The DMM should read 12 volts. If not, replace relay.
5. Disconnect white wire from +12V (Bat).
   - After a 1 to 2 second delay, voltage reading on DMM should drop out, if not, replace relay.

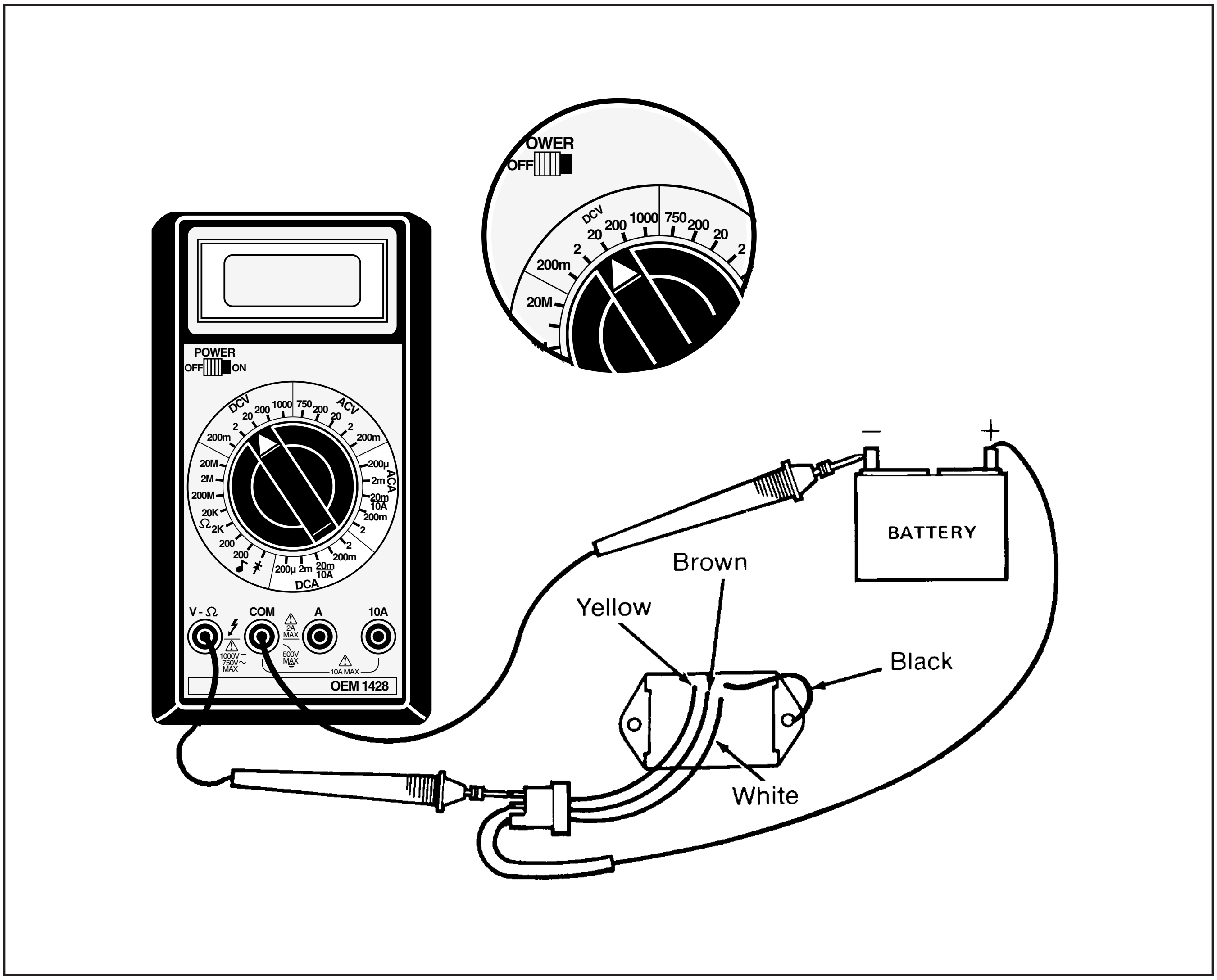


Figure 10H-3. Seat Delay Relay Test

SECTION 10I. SOLENOIDS

FUEL SOLENOID (See Figure 10I-1)

When the ignition switch is turned to the START position, the solenoid plunger retracts approximately 1" (25.4 mm). This opens the fuel system. With the plunger retracted there should be a gap between the lever and top.

TEST

Solenoid does not retract when ignition switch is turned to start.

1. Disconnect solenoid plug.
2. Set multimeter to 20 VDC range.
3. Connect black NEG (–) lead of multimeter to terminal of BLK wire.
4. Connect red POS (+) lead of multimeter to terminal of RED wire, turn ignition switch ON.
   - If multimeter reads battery voltage, tractor wiring is okay, proceed with Step 5.
   - If battery voltage is not present, check wiring for an open or high resistance.
5. Connect red POS (+) lead of multimeter to terminal of WHT wire.
   - No voltage should register, proceed with Step 6.
   - If battery voltage is present, fuel solenoid relay may be faulty.
6. Turn and hold ignition switch in the START position.
   - Multimeter should read battery voltage if tests are okay, fuel solenoid may be faulty.
   - If low or no voltage registers, check that fuel solenoid relay and/or wiring for high resistance or opens.

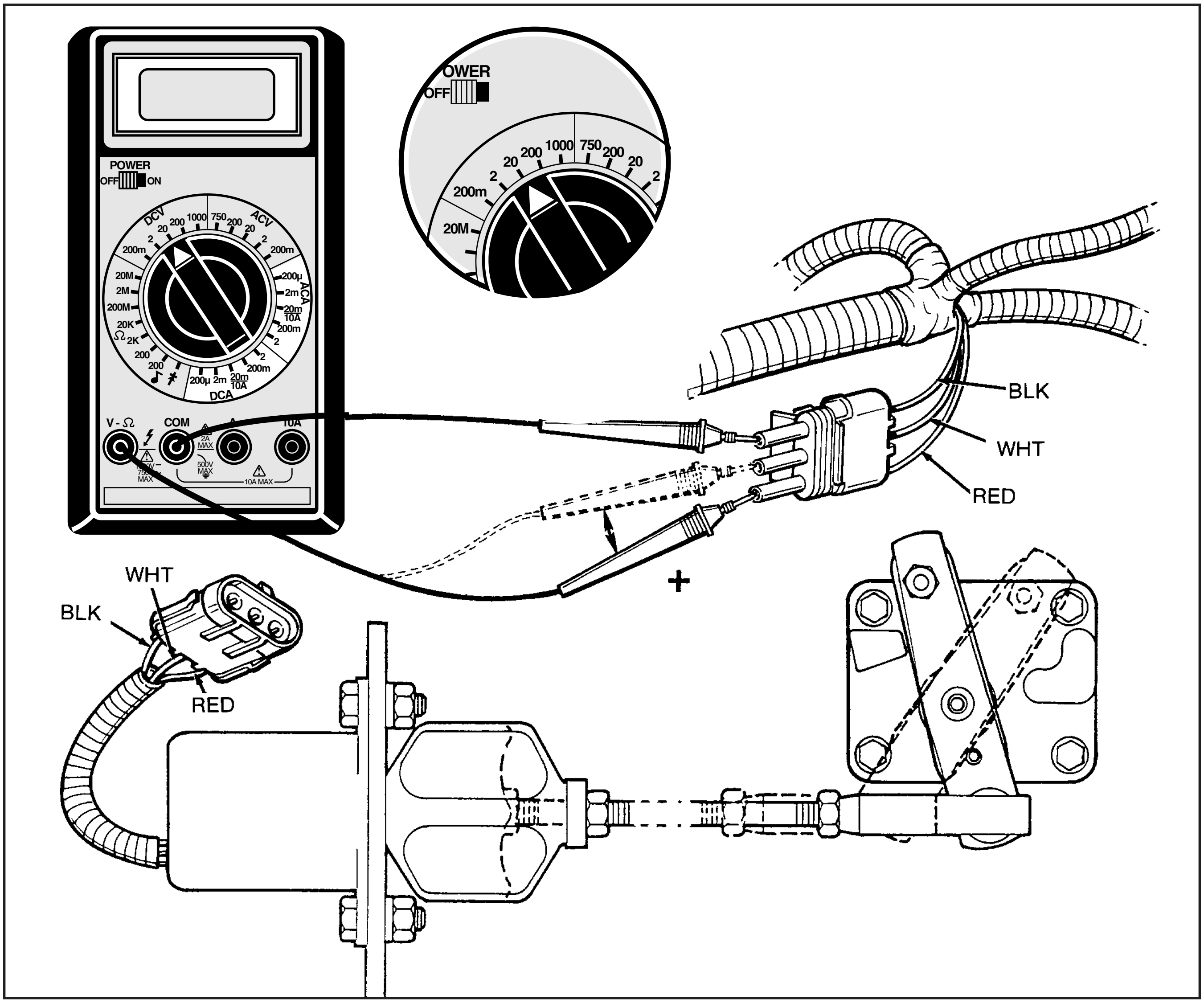


Figure 10I-1. Fuel Solenoid Test

SECTION 10I. SOLENOIDS

ADJUSTMENT (See Figure 10I-2)

1. Disconnect solenoid rod at lever.
2. Turn ignition switch to START momentarily without starting engine. This will seat solenoid plunger. Leave ignition switch in RUN position.
3. Adjust and connect rod at stop lever as necessary so that there is a gap between lever and stop with solenoid engaged.
4. After adjustment, turn ignition switch to OFF.

NOTE

If not adjusted properly, solenoid will not “hold in” when ignition switch is returned to the run position after starting.

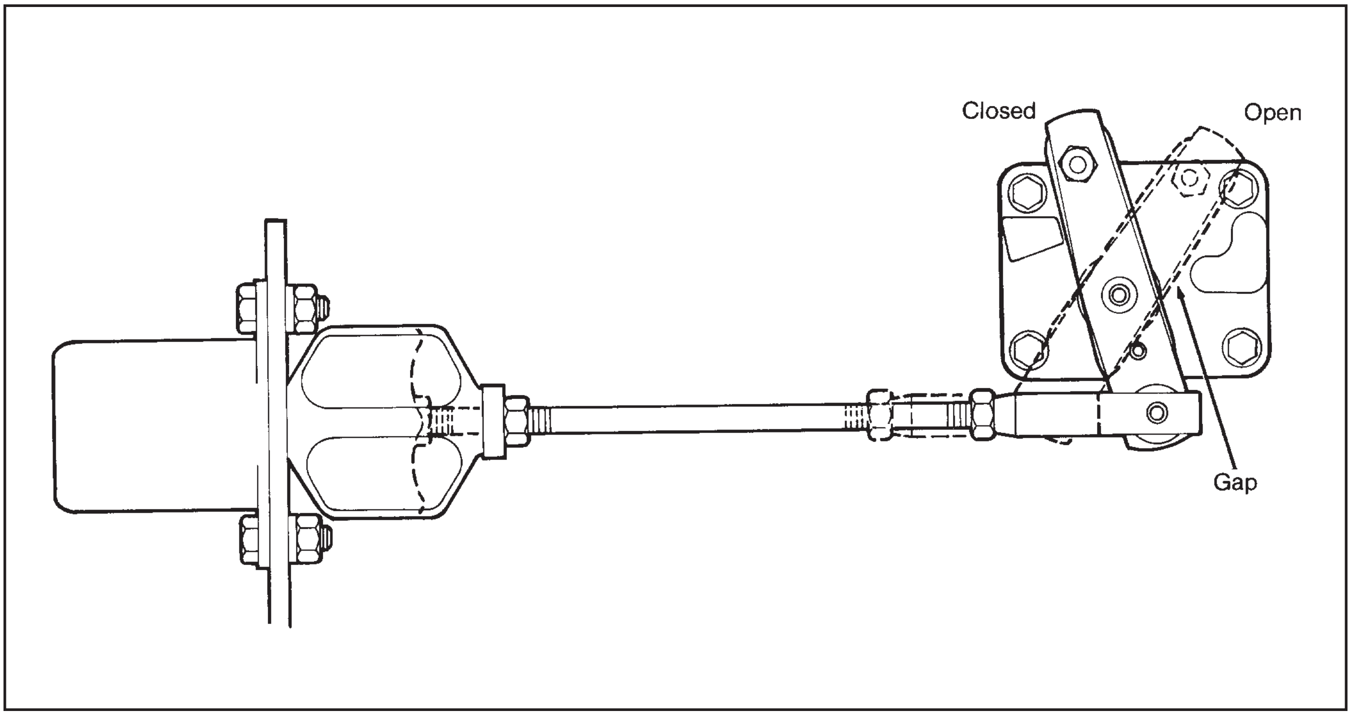


Figure 10I-2. Fuel Solenoid Adjustment

SECTION 10I. SOLENOIDS

DIFFERENTIAL LOCK 4 WHEEL DRIVE (See Figure 10I-3)

1. Energize the solenoid.
2. Notice if the LED (light emitting diode) is lit.
   - If LED is lit, proceed with Step 3.
   - If LED does not light, check interlock switches and wiring.
3. Remove the Hirshman connector from solenoid.
4. Set multimeter to 20 VDC range.
5. Connect black NEG (–) multimeter lead to connector as shown.
6. Connect red POS (+) lead of multimeter to connector as shown.
   - Multimeter reads battery voltage, coil may be faulty, proceed with Step 7.
   - Low or no voltage, check for high resistance or opens in wiring and/or interlock switch.

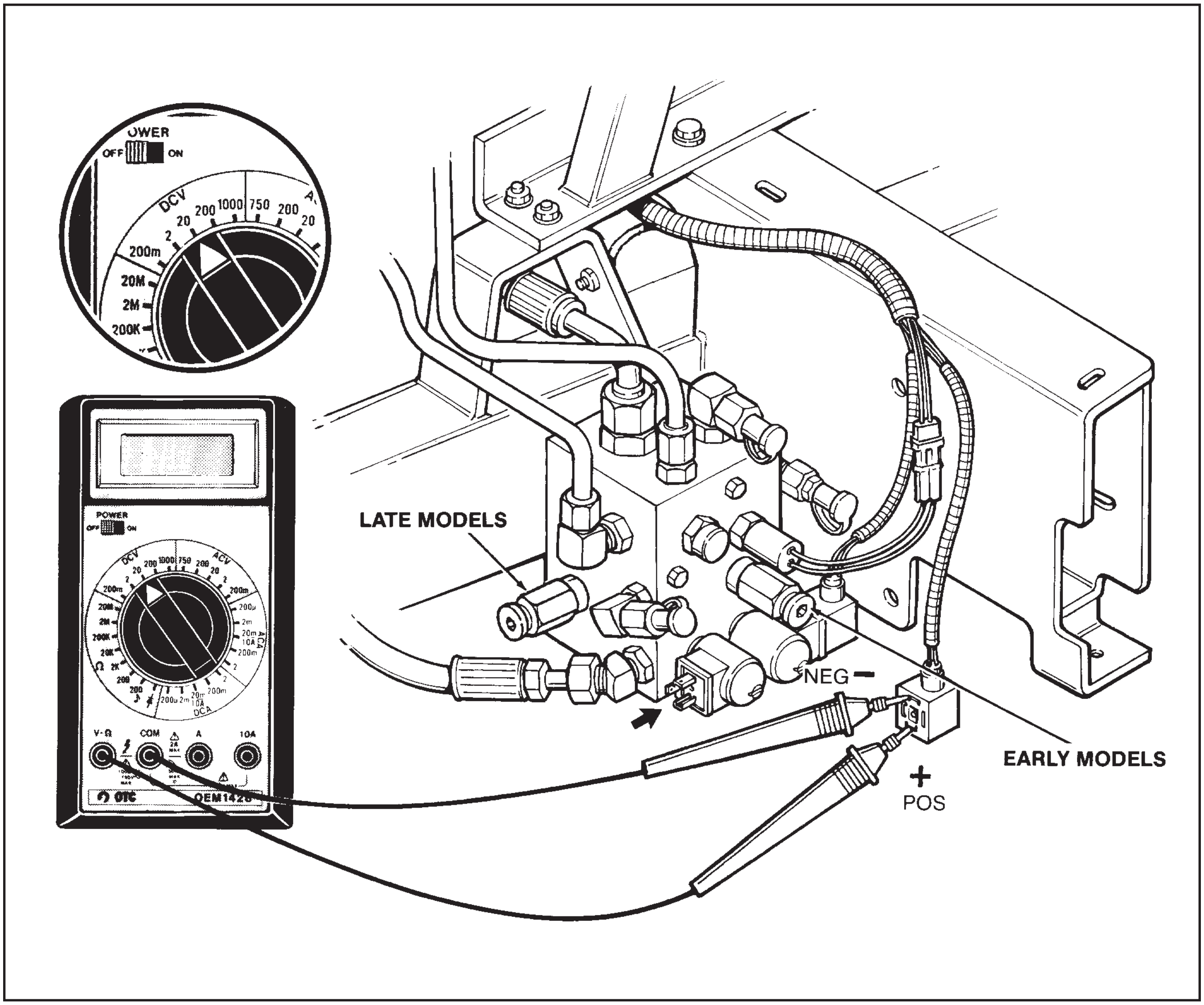


Figure 10I-3. Solenoid Plug Test

SECTION 10I. SOLENOIDS

(See Figure 10I-4)

7. Set multimeter to 200 ♪ Ω (ohms) range.
8. Connect multimeter leads to coil as shown.

- Coil Ω (ohms) reading should be approximately 10 Ω (ohms) if reading is correct. Valve cartridge may be faulty.
- Coil Ω (ohm) reading not to specification, change coil.

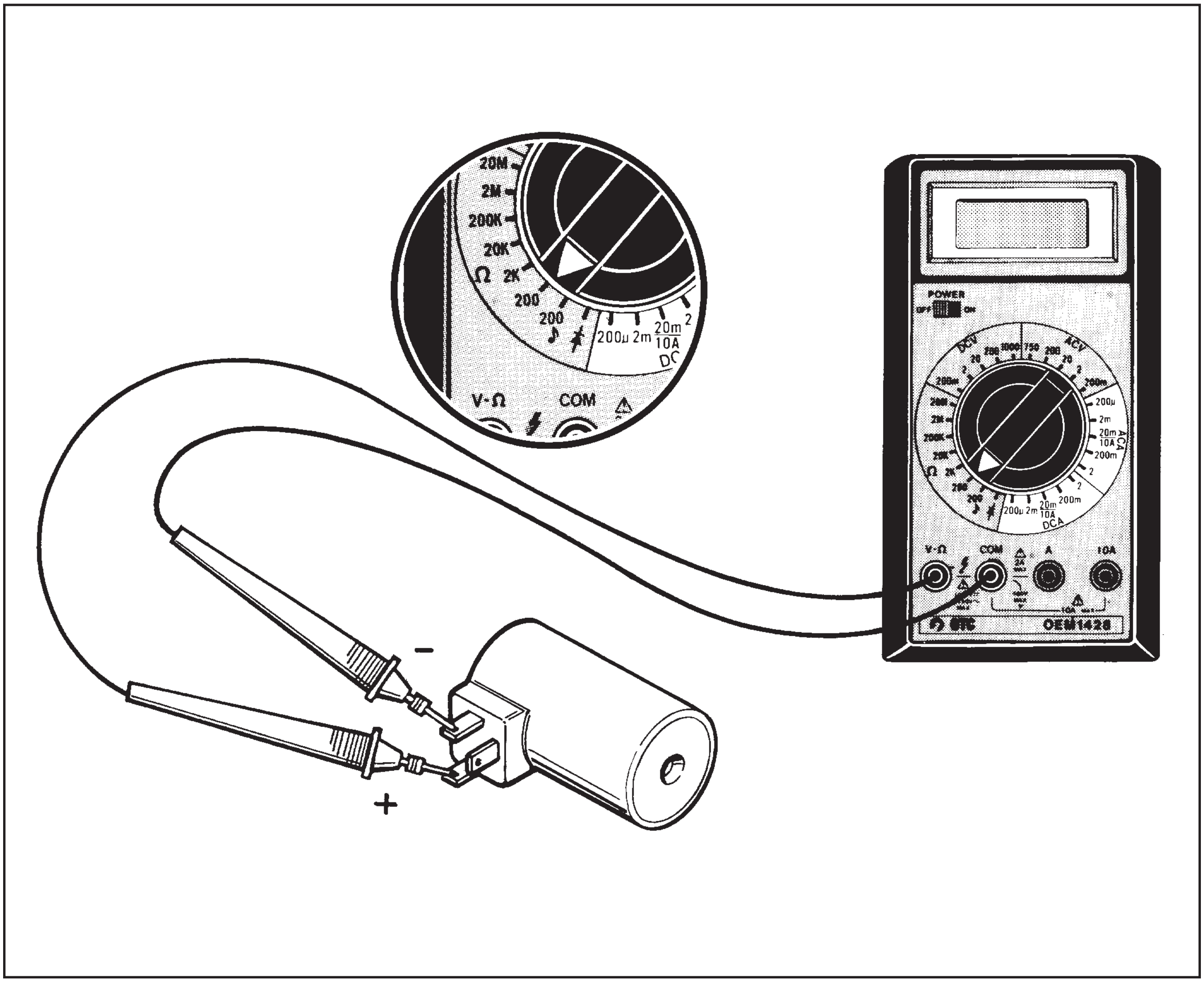


Figure 10I-4. Solenoid Coil Test

SECTION 10I. SOLENOIDS

GLOW PLUG SOLENOID TEST (See Figure 10I-5)

1. Connect a 12 VDC battery to terminals 1 and 2.
   - There should be an audible “click”.
2. Set multimeter to 200 ♪ Ω (ohms) scale.
3. Connect multimeter test leads to terminals 3 and 4.
   - Multimeter reading should be less than 0.5 Ω (ohms).

Replace a solenoid that does not meet all the above test results or has resistance of 0.5 Ω (ohms) or more.

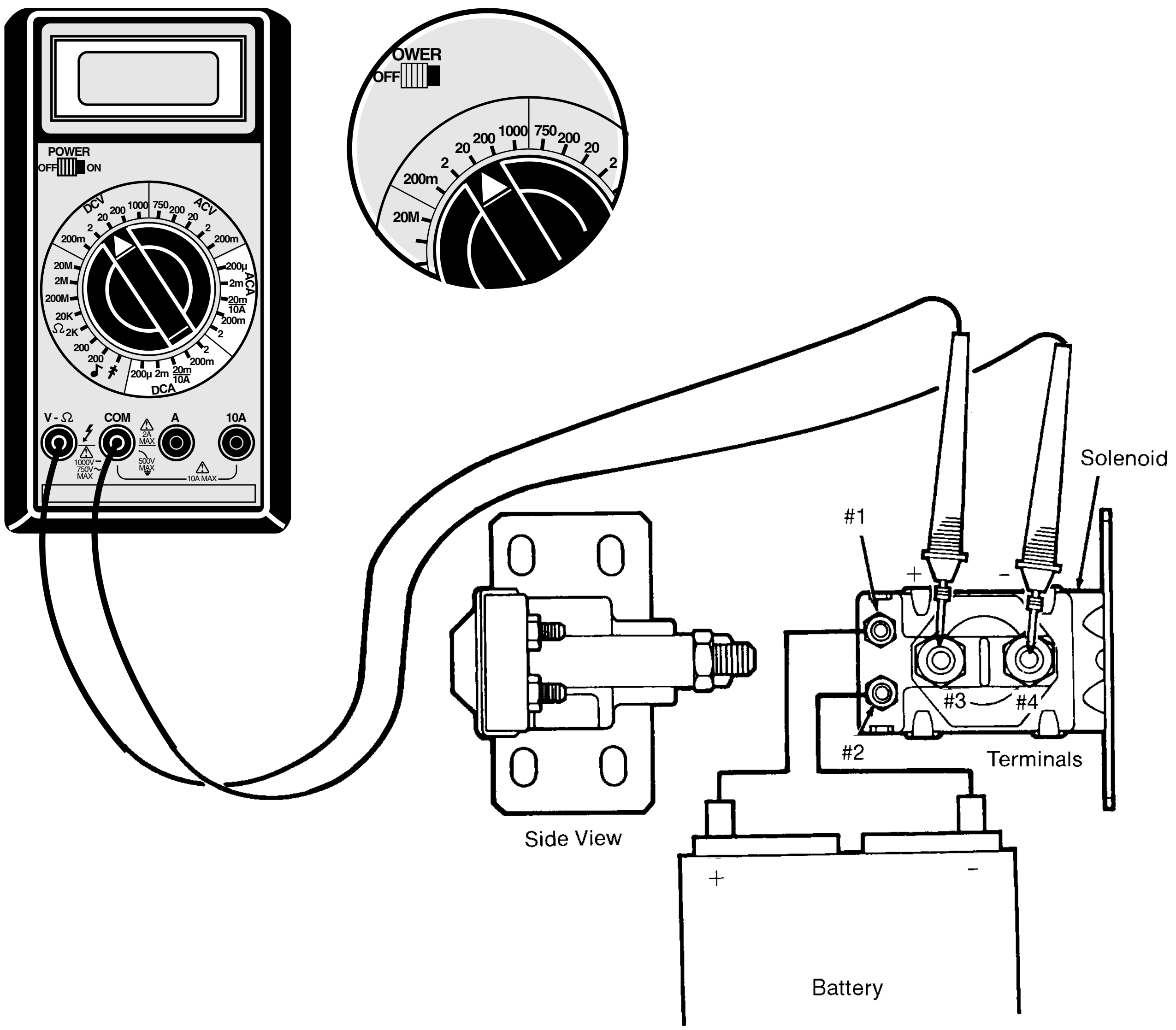


Figure 10I-5. Glow Plug Solenoid Test

SECTION 10I. SOLENOIDS

DECK MOTOR VALVE SOLENOID (See Figure 10I-6)

1. Energize the solenoid.
2. Notice of the LED (light emitting diode) is lit.
   - If LED is lit, proceed with Step 3.
   - If LED does not light, check interlock switches and wiring.
3. Remove the Hirshman connector from solenoid.
4. Set multimeter to 20 VDC range.
5. Connect black NEG (–) multimeter lead to connector as shown.
6. Connect red POS (+) lead of multimeter to connector as shown.
   - Multimeter reads battery voltage, coil may be faulty, proceed with Step 7.
   - Low or no voltage, check for high resistance or opens in wiring and/or interlock switch.

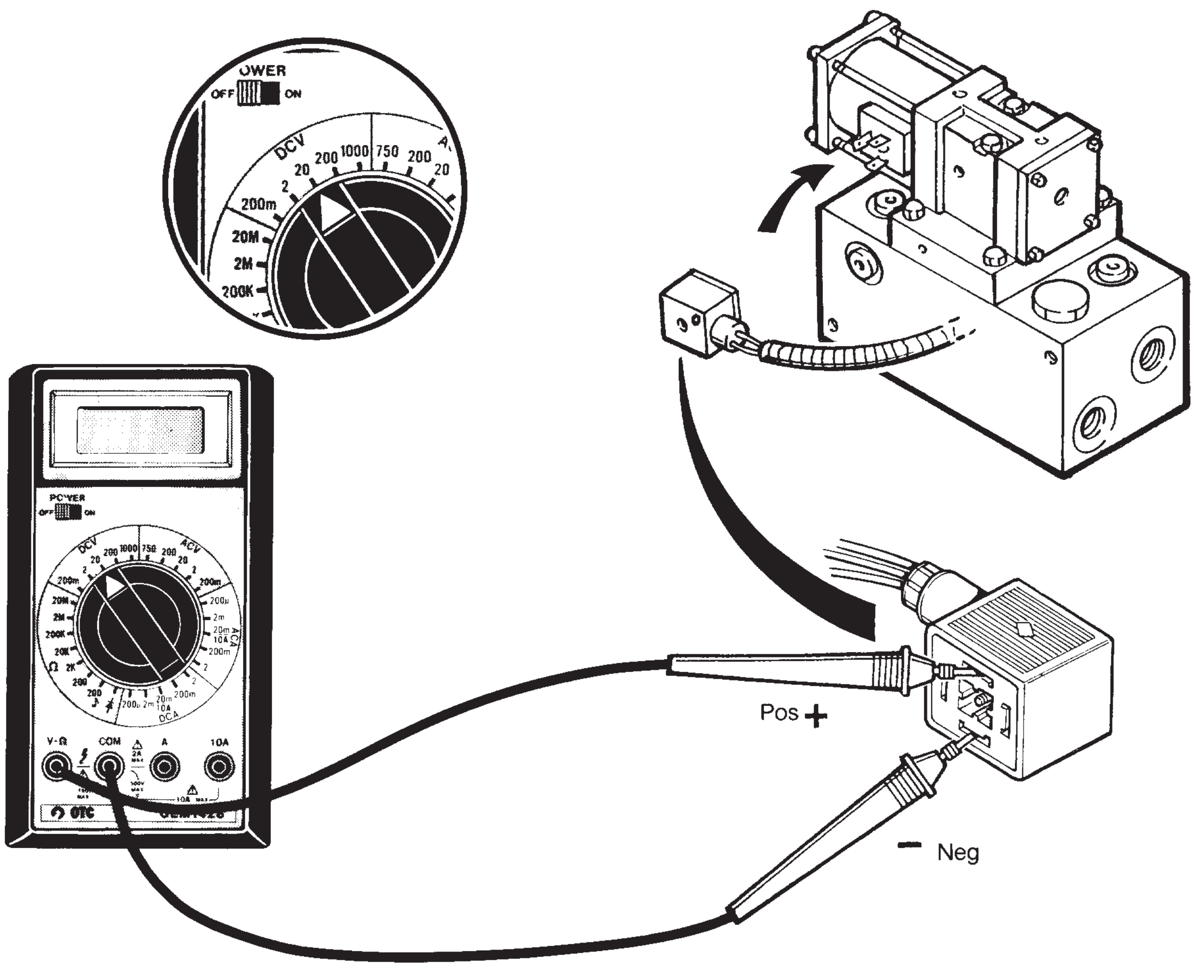


Figure 10I-6. Mower Solenoid Plug Test

SECTION 10I. SOLENOIDS

(See Figure 10I-7)

7. Set multimeter to 200 ♪ Ω (ohms) range.
8. Connect multimeter leads to coil as shown.

- Coil Ω (ohms) reading should be approximately 2.98–3.65 Ω (ohms) if reading is correct. Valve cartridge may be faulty.
- Coil Ω (ohms) reading is not to specification, change coil.

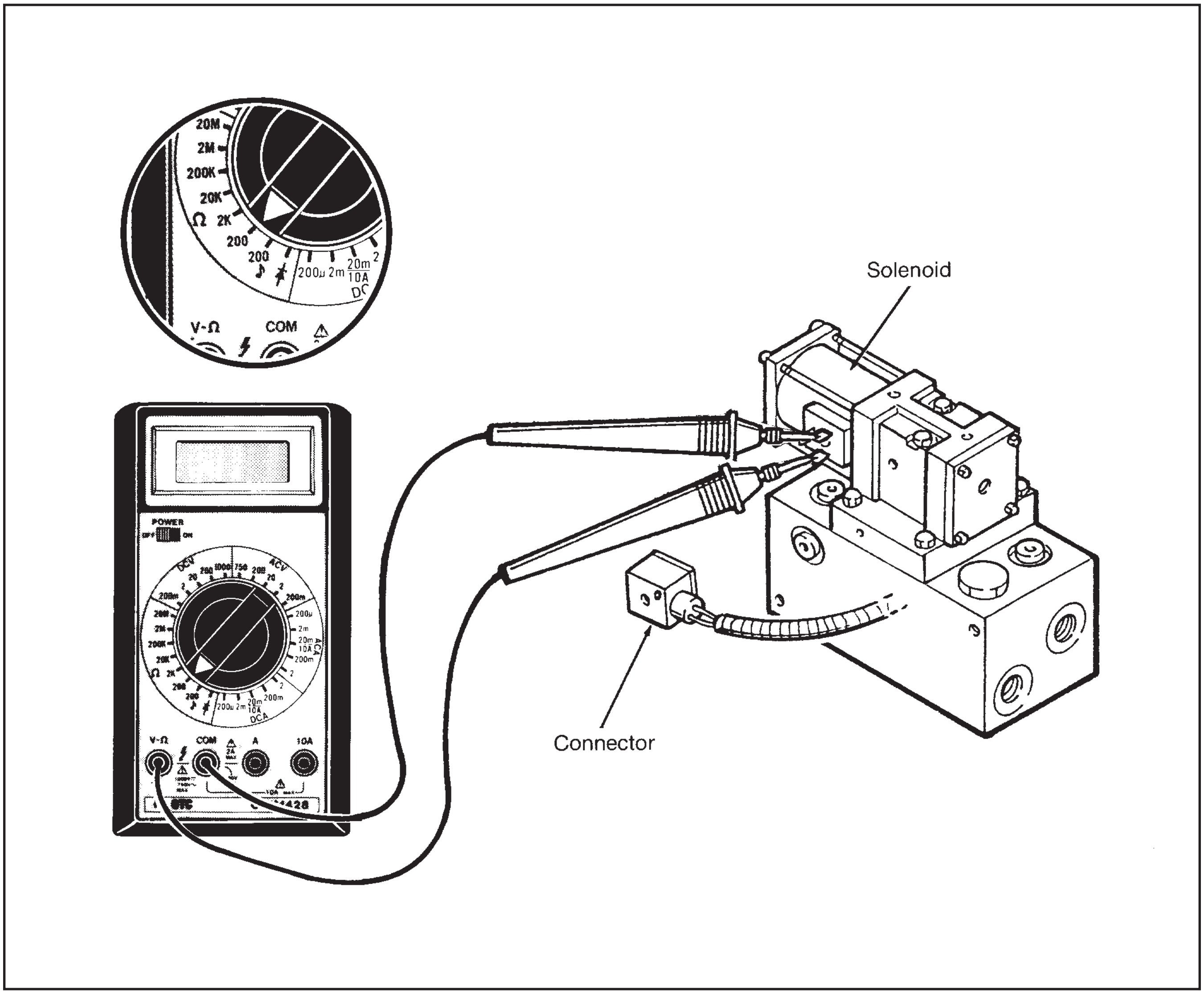


Figure 10I-7. Reel Solenoid Coil Test

SECTION 10J. CIRCUIT BREAKERS AND FUSE

CIRCUIT BREAKER TEST

See Figure 10J-1 and test circuit breaker as follows:

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect meter leads to terminals as shown.
   - With the circuit breaker open (tripped) there should be no continuity on the meter scale.
3. Depress button (close).
   - There should be a reading (continuity) on meter scale.

Replac*e a circuit breaker that does not meet these test results.*

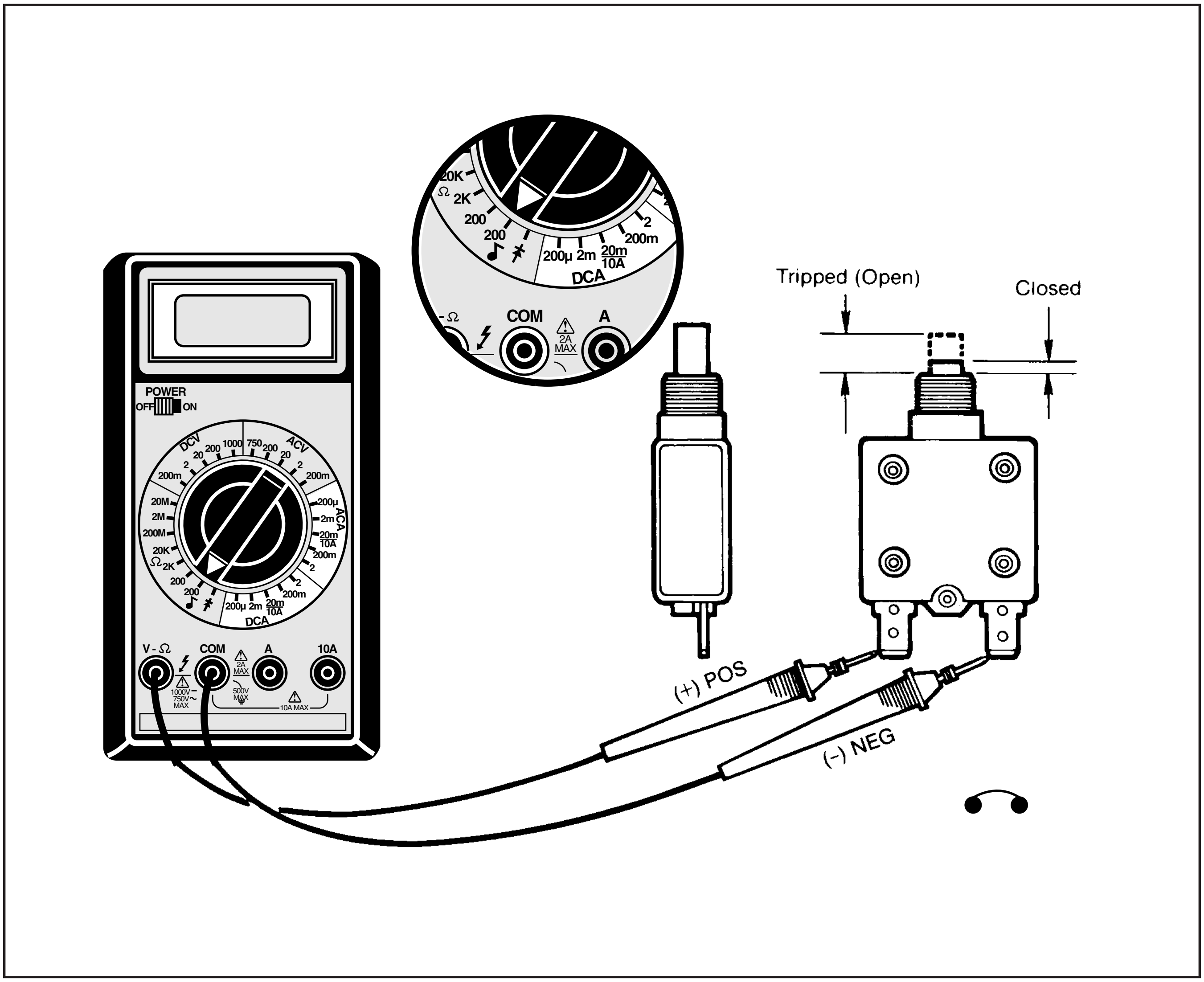


Figure 10J-1. Circuit Breaker Test

SECTION 10J. CIRCUIT BREAKERS AND FUSE

FUSE TEST

See Figure 10J-2 and test fuse as follows:

1. Set multimeter to 200 ♪ Ω (ohms) scale.
2. Connect meter leads to fuse as shown.
   - There should be a reading (continuity) on the meter scale. If not, replace fuse.

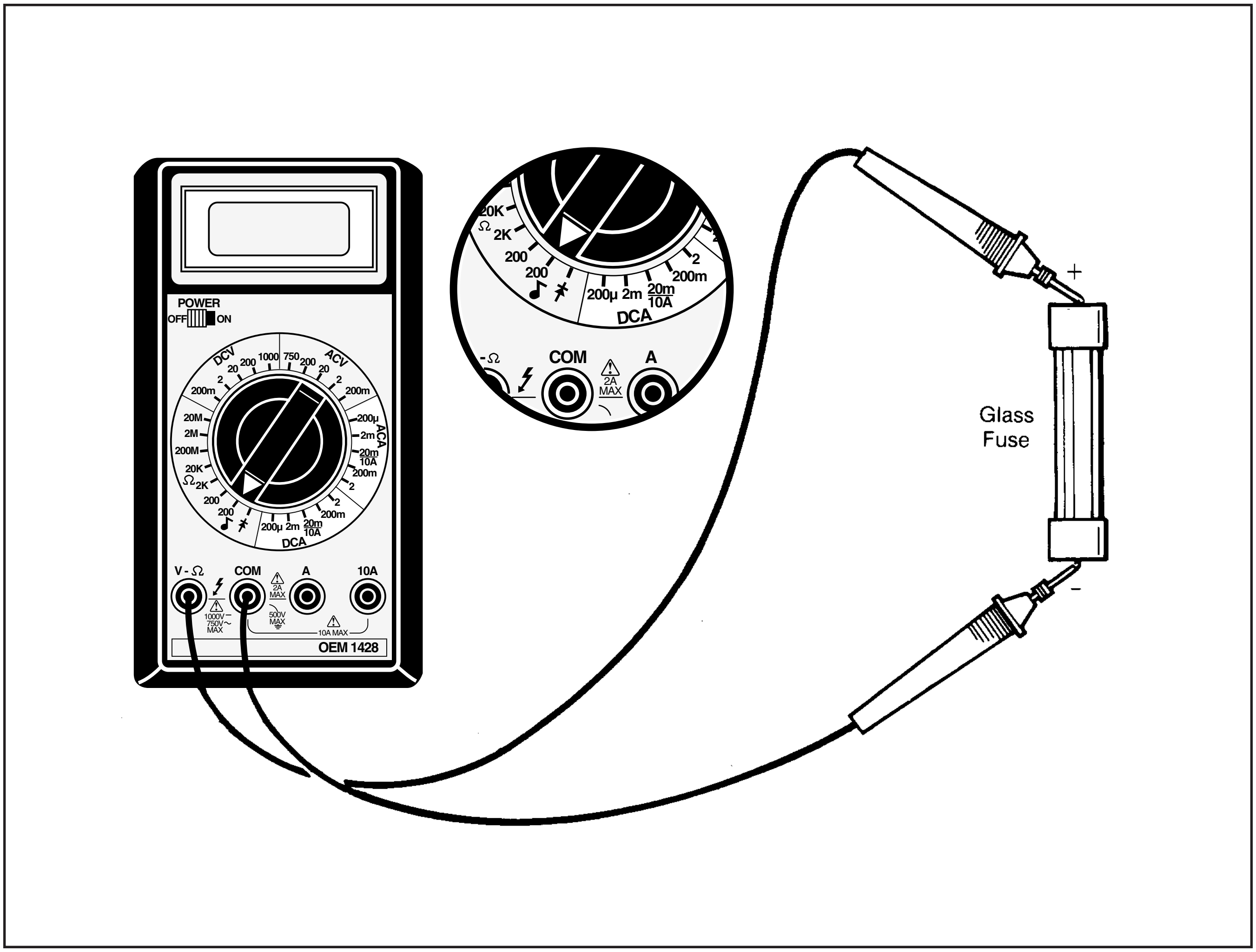


Figure 10J-2. Fuse Test

SECTION 10K. GAUGES

GENERAL

Repair of gauges and sending units are limited to the replacement of faulty components or wiring. Before replacing a gauge that is not working make sure to perform a voltage check at the gauge wire. If voltage checks okay, a gauge that does not work is faulty except for a water temperature gauge which can be tested as described below.

NOTE

See Section 10N for the location of all instruments and gauges.

WATER TEMPERATURE GAUGE TEST (See Figure 10K-1)

Test the water temperature gauge as follows:

1. Turn ignition switch to RUN (ON).
2. Disconnect lead wire to sending unit on engine and ground it.
   - The gauge indicator should go all the way up. If not, gauge or wiring is defective and must be replaced. If gauge needle does go to upper limit but does not work during operation, sending unit is faulty.

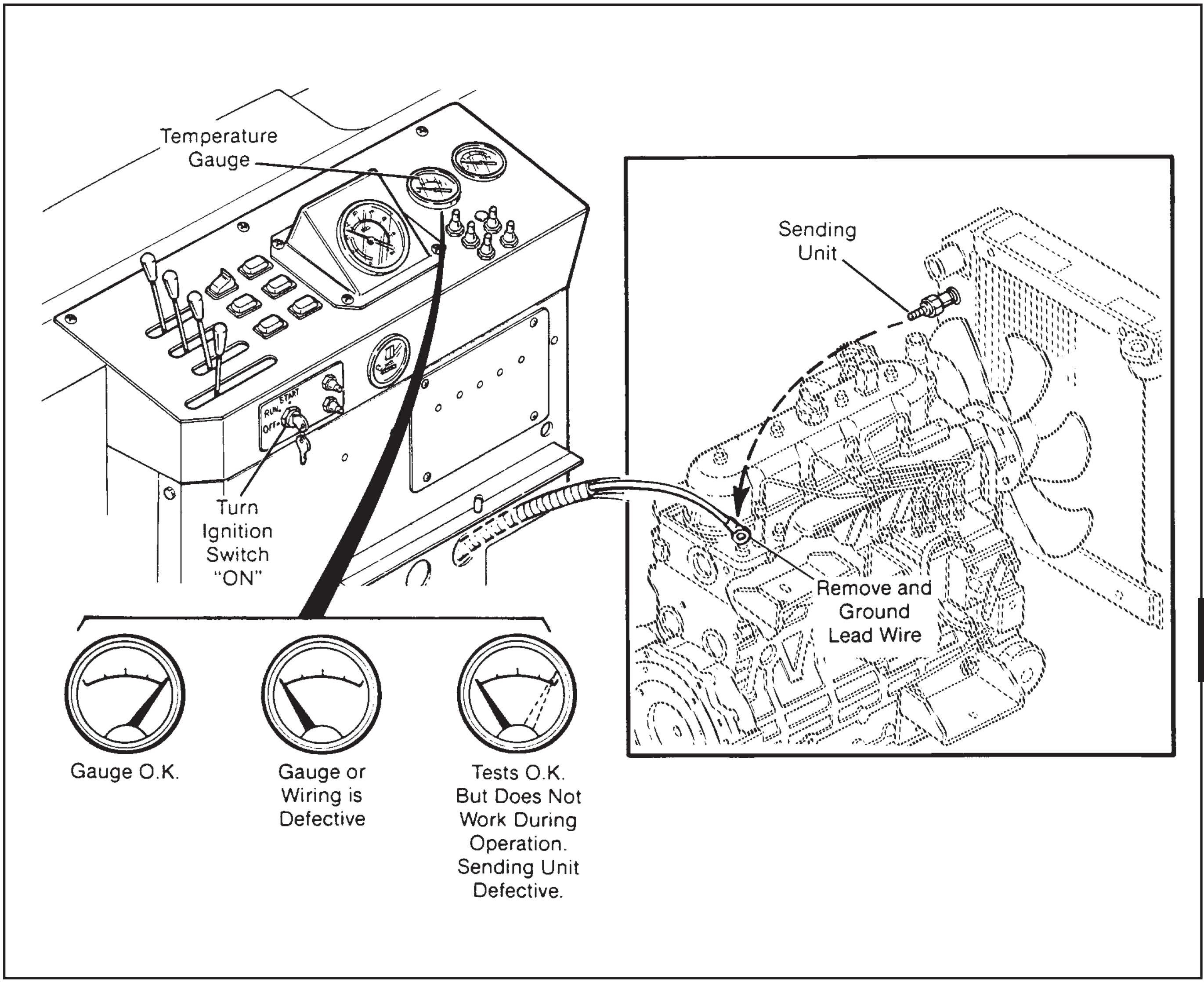


Figure 10K-1. Water Temperature Gauge Test

10K

SECTION 10L. GLOW PLUGS

GLOW PLUG TEST

See Figure 10L-1 and test a suspected faulty glow plug as follows:

1. Shut down and allow engine to cool.
2. Disconnect glow plug lead wire.
3. Set multimeter to 200 Ω (ohms) scale.
4. Connect one multimeter test lead to glow plug terminal and the other to housing.
   - The multimeter reading should be approximately 0.8 Ω (ohms) (cold). If the reading is at infinity or 0 Ω (ohms) the glow plug is defective and must be replaced.

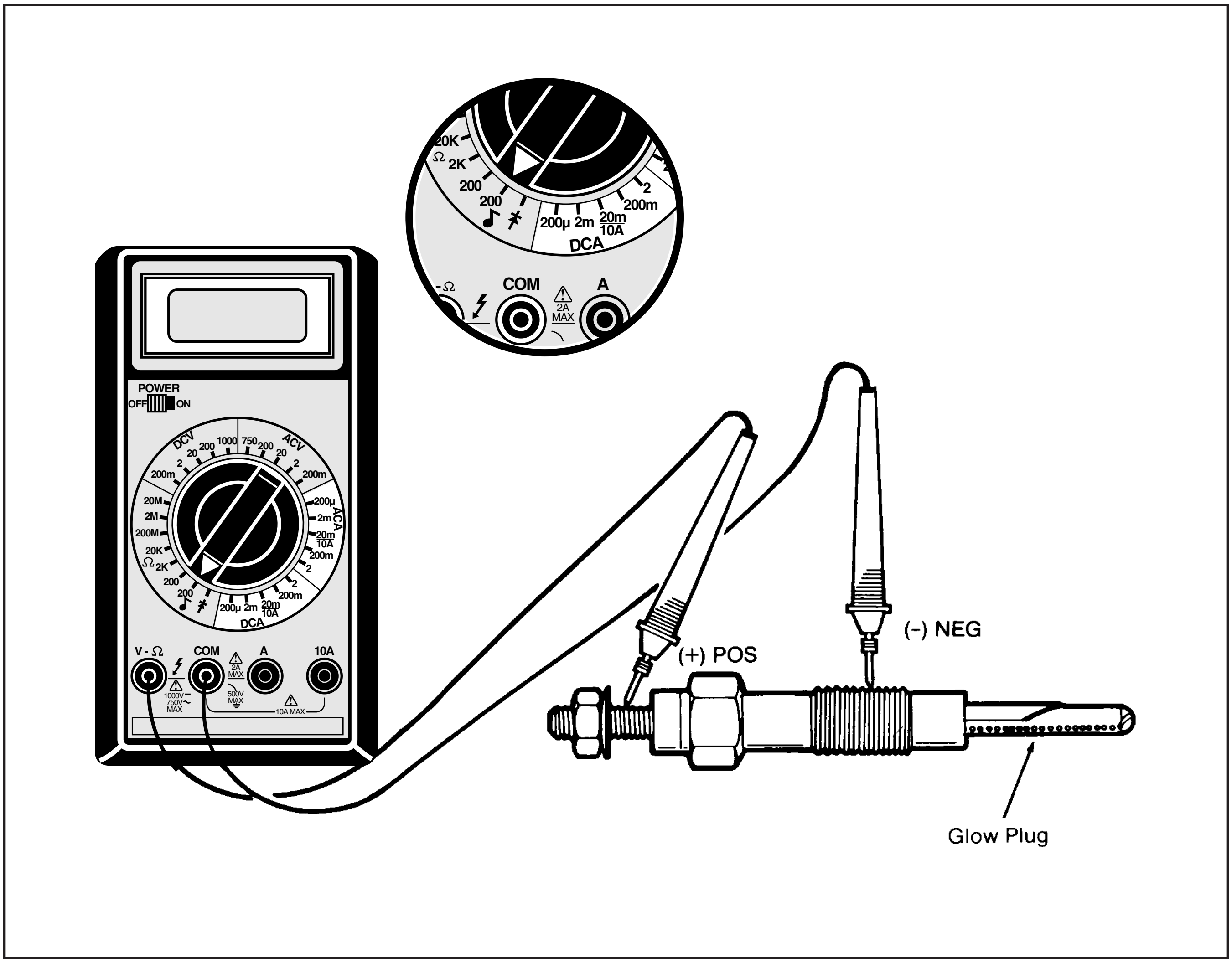


Figure 10L-1. Glow Plug Test

SECTION 10M. DIODE TEST

DIODE TEST

See Figure 10M-1 and test diode as follows:

1. Set meter to —▶|— scale.
2. Connect meter leads to diode as shown.
   - There should be a reading (continuity on the meter scale.
3. Reverse the POS (+) and NEG (–) test leads.

- There should be no continuity.
- If continuity registers in both positions, the diode is faulty.
- If there is no continuity in either direction, diode is also faulty.

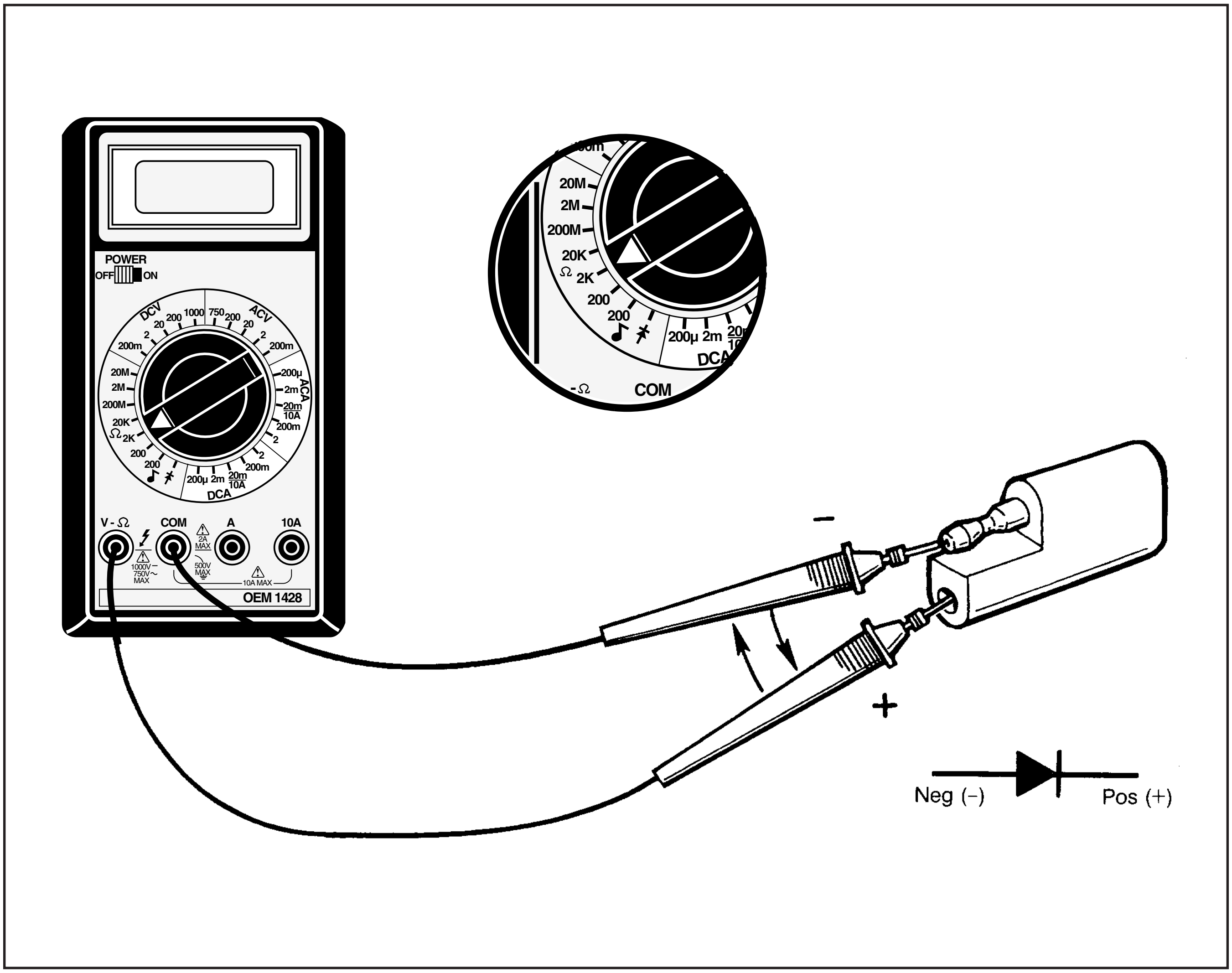
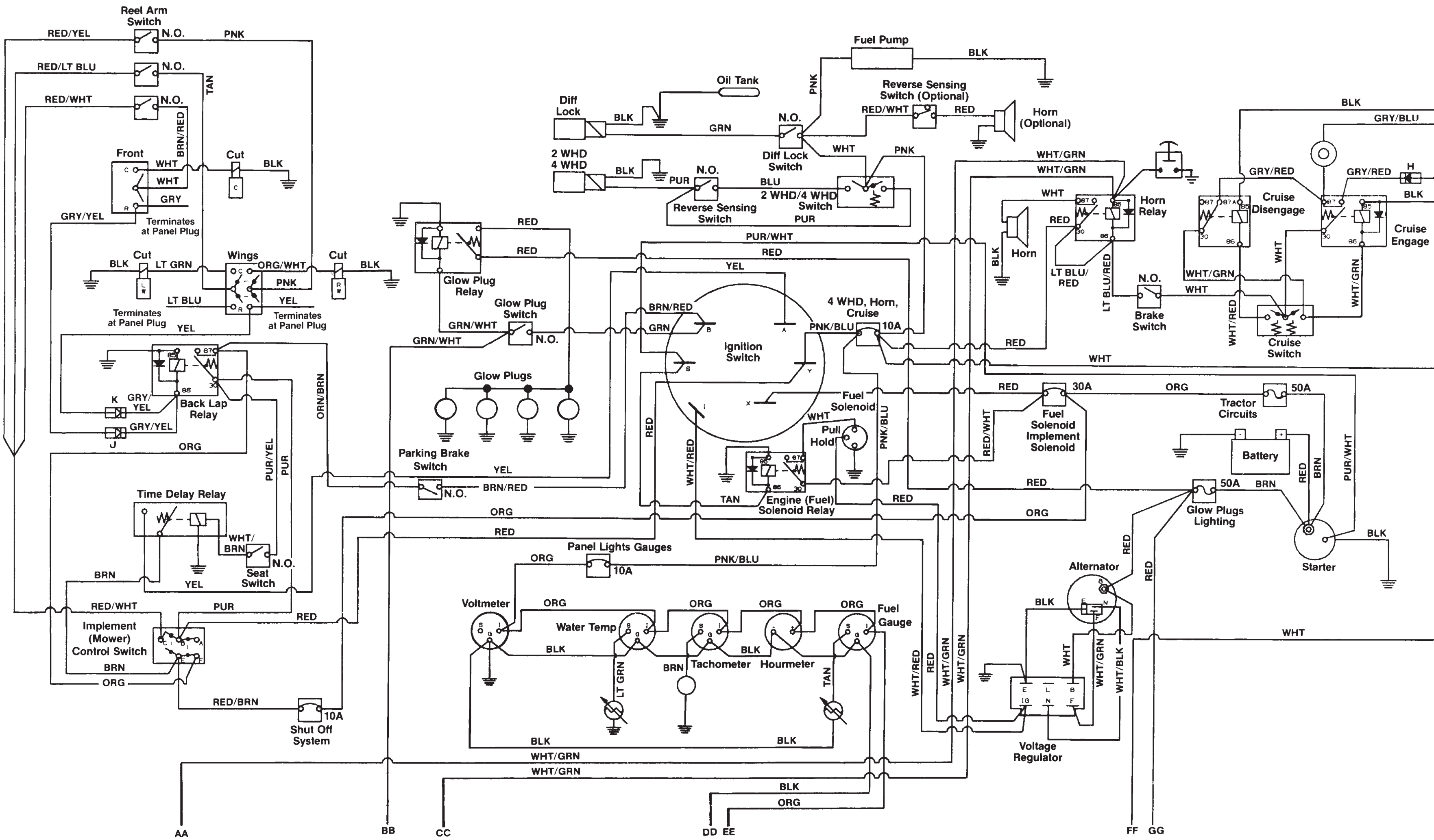


Figure 10M-1. Diode Test



Fogire 10N-1. Wiring Diagram (1 of 2)

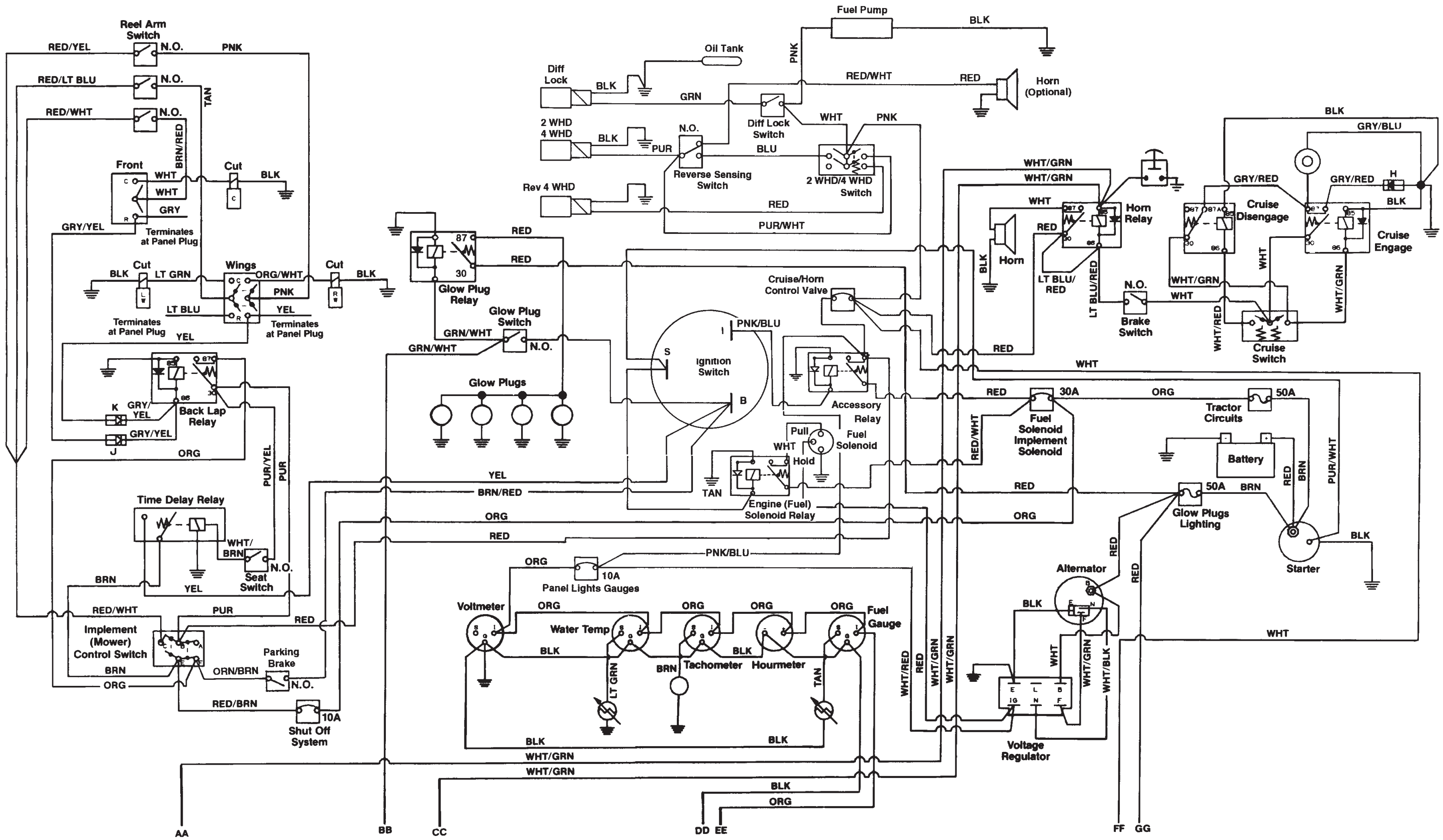


Figure 10N-2. Wiring Diagram (1 of 2)

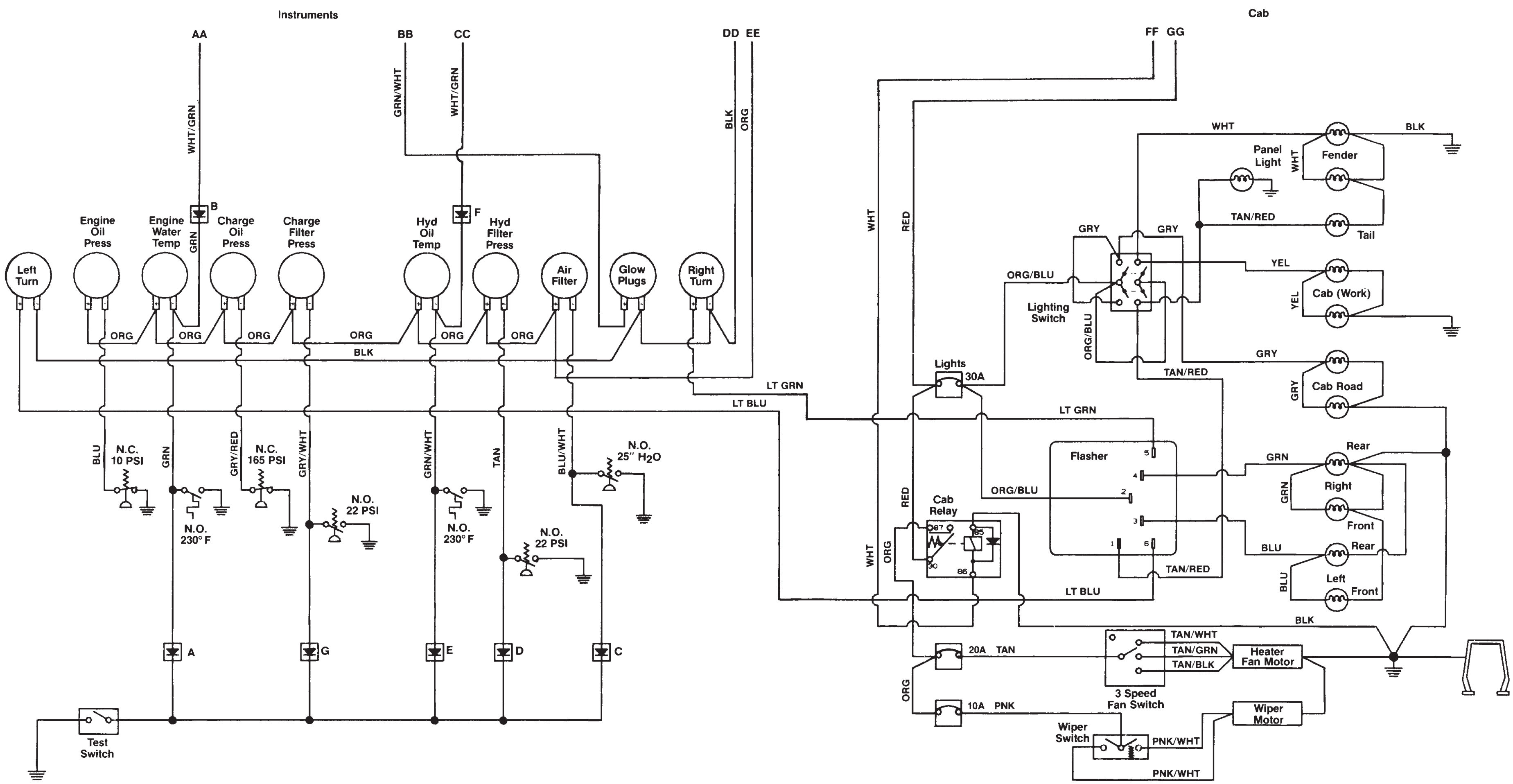
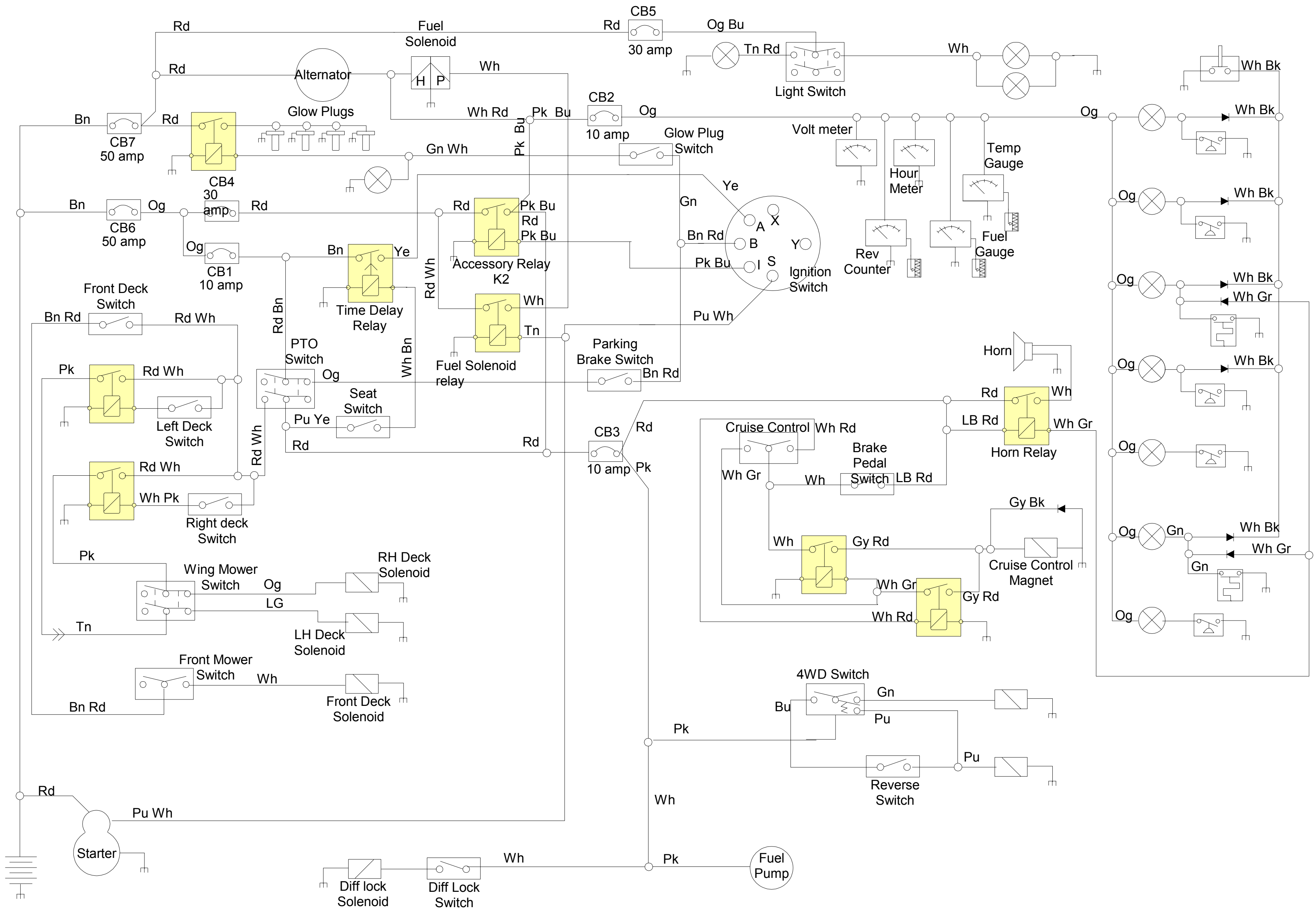
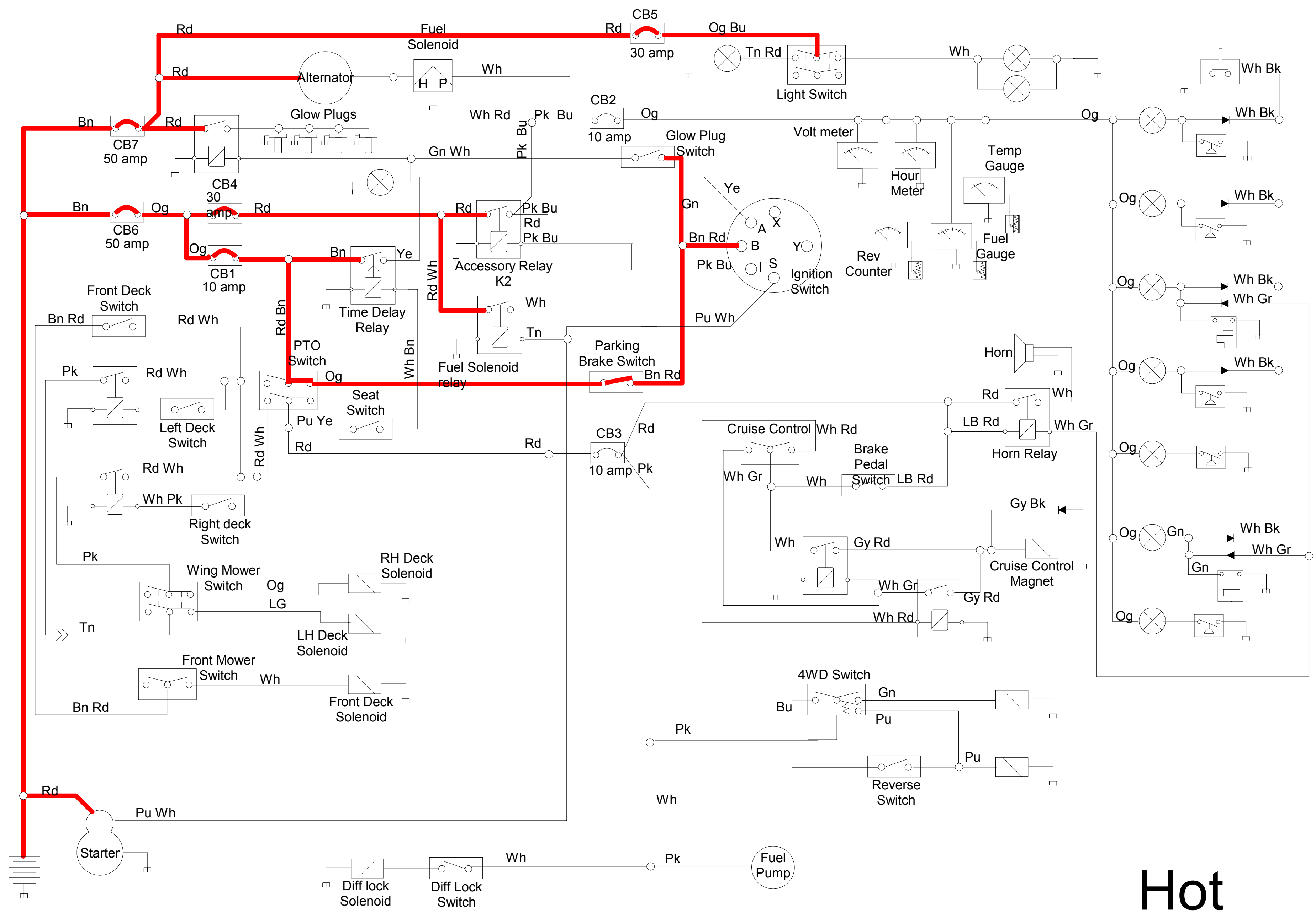


Figure 10N-3. Wiring Diagram for Figures 10N-1 and 10N-2 (2 of 2)



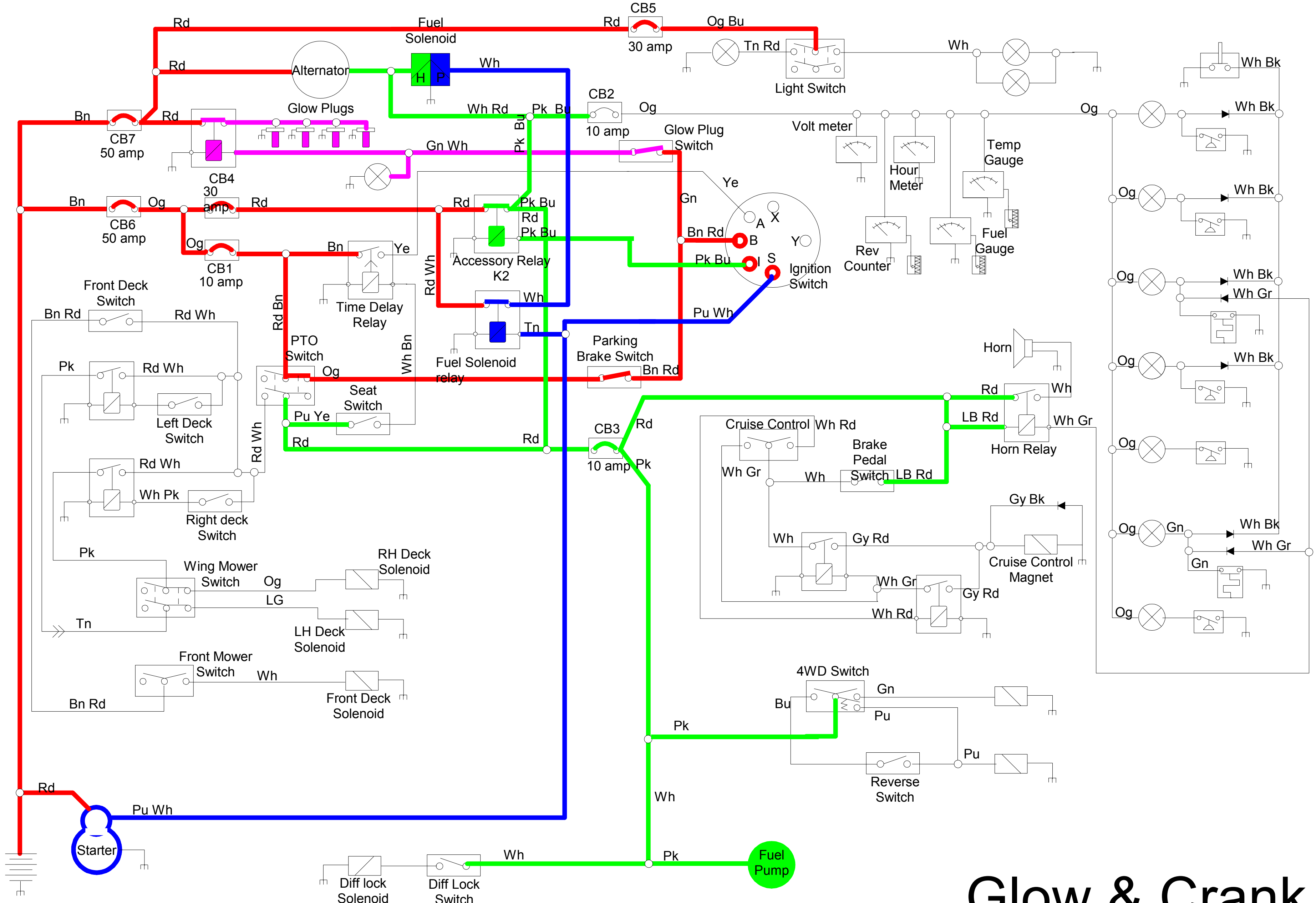
Fuel Solenoid
CB5
30 amp
Og Bu
Tn Rd
Light Switch
Alternator
H P
Glow Plugs
CB7
50 amp
CB4
30 amp
CB2
10 amp
Glow Plug Switch
Volt meter
Hour Meter
Temp Gauge
CB6
50 amp
CB1
10 amp
Accessory Relay K2
Time Delay Relay
Fuel Solenoid relay
Ignition Switch
Rev Counter
Fuel Gauge
Front Deck Switch
Left Deck Switch
Right deck Switch
PTO Switch
Seat Switch
Parking Brake Switch
Horn
Horn Relay
Cruise Control
Brake Pedal Switch
CB3
10 amp
Cruise Control Magnet
Wing Mower Switch
RH Deck Solenoid
LH Deck Solenoid
Front Mower Switch
Front Deck Solenoid
4WD Switch
Reverse Switch
Starter
Diff lock Solenoid
Diff Lock Switch
Fuel Pump

10N



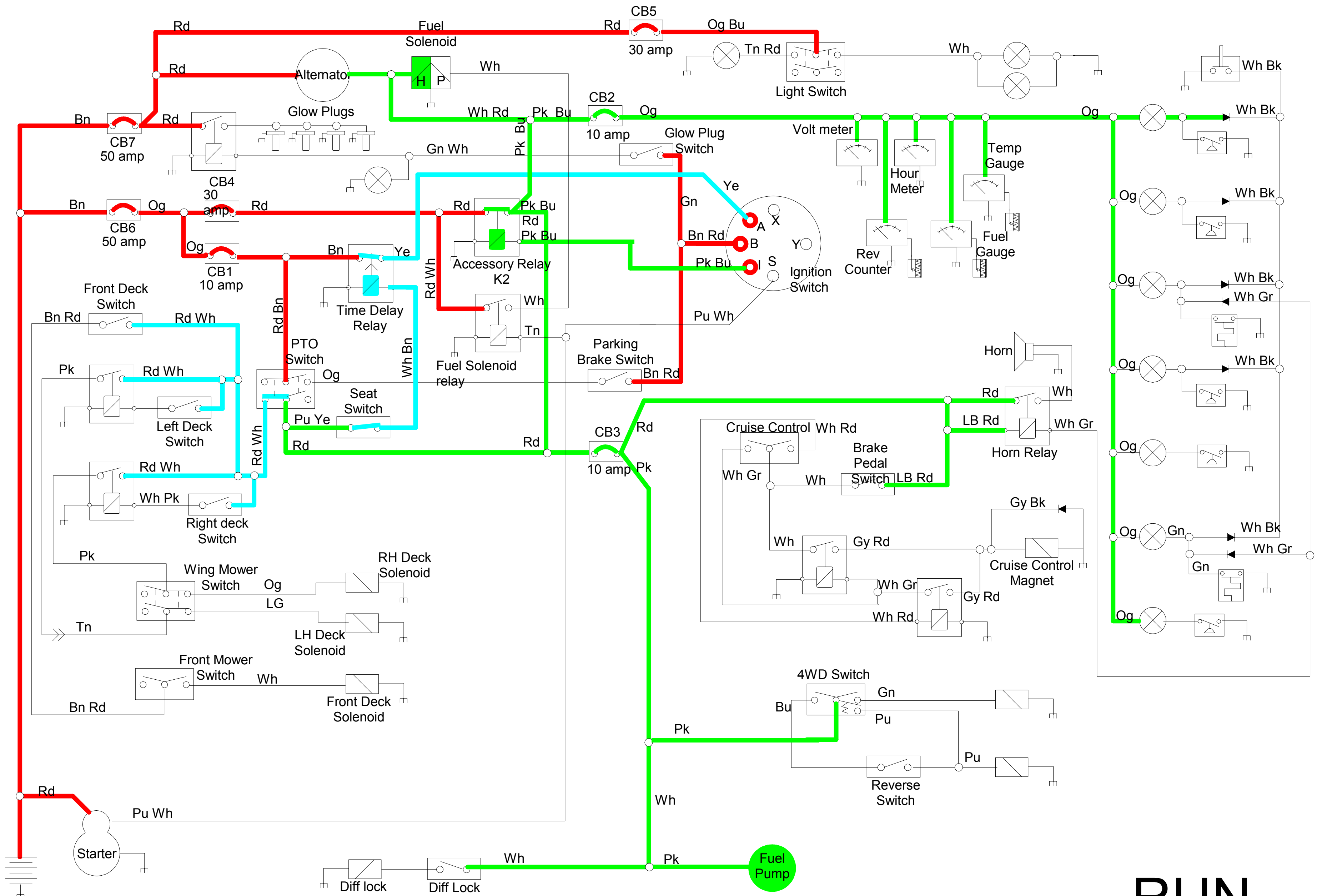
Fuel Solenoid
CB5
30 amp
Og Bu
Tn Rd
Light Switch
Alternator
Glow Plugs
CB7
50 amp
CB2
10 amp
Glow Plug Switch
Volt meter
Hour Meter
Temp Gauge
CB4
30 amp
CB6
50 amp
CB1
10 amp
Accessory Relay K2
Time Delay Relay
Fuel Solenoid relay
Ignition Switch
Rev Counter
Fuel Gauge
Front Deck Switch
Left Deck Switch
Right deck Switch
PTO Switch
Seat Switch
Parking Brake Switch
Horn
Horn Relay
CB3
10 amp
Cruise Control
Brake Pedal Switch
Cruise Control Magnet
Wing Mower Switch
RH Deck Solenoid
LH Deck Solenoid
Front Mower Switch
Front Deck Solenoid
4WD Switch
Reverse Switch
Starter
Diff lock Solenoid
Diff Lock Switch
Fuel Pump

Hot

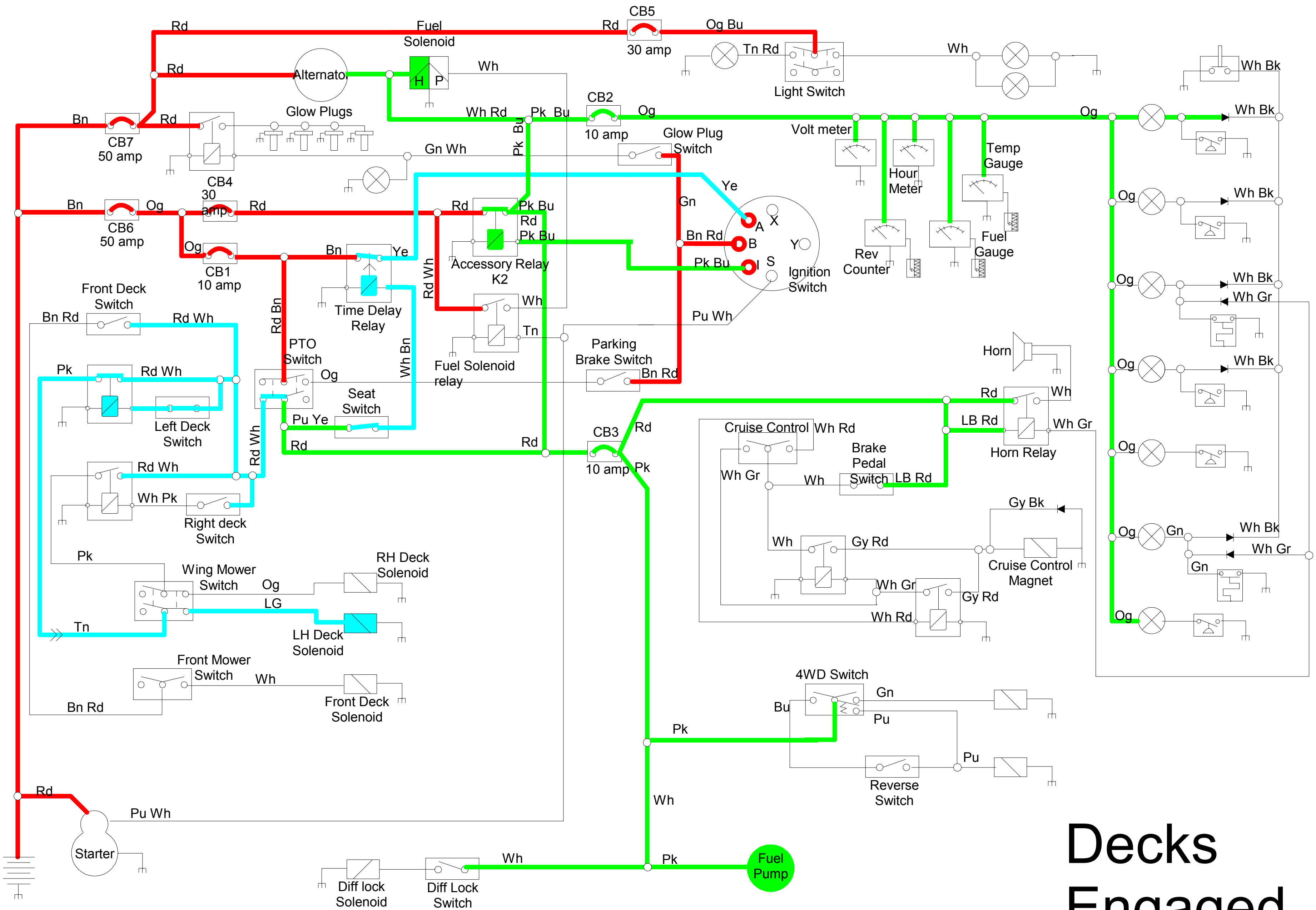


Fuel Solenoid
H
P
CB5
30 amp
Og Bu
Tn Rd
Light Switch
Alternator
Glow Plugs
CB7
50 amp
CB2
10 amp
Og
Glow Plug Switch
Gn Wh
Pk Bu
Wh Rd
Volt meter
Hour Meter
Temp Gauge
Rev Counter
Fuel Gauge
CB4
30 amp
CB6
50 amp
CB1
10 amp
Accessory Relay K2
Time Delay Relay
Fuel Solenoid relay
Ignition Switch
A
X
B
Y
I
S
Bn Rd
Pu Wh
Parking Brake Switch
Front Deck Switch
Left Deck Switch
Right deck Switch
PTO Switch
Seat Switch
Pu Ye
Rd Bn
Rd Wh
Wh Bn
Wh Pk
Wing Mower Switch
RH Deck Solenoid
LH Deck Solenoid
LG
Tn
Front Mower Switch
Front Deck Solenoid
CB3
10 amp
Horn
Horn Relay
LB Rd
Wh Gr
Cruise Control
Brake Pedal Switch
Gy Bk
Gy Rd
Cruise Control Magnet
4WD Switch
Reverse Switch
Wh Bk
Starter
Diff lock Solenoid
Diff Lock Switch
Fuel Pump

Glow & Crank


Fuel Solenoid
CB5
30 amp
Og Bu
Tn Rd
Light Switch
Alternator
H
P
Wh
Wh Rd
Pk Bu
CB2
10 amp
Og
CB7
50 amp
Glow Plugs
Gn Wh
Glow Plug Switch
Volt meter
Hour Meter
Temp Gauge
Wh Bk
Wh Gr
CB4
30 amp
CB6
50 amp
CB1
10 amp
Accessory Relay K2
Ignition Switch
Rev Counter
Fuel Gauge
Time Delay Relay
Front Deck Switch
Bn Rd
Rd Wh
PTO Switch
Seat Switch
Fuel Solenoid relay
Parking Brake Switch
Pu Wh
Horn
Horn Relay
Left Deck Switch
Right deck Switch
CB3
Cruise Control
Brake Pedal Switch
LB Rd
Wh Pk
Wing Mower Switch
RH Deck Solenoid
LH Deck Solenoid
Cruise Control Magnet
Front Mower Switch
Front Deck Solenoid
4WD Switch
Reverse Switch
Starter
Diff lock Solenoid
Diff Lock Switch
Fuel Pump

RUN



10N

Decks Engaged

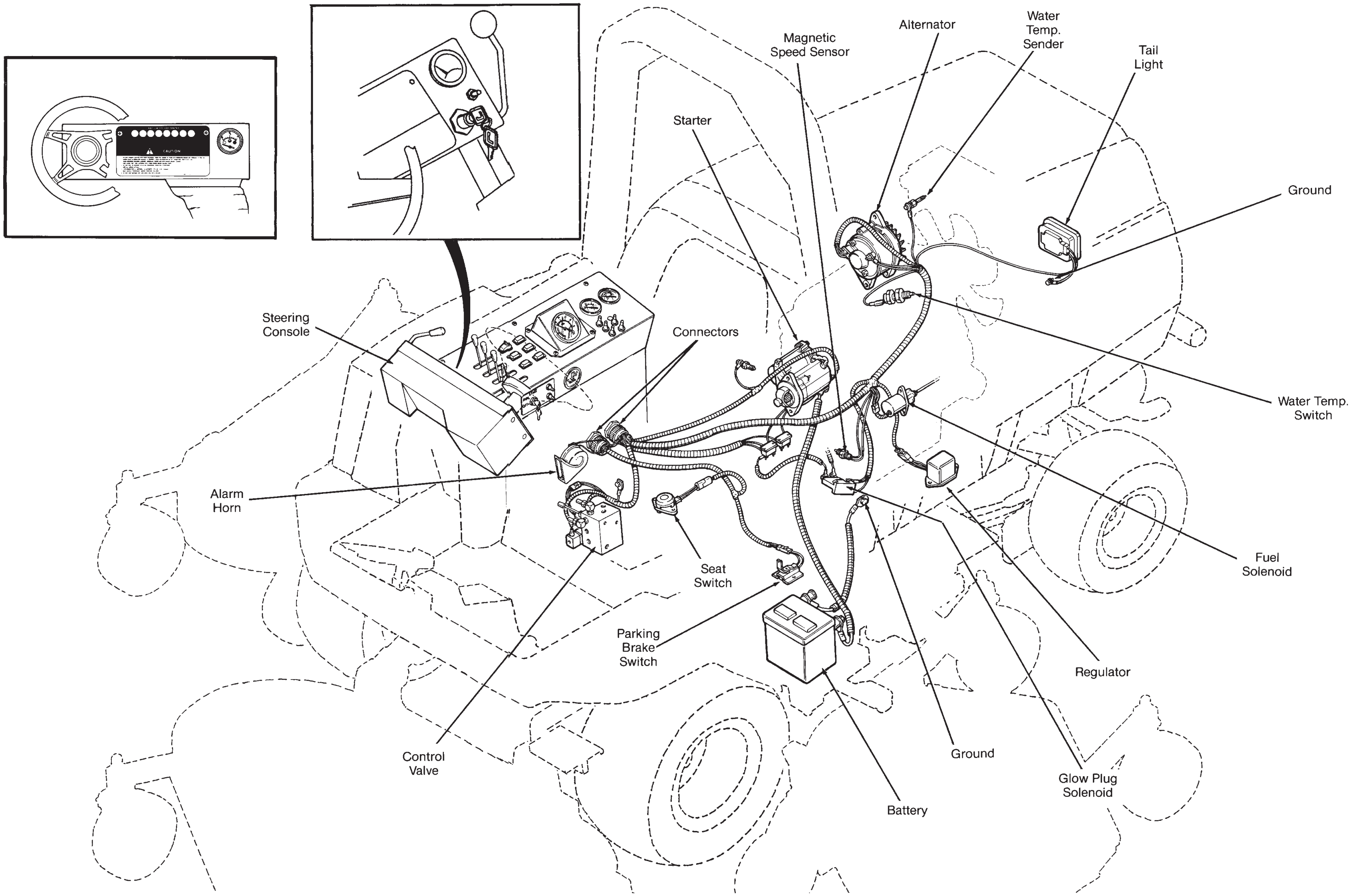


Figure 10N-4. Component Location (1 of 3)

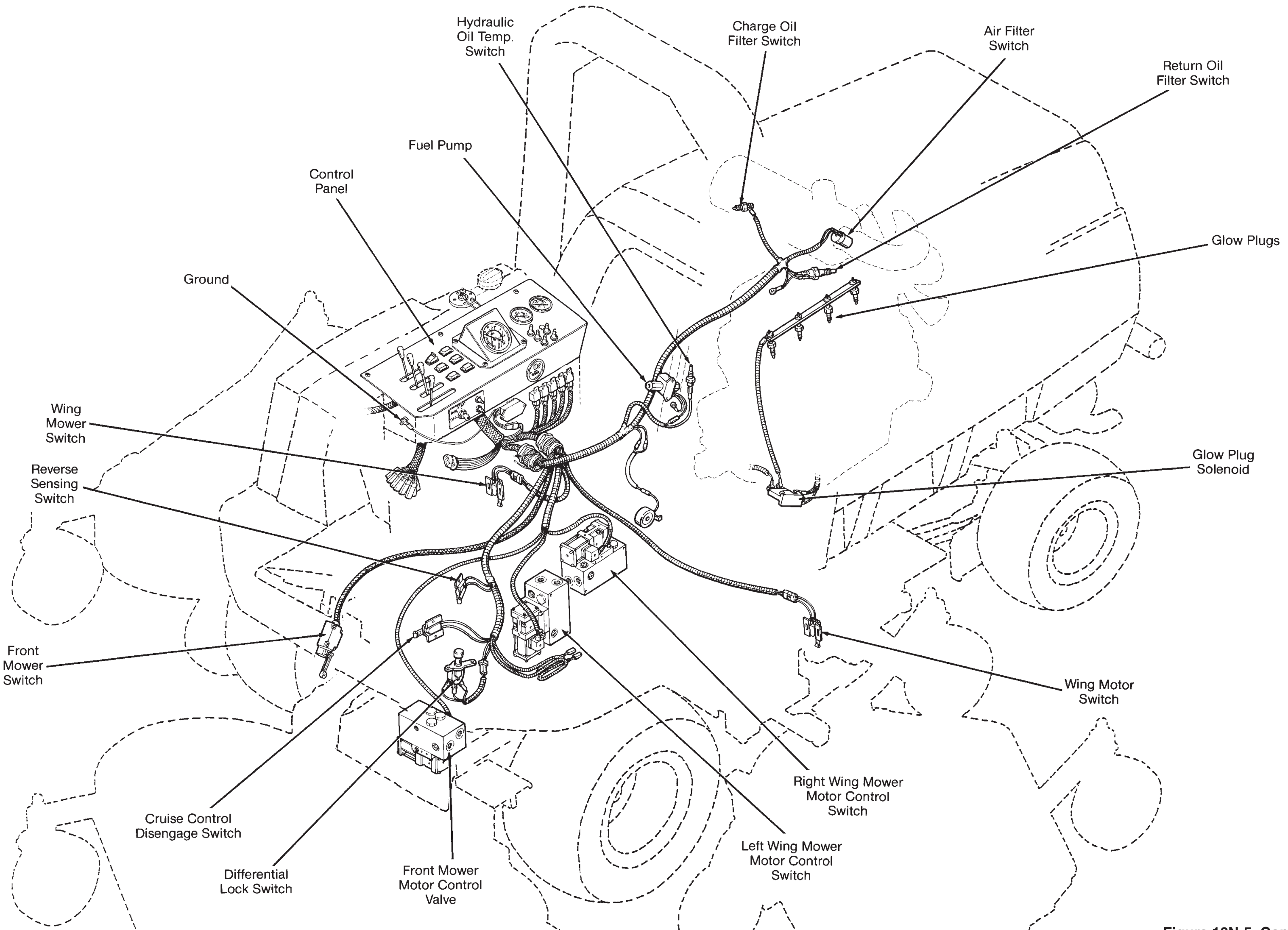
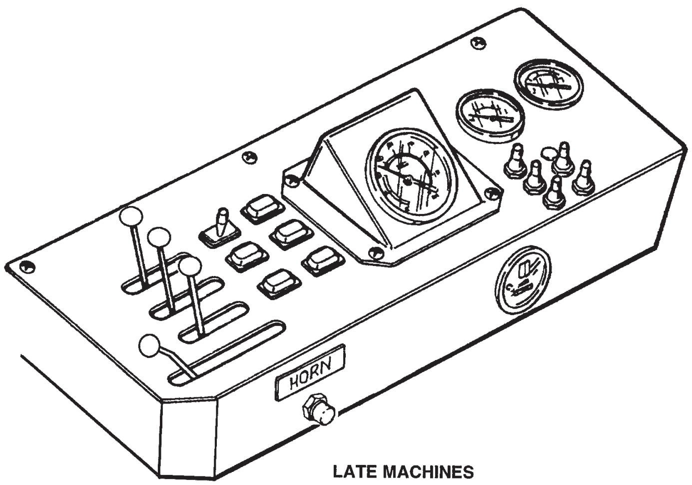
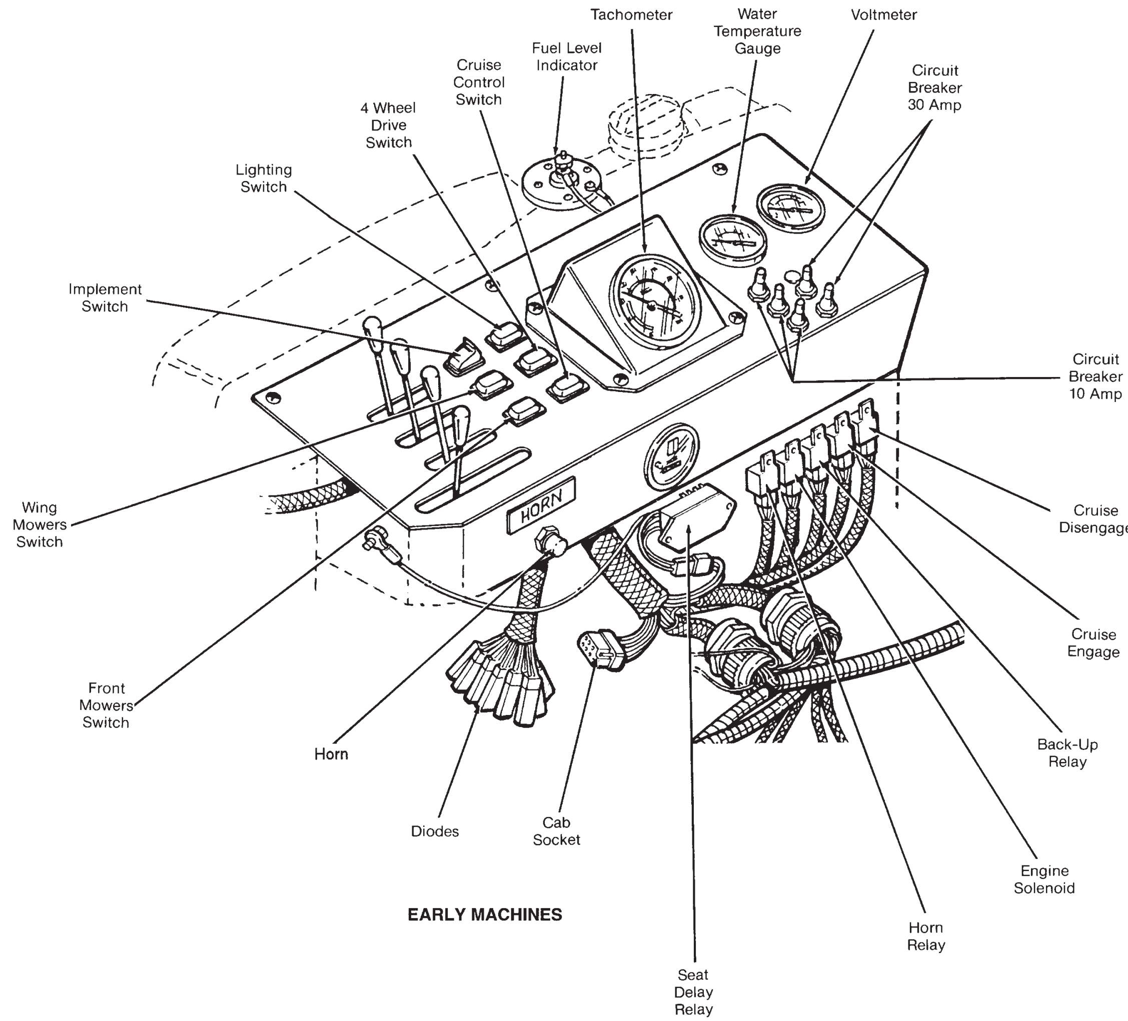


Figure 10N-5. Component Location (2 of 3)



LATE MACHINES



EARLY MACHINES

Figure 10N-6. Component Location (3 of 3)

SECTION 11
PREVENTIVE MAINTENANCE

SECTION 11A. GENERAL

PREVENTIVE MAINTENANCE

Preventive Maintenance (PM) is maintenance performed to prevent malfunctions and parts breakdowns by periodically and systematically checking equipment and its systems.

Preventive Maintenance will cut back corrective maintenance.

SCHEDULING

Each machine should be scheduled for preventive maintenance according to the hours used, its severity of use, and the type of environment the machine is used in.

Use the manufacturer's recommendation of preventive maintenance. These recommendations can then be altered as experience is gained with the type of equipment and the type of environment in which it operates.

While performing preventive maintenance tasks the individual should always be alert to conditions that may seem abnormal. If an abnormal condition is detected a determination must be made to either correct the condition immediately or schedule the tractor in the shop for necessary repairs.

ADMINISTRATION

Record keeping is an important and most often a forgotten part of preventive maintenance.

Jacobsen has developed a PMMRS (Preventive Maintenance Management Record System).

PMMRS PROGRAM KITS

The PMMRS kits and replacement forms (see Figure 11A-1) are available directly from your local Jacobsen Distributor.

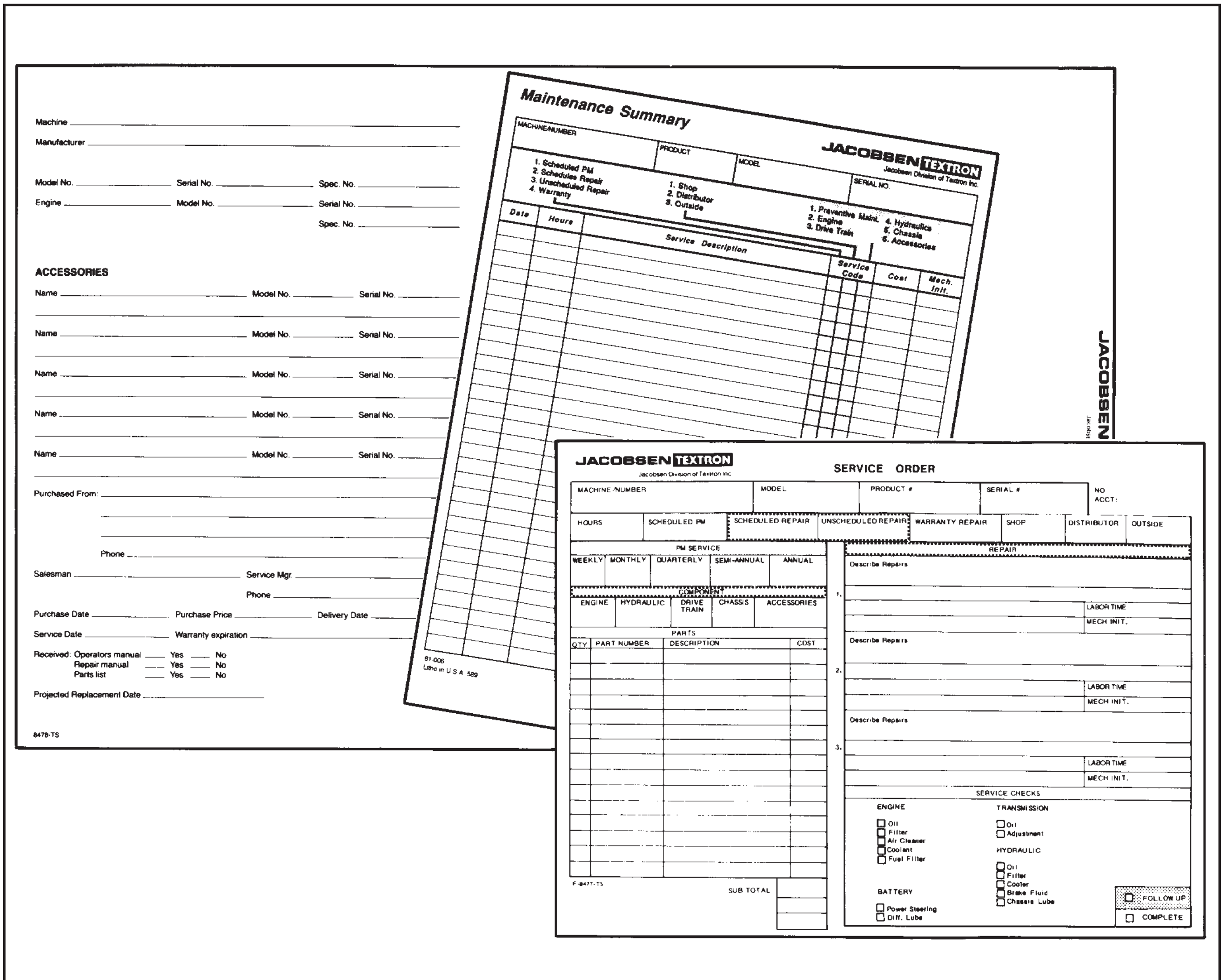


Figure 11A-1. PMMRS Kit Order Forms

PLEASE MAKE COPIES OF THIS PAGE

PMMRS

PREVENTIVE MAINTENANCE MANAGEMENT RECORD SYSTEM

ORDER BLANK

NAME ______________________

ADDRESS ______________________

CITY ______________________

STATE ____________ ZIP ________

DISTRIBUTOR
P.O. NO. ______________
CHECK NO. ______________

CUSTOMER CHECK
MUST ACCOMPANY ORDER

PMMRS KIT @ $6.00 per kit QTY. KITS ORDERED ________

Kit consists of: 10 ea. 8476-TS Maintenance Summary Sheets
20 ea. 8477-TS Service Order Sheets
5 ea. 8478-TS Folders (check color desired)

____Orange	Turf Tractors
____Gray	Reel Mowers
____Lt. Blue	Aerators
____Red	Rotarys
____Dk. Blue	Seeders
____Yellow	Sweepers and Blowers
____White	Grooming Equipment
____Copper	Trucks
____Green	Greens Equipment

TO ORDER SEPARATELY	QTY.	PRICE
5 Folders $2.50 (state colors)	______	______
10 Maintenance Summary Sheets @ $1.50	______	______
25 Service Order Sheets @ $2.00	______	______

JACOBSEN TEXTRON

Jacobsen Division of Textron, Inc.
1721 Packard Avenue
Racine, Wisconsin 53403-9988

____
Authorized Signature

Price subject to change, contact your Jacobsen Dealer.

PMMRS

PREVENTIVE MAINTENANCE MANAGEMENT RECORD SYSTEM

ORDER BLANK

NAME ______________________

ADDRESS ______________________

CITY ______________________

STATE ____________ ZIP ________

DISTRIBUTOR
P.O. NO. ______________
CHECK NO. ______________

CUSTOMER CHECK
MUST ACCOMPANY ORDER

PMMRS KIT @ $6.00 per kit QTY. KITS ORDERED ________

Kit consists of: 10 ea. 8476-TS Maintenance Summary Sheets
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____Dk. Blue	Seeders
____Yellow	Sweepers and Blowers
____White	Grooming Equipment
____Copper	Trucks
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JACOBSEN TEXTRON

Jacobsen Division of Textron, Inc.
1721 Packard Avenue
Racine, Wisconsin 53403-9988

____
Authorized Signature

Price subject to change, contact your Jacobsen Dealer.

SECTION 11B. LUBRICATION SCHEDULES AND CHARTS

GENERAL

This section contains lubrication and maintenance charts. For easy reference a 25" x 19" wall chart can be obtained from your Jacobsen Distributor.

Footnotes are found on Page 11C-4 and are shown in bold type; example: **a, b,** etc.

LUBRICATION SCHEDULES

The following lubrication charts outline grease and oil intervals. Intervals are based on a 40 hour week. These are suggested intervals only. As experience is gained in operating this machine, the schedule can be tailored to your operating time. Reference numbers are keyed to the illustration on page 11C-3. The footnotes on page 11C-3 (letters a thru k) give more detailed information.

TRACTOR GREASE CHART

Ref.	Qty.		Description	Remarks
			40 HOURS (Every Week)	
1	2	**a**	Steering axle spindle housings	
2	1	**a**	Steering axle pivot	
3	1	**a**	Steering column tilt	
4	1	**a**	Brake pedal pivot	
5	2	**a**	Pump drive shaft	
7	2	**a**	Axle drive shaft	
			ANNUALLY	
6	1	**h**	Pump shaft spline	
8	1	**h**	Axle input shaft spline	

TRACTOR OIL CHART (Use SAE 30 Oil)

Ref.	Qty.	Description	Remarks
		MONTHLY	
9	3	Lift valve linkage	
10	6	Traction pedal linkage	
11	1	Master cylinder ball joint	
12	2	Parking brake cable pulleys	

TRACTOR LUBRICATION CHART

Ref.	Qty.		Description	Remarks
14	1	**g**	Axle	Check daily, change annually.
15	1	**h**	Parking brake lever	Monthly.

SECTION 11B. LUBRICATION SCHEDULES AND CHARTS

MOWER LUBRICATION CHART

Ref.	Qty.	Description		Remarks
40 HOURS (Every Week)				
1	8	**a**	Hydraulic lift cylinder ends	
2	4	**a**	Mower arm pivots	
4	8	**a**	Wing mower unit pivots	
5	8	**a**	Caster wheel pivots	
6	10	**a**	Caster wheel axle	

SECTION 11C. MAINTENANCE SCHEDULES

GENERAL

The following charts summarize maintenance to be performed daily, weekly, every two weeks, monthly, every three months, and annually.

The maintenance charts give recommended hours of operation between various procedures. Intervals are based on a 40 hour week.

Reference numbers are keyed to the illustration on page 11C-3. Footnotes on page 11C-3 give additional information.

MAINTENANCE SCHEDULE CHART

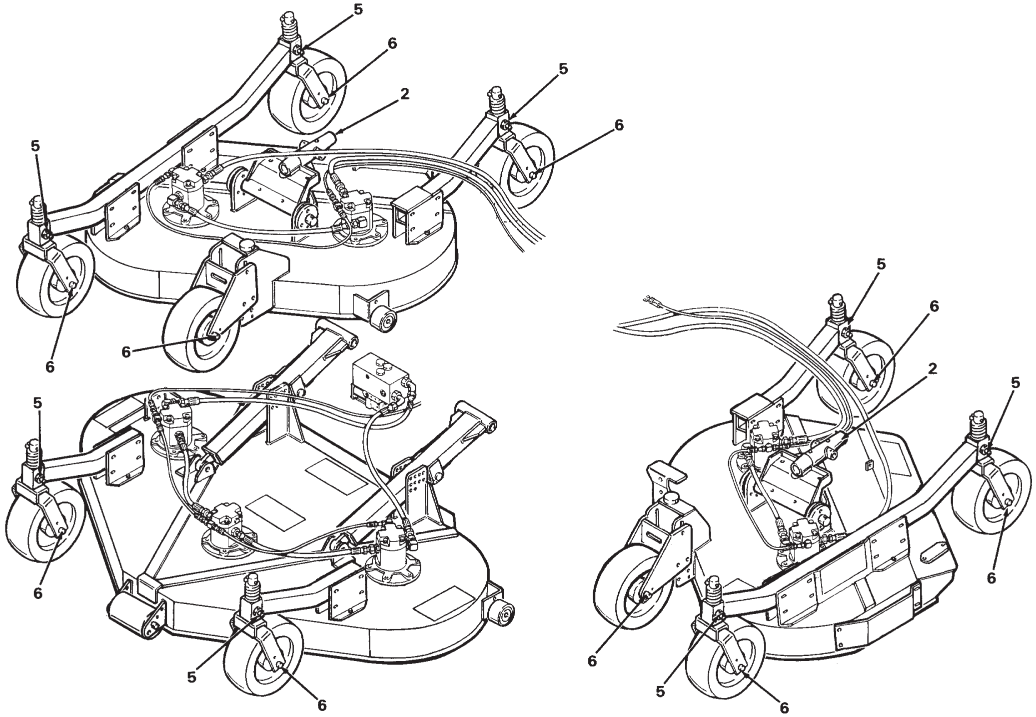
Ref.	Qty.		Description	Daily	Weekly	Every 2 Weeks	Monthly	Every 3 Months	Annually	
			TRACTOR							
16	1	**c**	Hydraulic reservoir	X						Check.
		c	Hydraulic oil						X	Change every 500 hours.
17	1	**j**	Charge filter							Change the first 25 hours. Change every 250 hours thereafter.
18	1	**j**	Return filter							
19	1		Tank strainer						X	
20	1	**g**	Front drive wheel lube	X					X	Change every 250 hours thereafter.
21	10		Front drive wheel nuts				X			Torque to 45–50 ft-lbs. (54–68 N.m). Retorque after first 20 hours, 250 hours thereafter.
22	8		Rear steer wheel bolts				X			Torque to 85–90 ft-lbs. (115–122 N.m). Retorque after first 20 hours, 250 hours thereafter.
23	4		Tire pressure		X					Front: 20–24 psi (138–165 kPa). Rear: 6–10 psi (41–69 kPa).
			Hydraulic hoses and tubing	X						Inspect.
	1		Wheel alignment				X			Check.
24	1	**e**	Brake master cylinder fluid level	X						

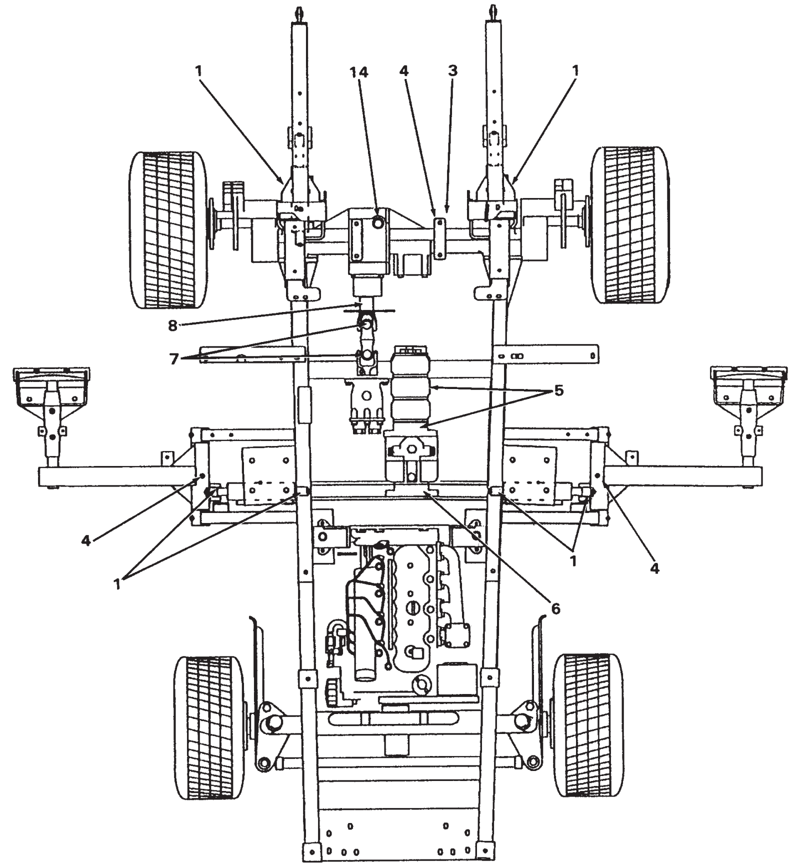
11C

SECTION 11C. MAINTENANCE SCHEDULES

MAINTENANCE SCHEDULE CHART

Ref.	Qty.		Description	Daily	Weekly	Every 2 Weeks	Monthly	Every 3 Months	Annually	
			ENGINE							
25	1		Fuel	X						Check. Fuel oil #2 Cetane rating 45.
26			Fuel filter				X			Clean 100 hours.
								X		Replace 500 hours.
			Fuel lines and clamps			X				Check 50 hours.
									X	Replace every 2 years.
		d	Engine oil	X						Check.
					X					Change first 25 hours.
						X				Change 100 hours or more often if under dusty conditions.
			Engine oil filter cartridge		X					Change first 25 hours.
							X			Change 250 hours or more often if under dirty conditions.
			Oil cooler	X						Check/clean.
			Radiator core	X						Check/clean.
		f	Radiator coolant		X					Check when cooled.
									X	Change.
			Hood screen	X						Check/clean.
			Ensure trap door is closed	X						Close.
			Ensure sealing foam on top of radiator and on trap door is in place	X						Install sealing foam.
			Fan belt			X				Belt deflects 3/16" (4.8 mm) with 1.2 to 1.5 lb. (0.54–0.68 kg) pull.
27			Air cleaner dust cup	X						Clean.
		j	Air cleaner element							When filter light indicates.
			Battery				X			Check.
			Water pump belt			X				Belt deflects 1/4–3/8" (6.3–9.5 mm) with 20 lb. (9 kg) pull.
			Glow plugs	X						Preheating time (approximate) Above 32°F (0°C) 15 sec. Above 32°F (0°C) 30 sec.
			MOWERS							
9	5		Height of cut		X					Check.
			Mower unit hardware				X			Check tightness.





FOOTNOTES

a Use pressure gun grease (NLGI Grade 0). Apply with grease gun.

b Use hand grease gun (NLGI Grade 0).

c System capacity: 20 gallons. Jacobsen hydraulic oil. Part No. 502696 carton containing two 2-1/2 gallons (9.5 liters) bottles or Part No. 502693, pail containing 5 gallons (19 liters).

d Capacity: 9 quarts. Use MIL-L-214OC or API Classification CC/CD/CE/Grade oil.

Recommended Oils:

Above 77°F use SAE 30
32°F to 77°F use SAE 20
Below 32°F Use SAE 10 or SAE 10W-30

e System capacity: 8 oz. heavy duty brake fluid 116-DOT-3.

f System capacity: 2-1/2 gallons (9.5 liters). Water and ethylene glycol.

g System capacity: 2 quarts. 90 wt. gear lube.

h Coat liberally with Molybdenum disulfide E.P. grease annually or when being serviced.

i WD40.

j Service as indicated by the performance monitor light.

k Use 90 weight gear lube. Extremely high temperature, use 140 weight gear lube.

SECTION 12
ATTACHMENTS

SECTION 12A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools, including driving tools, and seal spreaders; Blade Grinder.
Cleaning materials:	Stoddard or equivalent solvent. Detergent and water.
Lubricants:	Non-metallic additive wheel bearing grease (eg. Sunray DX 692 or Enco Fibrox 280).
	Grease gun grease (eg. Sunray DX 671 or Gulf Supreme No. 0 [SAE 30 oil]).
Other service items:	Service blades (cutter bars).

SECTION 12B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Blades do not turn.	a. Blades jammed.	a. Clean underside of deck.
	b. Spindle bearing failure.	b. Check bearings, repair (Section 12D).
	c. Drive assembly malfunctioning.	c. Inspect, repair (Section 12D).
	d. Drive motor malfunctioning.	d. Repair/replace (Sections 8L, 8M, 8N).
	e. Tractor hydraulic system malfunctioning.	e. Test (Sections 8M, 8N).
2. Blades run slow.	a. Blades jammed.	a. Clean underside of deck.
	b. Spindle bearing failure.	b. Check bearings, repair (Section 12D).
	c. Drive assembly malfunctioning.	c. Inspect, repair (Section 12D).
	d. Drive motor malfunctioning.	d. Repair/replace (Sections 8L, 8M, 8N).
	e. Tractor hydraulic system malfunctioning.	e. Test (Sections 8M, 8N).
3. Uneven cutting.	a. Deck not adjusted level.	a. Adjust deck (see Operator's Manual).
	b. Blades loose.	b. Tighten (Section 12D).
	c. Blades bent.	c. Replace.
	d. Spindle bearing failure.	d. Check bearings, repair (Section 12D).
	e. Deck shell bent.	e. Replace.
4. Ragged cut.	a. Operating too fast for conditions.	a. Slow down ground speed (see Operator's Manual).
	b. Blade dull.	b. Sharpen/replace (Section 12F).
	c. Blades loose.	c. Tighten (Section 12F).
	d. Blades installed wrong.	d. Install correctly (Section 12F).
5. Excessive vibration.	a. Blade not balanced.	a. Balance (Section 12F).
	b. Blades loose.	b. Tighten (Section 12F).
	c. Blades bent.	c. Replace.
	d. Spindle bearing failure.	d. Check bearing, repair (Section 12D).
	e. Spindle housing or deck shell cracked.	e. Replace.

SECTION 12C. GENERAL INSTRUCTIONS

PREPARATION FOR REPAIR

Thoroughly clean decks prior to removal, disassembly and/or repair. Coat bare metal parts with light oil to prevent rust and corrosion.

Decks are exposed to water, grass clippings, sand, corrosive fertilizers, and foreign objects. It may be necessary to use bearing pullers and/or wooden blocks and hammer to free up some parts.

When such force is required to remove parts, those parts should be replaced rather than reinstalled on the machine.

⚠ WARNING

Before removing components or performing repairs and adjustments, lower attachment, stop engine, set parking brake and remove key from ignition switch.

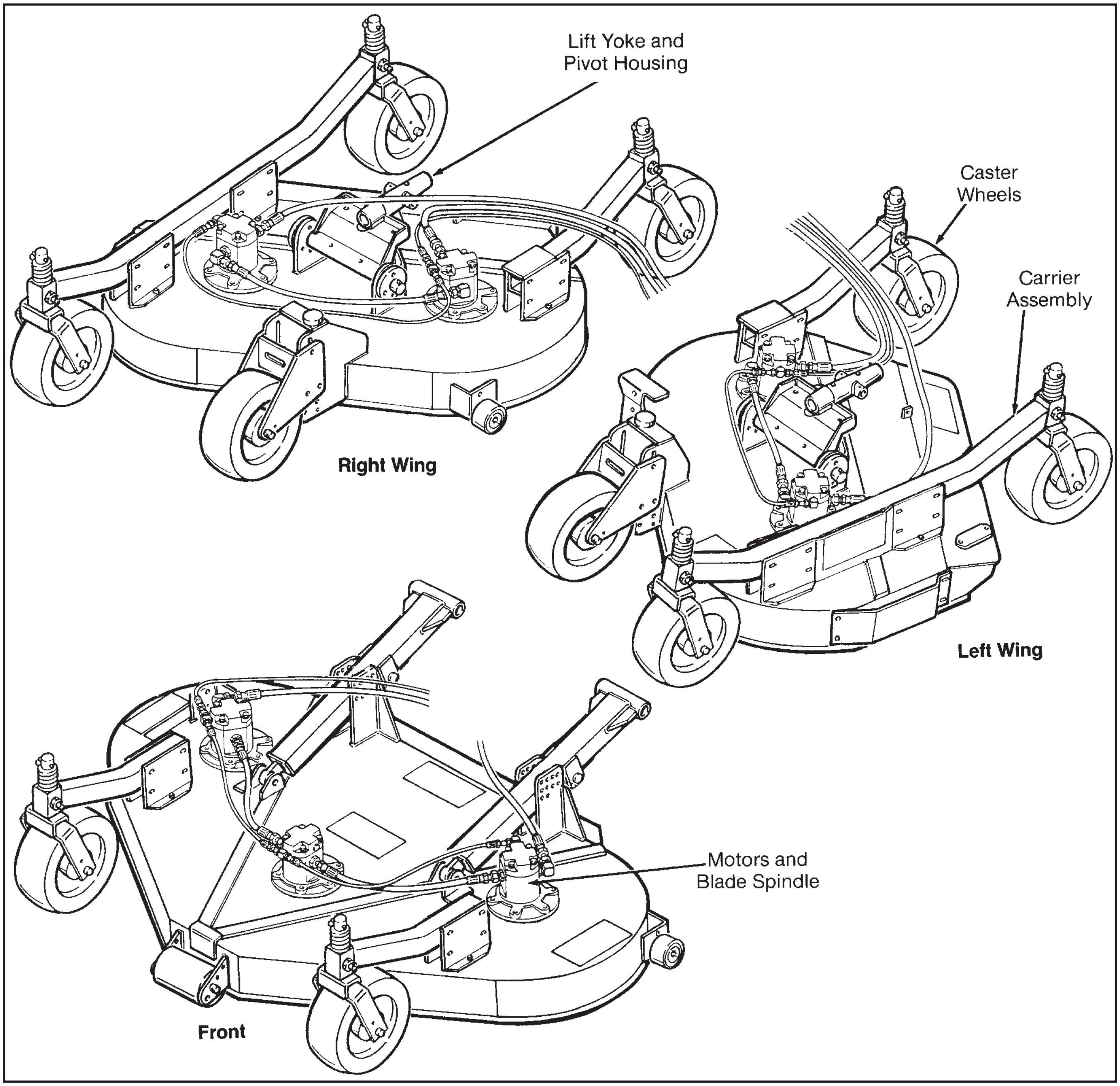


Figure 12C-1. Mowers

SECTION 12D. MOWERS

PIVOT HOUSING AND PUSH ARMS

Removal and installation of the pivot housings and push arms are illustrated in Figure 12D-1.

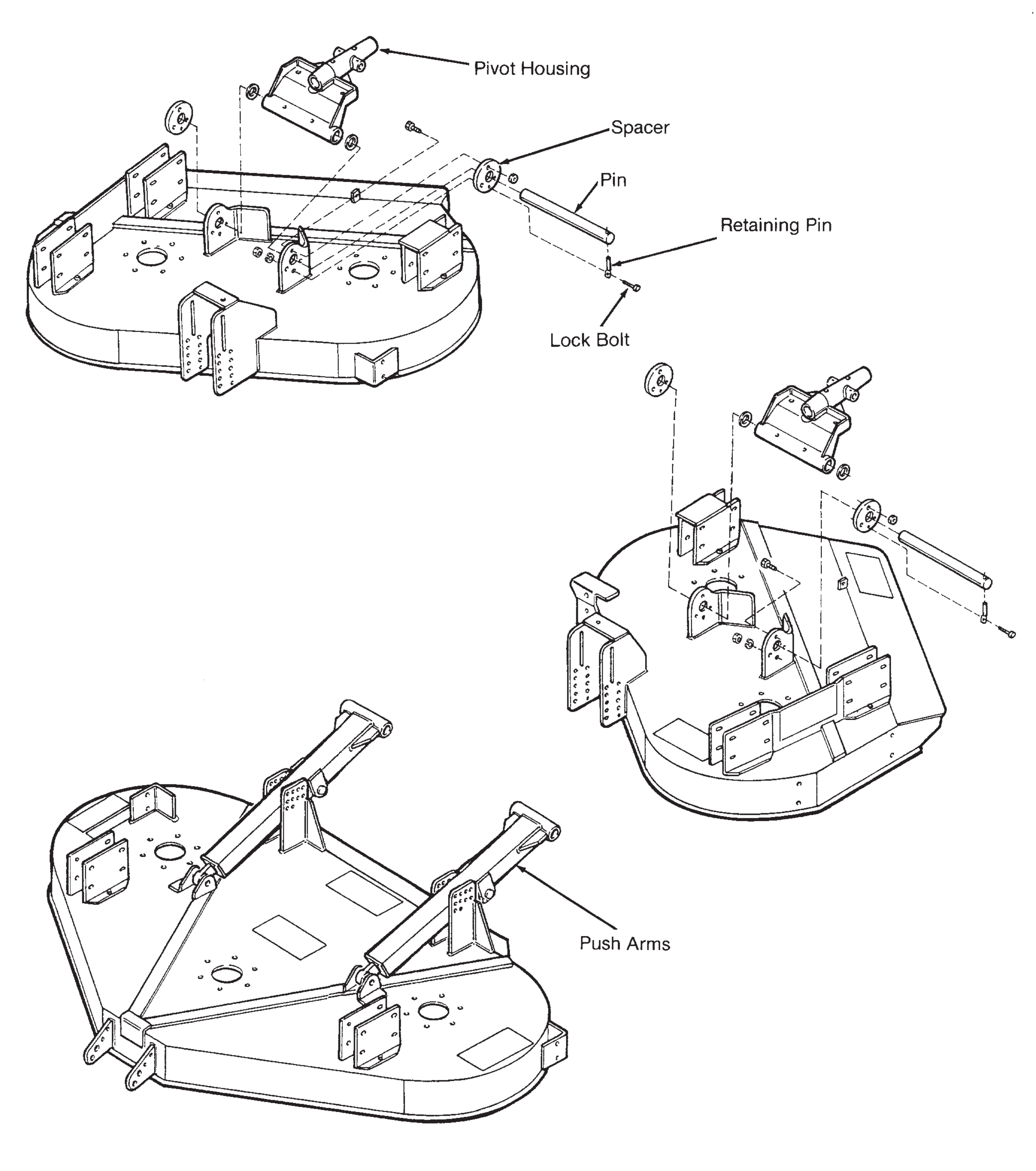


Figure 12D-1. Pivot Housings and Push Arms

SECTION 12D. MOWERS

CARRIER ASSEMBLY

Repair of the carrier assemblies consist of replacing bushings and worn or damaged components, see Figure 12D-2.

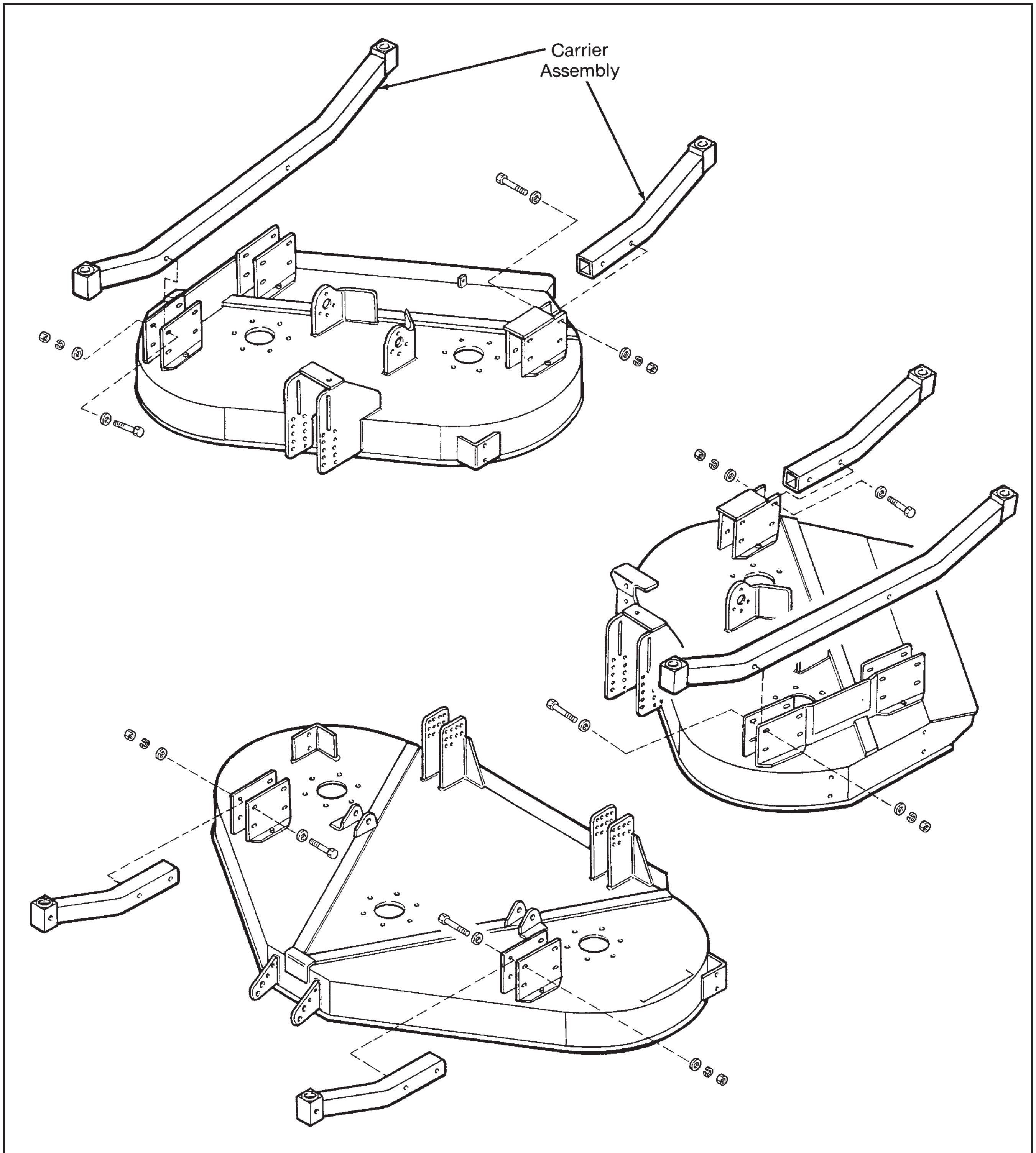


Figure 12D-2. Carrier Assembly

SECTION 12D. MOWERS

DECK FITTINGS

Removal and installation of deck fittings are illustrated in Figure 12D-3.

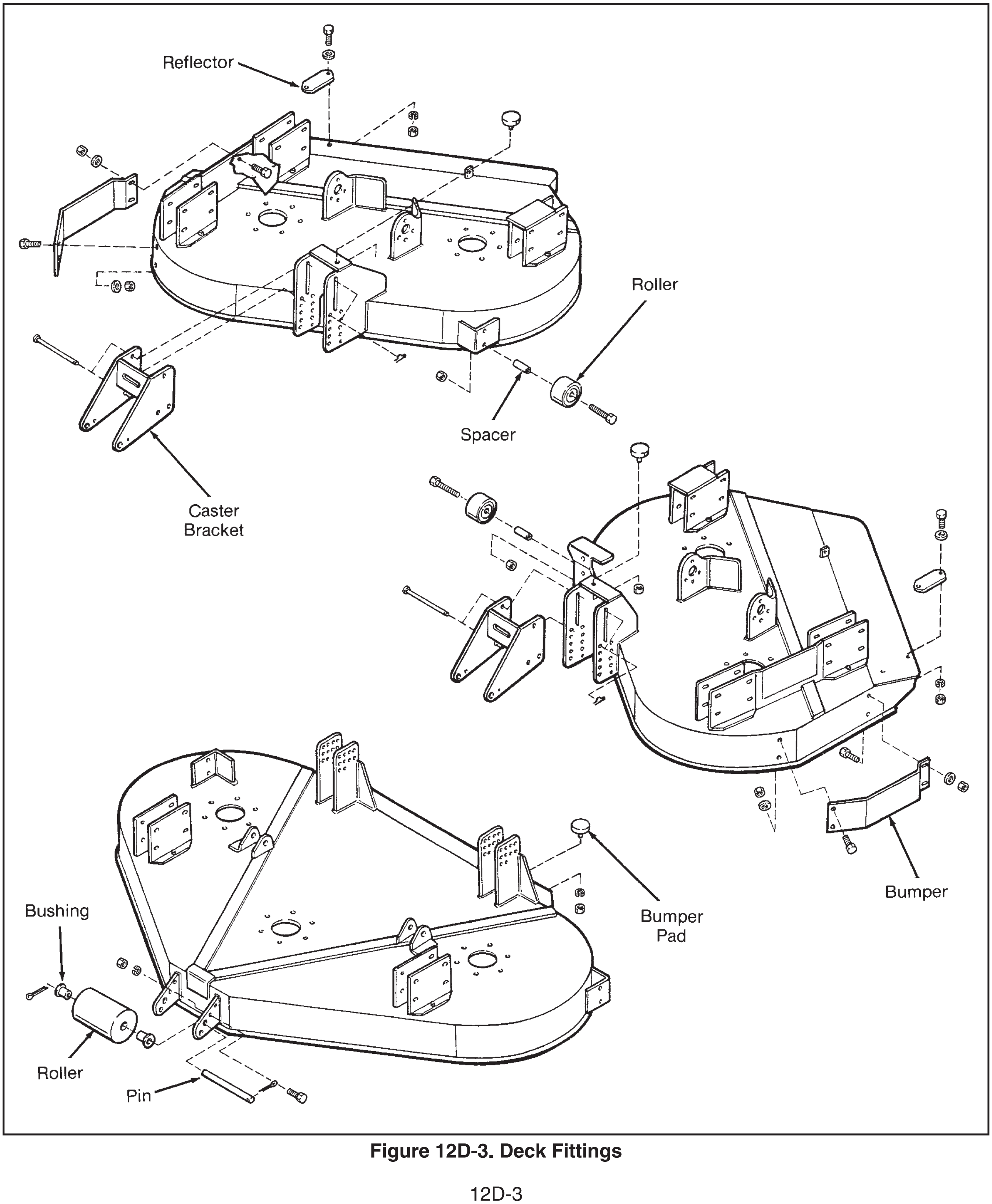


Figure 12D-3. Deck Fittings

SECTION 12D. MOWERS

BLADE SPINDLE ASSEMBLY

GENERAL

There are 7 motors, one for each blade on the HR111. Motor rotation is identified in two ways, first: by their position on the decks, see Figure 12D-4 and second: by the code letter which is part of the model number, see Figure 12D-5.

In this section service of the motors consists only of the spindle assembly. For service of the hydraulic motor see Section 8O.

In most cases the spindle housing and motor do not have to be removed to service the spindle assembly. If the spindle bearing in the housing needs to be replaced it will be necessary to only remove the hydraulic motor.

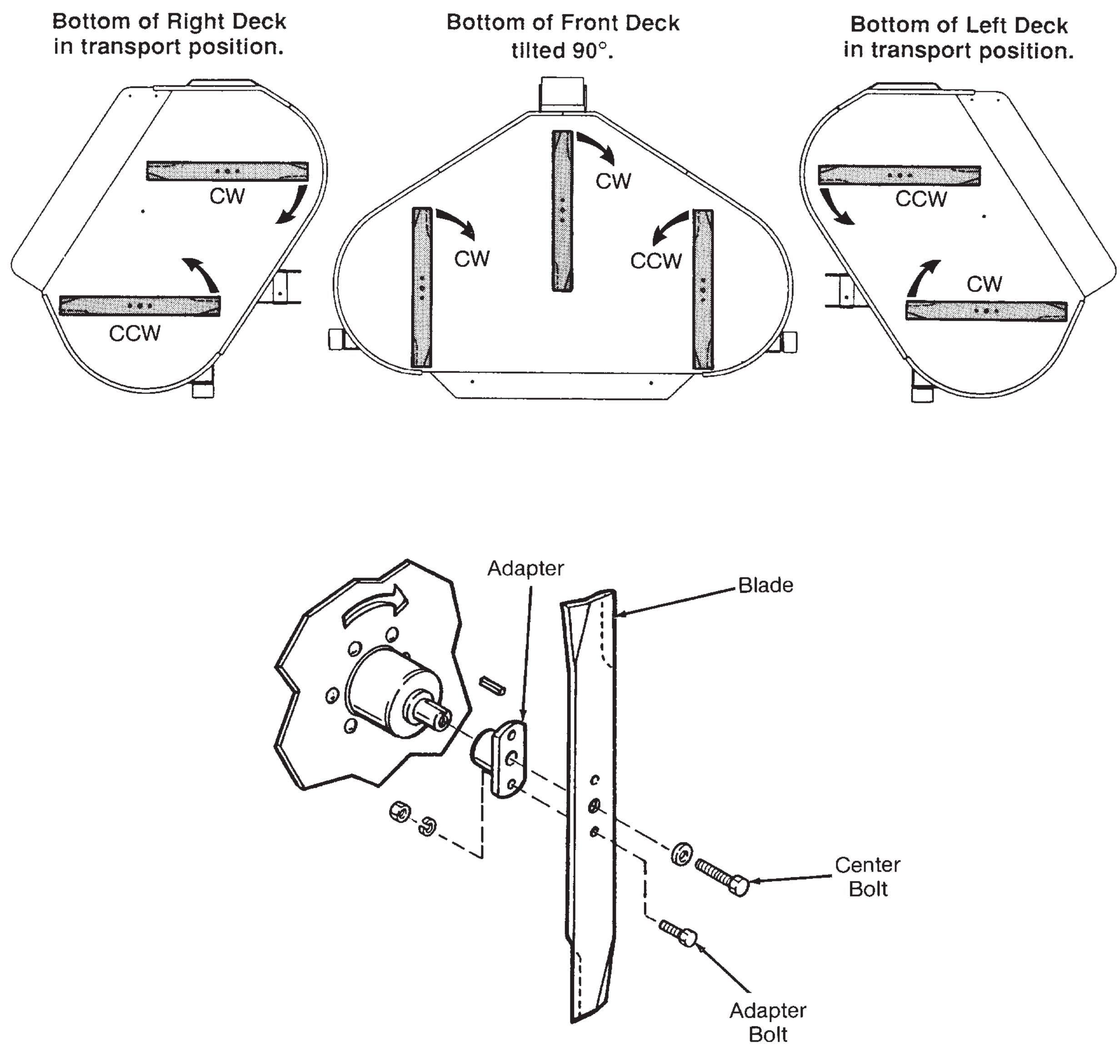


Figure 12D-4. Motor Locations On Decks

SECTION 12D. MOWERS

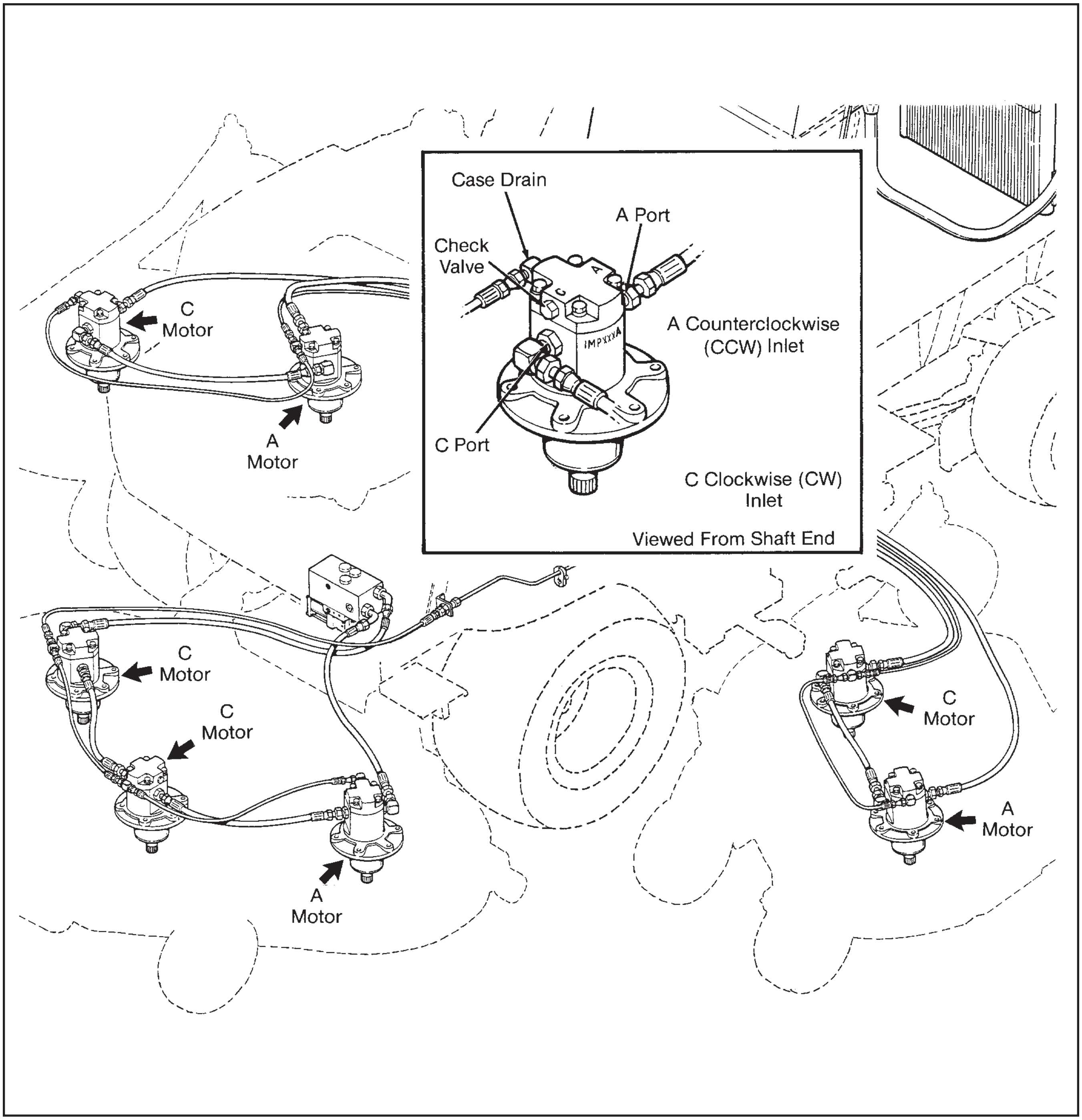


Figure 12D-5. Motor Rotation By Code Letter

SECTION 12D. MOWERS

DISASSEMBLY (See Figure 12D-6)

1. Remove blade and adapter.
2. Remove square drive key.
3. Remove shaft protector.
4. Remove large lock ring.
5. Install blade with adapter.
6. Pull spindle shaft and guide from housing.

NOTE

A suction will be felt when pulling the guide from the housing. The suction will be broken when O-ring clears the housing.

7. Remove blade with adapter.
8. Remove small lock ring.
9. Remove spacer, seal and spindle shaft.

NOTE

Perform Step 10 only if spindle housing bearing is to be changed.

10. Remove motor assembly from spindle housing. Do not disassemble motor.
11. Remove spindle shaft bearing.

REASSEMBLY (See Figure 12D-6)

1. Install spindle bearing if removed.
2. Install motor onto spindle housing. Torque bolts to 18 ft-lbs. (24 N.m).
3. Install spindle shaft.
4. Install spindle shaft guide.
5. Install large snap ring.
6. Install seat (lip to the inside), spacer and small lock ring.
7. Install shaft protector and square drive key.
8. Install blade with adapter. Torque center blade screw to 75 ft-lbs. (102 N.m).
9. Check torque of blade mounting screws, torque to 35–40 ft-lbs. (47–54 N.m).

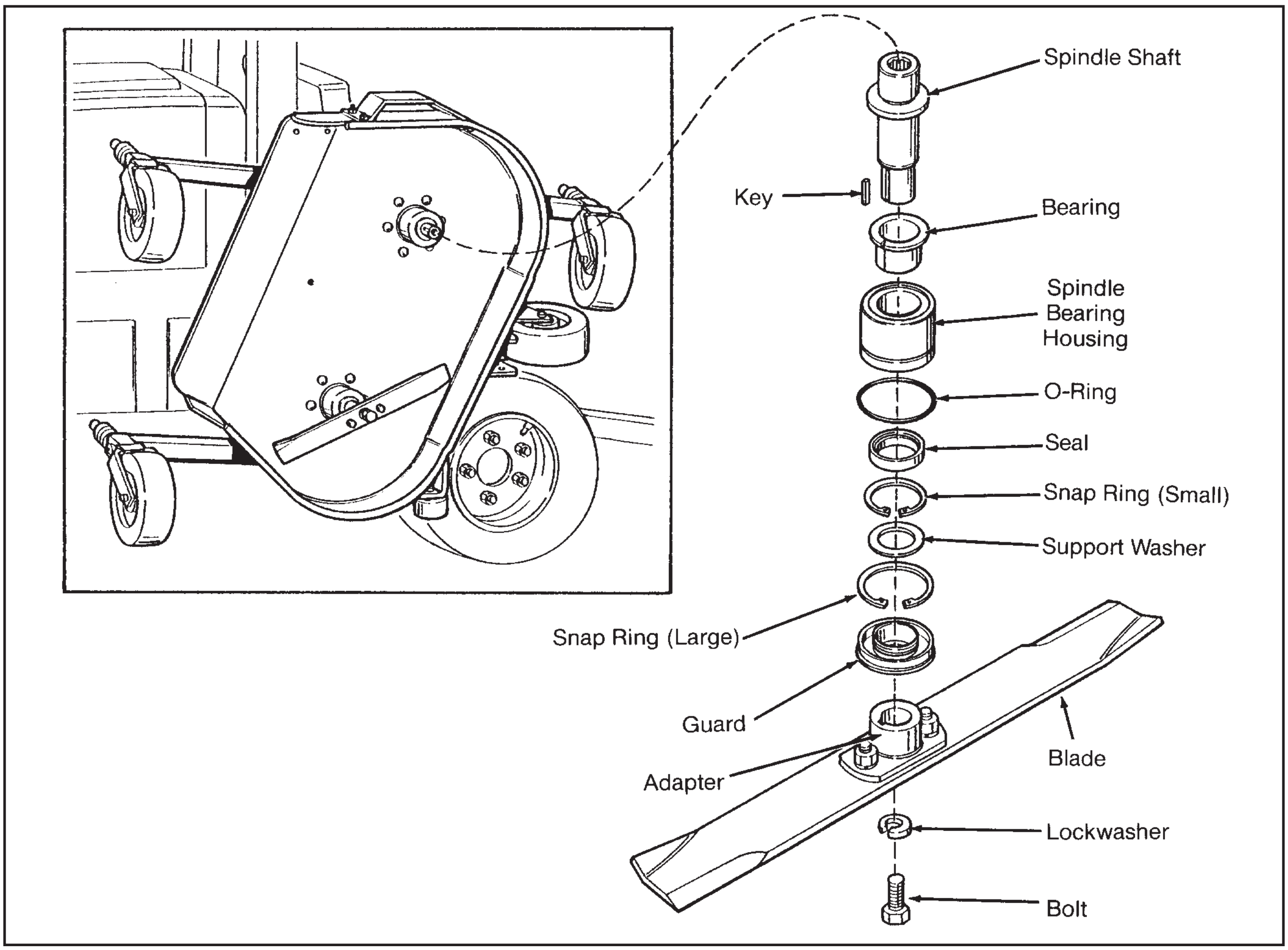


Figure 12D-6. Spindle Assembly

SECTION 12E. BLADES

GENERAL

Every 50 hours examine the cutter bars to make sure they are in good operating condition. See Figure 12E-1.

1. The blades should follow along a straight line and should not be bent.

   Replace all bent blades. The damage may include a microscopic crack which could grow, allowing a piece of the bar to break off and be thrown out from under the mower, causing serious bodily injury.

2. Examining the ends of the blades and at the bend of the air vanes, inspect edge of bar to determine if bar is becoming thin.

⚠ WARNING

Do not attempt to bend blade back to its original flat condition. Replace bar.

3. If wear is allowed to continue, a slit will develop and grow, permitting a piece of the blade to break off. At the first sign of a slit in the bar, the bar must be replaced.

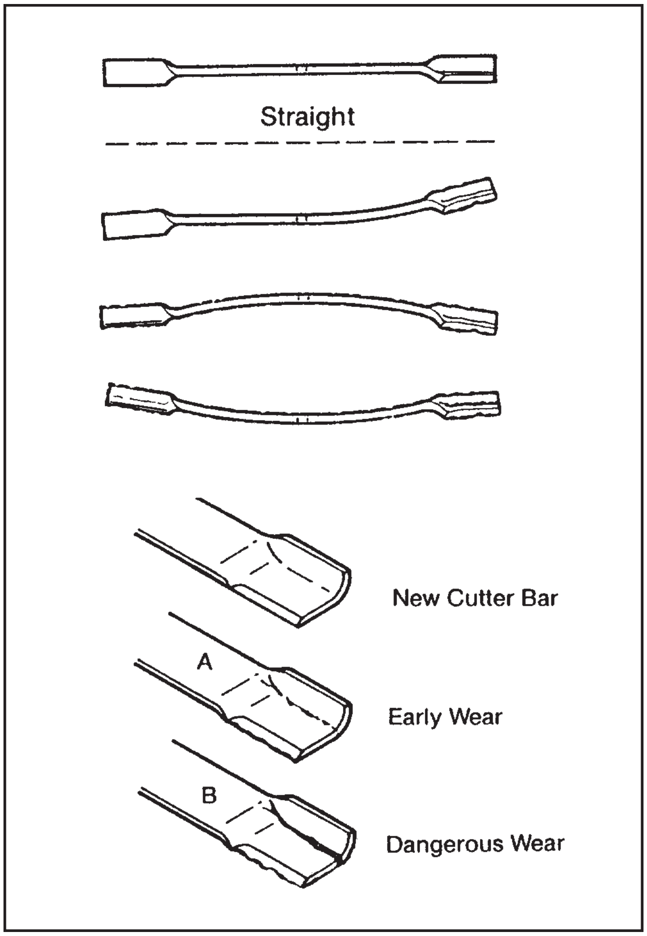


Figure 12E-1. Condition of Blades

SHARPENING

When dressing or resharpening the blades, DO NOT follow the original angle of grind “A”, Figure 12E-2.

1. Grind new cutting edges on a diagonal as shown in “B”.
2. Do not exceed 1/2" (12.7 mm) total metal removed at end of bar.
3. Make sure that each cutting edge receives an equal amount of grinding to prevent having an unbalanced bar, which will cause excessive vibration at high speeds and may damage the mower.

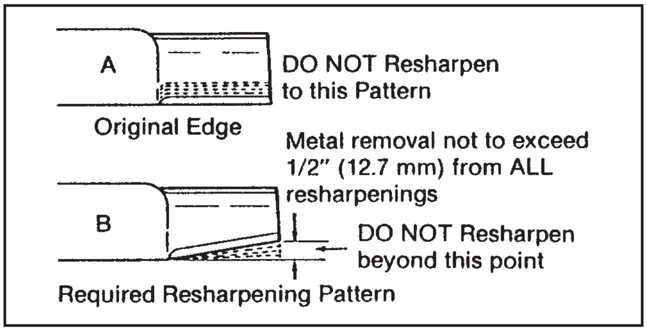


Figure 12E-2. Sharpening

⚠ DANGER

Incorrect resharpening of the blade beyond the point illustrated in “B”, Figure 12E-2, may result in a broken blade tip which may be discharged from under the mower.

4. After blade has been sharpened it must be balanced (see Figure 12E-3).
5. If blade is out of balance remove metal on the heavy end by grinding until bar is balanced.

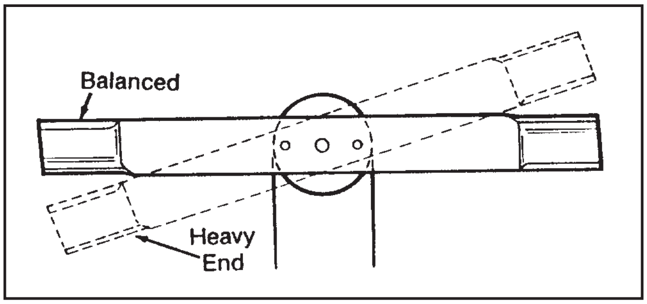


Figure 12E-3. Blade Balance

SECTION 12E. BLADES

BLADE INSTALLATION (See Figure 12E-4)

When installing blades make sure blade is positioned correctly. Torque center blade mounting screw to 75 ft-lbs. (102 N.m) and the two blade mounting adapter screws to 35–40 ft-lbs. (47–54 N.m).

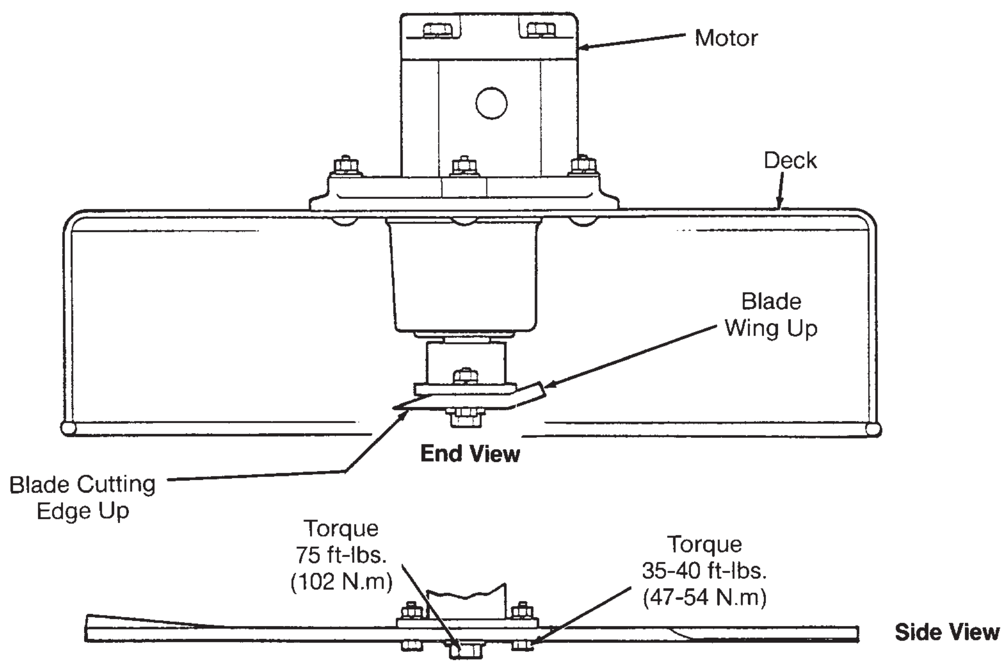


Figure 12E-4. Blade Installation

SECTION 12F. CASTER WHEELS

Repair of the caster wheels consist of replacing bushings and worn or damaged components. See Figure 12F-2.

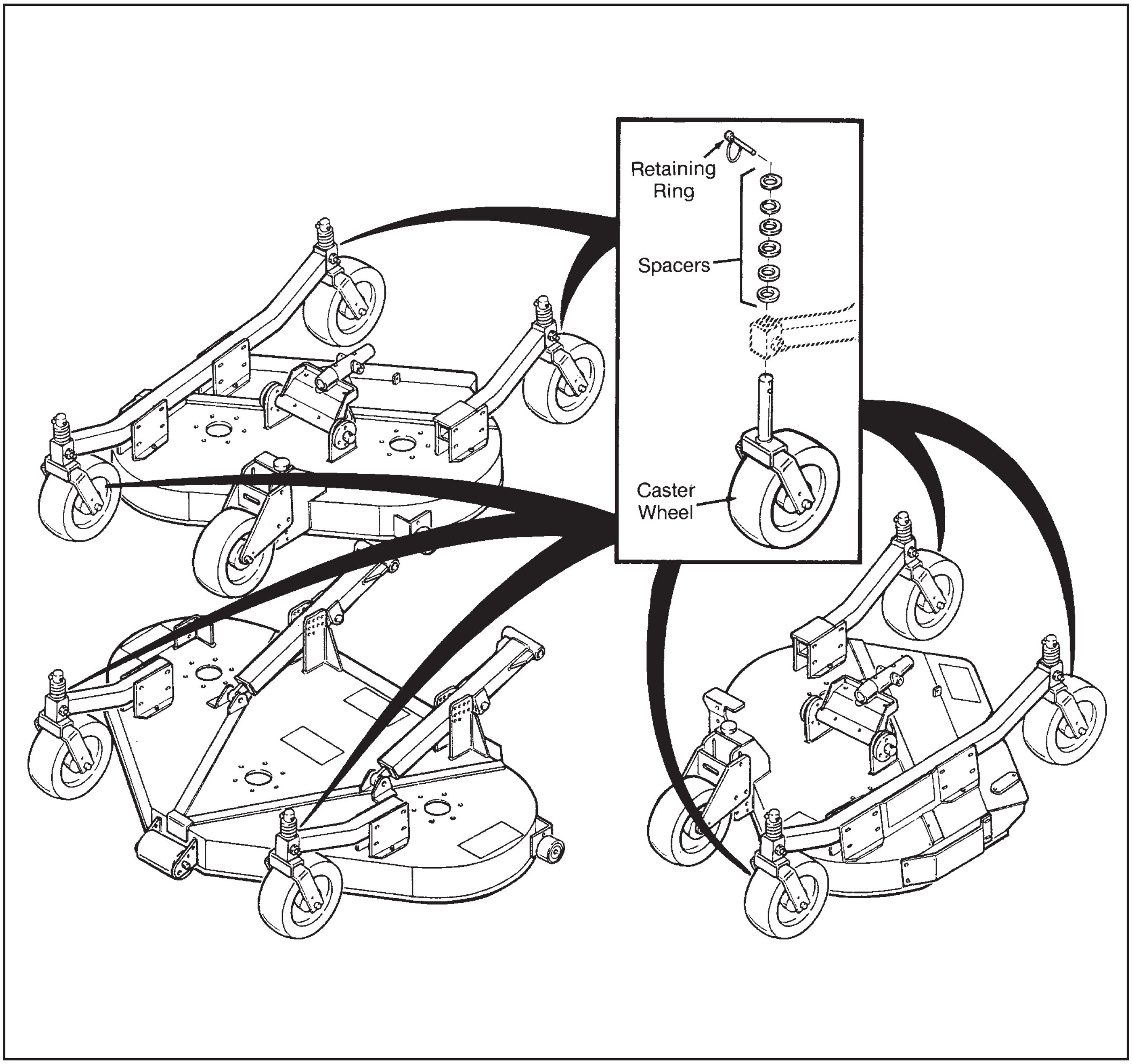


Figure 12F-1. Caster Wheels

SECTION 12F. CASTER WHEELS

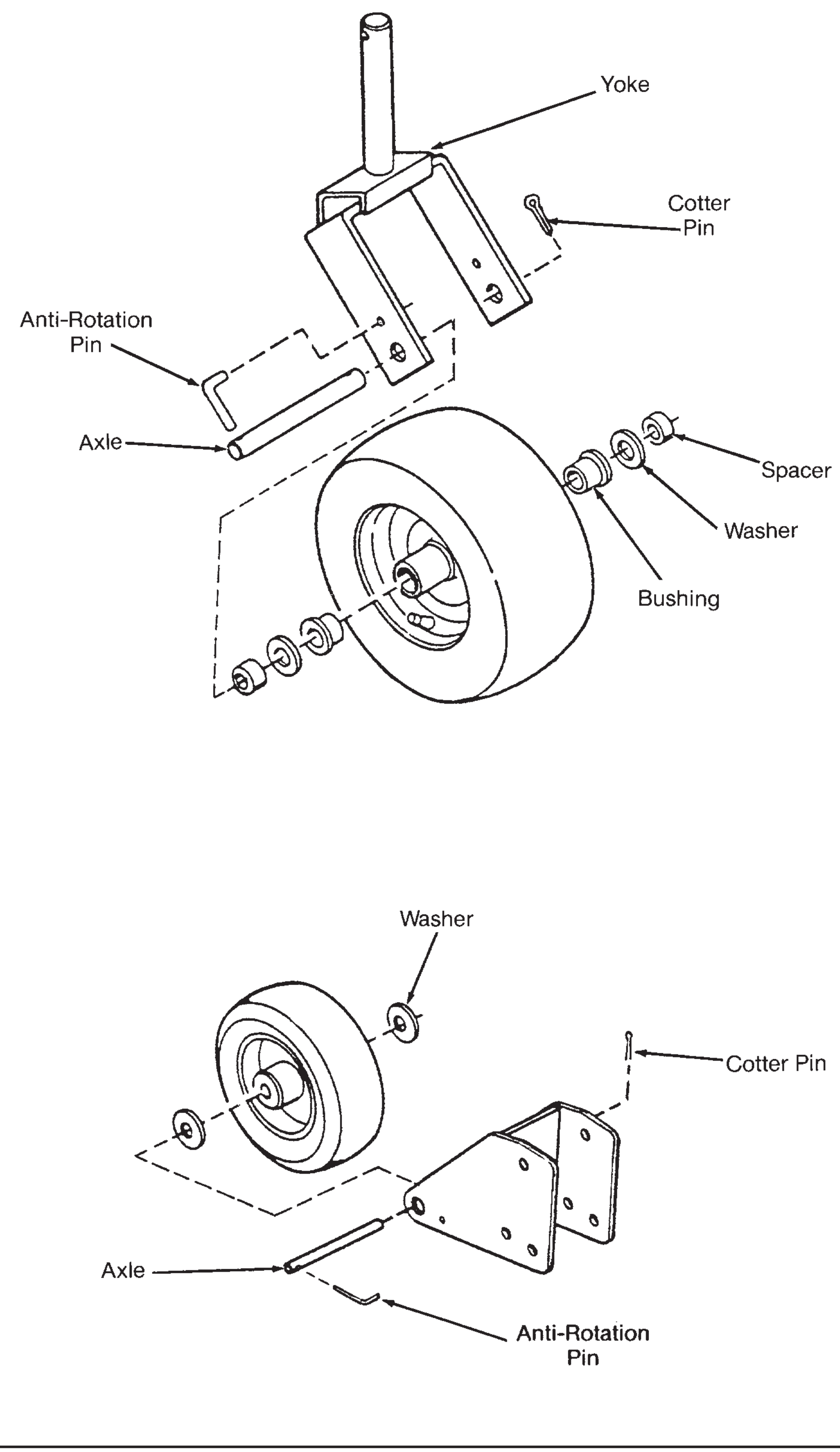


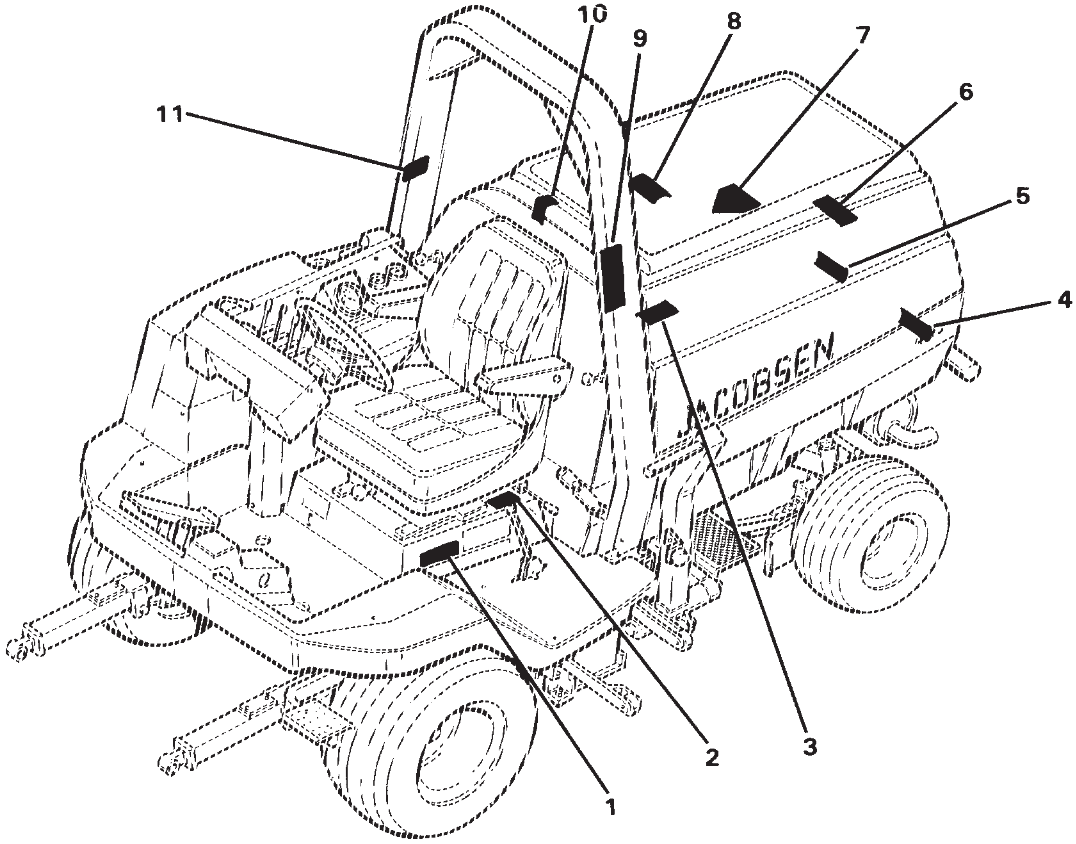
Figure 12F-2. Caster Wheel Repair

SECTION 13
OPTIONS

THIS SECTION INTENTIONALLY LEFT BLANK

SECTION 14
MISCELLANEOUS

SECTION 14A. PRECAUTION DECAL LOCATIONS



TRACTOR

1 Part No. 964907

⚠ CAUTION

TOW VALVE TO BE USED IN CASE OF EMERGENCY ONLY. EXCESS TOWING MAY DAMAGE HYDRAULIC SYSTEM. BEFORE TOWING VEHICLE, TURN VALVE 90° TO DE-CLUTCH. DO NOT TURN VALVE WHILE MACHINE IS IN MOTION.

J-T 364907CA

2 Part No. 365339

⚠ WARNING

DISCONNECTING OR TAMPERING WITH THE SEAT SWITCH CAN CAUSE SERIOUS PERSONAL INJURY.

REFER TO OPERATORS MANUAL FOR PROPER SWITCH OPERATION.

J-T 365339 CA

3 Part No. 365919

⚠ CAUTION

FILL OIL TANK TO 2 INCHES BELOW FILLER NECK.

DO NOT OVERFILL

J-T 365919 CA

SECTION 14A. PRECAUTION DECAL LOCATIONS

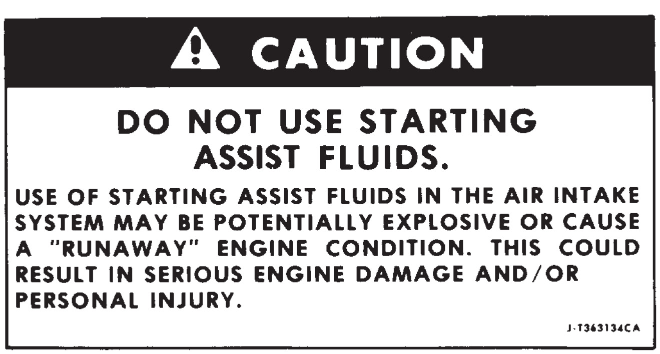
4 Part No. 361175

5 Part No. 339237

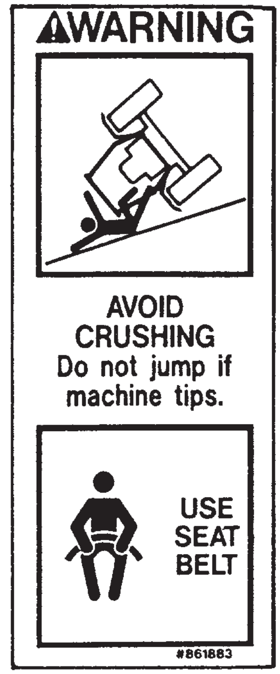
6 Part No. 365956

7 Part No. 339460

8 Part No. 363134



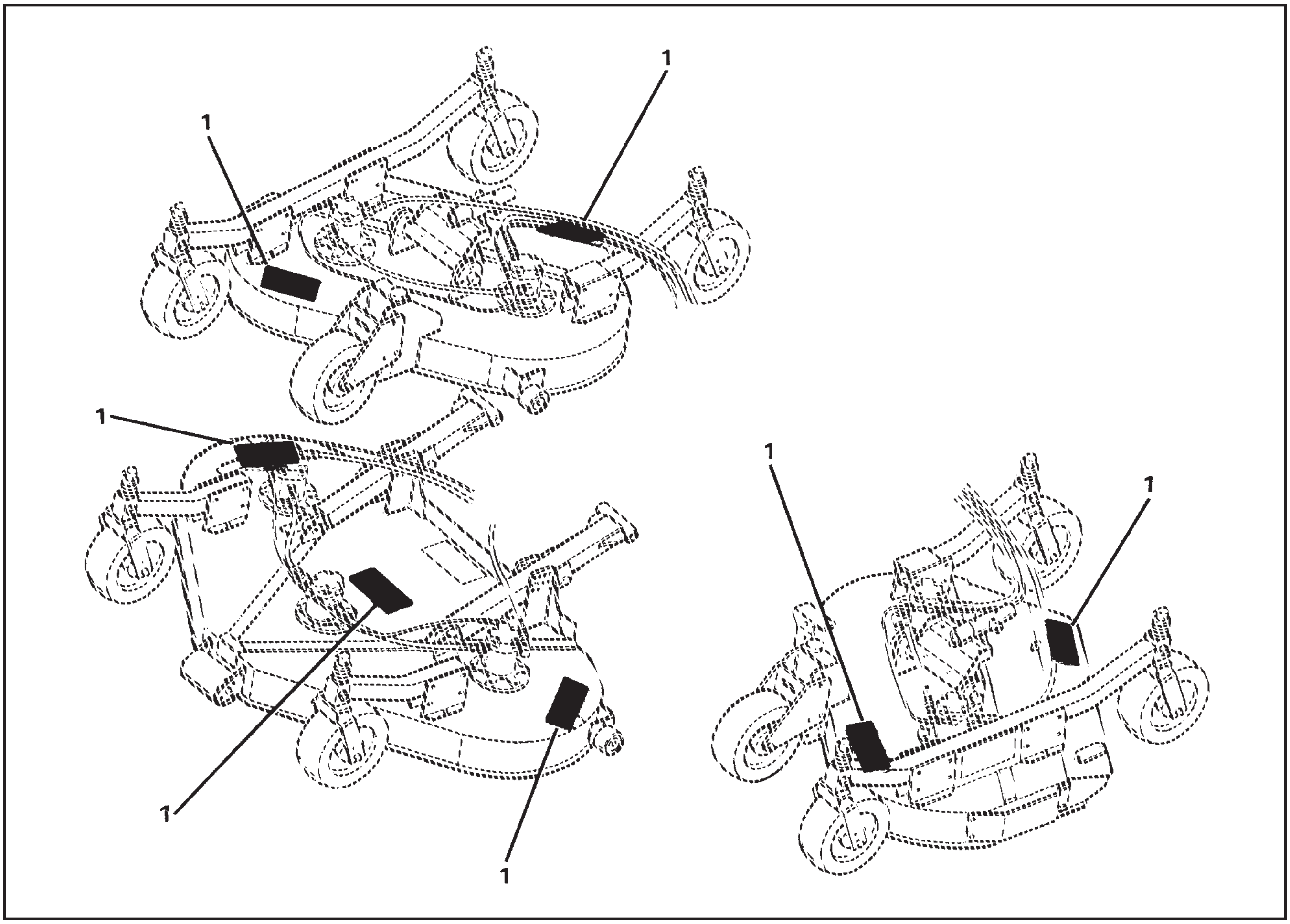
9 Part No. 861883



10 Part No. 366160

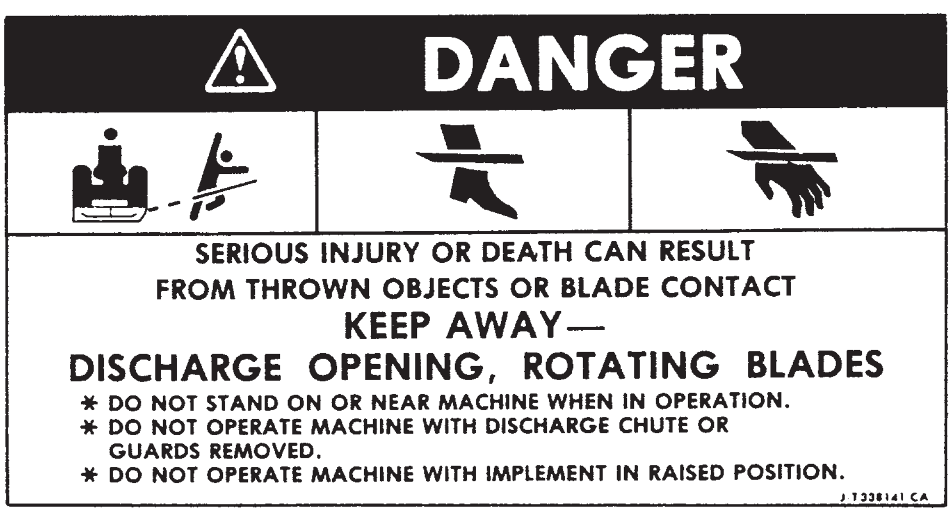
11 Part No. 366527

SECTION 14A. PRECAUTION DECAL LOCATIONS



MOWER

1 Part No. J-T338141



SECTION 14B. CONVERSION CHARTS

MILLIMETERS TO DECIMALS

Starrett® Metric Tools

MILLIMETERS TO DECIMALS

mm	Decimal	mm	Decimal	mm	Decimal	mm	Decimal	mm	Decimal
0.01	.00039	0.41	.01614	0.81	.03189	21	.82677	61	2.40157
0.02	.00079	0.42	.01654	0.82	.03228	22	.86614	62	2.44094
0.03	.00118	0.43	.01693	0.83	.03268	23	.90551	63	2.48031
0.04	.00157	0.44	.01732	0.84	.03307	24	.94488	64	2.51969
0.05	.00197	0.45	.01772	0.85	.03346	25	.98425	65	2.55906
0.06	.00236	0.46	.01811	0.86	.03386	26	1.02362	66	2.59843
0.07	.00276	0.47	.01850	0.87	.03425	27	1.06299	67	2.63780
0.08	.00315	0.48	.01890	0.88	.03465	28	1.10236	68	2.67717
0.09	.00354	0.49	.01929	0.89	.03504	29	1.14173	69	2.71654
0.10	.00394	0.50	.01969	0.90	.03543	30	1.18110	70	2.75591
0.11	.00433	0.51	.02008	0.91	.03583	31	1.22047	71	2.79528
0.12	.00472	0.52	.02047	0.92	.03622	32	1.25984	72	2.83465
0.13	.00512	0.53	.02087	0.93	.03661	33	1.29921	73	2.87402
0.14	.00551	0.54	.02126	0.94	.03701	34	1.33858	74	2.91339
0.15	.00591	0.55	.02165	0.95	.03740	35	1.37795	75	2.95276
0.16	.00630	0.56	.02205	0.96	.03780	36	1.41732	76	2.99213
0.17	.00669	0.57	.02244	0.97	.03819	37	1.45669	77	3.03150
0.18	.00709	0.58	.02283	0.98	.03858	38	1.49606	78	3.07087
0.19	.00748	0.59	.02323	0.99	.03898	39	1.53543	79	3.11024
0.20	.00787	0.60	.02362	1.00	.03937	40	1.57480	80	3.14961
0.21	.00827	0.61	.02402	1	.03937	41	1.61417	81	3.18898
0.22	.00866	0.62	.02441	2	.07874	42	1.65354	82	3.22835
0.23	.00906	0.63	.02480	3	.11811	43	1.69291	83	3.26772
0.24	.00945	0.64	.02520	4	.15748	44	1.73228	84	3.30709
0.25	.00984	0.65	.02559	5	.19685	45	1.77165	85	3.34646
0.26	.01024	0.66	.02598	6	.23622	46	1.81102	86	3.38583
0.27	.01063	0.67	.02638	7	.27559	47	1.85039	87	3.42520
0.28	.01102	0.68	.02677	8	.31496	48	1.88976	88	3.46457
0.29	.01142	0.69	.02717	9	.35433	49	1.92913	89	3.50394
0.30	.01181	0.70	.02756	10	.39370	50	1.96850	90	3.54331
0.31	.01220	0.71	.02795	11	.43307	51	2.00787	91	3.58268
0.32	.01260	0.72	.02835	12	.47244	52	2.04724	92	3.62205
0.33	.01299	0.73	.02874	13	.51181	53	2.08661	93	3.66142
0.34	.01339	0.74	.02913	14	.55118	54	2.12598	94	3.70079
0.35	.01378	0.75	.02953	15	.59055	55	2.16535	95	3.74016
0.36	.01417	0.76	.02992	16	.62992	56	2.20472	96	3.77953
0.37	.01457	0.77	.03032	17	.66929	57	2.24409	97	3.81890
0.38	.01496	0.78	.03071	18	.70866	58	2.28346	98	3.85827
0.39	.01535	0.79	.03110	19	.74803	59	2.32283	99	3.89764
0.40	.01575	0.80	.03150	20	.78740	60	2.36220	100	3.93701

THE L. S. STARRETT COMPANY
Athol, Massachusetts 01331, U. S. A.

SECTION 14B. CONVERSION CHARTS

DECIMALS TO MILLIMETERS, FRACTIONS TO DECIMALS TO MILLIMETERS

Starrett® Metric Tools

DECIMALS TO MILLIMETERS

Decimal	mm	Decimal	mm
0.001	0.0254	0.500	12.7000
0.002	0.0508	0.510	12.9540
0.003	0.0762	0.520	13.2080
0.004	0.1016	0.530	13.4620
0.005	0.1270	0.540	13.7160
0.006	0.1524	0.550	13.9700
0.007	0.1778	0.560	14.2240
0.008	0.2032	0.570	14.4780
0.009	0.2286	0.580	14.7320
0.010	0.2540	0.590	14.9860
0.020	0.5080	0.600	15.2400
0.030	0.7620	0.610	15.4940
0.040	1.0160	0.620	15.7480
0.050	1.2700	0.630	16.0020
0.060	1.5240	0.640	16.2560
0.070	1.7780	0.650	16.5100
0.080	2.0320	0.660	16.7640
0.090	2.2860	0.670	17.0180
0.100	2.5400	0.680	17.2720
0.110	2.7940	0.690	17.5260
0.120	3.0480	0.700	17.7800
0.130	3.3020	0.710	18.0340
0.140	3.5560	0.720	18.2880
0.150	3.8100	0.730	18.5420
0.160	4.0640	0.740	18.7960
0.170	4.3180	0.750	19.0500
0.180	4.5720	0.760	19.3040
0.190	4.8260	0.770	19.5580
0.200	5.0800	0.780	19.8120
0.210	5.3340	0.790	20.0660
0.220	5.5880	0.800	20.3200
0.230	5.8420	0.810	20.5740
0.240	6.0960	0.820	20.8280
0.250	6.3500	0.830	21.0820
0.260	6.6040	0.840	21.3360
0.270	6.8580	0.850	21.5900
0.280	7.1120	0.860	21.8440
0.290	7.3660	0.870	22.0980
0.300	7.6200	0.880	22.3520
0.310	7.8740	0.890	22.6060
0.320	8.1280	0.900	22.8600
0.330	8.3820	0.910	23.1140
0.340	8.6360	0.920	23.3680
0.350	8.8900	0.930	23.6220
0.360	9.1440	0.940	23.8760
0.370	9.3980	0.950	24.1300
0.380	9.6520	0.960	24.3840
0.390	9.9060	0.970	24.6380
0.400	10.1600	0.980	24.8920
0.410	10.4140	0.990	25.1460
0.420	10.6680	1.000	25.4000
0.430	10.9220		
0.440	11.1760		
0.450	11.4300		
0.460	11.6840		
0.470	11.9380		
0.480	12.1920		
0.490	12.4460		

FRACTIONS TO DECIMALS TO MILLIMETERS

Fraction	Decimal	mm	Fraction	Decimal	mm
1/64	0.0156	0.3969	33/64	0.5156	13.0969
1/32	0.0312	0.7938	17/32	0.5312	13.4938
3/64	0.0469	1.1906	35/64	0.5469	13.8906
1/16	0.0625	1.5875	9/16	0.5625	14.2875
5/64	0.0781	1.9844	37/64	0.5781	14.6844
3/32	0.0938	2.3812	19/32	0.5938	15.0812
7/64	0.1094	2.7781	39/64	0.6094	15.4781
1/8	0.1250	3.1750	5/8	0.6250	15.8750
9/64	0.1406	3.5719	41/64	0.6406	16.2719
5/32	0.1562	3.9688	21/32	0.6562	16.6688
11/64	0.1719	4.3656	43/64	0.6719	17.0656
3/16	0.1875	4.7625	11/16	0.6875	17.4625
13/64	0.2031	5.1594	45/64	0.7031	17.8594
7/32	0.2188	5.5562	23/32	0.7188	18.2562
15/64	0.2344	5.9531	47/64	0.7344	18.6531
1/4	0.2500	6.3500	3/4	0.7500	19.0500
17/64	0.2656	6.7469	49/64	0.7656	19.4469
9/32	0.2812	7.1438	25/32	0.7812	19.8438
19/64	0.2969	7.5406	51/64	0.7969	20.2406
5/16	0.3125	7.9375	13/16	0.8125	20.6375
21/64	0.3281	8.3344	53/64	0.8281	21.0344
11/32	0.3438	8.7312	27/32	0.8438	21.4312
23/64	0.3594	9.1281	55/64	0.8594	21.8281
3/8	0.3750	9.5250	7/8	0.8750	22.2250
25/64	0.3906	9.9219	57/64	0.8906	22.6219
13/32	0.4062	10.3188	29/32	0.9062	23.0188
27/64	0.4219	10.7156	59/64	0.9219	23.4156
7/16	0.4375	11.1125	15/16	0.9375	23.8125
29/64	0.4531	11.5094	61/64	0.9531	24.2094
15/32	0.4688	11.9062	31/32	0.9688	24.6062
31/64	0.4844	12.3031	63/64	0.9844	25.0031
1/2	0.5000	12.7000	1	1.0000	25.4000

SECTION 14B. CONVERSION CHARTS

U.S. TO METRIC CONVERSIONS

	To Convert	Into	Divide By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
		Bars	14.5
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32° 2. Multiply by 5/9