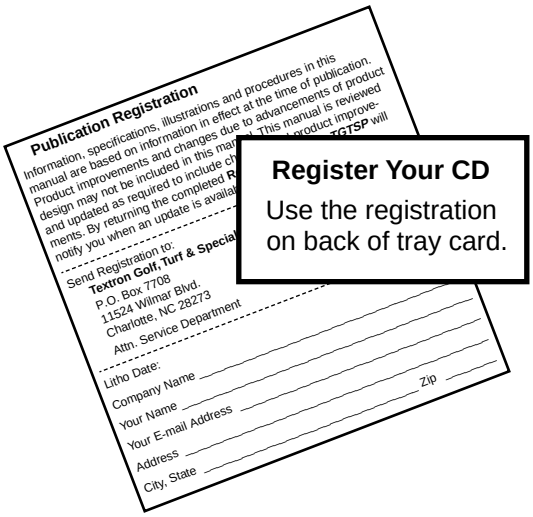
CUSHMAN

TEXTRON

SERVICE & REPAIR INSTRUCTIONS

TURF-TRUCKSTER®



DIESEL & GASOLINE ENGINES

MANUAL TRANSMISSION

TEXTRON
GOLF, TURF & SPECIALTY PRODUCTS

Litho in U.S.A. 08/00
Revised 12/01

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.

CD-SRI-TRKMNL

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TABLE OF CONTENTS

SECTION 1
INTRODUCTION

SECTION 1A. GENERAL INFORMATION

CONTENTS

This manual contains repair instructions for truck 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 appropriate operations and parts manuals for this equipment.

This manual is for trucks equipped with hydraulic actuated dump boxes. Manuals covering optional accessories (such as sprayers and core harvesters) are listed in Section 13 of this manual.

This manual covers models with engine and rear axle variations listed in the table below.

Normal maintenance, adjustment, and operating procedures are also covered in the user operator's manuals and are only included where appropriate in this 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 sitting in the normal operating position.

REGISTRATION

A registration card is provided in the back of this manual (bottom portion of page). Fill out the card, remove and mail immediately upon opening the manual for the first time.

The registration entitles you to receive manual updates for a period of two years. Updates are sent free of charge.

NOTE

Only the original registration card will be accepted. Photo copies, cards from other manuals, suggestion cards, or any facsimile are not acceptable and will not constitute a registration.

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.

MODEL DIFFERENCES

Engine	Rear Axle
Suzuki 660, 3-cylinder, gasoline, 31 hp (23.1 kW) at 4450 RPM, 6.7" (170 mm) clutch	2-speed hypoid, 14.21:1 ratio
Suzuki 970, 4-cylinder, gasoline, 34 hp (25.4 kW) at 3600 RPM, 7.1" (180 mm) clutch	2-speed hypoid, 11.16:1 ratio
Perkins 103-10, 3-cylinder, diesel, 22.3 hp (16.6 kW) at 3000 RPM, 7.1" (180 mm) clutch	2-speed hypoid, 11.16:1 ratio

SECTION 1A. GENERAL INFORMATION

REPLACEMENT PARTS

Use the appropriate parts manual when ordering replacement parts. Follow installation instructions shipped with service parts or kits. When ordering parts, always give the model number and serial number of your machine as well as quantity, part number and description of the parts needed (see Figure 1A-1 for model and serial number location).

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 MODEL (or PRODUCT) NUMBER, NAME and SERIAL NUMBER that is stamped on name and serial number plates on your unit.
4. Order by QUANTITY DESIRED, the PART NUMBER and the DESCRIPTION OF PART.
5. Send your order to or visit your nearest AUTHORIZED TURF EQUIPMENT dealer and 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 dealer or 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.

IDENTIFICATION NUMBERS

See Figure 1A-1 for location of vehicle model and serial numbers.

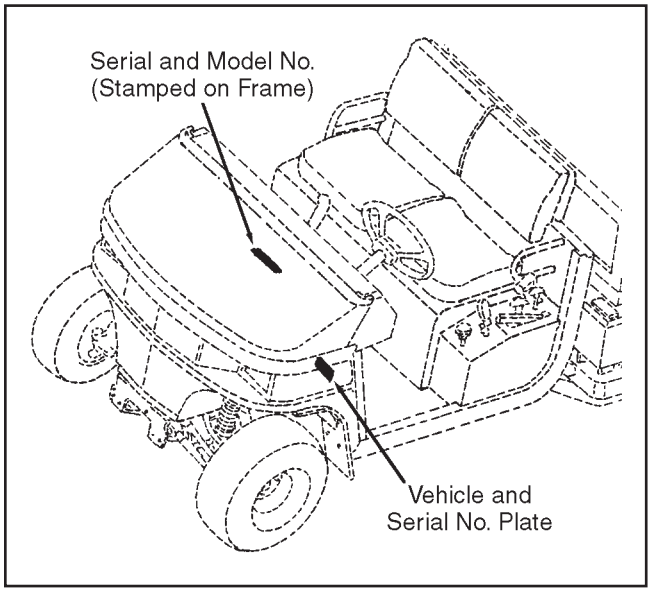

Figure 1A-1. Identification

GENERAL CLEANING

Improper cleaning and lubrication of your vehicle 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 vehicle.

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.

In addition to the decals on the vehicle, you must know and observe all cautions, warnings and danger precautions given in your vehicle's Safety and Operation Manual(s).

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.

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

ACCESS LATCHES (See Figure 1A-2)

ACCESS TO ENGINE

WARNING

The engine cover is a MACHINERY GUARD and its removal exposes you to moving parts. Keep hands, hair and clothing away from flywheel, radiator cooling fan, alternator fan, engine belts, pulleys and air intake. Never remove or install the engine cover while engine is running.

For servicing the engine and related components, the engine cover can be tilted forward or removed. To gain access to the engine, push the engine cover latch to the rear of the unit, tilt cover forward. The latch is located at the center rear on top of the engine cover (between the seat cushion(s) and backwall).

NOTE

European market (CE compliant) vehicles have a key which is used to release a locking handle at the side of the engine cover latch. Turn the key to allow the latch to be pushed back.

DUMP BOX RELEASE LEVER

For servicing drive train and other components mounted under the dump box, pull back the dump box lever to extend the hydraulic cylinder and raise the dump box. Push forward on the dump box lever to lower the dump box.

FRONT COWL ACCESS

The front cowl opens to gain access to the fuse panel, the horn, the master cylinder reservoir as well as various access panels which when removed, allow access to the shifting lever linkage and front suspension.

To open the front cowl, locate the release lever next to the left side headlight.

Pull the lever to the right to release the front cowl latch and at the same time pull up on the front cowl.

Open the cowl allowing it to rest against the ROPS structure (if equipped) or the steering wheel.

The front cowl will not “spring up” when the release lever is pulled. The cowl will have to be raised when the latch is released.

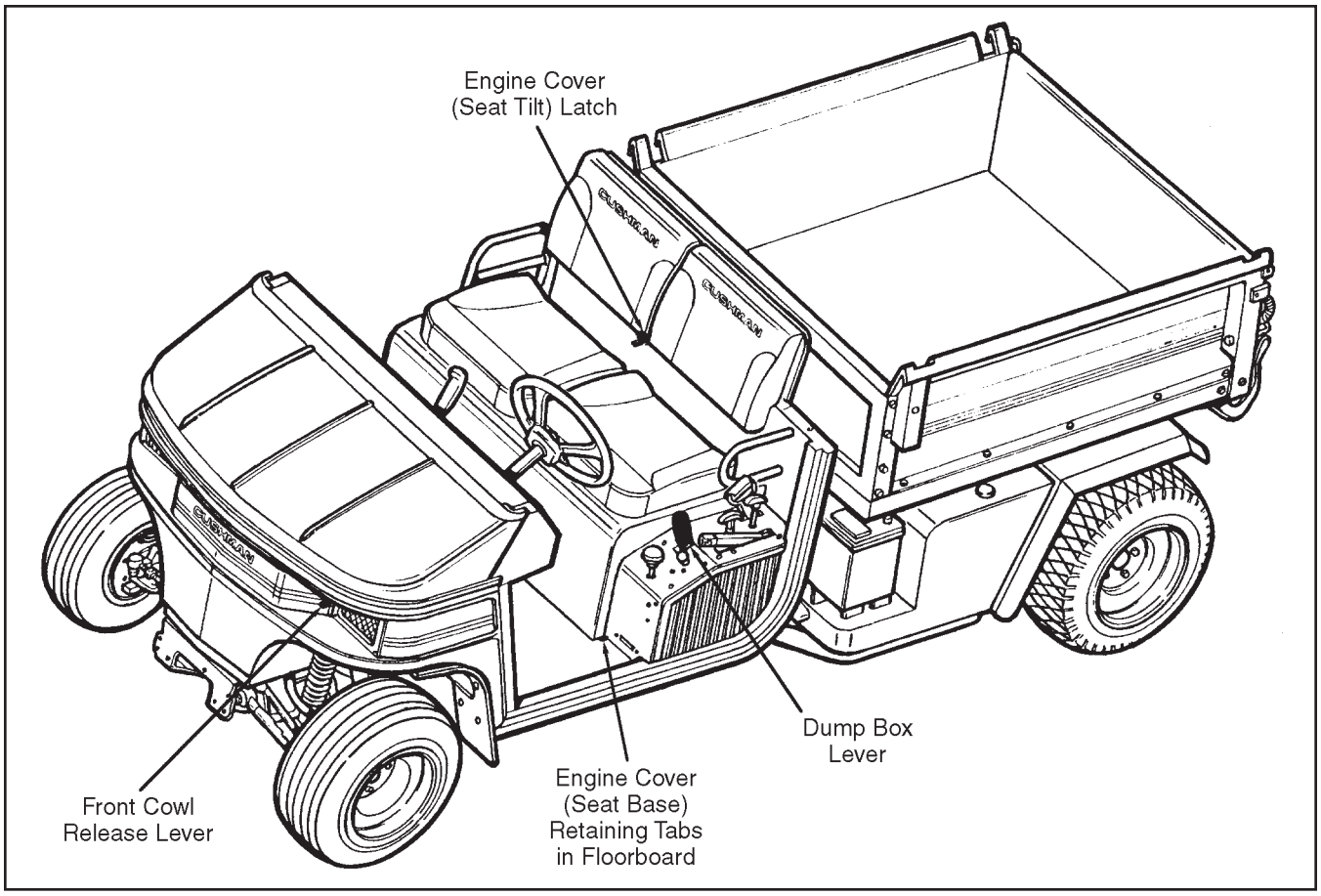

Figure 1A-2. Access Latches

SECTION 1A. GENERAL INFORMATION

JACKS, JACKING LOCATIONS AND USING A HOIST

A scissors type jack or a floor jack with a 1-1/2 ton (minimum) capacity that can be lowered to 3-3/8 inches (86 mm) height is required.

The jacking locations are shown in Figure 1A-3.

Put the gear selector in 1st gear. Apply the park brake. Raise the vehicle only enough to perform maintenance required.

Place a jack in the appropriate location (see Figure 1A-3) and place a block behind (or in front) of the tire diagonally opposite the side which is being raised (see Figure 1A-4).

WARNING

Do not rely solely on hydraulic or mechanical jacks for support. Use appropriate jack stands or equivalent for supporting the vehicle. If using a hoist, raise vehicle to appropriate height and support using jack stands or equivalent support.

Never place feet, hands or any part of your body under the vehicle when raising it with a hoist.

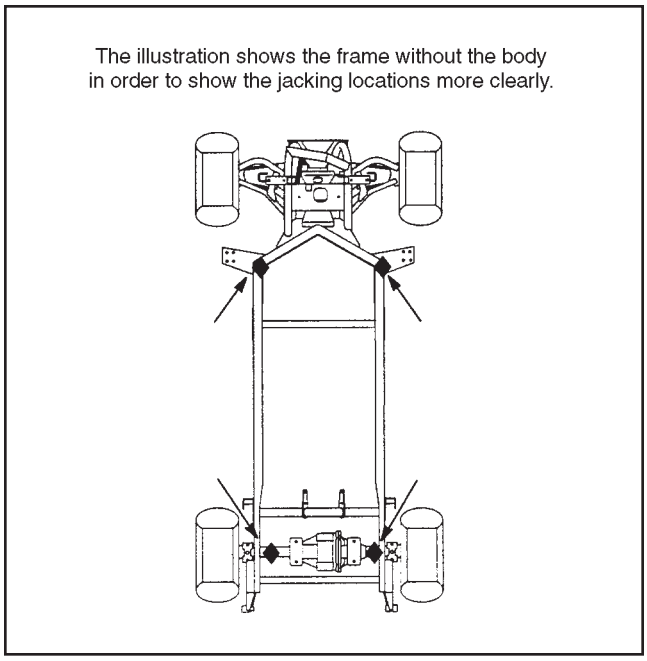

Figure 1A-3. Jacking Locations

Jack the vehicle to the appropriate height and place jack stands or equivalent support beneath the frame near the jack. Lower the jack and allow the vehicle to rest on the jack stands. Raise the vehicle only enough to perform the maintenance required.

Make sure to block the tire diagonally opposite of the side which is being raised (see Figure 1A-4).

When using a hoist to raise the vehicle, use the same procedure for supporting the frame and blocking the tires as you would when using a jack.

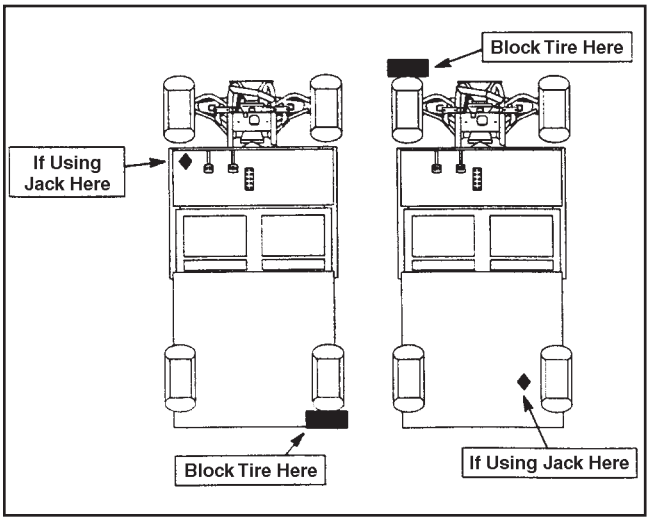

Figure 1A-4. Blocking

CAUTION

To prevent damage to the vehicle or attached accessory, never use a hoist to raise only one corner of the vehicle. Always raise both front or rear corners equally.

SECTION 1A. GENERAL INFORMATION

TOWING

If for any reason the vehicle needs to be towed, follow the guidelines below to properly tow the vehicle.

If towing the vehicle with a tow-rope or a chain, an operator is required to steer the vehicle and to control the brakes.

Attach a tow line only to the front vertical frame member on either side of vehicle as shown in Figure 1A-5.

Make sure the drive transmission is in “neutral” (out of gear) and the park brake is released.

With the tow line attached, have the towing vehicle move forward until the tow line becomes tight.

WARNING

Never tow the vehicle faster than 5 M.P.H. (8 km/h). Towing at excessive speed could cause either vehicle to lose proper steering control.

While towing, try to keep the tow line taut at all times. Be cautious going down inclines and while turning corners.

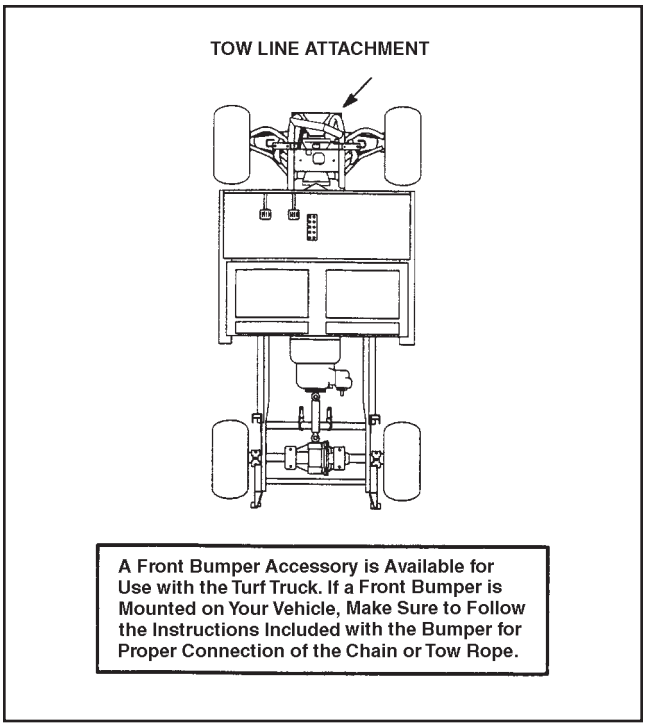

Figure 1A-5. Tow Line Attachment Locations

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SECTION 2
CONTROLS

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.

PROBLEM	PROBABLE CAUSE	REMEDY
1. Engine does not turn over when ignition switch is engaged.	a. Battery dead. b. Circuit breaker tripped. c. Clutch not disengaged. d. Faulty starter. e. Faulty clutch switch. f. Faulty PTO switch. g. Faulty ignition switch. h. Faulty electrical circuit.	a. Charge or replace (Section 10). b. Reset. c. Push pedal and disengage. d. Test (Section 10). e. Test (Section 10). f. Test (Section 10). g. Test (Section 10). h. Test (Section 10).
2. Engine turns over but does not start.	a. Battery low. b. No fuel. c. Glow plugs not set (diesel). d. Faulty glow plug switch (diesel). e. Faulty glow plugs (diesel). f. Faulty system relay. g. Faulty fuel solenoid (diesel). h. Faulty ignition system (gas).	a. Charge or replace (Section 10). b. Fill. c. Set for 7 seconds. d. Test (Section 10). e. Test (Section 10). f. Test (Section 10). g. Test (Section 10). h. Test (Section 3E).
3. Parking brake does not hold.	a. Brake not adjusted. b. Worn brakes.	a. Adjust (Section 2). b. Replace (Section 5).
4. Slow traction speed.	a. Parking brake not released. b. Clutch slipping.	a. Release. b. Adjust (Section 4).
5. Instrument(s) do not work.	a. Circuit breaker tripped. b. Faulty instrument(s). c. Faulty electrical circuit.	a. Reset. b. Replace (Section 2D). c. Test (Section 10).
6. Glow plugs do not light (diesel).	a. Circuit breaker tripped. b. Faulty glow plug(s). c. Faulty electrical circuit.	a. Reset. b. Test (Section 10). c. Test (Section 10).

SECTION 2C. CONTROL ADJUSTMENTS

GENERAL

This section covers adjustments to speed controls, parking and service brakes, power take off (PTO) controls, clutch interlocks, transmission gear selectors and other functional controls which vary according to the engine, transmission, PTO, etc. used on your specific vehicle.

SPEED CONTROLS (See Figure 2C-1)

WARNING

It is essential that operators, maintenance and service personnel understand the interrelationship between the accelerator (foot) pedal, hand throttle lever (see Figure 2C-1) and governor controls on the engine in order to safely operate and service this vehicle.

WARNING

On gasoline engine powered vehicles, never attempt to drive the vehicle with the engine speed increased by the hand throttle. The hand throttle also controls the foot throttle, so the foot throttle pedal cannot be used to reduce engine and vehicle speed. Failure to obey this warning may result in losing vehicle control.

1. Only on diesel engine powered vehicles does the accelerator (foot) pedal retain full control of throttle lever position. An internal engine governor adjusts the injector pump to compensate for variations in power requirements (maintains RPM dictated by position of foot pedal accelerator).
2. On gasoline engine powered vehicles the hand throttle, when activated, overrides the accelerator foot control. The hand throttle is activated by moving hand throttle control to the “DOWN” (rearward) position and the governor hand control to the “UP” (forward) position.
3. On gasoline engine powered vehicles, the hand throttle lever, when pushed forward (“UP”) overrides the accelerator pedal. The hand throttle lever is connected to the engine governor which in turn controls the opening and closing of the carburetor butterfly plate.
4. The engine governor is preset to control engine ground (vehicle) speeds to design limits.

   Normal mode:

   - Hand throttle control lever in “DOWN” position.
   - Variable governor control in “UP” position.

WARNING

To prevent speeds greater than design limits, never alter the governor controls in any manner to increase speed beyond the recommended maximum RPM. Over-speeding may result in engine failure and possible injury to operator and/or bystanders.

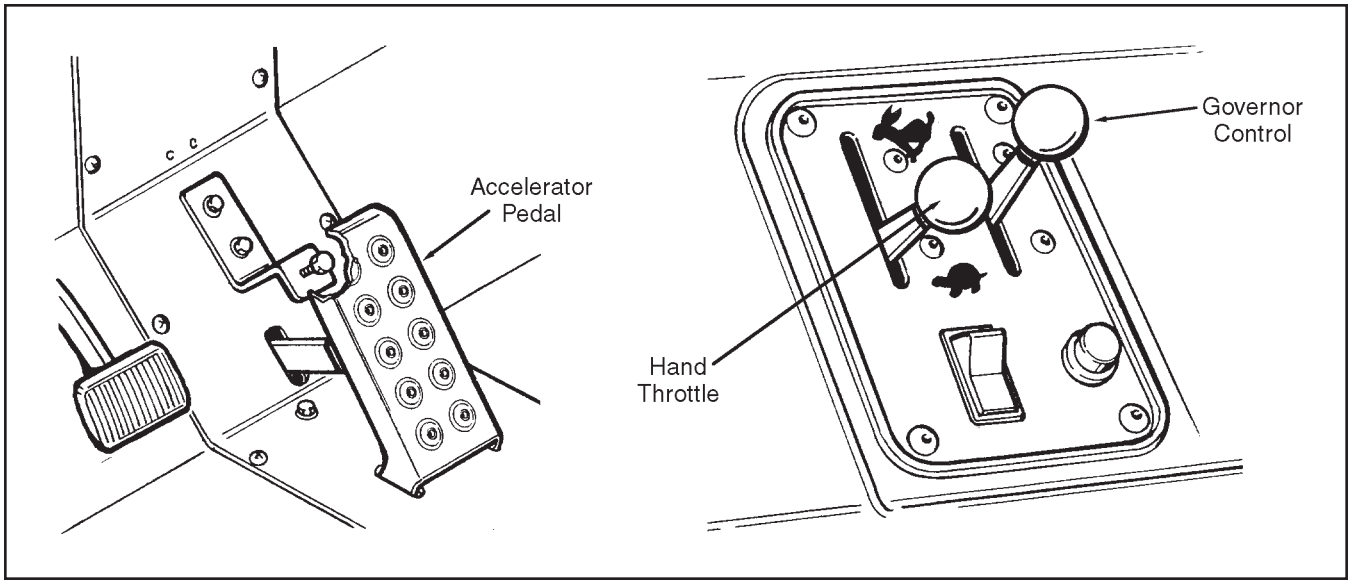

Figure 2C-1. Speed Controls

SECTION 2C. CONTROL ADJUSTMENTS

5. Maximum RPM and low idle speeds for various Turf Truckster® engines are as follows:

Engine	Maximum RPM	Low Idle
Suzuki 660 gasoline	4450 RPM Adjust governor to 4400 RPM max.	950 ± 50 RPM Adjust to 900 RPM.
Suzuki 970 gasoline	3600 RPM Adjust governor to 3550 RPM max.	950 ± 50 RPM Adjust to 900 RPM.
Perkins 103-10 diesel	3000 RPM Governor is factory preset. See manufacturer's instructions for adjustments.	950 ± 50 RPM See engine manufacturer's instructions for adjustment.

3-CYLINDER GASOLINE ENGINE (Suzuki 660) GOVERNOR AND HAND THROTTLE ADJUSTMENTS

1. Start and warm up the engine to normal operating temperature. Move the hand throttle and governor control levers to forward positions. Adjust the idle speed setscrew to obtain 900 RPM (see Figure 2C-2).

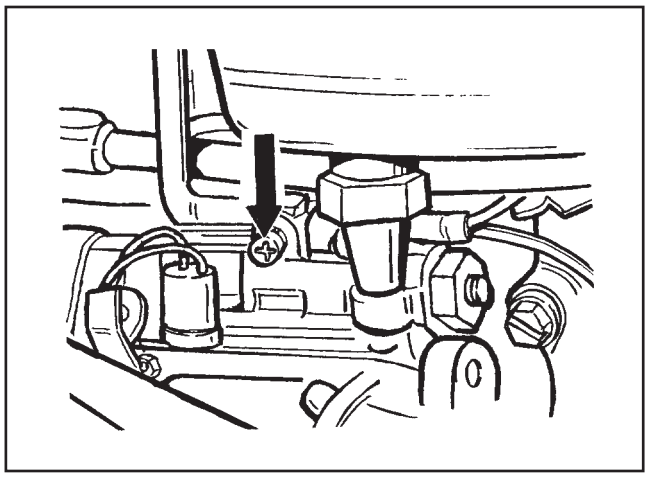

Figure 2C-2. Idle Speed Setscrew

2. Adjust the counterbalance screw (see Figure 2C-3) to obtain proper deflection in both cables. Proper cable deflection is 1/8 to 3/16 inch.

NOTE

Make sure both cable eyelets move freely.

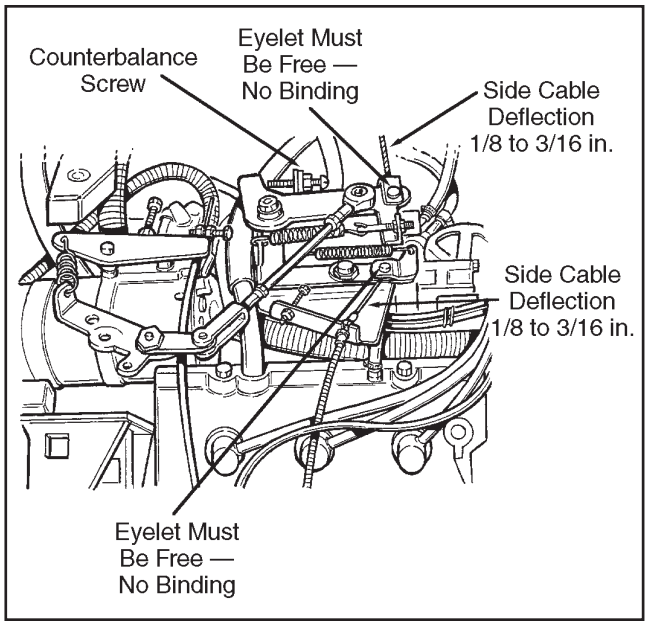

Figure 2C-3. Cable Deflection Adjustment

3. Depress the accelerator pedal down against the pedal stop screw (see Figure 2C-4). Turn the stop screw out of its bracket one revolution counter-clockwise (against the accelerator pedal) so that the pedal touches the stop screw before reaching its maximum forward (down) travel position.

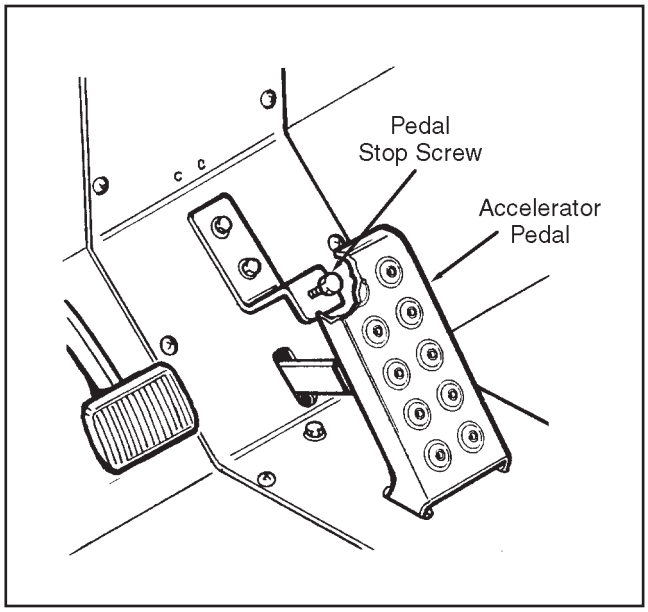

Figure 2C-4. Accelerator Pedal Stop Screw

SECTION 2C. CONTROL ADJUSTMENTS

4. With the accelerator pedal fully depressed, adjust the second throttle stop screw (see Figure 2C-5). Adjust the second throttle stop screw so that it just touches the counterbalance pivot lever.

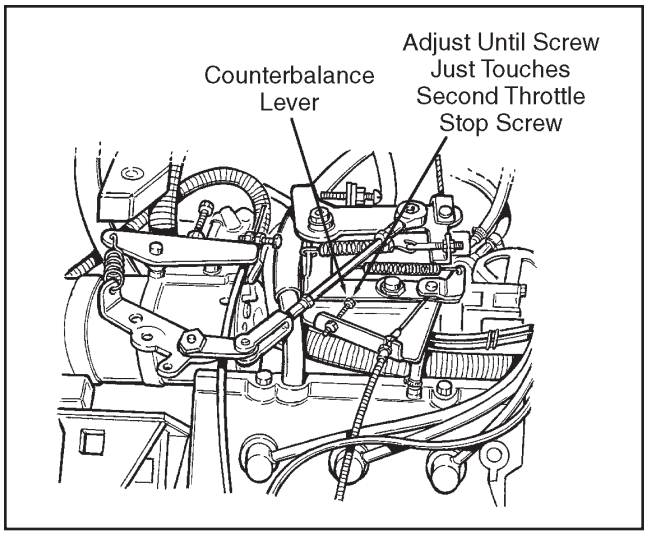

Figure 2C-5. Second Throttle Stop Screw Adjustment

5. With accelerator pedal fully depressed, check throttle plate. Pull spring bracket toward you, the throttle should be 5 degrees from full open (see Figure 2C-6).

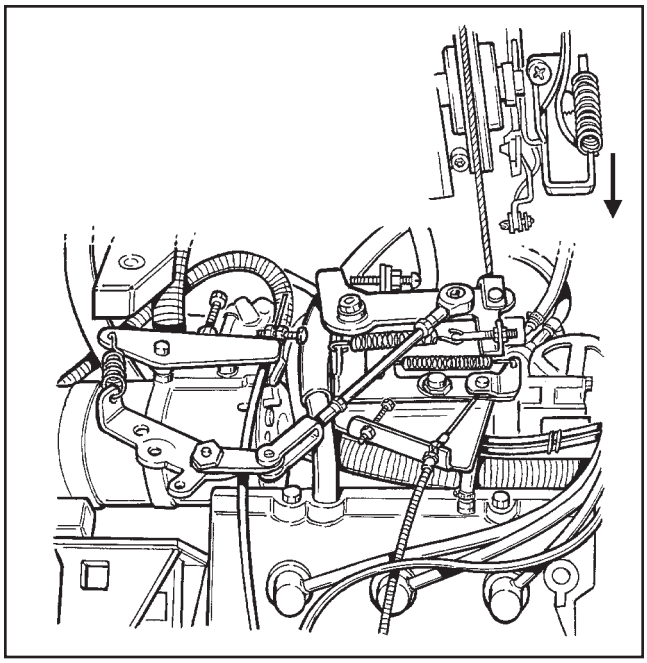

Figure 2C-6. Throttle Plate Check

6. With the accelerator pedal fully depressed, remove the cotter pin, turnbuckle pin and flat washer (see Figure 2C-7). Disconnect the turnbuckle from the broken knee lever.

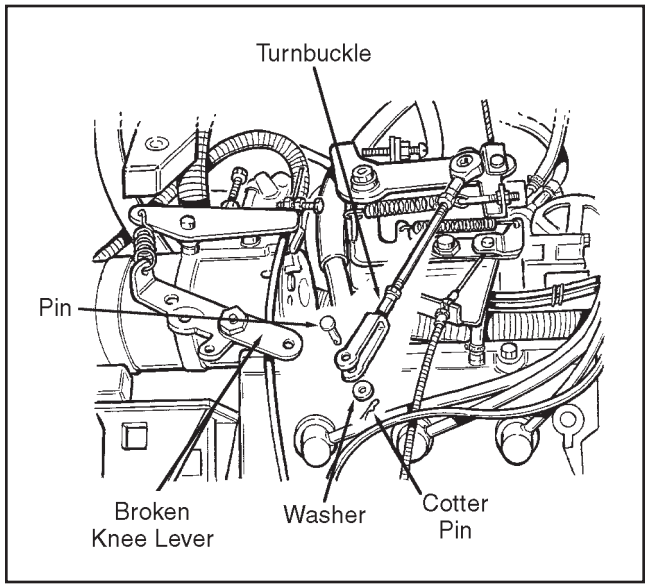

Figure 2C-7. Disconnect Turnbuckle from Broken Knee Lever

7. Push the broken knee lever to its full at rest position (see Figure 2C-8).

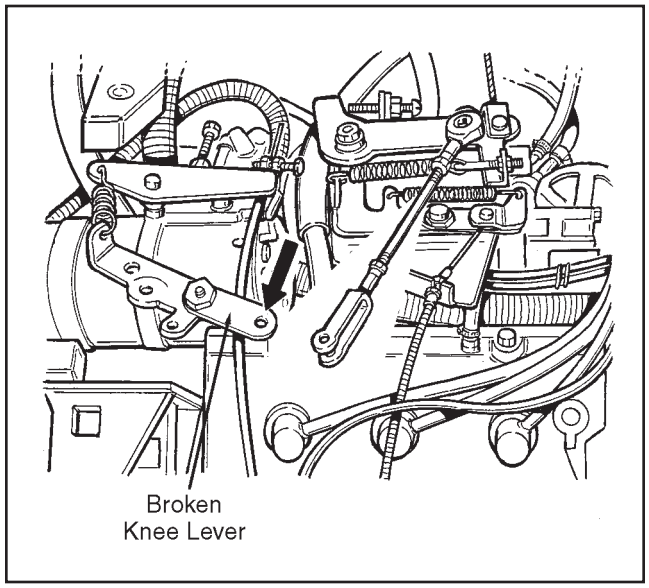

Figure 2C-8. Broken Knee Lever to Full at Rest Position

SECTION 2C. CONTROL ADJUSTMENTS

8. Pull the turnbuckle to the full throttle position (see Figure 2C-9). Install the turnbuckle pin, washer and cotter pin so that the turnbuckle pin is snug against the broken knee lever when pressure is applied to the lever.

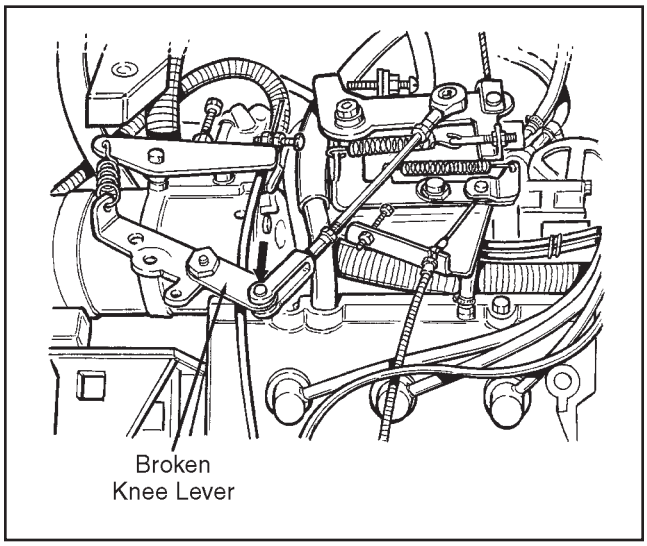

Figure 2C-9. Connect Turnbuckle to Broken Knee Lever

9. Adjust the cable stop screw (see Figure 2C-10) to obtain 4400 RPM. Adjust the governor stop screw so it just touches the governor body and lock the jam nut.

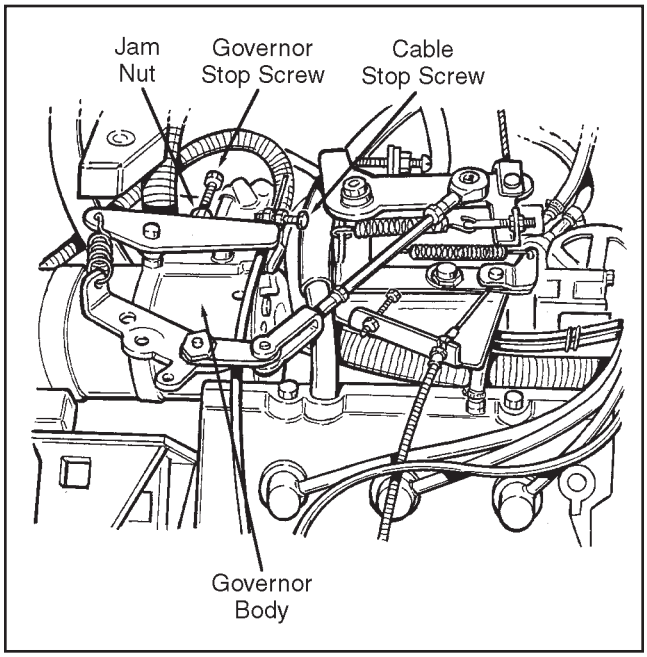

Figure 2C-10. Governor High RPM Adjustment

10. Move the governor lever to the low RPM position (see Figure 2C-11). Adjust the counterbalance spring by centering the jam nuts on the governor adjustment stud thread. Adjust until low 2500 RPM is obtained.

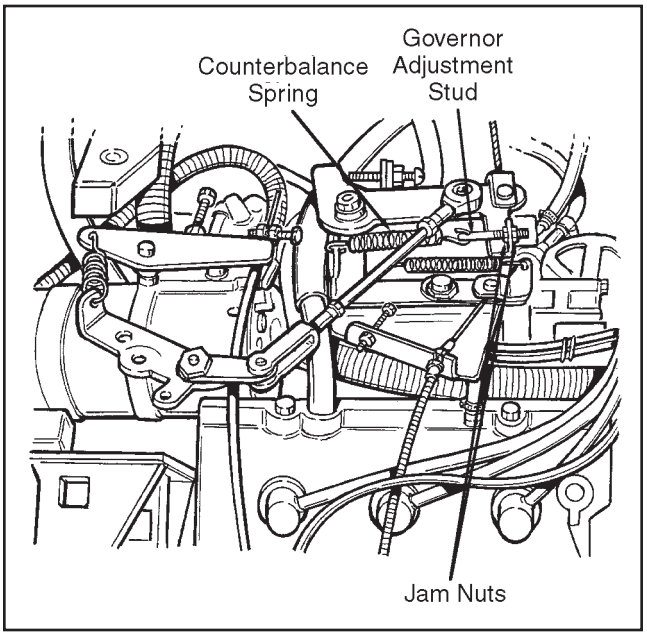

Figure 2C-11. Governor Low RPM Adjustment

4-CYLINDER GASOLINE ENGINE (Suzuki 970) GOVERNOR AND HAND THROTTLE ADJUSTMENTS

1. Start and warm up the engine to normal operating temperature. Move the hand throttle and governor control levers to forward positions. Adjust the idle speed setscrew to obtain 990 RPM (see Figure 2C-12).

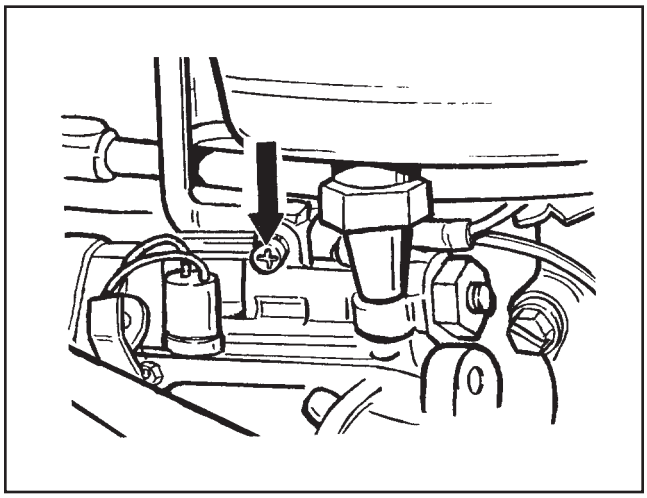

Figure 2C-12. Idle Speed Adjustment

2. Adjust the counterbalance screw (see Figure 2C-13) to obtain proper deflection in both cables. Proper cable deflection is 1/8 to 3/16 inch.

NOTE

Make sure both cable eyelets move freely.

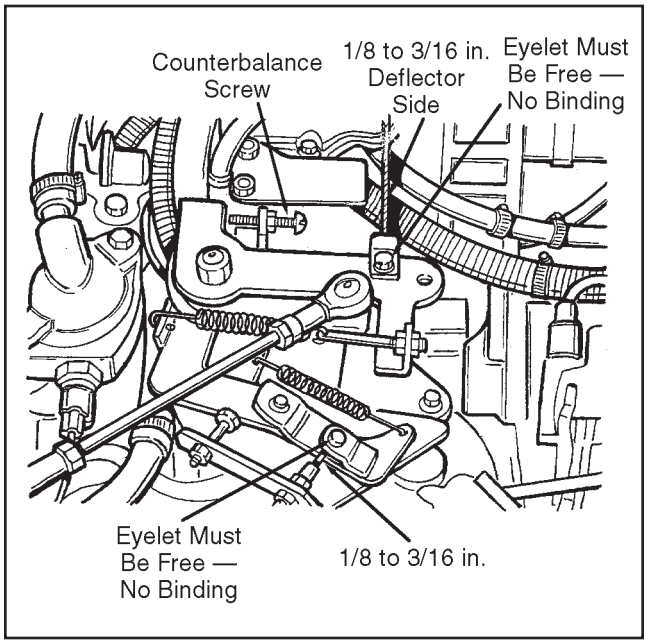

Figure 2C-13. Cable Deflection Adjustment

3. Depress the accelerator pedal down against the pedal stop screw (see Figure 2C-14). Turn the stop screw out of its bracket one revolution counterclockwise (against the accelerator pedal) so that the pedal touches the stop screw before reaching its maximum forward (down) travel position.

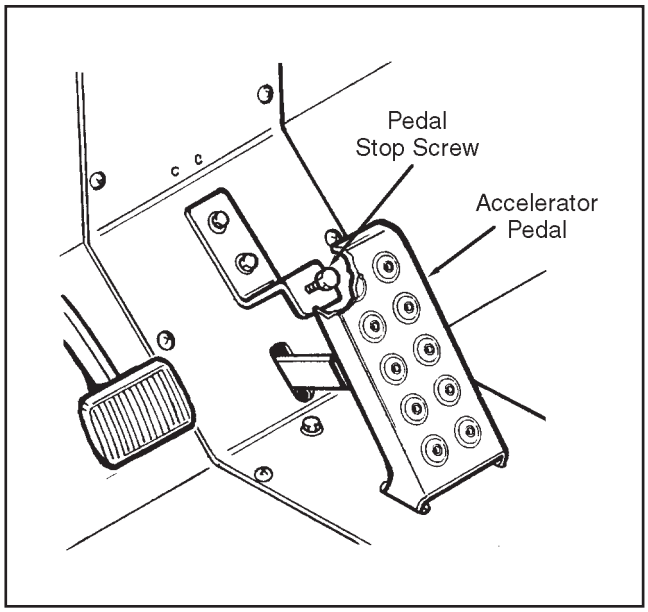

Figure 2C-14. Accelerator Pedal Stop Screw

4. With the accelerator pedal fully depressed, adjust the second throttle stop screw (see Figure 2C-15). Adjust the second throttle stop screw so that it just touches the counterbalance pivot lever.

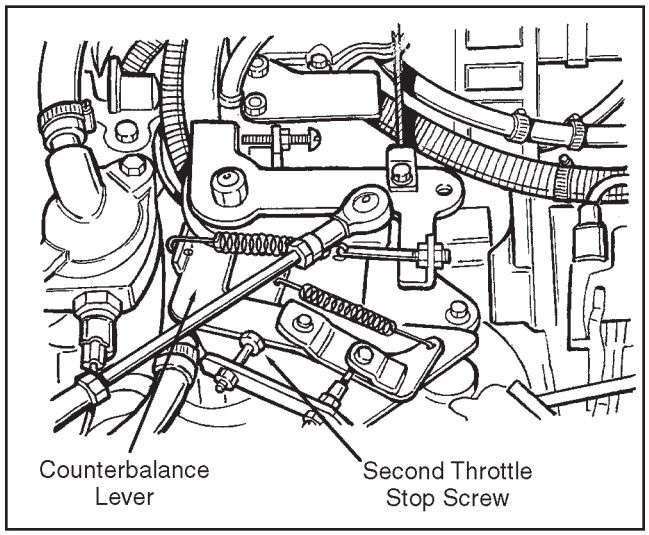

Figure 2C-15. Second Throttle Stop Screw Adjustment

SECTION 2C. CONTROL ADJUSTMENTS

5. With accelerator pedal fully depressed, check throttle plate. Pull spring bracket toward you, the throttle should be 5 degrees from full open (see Figure 2C-16).

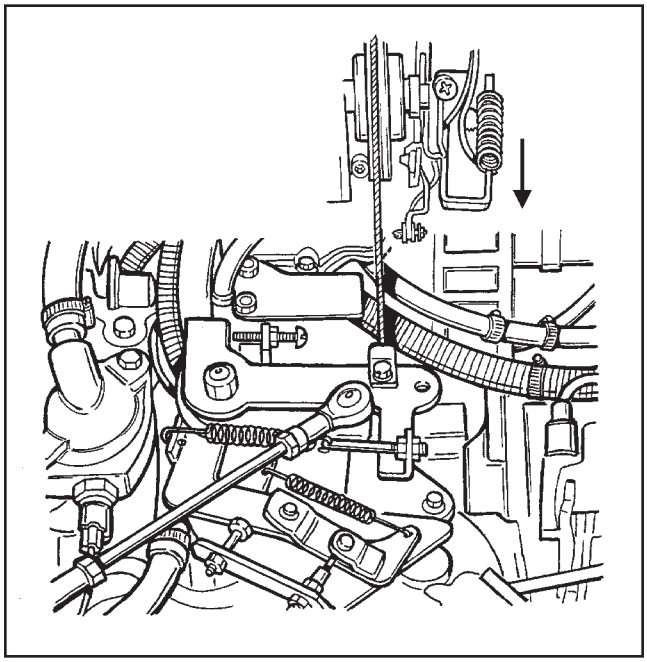

Figure 2C-16. Throttle Plate Check

6. With the accelerator pedal fully depressed, remove the cotter pin, turnbuckle pin and flat washer (see Figure 2C-17). Disconnect the turnbuckle from the broken knee lever.

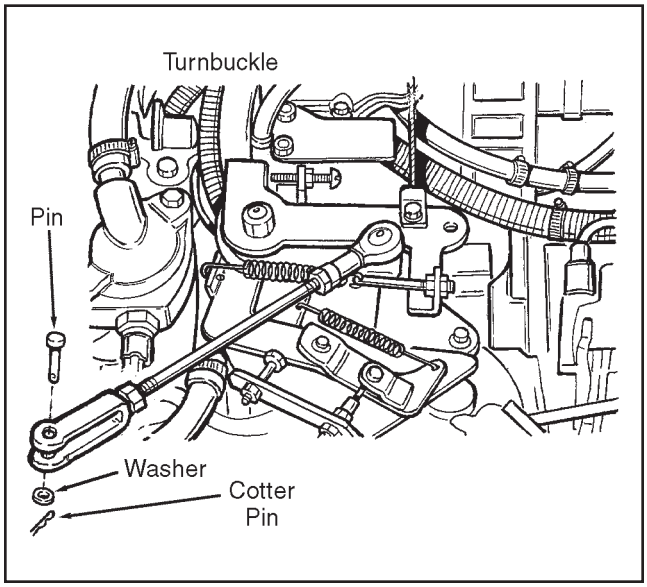

Figure 2C-17. Disconnect Turnbuckle from Broken Knee Lever

7. Push the broken knee lever to its full at rest position (see Figure 2C-18).

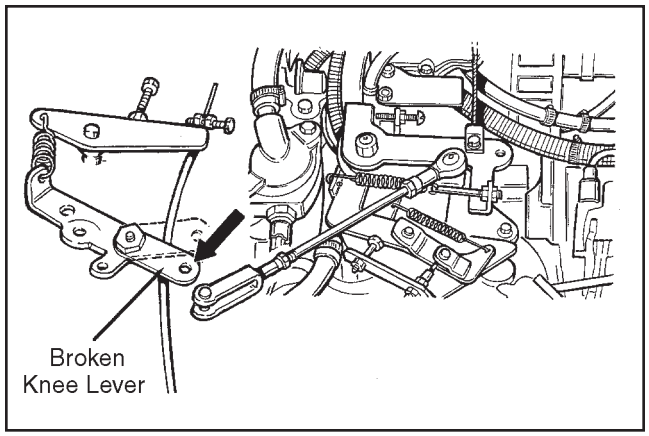

Figure 2C-18. Broken Knee Lever to Full at Rest Position

8. Pull the turnbuckle to the full throttle position (see Figure 2C-19). Install the turnbuckle pin, washer and cotter pin so that the turnbuckle pin is snug against the broken knee lever when pressure is applied to the lever.

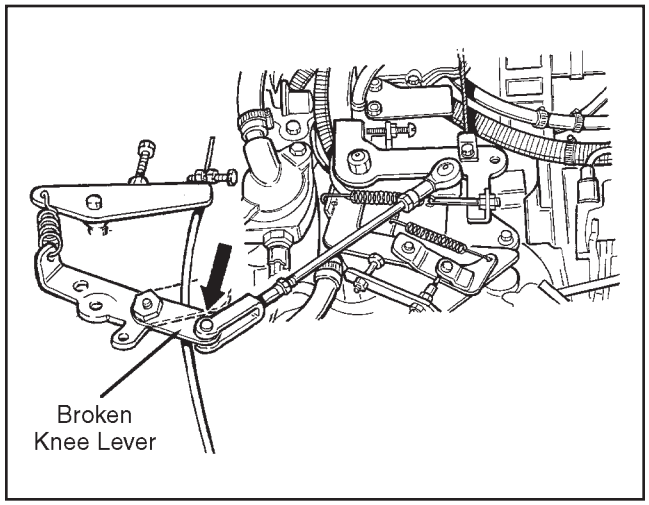

Figure 2C-19. Connect Turnbuckle to Broken Knee Lever

9. Adjust the cable stop screw (see Figure 2C-20) to obtain 3600 RPM. Adjust the governor stop screw so it just touches the governor body and lock the jam nut.

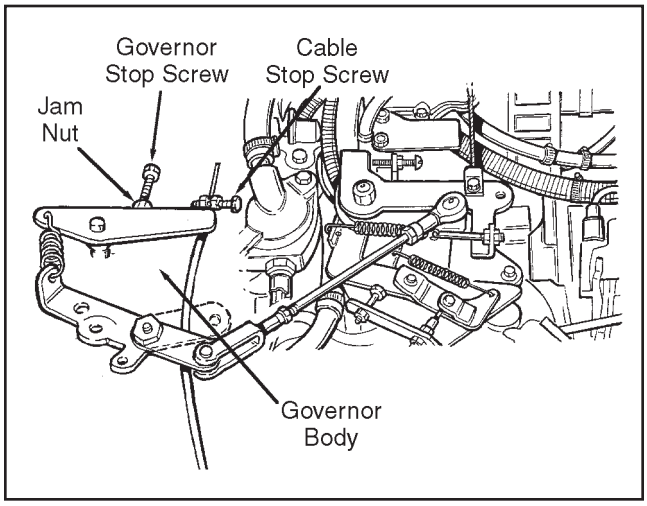

Figure 2C-20. Governor High RPM Adjustment

10. Move the governor lever to the low RPM position (see Figure 2C-21). Adjust the counterbalance spring by centering the jam nuts on the governor adjustment stud thread. Adjust until low 2500 RPM is obtained.

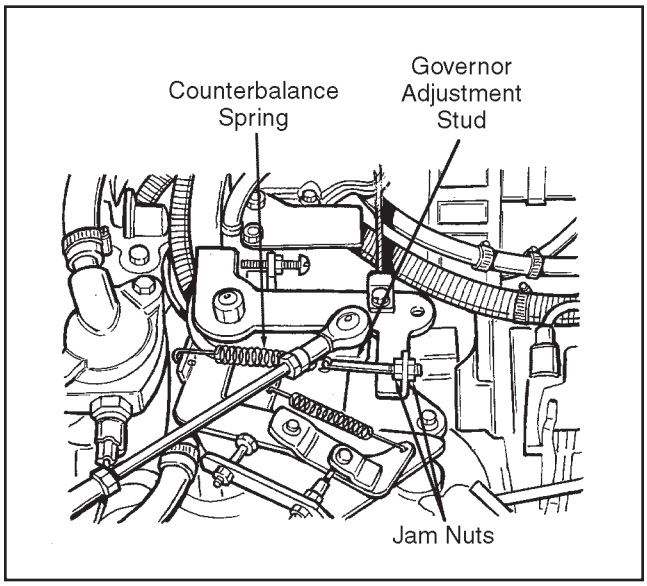

Figure 2C-21. Governor Low RPM Adjustment

GOVERNOR AND HAND THROTTLE ADJUSTMENTS — DIESEL ENGINE

1. The diesel engine governor is factory preset and not adjustable.
2. Adjust the throttle cable by moving accelerator to low idle and adjusting the cable connections at the fuel injection pump.

CHOKE ADJUSTMENTS — 4-CYLINDER GASOLINE ENGINES (See Figure 2C-22)

4-cylinder (Suzuki 970) gasoline engines are equipped with a diaphragm type choke opener.

When the choke control knob is pulled out fully, the choke valve is closed tight by spring force. At the same time, the fast idle lever holds the throttle valve at the optimum opening for the cold engine start.

Once the engine has started, the intake manifold vacuum rises. As the engine is warmed up and the cooling water temperature exceeds 64°F (18°C), the hoses of BVSV are connected through and the intake manifold vacuum pulls the diaphragm. The diaphragm of the choke opener opens the choke valve a little (by forcing the choke opener lever linked with the choke shaft to rotate), thus preventing mixture from becoming too rich.

If the choke valve is opened rapidly, however, the engine revolution becomes unstable. To prevent this, a jet is added between the vacuum hoses of the choke opener so that the choke valve is opened gradually.

To check for proper choke operation proceed as follows:

1. Remove air cleaner and check to be sure that when the choke control is pulled out all the way, the choke valve is fully closed, and that, when the choke control is pushed in, the choke valve is back to original position.
2. If the choke valve does not open to its original position when the choke control is pushed in, adjust the choke cable connection to the carburetor with the choke control pulled out about 0.27 inch (7 mm).

SECTION 2C. CONTROL ADJUSTMENTS

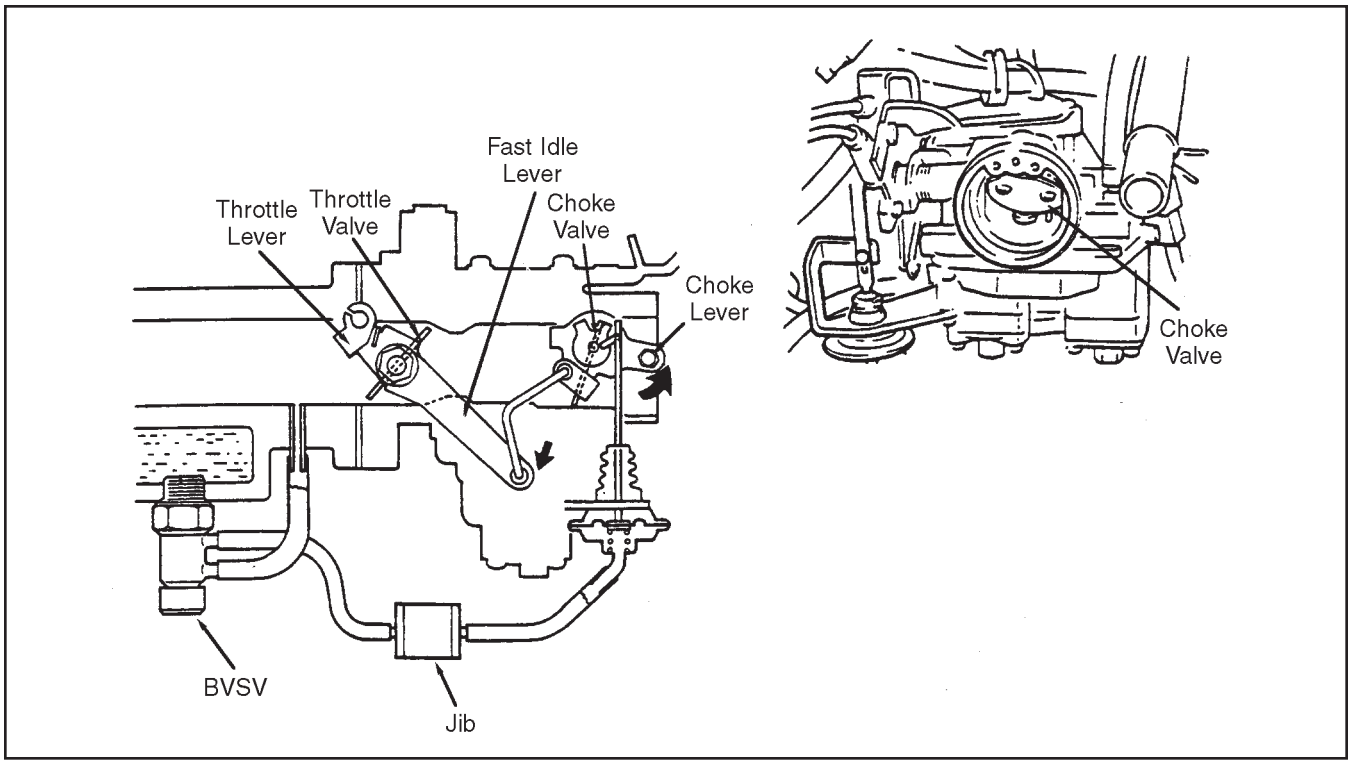

Figure 2C-22. Choke Adjustment

PARKING BRAKE ADJUSTMENT (See Figure 2C-23)

1. The parking brake activates only the two rear brakes of the vehicle. Raise the engine cover to gain access to the parking brake cables.
2. Release the parking brake lever (lever fully down).
3. Tighten the adjustment nut (1 or 2 turns) and apply the brake lever. Continue tightening the adjustment nut until the lever is at approximately 45° when the brake is applied.

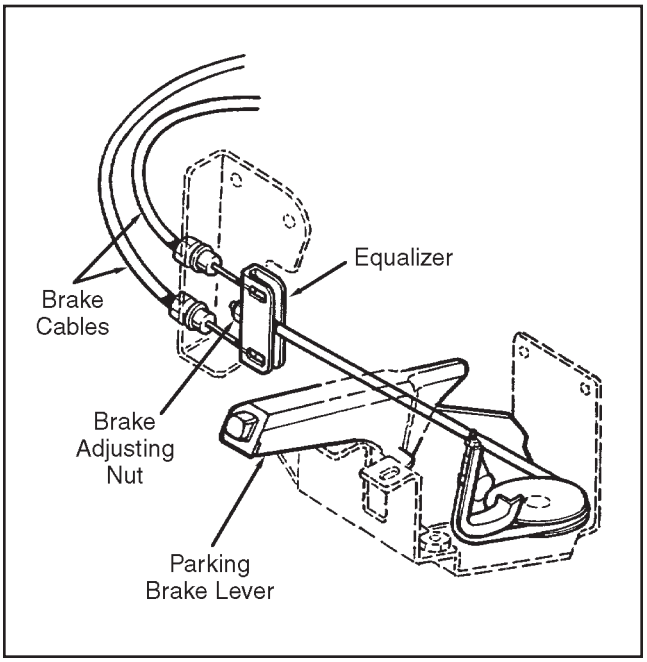

Figure 2C-23. Parking Brake Adjustment

SERVICE BRAKES (See Figure 2C-24)

1. This vehicle is equipped with four hydraulic brakes controlled by the brake pedal. Open the front cowl of the vehicle to gain access to the brake fluid reservoir.
2. A brake fluid indicator light on the control panel (see Figure 2D-1) will come on and stay on if the brake fluid level is low. The fluid level must be maintained between the minimum and maximum markings on the gauge attached to the brake fluid reservoir. Use DOT 3 Type brake fluid.
3. If the brakes do not hold properly, if they feel spongy or if the brake fluid reservoir is allowed to "run-dry", it may be necessary to bleed the brake lines in order to get fluid back into the system. Follow the steps below to properly bleed the brake system.
4. When bleeding the brake system, bleed the left rear brake first, then the right rear, then the right front and finally the left front.
5. Attach a hose to the bleeder screw on top of the left rear dust shield and place the other end of the hose in a container to catch the fluid run-off when bleeding the system.
6. Loosen the bleeder screw. Have an assistant push down on the brake pedal and hold pedal down. Tighten the bleeder screw and release the brake pedal. Loosen the bleeder screw again, press down on the brake pedal, hold pedal down and tighten the bleeder screw, release pedal. Do not release the brake pedal until the bleeder screw is tightened otherwise air will be sucked back into the brake lines.
7. Continue this procedure until all air bubbles are purged from the system and a steady flow of fluid comes from the brake line. Repeat the procedure on the opposite side of the unit, then on the front.

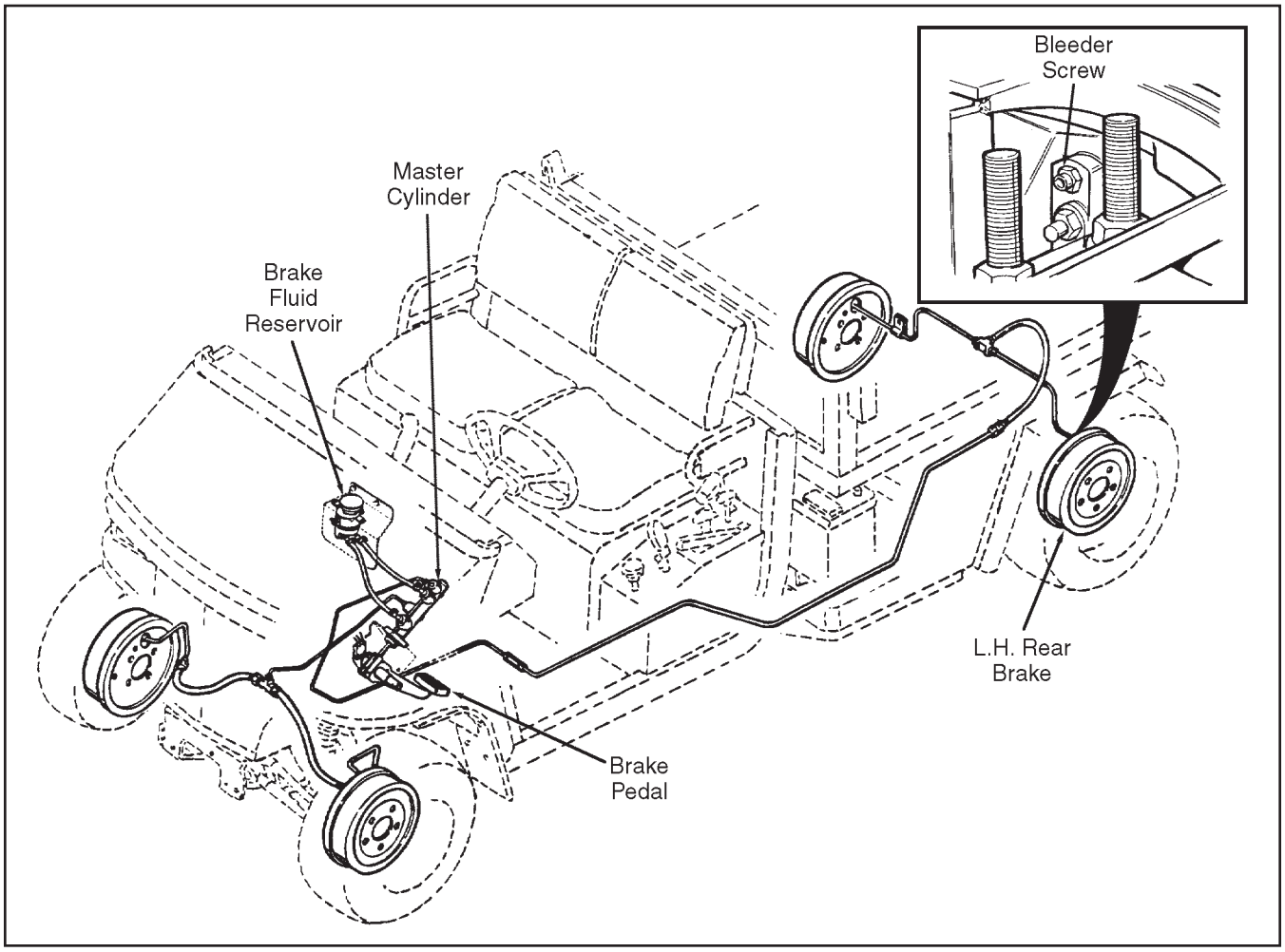

Figure 2C-24. Service Brake System

SECTION 2C. CONTROL ADJUSTMENTS

CLUTCH PEDAL FREE TRAVEL

1. Depress clutch pedal, stop as soon as clutch resistance is felt, and measure clutch pedal free travel as shown in Figure 2C-25.

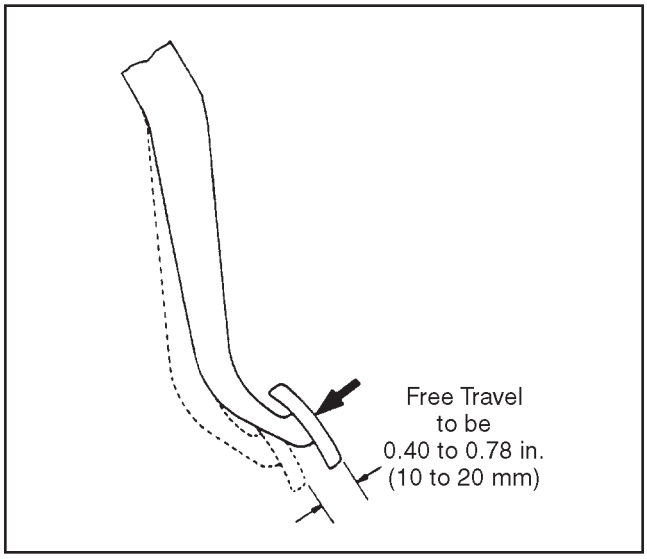

Figure 2C-25. Clutch Free Travel

2. If free travel is out of specification, adjust the clutch outer cable nuts (at both pedal and release arm sides).

NOTE

After adjusting free travel, make sure that clutch cable end protrudes from joint nut as shown in Figure 2C-26.

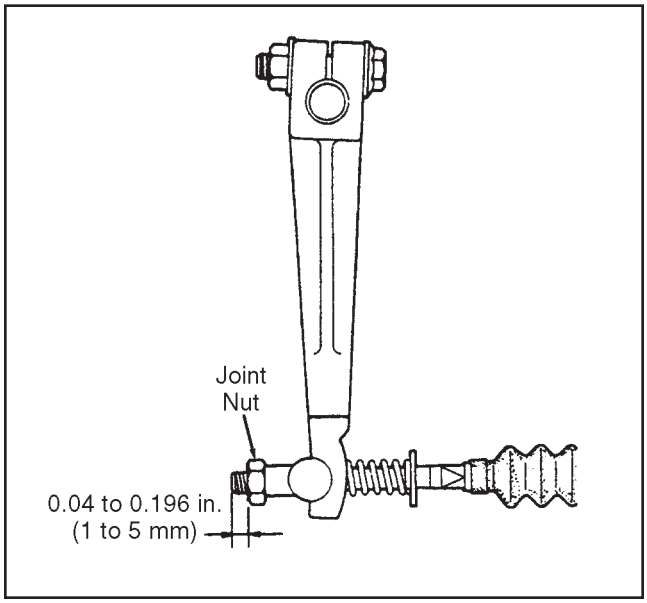

Figure 2C-26. Clutch Cable Adjustment

CLUTCH INTERLOCK SWITCH (See Figure 2C-27)

A clutch interlock switch allows the engine starter to operate only when the clutch pedal is depressed (closing the switch). If the engine starts when the clutch pedal is not depressed, check for a broken damaged switch actuator and/or loose wiring. Test the switch as described in Section 10 and replace it if necessary.

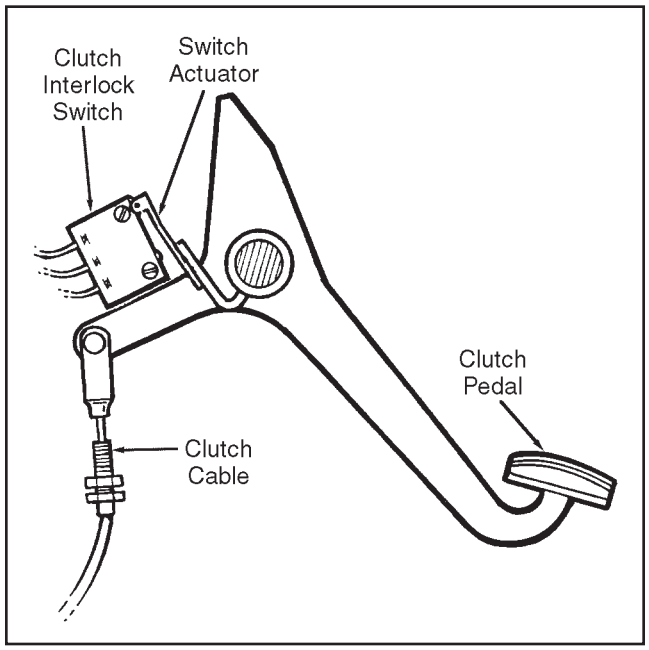

Figure 2C-27. Clutch Interlock Switch

SECTION 2C. CONTROL ADJUSTMENTS

GEAR SELECTOR ADJUSTMENT (See Figure 2C-28)

NOTE

Before adjustment, check to make sure that each lubrication point is greased properly (see Section 11) and that bushings and linkages are not worn. Repair as necessary.

If the gear shift control lever can be shifted from neutral (vertical) position to and between 3rd and 4th positions smoothly, the gear select cable is adjusted properly.

If smooth shifting from neutral position to and between 3rd and 4th positions is not obtained, adjust the select cable as follows:

1. Tilt shift lever a little toward LOW and 2nd position side (selected position) from neutral position. If it can be shifted smoothly to and between 3rd and 4th positions from there, loosen cable clamp A shown in Figure 2C-28 and tighten select cable adjusting nut A until control lever can be shifted smoothly to and between 3rd and 4th positions from neutral position. Tighten cable clamp A.
2. Tilt control lever a little toward REVERSE side (selected position) from neutral position. If it can be shifted smoothly to and between 3rd and 4th positions from there, loosen cable clamp B and then tighten adjusting nut B until control lever can be shifted to and between 3rd and 4th positions smoothly from neutral position. Tighten cable clamp B.

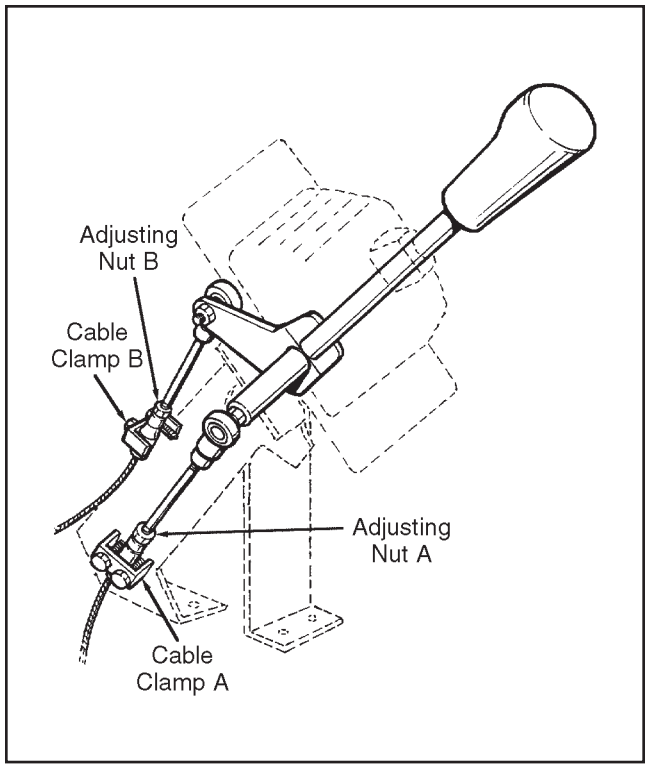

Figure 2C-28. Gear Selector Adjustment

POWER TAKE OFF (PTO) ADJUSTMENTS

See Section 12 for PTO adjustments and repairs.

SECTION 2D. GAUGES AND INSTRUMENTS

REPAIR (See Figure 2D-1)

The instrument panel gauges are not individually replaceable. Replace the entire panel if the tachometer, hour meter, fuel gauge, voltmeter or water temperature gauge are defective. See Section 10 for electrical testing. Disconnect the battery cables and tag instrument panel wiring prior to replacement.

If a bulb needs replacement, remove the four screws that secure the instrument panel to the dash and tilt the panel forward to gain access to the rear of the panel. Rotate the bulb holder 1/4 turn counterclockwise and pull up the holder to gain access to bulbs.

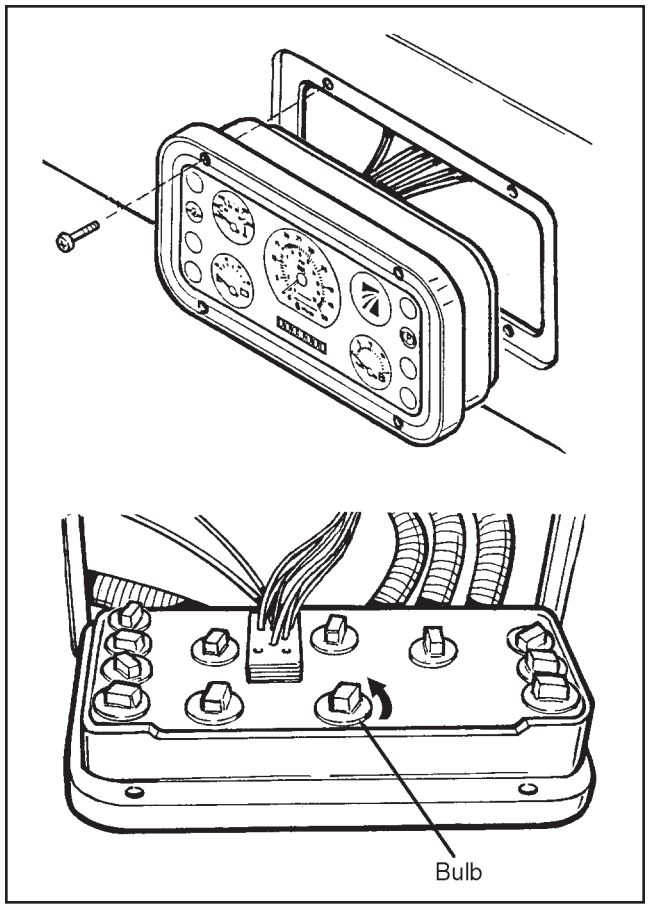

Figure 2D-1. Instrument Panel and Bulb Replacement

SECTION 3
ENGINE

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:	See Section 11.
Other service items:	Compressed air source. Engine hoist. Oil filter. Fuel filter. Air cleaner element. Fan belt. Loctite® 565 (Textron P/N 2810299). Loctite® 243 (Textron P/N 2810300, 10 ml btl; 2811163, 50 ml btl).

SECTION 3B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Engine will not start.	a. Parking brake disengaged.	a. Engage brake.
	b. Glow plug has not timed out (diesel).	b. Reset ignition switch and allow glow plug to time out before cranking engine.
	c. Defective spark plug (gasoline).	c. Replace (Section 3E).
	d. Battery low on charge or defective.	d. Inspect condition of battery and battery connections.
	e. Fuel tank empty or dirty.	e. Fill with fresh fuel. Change fuel filter. Bleed fuel lines (Section 3D).
	f. Main fuse blown.	f. Replace fuse.
	g. Relay defective.	g. Test and replace relay (Section 10).
	h. Clutch pedal not depressed.	h. Depress clutch pedal.
2. Engine hard to start or runs poorly.	a. Fuel level low, fuel or fuel filter dirty.	a. Fill with fresh fuel. Change fuel filter. Bleed fuel lines (Section 3D).
	b. Air cleaner dirty.	b. Inspect and replace air filter (Section 3D).
	c. Injectors, fuel pump faulty.	c. Consult engine manufacturer's manual.
	d. Engine problem.	d. Consult engine manufacturer's manual.
3. Engine stops.	a. Fuel tank empty.	a. Fill with fresh fuel and bleed fuel lines (Section 3D).
	b. Parking brake not set.	b. Engage parking brake.
4. Engine overheating.	a. Coolant level low.	a. Inspect and add coolant.
	b. Air intake restricted.	b. Clean air intake or radiator.
	c. Water pump belt broken or loose.	c. Tighten or replace belt.
	NOTE See engine manufacturer's manual for additional Failure Analysis.	

SECTION 3C. GENERAL INSTRUCTIONS

CONTENTS

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. Engine manuals are available from your local dealer.

NOTE

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

Unlatch and tilt the engine cover forward to gain access to the engine (see Figure 1A-2).

CLEANING AND LUBRICATION

Thoroughly clean each component after removal from the machine. Follow engine manufacturer's instructions for lubrication of engine.

WARNING

Before servicing or doing any maintenance work around the engine area, make sure the engine has had time to cool. Serious burns can result if the engine or surrounding area is hot.

SECTION 3D. DIESEL ENGINE

GENERAL

Diesel engines used on this vehicle are 3-cylinder, 4-cycle, liquid cooled Perkins 100 Series. A “Workshop” manual is available from the engine manufacturer.

AIR CLEANER (See Figure 3D-1)

The air cleaner is a dry type with a replaceable element.

The filter element should be replaced before engine performance is affected. This may occur at 250 hours of service in very dirty operating conditions or at 500 hours in normal operating conditions.

Cleaning the filter element is not recommended because of the possibility of damaging the element.

To remove the air cleaner element release the latches securing the cover to the air cleaner assembly. Remove the filter element.

Check the element for damage, pin holes, etc. by placing a light source such as a flashlight inside.

Clean dust from inside of housing with damp cloth, making sure dust does not enter air intake.

Check all gaskets to be sure they are not damaged or loose.

Replace the element if it is damaged or is excessively clogged with dirt and/or debris.

Insert element in housing open end first.

Position the cover so that the dust collector is pointing down. Clamp cover into position with collector pointing down. The dust collector empties automatically when properly installed with collector down.

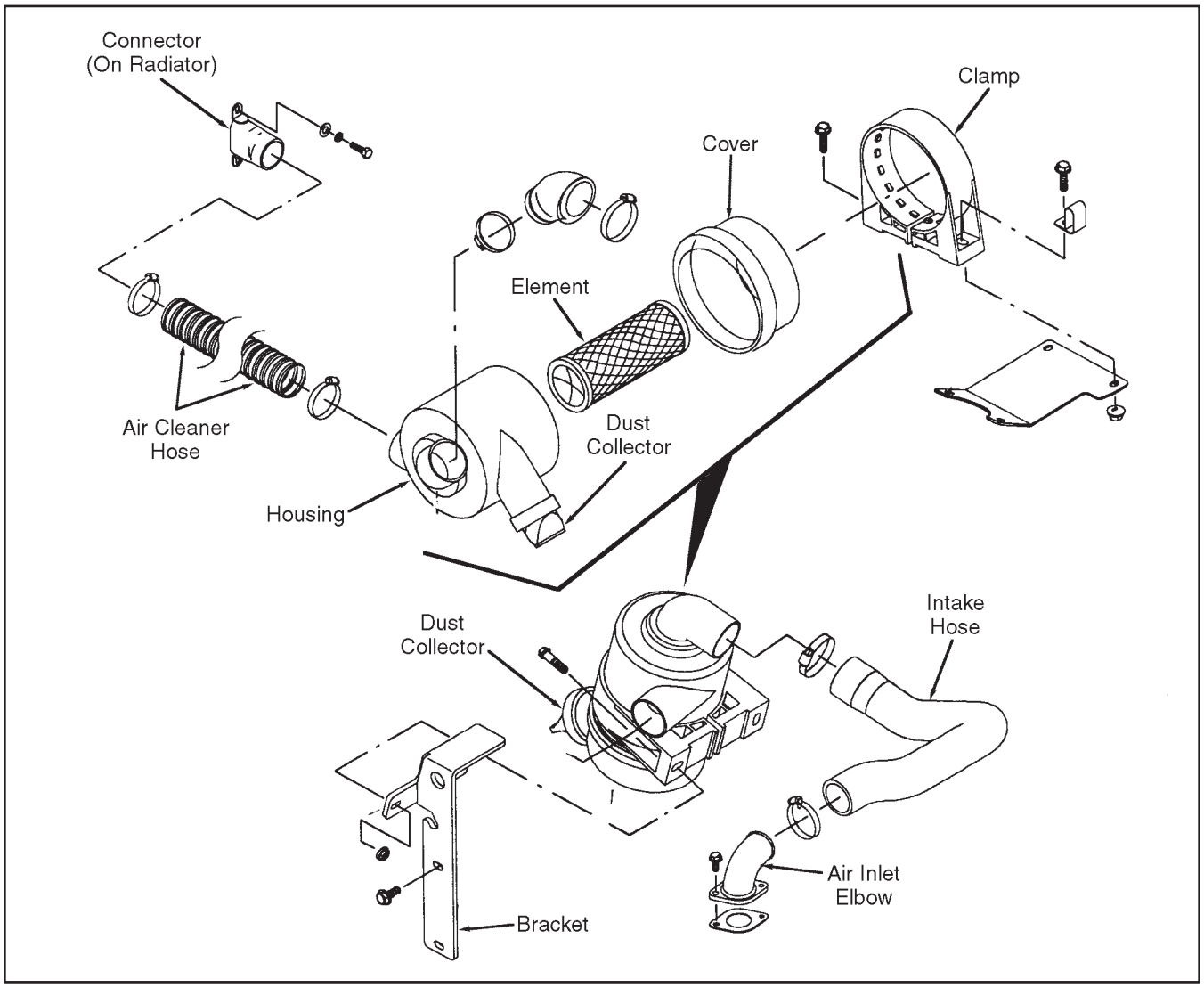

Figure 3D-1. Air Cleaner

SECTION 3D. DIESEL ENGINE

RADIATOR AND COOLING SYSTEM

The engine is equipped with a cooling radiator and an electric cooling fan.

WARNING

The cooling fan is thermostatically controlled and may start at any time. Even with the ignition key in the off position, do not attempt service without first disconnecting the negative (–) battery cable or without first removing the fan fuse.

The cooling system is under pressure, if a leak is present, be careful when raising the seat or when opening the engine cover. Hot coolant can be sprayed causing personal injury.

CHANGING OR REPLENISHING COOLANT

WARNING

Always make sure the engine is stopped and cool before removing the radiator cap. To prevent scalding by hot water, never remove cap while radiator is hot.

INSPECTING THE COOLING SYSTEM

Check the radiator and coolant hoses for leaks and faulty connections, repair as necessary (see Figure 3D-2).

Inspect the engine belts for fraying or cracking and check the engine for loose hardware.

Check the coolant reservoir (there should be approximately four 4 inches (102 mm) of coolant in the reservoir).

Remove the radiator cap and check the coolant level. The coolant should be at, or within a 1/4 inch (6 mm) from the bottom of the filler port (if coolant is needed, add a 50/50 anti-freeze/water mixture following the procedures stated below).

ADDING ANTI-FREEZE TO THE COOLING SYSTEM

The cooling system should be drained and refilled every 400 hours or nine (9) months.

Make a 50/50 mixture of anti-freeze and water in a separate container before adding coolant to the radiator. Never add straight anti-freeze to the radiator, the mixture must never be more than 50% anti-freeze. Cooling system capacity for the diesel engine is 5.0 qts. (4.7 L).

Unless the radiator is very low, always add coolant to the overflow reservoir, not to the radiator.

With the park brake applied and the gear selector in neutral start the engine and let idle.

Remove the overflow reservoir cap, add the anti-freeze mixture to the overflow bottle until the coolant level reaches approximately 4 inches (102 mm) in the bottle, replace reservoir cap.

If the radiator level is very low, add the anti-freeze mixture directly to the radiator until it reaches approximately 1/4 inch (6 mm) from the bottom of the filler neck, then start the engine and add mixture to the overflow reservoir until proper level is reached.

CHANGING COOLANT (See Figure 3D-2)

1. Remove the radiator cap when the engine is cool.
2. Remove drain pug and drain coolant.
3. Remove and drain overflow bottle.
4. Reinstall plug.
5. Reinstall overflow tank.
6. Fill the cooling system with 5.0 qts. (4.7 L) of coolant (includes engine, radiator and overflow bottle) and run engine for 2 or 3 minutes at idle. This forces out air which still may be trapped within the cooling system. Stop engine and add coolant as necessary until coolant level reaches the filler throat of radiator. Reinstall radiator cap.
7. Add coolant to reservoir tank so that the level is at the full mark.

CLEANING RADIATOR CORE

Keep the radiator intake screen (see Figure 3D-2), radiator fins and surrounding engine areas free of debris.

If the radiator fins or intake screen become dirty, air cannot circulate well enough to cool the engine sufficiently, therefore you risk the chance of the engine overheating.

Clean the radiator fins with compressed air. If water is used to clean the radiator, use compressed air to blow all the water from the fins. Water left between the fins will collect dirt and plug the radiator, this will reduce the amount of air flow to properly cool the engine.

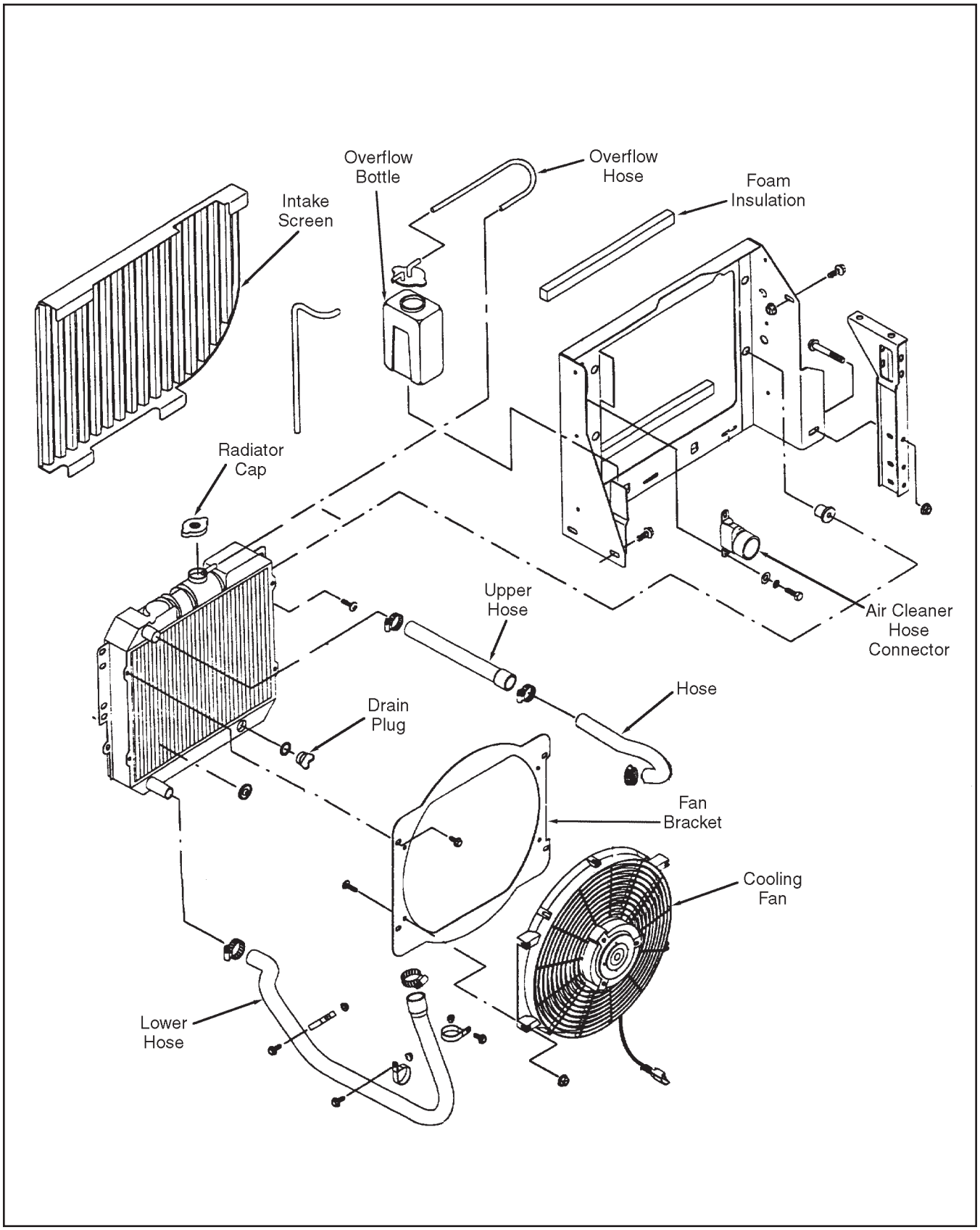

Figure 3D-2. Radiator and Cooling System Repair

SECTION 3D. DIESEL ENGINE

MUFFLER AND EXHAUST SYSTEM (See Figure 3D-3)

WARNING

To avoid danger of being burned, do not touch exhaust system when system is hot. Any service on exhaust system should be performed when system is cool.

INSPECTION

1. Check rubber mountings for damage, deterioration and out of position.
2. Check exhaust system for leakage, loose connections, dents and damages. If nuts or bolts are loose, tighten them to 29 to 43 ft-lbs. (40 to 60 N.m).
3. Check nearby body areas for damaged, missing, or mispositioned parts, open seams, holes, loose connections or other defects which could permit exhaust fumes to seep into the vehicle.

REPAIR

Remove and replace damaged mufflers, hoses and other exhaust system components as shown in Figure 3D-3.

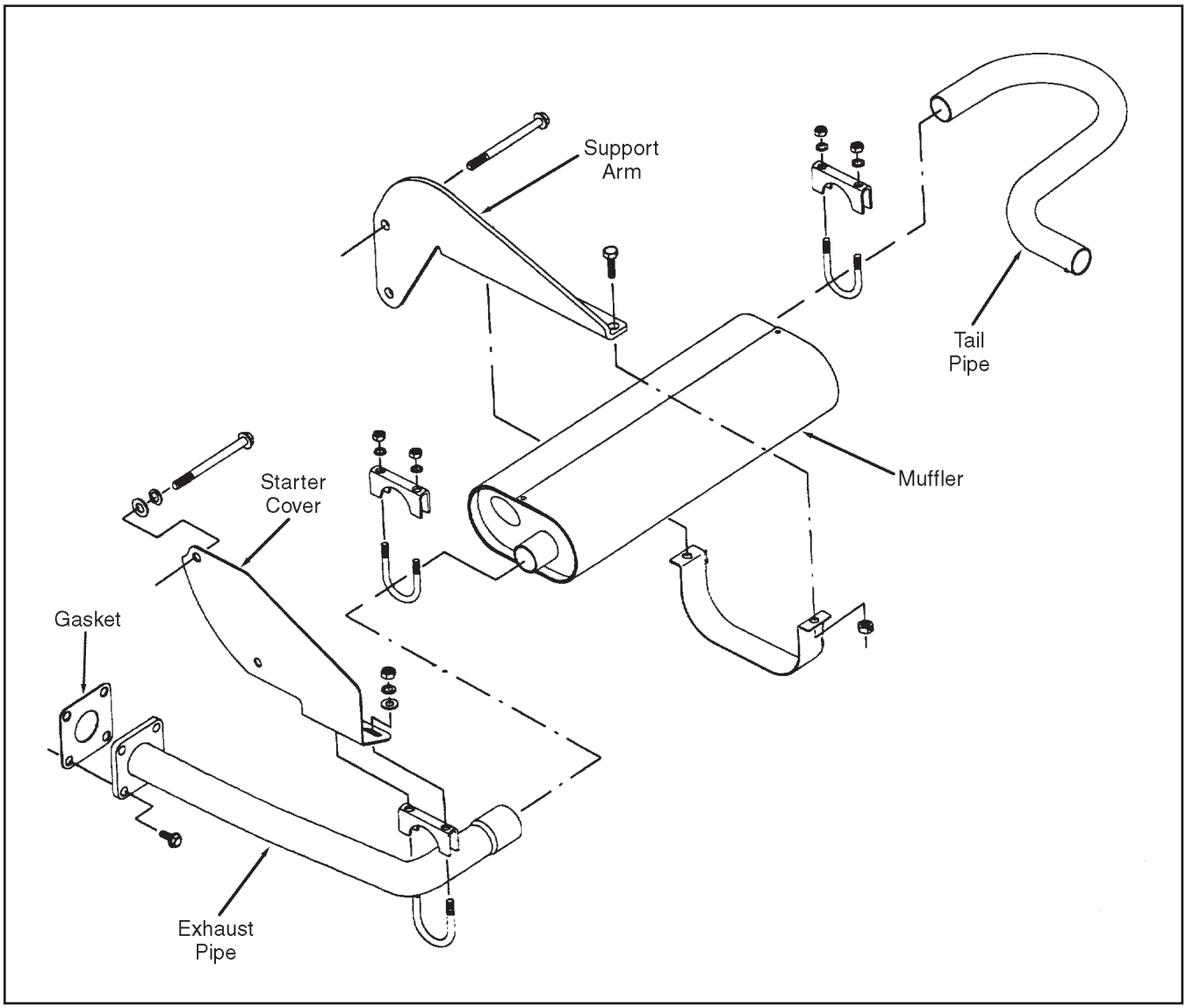

Figure 3D-3. Muffler and Exhaust System

FUEL FILTER SERVICE (See Figure 3D-4)

There are two fuel filters in the diesel engine fuel system. A pre-filter is located in-line between the fuel tank and inlet to the fuel pump. A larger cartridge filter is located between the outlet of the fuel pump and the engine fuel injection pump.

Moisture and other foreign matter accumulate in the fuel filters. Periodically clear and replace the filter elements (refer to Section 11).

Purge air from the fuel system whenever filters are replaced.

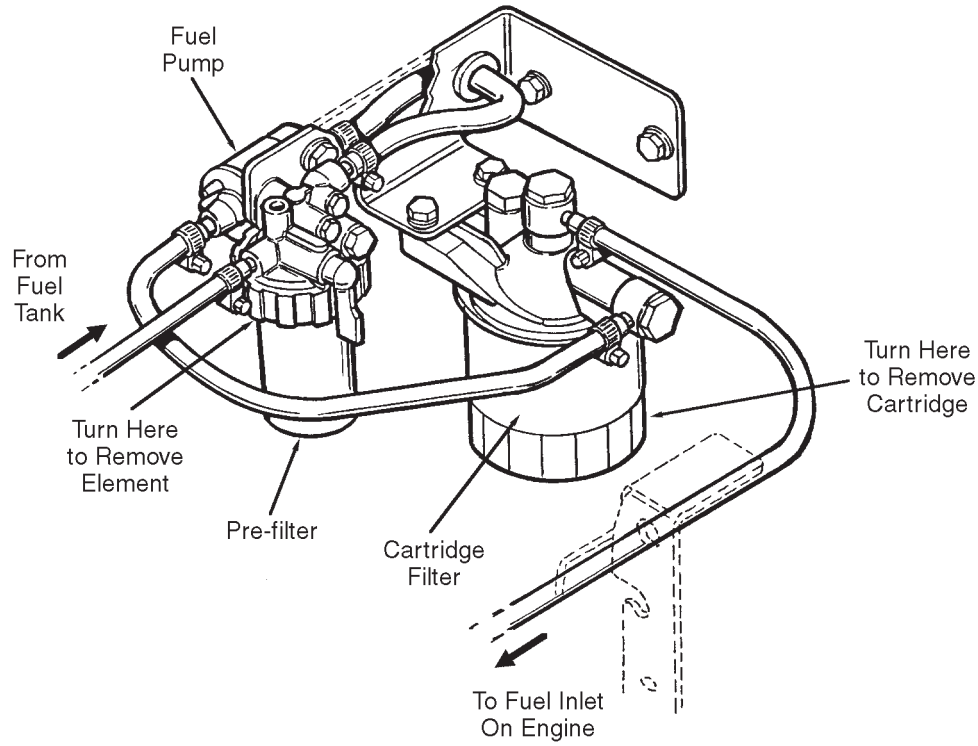

Figure 3D-4. Fuel Filter Service

PURGING THE FUEL SYSTEM

The diesel fuel system must be purged when starting a new diesel engine for the first time, after prolonged storage, the fuel tank is allowed to run dry, or when the fuel filter and/or fuel lines have been loosened, removed or replaced.

Purge the fuel system using one of the procedures as follows:

PURGING FUEL SYSTEM USING A JUMPER WIRE

This method allows the fuel pump to run continuously when purging the system.

1. Turn the ignition key to the “OFF” position.
2. Disconnect the white/red wire from the starter solenoid.

⚠ WARNING

Failure to remove this wire may result in the starter engaging causing the vehicle to move. This movement could result in personal injury and/or property damage.

3. Clip one end of a jumper wire to the EXC terminal on the back of the alternator as shown in Figure 3D-5. (This terminal will have a green wire connected to it.)
4. Clip the other end of the jumper wire to the “I” terminal on the starter solenoid.

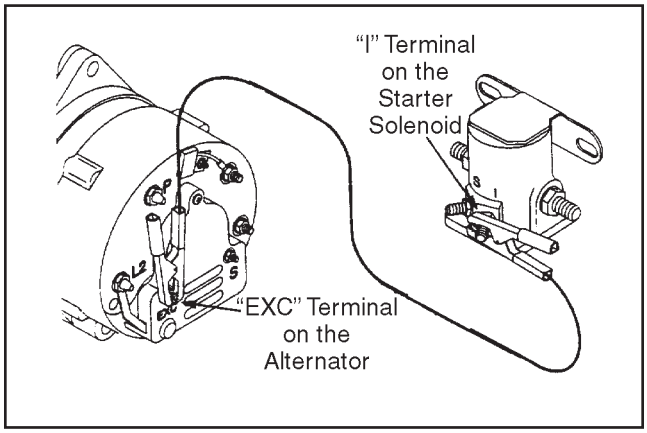

Figure 3D-5. Jumper Wire to Alternator and Solenoid

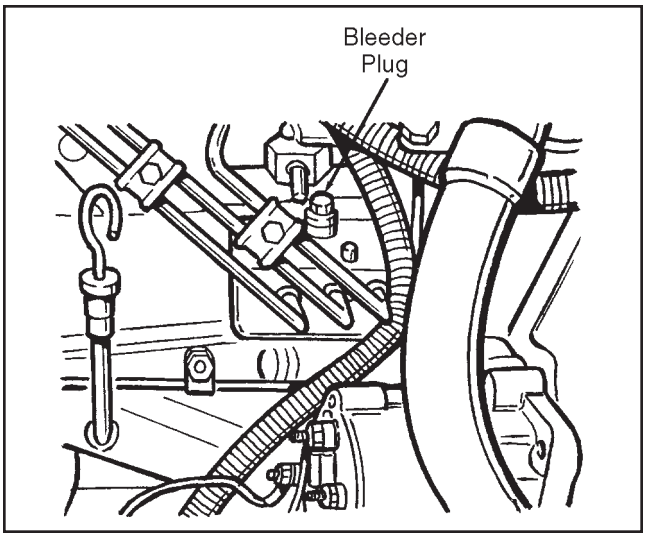

Figure 3D-6. Bleeder Plug

5. Open the bleeder plug located on top of the fuel injector (see Figure 3D-6).
6. Turn the ignition key to the “ON” position (the fuel pump will begin to pump). When the fuel pump is pumping fuel only, the “thumping” sound will become more of a “purring” sound, when this occurs tighten the bleeder plug.
7. Turn the ignition key to the “OFF” position, remove the jumper wire and reconnect the white with red wire onto the starter solenoid.

PURGING FUEL SYSTEM WITHOUT THE USE OF A JUMPER WIRE

Fuel system bleed may be accomplished using the glow plug timer if no jumper wire is available.

1. Open the bleeder plug on top of the fuel injector pump (see Figure 3D-6).
2. Turn the ignition key to the “ON” position. The fuel pump will be activated for about 20 seconds until the glow plug timer stops.
3. When the timer stops, turn the key to the “OFF” position, then turn it back to the “ON” position, the fuel pump will run again for approximately 20 seconds, when the glow plug timer stops, turn the key off again. Continue with this procedure until the system is purged. When the fuel pump is pumping fuel only, the “thumping” sound will be more of a “purring” sound, when this occurs, tighten the bleeder plug.

SECTION 3D. DIESEL ENGINE

ENGINE REMOVAL

1. Raise dump box and open engine cover.
2. Disconnect NEG (–) battery cable from battery.
3. Drain engine cooling water and hydraulic fluid.
4. Remove radiator hoses and air cleaner hose.
5. Remove radiator.
6. Tag and disconnect wiring from engine.
7. Disconnect accelerator and governor cables from engine.
8. Remove drive shaft.
9. Shut off the fuel and remove fuel line.
10. Disconnect clutch cable and return spring from clutch lever.
11. Remove transmission mounting hardware from clutch housing.
12. Connect a suitable lifting device to the engine.
13. Remove engine mounting hardware.
14. Using suitable hoist carefully lift engine and pull away from transmission to remove.

NOTE

Clutch disc and cover will be removed with engine.

ENGINE INSTALLATION

1. Using a suitable lifting device, lift engine and position in-line with transmission.
2. Push engine toward transmission so drive shaft splines of transmission engage clutch. It may be necessary to rotate transmission gearing to index clutch disc splines.
3. Fasten engine to bell housing.
4. Install engine mounting hardware.
5. Reconnect clutch cable to clutch arm and reconnect return spring. To adjust see Section 2C.
6. Install drive shaft.
7. Reconnect accelerator and governor cables. See Section 2C for adjustments.
8. Reconnect exhaust pipe.
9. Reconnect intake and return fuel lines.
10. Reconnect electrical wiring.
11. Install radiator and hoses.
12. Install air cleaner hose.
13. Fill cooling system.
14. Purge air from the fuel system as described in this section.

SECTION 3E. GASOLINE ENGINES

GENERAL

The gasoline engine used on your vehicle is either a 3-cylinder Suzuki 660 or 4-cylinder Suzuki 970. Service manuals for both these engines are available from the manufacturer.

Instructions in this section apply to both engines unless otherwise stated.

IGNITION SYSTEM — 4-CYLINDER ENGINE (SUZUKI 970)

GENERAL

The principal components of this ignition system are the 4 spark plugs, distributor, contact breaker, ignition coil and, as the source of igniting energy, the battery. The ignition coil has two windings, primary and secondary.

Current from the battery flows through the primary winding and then the contact breaker; the contact point in the breaker opens and closes to interrupt this current intermittently.

Each time the primary current is interrupted, a very high voltage develops in secondary winding. It is this intermittent high voltage that the distributor passes sequentially to the 4 spark plugs to fly a spark across the gap in each, one plug at a time.

IGNITION COIL TEST (See Figure 3E-1)

Measure resistances of primary and secondary windings of the ignition coil. Take readings when coil is hot, about 176°F (80°C). If resistance is out of specification replace coil with a new one.

Primary Winding Resistance	About 3.40 Ω (ohms) (between B and – terminals) (inclusive of 1.30 Ω (ohms) resistor)
Secondary Winding Resistance	About 19.9 kΩ (kilohms) (between high tension terminal and – terminal)

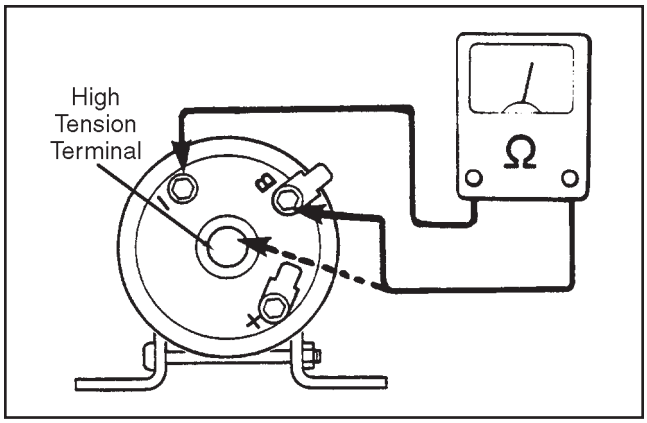

Figure 3E-1. Ignition Coil Test, 4-Cylinder Engine

SPARK PLUG WIRES

1. Remove high tension coil cable at ignition coil while gripping its cap.

CAUTION

Removal of spark plug wires together with clamps is recommended so as not to damage their inside wire. For the same reason, pull out each connection by gripping at the cap.

2. Remove distributor cap with spark plug wires installed.
3. Remove high tension cable clamp from cylinder head cover.
4. Pull out spark plug wire from each spark plug while gripping its cap.
5. Use an ohmmeter to measure spark plug wire resistance. Resistance should be 10 to 22 kΩ (kilohms).
6. If resistance is outside of specified reading, inspect and replace the distributor cap and/or spark plug wires as required.

CAUTION

Never use metal conductor high tension wires as replacement parts. Insert each cap portion fully when installing spark plug wires.

SPARK PLUGS

1. Pull out spark plug wires by gripping their caps and then remove the spark plugs.
2. Inspect for electrode wear, carbon deposits and insulator damage.
3. If any problem is found, adjust spark plug air gap, clean with spark plug cleaner or replace them with specified new plugs.
4. Gap spark plugs to 0.032 to 0.035 inch (0.8 to 0.9 mm).
5. Torque spark plugs to 18.5 to 21.5 ft-lbs. (25 to 30 N.m).
6. Install spark plug wires securely by gripping their caps.

SECTION 3E. GASOLINE ENGINES

IGNITION SYSTEM — 3-CYLINDER ENGINE (SUZUKI 660)

The 3-cylinder (Suzuki 660) engine uses a solid-state ignition system.

The basic components of this ignition system are ignition coil, distributor and spark plugs. The components of the distributor are signal generator (signal rotor and pickup coil), igniter, rotor, cap and both vacuum and centrifugal advance.

When the distributor shaft rotates, the magnetic flux passing through the pickup coil varies due to the change in air gap between the pickup coil and the signal rotor. As a result, the alternating current voltage is induced in the pickup coil.

The voltage induced, turns on and off the igniter which switched off the ignition coil primary current. Thus, the high voltage is induced in the secondary winding of ignition coil and ignition sparks are generated at the spark plugs.

The spark advance is produced by the vacuum advancer which operates based on the engine vacuum and centrifugal advancer.

IGNITION COIL TEST (See Figure 3E-2)

Measure resistances of primary and secondary windings of the ignition coil at 68°F (20°C). If resistance is out of specification replace coil with a new one.

Primary Winding Resistance	1.08 to 1.32 Ω (ohms)
Secondary Winding Resistance	22.1 to 29.2 Ω (ohms)

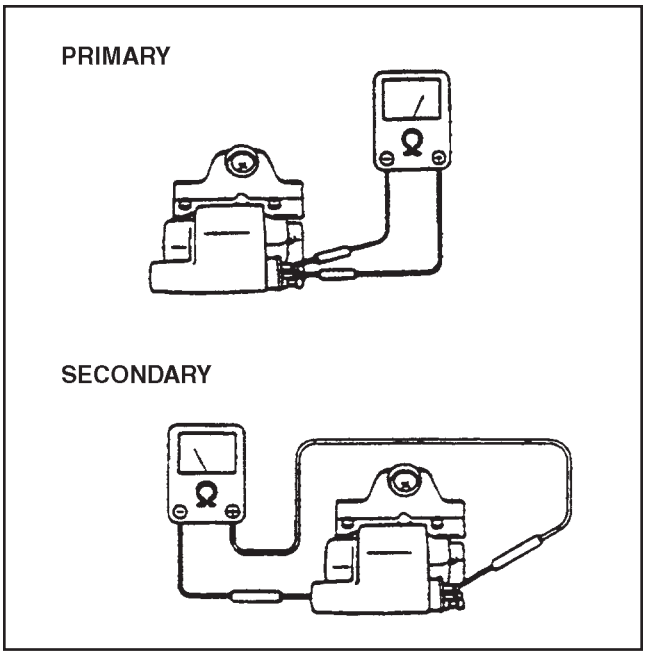

Figure 3E-2. Ignition Coil Test, 3-Cylinder Engine

SPARK PLUG WIRES

Check and replace (if required) spark plug wires using the same procedures as for Suzuki 970 engines (see proceeding paragraphs).

SPARK PLUGS

Check gap and replace spark plugs as described above for Suzuki 970 engines.

CARBURETOR

Carburetor adjustments (choke/throttle) are covered in Section 2C. Cleaning and rebuilding of carburetors is included in great detail in engine manufacturer's Service Manual.

AIR CLEANER (See Figure 3E-3)

The air cleaner is a dry type with a replaceable element.

The filter element should be replaced before engine performance is affected. This may occur at 250 hours of service in very dirty operating conditions or at 500 hours in normal operating conditions.

Cleaning the filter element is not recommended because of the possibility of damaging the element.

To remove the air cleaner element release the latches securing the cover to the air cleaner assembly. Remove the filter element.

Check the element for damage, pin holes, etc. by placing a light source such as a flashlight inside.

Clean dust from inside of housing with damp cloth, making sure dust does not enter air intake.

Check all gaskets to be sure they are not damaged or loose.

Replace the element if it is damaged or is excessively clogged with dirt and/or debris.

Insert element in housing open end first.

Position the cover so that the dust collector is pointing down. Clamp cover into position with collector pointing down. The dust collector empties automatically when properly installed with collector down.

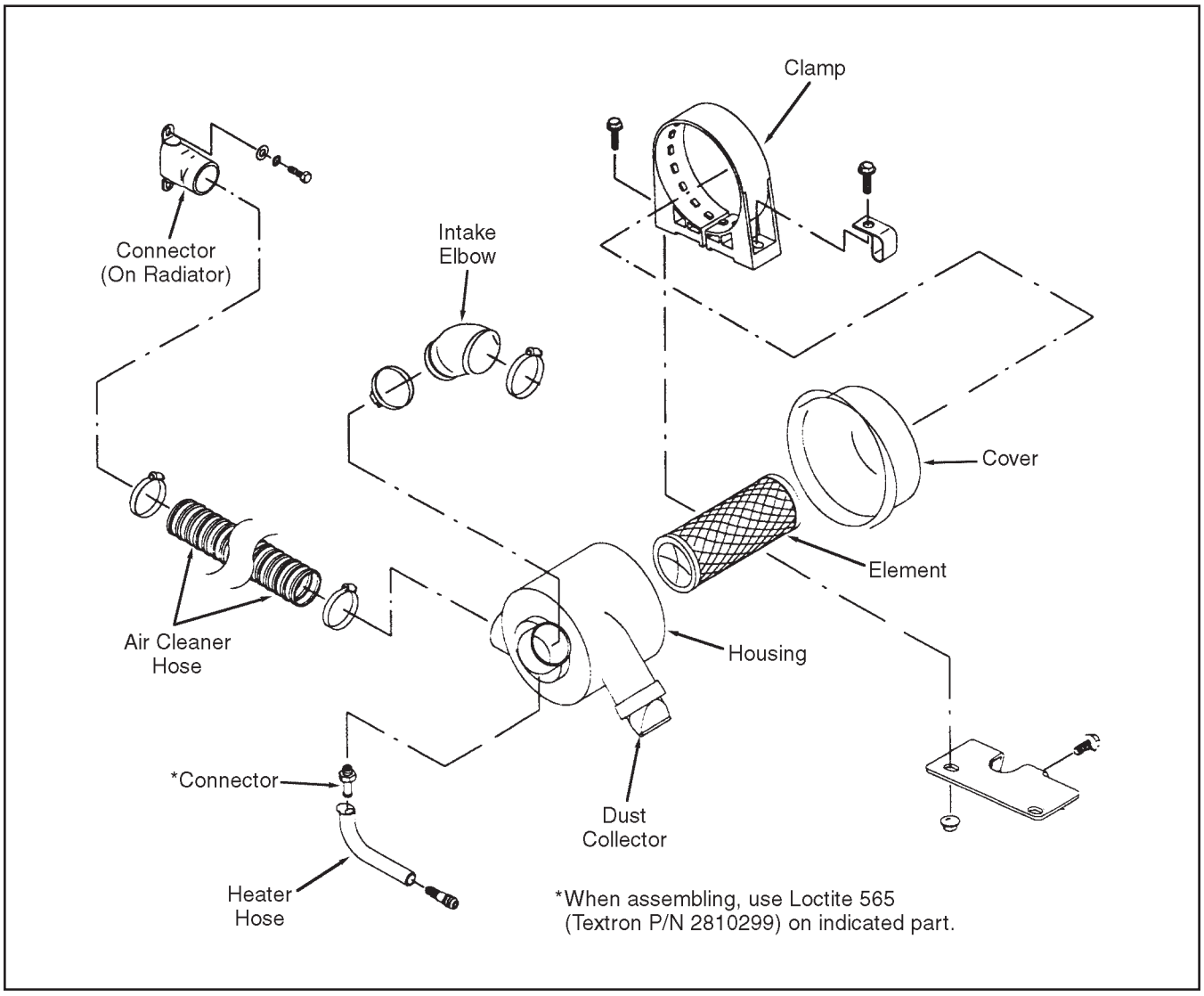

Figure 3E-3. Air Cleaner

RADIATOR AND COOLING SYSTEM

The engine is equipped with a cooling radiator and an electric cooling fan.

WARNING

The cooling fan is thermostatically controlled and may start at any time. Even with the ignition key in the off position, do not attempt service without first disconnecting the negative (–) battery cable or without first removing the fan fuse.

The cooling system is under pressure, if a leak is present, be careful when raising the seat or when opening the engine cover. Hot coolant can be sprayed causing personal injury.

CHANGING OR REPLENISHING COOLANT

WARNING

Always make sure the engine is stopped and cool before removing the radiator cap. To prevent scalding by hot water, never remove cap while radiator is hot.

INSPECTING THE COOLING SYSTEM

Check the radiator and coolant hoses for leaks and faulty connections, repair as necessary (see Figures 3E-4 and 3E-5).

Inspect the engine belts for fraying or cracking and check the engine for loose hardware.

Check the coolant reservoir (there should be approximately 4 inches (102 mm) of coolant in the reservoir).

Remove the radiator cap and check the coolant level. The coolant should be at, or within a 1/4 inch (6 mm) from the bottom of the filler port (if coolant is needed, add a 50/50 anti-freeze/water mixture following the procedures stated below).

ADDING ANTI-FREEZE TO THE COOLING SYSTEM

The cooling system should be drained and refilled every 400 hours or nine (9) months.

Make a 50/50 mixture of anti-freeze and water in a separate container before adding coolant to the radiator. Never add straight anti-freeze to the radiator, the mixture must never be more than 50% anti-freeze. Cooling system capacity for the diesel engine is 5.0 qts. (4.7 L).

Unless the radiator is very low, always add coolant to the overflow reservoir, not to the radiator.

With the park brake applied and the gear selector in neutral start the engine and let idle.

Remove the overflow reservoir cap, add the anti-freeze mixture to the overflow bottle until the coolant level reaches approximately 4 inches (102 mm) in the bottle, replace reservoir cap.

If the radiator level is very low, add the anti-freeze mixture directly to the radiator until it reaches approximately 1/4 inch (6 mm) from the bottom of the filler neck, then start the engine and add mixture to the overflow reservoir until proper level is reached.

CHANGING COOLANT
(See Figures 3E-4 and 3E-5)

1. Remove the radiator cap when the engine is cool.
2. Remove drain pug and drain coolant.
3. Remove and drain overflow bottle.
4. Reinstall plug.
5. Reinstall overflow tank.
6. Fill the cooling system with 5.0 qts. (4.7 L) of coolant (includes engine, radiator and overflow bottle) and run engine for 2 or 3 minutes at idle. This forces out air which still may be trapped within the cooling system. Stop engine and add coolant as necessary until coolant level reaches the filler throat of radiator. Reinstall radiator cap.
7. Add coolant to reservoir tank so that the level is at the full mark.

CLEANING RADIATOR CORE

Keep the radiator intake screen (see Figures 3E-4 and 3E-5), radiator fins and surrounding engine areas free of debris.

If the radiator fins or intake screen become dirty, air cannot circulate well enough to cool the engine sufficiently, therefore you risk the chance of the engine overheating.

Clean the radiator fins with compressed air. If water is used to clean the radiator, use compressed air to blow all the water from the fins. Water left between the fins will collect dirt and plug the radiator, this will reduce the amount of air flow to properly cool the engine.

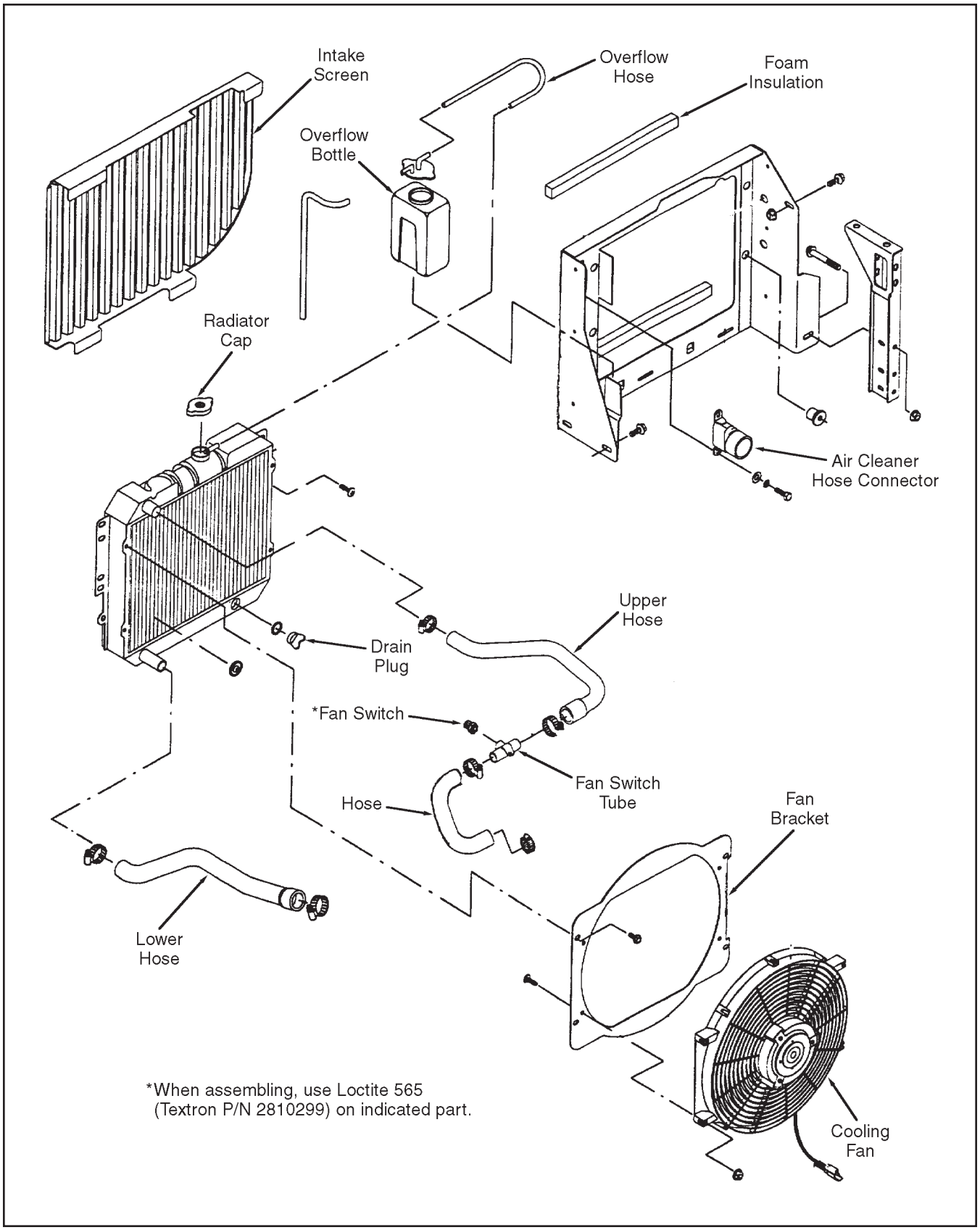

Figure 3E-4. Radiator and Cooling System Repair — 3-Cylinder Engine (Suzuki 660)

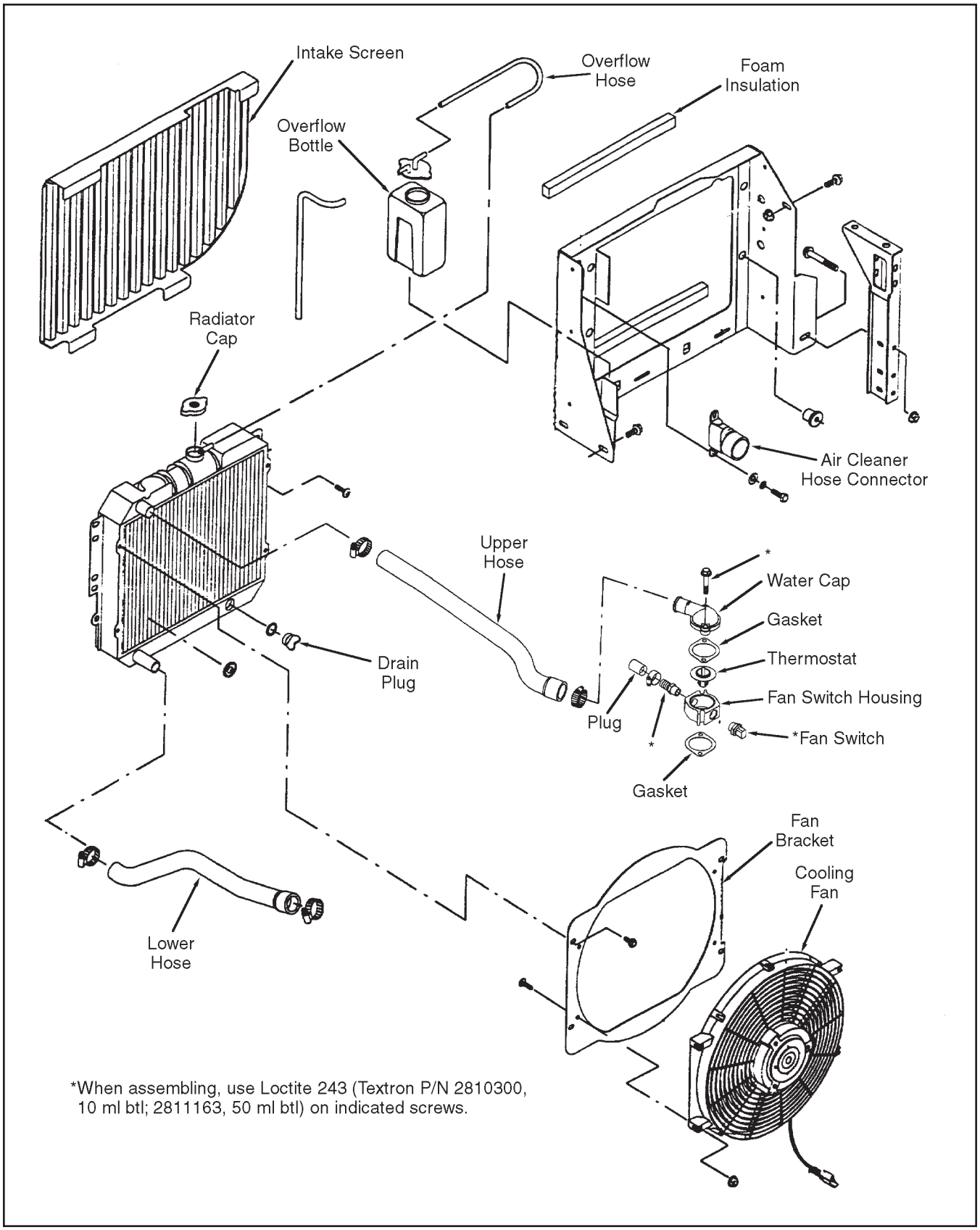

Figure 3E-5. Radiator and Cooling System — 4-Cylinder Engine (Suzuki 970)

MUFFLER AND EXHAUST SYSTEM (See Figures 3E-6 and 3E-7)

WARNING

To avoid danger of being burned, do not touch exhaust system when system is hot. Any service on exhaust system should be performed when system is cool.

INSPECTION

1. Check rubber mountings for damage, deterioration and out of position.
2. Check exhaust system for leakage, loose connections, dents and damages. If nuts or bolts are loose, tighten them to 29 to 43 ft-lbs. (40 to 60 N.m).
3. Check nearby body areas for damaged, missing, or mispositioned parts, open seams, holes, loose connections or other defects which could permit exhaust fumes to seep into the vehicle.

REPAIR

Remove and replace damaged mufflers, hoses and other exhaust system components as shown in Figures 3E-6 and 3E-7.

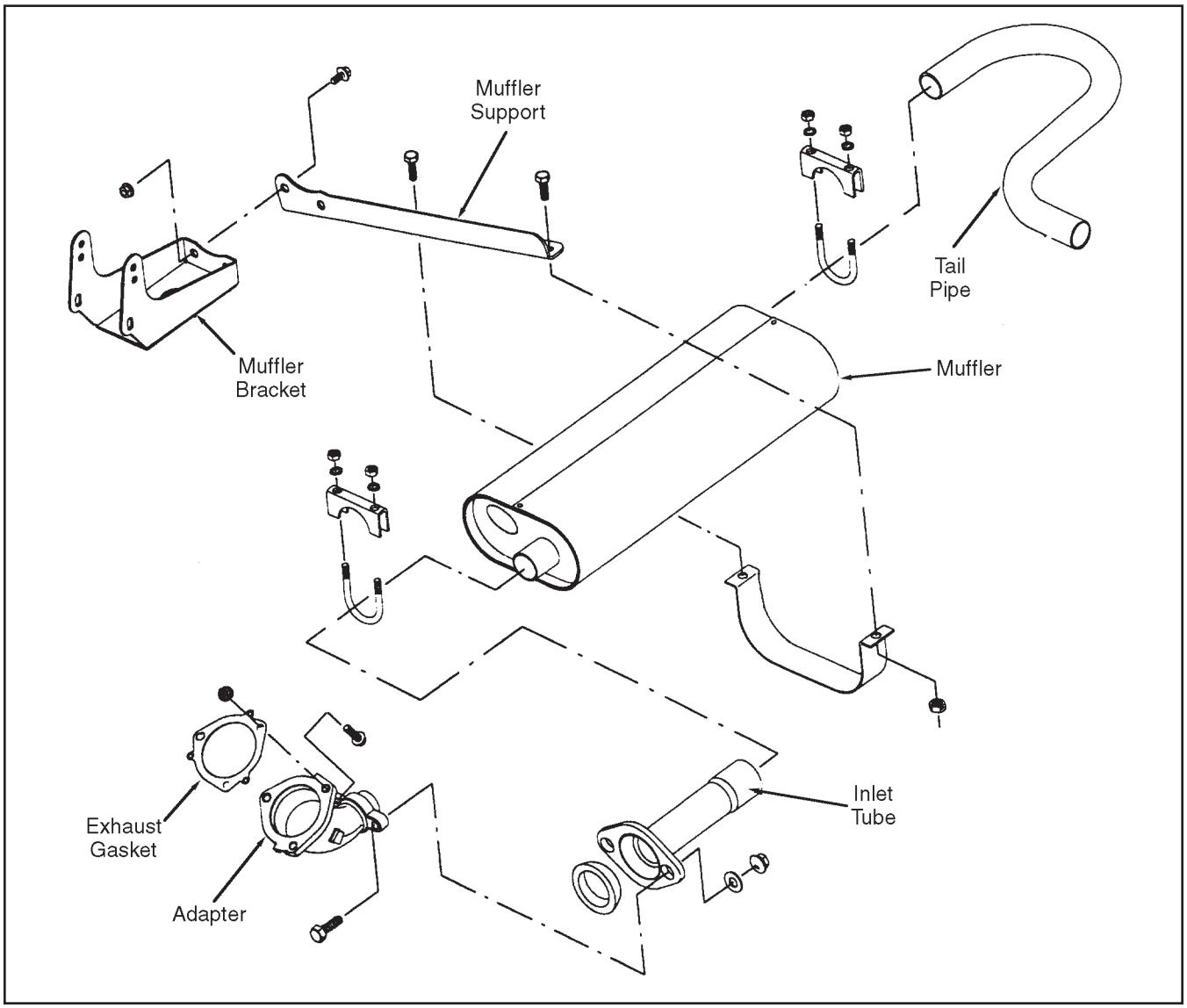

Figure 3E-6. Muffler and Exhaust System — 3-Cylinder Engine (Suzuki 660)

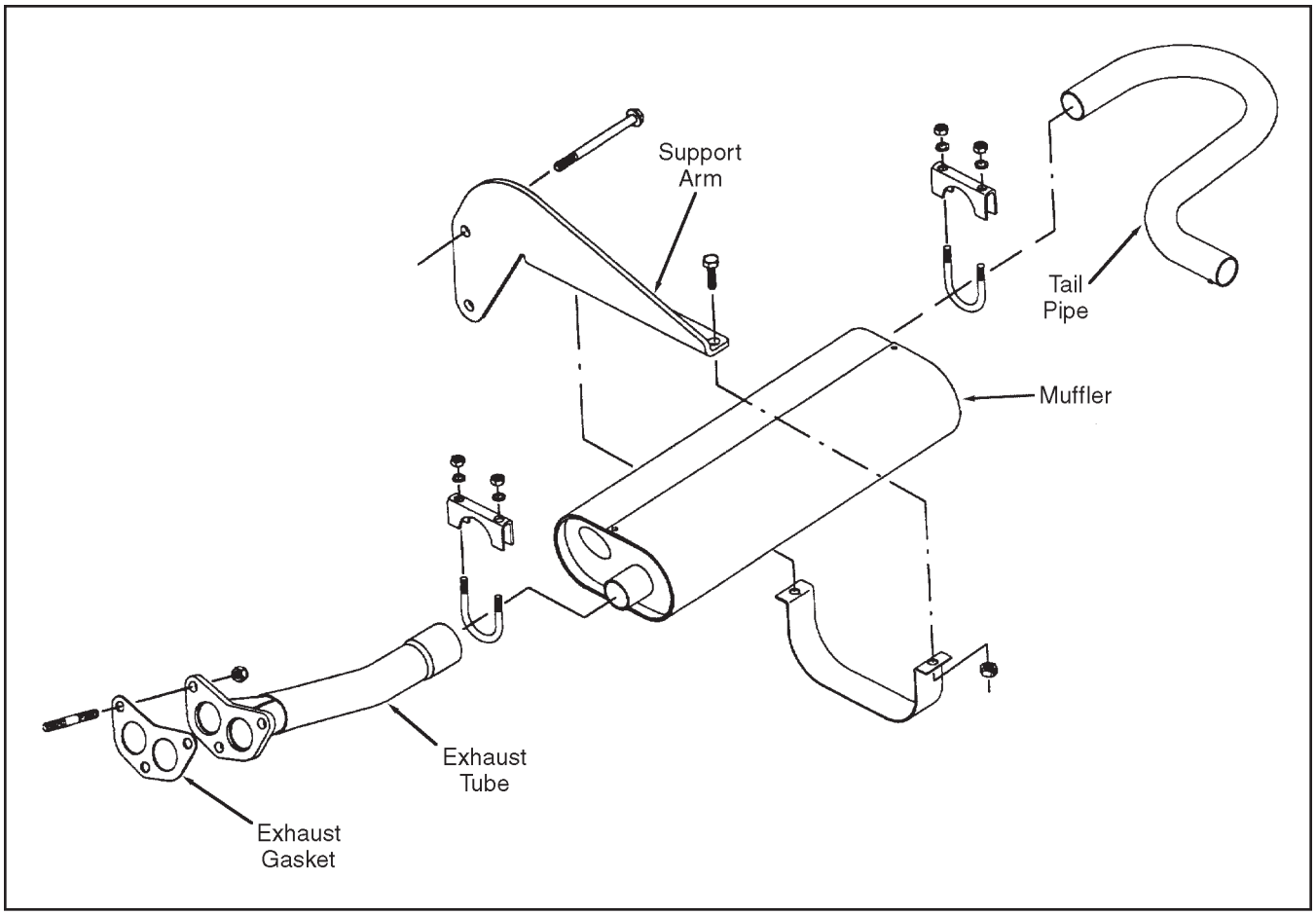

Figure 3E-7. Muffler and Exhaust System — 4-Cylinder Engine (Suzuki 970)

FUEL FILTER SERVICE (See Figure 3E-8)

WARNING

The following procedure must be performed in a well ventilated area and away from any open flames (such as gas hot water heaters).

REMOVAL

1. Remove negative (–) battery cable.
2. Remove fuel filler cap from fuel filler neck to release fuel vapor pressure in fuel tank. After releasing vapor, reinstall cap.
3. Hoist vehicle.
4. Place fuel container under fuel filter.
5. Disconnect inlet and outlet hoses from fuel filter using two wrenches.
6. Remove fuel filter from body.

INSTALLATION

1. Position the new filter in place and connect the inlet and outlet hoses to it.
2. Lower vehicle and reconnect negative (–) battery cable.

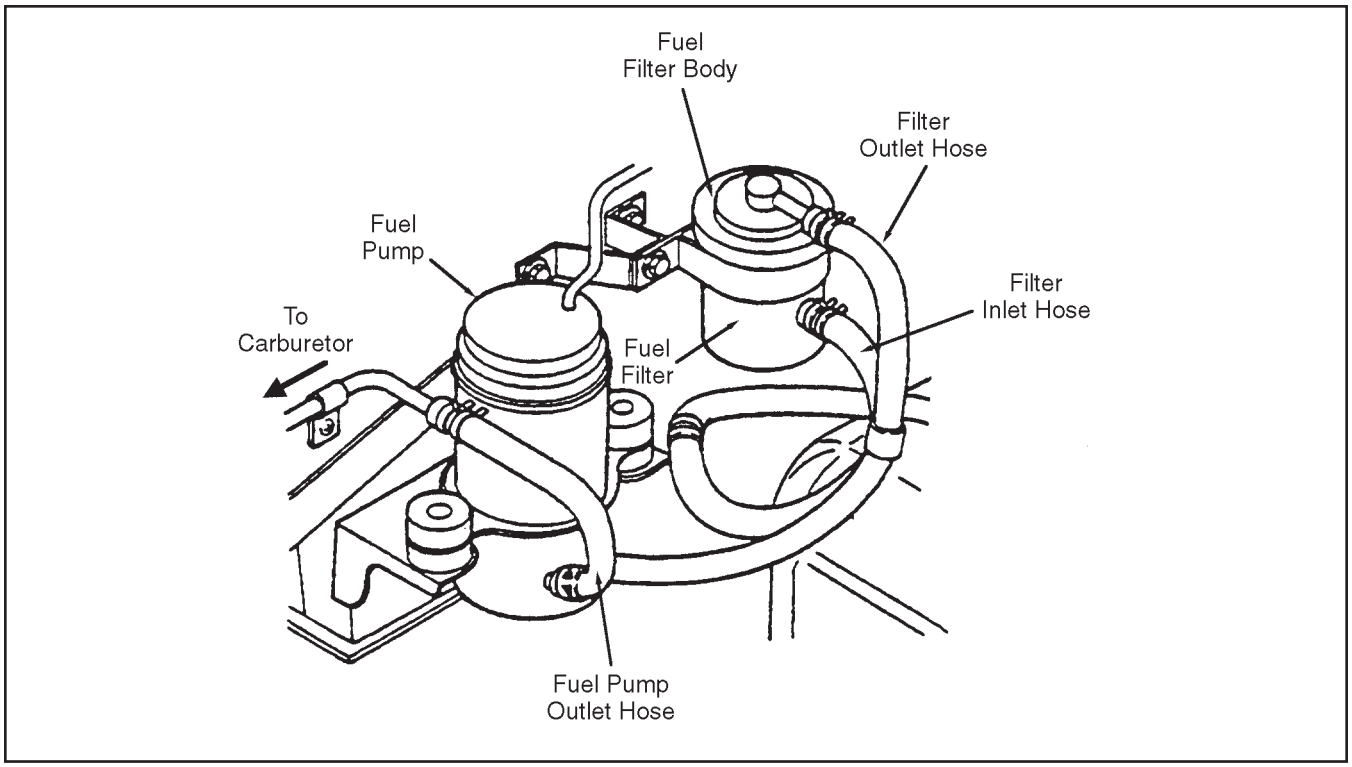

Figure 3E-8. Fuel System

ENGINE REMOVAL

1. Raise dump box and open engine cover.
2. Disconnect NEG (–) battery cable from battery.
3. Drain engine cooling water and hydraulic fluid.
4. Remove radiator hoses and air cleaner hose.
5. Remove radiator.
6. Tag and disconnect wiring from engine.
7. Disconnect accelerator and governor cables from engine.
8. Remove drive shaft.
9. Shut off the fuel and remove fuel line.
10. Disconnect clutch cable and return spring from clutch lever.
11. Remove transmission mounting hardware from clutch housing.
12. Connect a suitable lifting device to the engine.
13. Remove engine mounting hardware.
14. Using suitable hoist carefully lift engine and pull away from transmission to remove.

NOTE

Clutch disc and cover will be removed with engine.

ENGINE INSTALLATION

1. Using a suitable lifting device, lift engine and position in-line with transmission.
2. Push engine toward transmission so drive shaft splines of transmission engage clutch. It may be necessary to rotate transmission gearing to index clutch disc splines.
3. Fasten engine to bell housing.
4. Install engine mounting hardware.
5. Reconnect clutch cable to clutch arm and reconnect return spring. To adjust see Section 2C.
6. Install drive shaft.
7. Reconnect accelerator and governor cables. See Section 2C for adjustments.
8. Reconnect exhaust pipe.
9. Reconnect intake and return fuel lines.
10. Reconnect electrical wiring.
11. Install radiator and hoses.
12. Install air cleaner hose.
13. Fill cooling system.

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SECTION 4
DRIVE TRAIN

RETURN TO MAIN
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SECTION 4A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools.
	Blind hole bearing puller.
	Bearing and gear installation tools.
Cleaning materials:	Stoddard or equivalent solvent.
	Loctite® “chisel” gasket remover or equivalent.
	Loctite® Sealant 518 (Textron P/N 2811582, 50 ml btl).
Lubricants:	Refer to Section 11.
	Loctite® Blue 243 (Textron P/N 2810300, 10 ml btl; 2811163, 50 ml btl).

SECTION 4B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Noisy when vehicle moving forward or reverse.	a. Excessive gear backlash. b. Faulty U-joints.	a. Adjust (Section 4G or 4H). b. Repair (Section 4C).
2. Clunking sound when changing direction.	a. Axle drive U-joint faulty. b. Excessive differential gear backlash.	a. Repair (Section 4C). b. Adjust (Section 4I).
3. Control lever moves but will not shift.	a. Control lever assembly broken or damaged. b. Damaged offset lever, shift fork, selector plate or selector arm.	a. Replace control lever or housing assembly (Section 4G or 4H). b. Remove shifter case cover. Check for damaged parts. Replace damaged parts (Section 4G).
4. Hard shift or control lever will not move into gear.	a. Clutch not releasing. b. Improper or low transmission lubricant. c. Shifter shaft or shift rail binding. d. Binding of sliding synchronizer or gears. e. Reverse only, seized backup switch.	a. Adjust or replace clutch (Section 4D). b. Add or drain and replace with proper lubricant (Section 11). c. Remove shifter case cover. Check for damaged parts. Replace damaged parts (Section 4G or 4H). d. Remove shifter case cover. Check that synchronizers and gears (parts with shifting grooves) slide freely on shafts. Remove and replace damaged parts (Section 4G or 4H). e. Remove and check backup switch. Replace if seized (Section 10).
5. Slipping clutch.	a. Loss of clearance at the tip of release fork. b. Clutch facings dirty with oil or excessively worn. c. Weakened diaphragm spring. d. Distorted pressure plate or flywheel surface. e. Improper clutch pedal free travel.	a. Adjust (Section 4D). b. Replace (Section 4D). c. Replace (Section 4D). d. Replace (Section 4D). e. Adjust and/or replace clutch facings (Section 4D).
6. Dragging clutch.	a. Improper clutch pedal free travel. b. Weakened diaphragm spring or worn spring tip. c. Damaged or worn splines of transmission input shaft. d. Front input shaft bearing worn or broken. e. Excessively wobbly clutch disc. f. Clutch facings broken or dirty with oil.	a. Adjust free travel (Section 4D). b. Replace (Section 4D). c. Replace (Section 4G or 4H). d. Replace (Section 4G or 4H). e. Replace (Section 4D). f. Replace (Section 4D).

SECTION 4B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
7. Clutch vibration.	a. Glazed (glass-like) clutch facings or clutch facings dirty with oil.	a. Repair or replace (Section 4D).
	b. Wobbly clutch disc or poor facing contact.	b. Replace (Section 4D).
	c. Weakened torsion springs (in clutch disc).	c. Replace (Section 4D).
	d. Clutch disc rivets loose.	d. Replace the disc (Section 4D).
	e. Weakened engine mounting or loosened mounting bolt or nut.	e. Retighten or replace.
8. Noisy clutch.	a. Worn or broken release bearing.	a. Replace (Section 4D).
	b. Front input shaft bearing worn down.	b. Replace (Section 4D).
	c. Excessive rattle of clutch disc hub.	c. Replace the disc (Section 4D).
	d. Cracked clutch disc.	d. Replace (Section 4D).
	e. Pressure plate and diaphragm spring rattling.	e. Replace (Section 4D).
9. Grabbing clutch.	a. Clutch facings soaked with oil.	a. Replace (Section 4D).
	b. Excessively worn clutch facings.	b. Replace (Section 4D).
	c. Rivet heads showing out of the facing.	c. Replace (Section 4D).
	d. Weakened torsion springs.	d. Replace (Section 4D).
10. Gears clash when shifting.	a. Engine idle speed too high.	a. Adjust idle speed to specifications.
	b. Clutch damaged or out of adjustment.	b. Adjust or replace clutch (Section 4D).
	c. Pilot bearing between input shaft and output shaft binding.	c. Disassemble and check bearing rollers, input shaft ID and output shaft OD. Replace damaged parts.
	d. Damaged synchronizer.	d. Disassemble and check for damaged synchronizer parts. Replace damage parts (Section 4G or 4H).
	e. Damaged gear or gears.	e. Disassemble and check for gear damage. Replace damaged gears (Section 4G or 4H).

SECTION 4B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
11. Transmission jumps out of gear.	a. Shifting fork loose on shaft or rail; worn or damaged fork or inserts.	a. Disassemble and check for wear or damage. Replace worn or damaged parts (Section 4G or 4H).
	b. Loose transmission or flywheel housing bolts.	b. Torque bolts to specifications (Section 4G or 4H).
	c. Synchronizer damaged or excessively worn.	c. Disassemble and check for worn or damaged synchronizer parts. Replace damaged parts (Section 4G or 4H).
	d. Blocking ring damaged, worn index slots or friction surfaces worn or damaged.	d. Disassemble and check blocking ring for wear or damage. Replace worn or damaged parts (Section 4G or 4H).
	e. Excessive countershaft end play.	e. Disassemble and check. Replace worn or damaged parts. Reshim if roller bearings used (Section 4G or 4H).
12. Transmission locked in one gear.	a. Fork or offset lever loose on shaft or rail.	a. Remove shifter case cover. Check for loose parts on shifter shaft or rail. Replace roll pin(s). If still loose, replace shaft or rail and/or attached parts as required (Section 4G or 4H).
	b. Worn or damaged forks, offset lever, shaft or rail.	b. Remove extension or adapter and case cover. Check for wear or damage. Replace damaged parts (Section 4G or 4H).
	c. Worn or damaged synchronizer.	c. Disassemble and check for worn or damaged synchronizer parts. Replace worn or damaged parts (Section 4G or 4H).
	d. Worn or damaged gears.	d. Disassemble and check for worn or damaged gears. Replace worn or damaged gears (Section 4G or 4H).
13. Transmission noise. NOTE: Make sure noise is coming from transmission and not clutch throwout bearing or other components.	a. Improper or low transmission lubricant.	a. Add or drain and replace with proper lubricant (Section 11).
	b. Loose bolts or other attaching parts.	b. Make sure all attaching parts are torqued to specifications (Section 4G or 4H).
	c. Noisy transmission bearings.	c. Disassemble and check bearings, bearing rollers and parts in and on which they operate for wear or damage. Replace worn or damaged parts (Section 4G or 4H).
	d. Noisy gears.	d. Disassemble and check for worn or damaged gears (including speedometer gear). Replace worn or damaged gears (Section 4G or 4H).

SECTION 4B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
14. Transmission leakage.	a. Vent or breather clogged.	a. Remove vent or breather and clean or replace (Section 4G or 4H).
	b. Too much or improper lubricant.	b. Remove fill plug to check for excess, or drain and replace (Section 4G or 4H).
	c. Loose bolts at sealing faces.	c. Torque bolts to specifications (Section 4G or 4H).
	d. Improperly applied sealant.	d. Separate and thoroughly clean leaking surfaces. Reapply sealant. Replace parts and torque bolts to specifications (Section 4G or 4H).
	e. Worn or damaged oil seal.	e. Replace oil seal (Section 4G or 4H).
15. Differential gear noise.	a. Maladjusted backlash between drive pinion and ring gear.	a. Adjust (Section 4I).
	b. Damaged gear teeth or improper mesh of drive pinion and ring gear.	b. Replace or adjust (Section 4I).
	c. Improper tooth contact in the mesh between drive pinion and ring gear.	c. Adjust (Section 4I).
	d. Insufficient or wrong kind of gear oil.	d. Replenish or replace (Section 4I).
	e. Ring gear wobbling when turning, or ring gear securing bolts loose.	e. Replace or retighten (Section 4I).
	f. Broken or otherwise damaged teeth of side gears or differential pinion gears.	f. Replace (Section 4I).
16. Differential bearing noise.	a. (Constant noise.) Insufficient or wrong kind of gear oil.	a. Replenish or change (Section 4I).
	b. (Constant noise.) Damaged or worn bearings or worn parts.	a. Replace (Section 4I).
	c. (Noise during coasting.) Damaged bearings of drive pinion.	c. Replace (Section 4I).
	d. (Noise during turning.) Broken bearings on axle shafts.	d. Replace (Section 4I).

SECTION 4C. DRIVE SHAFT

GENERAL

The rear differential is driven by a universal joint type drive shaft connected between the transmission and rear differential (axle).

Repairs are limited to renewing the cross and bearings.

If the drive shaft or end yokes become damaged, they must be replaced as an assembly.

REMOVAL (See Figures 4C-1 and 4C-2)

NOTE

At least two service personnel are required to perform this procedure.

1. Disconnect control linkages and any cables that would prohibit pushing the drive shaft end of the transmission downward about 4 inches.
2. Remove hardware at transmission mounting brackets as shown in Figures 4C-1 and 4C-2.
3. Push down on the transmission upper mounting bracket until the drive shaft yoke can be freed of the transmission shaft.
4. Raise and support the transmission to its original mounted position.
5. Hold the input shaft of the differential while loosening the yoke nut with a box end wrench. Remove the nut and washer and pull the assembled drive shaft out of the differential.

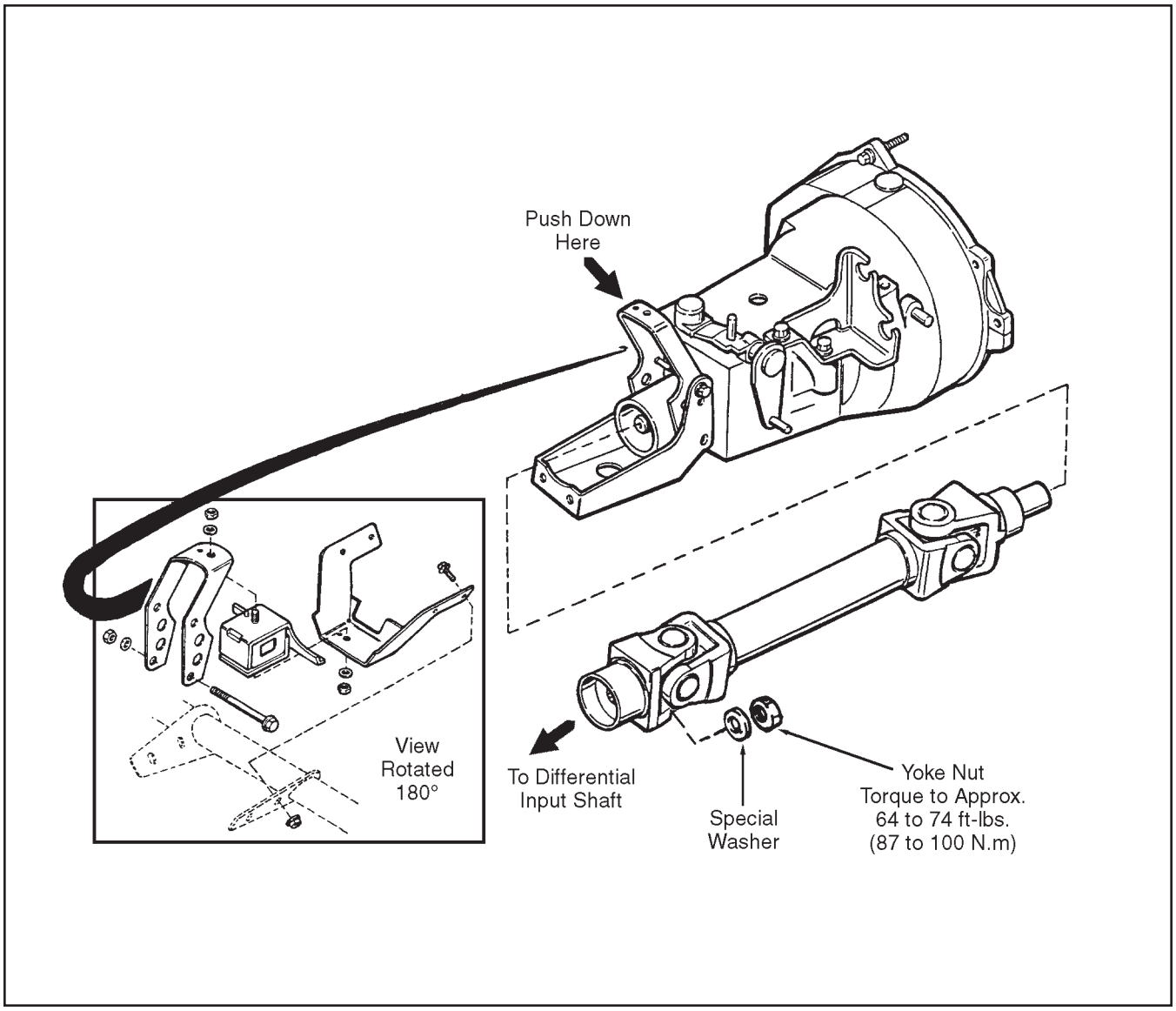


Figure 4C-1. Drive Shaft Removal and Installation — Vehicles with 3-Cylinder Gasoline Engines

SECTION 4C. DRIVE SHAFT

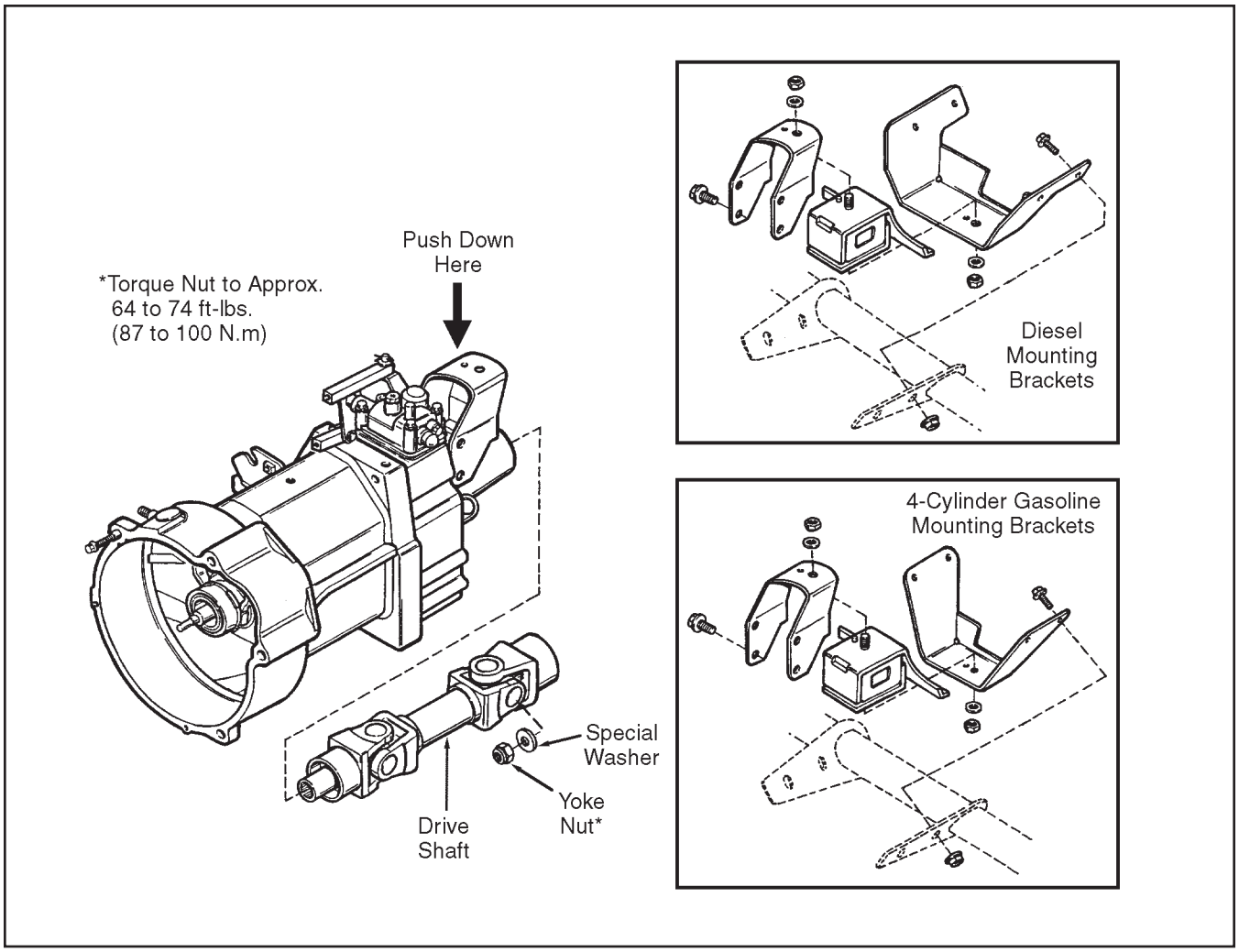


Figure 4C-2. Drive Shaft Removal and Installation — Vehicles with 4-Cylinder Gasoline Engines and Diesel Engines

DISASSEMBLY (See Figure 4C-3)

1. Position the joint in a vise as shown.
2. Remove the four snap rings.
3. With a soft face hammer, strike the top ear of the yoke. This will drive the top bearing outward 3/8 inch.
4. Grip the loose bearing in the vise and drive the end yoke off the center cross.
5. Repeat Steps 3 and 4 for the remaining end yoke.

REASSEMBLY (See Figure 4C-3)

NOTE

During reassembly, be sure all the parts are clean and free of dirt. Align yokes as shown in Figures 4C-1 and 4C-2.

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 ears of yokes.

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

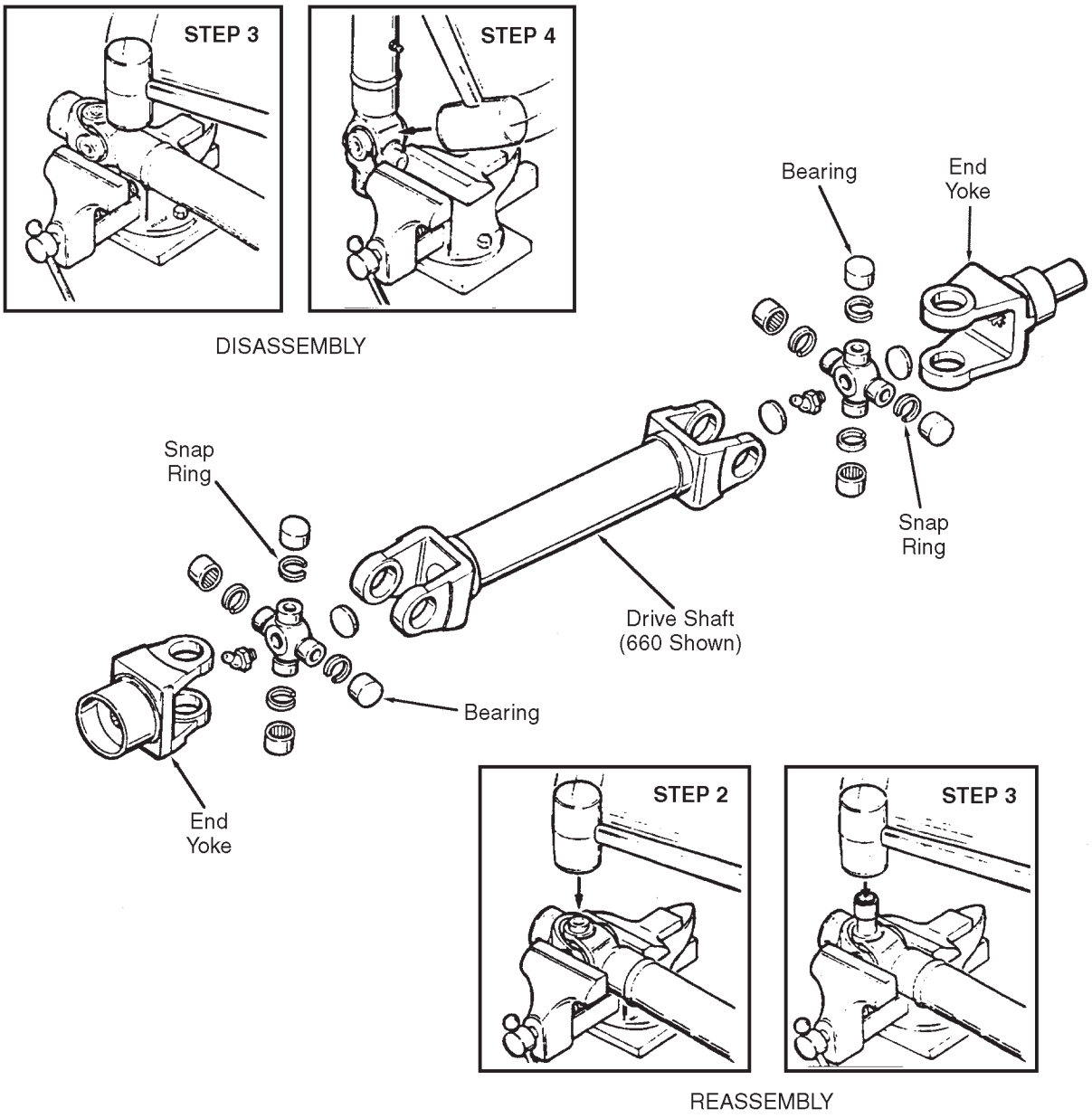


Figure 4C-3. Drive Shaft Disassembly and Reassembly

SECTION 4C. DRIVE SHAFT

INSTALLATION
(See Figures 4C-1 and 4C-2)

1. Make certain that the yokes of the drive shaft are correctly aligned with the yokes in the transmission and differential.
2. Install the drive shaft yoke onto the differential input shaft. Hold the input shaft to keep it from turning, install the special washer and yoke nut and use a box wrench to tighten the nut to approximately 64 to 74 ft-lbs. (87 to 100 N.m).

NOTE

The torque of the yoke nut can only be approximately determined.

3. Loosely install the drive shaft in the yoke at the transmission.
4. Lift and/or support the transmission and install transmission mounting brackets and hardware.
5. Connect cables and linkages removed during disassembly. Adjust shift control cables and linkages as described in Section 2.

SECTION 4D. CLUTCH

REMOVAL

The clutch components can only be removed when the engine and transmission have been separated.

See Figure 4D-1 for clutch arrangements. To gain access to the clutch components, either remove the engine as described in Section 3D or remove the transmission as described in Section 4H.

CLUTCH DISASSEMBLY

1. Use a flywheel holder tool to hold the engine flywheel (see Figure 4D-2) in place and remove the six bolts that secure the clutch cover to the flywheel and remove the clutch cover and disc.
2. Refer to Figure 4D-3, remove the clutch release bearing from the transmission input shaft retainer.
3. Disconnect spring from clutch release lever.

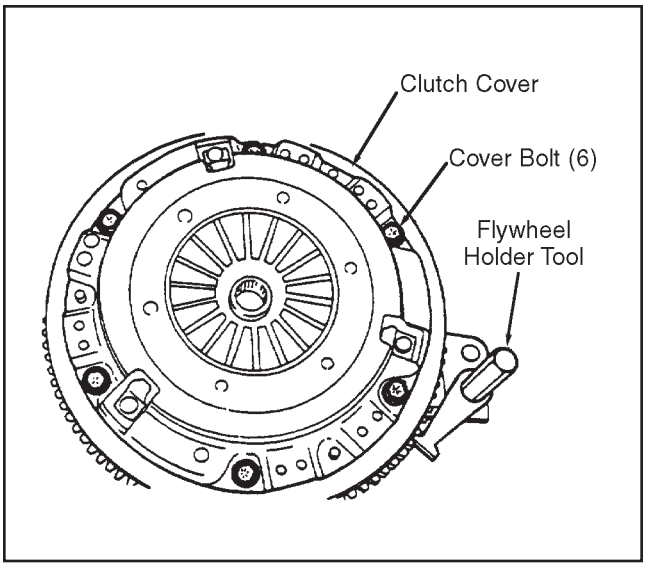


Figure 4D-2. Clutch Cover and Disc Removal and Replacement

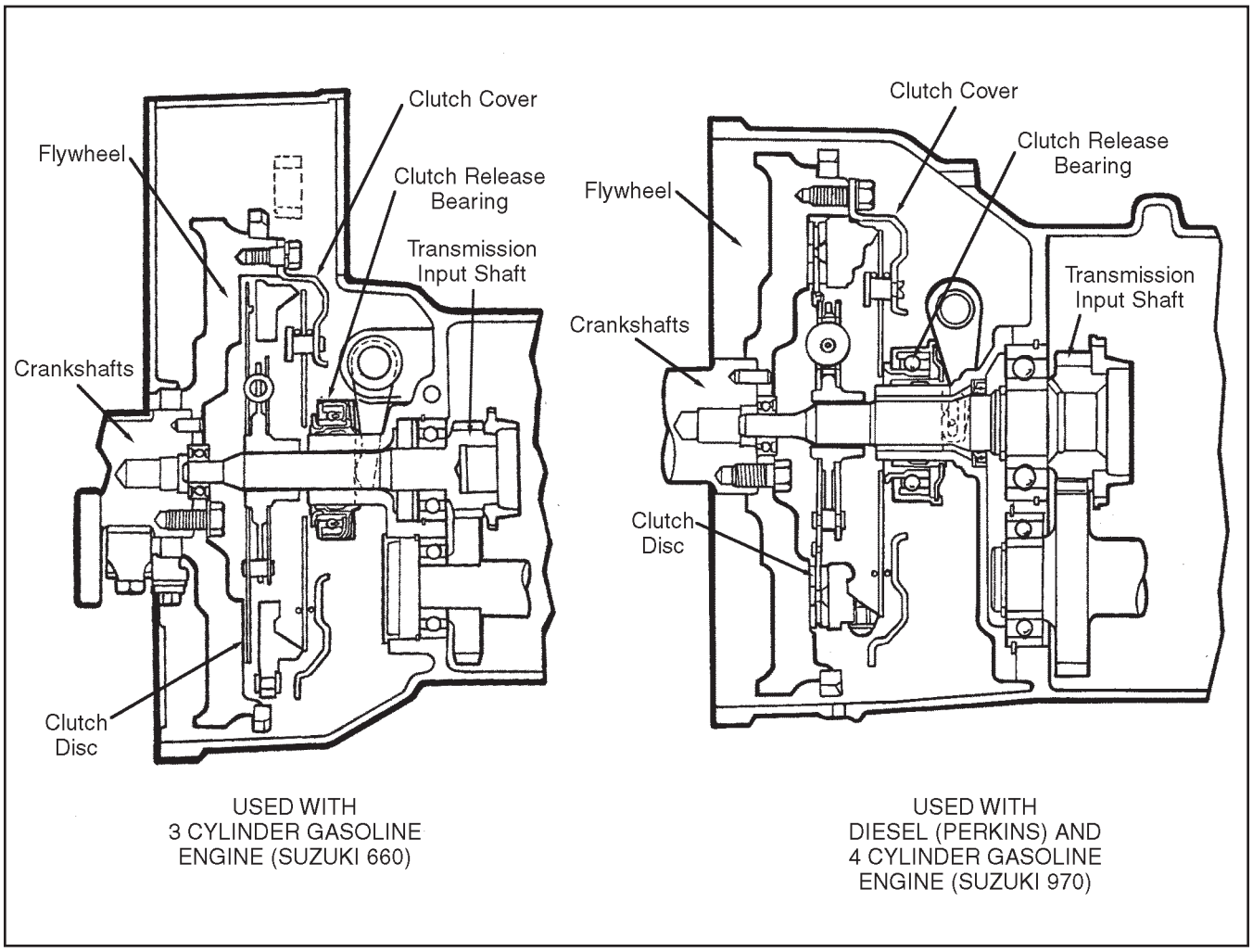


Figure 4D-1. Clutch Arrangements

SECTION 4D. CLUTCH

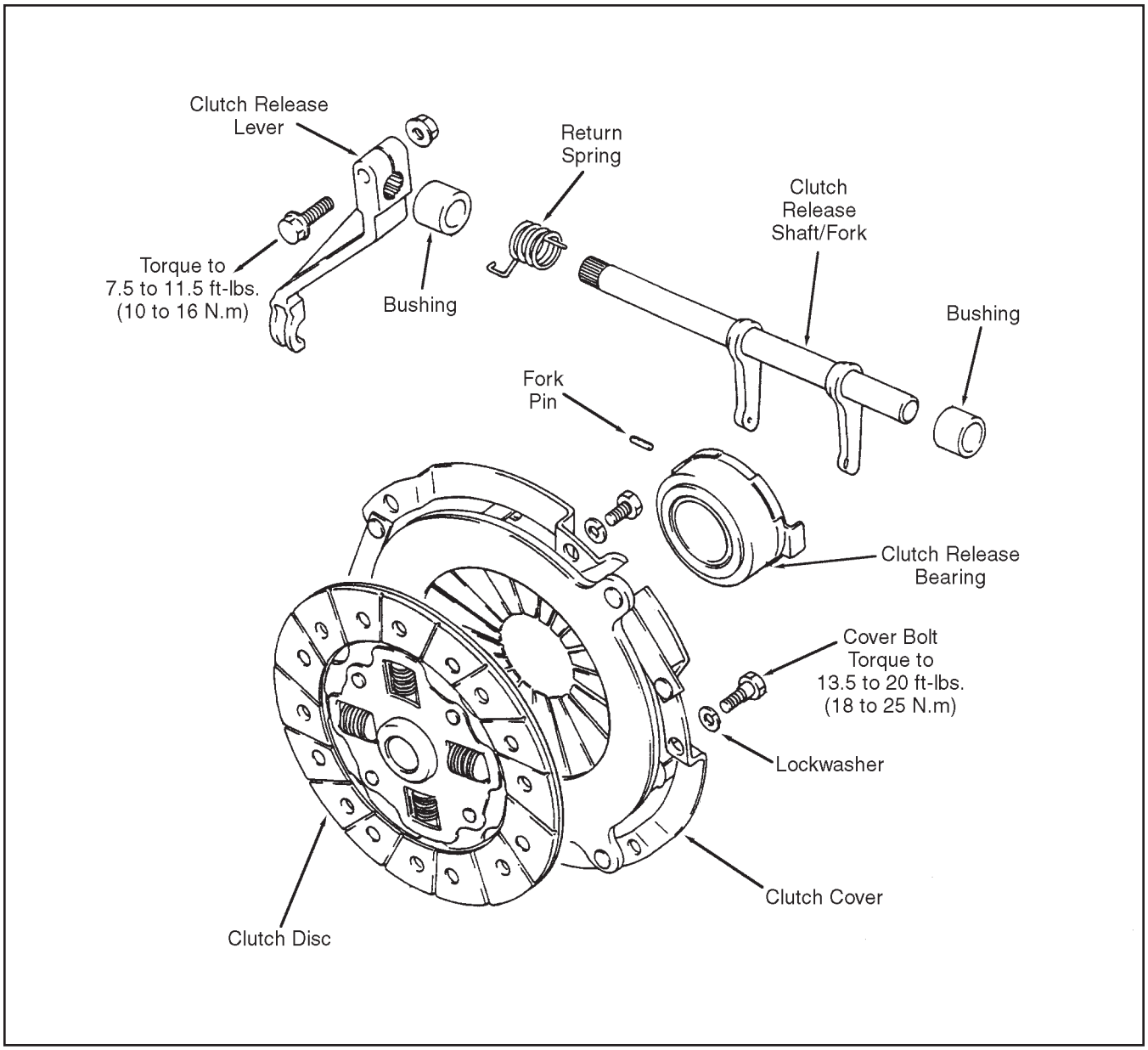


Figure 4D-3. Clutch Repair

4. Remove clutch release lever from shaft/fork. With clutch release bushing removal tool applied as shown in Figure 4D-4 tap its end to remove bushing. If bushing can not be removed from the transmission case in the above manner, grip bushing with pliers and pull out.
5. Remove clutch release shaft/fork from transmission housing.

INSPECTION OF CLUTCH COMPONENTS

1. If the release bearing (Figure 4D-3) sticks, rattles or makes abnormal noise when turned by hand, replace the bearing.
2. Inspect clutch cover for evidence of diaphragm spring rivets getting loose. If rivets are loose or are getting loose, replace cover assembly with loose rivets, the cover makes rattling noise when clutch pedal is depressed.
3. Inspect tips of tapering fingers (on which the release bearing exerts a push to disengage clutch) for wear. If tips are worn excessively, replace cover assembly.

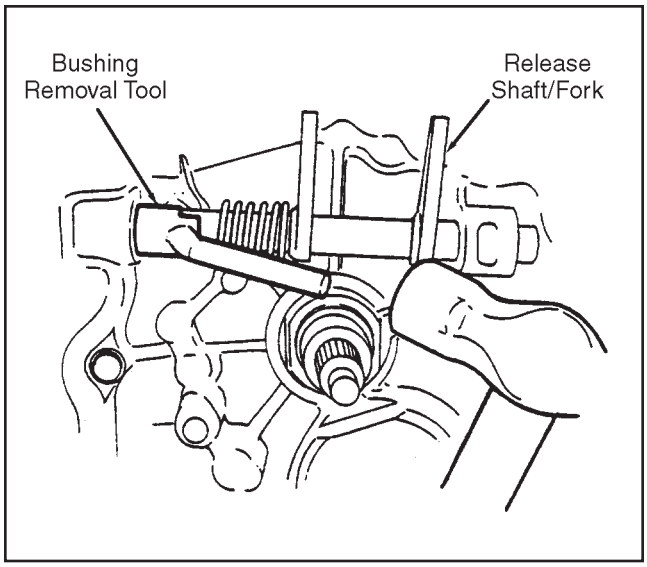


Figure 4D-4. Release Bushing Removal

4. Refer to Figure 4D-5, check wear of facing by measuring depth of each rivet head depression, i.e. distance between rivet head and facing surface. If depression is found to have reached service limit of 0.02 inch (0.5 mm) at any of the holes, replace clutch disc assembly.

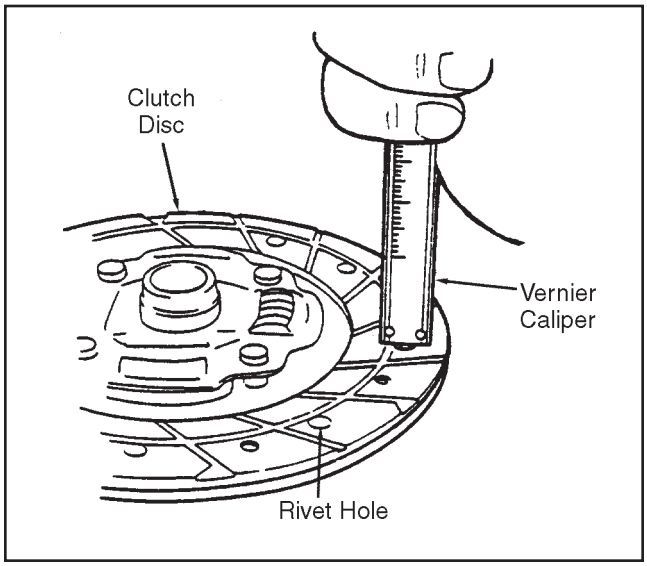


Figure 4D-5. Clutch Disc Facing Inspection

5. Refer to Figure 4D-6, check backlash by turning disc back and forth as mounted on transmission input shaft. Replace disc assembly if backlash is noted to exceed 0.04 inch (1.0 mm). Backlash here is a circular displacement as measured with a dial indicator.

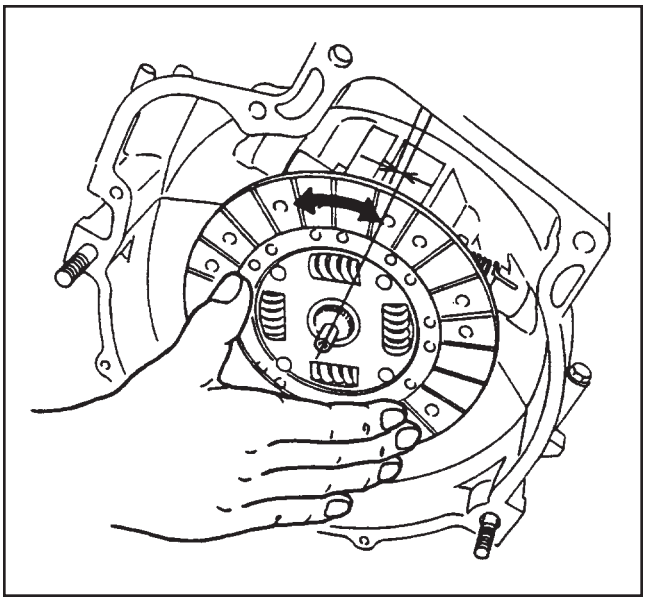


Figure 4D-6. Checking Backlash in Disc Serration

CLUTCH REASSEMBLY

1. Before reassembling the clutch, lubricate the following components (see Section 11 for recommended lubricants).
   - Clutch release bearing — lubricate inner diameter.
   - Clutch release shaft/fork — lubricate wear surfaces.
   - Transmission input shaft — lubricate wear surfaces.
   - Clutch release shaft/fork bushings — lubricate inner diameter.
2. Drive in release shaft/fork bushings to the same level as outside surface of transmission housing as shown in Figure 4D-7.

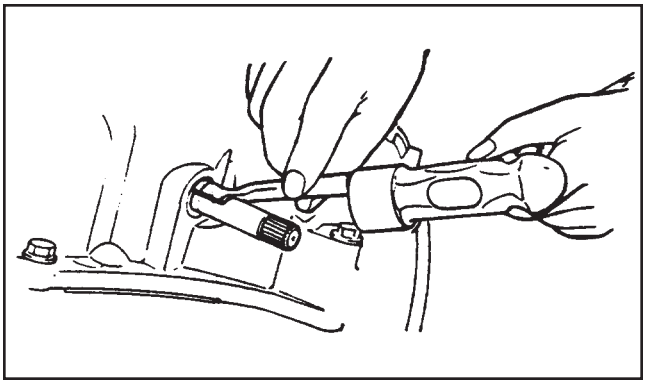


Figure 4D-7. Installing Release Shaft/Fork Bushings

SECTION 4D. CLUTCH

3. After installing release shaft/fork bushings, caulk transmission case against bushings at two points.
4. Position the return spring (see Figure 4D-3) on the clutch release shaft/fork.
5. Install the clutch release shaft/fork in the bushings. Install the clutch release lever on the shaft/fork as shown in Figure 4D-8, aligning the two punch marks on the release arm with the shaft/fork.

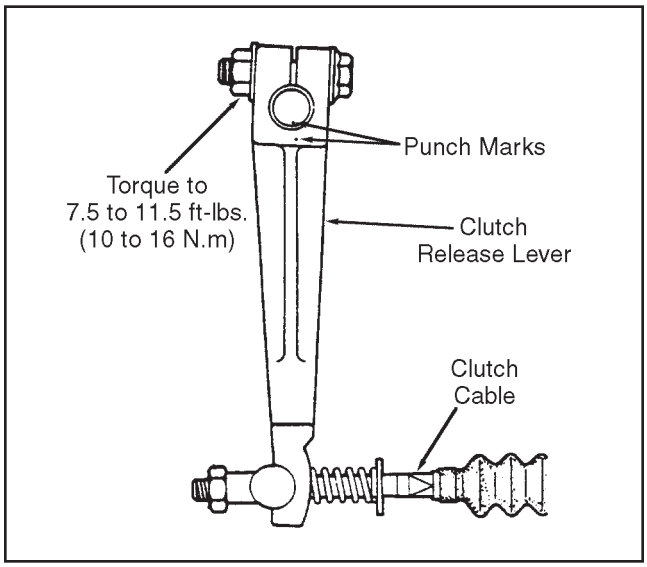


Figure 4D-8. Clutch Release Lever Installation

6. Hook the return spring (Figure 4D-3) onto the clutch release lever.
7. Install the clutch release bearing on the transmission input shaft retainer.
8. Refer to Figure 4D-9, use a flywheel holder tool to hold the engine flywheel. Use a clutch center guide tool to install the disc and clutch cover to the flywheel. Secure with six cover bolts. Torque bolts to 13.5 to 20 ft-lbs. (18 to 25 N.m). Remove the center guide tool.

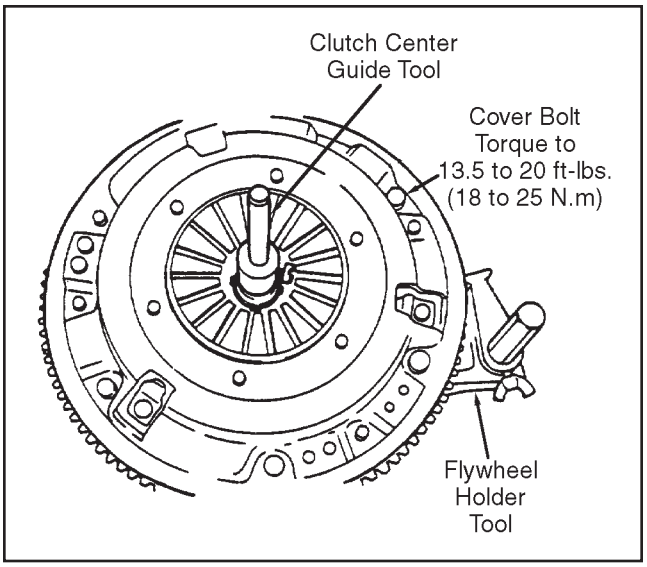


Figure 4D-9. Clutch Cover and Disc Installation

CLUTCH ADJUSTMENTS

After repair of the clutch and/or removal of the engine or transmission, adjust clutch pedal free travel, clutch cable and interlock switch as described in Section 2C.

SECTION 4E. GEAR SHIFT CABLES/CONNECTORS

REPAIR (See Figures 4E-1 or 4E-2)

Replace worn or damaged gear shift cables and connectors as shown in Figures 4E-1 or 4E-2. Adjust shift controls as described in Section 2C.

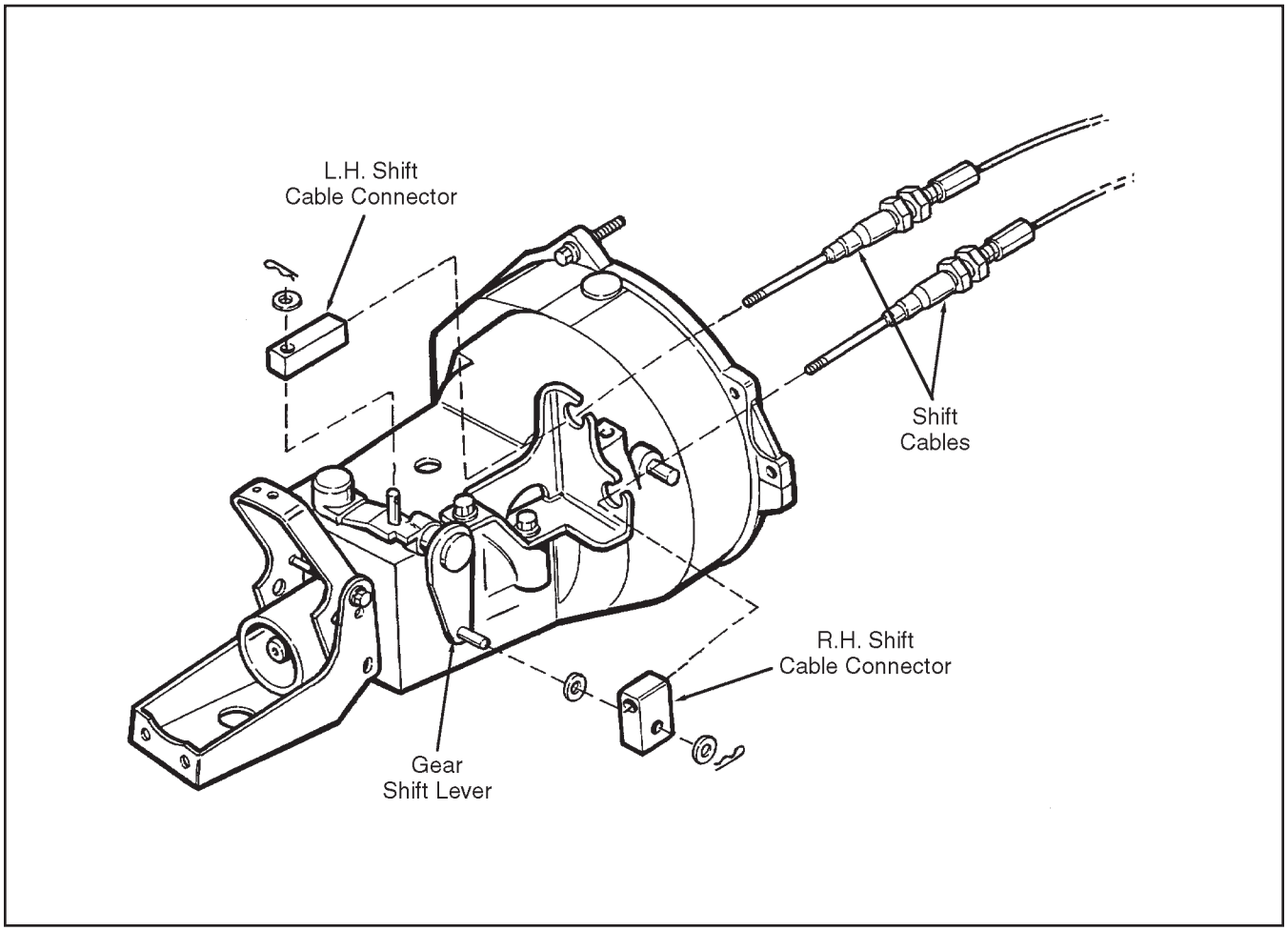


Figure 4E-1. Gear Shift Cables/Connectors (3-Cylinder Gasoline Engine)

SECTION 4E. GEAR SHIFT CABLES/CONNECTORS

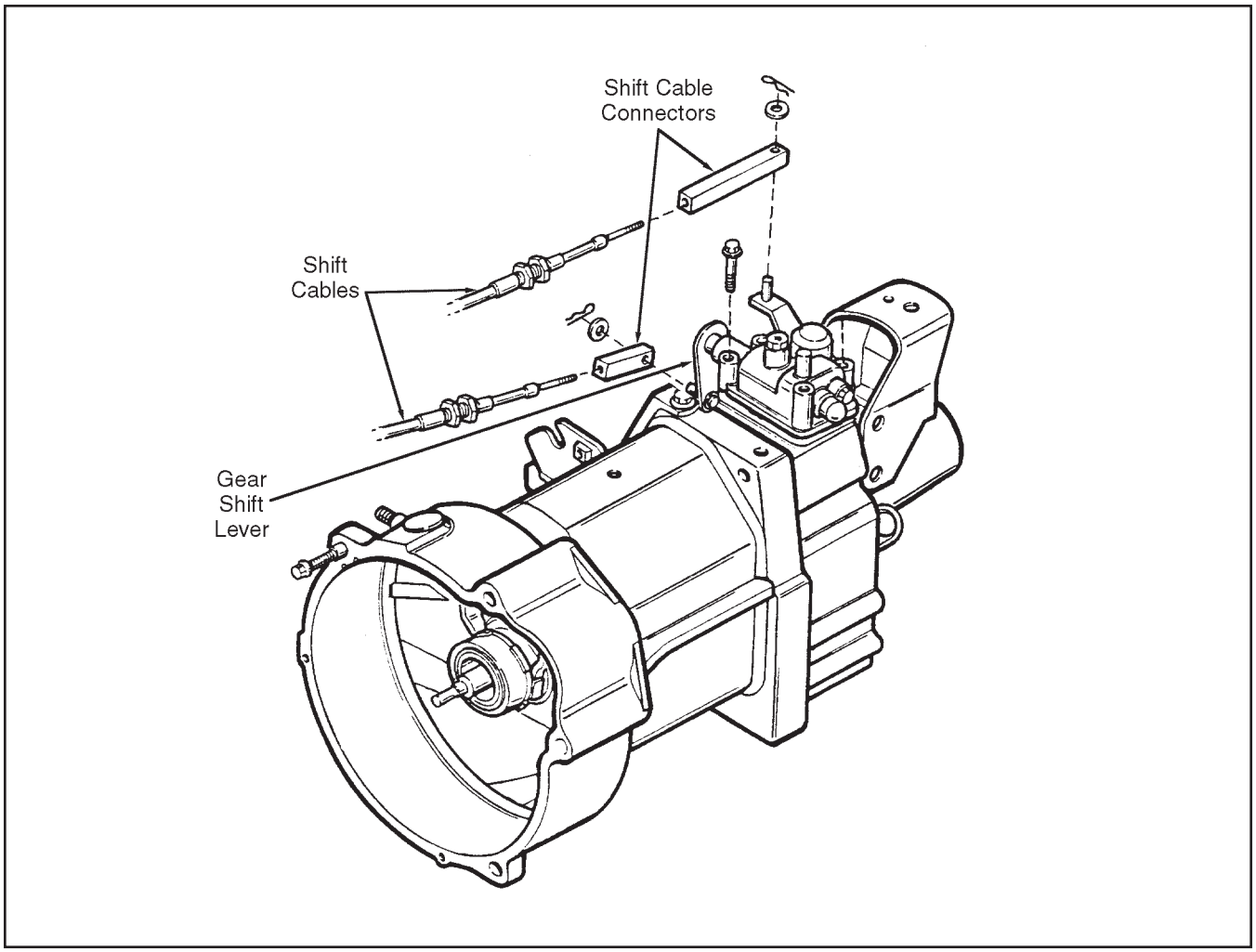


Figure 4E-2. Gear Shift Cables/Connectors (4-Cylinder Gasoline or Diesel Engine)

SECTION 4F. PRESSURE PLATE RING (DIESEL ONLY)

REPAIR (See Figure 4F-1)

A pressure plate ring is used as an interface between the clutch disc and engine flywheel for diesel engine equipped vehicles only.

If worn or damaged, replace the pressure plate ring as shown in Figure 4G-1.

If necessary, repair the clutch as described in Section 4D. Adjust the clutch as described in Section 2C.

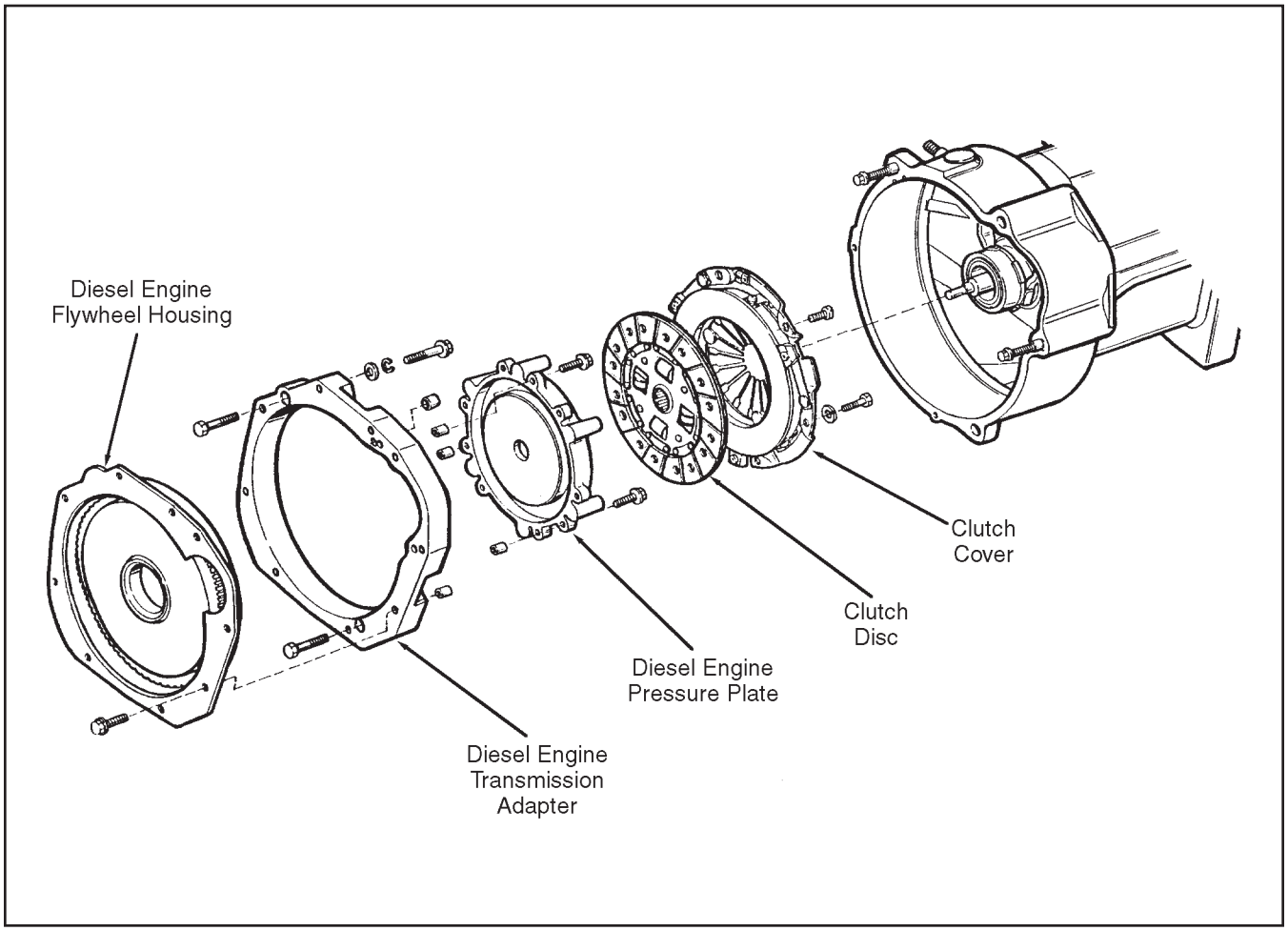


Figure 4F-1. Pressure Plate Ring — Vehicles with Diesel Engines Only

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

GENERAL

The transmission is a 4 speed manual shift type. The shift pattern is a standard H pattern with reverse R over to the right and down.

In some cases the entire transmission may not have to be disassembled. Disassemble only what is needed for repair.

TRANSMISSION REMOVAL

1. Disconnect the negative (–) and positive (+) battery cables from battery terminals.
2. Tag and disconnect all cables, hoses, tubes or control linkages which would obstruct lifting the transmission out of the frame.
3. Remove any sheet metal which would obstruct lifting the transmission out of the frame.
4. Remove the drain plug and drain oil from the transmission. Replace drain plug and torque to 14.5 to 21.5 ft-lbs. (20 to 30 N.m) for units with 3-cylinder gasoline engines and 26.5 to 36.0 ft-lbs. (36 to 50 N.m) for units with 4-cylinder gasoline or diesel engines.
5. Disconnect the clutch cable from the clutch release lever.
6. Disconnect the shift cables (see Section 4E).
7. Disconnect the drive shaft at the transmission (see Section 4C).
8. Attach a suitable hoist to the transmission.
9. Remove hardware that fastens the transmission to the engine.
10. Remove any remaining transmission hardware from mounting brackets on the frame until the transmission is free to be lifted.
11. Carefully move the transmission away from the engine flywheel and move the transmission out of the frame to a suitable work stand.

INPUT SHAFT BEARING REPLACEMENT

NOTE

Whenever the engine and transmission are separated, the transmission input shaft bearing mounted in the engine flywheel should be inspected for wear or damage.

1. Turn the bearing by hand, if it sticks, rattles or makes abnormal noise when spun, it should be replaced.
2. Remove the input shaft bearing using a removal tool as shown in Figure 4G-1.
3. Install a new bearing as shown in Figure 4G-1.
4. Visually check the flywheel surface, where it contacts the clutch disc, for wear or damage. If wear or damage is determined, replace the flywheel in accordance with engine manufacturer's instructions.

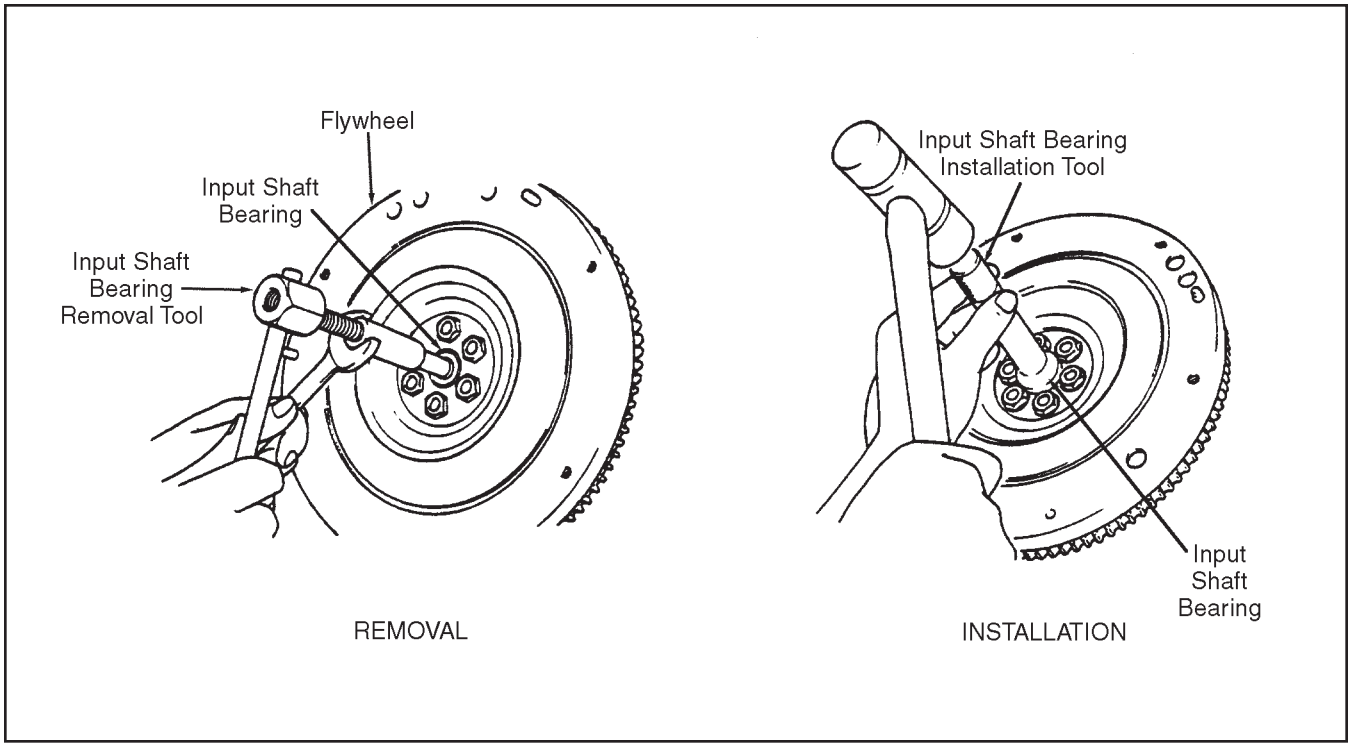


Figure 4G-1. Input Shaft Bearing Replacement

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

TRANSMISSION DISASSEMBLY

GEAR SHIFT CASE (See Figure 4G-2)

1. Remove the mounting bolts, disengage the gear selector shaft from the gear shift lever in the transmission and lift the assembled gear shift case off the transmission case.
2. If necessary, disassemble the gear shift as shown in Figure 4G-2.

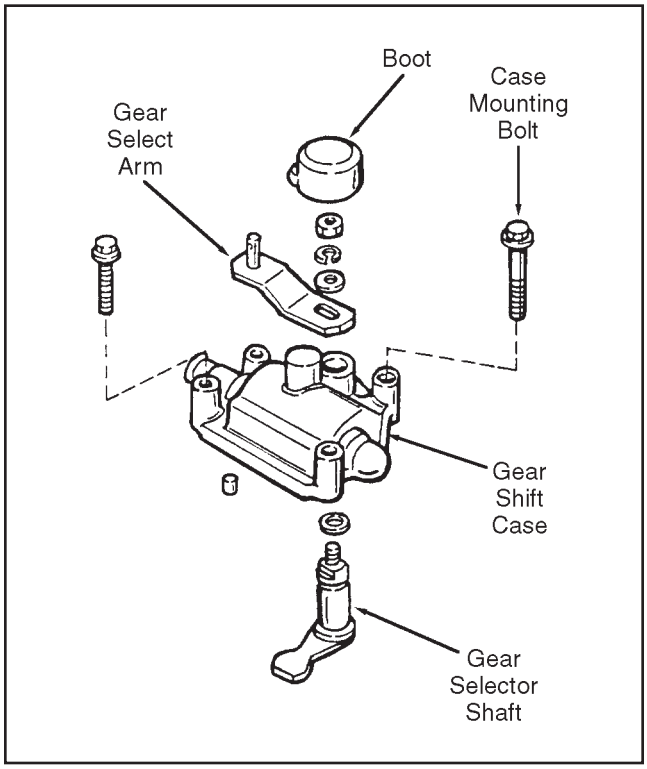


Figure 4G-2. Gear Shift Case

EXTENSION CASE (See Figure 4G-3)

1. Remove the bolts securing the extension case to he transmission case and detach the extension case and mounting bracket.
2. If necessary, remove the mounting bracket from the extension case.

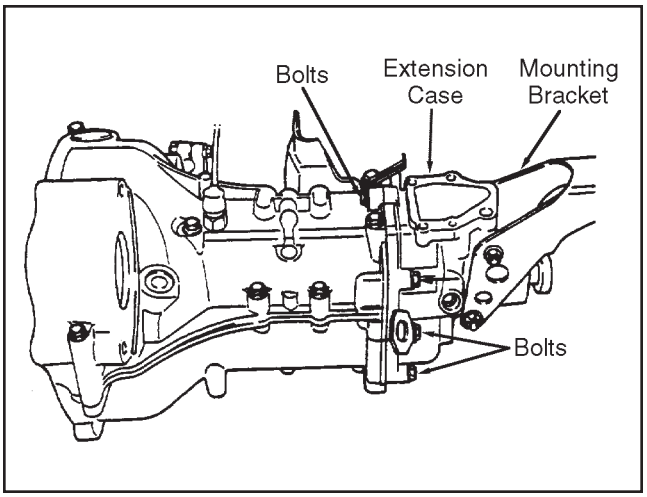


Figure 4G-3. Extension Case

SPLITTING THE TRANSMISSION (See Figure 4G-4)

1. Remove the bolts that fasten the upper and lower transmission cases together.
2. Use a steel pry bar or large screwdriver to pry the two case halves apart being careful not to damage the mating faces.

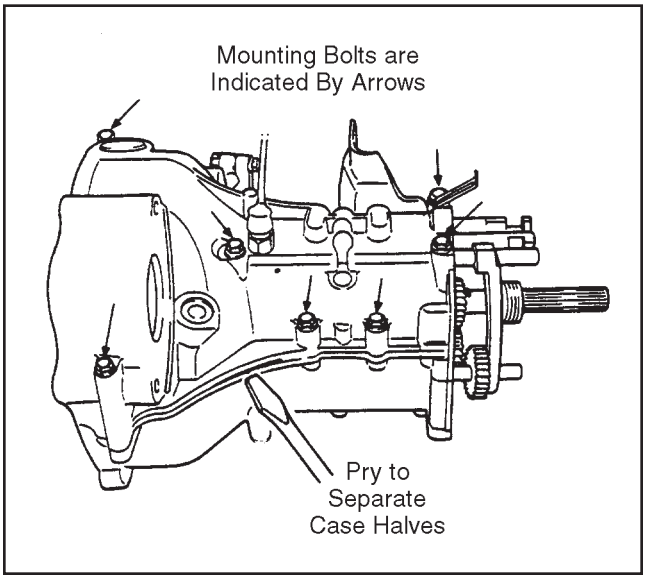


Figure 4G-4. Splitting the Case Halves

GEAR AND SHAFT REPAIR

NOTE

The arrangement of gears and shafts is shown in Figure 4G-5.

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

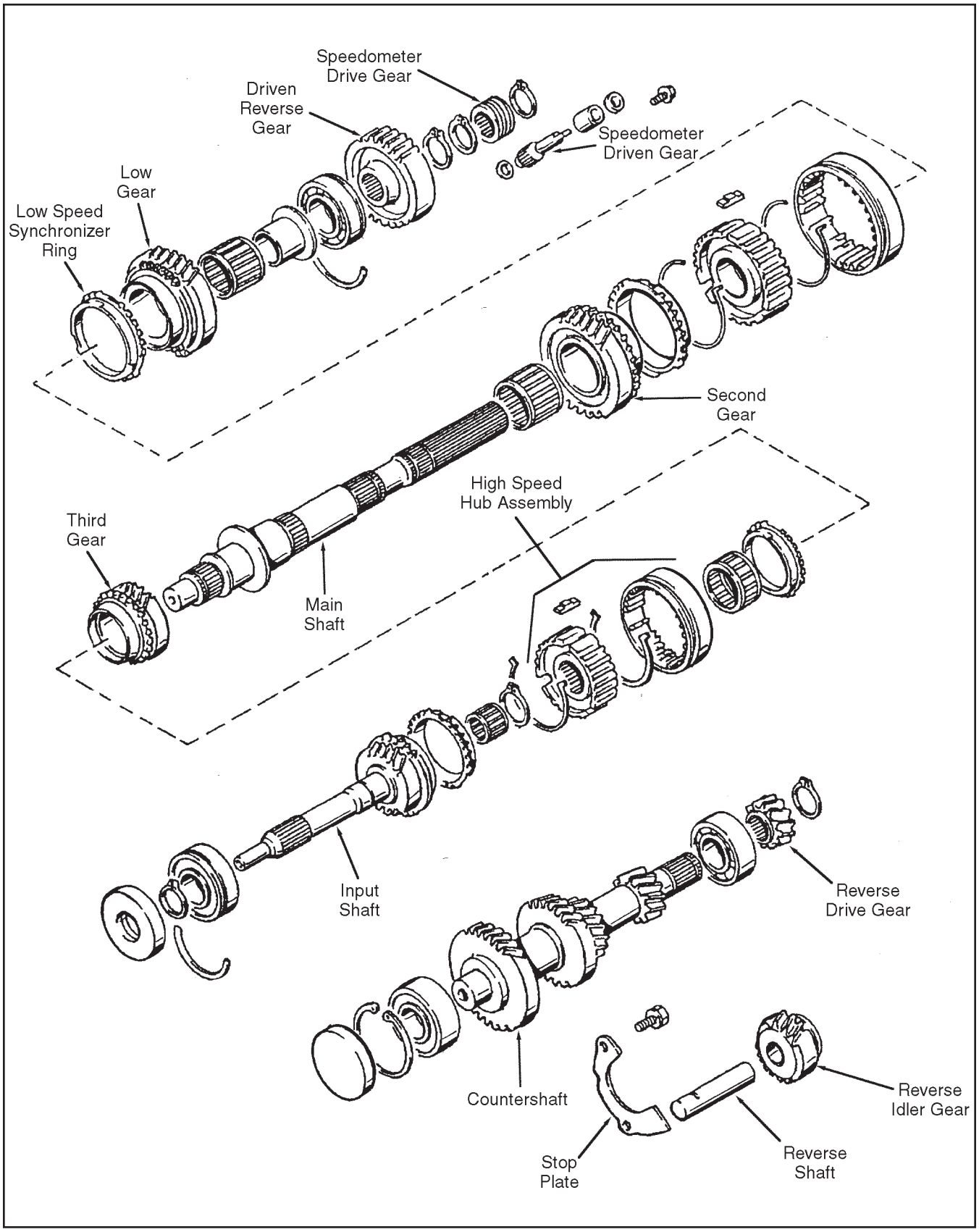


Figure 4G-5. Gear and Shaft Arrangement

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

COUNTERSHAFT

1. Remove the two bolts securing the stop plate to the case. Remove the stop plate, reverse idle gear and shaft (see Figure 4G-6).

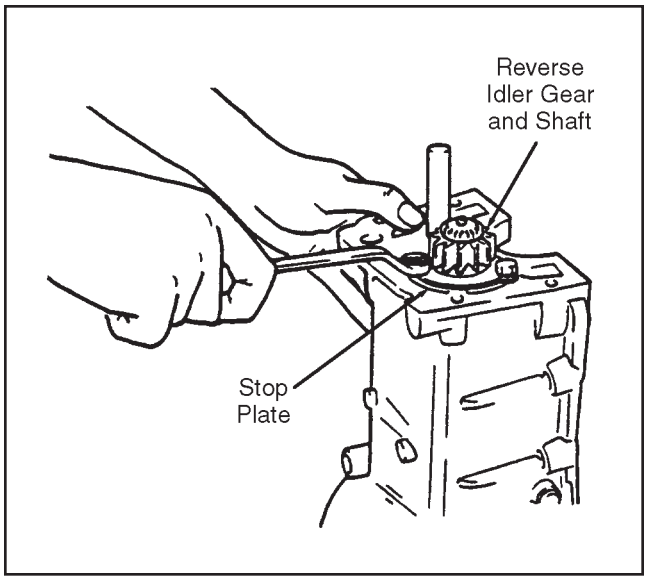


Figure 4G-6. Countershaft — Step 1

2. Remove the retaining ring from the reverse gear on countershaft and slide the reverse gear off countershaft (see Figure 4G-7).

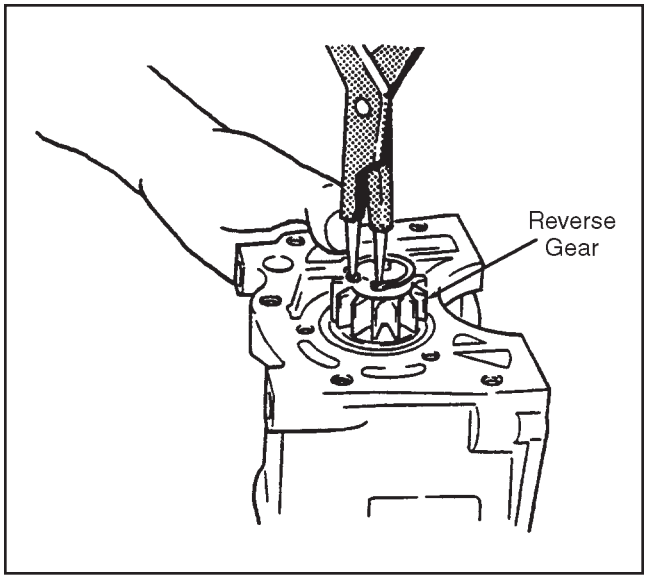


Figure 4G-7. Countershaft — Step 2

3. Remove the rubber plug and retaining ring from the countershaft (see Figure 4G-8).

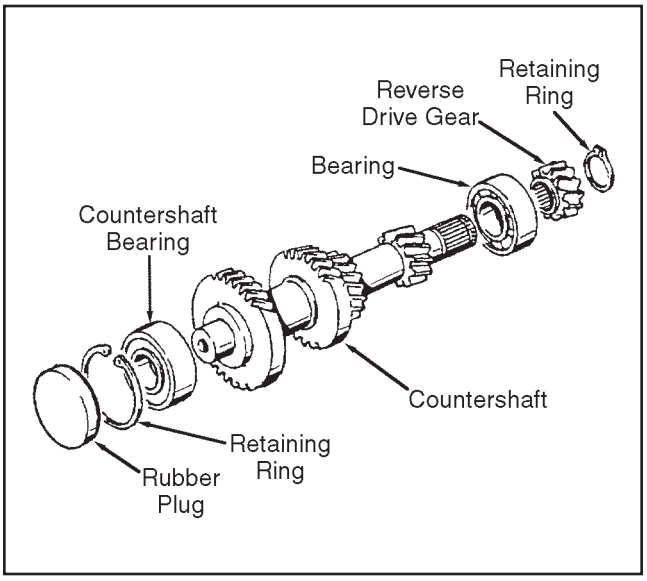


Figure 4G-8. Countershaft — Steps and 4

4. Pull the countershaft to the low gear side (see Figure 4G-5). Remove the bearings and remove the countershaft from the case.

INPUT SHAFT AND MAIN SHAFT

1. Refer to Figure 4G-9, remove the oil seal, retaining ring, bearing and input shaft. Pull out the input shaft, by hand, taking care not to drop the high speed synchronizer rings.
2. Remove the retaining ring, high speed synchronizer rings, needle bearings, high speed hub assembly, and third driven gear from the main shaft.
3. Remove the retaining rings from the speedometer drive gear and remove the speedometer drive and driven gears and reverse gear.
4. Remove the main shaft bearing using a hydraulic press.
5. Remove the low driven gear, low speed synchronizer hub assembly, second driven gear and needle bearings from the main shaft. Make certain the synchronizer rings do not drop when the synchronizer hub assembly is being removed.

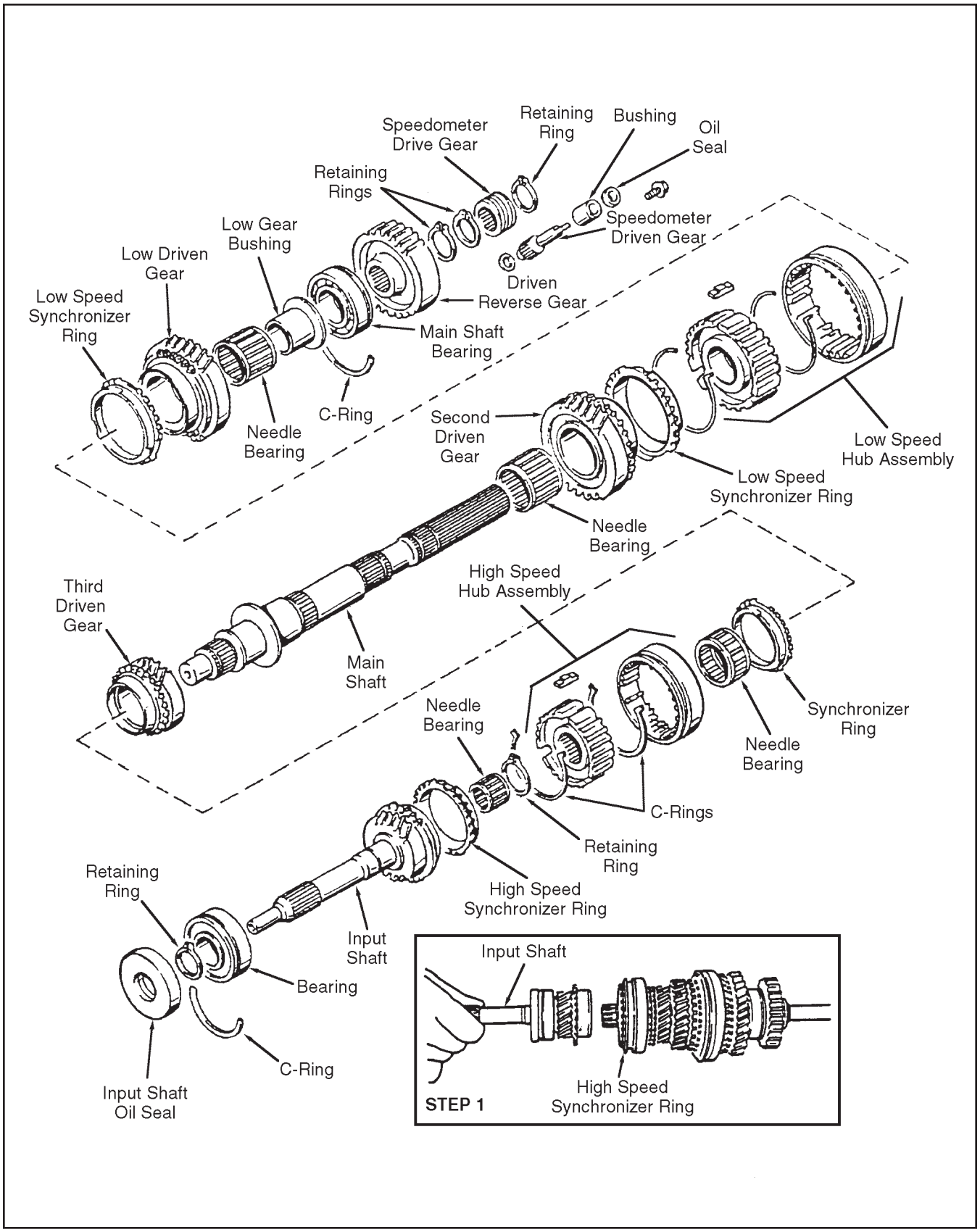


Figure 4G-9. Input Shaft and Main Shaft — Steps 1 thru 5

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

SHIFTER SHAFTS AND FORKS (See Figure 4G-10)

1. Before starting the removal work, make sure that all the shifter fork shafts in place are in neutral position. First, remove the stop plate for shifter fork shafts by removing the two bolts securing this plate.
2. It is important that the three shifter fork shafts be kept in neutral position in order to make sure that the interlock balls between two adjacent shafts are seated fully in the detents of respective shafts. If any of these interlock balls are out of the detents, some of the fork shafts will refuse to come out when pulled.
3. Using a spring pin remover, drive out the spring pin on reverse shifter fork, and pull out the reverse fork shaft. As this shaft comes out, the locating ball and spring will jump out of the hole; do not let them fly away.

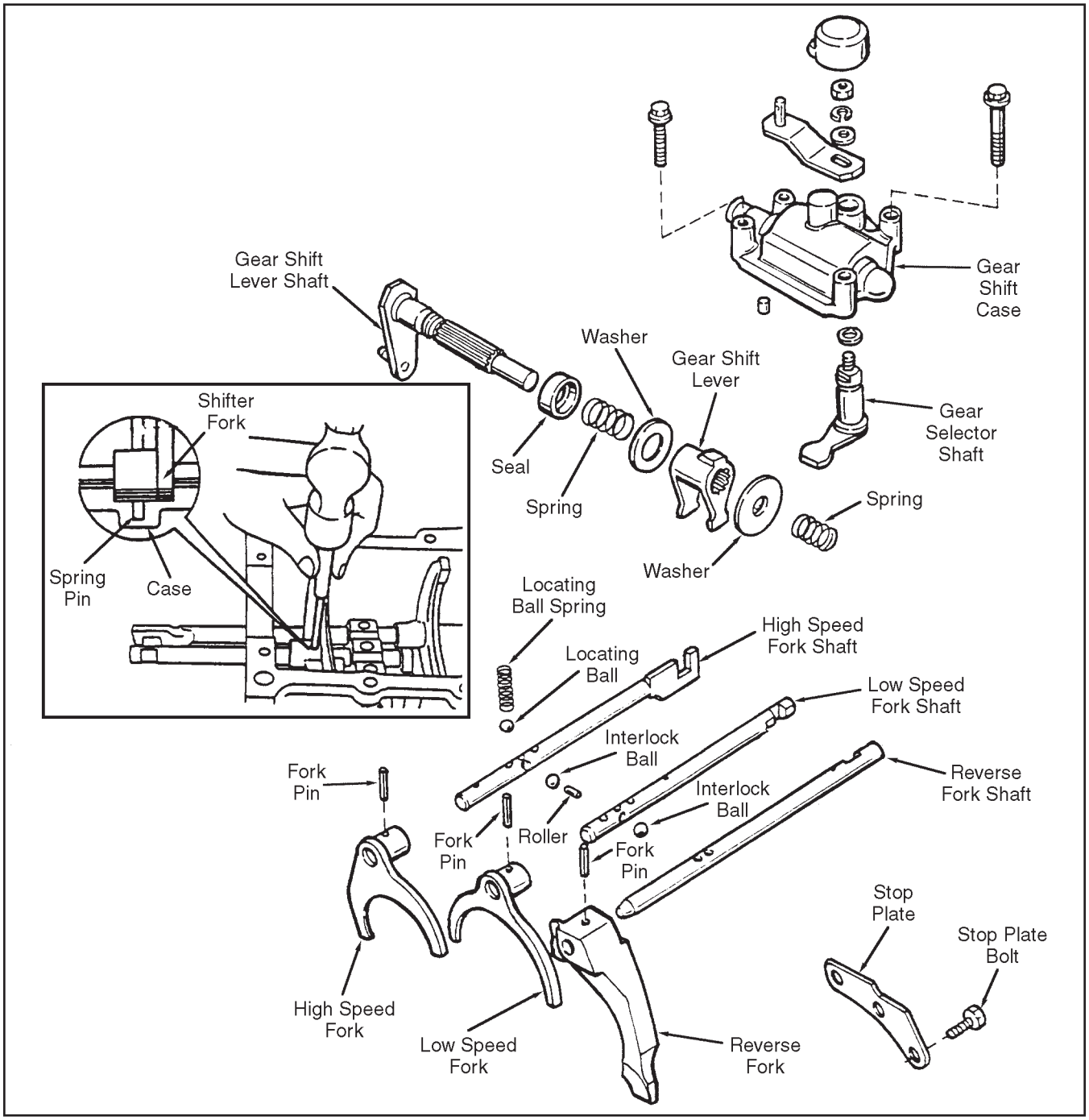


Figure 4G-10. Shifter Shafts and Forks

4. Move the low-speed fork shaft into the position for “second”. This will allow the spring pin to shift into the detent provided in the case. Using a spring remover tool, draw out the spring pin and pull out the fork shaft. Be careful not to let the locating ball and spring fly away.
5. Remove the high-speed shifter fork shaft, as follows: Move this fork shaft into the position for “third”, so that the spring pin will shift into the detent provided in the case; draw out the spring pin by using a spring pin remover tool and remove the shaft by pulling it out.

INSPECTION AND REPAIR

GEAR TEETH

Prior to cleaning, check bottom of transmission case for metal particles. If metal is detected, inspect parts closely for damage and/or wear.

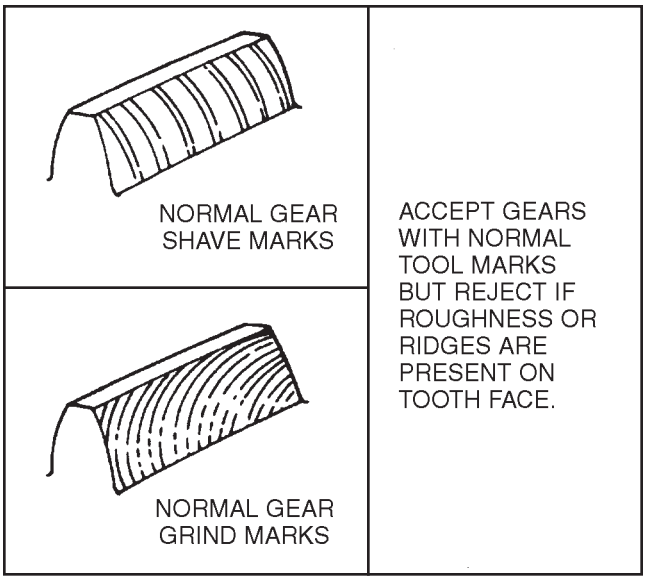


Figure 4G-11. Normal Gear Tooth Tool Marks

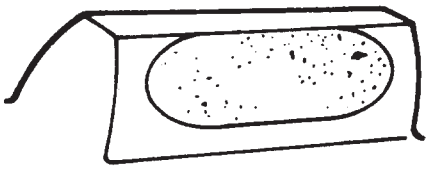
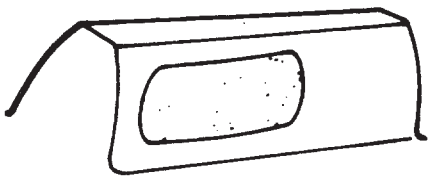
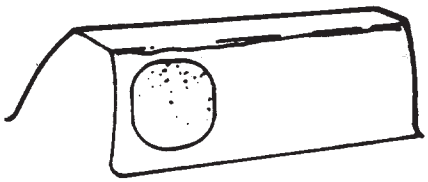
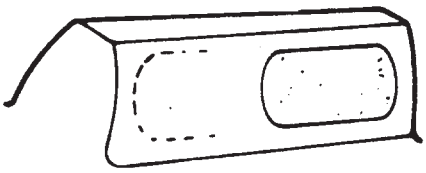
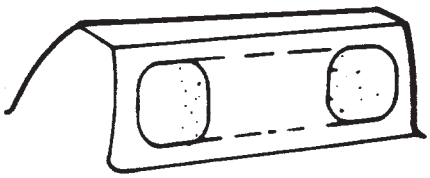
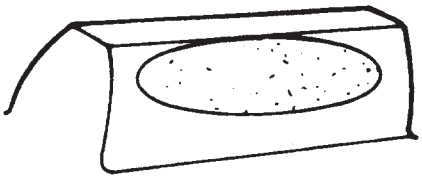
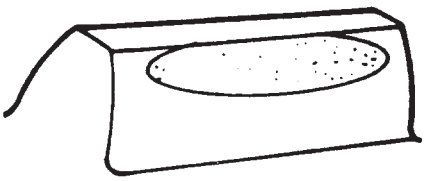
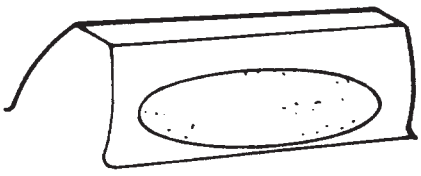
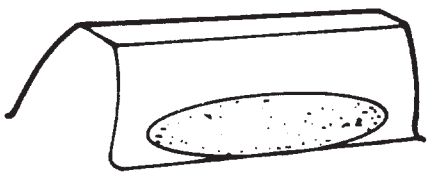
DESCRIPTION	ACCEPT	REJECT
DESIRED CONTACT PATTERN		
END CONTACT PATTERN		
TRAVELING CONTACT PATTERN (MOVES FROM SIDE TO SIDE)		
HIGH CONTACT PATTERN		
LOW CONTACT PATTERN		

Figure 4G-12. Gear Tooth Contact Patterns

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

Clean parts in a suitable non-flammable solvent. Remove old sealant material being careful not to damage seal surfaces.

Dry parts thoroughly. Do not allow bearings to spin dry, lubricate after cleaning (see Section 11).

Discard any parts that show signs of damage or wear. Pack bearings with grease and wrap to protect from dirt (see Section 11).

NOTE

Do not confuse gear contact patterns with normal tool marks that are a result of manufacture. Typical tool marks are shown in Figure 4G-11.

Check gear tooth contact patterns (see Figure 4G-12).

Check gear teeth for chips, see Figure 4G-13.

Parts with small chips shown in REPAIR column in Figure 4G-13 may be blend-repaired and reused.

Chips or broken teeth as shown in REJECT column in Figure 4G-13 are not repairable and the part must be rejected.

Check clutch teeth for rounding, see Figure 4G-14.

Face rounding will cause the clutch to jump out. Clutch teeth with rounding on the end are usable, but will cause hard shifting.

Clutch teeth with chips may be blend-repaired in the same manner as gear teeth.

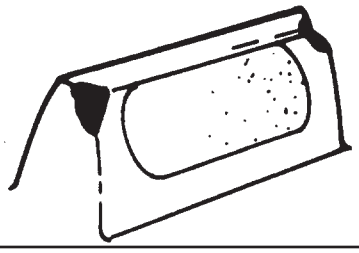
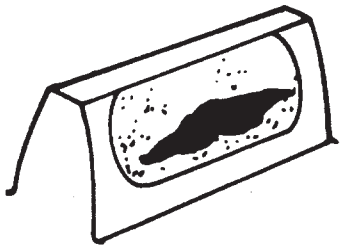
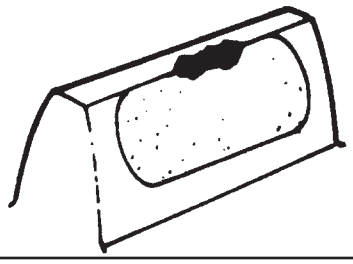
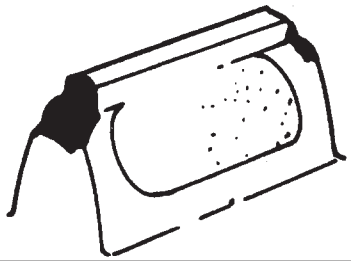
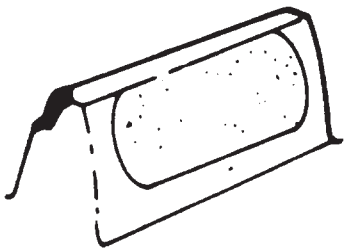
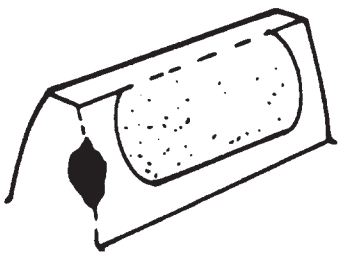
REPAIR		REJECT	
CORNER CHIP AT DRIVE FACE		CHIP WITHIN CONTACT PATTERN	
O.D. EDGE FACE AT DRIVE FACE. MAY EXTEND SLIGHTLY INTO CONTACT PATTERN.		CHIP COMPLETELY THROUGH TOOTH (CONSIDERED TO BE BROKEN)	
CORNER CHIP AT COAST FACE			
SIDE EDGE CHIP AT DRIVE FACE			

Figure 4G-13. Gear Tooth Chips

SPLINE TEETH

Check for broken or chipped spline teeth. Small chips may be blend-repaired in same manner as gear teeth.

If any spline tooth is broken, the part must be rejected.

Spline teeth will not show contact patterns as gear teeth do.

However, they may show evidence of step wear which is cause for rejection.

GEAR REPAIR

Parts which are rejected by inspection are to be replaced, unless repair procedures specified in the following paragraphs, or other obvious minor repair, will restore the part to complete serviceability.

Repair is limited to blend-repair of chips. See Figure 4G-14.

Blend repair chips using a suitable hand-held, high speed grinding tool.

Blend chip into surrounding base metal, but do not remove any more metal than necessary.

Blend all sharp edges into smooth contour. Sharp edges may chip again or develop cracks.

Use a suitable abrasive stone to remove burrs. Be careful to remove only raised material, not base metal.

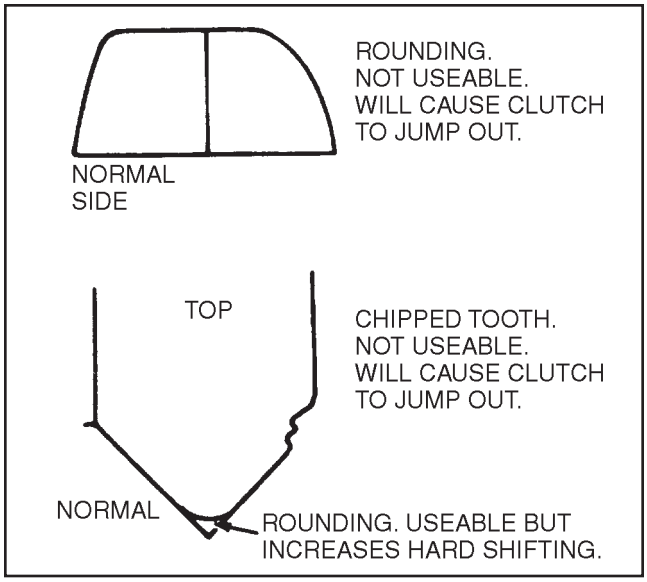


Figure 4G-14. Clutch Tooth Inspection

SYNCHRONIZER RINGS

Fit the rings to the cone of the gear (input gear, or “third,” “second” or “low” gear), and measure the clearance between the two at the peripheral teeth, as shown in Figure 4G-15. Standard clearance is 0.03 to 0.05 inch (0.8 to 1.2 mm). If the clearance is less than 0.02 inch (0.5 mm) the ring and gear should be replaced.

Inspect the external cone (of the gear) and internal cone (of the ring) for abnormal wear. Be sure that the contact patterns on these surfaces indicate uniform full-face contact, and that the surfaces are free from any wavy wear. A badly worn ring or gear must be replaced.

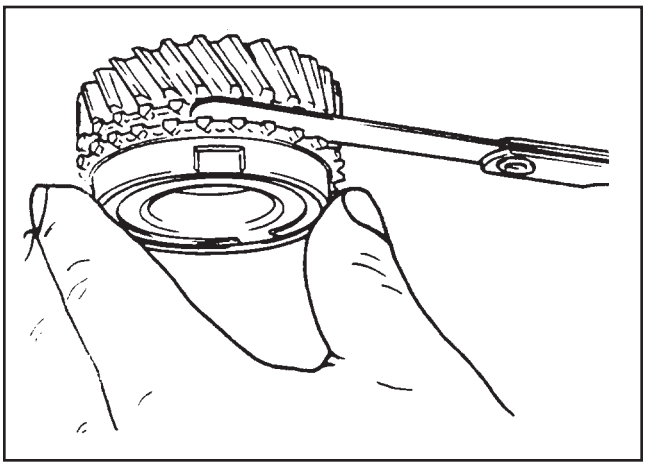


Figure 4G-15. Synchronizer Ring-to-Gear Clearance

Proper synchronizing action on gear shifting can be expected only when the ring-to-gear clearance and the condition of cone surfaces, are satisfactory.

RING (EXTERNAL) AND GEAR SLEEVE (INTERNAL) TEETH

Synchronizer rings and hubs have three slots each, in which the keys are carried as backed by expanding springs, so that the hub and its two rings, one on each end, are capable of running together. Since the sleeve is engaged by its internal teeth with the hub, as if the two were splined together, the sleeve also runs with the hub and rings.

In meshing action, the sleeve is pushed (by the shifter fork) to one side, so that it slides axially on the hub, pushing the ring toward the cone surface of the gear. This push is transmitted by the three keys, which are lightly gripped by the sleeve.

By the friction between the gear cone and the ring cone (internal), the ring begins to rotate but is opposed by the hub because of the keys. In other words, the ring is (at this time) twisted, while the sleeve is advancing further to push the ring fully against the gear cone. Since the ring is unable to slide along any further, the sleeve lets go of the keys and rides over to the ring. At this moment, the initial contact between the chamfered ends of teeth of the ring and those of internal teeth of the sleeve occurs. This contact is such that the internal teeth of the sleeve align themselves to those of the ring. When

the sleeve advances and slides into the ring, the ring will be rotating nearly with the speed of the gear, so that the sleeve can smoothly slide over into the clutch teeth of the gear.

The initial contactor mesh between sleeve and ring is determined by the widths of key and slot. The key clearance in the slot should extend at least a third (1/3) of the chamfer (see Figure 4G-16).

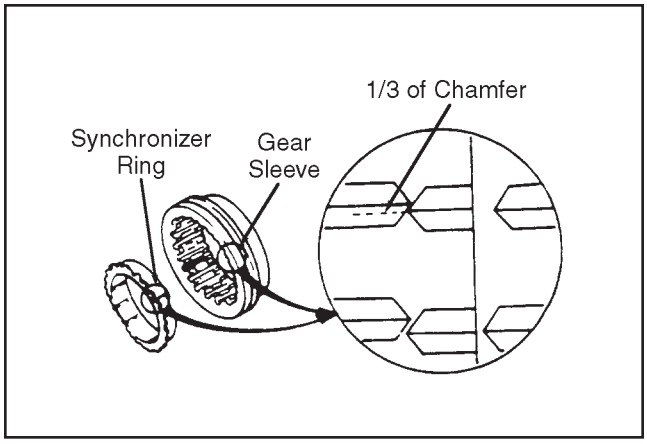


Figure 4G-16. Checking Key Clearance

With the synchronizer properly assembled on the shaft, push in and twist each synchronizer to see if the one-third mesh occurs or not; if not, it means that the overall wear (which is the sum of the wears of slots, keys and chamfered tooth ends) is excessive and, in such a case, the entire synchronizer assembly must be replaced.

Inspect each synchronizer ring for wear of its key slots by measuring the width of each slot. If the width reading exceeds the limit shown in Figure 4G-17, replace the ring.

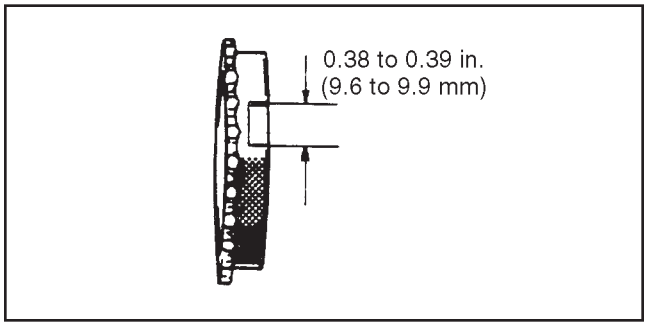


Figure 4G-17. Synchronizer Ring Slot Wear

FORK SHAFT LOCATING SPRINGS

Locating springs are used as retainers for the three shifter fork shafts. If gears have been slipping out of mesh, check these springs for strength by measuring their free lengths (see Figure 4G-18), and replace them if their free lengths are less than 0.727 inch (18.45 mm).

	Standard	Service Limit
Spring Free Length	0.807 inch (20.5 mm)	0.727 inch (18.45 mm)

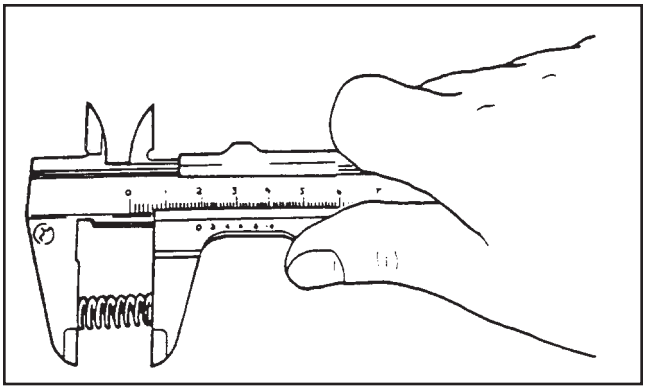


Figure 4G-18. Checking Locating Spring Free Length

GEAR SHIFT FORK SHAFTS

Check the shift fork shafts at the gear shift lever end (see Figure 4G-10) for uneven wear. Replace worn shift fork shafts.

EXTENSION CASE BUSHING

Check the bushing press-fitted into the extension case for wear by measuring the radial clearance between bushing bore and sliding yoke as shown in Figure 4G-19. If the sliding yoke is capable of rattling in the bush because of advanced wear it will cause the drive shaft to rattle. For this reason, an extension case found to allow the drive shaft yoke to rattle in excess of 0.004 inch (0.1 mm) must be replaced; replacement of the bushing alone will not fix the problem.

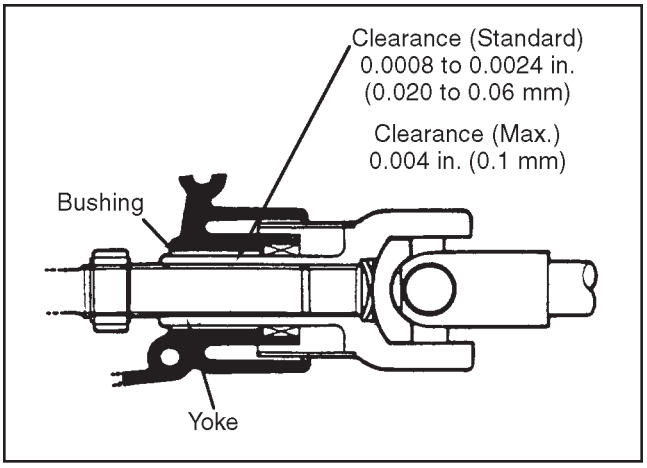


Figure 4G-19. Bushing-to-Yoke Clearance

TRANSMISSION REASSEMBLY

GENERAL

Normally, the entire transmission will not have been disassembled. Reassembly is essentially the reverse of disassembly; however, special procedures are included in the following paragraphs.

SHIFTER SHAFTS AND FORKS

1. See Figure 4G-20 for arrangement of shifter shafts, forks and gear shift case.

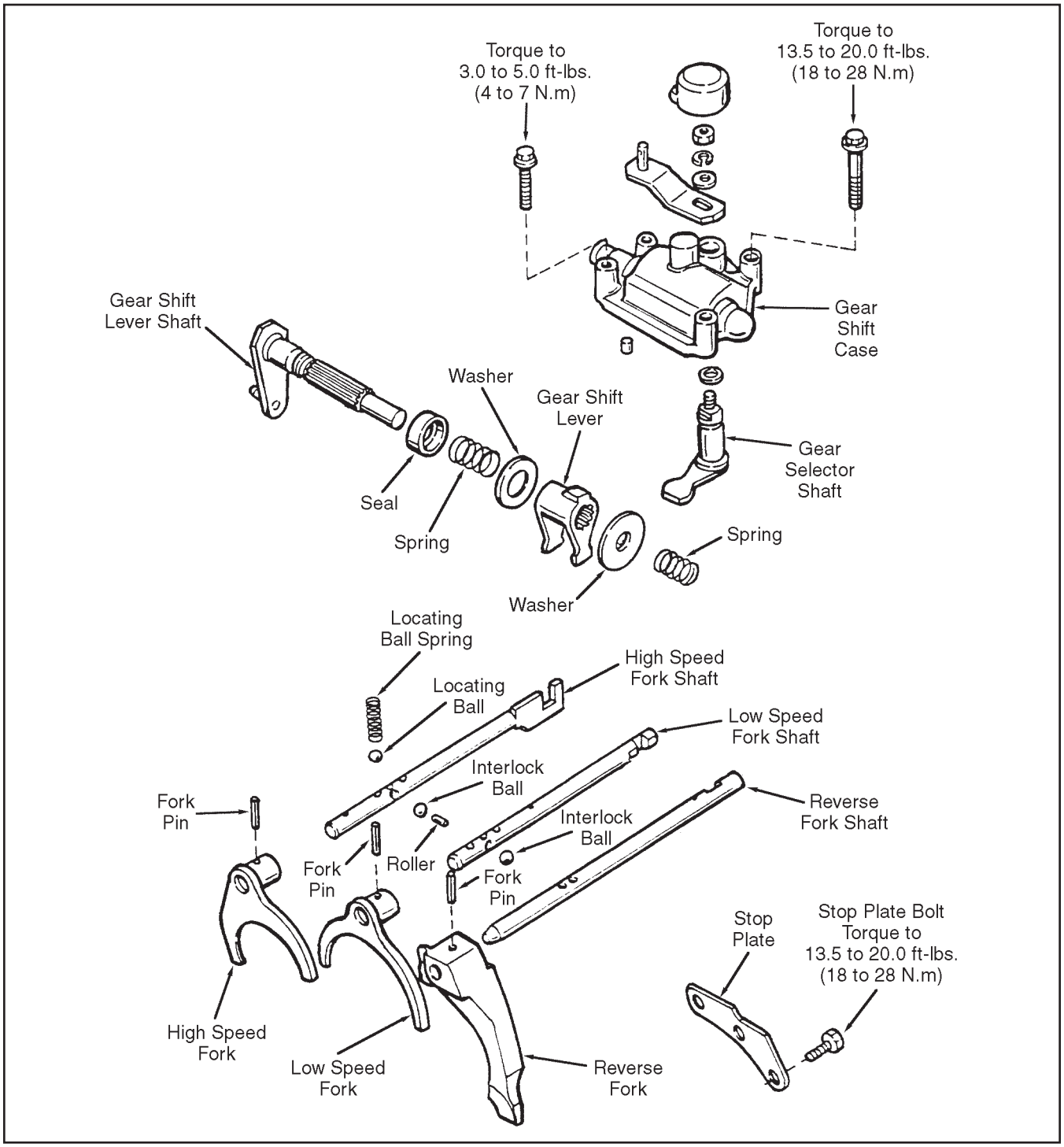


Figure 4G-20. Shifter Shaft and Forks

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

2. When feeding each shifter fork onto its shaft, be sure to bring the boss (in which the hole for admitting the spring pin is provided) to the extension case side as shown in Figure 4G-21.

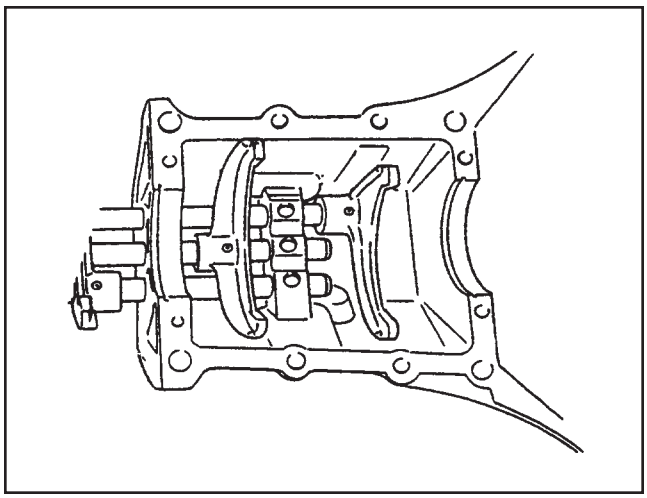


Figure 4G-21. Shifter Fork and Shaft Orientation

3. The coil springs keep the locating steel balls pushed down against the fork shafts (REVERSE, HIGH and LOW) to hold the shafts in respective operating positions as shown in Figure 4G-22.

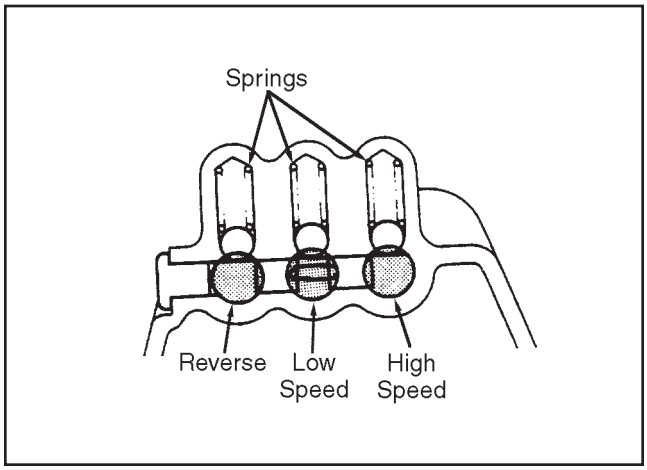


Figure 4G-22. Spring and Locating Ball Assembly

4. The shifter fork shafts are to be installed sequentially. First to be put in place is high speed shaft, followed by low speed shaft and then reverse shaft. The sequence is indicated in the ascending order of numbers as shown in Figure 4G-23.

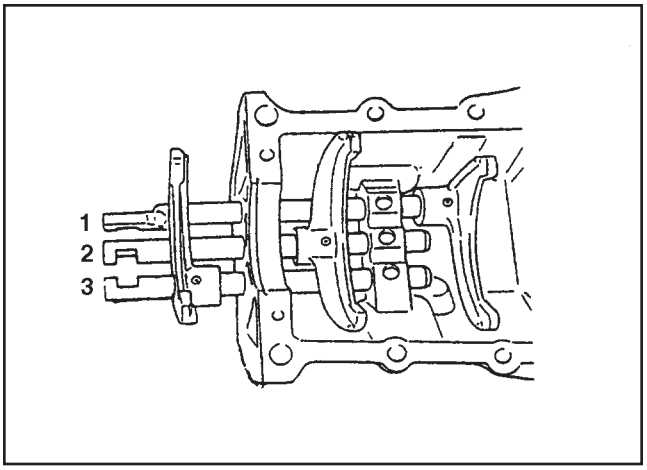


Figure 4G-23. Shifter Fork Assembly

5. Holes for installing the interlock steel balls are in the side wall, next to the reverse shifter fork shaft, of the transmission case. Be sure to feed in one ball after another, positioning each ball between two adjacent shafts, as shown in Figure 4G-24.

NOTE

Be sure to put in the pin for preventing two shafts from getting shifted at the same time. This pin goes into the hole provided in the low speed shaft.

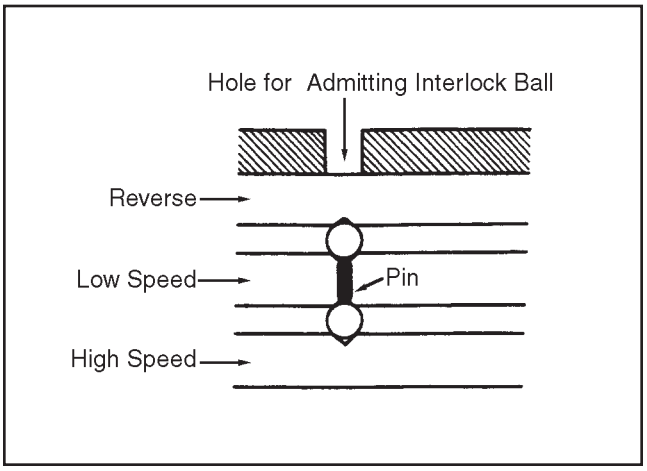


Figure 4G-24. Interlock Ball and Pin Installation

COUNTERSHAFT, MAIN SHAFT, INPUT SHAFT AND STOP PLATE

1. See Figure 4G-25 for general arrangement of the countershaft, main shaft, input shaft and stop plate.

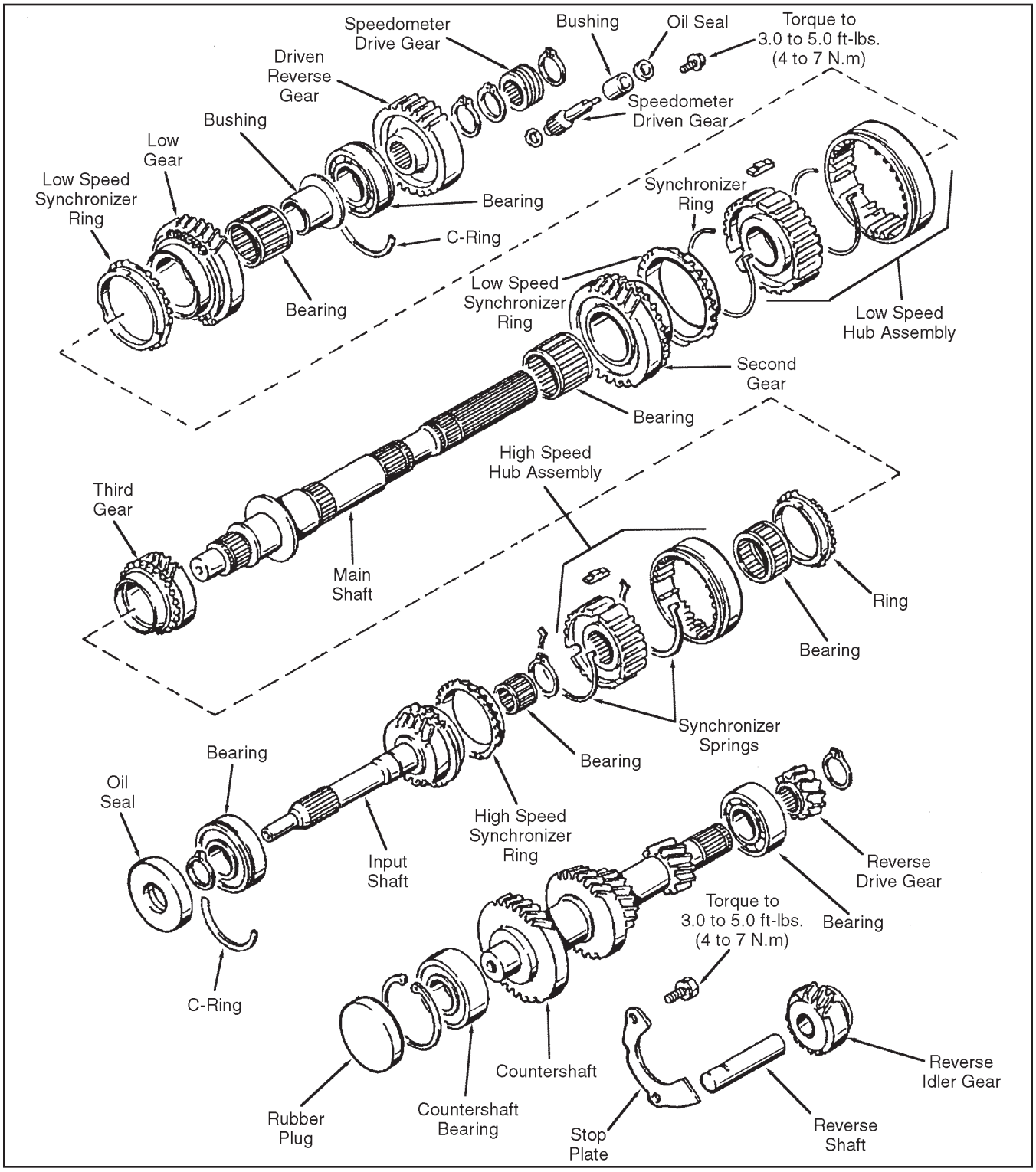


Figure 4G-25. Countershaft, Main Shaft, Input Shaft and Stop Plate

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

2. When assembling the two synchronizer hubs on main shaft, be sure to position the hub of each correctly as shown in Figure 4G-26.

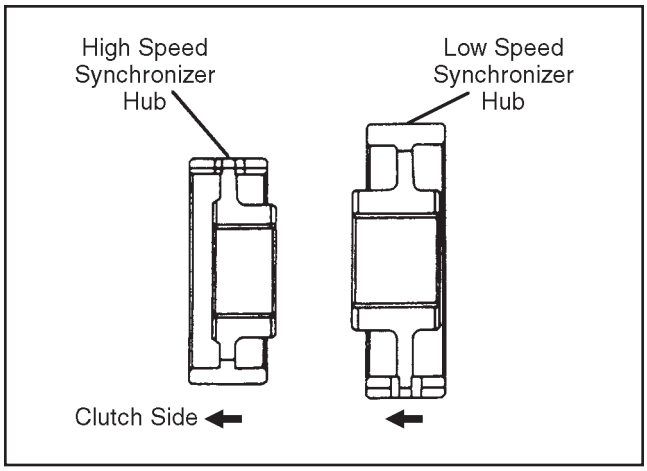


Figure 4G-26. Synchronizer Hub Installation

3. Care must be exercised in positioning the sleeve of each synchronizer. Be sure to bring the groove for admitting the fork to the clutch side.

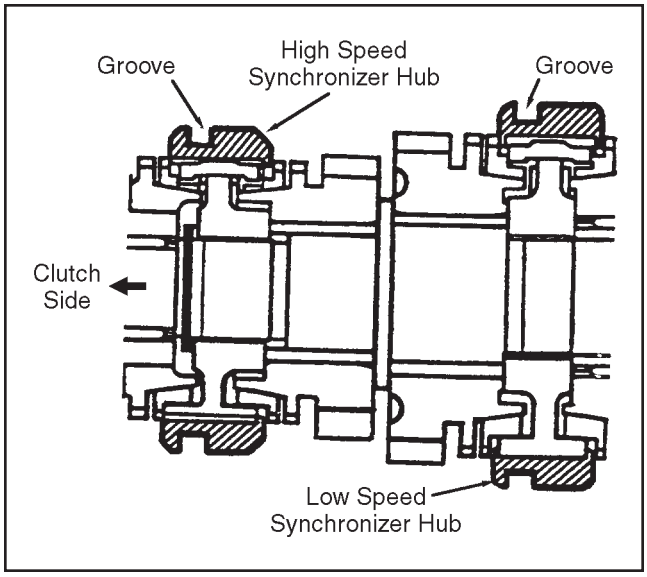


Figure 4G-27. Positioning Synchronizers

4. After installing each synchronizer, be sure that the three keys mounted on the hub fit snugly into the slots provided in the ring.

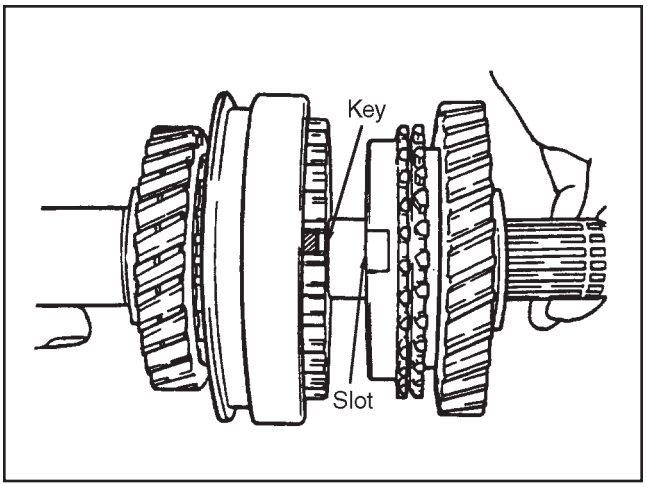


Figure 4G-28. Key and Slot Alignment

5. If it is hard to install the low gear bushing, use hydraulic press and bearing installation tool.

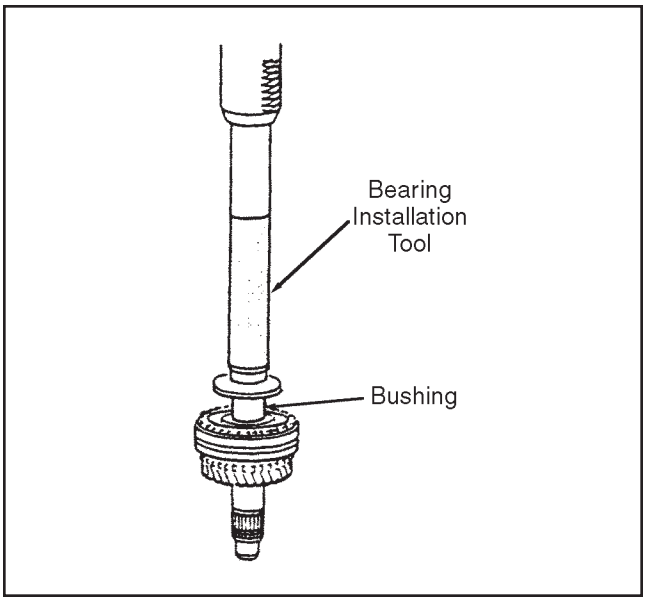


Figure 4G-29. Low Gear Bushing Installation

6. The two reverse gears have their teeth chamfered on one end, and the reverse idle gear is similarly chamfered. When mounting the reverse gears on main shaft and countershaft, respectively, be sure to bring the chamfered end to the outboard side. The chamfered end of the idle gear, however, must face inwardly, as shown in Figure 4G-30.

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

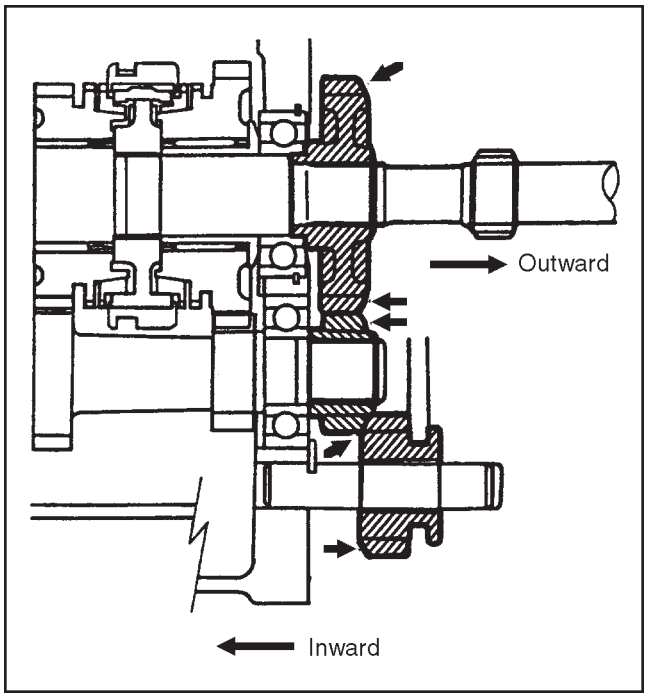


Figure 4G-30. Reverse and Idler Gear Positioning

7. Before installing the input and main shaft assembly on the lower case, be sure to fit the C-rings and dowel pins into the case as shown in Figure 4G-31.

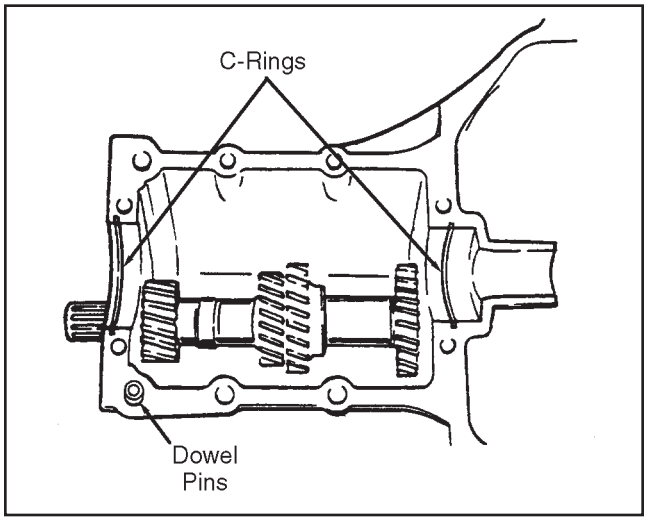


Figure 4G-31. Input Shaft and Main Shaft Installation

JOINING UPPER AND LOWER CASES

1. Clean the joint faces, removing any foreign matters adhering to these faces, and then apply liquid sealing compound to the joint faces, coating each face uniformly with the compound, and match the two cases together.
2. When joining the two cases as shown in Figure 4G-32, be sure to guide each shifter fork into the groove of its synchronizer sleeve. After putting the upper case on the lower case, tighten the joint bolts uniformly and sequentially so as to equalize the joint pressure all around. Torque bolts to 13.5 to 20.0 ft-lbs. (18 to 28 N.m).

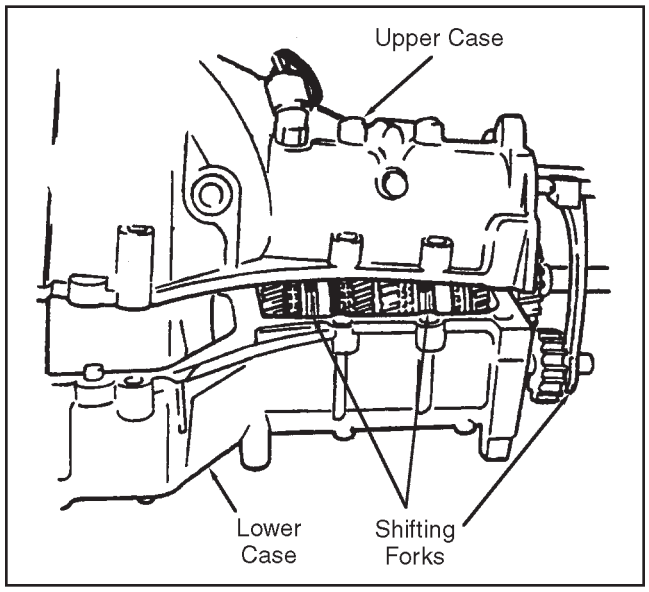


Figure 4G-32. Joining Transmission Cases

EXTENSION CASE

1. When installing the extension case oil seal be sure to position it so that the spring is on the inner side as shown in Figure 4G-33.

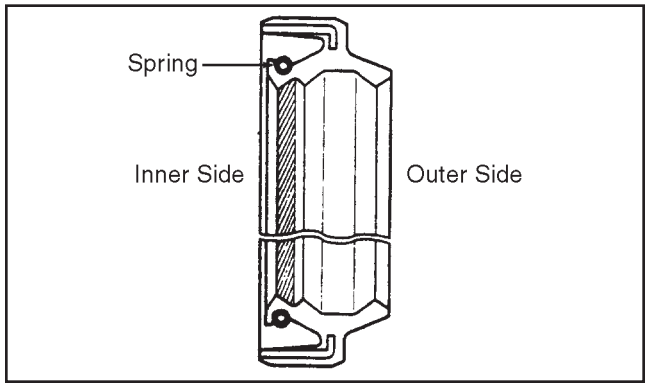


Figure 4G-33. Extension Case Oil Seal

2. Refer to Figure 4G-3, install the extension case and torque mounting bolts to 13.5 to 20.0 ft-lbs. (18 to 28 N.m).

GEAR SHIFT CASE

Refer to Figure 4G-20, install the gear shift case and torque bolts as shown.

SECTION 4G. TRANSMISSION (3-CYLINDER 660 GASOLINE ENGINE)

TRANSMISSION INSTALLATION

Following any clutch repair or any other procedure that involves removal of the transmission from the vehicle the following steps should be taken.

1. Lubricate transmission and fill with fluid as described in Section 11.
2. Install mounting brackets as shown in Figure 4C-1.
3. Using a suitable hoist, position the transmission near the clutch disc.
4. Slide transmission forward until input shaft splines engage clutch disc. It may be necessary to turn the input shaft to index splines.
5. Install transmission mounting hardware, do not tighten.
6. Apply Loctite 243 (Textron P/N 2810300 or 2811163). Install transmission bell housing to engine. Mount with socket head capscrews. Torque to 37 ft-lbs. (51 N.m). Diesel only: Install the two lower socket head capscrews. Torque to 37 ft-lbs. (51 N.m).
7. Install and tighten all transmission-to-frame mounting hardware.
8. Install mounting brackets to transmission extension case and install drive shaft to transmission as described in Section 4C.
9. Connect clutch cable on clutch release lever and gear shift cables/connectors on gear shift lever and selector arm as described in Sections 4D and 4E. Make certain connections to operator controls are correct and shifting/selecting operates smoothly. Adjust as described in Section 2C.
10. Install all electrical cables, hoses and tubes disconnected during transmission removal.
11. Install any brackets or sheet metal that were removed.
12. Connect battery cables.
13. Adjust clutch cable, pedal free travel and interlock switch (Section 2C).

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

GENERAL

The transmission is a 4 speed manual shift type. The shift pattern is a standard H pattern with reverse R over to the right and down.

In some cases the entire transmission may not have to be disassembled. Disassemble only what is needed for repair.

TRANSMISSION REMOVAL

1. Disconnect the negative (–) and positive (+) battery cables from battery terminals.
2. Tag and disconnect all cables, hoses, tubes or control linkages which would obstruct lifting the transmission out of the frame.
3. Remove any sheet metal which would obstruct lifting the transmission out of the frame.
4. Remove the drain plug and drain oil from the transmission. Replace drain plug and torque to 14.5 to 21.5 ft-lbs. (20 to 30 N.m) for units with 3-cylinder gasoline engines and 26.5 to 36.0 ft-lbs. (36 to 50 N.m) for units with 4-cylinder gasoline or diesel engines.
5. Disconnect the clutch cable from the clutch release lever.
6. Disconnect the shift cables (see Section 4E).
7. Disconnect the PTO control cable on vehicles with mechanical PTOs (see Section 12).
8. Disconnect the drive shaft at the transmission (see Section 4C).
9. Attach a suitable hoist to the transmission.
10. Remove hardware that fastens the transmission to the engine.
11. Remove any remaining transmission hardware from mounting brackets on the frame until the transmission is free to be lifted.
12. Carefully move the transmission away from the engine flywheel and move the transmission out of the frame to a suitable work stand.

INPUT SHAFT BEARING REPLACEMENT

NOTE

Whenever the engine and transmission are separated, the transmission input shaft bearing mounted in the engine flywheel should be inspected for wear or damage.

1. Turn the bearing by hand, if it sticks, rattles or makes abnormal noise when spun, it should be replaced.
2. Remove the input shaft bearing using a removal tool as shown in Figure 4H-1.
3. Install a new bearing as shown in Figure 4H-1.
4. Visually check the flywheel surface, where it contacts the clutch disc, for wear or damage. If wear or damage is determined, replace the flywheel in accordance with engine manufacturer's instructions.

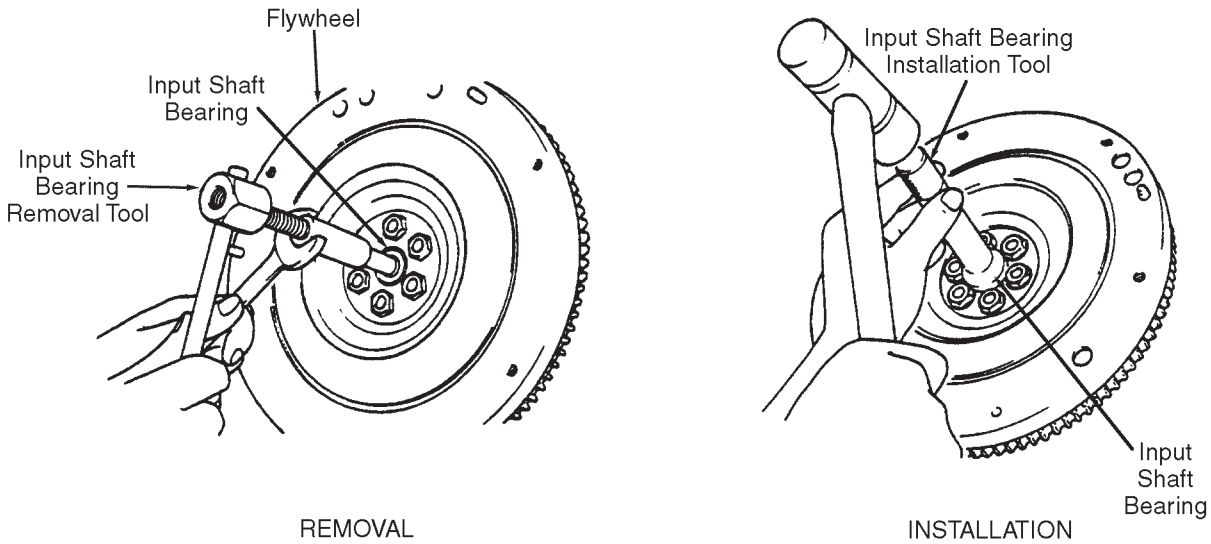


Figure 4H-1. Input Shaft Bearing Replacement

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

TRANSMISSION DISASSEMBLY

GEAR SHIFT CASE (See Figure 4H-2)

1. Remove the mounting bolts, disengage the gear selector shaft from the gear shift lever in the transmission and lift the assembled gear shift case off the transmission case.
2. If necessary, disassemble the gear shift as shown in Figure 4H-2.

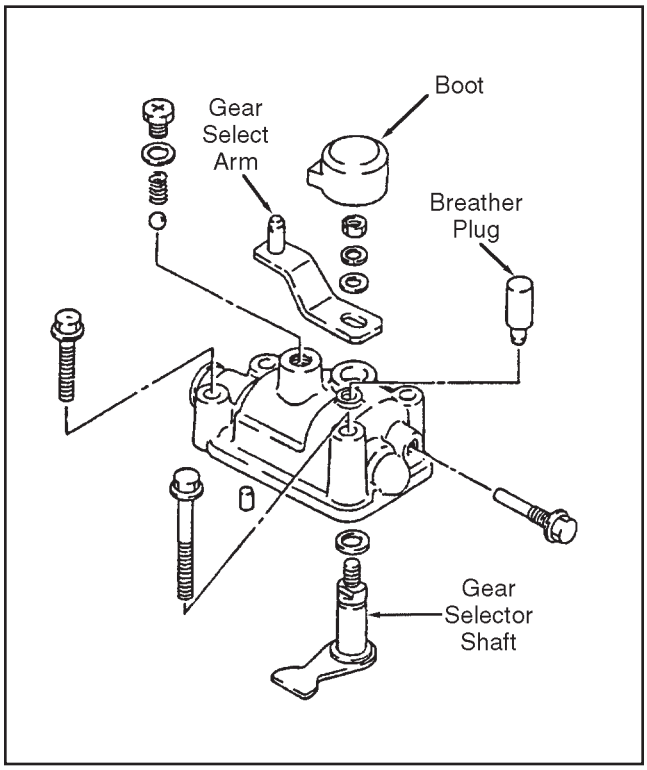


Figure 4H-2. Gear Shift Case

EXTENSION CASE (See Figure 4H-3)

1. Remove the extension case seal from the extension case.
2. Remove the hardware securing the extension case to he transmission case and detach the extension case and mounting bracket.

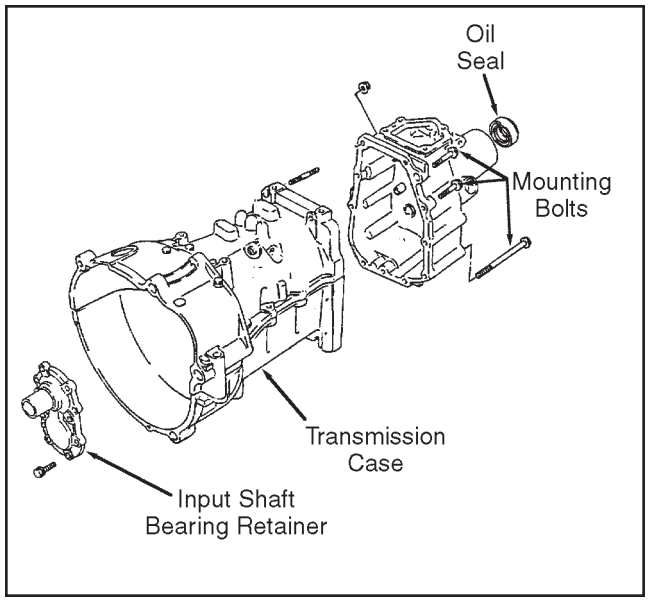


Figure 4H-3. Extension Case

SPLITTING THE TRANSMISSION (See Figure 4H-4)

1. Remove the bolts that fasten the upper and lower transmission cases together.
2. Use a steel pry bar or large screwdriver to pry the two case halves apart being careful not to damage the mating faces.

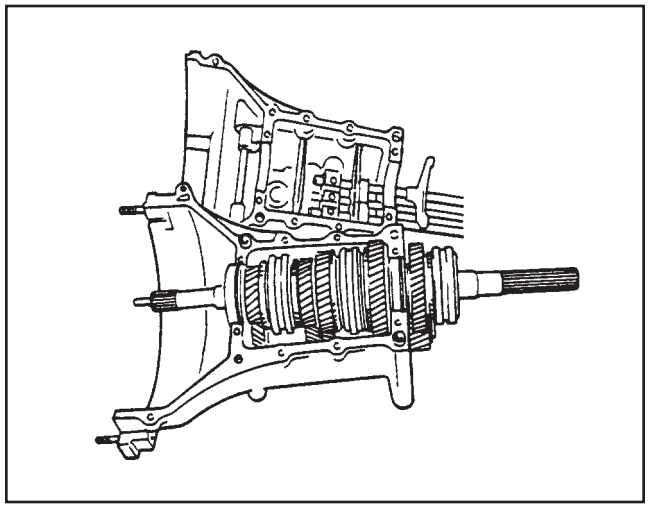


Figure 4H-4. Splitting the Case Halves

GEAR AND SHAFT DISASSEMBLY

NOTE

The arrangement of gears and shafts is shown in Figure 4H-5.

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

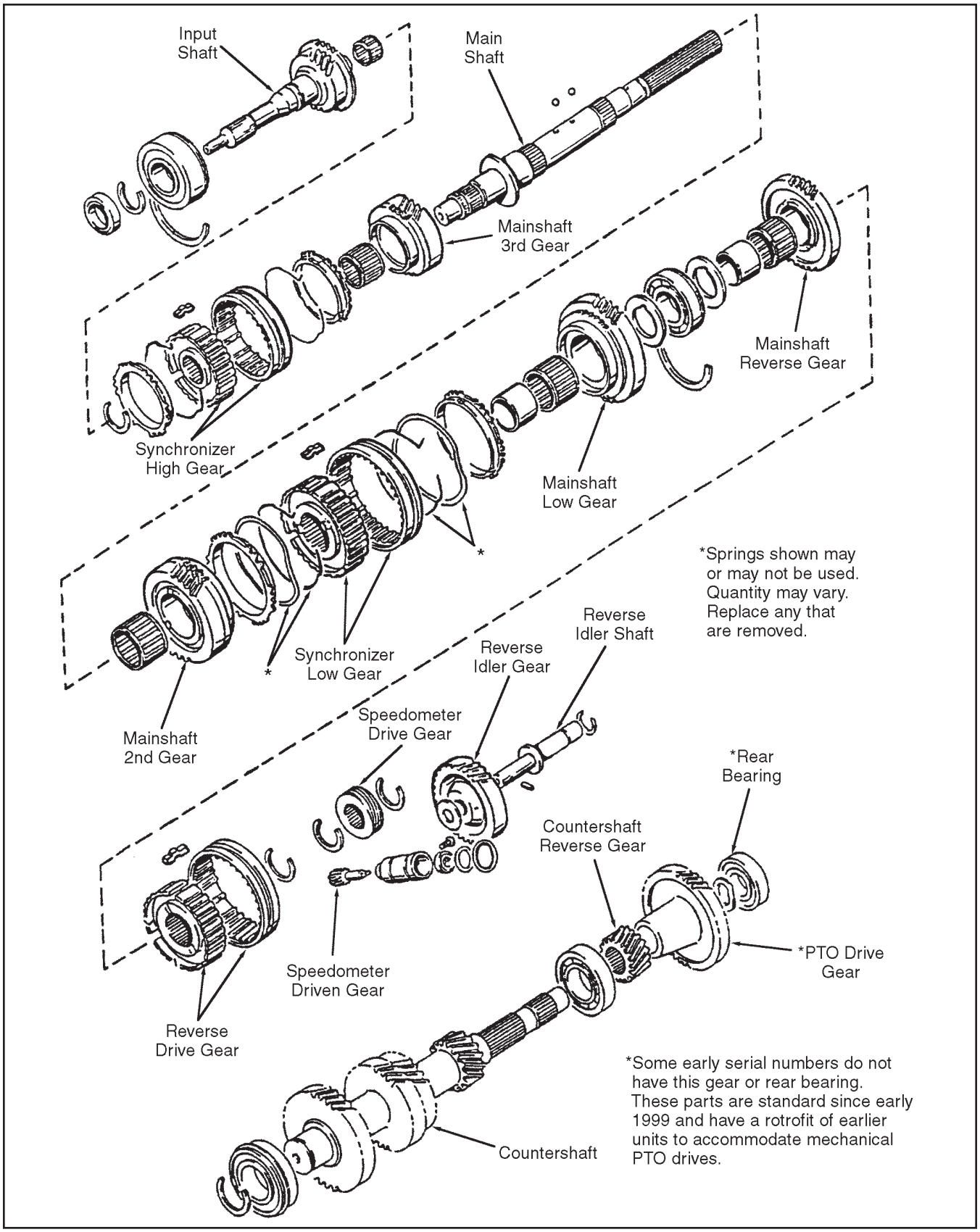


Figure 4H-5. Gear and Shaft Arrangement

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

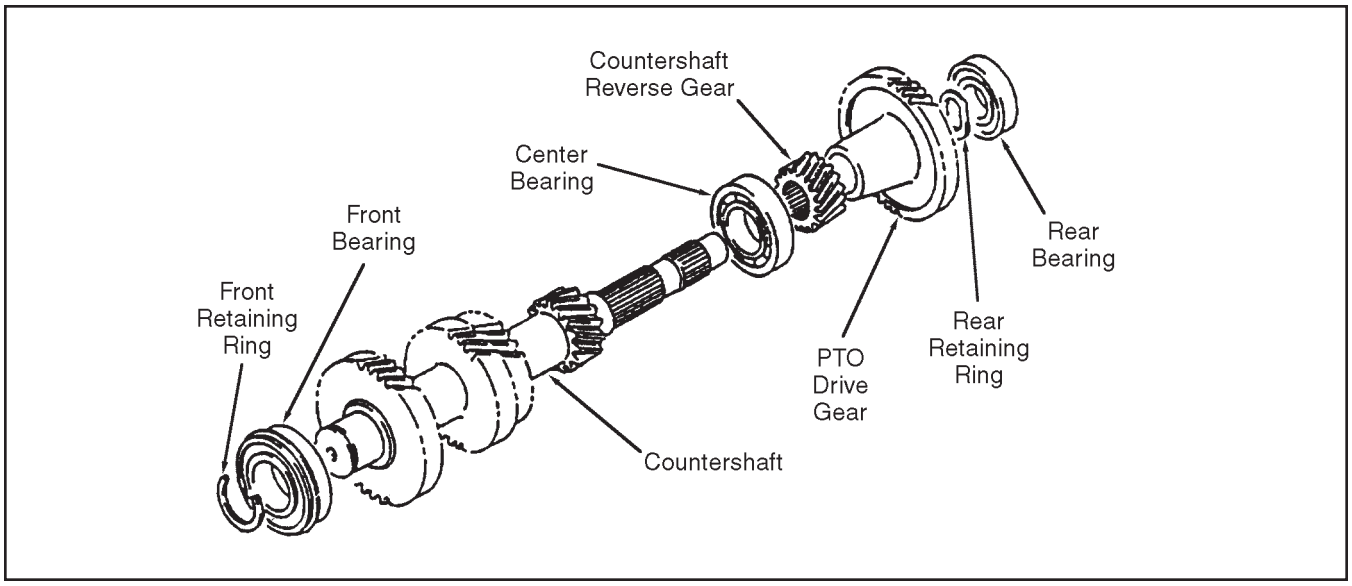


Figure 4H-6. Countershaft Disassembly

COUNTERSHAFT

1. Use a bearing puller to pull the rear bearing (see Figure 4H-6) off the countershaft.
2. Remove the rear retaining ring and PTO drive gear.

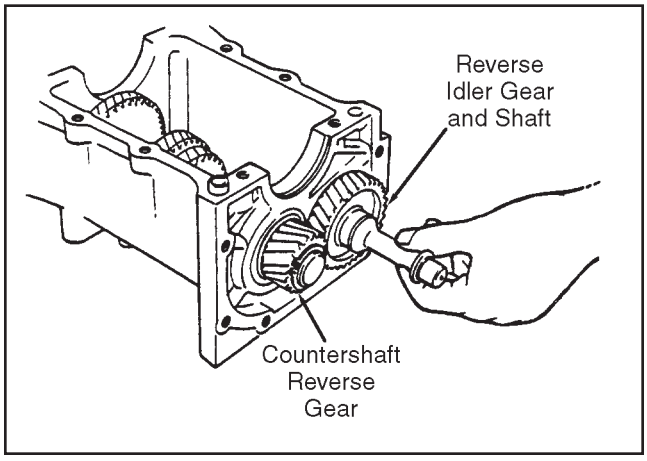


Figure 4H-7. Reverse Idler Gear and Shaft

3. Remove reverse idler gear and shaft (see Figure 4H-7).
4. Remove the countershaft reverse gear (see Figure 4H-6).
5. Remove front retaining ring from countershaft. Push out countershaft to extension case side by using hydraulic press. Take countershaft assembly out of case (see Figure 4H-8).

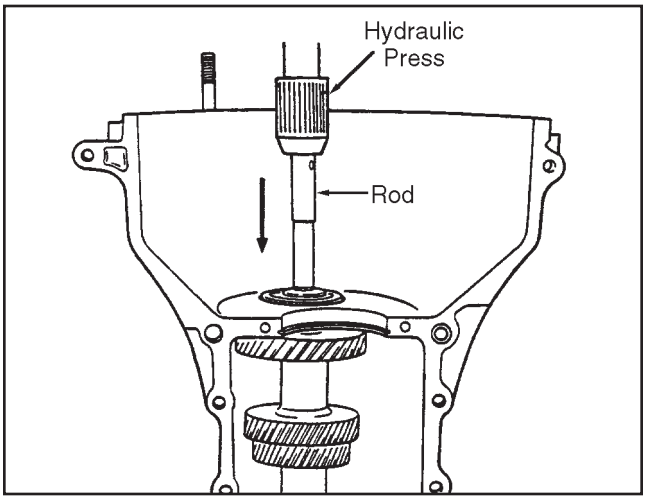


Figure 4H-8. Countershaft — Step 5

INPUT SHAFT AND MAIN SHAFT

1. Refer to Figure 4H-9, remove the oil seal, retaining ring, bearing and input shaft. Pull out the input shaft, by hand, taking care not to drop the high speed synchronizer rings.
2. Remove the retaining ring, high speed synchronizer rings, springs, needle bearings, high speed hub and sleeve, and third driven gear from the main shaft.
3. Remove retaining ring for speedometer drive gear and slide off speedometer drive gear.
4. Remove retaining ring and reverse synchronizer hub from main shaft.
5. Remove reverse drive hub, reverse gear and reverse gear needle bearing.

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

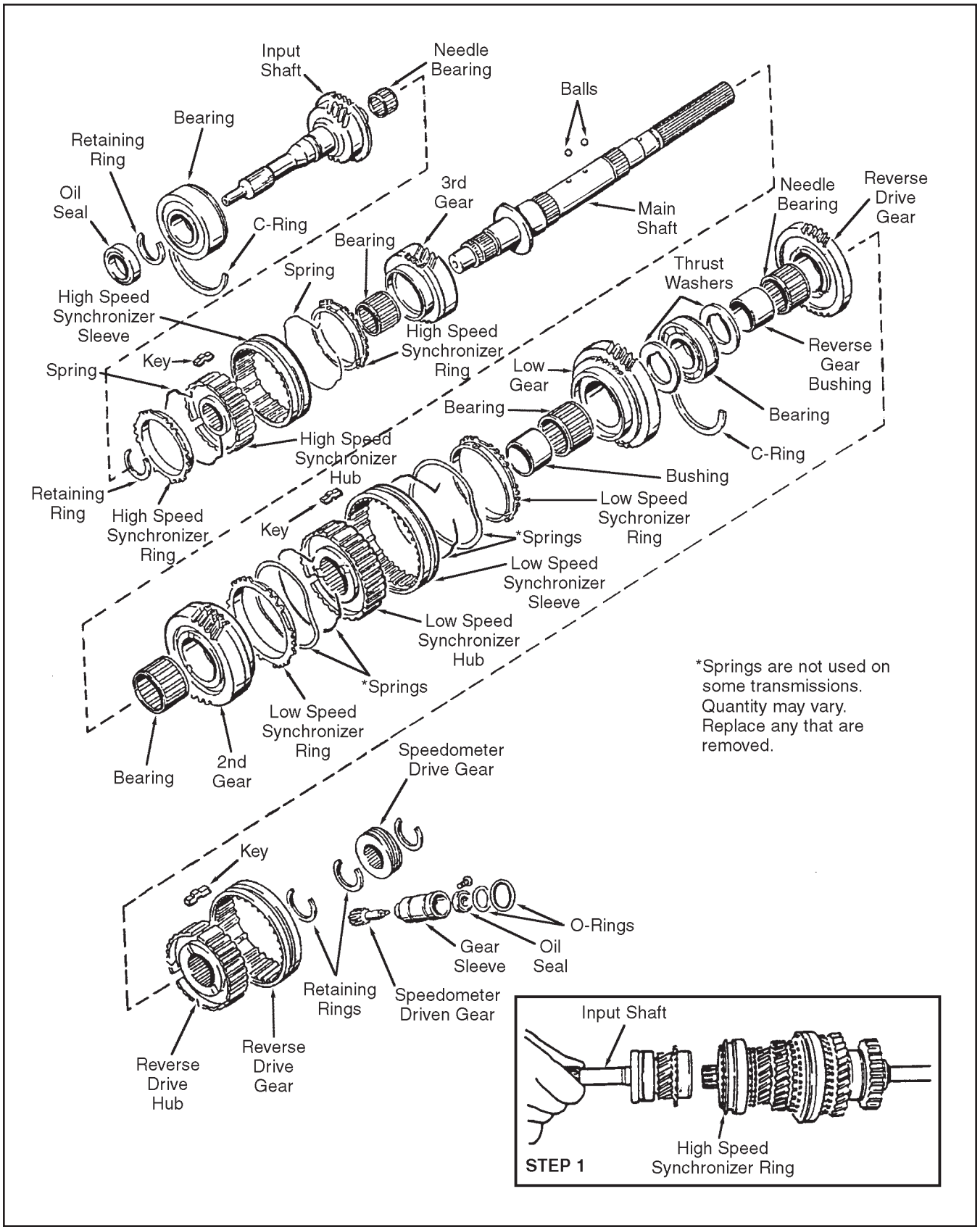


Figure 4H-9. Input Shaft and Main Shaft

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

6. Remove bearing thrust washer and reverse gear bushing on main shaft by using hydraulic press as shown in Figure 4H-10.

NOTE

During this removal, watch out for balls which may fall off. They must not be lost. Also, ball bearing should not be removed together with above washer and bushing.

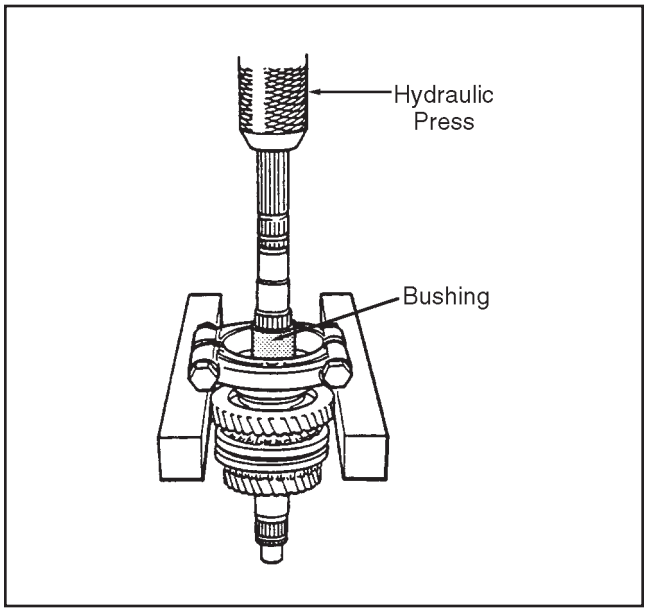


Figure 4H-10. Main Shaft — Step 6

7. Remove ball bearing and main shaft (center) bearing by using hydraulic press as shown in Figure 4H-11.

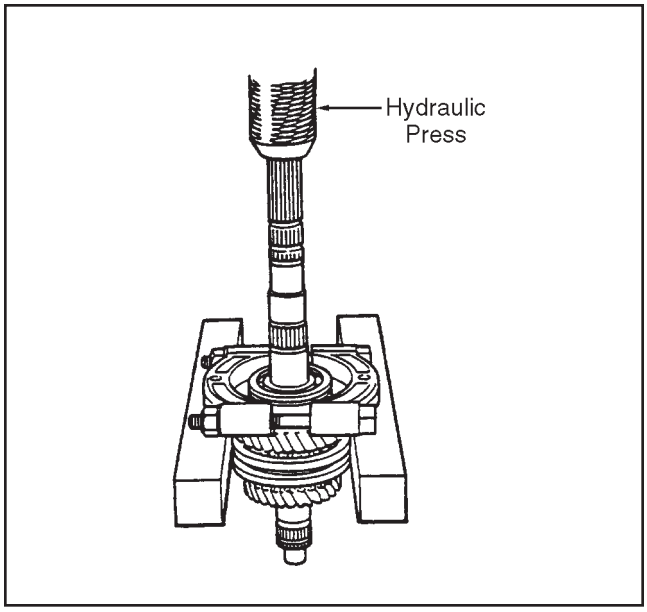


Figure 4H-11. Main Shaft — Step 7

8. Remove low gear, needle bearing and synchronizer ring from main shaft as shown in Figure 4H-9.
9. Remove low gear bushing, low speed synchronizer hub, ring, 2nd gear and 2nd gear bearing by using hydraulic press as shown in Figure 4H-12.

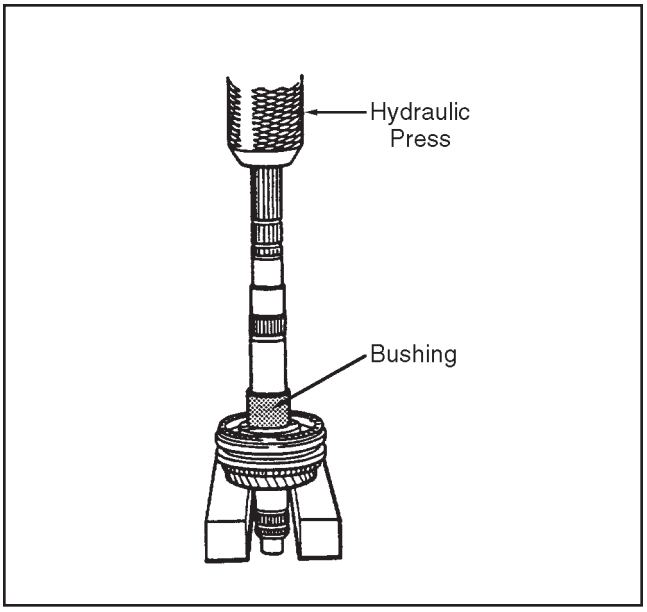


Figure 4H-12. Main Shaft — Step 9

SHIFTER SHAFTS AND FORKS (See Figure 4H-13)

1. Before starting the removal work, make sure that all the shifter fork shafts in place are in neutral position.
2. It is important that the three shifter fork shafts be kept in neutral position in order to make sure that the interlock balls between two adjacent shafts are seated fully in the detents of respective shafts. If any of these interlock balls are out of the detents, some of the fork shafts will refuse to come out when pulled.
3. Pull out reverse gear shift shaft. As this shaft comes out, locating ball and spring will jump out of hole; do not let them fly away.
4. Using spring pin remover, drive out yoke pin on low speed gear shift fork and pull out shift shaft. During this work, be careful not to let locating ball, interlock ball and spring fly away.

CAUTION

When removing yoke pin, be sure not to drive it out so far as to contact case, or it will cause damage to case.

5. Drive yoke pin out of high speed gear shift fork as in Step 3, on previous page, and pull out fork shaft and fork.

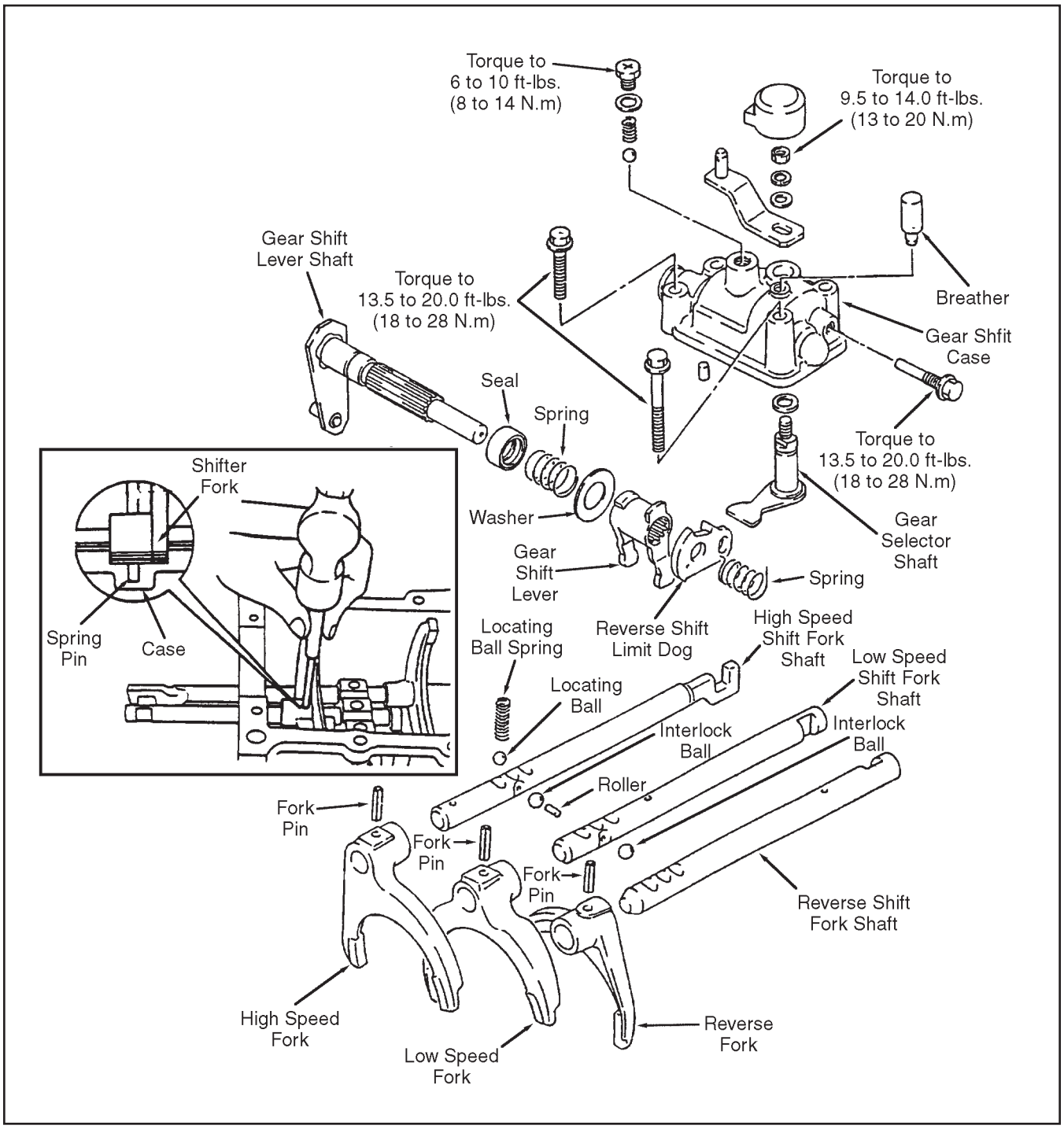


Figure 4H-13. Shifter Shafts and Forks

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

INSPECTION AND REPAIR

GEAR TEETH

Prior to cleaning, check bottom of transmission case for metal particles. If metal is detected, inspect parts closely for damage and/or wear.

Clean parts in a suitable non-flammable solvent. Remove old sealant material being careful not to damage seal surfaces.

Dry parts thoroughly. Do not allow bearings to spin dry, lubricate after cleaning (see Section 11).

Discard any parts that show signs of damage or wear. Pack bearings with grease and wrap to protect from dirt (see Section 11).

NOTE

Do not confuse gear contact patterns with normal tool marks that are a result of manufacture. Typical tool marks are shown in Figure 4H-14.

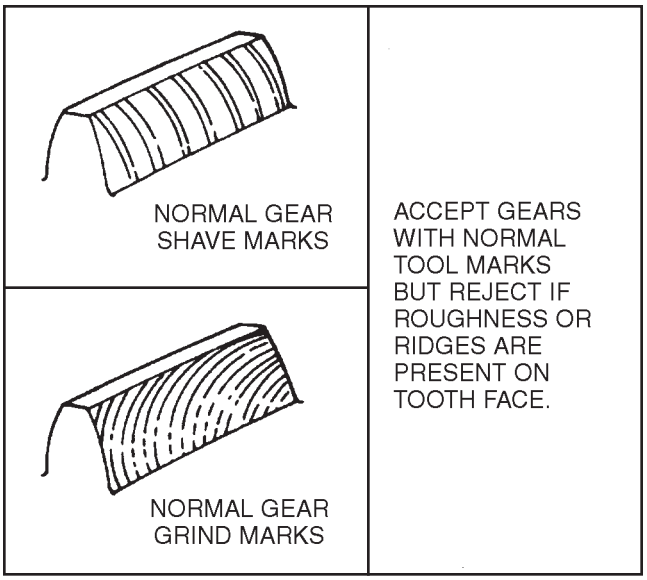


Figure 4H-14. Normal Gear Tooth Tool Marks

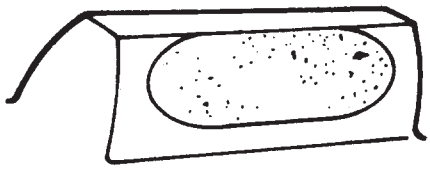
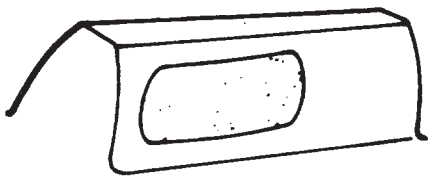
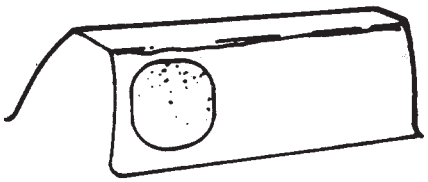
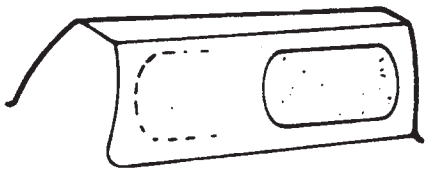
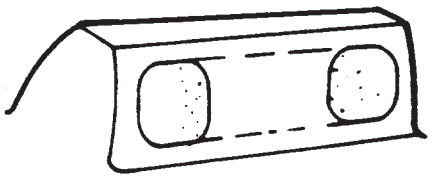
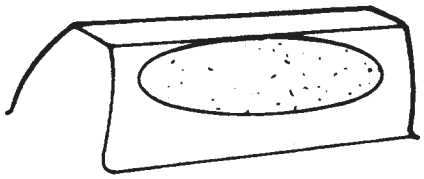
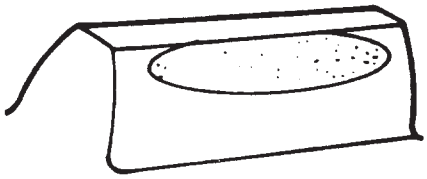
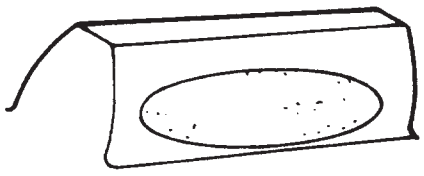
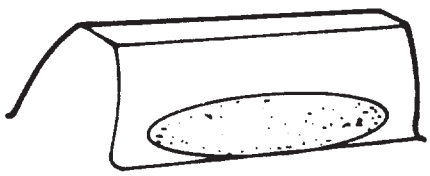
DESCRIPTION	ACCEPT	REJECT
DESIRED CONTACT PATTERN		
END CONTACT PATTERN		
TRAVELING CONTACT PATTERN (MOVES FROM SIDE TO SIDE)		
HIGH CONTACT PATTERN		
LOW CONTACT PATTERN		

Figure 4H-15. Gear Tooth Contact Patterns

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

Check gear tooth contact patterns (see Figure 4H-15).

Check gear teeth for chips, see Figure 4H-16.

Parts with small chips shown in REPAIR column in Figure 4H-16 may be blend-repaired and reused.

Chips or broken teeth as shown in REJECT column in Figure 4H-16 are not repairable and the part must be rejected.

Check clutch teeth for rounding, see Figure 4H-17.

Face rounding will cause the clutch to jump out. Clutch teeth with rounding on the end are usable, but will cause hard shifting.

Clutch teeth with chips may be blend-repaired in the same manner as gear teeth.

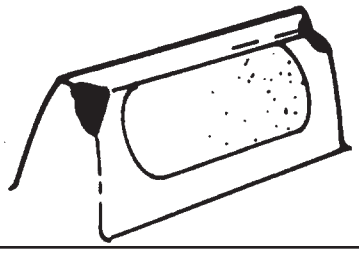
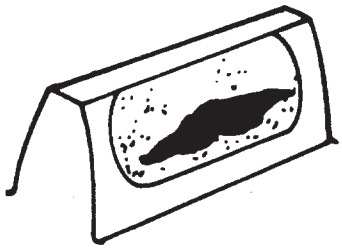
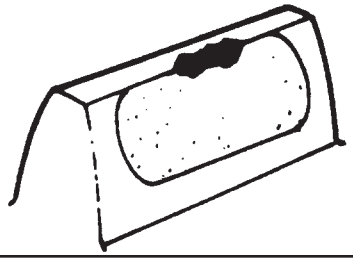
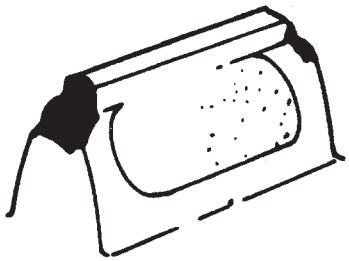
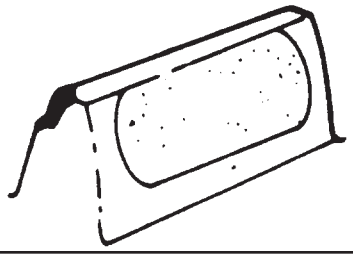
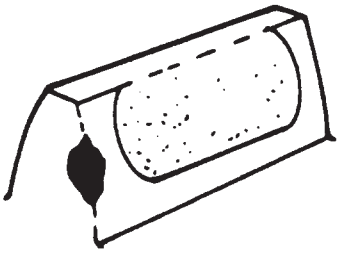
REPAIR		REJECT	
CORNER CHIP AT DRIVE FACE		CHIP WITHIN CONTACT PATTERN	
O.D. EDGE FACE AT DRIVE FACE. MAY EXTEND SLIGHTLY INTO CONTACT PATTERN.		CHIP COMPLETELY THROUGH TOOTH (CONSIDERED TO BE BROKEN)	
CORNER CHIP AT COAST FACE			
SIDE EDGE CHIP AT DRIVE FACE			

Figure 4H-16. Gear Tooth Chips

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

SPLINE TEETH

Check for broken or chipped spline teeth. Small chips may be blend-repaired in same manner as gear teeth.

If any spline tooth is broken, the part must be rejected.

Spline teeth will not show contact patterns as gear teeth do.

However, they may show evidence of step wear which is cause for rejection.

GEAR REPAIR

Parts which are rejected by inspection are to be replaced, unless repair procedures specified in the following paragraphs, or other obvious minor repair, will restore the part to complete serviceability.

Repair is limited to blend-repair of chips. See Figure 4H-17.

Blend repair chips using a suitable hand-held, high speed grinding tool.

Blend chip into surrounding base metal, but do not remove any more metal than necessary.

Blend all sharp edges into smooth contour. Sharp edges may chip again or develop cracks.

Use a suitable abrasive stone to remove burrs. Be careful to remove only raised material, not base metal.

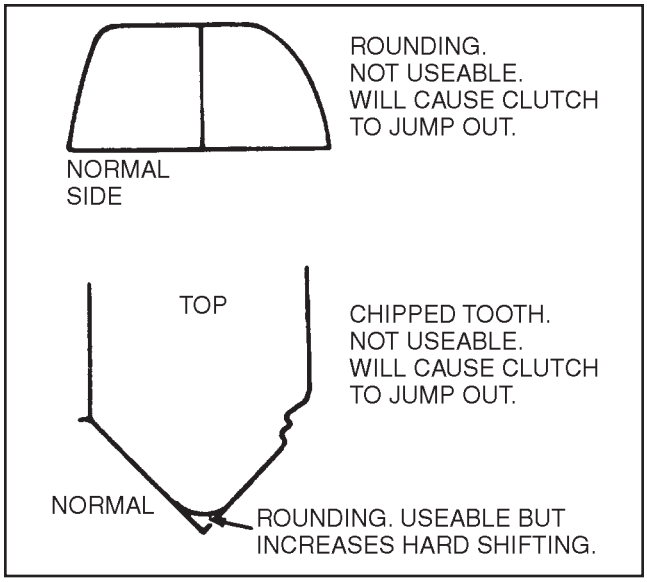


Figure 4H-17. Clutch Tooth Inspection

SYNCHRONIZER RINGS

Fit the rings to the cone of the gear (input gear, or “third,” “second” or “low” gear), and measure the clearance between the two at the peripheral teeth, as shown in Figure 4H-18. Standard clearance is 0.039 to 0.055 inch (1.0 to 1.4 mm). If the clearance is less than 0.02 inch (0.5 mm) the ring and gear should be replaced.

Inspect the external cone (of the gear) and internal cone (of the ring) for abnormal wear. Be sure that the contact patterns on these surfaces indicate uniform full-face contact, and that the surfaces are free from any wavy wear. A badly worn ring or gear must be replaced.

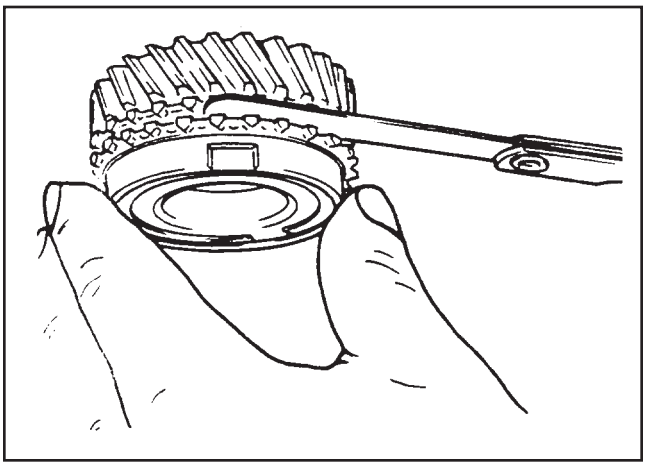


Figure 4H-18. Synchronizer Ring-to-Gear Clearance

Proper synchronizing action on gear shifting can be expected only when the ring-to-gear clearance and the condition of cone surfaces, are satisfactory.

RING (EXTERNAL) AND GEAR SLEEVE (INTERNAL) TEETH

Synchronizer rings and hubs have three slots each, in which the keys are carried as backed by expanding springs, so that the hub and its two rings, one on each end, are capable of running together. Since the sleeve is engaged by its internal teeth with the hub, as if the two were splined together, the sleeve also runs with the hub and rings.

In meshing action, the sleeve is pushed (by the shifter fork) to one side, so that it slides axially on the hub, pushing the ring toward the cone surface of the gear. This push is transmitted by the three keys, which are lightly gripped by the sleeve.

By the friction between the gear cone and the ring cone (internal), the ring begins to rotate but is opposed by the hub because of the keys. In other words, the ring is (at this time) twisted, while the sleeve is advancing further to push the ring fully against the gear cone. Since the ring is unable to slide along any further, the sleeve lets go of the keys and rides over to the ring. At this moment, the initial contact between the chamfered ends of teeth of the ring and those of internal teeth of the sleeve occurs. This contact is such that the internal teeth of the sleeve align themselves to those of the ring. When

the sleeve advances and slides into the ring, the ring will be rotating nearly with the speed of the gear, so that the sleeve can smoothly slide over into the clutch teeth of the gear.

The initial contactor mesh between sleeve and ring is determined by the widths of key and slot. The key clearance in the slot should extend at least a third (1/3) of the chamfer (see Figure 4H-19).

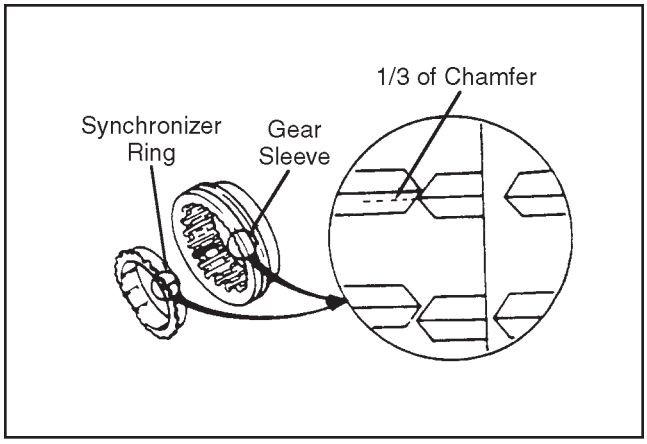


Figure 4H-19. Checking Key Clearance

With the synchronizer properly assembled on the shaft, push in and twist each synchronizer to see if the one-third mesh occurs or not; if not, it means that the overall wear (which is the sum of the wears of slots, keys and chamfered tooth ends) is excessive and, in such a case, the entire synchronizer assembly must be replaced.

Inspect each synchronizer ring for wear of its key slots by measuring the width of each slot. If the width reading exceeds the limit shown in Figure 4H-20, replace the ring.

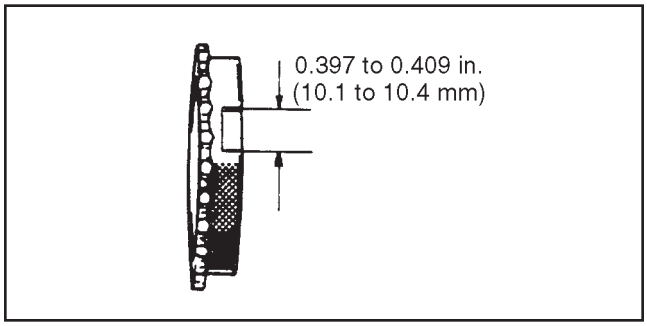


Figure 4H-20. Synchronizer Ring Slot Wear

FORK SHAFT LOCATING SPRINGS

Locating springs are used as retainers for the three shifter fork shafts. If gears have been slipping out of mesh, check these springs for strength by measuring their free lengths (see Figure 4H-21), and replace them if their free lengths are less than 0.826 inch (21.0 mm).

	Standard	Service Limit
Spring Free Length	1.004 inches (25.5 mm)	0.286 inch (21.0 mm)

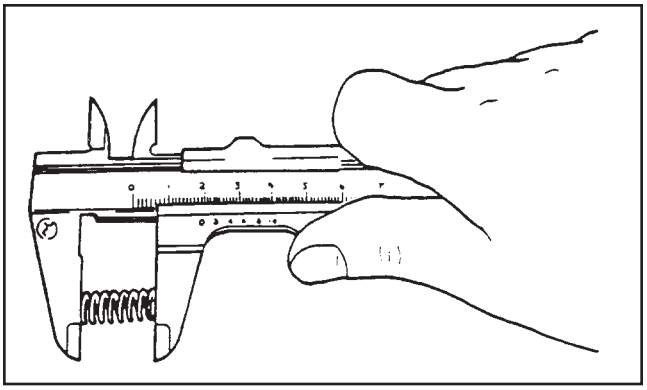


Figure 4H-21. Checking Locating Spring Free Length

GEAR SHIFT FORK SHAFTS

Check the shift fork shafts at the gear shift lever end (see Figure 4H-13) for uneven wear. Replace worn shift fork shafts.

EXTENSION CASE BUSHING

Check the bushing press-fitted into the extension case for wear by measuring the radial clearance between bushing bore and sliding yoke as shown in Figure 4H-22. If the sliding yoke is capable of rattling in the bush because of advanced wear it will cause the drive shaft to rattle. For this reason, an extension case found to allow the drive shaft yoke to rattle in excess of 0.0078 inch (0.2 mm) must be replaced; replacement of the bushing alone will not fix the problem.

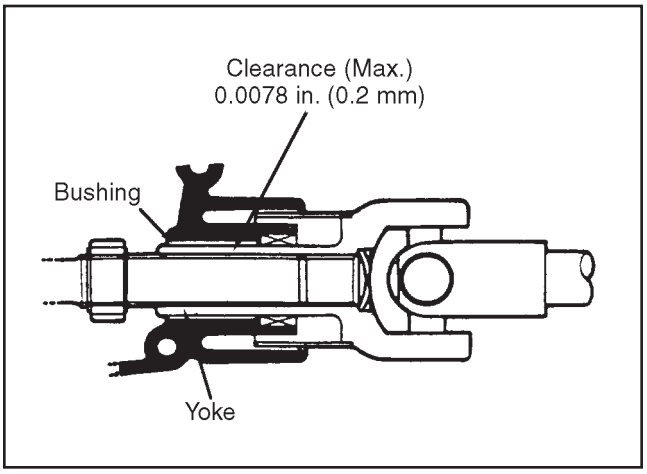


Figure 4H-22. Bushing-to-Yoke Clearance

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

TRANSMISSION REASSEMBLY

GENERAL

Normally, the entire transmission will not have been disassembled. Reassembly is essentially the reverse of disassembly; however, special procedures are included in the following paragraphs.

SHIFTER SHAFTS AND FORKS

1. See Figure 4H-23 for arrangement of shifter shafts, forks and gear shift case.

   Note that three shift shafts individually have a locating ball and locating spring, and that 2 interlock balls and an interlock roller are used between shafts as shown in Figure 4H-24.

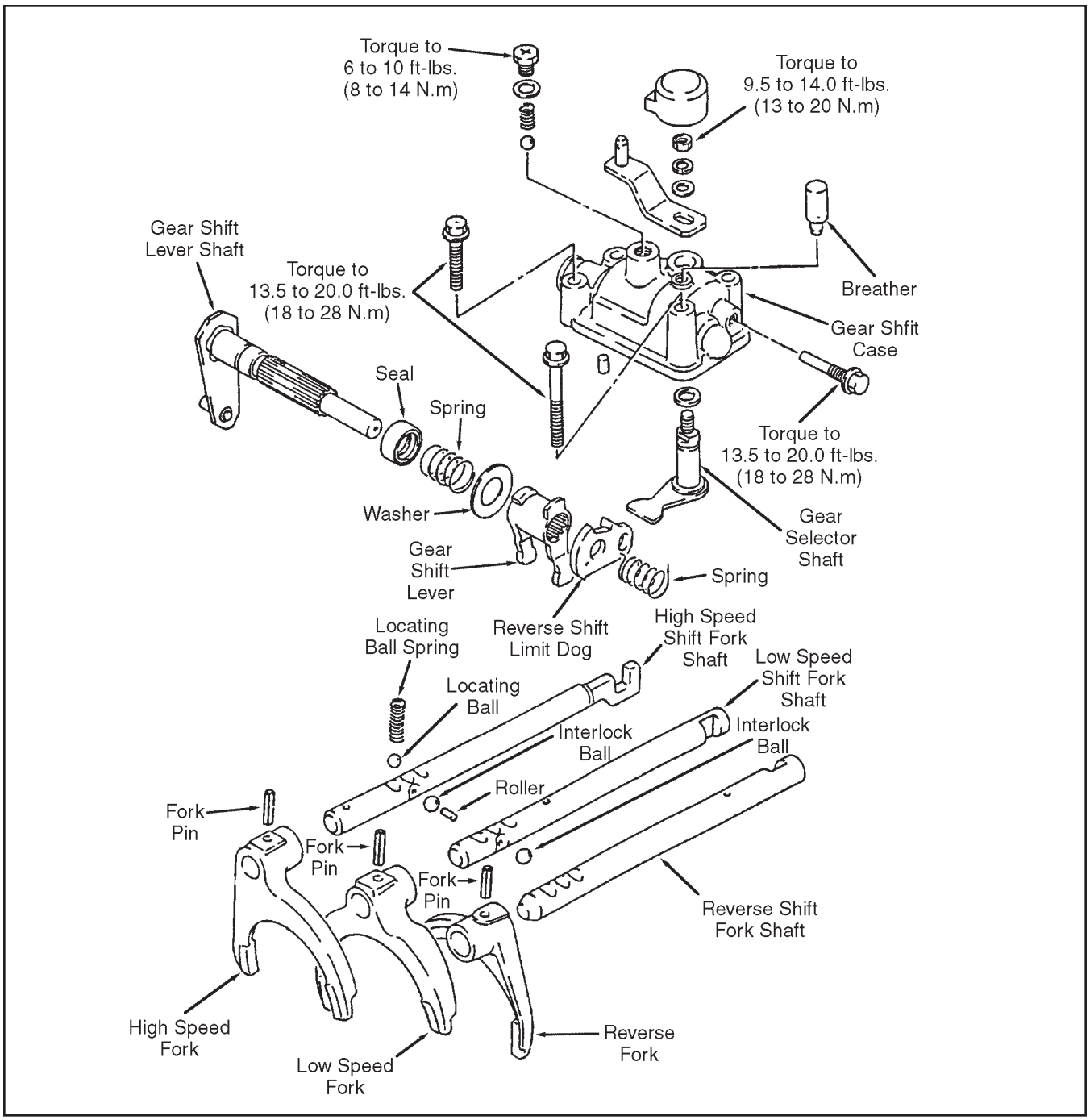


Figure 4H-23. Shifter Shaft and Forks

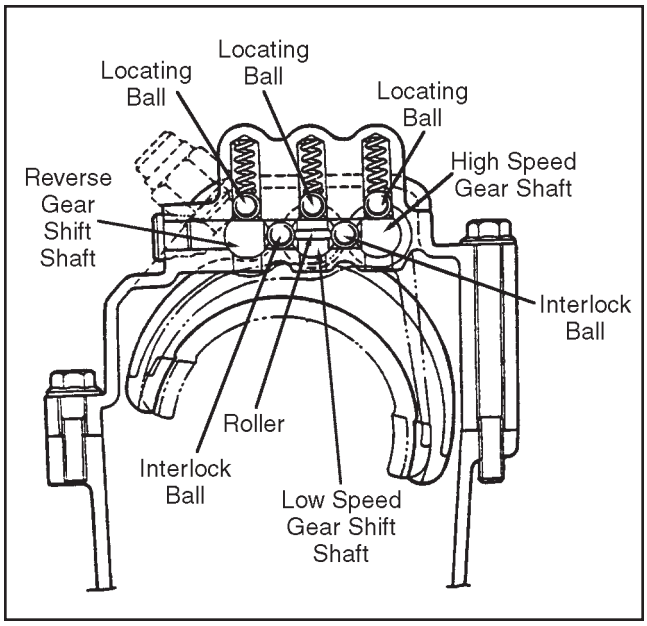


Figure 4H-24. Spring and Ball Arrangement

2. Install high, low and reverse shafts in that order.
3. Install 3 locating springs into 3 holes in upper case. Fit locating ball on top of locating spring in hole as shown in Figure 4H-25.

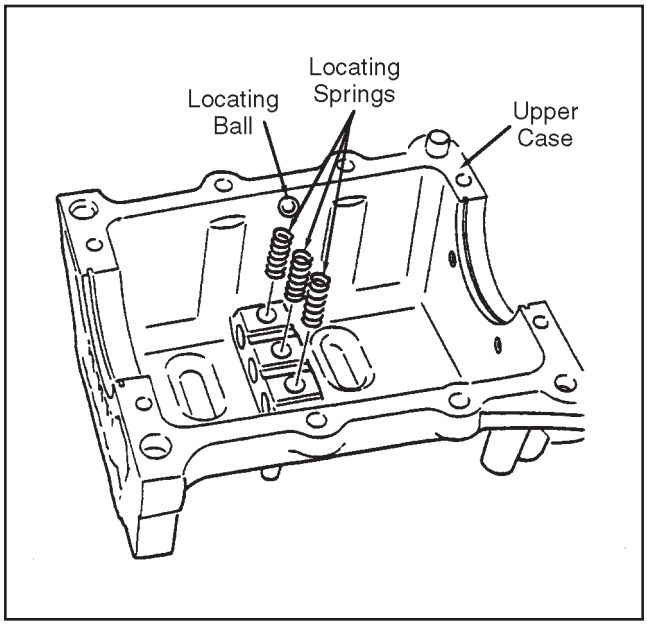


Figure 4H-25. Installing Locating Balls and Springs

4. Insert high speed gear shift shaft into upper case. Push down high speed gear shift shaft locating ball to pass shaft over it and keep inserting shaft until locating ball fits in center slot of 3 continuous slots in shaft.

   Insert high speed shift fork in the direction shown in Figure 4H-23.

   Drive fork pin into fork and shaft.
5. Refer to Figures 4H-24 and 4H-25. Install interlock ball and locating ball in upper case. After installing interlock roller in low speed gear shift shaft, insert shaft into upper case as described in Step 4 above.

   Fork should be installed as shown in Figure 4H-24. Then drive fork pin until it becomes flush with outer surface of fork.
6. Install interlock ball and locating ball into upper case. Then insert reverse gear shift shaft into upper case as shown in Step 4 above.

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

MAIN SHAFT AND INPUT SHAFT

1. See Figure 4H-26 for general arrangement of the countershaft, main shaft and input shaft.

NOTE

Be careful to install each washer, gear, synchronizer hub and sleeve in the proper direction. Make sure that balls are installed on the main shaft.

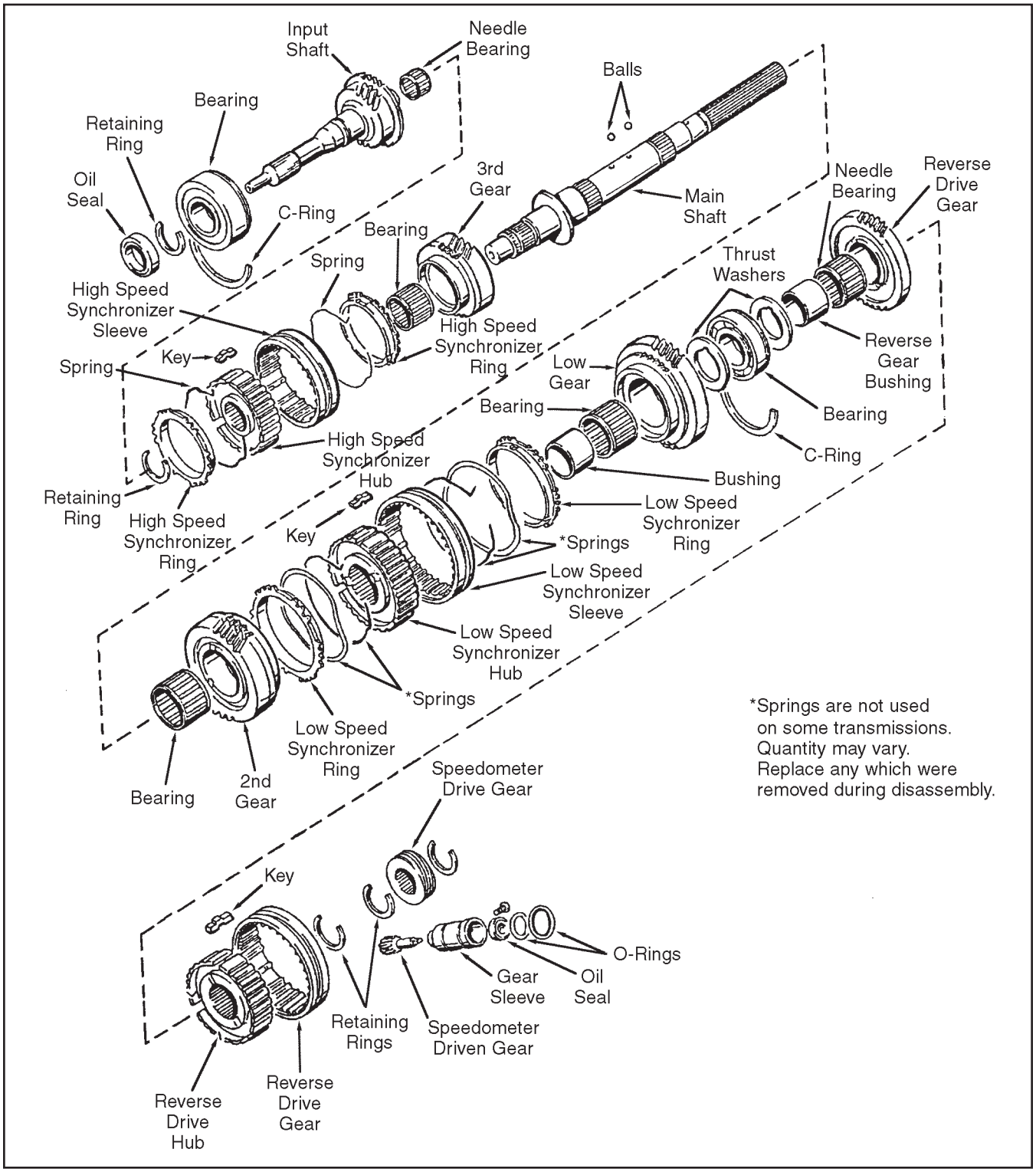


Figure 4H-26. Main Shaft and Input Shaft

2. Install 2nd gear bearing, 2nd gear, synchronizer ring and low speed synchronizer hub/sleeve onto main shaft, using care for installing direction of synchronizer sleeve as shown in Figure 4H-27.

   After putting on each synchronizer, be sure that 3 keys mounted on hub fit snugly into slots cut in ring.

NOTE

Do not forget to install synchronizer ring spring between synchronizer ring of 2nd gear side and synchronizer hub.

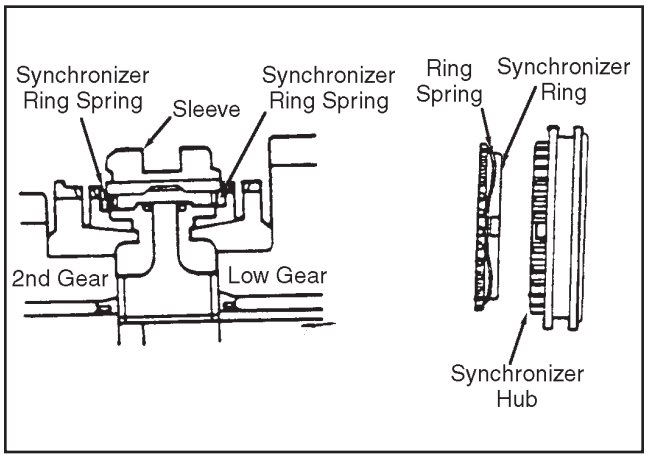


Figure 4H-27. Synchronizer Ring Spring Installation

3. Press-fit the low gear bushing on the shaft using a hydraulic press.
4. Install low gear needle bearing, synchronizer ring spring, synchronizer ring, low gear, ball and washer onto main shaft as shown in Figure 4H-28.

   Fit ball into hole in shaft and install washer so that its slot comes over ball.

   Install washer so that its chamfered side is on the main shaft center bearing side.

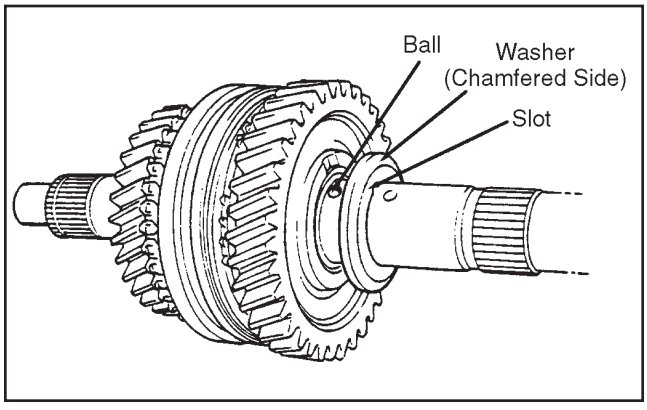


Figure 4H-28. First Ball and Washer Installation

5. Press-fit center bearing with bearing installation tool as shown in Figure 4H-29, using care for its installing direction.

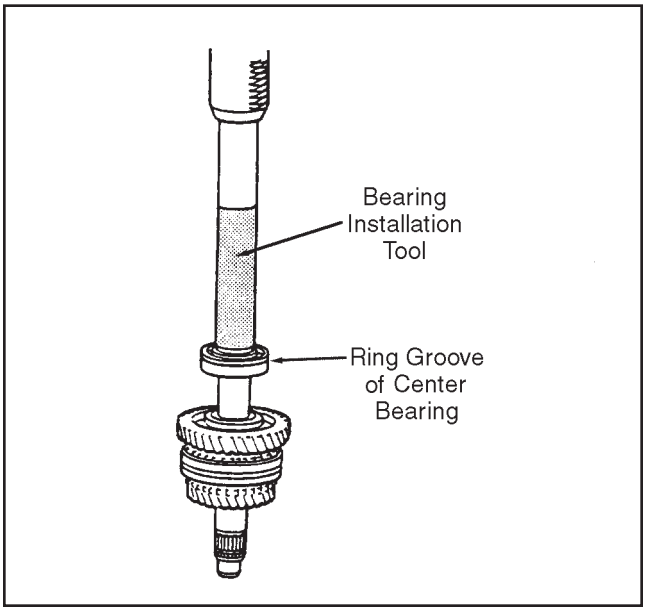


Figure 4H-29. Installing Center Bearing

6. Install ball and washer. As Figure 4H-30 shows, install washer so that its circumference chamfered side faces center bearing and its slot comes over ball.

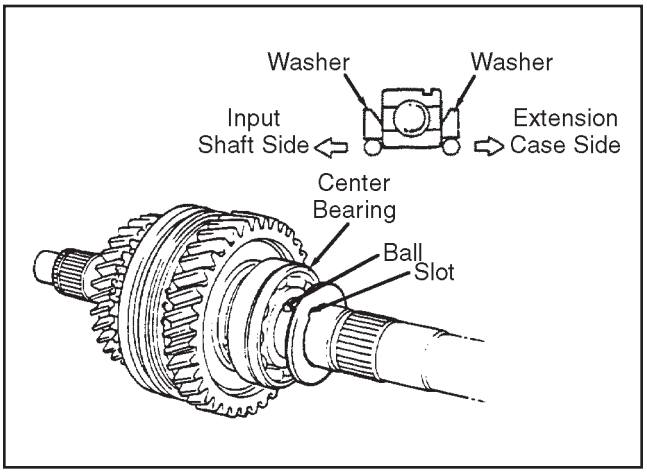


Figure 4H-30. Second Ball and Washer Installation

7. Press-fit reverse gear bushing, preventing ball installed in Step 6 from coming off.

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

8. Install reverse gear bearing, reverse gear and reverse drive hub/sleeve. For proper direction, make sure to install hub so that the side whose inside boss is smaller in diameter and longer is at the transmission case rear side (see Figure 4H-31).

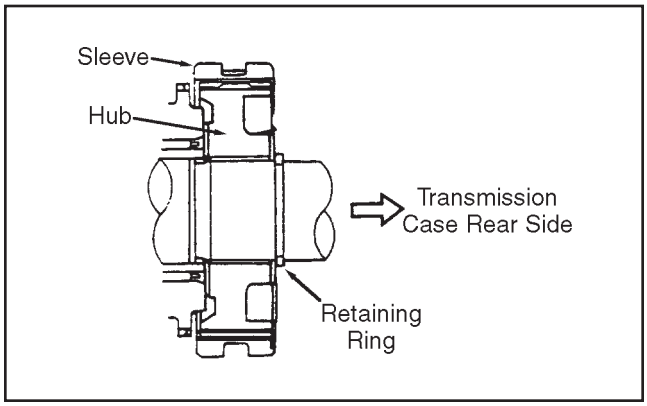


Figure 4H-31. Main Shaft Assembly — Steps 8 and 9

9. Fit reverse hub retaining ring into groove in main shaft.
10. Install 3rd gear bearing, 3rd gear, high speed synchronizer ring and hub/sleeve. When installing hub, position the side with larger outer diameter boss to 3rd gear side, then fit retaining ring into groove in main shaft.
11. Install speedometer drive gear on the main shaft.
12. Install synchronizer ring, needle bearing and input shaft.

COUNTERSHAFT AND REVERSE IDLE GEAR

1. Drive countershaft front bearing into lower case. Then, using plastic hammer, drive countershaft slightly into front bearing.

   Using bearing installation tool, drive rear bearing onto countershaft and into lower case (see Figure 4H-32).
2. Fit countershaft front retaining ring into groove in shaft.
3. Install countershaft reverse drive gear (see Figure 4H-33) onto countershaft, and then fit countershaft rear retaining ring into groove in shaft.

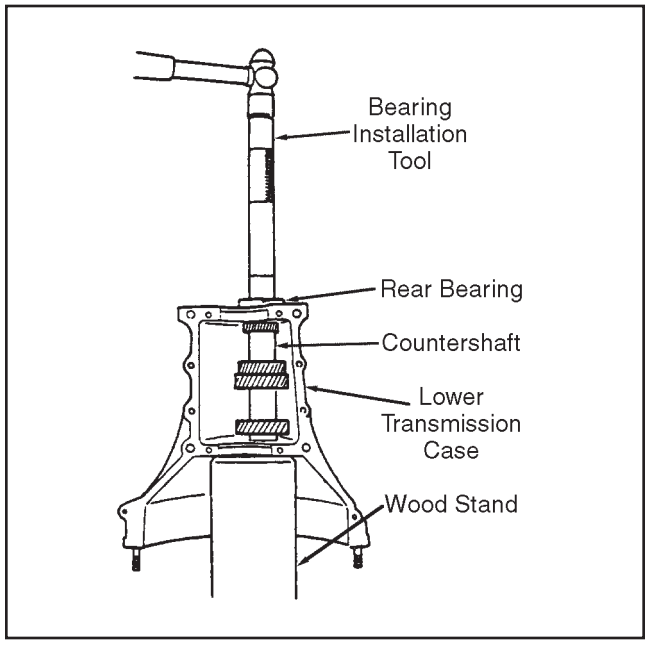


Figure 4H-32. Countershaft Front Bearing

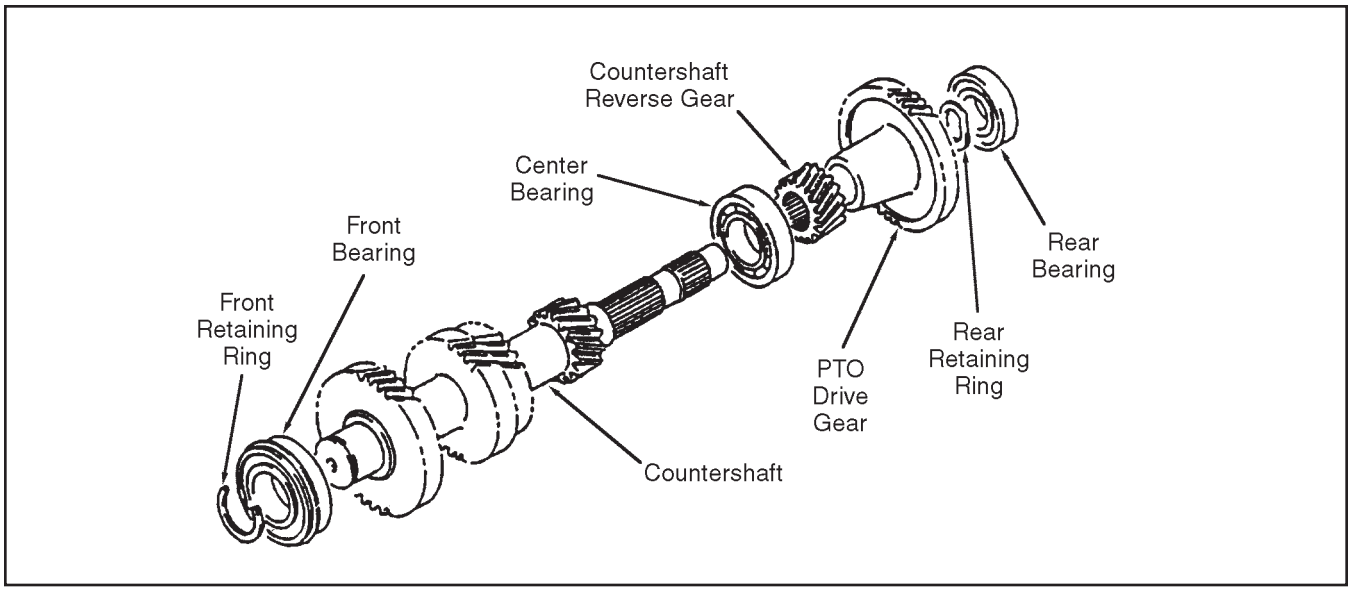


Figure 4H-33. Countershaft Reassembly

4. Install idle gear and washer onto reverse gear shaft and pin into it as shown in Figure 4H-34.

   Install above as assembled into lower case with pin and washer tongue aligned as shown in Figure 4H-34.

5. Install the PTO drive gear (see Figure 4H-33), rear retaining ring, and rear bearing.

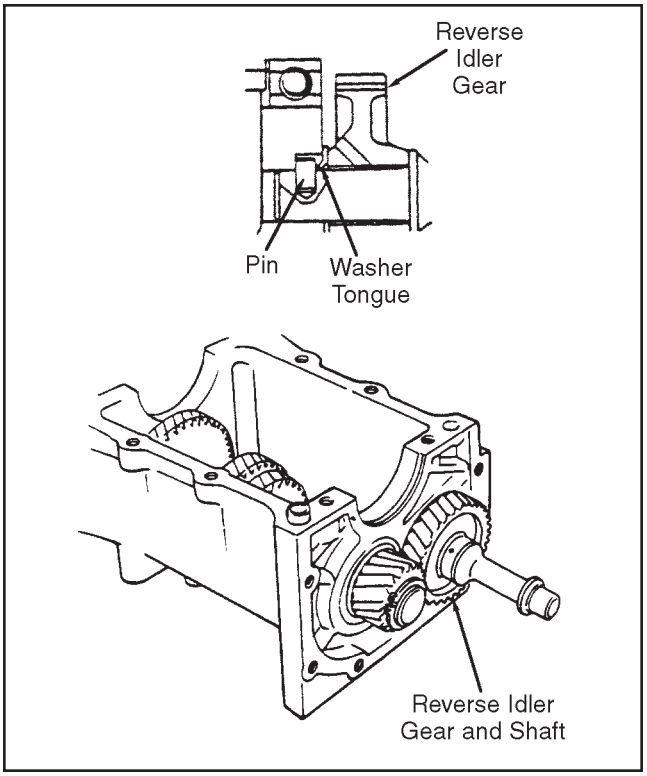


Figure 4H-34. Reverse Idler Gear and Shaft Installation

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

JOINING UPPER AND LOWER CASES (See Figure 4H-35)

1. Make certain the case alignment pins are fitted on each side of the lower case.
2. Clean the joint faces, removing any foreign matter.
3. Make certain the C-rings are fitting in the shaft bearing grooves.
4. With the forks previously installed in the upper case and the countershaft, reverse idler gear and reverse shaft installed in the lower case, install the assembled main shaft and input shaft in the lower case.
5. Uniformly apply sealant compound to the mating face of the lower case.
6. Match the upper case to the lower case by aligning the three shift forks with the three grooves in the synchronizer sleeve on the main shaft.
7. Check that transmission input shaft rotates easily when turned by hand.
8. Install case bolts and torque to 13.5 to 20.0 ft-lbs. (18 to 28 N.m).

INPUT SHAFT BEARING RETAINER (See Figure 4H-36)

1. Prior to installing the bearing retainer, grease the clutch release mechanisms as described in Section 4D.
2. Install the input shaft bearing retainer in the transmission case and torque the engine mounting bolts to 13.5 to 20.0 ft-lbs. (18 to 28 N.m).

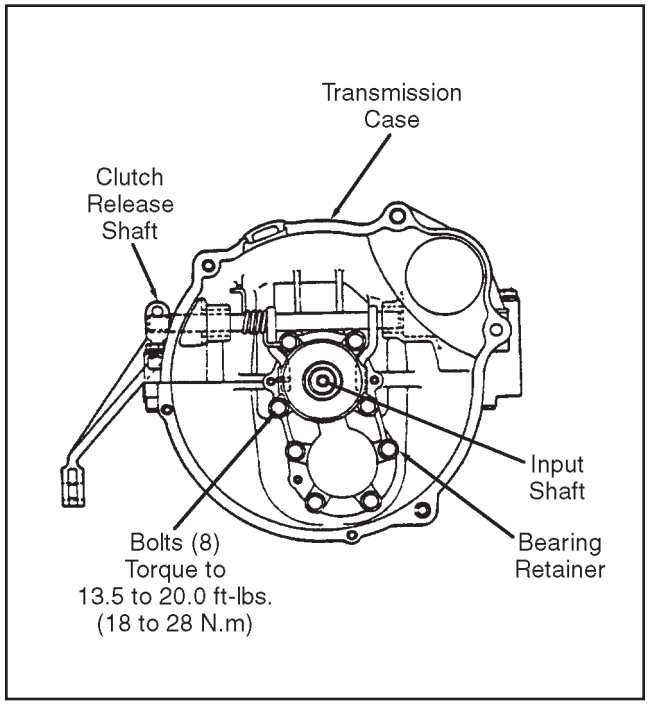


Figure 4H-36. Input Shaft Bearing Retainer Installation

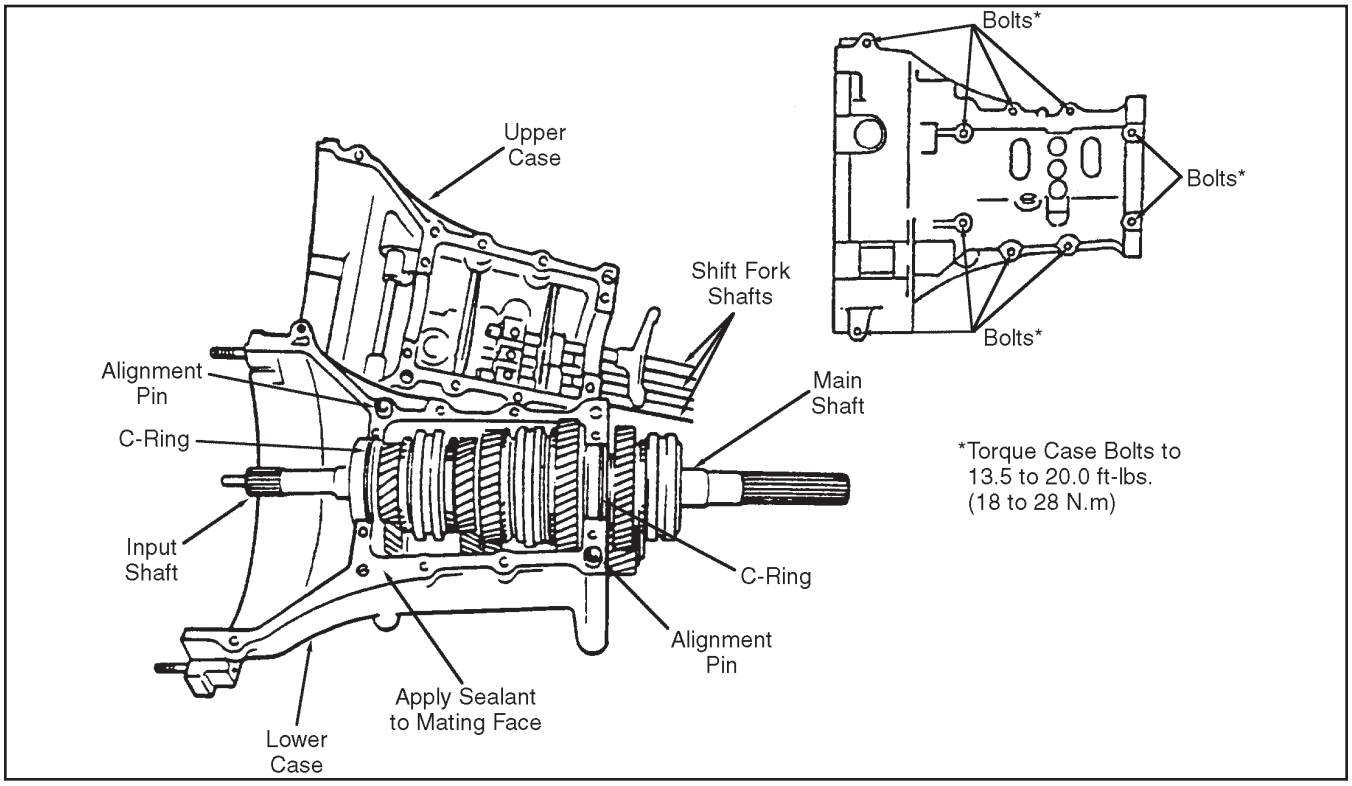


Figure 4H-35. Joining Upper and Lower Case

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

EXTENSION CASE (LATER SERIAL NUMBERS AND RETROFIT VEHICLES)

NOTE

Vehicles produced since early 1999 have an extension case designed to accommodate a mechanical PTO as shown in Figure 4H-37. Most earlier vehicles have been retrofit to this configuration. However, if your vehicle does not have this extension case, refer to "EXTENSION CASE WITHOUT PTO GEARING".

1. If necessary, replace worn or damaged extension case components as shown in Figure 4H-37.
2. Install the extension case oil seal.
3. Install the extension case on he transmission case and torque bolts to 13.5 to 20.0 ft-lbs. (18 to 20 N.m).

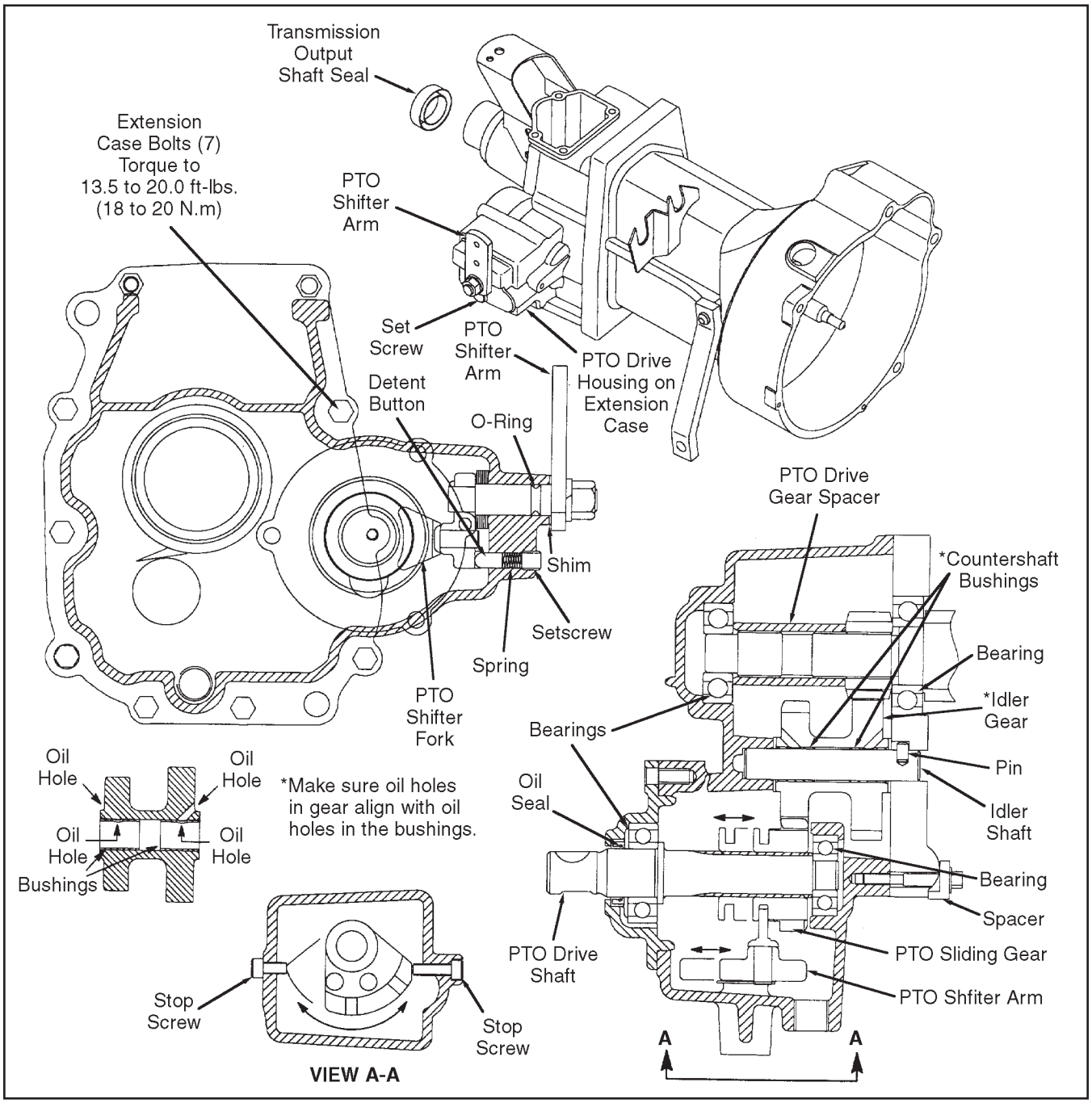


Figure 4H-37. Extension Case — Later Serial Numbers

SECTION 4H. TRANSMISSION (4-CYLINDER 970 GASOLINE OR DIESEL ENGINES)

EXTENSION CASE (EARLY SERIAL NUMBERS, NOT RETROFIT)

1. Install the extension case oil seal (see Figure 4H-38).
2. Install the extension case on the transmission case and torque bolts to 13.5 to 20.0 ft-lbs. (18 to 28 N.m).

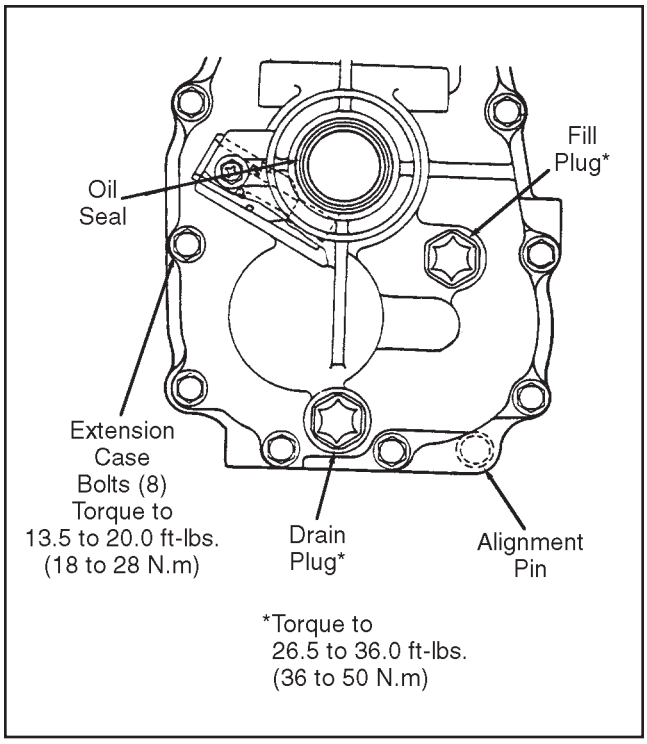


Figure 4H-38. Extension Case Installation

GEAR SHIFT CASE

1. Position the assembled gear shift case on the extension case as shown in Figure 4H-39.
2. Check operation of the gear shift lever to make certain the gear select arm and gear selector shaft are properly aligned with the gear shift lever.
3. Torque the four gear shift case bolts to 13.5 to 20.0 ft-lbs. (18 to 28 N.m).

TRANSMISSION INSTALLATION

Following any clutch repair or any other procedure that involves removal of the transmission from the vehicle the following steps should be taken.

1. Lubricate transmission and fill with fluid as described in Section 11.
2. Install mounting brackets as shown in Figure 4C-2.
3. Using a suitable hoist, position the transmission near the clutch disc.

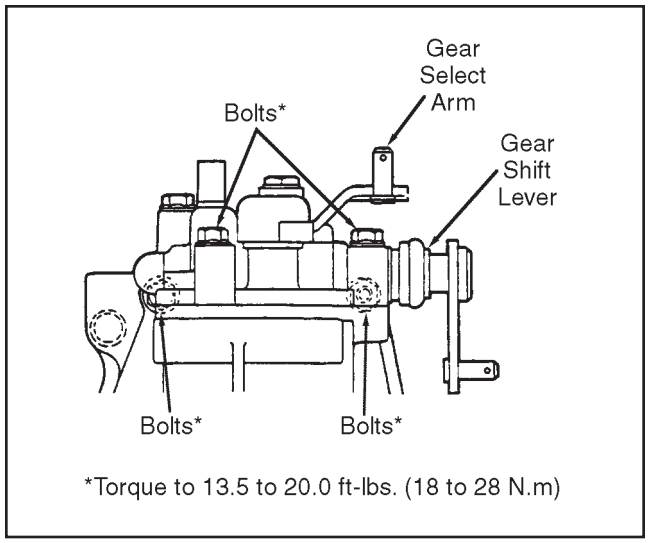


Figure 4H-39. Gear Shift Case Installation

4. Slide transmission forward until input shaft splines engage clutch disc. It may be necessary to turn the input shaft to index splines.
5. Install transmission mounting hardware, do not tighten.
6. Use Loctite 242 (blue). Install transmission bell housing to engine. Mount with socket head capscrews. Torque to 37 ft-lbs. (51 N.m). Diesel only: Install the two lower socket head capscrews. Torque to 37 ft-lbs. (51 N.m).
7. Install and tighten all transmission-to-frame mounting hardware.
8. Install mounting brackets to transmission extension case and install drive shaft to transmission as described in Section 4C.
9. Connect clutch cable on clutch release lever and gear shift cables/connectors on gear shift lever and selector arm as described in Sections 4D and 4E. Make certain connections to operator controls are correct and shifting/selecting operates smoothly. Adjust as described in Section 2C.
10. If vehicle is equipped with a mechanical PTO, connect control cable to PTO shifter arm (see Section 12).
11. Install all electrical cables, hoses and tubes disconnected during transmission removal.
12. Install any brackets or sheet metal that were removed.
13. Connect battery cables.
14. Adjust clutch cable, pedal free travel and interlock switch (Section 2C).

SECTION 4I. REAR AXLE

GENERAL

The rear axle assembly consists of brakes, wheel hubs, axle shafts, axle housings (tubes) and a differential/2-speed auxiliary transmission.

Wheel hub and brake repairs do not require removal of the axle from the vehicle. Axle shafts and housings may or may not require removal of the entire rear axle differential assembly depending upon the extent of repairs required.

Although some repairs to the differential can be performed with the differential installed on the vehicle, it is almost always more efficient to remove the differential if any of its bearings or gears require repairs.

⚠ WARNING

If service is to be performed with a dump box raised (rather than removed), install a cylinder ram stop to prevent the cylinder from retracting, causing the dump box to fall and injure service personnel.

If the vehicle is equipped with a dump box, removal of the dump box will greatly facilitate removal/repair of the rear axle. Remove the hydraulic lines (cap and plug lines and ports) from the box lift cylinder, disconnect the cylinder from the frame as shown in Figure 4I-1, remove dump box mounting hardware and lift the dump box off the frame.

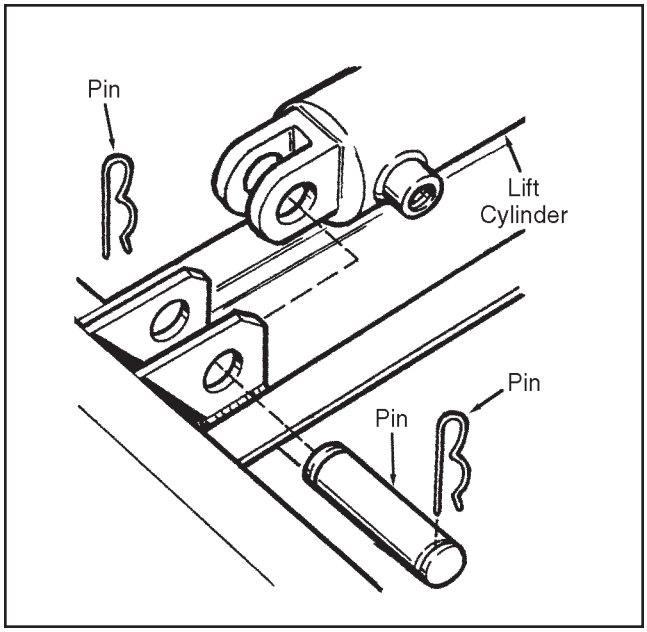


Figure 4I-1. Disconnecting Dump Box Lift Cylinder

BRAKES AND WHEEL HUBS (See Figure 4I-2)

REMOVAL

1. Raise and support the rear of the vehicle on jack stands. Remove the rear tires and wheels.
2. Disconnect the parking brake cable from the brake.
3. Disconnect the brake fluid line from the wheel cylinder (cap and plug brake line and wheel cylinder ports).
4. Remove the brake drum.
5. Remove the cotter pin, hub nut, washer and wheel hub. Use a bearing puller to remove the wheel hub.
6. Remove the four screws, backing ring, wheel bearing seal retainer and wheel bearing seal.
7. Remove the four mounting screws and remove the brake assembly from the axle housing.
8. If necessary, repair the brake assembly as described in Section 5.

INSTALLATION

1. Position the brake assembly on the axle housing.
2. Lubricate and install a new wheel bearing seal, seal retainer and blocking ring. Secure with four screws. Apply Loctite 243 (Textron P/N 2810300 or 2811163) to these screws and torque to 50 ft-lbs. (68 N.m).
3. Use a rubber mallet to drive the wheel hub on the axle shaft far enough to install the hub washer and nut. Torque the hub nut to 100 to 120 ft-lbs. (135 to 163 N.m). Install a new cotter pin on the nut.
4. Install the brake drum, wheels and tires. Secure with wheel nuts. Torque to 70 to 100 ft-lbs. (95 to 140 N.m).
5. Connect and tighten the brake fluid line.
6. Connect the parking brake cable.
7. Bleed the brake system (see Section 2).
8. Check the pressure (see Section 7).
9. Lower the vehicle and check brake operation (see Section 2).

SECTION 4I. REAR AXLE

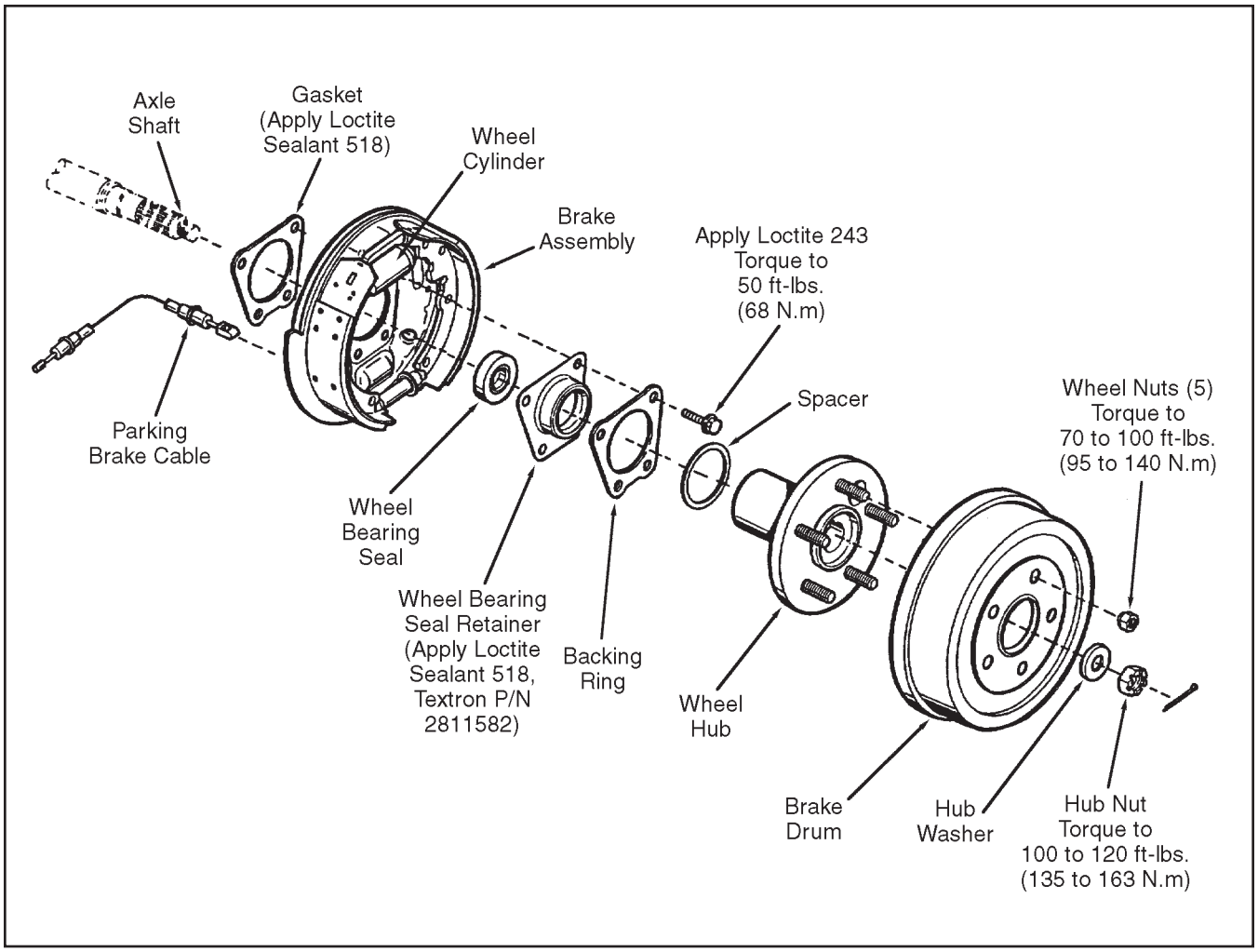


Figure 4I-2. Brake and Wheel Hub Repair

AXLES AND AXLE HOUSINGS

REMOVAL

1. Remove the brakes and wheel hubs as described in the preceding paragraphs.
2. Jack and support the differential on jack stands.
3. Place a floor jack under the center of the differential housing. Use an overhead hoist or lift truck to take up the weight of the chassis from the rear leaf springs.
4. Disconnect the lower nuts and washers that attach the lower shocks to the studs on the axle tube (see Figure 4I-3). Push the shock absorbers upwards to he retracted position.
5. Remove the left and right U-bolts from brackets as shown in Figure 4I-3.
6. Install the wheel hub castellated nut on the axle shaft (see Figure 4I-4) to protect the shaft threads and pull the axle shaft to remove the wheel bearing, collar and axle shaft. It may be necessary to tap the back of the bearing collar with a rubber mallet to remove it.

NOTE

The wheel bearing cup and cone are cemented together and may separate during removal, leaving the cup in the housing. The cup has a sliding fit in the housing and can be removed by carefully pulling straight out of the housing bore. Replace a separated or worn bearing.

7. Use a seal extractor to remove the oil seal from the axle housing.
8. If the axle housing is damaged, remove the four nuts and washers that mount the axle housing to the differential and remove the axle housing.

SECTION 4I. REAR AXLE

9. Clean and inspect the axle shaft, wheel bearing, collar and wheel hub for damage or wear. Replace damaged or worn parts.
10. Clean the axle housing flanges.
11. Remove the O-ring at the groove in the axle housing next to the differential.

INSTALLATION

1. Refer to Figure 4I-4, replace the O-ring and oil seal. Lubricate the oil seal. The lip of the oil seal must face inward. Use a plastic tube or seal driver to seat the oil seal.
2. Pack the wheel bearing with clean grease (see Section 11). Reassemble the wheel bearing and collar being careful not to damage the oil seal (see Figure 4I-4). The bearing cup should be to the differential housing side.
3. Refer to Figure 4I-3, install U-bolts and shocks on axle tubes. Torque as shown in Figure 4I-3.
4. Install the brakes and wheel hubs as described in the preceding paragraphs.

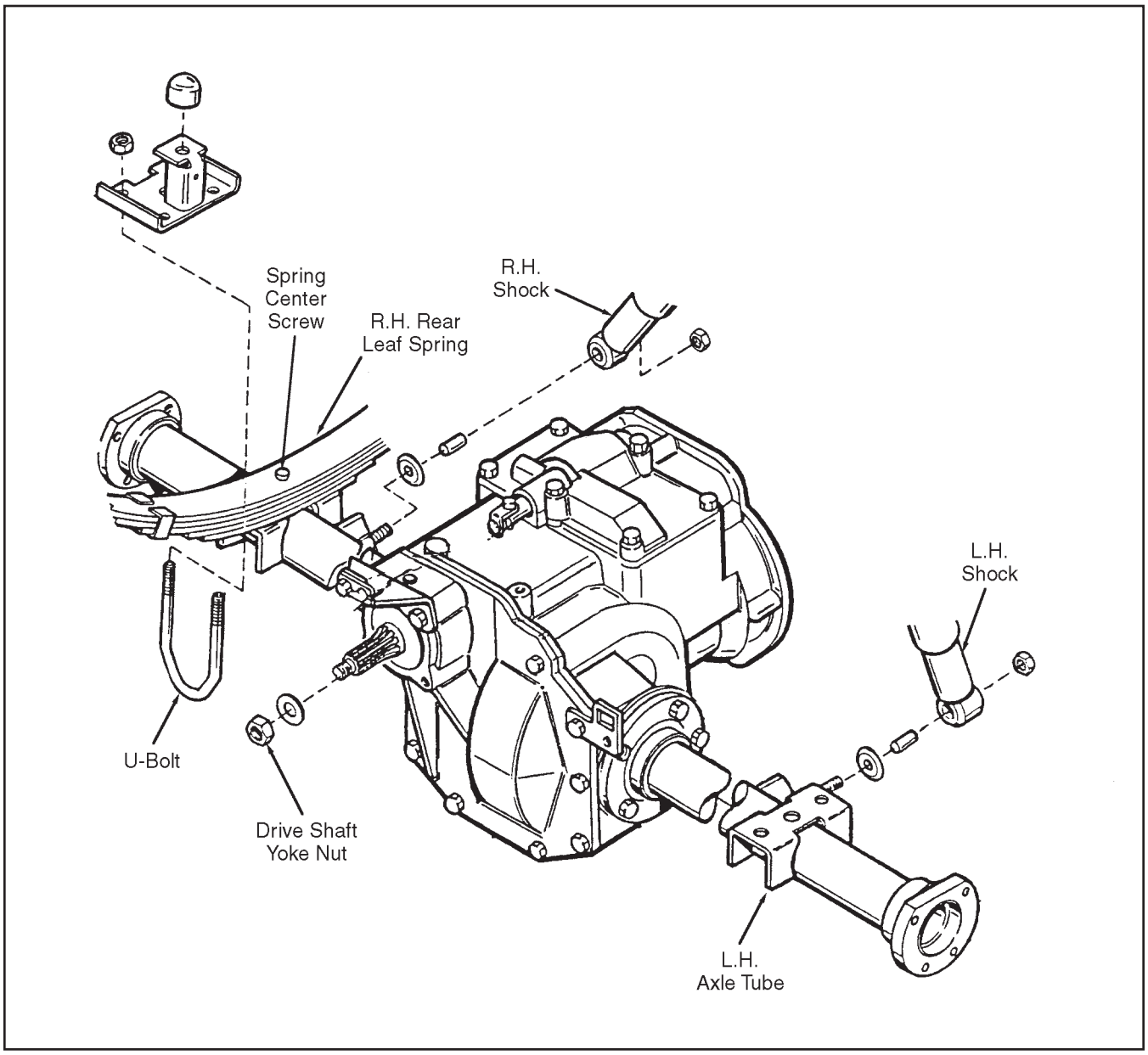


Figure 4I-3. Axle Housings and Differential

SECTION 4I. REAR AXLE

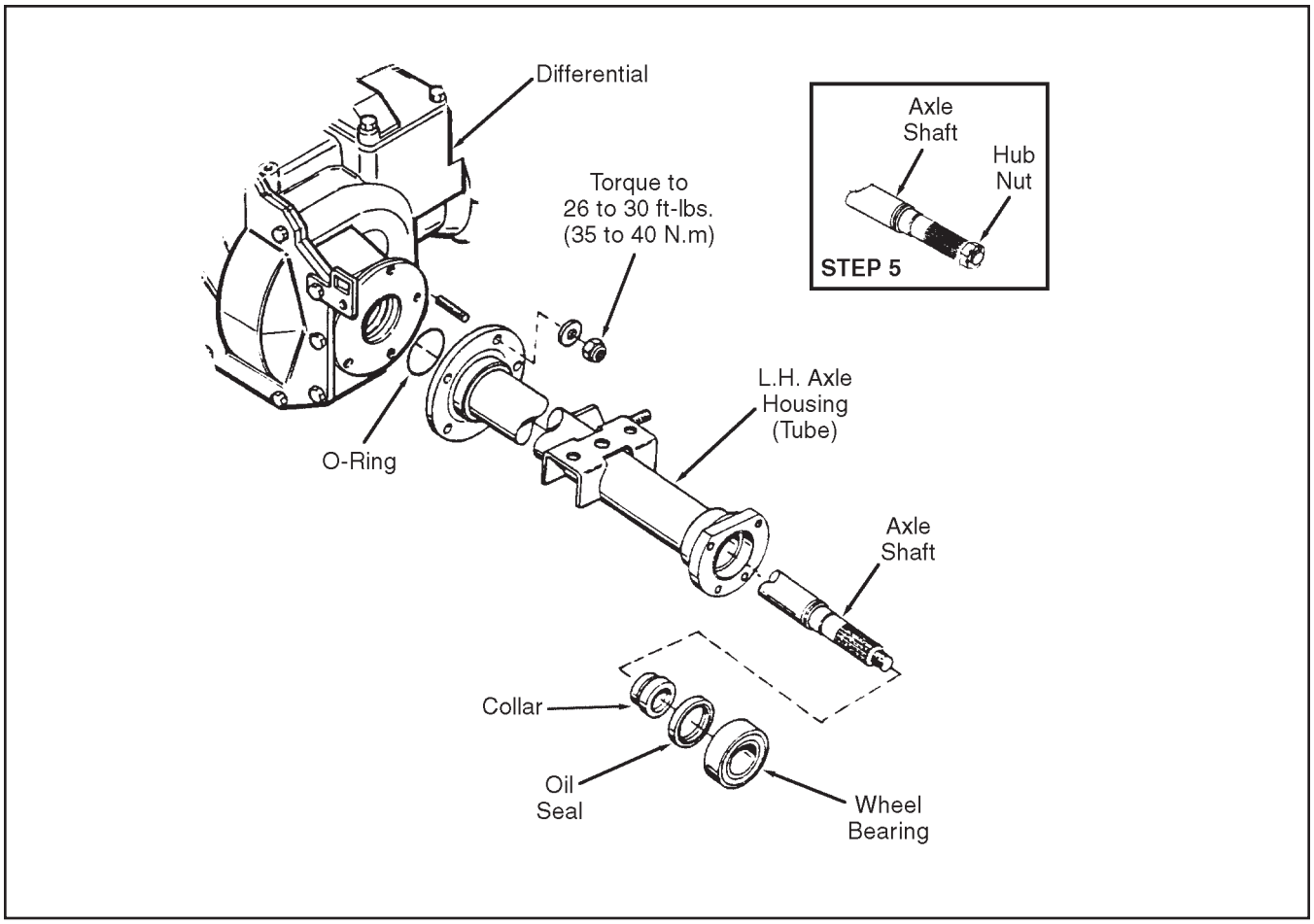


Figure 4I-4. Axles and Axle Housings

SECTION 4I. REAR AXLE

DIFFERENTIAL ASSEMBLY REMOVAL

1. Remove the brakes, wheel hubs, axles and axle tubes as described in the preceding paragraphs.
2. Remove the axle tubes as described in the preceding paragraphs.
3. Remove the brake tubes, brake hose, clamp, tee and bracket from the differential housing as shown in Figure 4I-5.
4. Disconnect the differential control cable from the shift shaft and cable bracket.
5. Remove the drain plug and drain oil from the differential in accordance with environmental regulations. Re-install and tighten the drain plug.
6. Disconnect the drive shaft yoke nut and special washer from the differential input shaft as shown in Figures 4C-1 and 4C-2.
7. Remove the jack stands from under the axle. Guide and carefully lower the differential until the drive shaft separates from the input shaft. Remove the differential assembly from under the chassis.
8. Clean the exterior of the differential before proceeding with further disassembly and repairs. Move the differential to a suitable work bench or table.

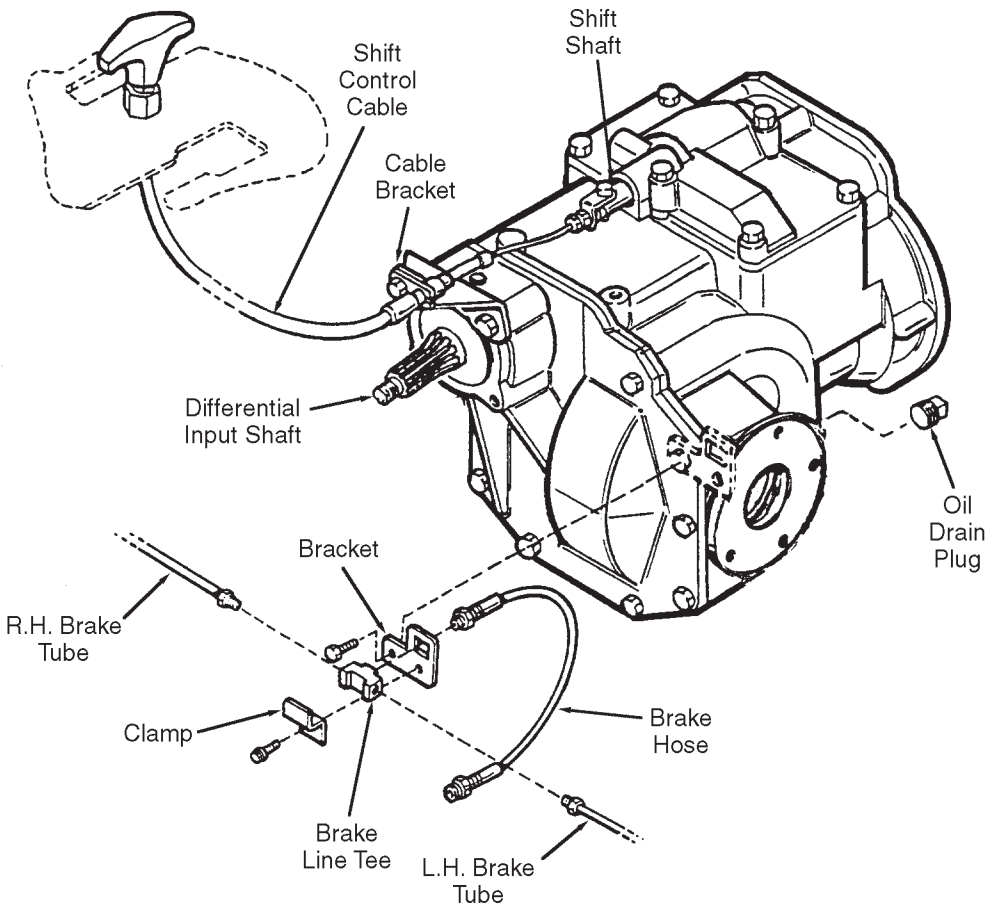


Figure 4I-5. Differential Removal

SECTION 4I. REAR AXLE

DIFFERENTIAL FRONT COVER

DISASSEMBLY

NOTE

The drive shaft yoke nut and special washer (see Figures 4C-1 and 4C-2) will have been removed during removal of the differential from the vehicle.

1. Re-install the driveshaft yoke nut and special washer on the input shaft to protect the shaft threads during the following procedure.
2. Remove the cover retaining screws as shown in Figure 4I-6 and the shift cable bracket screws (see Figure 4I-5).

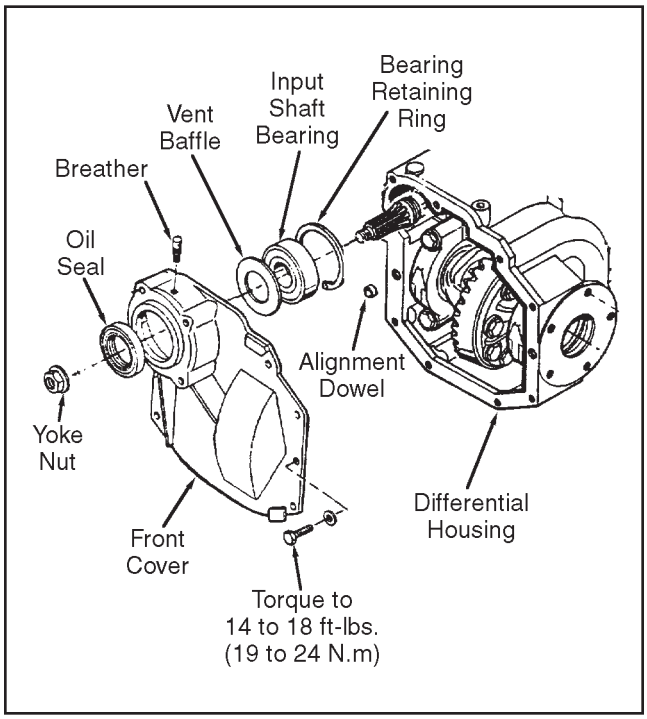


Figure 4I-6. Front Cover Disassembly

NOTE

Steps 3 and 4 below are necessary because the front cover can not be pried from the differential housing by a screwdriver or other metal object which would damage the machined surfaces of the differential housing.

3. Re-install the shift cable mounting bracket using one of the 3/8-16 x 2.75 inches long screws in the threaded front cover holes as shown in Figure 4I-7.
4. Use a curved bar to pry under the shift cable bracket and against the input shaft to “bump” the input shaft bearing from the shaft as shown in Figure 4I-7.

NOTE

Pressure must be held on the end of the input shaft to hold the shaft rearward in the case. This will prevent the shaft and rear bearing from coming forward out of the case bore.

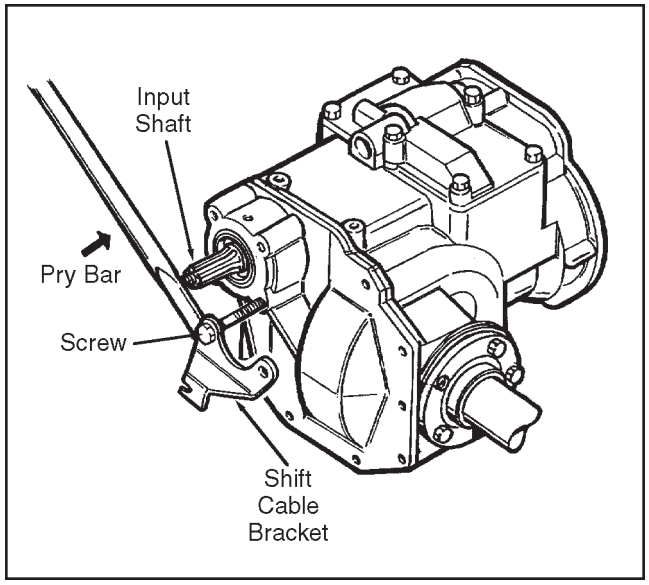


Figure 4I-7. Removing Input Shaft Bearing

5. Remove the cover assembly from the housing. Remove the screw installed in Step 3 above and cable bracket from the cover.
6. Remove the input shaft bearing retaining ring as shown in Figure 4I-6.
7. Support the front cover on wood blocks. Use a large drift against the inner race of the input shaft bearing. Drive the bearing out of the bore. Be careful not to drive on the vent baffle.
8. Support the cover on wood blocks. Use a large diameter drift to drive out the oil seal from the rear side. The shaft oil seal is retained with Loctite 290 adhesive.
9. Thoroughly clean the front cover and differential housing machined surfaces of all gasket material. Wash all parts in approved cleaning solvent and air dry. Inspect the input shaft bearing for cracked or chipped races, worn or scored balls. Replace the bearing if damaged.

REASSEMBLY

1. Apply Loctite 290 adhesive around the O.D. of a new oil seal.
2. Coat the lips of the oil seal with clean grease. Use a seal driver or tubing to install a new oil seal in the cover until seated.
3. Install the vent baffle in the bottom of the bearing bore and install the bearing in the bore of the cover.
4. Install the bearing retaining ring. The ends of the retaining ring must be in line with the oil drain groove in the cover. Be sure the ring is fully sealed.
5. Apply a bead of Loctite 518 (Textron P/N 2811582) sealant around the machined surface of the cover.

NOTE

If the ball bearing is reused, put clean grease or Lubriplate in the bearing. Use new bearing as received in the package.

6. Install two 5/16-18 pilot studs in the holes of the cover pilot bushings as shown in Figure 4I-8.

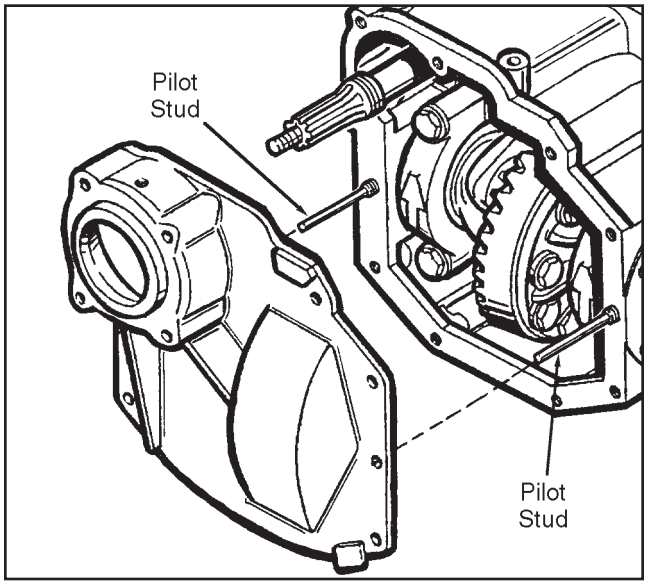


Figure 4I-8. Front Cover Installation

7. Align and push the cover on the shaft as far as possible by hand. Install the three 3/8-16 x 2.75 inches retaining screws and shift cable bracket.
8. Tighten each screw a small amount alternately and evenly to pull the bearing on the input shaft. Tighten the screws only enough to pull the cover up to the housing. Be sure the cover engages the two pilot bushings.
9. Install the 5/16-18 retaining screws and flat washers. Draw all retaining screws up evenly until the cover is firmly against the differential housing. Tighten the 3/8-16 screws alternately and evenly to a final torque of 26 to 30 ft-lbs. (35 to 40 N.m). The lower 3/8-16 screw is used to support the right side brake fluid line. Tighten the 5/16-18 retaining screws alternately and evenly to a torque of 14 to 18 ft-lbs. (19 to 24 N.m).
10. Connect the drive shaft yoke to the input shaft as shown in Figures 4C-1 and 4C-2. Tighten the yoke nut to approximately 64 to 74 ft-lbs. (87 to 100 N.m). This nut can not be accurately torqued.

SHIFT CONTROL COVER

DISASSEMBLY (See Figure 4I-9)

1. Remove the six cover retaining screws and flat washers and lift the cover assembly off the differential housing.
2. Remove the socket head setscrew and remove the detent spring and detent.

NOTE

If the detent sticks in the cover, remove it after the shift shaft is removed in Step 3 below. If necessary, use a stiff wire to push out the detent with the shift shaft up.

3. Clamp the shift control cover in a vise and use a drift punch to turn the shift shaft counterclockwise to loosen the shift shaft.

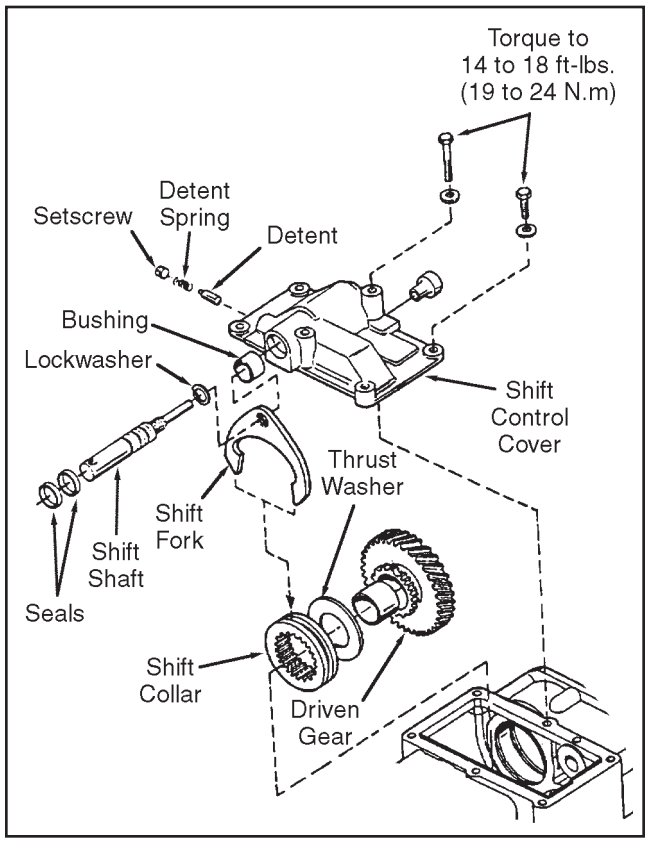


Figure 4I-9. Shift Control Cover

4. Remove the shift shaft, lockwasher and shift fork.
5. Remove the two seals from the cover. Thoroughly clean the cover and housing mating surface of all sealant. Clean and inspect all parts for damage or wear. Replace any damaged or worn parts.

REASSEMBLY (See Figure 4I-9)

1. Lubricate the shift shaft with clean grease. Rest the shift fork and lockwasher on the shaft guide. Install the shift shaft through the cover into the shift fork.
2. Use a drift punch. Turn the shaft clockwise to tighten the shaft on the fork.
3. Install new shaft seals into the cover. The lip of the first seal must face inward. A short length of 3/4 inch PVC pipe will work very well as a seal driver. The lip of the outer seal must face outward.
4. Install the detent and spring and secure with setscrew.
5. If repairs to the 2-speed auxiliary transmission are required, leave the cover off the differential housing.
6. If no further repairs to the differential are required, move the shift collar toward the rear cover. Put a bead of Loctite 518 (Textron P/N 2811582) sealant around the mating surface of the differential housing.
7. Install two 5/16-18 pilot studs in opposite holes as shown in Figure 4I-10. Install the cover over the pilot studs. Be sure the shift fork enters the groove of the shift collar and remove the pilot studs.

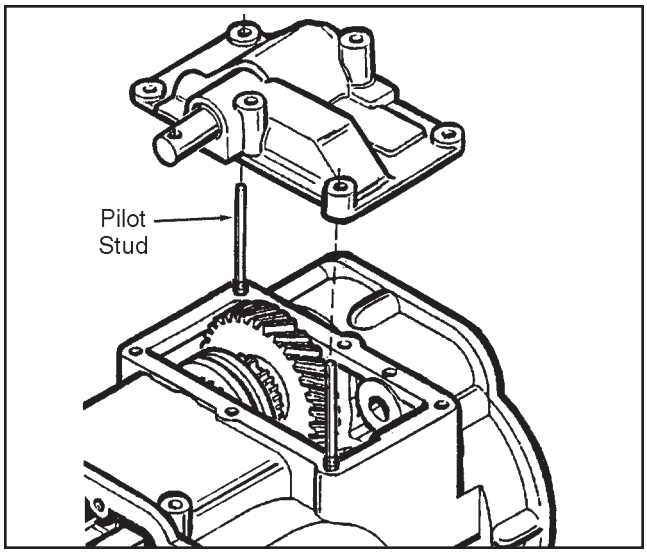


Figure 4I-10. Installing Shift Control Cover

8. Install and cover screws and washers. Tighten the cover screws alternately and evenly to 14 to 18 ft-lbs. (19 to 24 N.m).

2-SPEED AUXILIARY TRANSMISSION

DISASSEMBLY

1. If not previously removed for shift control cover repairs described above, remove the six cover retaining screws and flat washers and lift the shift cover off the differential housing as shown in Figure 4I-9.
2. Remove the front cover as described in Steps 1 thru 5 of “Differential Front Cover Repair.”
3. Refer to Figure 4I-11, remove the rear cover screws, flat washers and gear ratio tag. Remove the rear cover.

NOTE

Check the gear ratio tag; 14.21:1 ratio hypoid rear axles have a spacer under rear cover. This spacer is not used with 11.16: ratio axles.

4. Move the shift collar toward the front cover to engage the direct gear drive. Hold the input shaft (by gripping the yoke nut installed on the shaft) to keep it from turning and loosen (do not remove) the rear main shaft nut.
5. Remove the yoke nut and special washer from the input shaft.
6. Starting at the rear cover end of the shaft, remove the oil baffle and small pinion gear.
7. Use a large wrench to hold the large driven gear stationary. Remove the large driven gear nut. This nut is torqued to 200 to 225 ft-lbs. (271 to 305 N.m).
8. Remove the setscrew from the cluster gear jackshaft (setscrew is coated with thread sealant and will require heavy torque to remove).
9. Pull the jackshaft out of the cluster gear and housing.
10. Remove the cluster gear and spacer washers. One spacer washer is used on the rear side and two are used on the front side of the cluster gear. Front spacers will drop into the housing; use a magnet to retrieve the spacers.
11. Re-install the large driven gear nut to protect the shaft threads and use a large brass drift and hammer to strike the end of the shaft to “pop” the large driven gear loose on the shaft.
12. Remove the pinion drive gear spacer and main shaft retaining ring.
13. Install the nut on the main shaft to protect the shaft threads. Use a rubber mallet to tap on the main shaft. Tap the main shaft through the rear bearing until the input shaft intermediate bearing comes out of the bore of the housing.

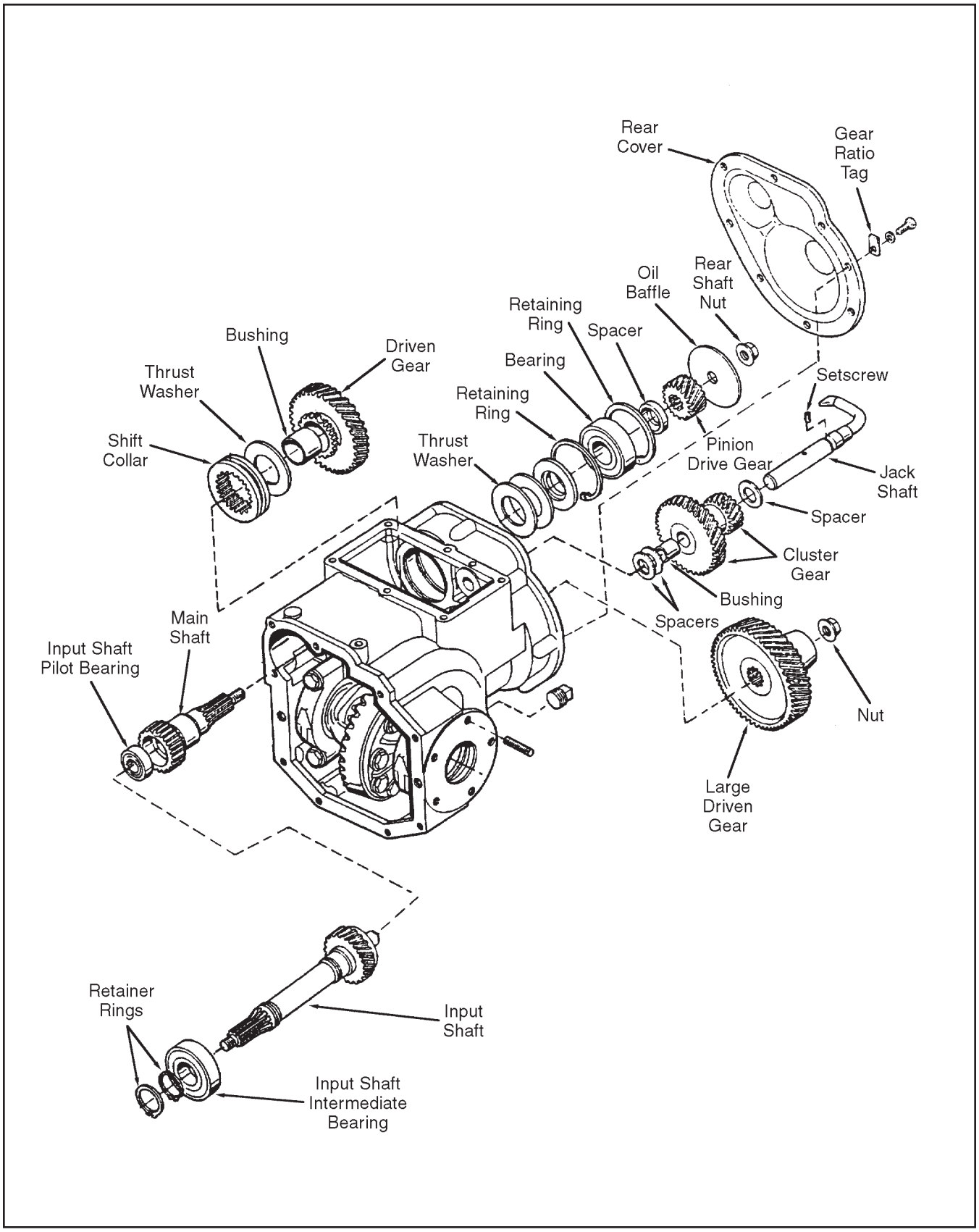


Figure 4I-11. Auxiliary Transmission Disassembly

SECTION 4I. REAR AXLE

NOTE

Bearings are a slip fit in the bores of the housing.

14. Push the top shaft assembly back as far as possible. Use a hook type tool to work around the I.D. of the bearing and pull the bearing out of the bore. If the bearing is too tight in the bore of the housing, use a slide hammer type bearing puller.
15. Remove the inner bearing retaining ring, bearing thrust collar and thrust washer.
16. Pull the input shaft pilot bearing out of the bore of the main shaft. Pull the input shaft as far forward as possible in the housing.
17. Lift the input shaft and gear assembly upwards through the top of the housing. The machined groove in the splines of the main shaft must be at the bottom to clear the input shaft pilot bearing as shown in Figure 4I-12.

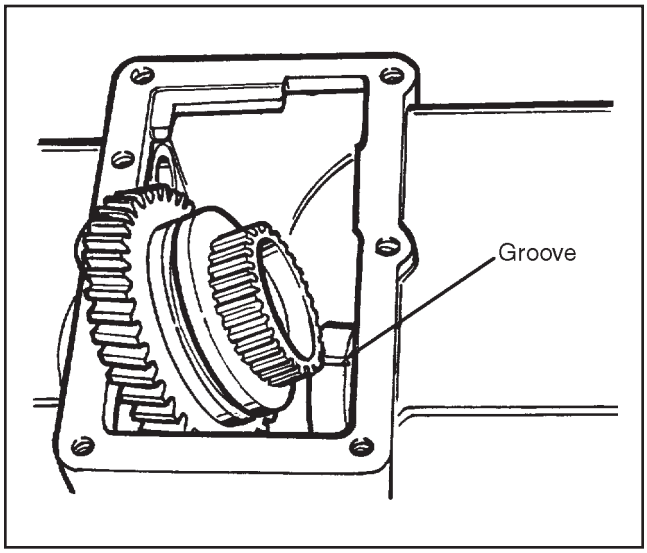


Figure 4I-12. Input Shaft and Gear Removal

18. Slide the main shaft, shift collar and driven gear assembly up and out the top opening of the housing.
19. Align the input shaft bearing in the bore of the housing. Carefully tap the shaft and bearing assembly toward the rear of the differential housing and through the bearing bore.
20. Align the input shaft bearing in the main shaft bearing bore and tap the bearing towards the rear through the bore.
21. Remove the input shaft assembly through the rear of the differential housing.
22. To replace the input shaft intermediate roller bearing, remove the outer and inner retaining rings and use a split, knife-edge bearing remover and hydraulic press to remove the intermediate bearing from the shaft.
23. If it is necessary to remove the pilot bearing, press the pilot bearing off the shaft.
24. Use a hydraulic press to install new intermediate and pilot bearings. Be certain the bearings are fully seated on the shaft. Lubricate both bearings with clear grease.
25. Install the input shaft inner and outer bearing retaining rings in the grooves of the shaft. Be sure the rings are fully seated in the grooves.

NOTE

The thicker retaining ring must go in the outer (top) groove of the shaft. Install the thinner ring with the beveled side up (away from the bearing).

INSPECTION AND CLEANING

1. Inspect the differential housing, ring gear and pinion gear set and bearings for damage or wear. If damage or wear is found, replace the entire differential and housing assembly.

NOTE

The differential housing, ring and pinion gear set and bearings are serviced as a complete assembly only.

2. Inspect the cluster gear for broken, chipped or cracked teeth. Inspect the cluster gear bushings and shaft for damage or wear.
3. Inspect the main shaft and drive gear for damage or wear. Replace the drive gear bushing if worn.
4. Inspect the main shaft bearing thrust washer. If badly scored or worn, replace the thrust washer.
5. Wash all parts in approved cleaning solvent and blow dry. Replace any worn or damaged parts found during inspection.
6. Use a 5/16-18 tap to clean thread lock material from the threaded hole for the jackshaft setscrew (see Figure 4I-11).
7. Be sure the differential housing is clean and free of foreign objects before beginning reassembly.

REASSEMBLY (See Figure 4I-13)

NOTE

Lubricants to be added during reassembly are specified in Section 11.

1. Install the input shaft through the main shaft rear bearing bore.
2. Align and install the input shaft through the intermediate bearing bore as far forward as possible.
3. Put approximately .5 oz. of clean grease in the pocket of the main shaft.
4. Lubricate the main shaft bearing surface. Install the main shaft into the driven gear.
5. Install the shift collar on the main shaft.
6. Install the driven gear, shift collar and main shaft assembly through the opening in the top of the housing in the same manner as removal was done.
7. Move the main shaft forward to engage the input shaft pilot bearing.
8. Align the input shaft intermediate bearing in the bore of the housing. Use a rubber mallet to tap the input shaft rearward in the bearing bore as far as possible.
9. Install two pilot studs and install the front cover as described in “Front Cover Reassembly.”
10. Turn the differential assembly on the work bench so that the main shaft is pointing upwards.
11. Lubricate and install the bronze thrust washer over the machined shoulder of the main shaft against the driven gear. Install the bearing collar against the thrust washer.
12. Install the bearing retaining ring in the groove of the housing.
13. Lubricate and install the main shaft bearing in the bore of the housing and install the retaining ring (beveled side up) in the groove of the housing.
14. Install the pinion drive gear spacer on the main shaft.
15. Turn the differential assembly so that it is horizontal on the work bench. Install the large driven gear on the pinion shaft.
16. Install the flat washer and new locknut on the pinion shaft. Only tighten the locknut to approximately 50 ft-lbs. (68 N.m) at this time.
17. Lubricate the bushings in each end of the cluster gear with clean grease.
18. Lubricate the jackshaft. Install the shaft through the bore of the housing only far enough to support one thrust washer. Retain the thrust washer on the shaft next to the housing with grease.
19. Install and align the cluster gear in the housing and push the jackshaft partially into the gear.
20. Lubricate the two front side cluster gear thrust washers with grease and carefully slide and align the two thrust washers between the housing and front face of the cluster gear. Push the jackshaft through until the groove in the shaft is visible in the setscrew hole.
21. Install the small pinion drive gear on the main shaft.
22. Put Loctite 243 (Textron P/N 2810300 or 2811163) thread lock on the jack shaft setscrew and install the jackshaft setscrew in the housing. Move the shaft, if necessary, so that the setscrew will engage the groove in the shaft. Center the oil pickup tube between the pinion drive and driven gears. Tighten the setscrew securely.

NOTE

The oil pickup tube must not contact or rub on either gear. There must be equal clearance.

23. Use a large wrench on the hub of the large driven gear to hold the gear stationary. Tighten the locknut to a torque of 200 to 225 ft-lbs. (270 to 305 N.m).
24. Install the oil baffle and main shaft washer on the main shaft.
25. Install a new locknut. Tighten the locknut to a torque of 64 to 74 ft-lbs. (87 to 100 N.m). Slide the shift collar forward on the main shaft and use a bar in the input drive yoke to hold the main shaft while tighten the nut.
26. Rotate the input shaft in each gear ratio to check operation. Transmission rotation must be smooth with no binding or lockup.
27. Install two pilot studs opposite each other in the threaded holes for the rear cover.

NOTE

Vehicles with 4-cylinder (Suzuki 970) gasoline engines have a 14.12:1 gear ratio hypoid and have a spacer between the rear cover and housing. Install a new spacer (see Parts Catalog) for these vehicles. Vehicles with other engines use a 11.16:1 gear ratio hypoid and do not use this spacer.

28. Coat the machined flange of the rear cover and align and install the cover.

SECTION 4I. REAR AXLE

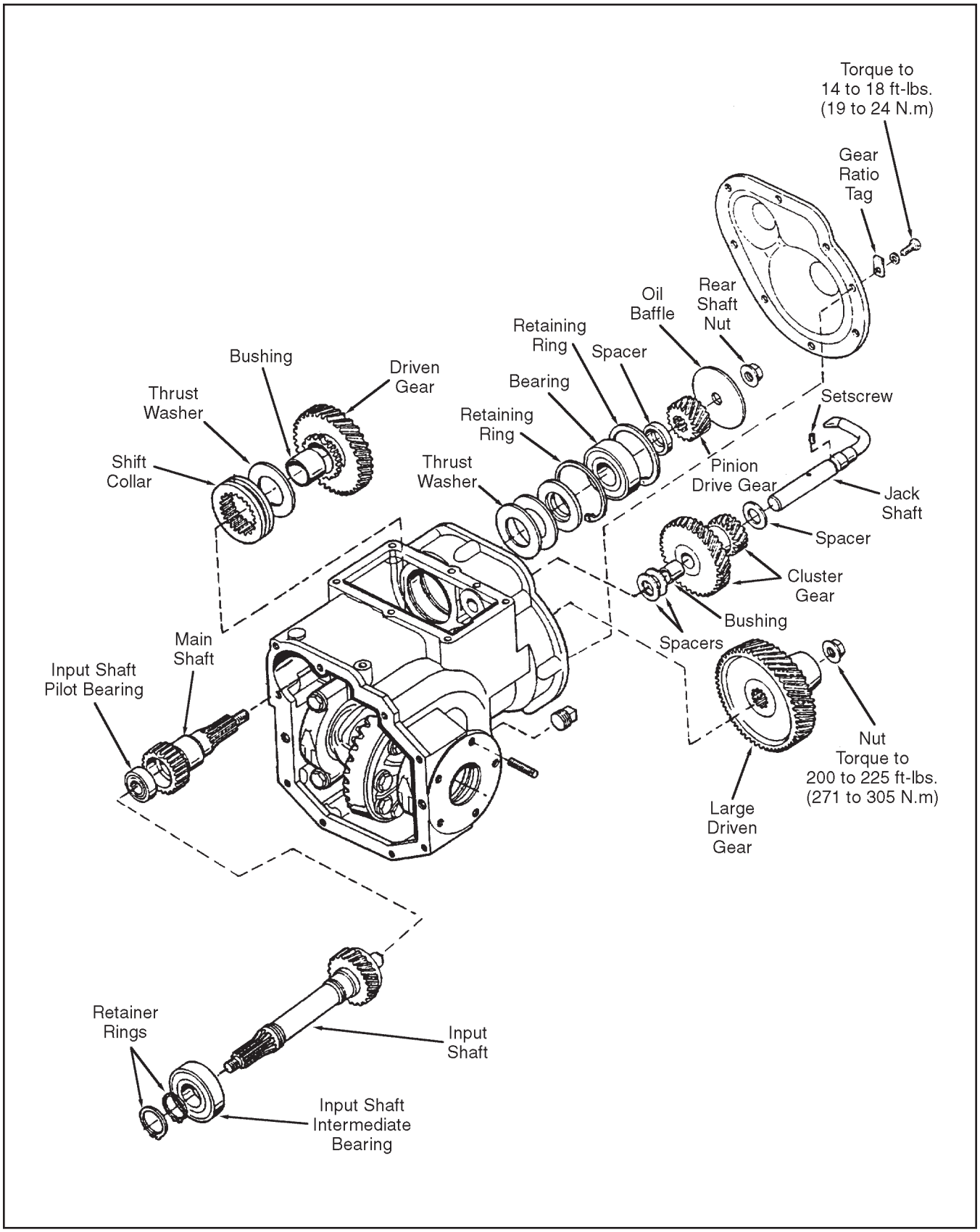


Figure 4I-13. Auxiliary Transmission Reassembly

29. Install cover screws, flat washers and gear ratio tag. Torque screws alternately and evenly to 14 to 18 ft-lbs. (19 to 24 N.m).
30. Install the shift control cover as shown in Figure 4I-10.
31. Install the axle housings and axles as shown in Figure 4I-4.

DIFFERENTIAL AND AXLE ASSEMBLY INSTALLATION

1. With the help of an assistant, position the differential and axle assembly on a floor jack under the chassis. Slowly raise the axle while at the same time aligning and connecting the drive shaft into the splined drive shaft. Place jack stands under the axle for support. Be sure the drive shaft U-joints are aligned correctly (see Figures 4C-1 and 4C-2). Hold the drive shaft from rotating and install yoke nut and washer and torque to 64 to 74 ft-lbs. (87 to 100 N.m). The yoke nut can not be accurately torqued.
2. Lower the chassis and align the axle so that the spring center screw will engage the center hole in the axle spring mounting pads (see Figure 4I-14). Install the axle U-bolt clamps and brackets. Tighten the U-bolts alternately and evenly until tight.
3. Install and align the auxiliary transmission shift cable on the mounting bracket. Install and tighten the retaining screw, lockwasher and nut.
4. Install the brakes and wheel hubs as described in “Brake and Wheel Hub Installation” earlier in this section.
5. Connect brake lines and parking brake cable (see Figures 4I-2 and 4I-14).
6. Extend and connect lower shock absorbers as shown in Figure 4I-14.
7. Adjust and bleed the brake system as described in Section 2C.
8. Connect and adjust control cables as described in Section 2C.
9. Remove the fill plug (see Figure 4I-14) and fill the differential with specified oil (see Section 11). Install and tighten fill plug.
10. Install the wheels and tires. Tighten wheel lug nuts to 70 to 100 ft-lbs. (95 to 140 N.m).
11. If previously removed, install the dump box and connect the box lift cylinder as shown in Figure 4I-1.

SECTION 4I. REAR AXLE

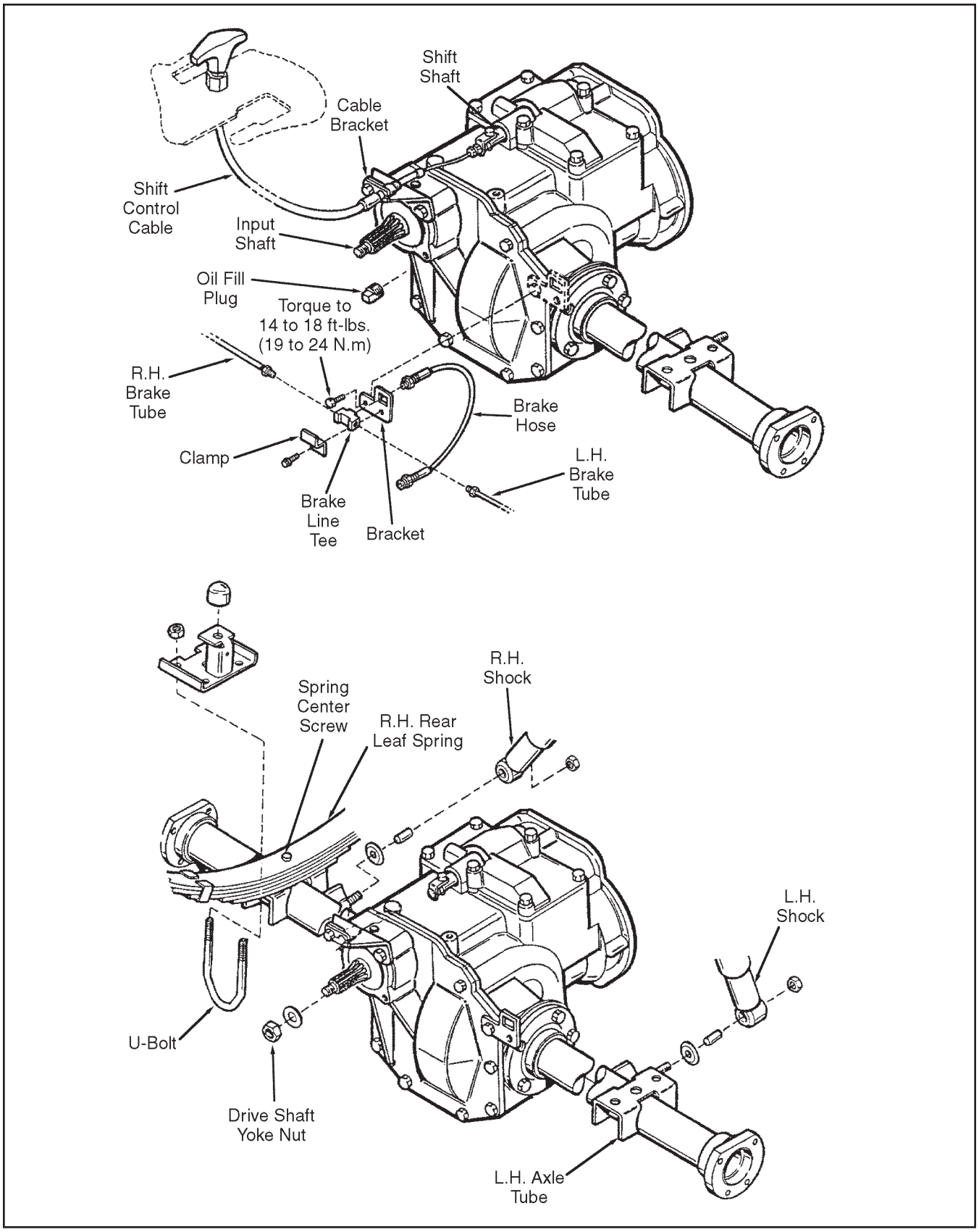


Figure 4I-14. Differential and Axle Assembly Installation

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SECTION 5
BRAKE SYSTEM

SECTION 5A. REPAIR AND SERVICE TOOLS AND MATERIALS

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

SECTION 5B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Parking brake does not hold truck in position.	a. Brake is not properly adjusted. b. Worn brake linings. c. Broken or worn cable.	a. Adjust brake (Section 2C). b. Replace lining (Section 5D). c. Replace.
2. Service brake does not hold truck in position.	a. Low fluid level. b. Leaking master cylinder. c. Worn brake linings.	a. Check (Section 11). b. Replace (Section 5E). c. Replace (Section 5D).
3. Service brake pedal fades when pushed.	a. Brake line leaks. b. Air in line.	a. Repair (Section 5D). b. Bleed (Section 5D).
4. Service brakes do not release.	a. Binding pedal. b. Faulty master cylinder.	a. Free and lubricate. b. Replace (Section 5E).
5. Service brakes leak fluid externally.	a. Faulty seals.	a. Replace seals (Section 5D).
6. 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 BRAKES

PARKING BRAKE

The parking brake system consists of a control lever and cables that mechanically control spring activated levers to compress and release brake shoes. (See Figure 5C-1 for parking brake arrangement.)

Raise the engine cover (front seat frame) and dump box (if so equipped) to gain access to the parking brake cables.

REPAIR

Parking brake control repairs consist of removal and replacement of components shown in Figures 5C-1 and 5C-2. Wheel brake repairs are included in Section 5D.

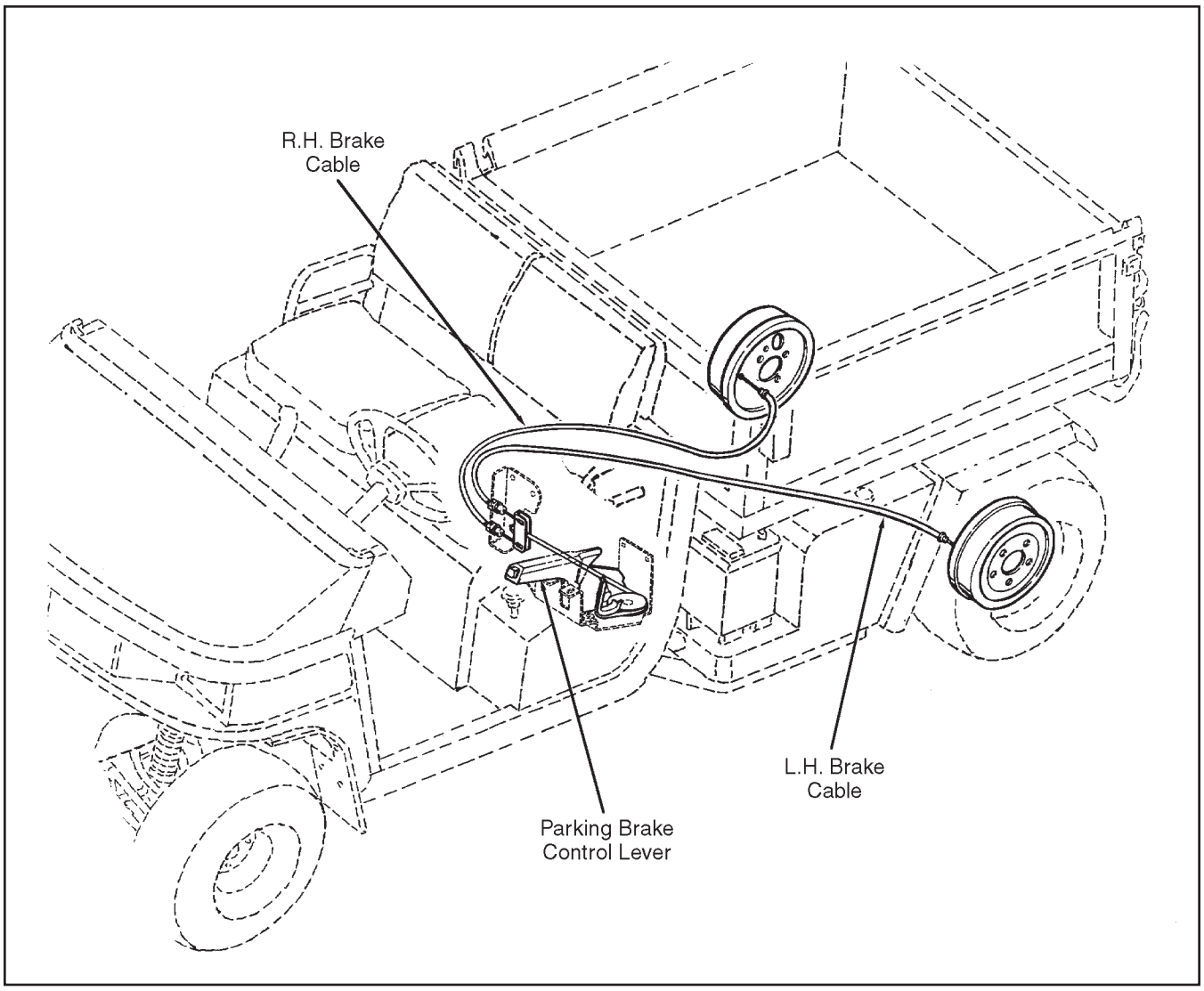


Figure 5C-1. Parking Brake Arrangement

SECTION 5C. PARKING BRAKES

PARKING BRAKE ADJUSTMENT (See Figure 5C-2)

1. Release the parking brake lever (lever fully down).
2. Tighten the adjustment nut (1 or 2 turns) and apply the brake lever. Continue tightening the adjustment nut until the lever is at approximately 45° when the brake is applied.

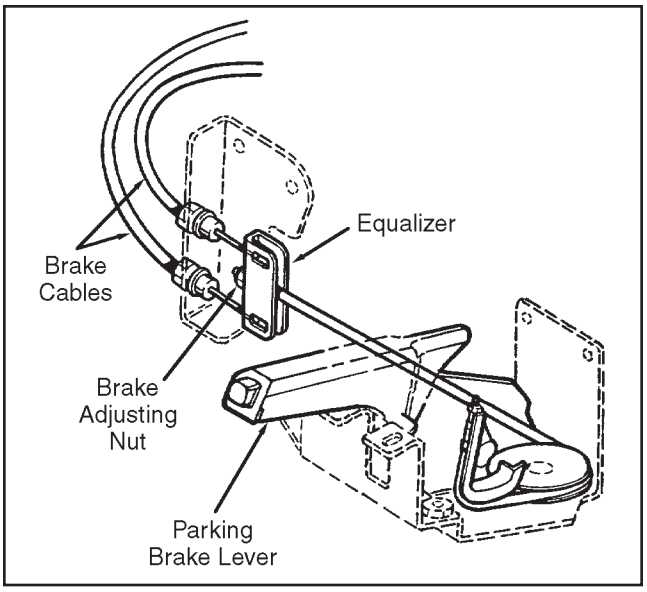


Figure 5C-2. Parking Brake Adjustment

SECTION 5D. SERVICE BRAKES

SERVICE BRAKES (See Figure 5D-1)

GENERAL

1. This vehicle is equipped with four hydraulic brakes controlled by the brake pedal. Open the front cowl of the vehicle to gain access to the brake fluid reservoir.
2. A brake fluid indicator light on the control panel (see Figure 5D-1) will come on and stay on if the brake fluid level is low. The fluid level must be maintained between the minimum and maximum markings on the gauge attached to the brake fluid reservoir. Use DOT 3 Type brake fluid.
3. If the brakes do not hold properly, if they feel spongy or if the brake fluid reservoir is allowed to "run-dry", it may be necessary to bleed the brake lines in order to get fluid back into the system. Follow the steps below to properly bleed the brake system.

BLEEDING BRAKES

1. When bleeding the brake system, bleed the left rear brake first, then the right rear, then the right front and finally the left front.
2. Attach a hose to the bleeder screw on top of the left rear dust shield and place the other end of the hose in a container to catch the fluid run-off when bleeding the system.
3. Loosen the bleeder screw. Have an assistant push down on the brake pedal and hold pedal down. Tighten the bleeder screw and release the brake pedal. Loosen the bleeder screw again, press down on the brake pedal, hold pedal down and tighten the bleeder screw, release pedal. Do not release the brake pedal until the bleeder screw is tightened otherwise air will be sucked back into the brake lines.
4. Continue this procedure until all air bubbles are purged from the system and a steady flow of fluid comes from the brake bleeder screw. Repeat the procedure on the opposite side of the unit, then on the front.

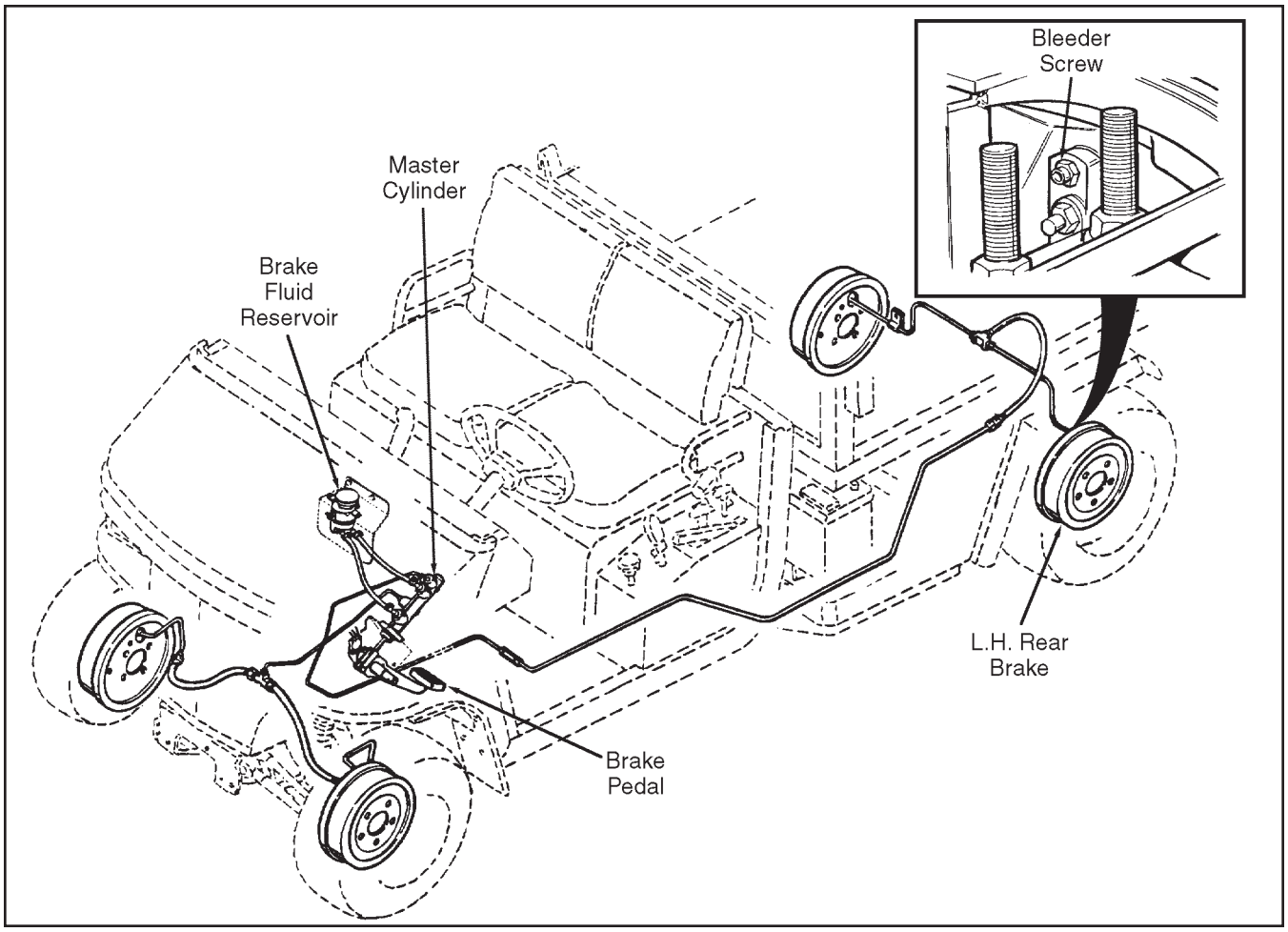


Figure 5D-1. Service Brake System

SECTION 5D. SERVICE BRAKES

BRAKE DISASSEMBLY (See Figure 5D-2)

1. Remove the wheels and brake drums (see Section 4I for rear brakes and Section 6C for front brakes).
2. Remove shoe hold down springs and pins.
3. Slightly spread shoes at top, lift shoes, springs and adjuster off backing plate.
4. Disconnect parking brake cable.
5. Disassemble to extent necessary to repair brakes.

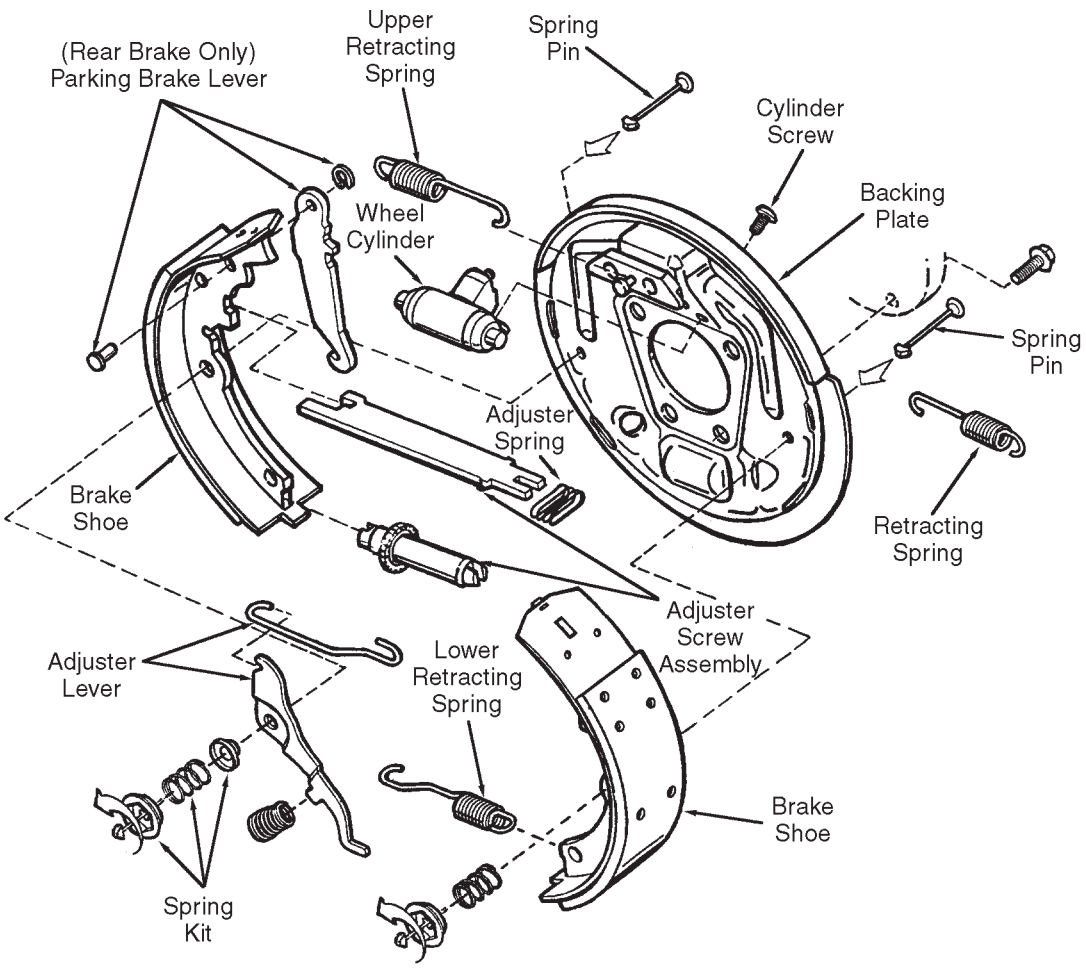


Figure 5D-2. Service Brake Disassembly

SECTION 5D. SERVICE BRAKES

SERVICING

Remove all dust from backing plate and parts.

Inspect shoes for excessive lining wear or damage. If linings are worn within 1/32 inch (0.79 mm) of rivet heads or shoe backing, replace linings.

NOTE

Always replace shoes as a set, do not replace only one lining.

Inspect drum, minor score marks can be removed using sandpaper. If the surface is polished, remove using sandpaper. If drum is to be ground, do not exceed maximum inside diameter specification. This dimension is on each drum.

Inspect all wheel cylinder parts, discard and replace rubber boots if disassembled.

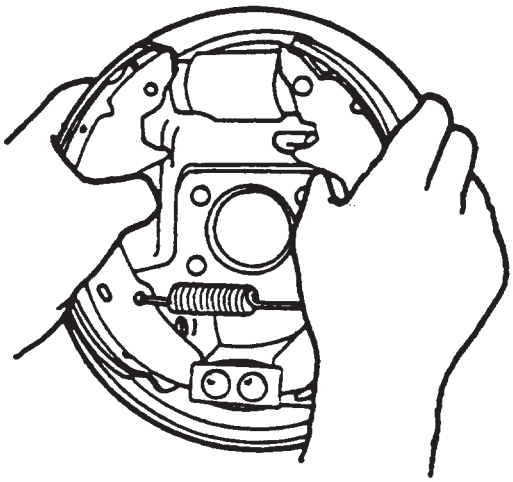
Inspect cylinder bore, hone if necessary.

NOTE

Cylinder should not be honed more than 0.003 inch (0.08 mm).

BRAKE SHOE REASSEMBLY

Follow the reassembly steps as described in Figures 5D-3 and 5D-4.



STEP 1

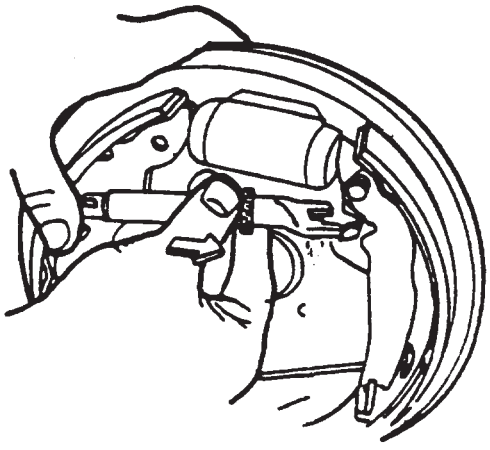
On rear brakes only, assemble parking brake cable to trailing shoe and parking brake lever.

STEP 2

Install lower retracting spring to leading-trailing shoes.

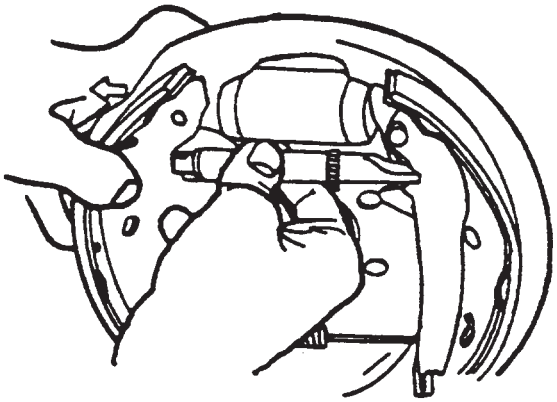
STEP 3

Install this assembly to backing plate.



STEP 4

Install adjuster screw assembly.

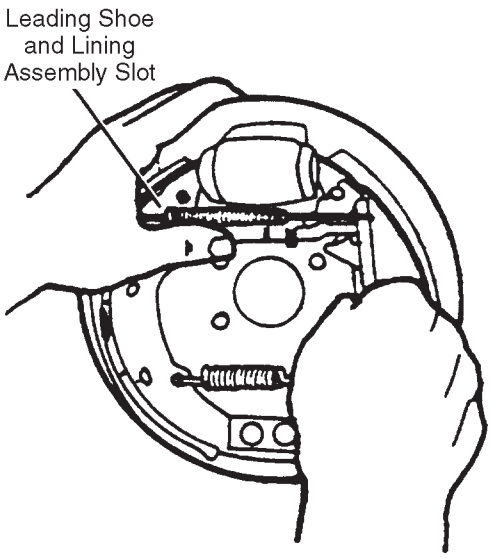


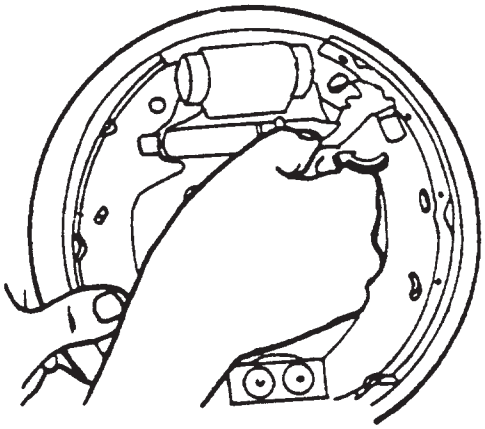
STEP 5

Install adjuster screw to leading shoe and lining assembly.

Figure 5D-3. Assembly — Steps 1 thru 5

SECTION 5D. SERVICE BRAKES





STEP 6

Install the adjuster lever.

STEP 7

Install shoe hold down springs and pins.

STEP 8

Install upper retracting spring to leading shoe slot. Stretch spring to install to trailing shoe. If adjuster lever does not contact star wheel after spring installation check adjuster socket installation.

STEP 9

Connect parking brake cable.

Figure 5D-4. Assembly — Steps 6 thru 9

SECTION 5D. SERVICE BRAKES

WHEEL CYLINDER (See Figure 5D-5)

NOTE

Wheel cylinders should not be removed and/or disassembled unless they are leaking.

1. Carefully pull lower edge of cylinder boot away from cylinder. Note if interior of boot is wet with brake fluid.

NOTE

A slight amount of fluid is always present for lubrication, this is normal.

- If wet, rebuild. Continue with Step 2.
- If dry, do not rebuild.

NOTE

Brake shoes must first be removed before proceeding, see “BRAKE DISASSEMBLY”.

2. Remove brake line.
3. Remove retaining bolts, remove wheel cylinder.
4. For Disassembly and Reassembly refer to Figure 5D-5.

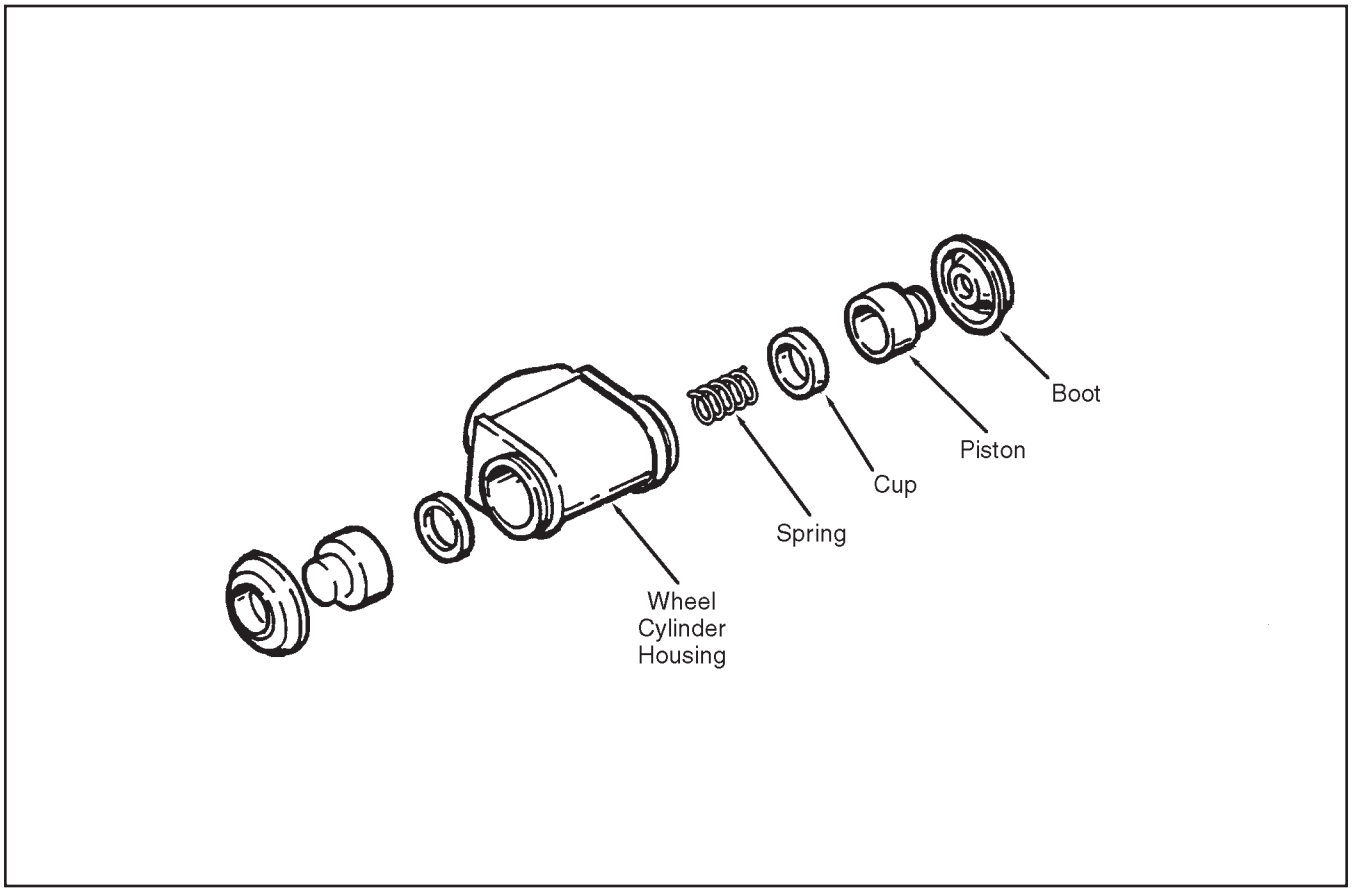


Figure 5D-5. Wheel Cylinder

SECTION 5E. MASTER CYLINDER

REPAIR

The master cylinder can not be repaired if (after checking brake lines and linkages, bleeding the system, replenishing fluid in the brake fluid reservoir, and checking/repairing the brake shoe assemblies and wheel cylinders) the brakes continue to be spongy or do not release; the master cylinder may require replacement as follows:

1. Disconnect brake lines at the master cylinder as shown in Figure 5E-1 (cap lines to prevent contamination).
2. Disconnect the brake pedal linkage and remove master cylinder mounting hardware as shown in Figure 5E-1.
3. Replace the master cylinder, install mounting hardware and reconnect the brake pedal linkage.
4. Reconnect brake lines as shown in Figure 5E-2, fill the reservoir and bleed the brake system as described in Section 5D.

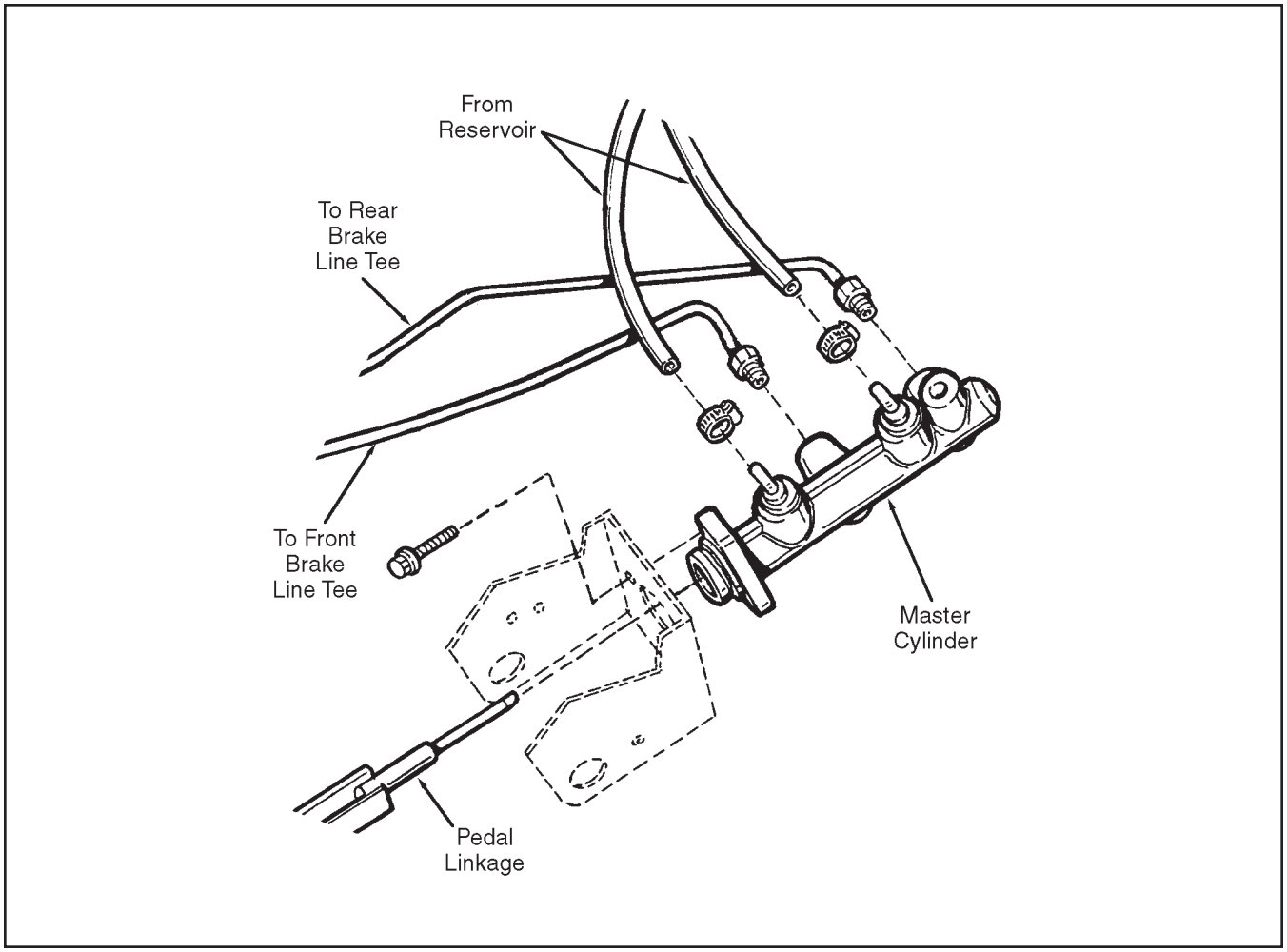


Figure 5E-1. Master Cylinder Removal and Replacement

SECTION 5E. MASTER CYLINDER

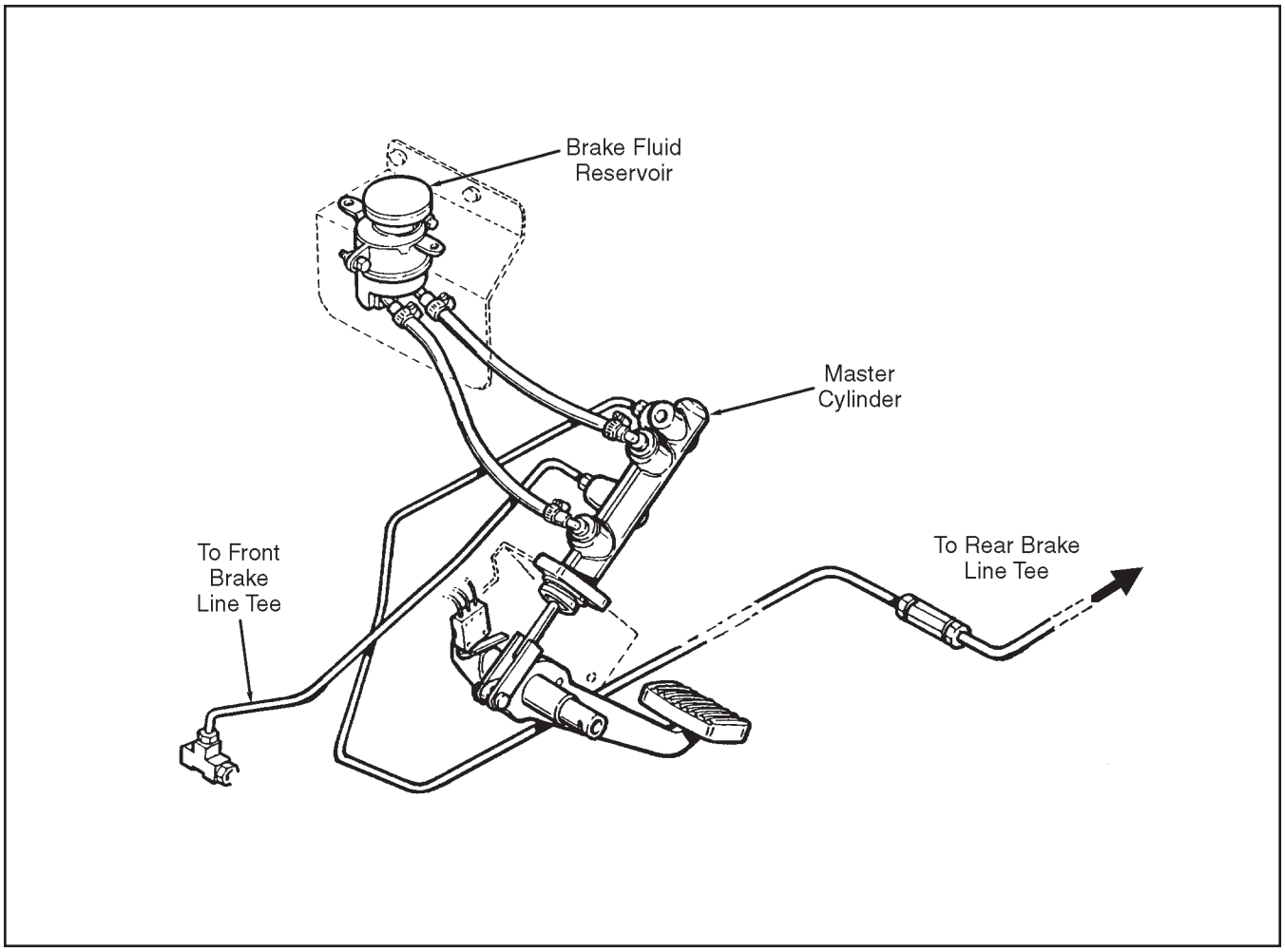


Figure 5E-2. Master Cylinder Connections

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SECTION 6
STEERING

SECTION 6A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools. Steering gear repair tools (available from AC Delco dealers). Pulley puller tool.
Cleaning materials:	Stoddard solvent or equivalent.
Lubricants:	Refer to Section 11.
Other service items:	Seal and Repair Kits (available from Textron dealers).

SECTION 6B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. No steering.	a. Steering gear excessive internal leakage or damage.	a. Test (Section 8). Repair (Section 6D).
	b. Faulty steering pump.	b. Repair (Section 6E).
	c. Broken pump drive belt.	c. Replace belt.
2. Noisy when steering wheel is turned.	a. Low hissing sound.	a. Normal.
	b. Steering gear squeals when steering to maximum turn.	b. Normal.
	c. Steering gear squeals while turning.	c. Repair steering gear (Section 6D).
	d. Low oil level or air in system.	d. Check, bleed, fill reservoir (Section 6C).
3. Steering wanders.	a. Tire pressure incorrect.	a. Properly inflate tires (Section 7C).
	b. Loose pitman arm.	b. Tighten nuts (Section 6C).
	c. Steering gear internal leakage.	c. Repair (Section 6D).
	d. Steering wheels out of adjustment.	d. Adjust (Section 6F).
	e. Faulty steering gear.	e. Repair/replace (Section 6D).
4. Shimmy.	a. Tire mounting nuts loose.	a. Tighten (Section 7).
	b. Loose or worn steering linkage.	b. Tighten or replace (Section 6C).
	c. Steering wheels out of alignment.	c. Adjust (Section 6F).
5. Hard steering in one direction.	a. Internal failure of steering gear.	a. Repair (Section 6D).
	b. Loose or worn steering linkage.	b. Tighten or repair (Section 6C).
6. Hard steering in both directions.	a. Tires under inflated.	a. Inflate tires (Section 7).
	b. Low hydraulic oil level.	b. Check level (Section 6C).
	c. Low hydraulic oil pressure.	c. Repair leaks at steering pump.
	d. Steering gear or pump failure.	d. Repair (Sections 6C and 6D).
7. Lost motion at steering wheel.	a. Steering wheel loose.	a. Tighten (Section 6C).
	b. Loosen or worn steering linkage.	b. Tighten or repair (Section 6C).
	c. Steering gear internal leakage.	c. Repair (Section 6D).
	d. Steering pump internal leakage.	d. Replace (Section 6C).

SECTION 6C. STEERING SYSTEM

GENERAL (See Figure 6C-1)

The steering system utilizes a steering wheel/steering shaft mechanical linkage to a steering gear assembly which moves a pitman arm to the left or right. The pitman arm directs motion of the front wheels through tie rod connections.

The steering gear is hydraulically assisted by a steering pump to provide “power steering” similar to most passenger cars. The steering pump has an integral fluid reservoir.

The steering pump is driven by a pulley connected by a belt to the engine.

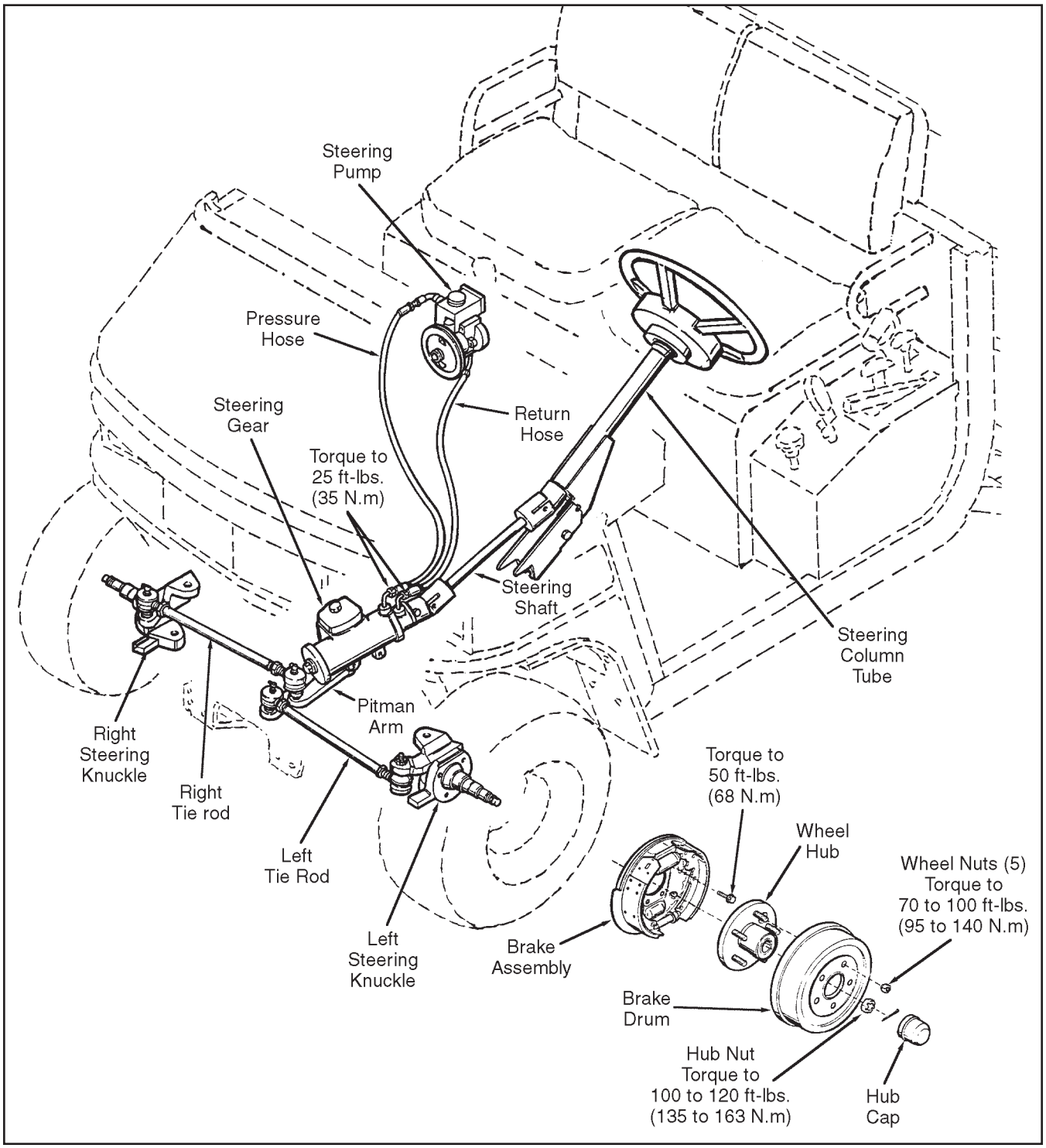

Figure 6C-1. Steering System Arrangement

SECTION 6C. STEERING SYSTEM

The steering gear assembly has an internal control valve which directs hydraulic fluid to either side of a rack piston. The rack piston converts hydraulic power into mechanical force. This force is transmitted through a pitman shaft to the pitman arm to the steering linkage.

NOTE

Prior to performing service or repairs on the steering gear or steering pump, make certain to check the simple mechanical causes of problems listed in Section 6B and isolate hydraulic problems by performing steering system tests in Section 8.

STEERING (FRONT) WHEELS, HUBS AND BRAKES

1. Disconnect front brake lines, remove front wheels and tires and remove brake drums, wheel hubs and brakes as shown in Figure 6C-1.
2. If necessary, remove and replace front wheel bearings as shown in Figure 6C-2. When replacing bearings, pack with grease (see Section 11).
3. Remove and replace grease seal.
4. If required, repair brakes as described in Section 5D.
5. Install brake assemblies, wheel hubs, brake drums, wheels and tires and torque mounting hardware as shown in Figure 6C-1.
6. Connect brake cables and bleed and adjust brakes as described in Section 2.
7. Adjust steering linkage as described in Section 6F.

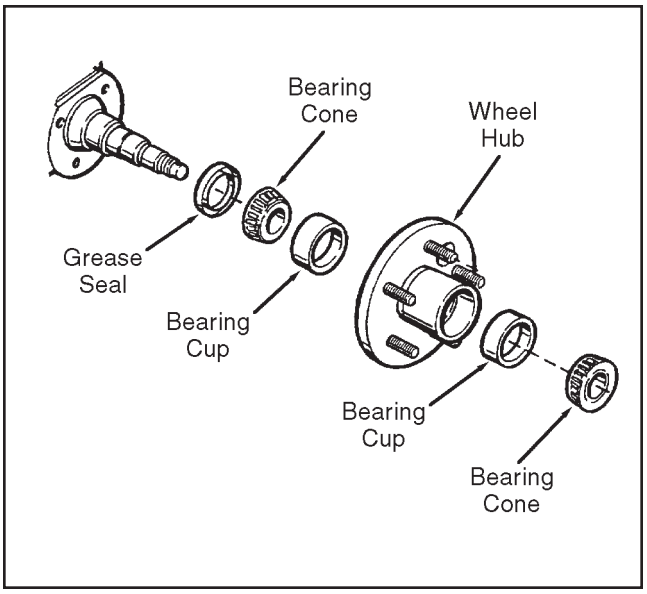

Figure 6C-2. Front Wheel Bearings

TIE RODS, BALL JOINTS AND STEERING KNUCKLES

1. Disconnect brake cables and remove wheels, brake drums, wheel hubs and brake assemblies as shown in Figure 6C-1.
2. Remove cotter pins and nuts and disconnect tie rod ends from pitman arm as shown in Figure 6C-3.
3. Remove and replace damaged or worn steering knuckles, ball joints and tie rods.
4. Reconnect tie rod ends to pitman arm, secure with nuts and cotter pins (Figure 6C-3).
5. Install brake assemblies, wheel hubs, brake drums, wheels and tires and torque hardware as shown in Figure 6C-1.
6. Connect brake cables and bleed and adjust brakes as described in Section 2.
7. Adjust steering linkage as described in Section 6F.

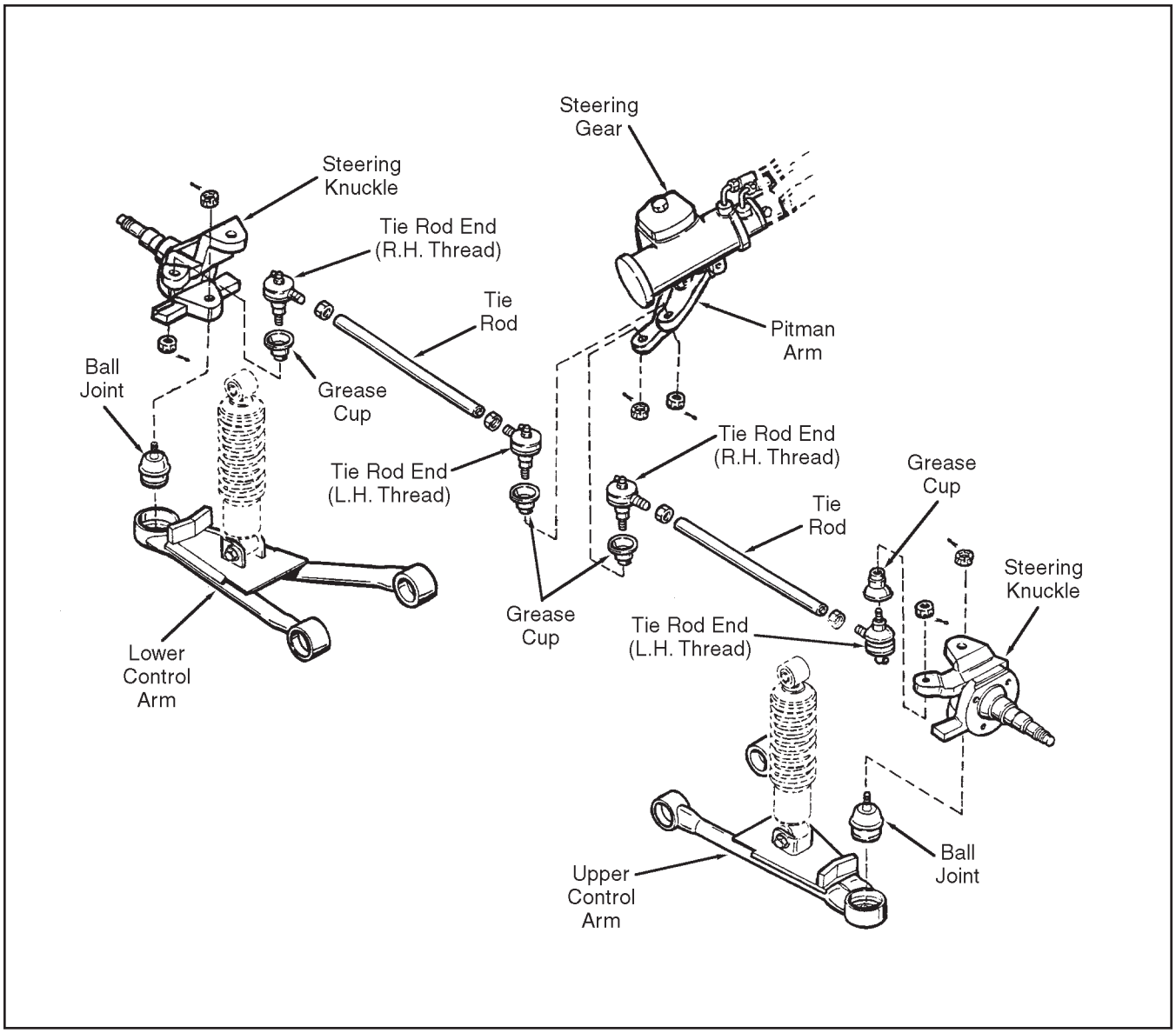

Figure 6C-3. Tie Rods and Steering Knuckles

STEERING COLUMN REPAIR (See Figure 6C-4)

If repairs to the steering wheel or shaft are required, replace the damaged components and reassemble as shown in Figure 6C-4.

PITMAN ARM

1. Remove the cotter pins and nuts from the tie rod ends and disconnect tie rods from the pitman arm as shown in Figure 6C-3.
2. Remove the nut and lockwasher that attach the pitman arm to the pitman shaft of the steering gear and remove the pitman arm as shown in Figure 6C-4.

NOTE

Whenever the pitman arm is removed, clean and inspect steering gear housing for pitting and rough spots and pitman shaft for burrs. Remove pitting, rough spots and burrs with sandpaper. Replace pitman shaft seals and bearing (if necessary) as described in Section 6D.

3. Install the pitman arm as shown in Figure 6C-4. Torque mounting nut to 180 ft-lbs. (244 N.m).
4. If no further repairs are required, reconnect the tie rods to the pitman arm and secure with nuts and cotter pins as shown in Figure 6C-3.

SECTION 6C. STEERING SYSTEM

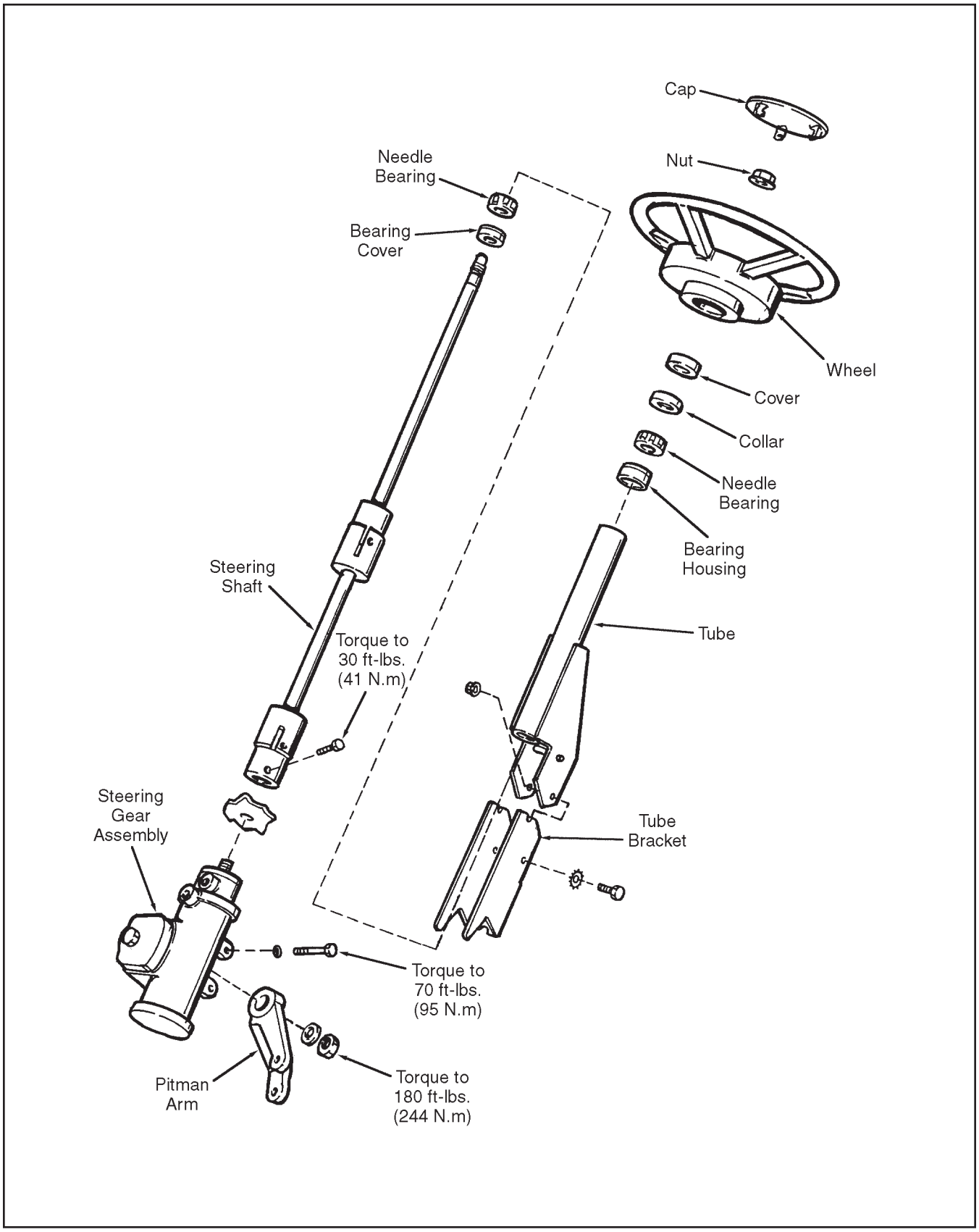

Figure 6C-4. Steering Column

REMOVING AND INSTALLING STEERING GEAR ASSEMBLY (See Figure 6C-4)

If tests (Section 8) and/or problem evaluation (Section 6B) indicate that the steering gear assembly should be replaced or extensively repaired, remove and install the steering gear as follows:

1. Remove pitman arm from pitman shaft as described in previous paragraphs.
2. Tag, mark and disconnect hoses from steering gear assembly (see Figure 6C-1). Plug and cap ports and hoses.
3. Remove screw that attaches steering shaft to steering gear (see Figure 6C-4).
4. Remove steering gear mounting screws and nuts and steering gear assembly as shown in Figure 6C-4.
5. Disassemble, inspect, repair and reassemble the steering gear assembly as described in Section 6D.
6. Adjust the steering gear assembly as described in Section 6D.
7. Insert the steering gear assembly into the steering shaft and mount the steering gear assembly to the frame and to the steering shaft and torque mounting hardware as shown in Figure 6C-4.
8. Connect the pitman arm to the steering gear assembly and torque nut as shown in Figure 6C-4.
9. Reconnect tie rods to the pitman arm, secure with nuts and cotter pins as shown in Figure 6C-3.
10. Reconnect hoses to steering gear assembly and torque fittings as shown in Figure 6C-1.
11. Bleed the system as described on following page.

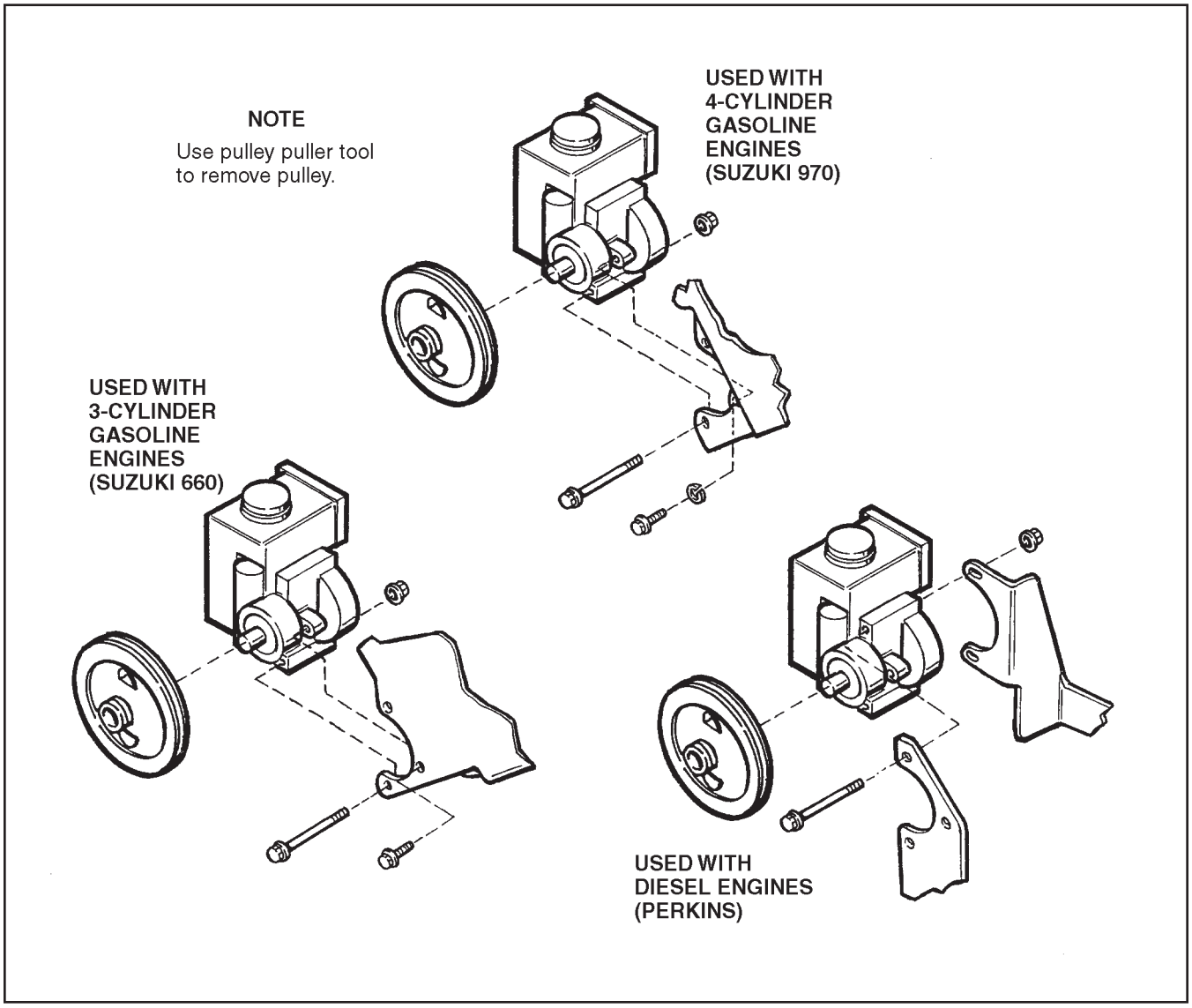

Figure 6C-5. Removal and Replacement of Steering Pumps

SECTION 6C. STEERING SYSTEM

REMOVING AND INSTALLING STEERING PUMP ASSEMBLY

1. Disconnect hoses at the steering pump (see Figure 6C-1). Plug and cap ports and hoses.
2. Remove pump mounting hardware, disconnect drive belt, and remove and replace the steering pump as shown in Figure 6C-5.
3. Install drive belt and mount pump to mounting bracket.
4. Reconnect hoses to pump and bleed the system as described below.

BLEEDING THE STEERING SYSTEM

Whenever a steering pump or steering gear is installed, the air that has entered the system must be bled out before the vehicle is again operated. If air is allowed to remain in the power steering fluid system, noisy and unsatisfactory operation of the system will result. Bleed air from the hydraulic system as follows:

⚠ CAUTION

When power steering fluid is added to power steering system, only clean new power steering fluid should be used (see Section 11).

1. Fill oil reservoir to “cold” mark on the dipstick and let oil remain undisturbed for at least two minutes.
2. Start engine and run momentarily.
3. Add oil, if necessary.
4. Run the engine and repeat above procedure until oil level remains constant between “cold” and “hot” marks on dipstick.
5. Raise front end of vehicle so that wheels are off the ground.
6. Turn the wheels several times (off ground) right and left, lightly contacting the wheel stops.
7. Add oil if necessary.
8. Lower the vehicle and turn wheels right and left on the ground.
9. Check oil level and refill as required.
10. If oil is extremely foamy, allow vehicle to stand a few minutes with engine off and repeat above procedure.
    a. Check steering pump belt tightness and check for a bent pulley. (Pulley should not wobble with engine running.)
    b. Check to make sure hoses are not touching any other parts of the vehicle, particularly sheet metal.
    c. Check oil level, filling to proper level if necessary, following Steps 1 thru 9. This step and step “d” are extremely important as low oil level and/or air in the oil are the most frequent causes of objectionable pump noises.
    d. Check the presence of air in the oil. Air will show up as milky appearing oil. If air is present, attempt to bleed system as described in Steps 1 thru 9. If it becomes obvious that the pump will not bleed after a few trials, proceed with steering system tests in Section 8. Replace faulty pump.
11. The presence of trapped air in the system will cause the fluid level in the pump to rise when the engine is turned off. Continue to bleed system until this condition no longer occurs.

SECTION 6D. STEERING GEAR

GENERAL

The steering gear assembly will rarely require complete disassembly to repair leaks or replace defective components. A complete exploded view of components is shown in Figure 6D-1.

NOTE

Prior to removing and/or disassembling the steering gear, carefully check Section 6B to determine causes of problems other than the steering gear. Also perform all steering system tests in Section 8 to isolate problems to the steering gear assembly.

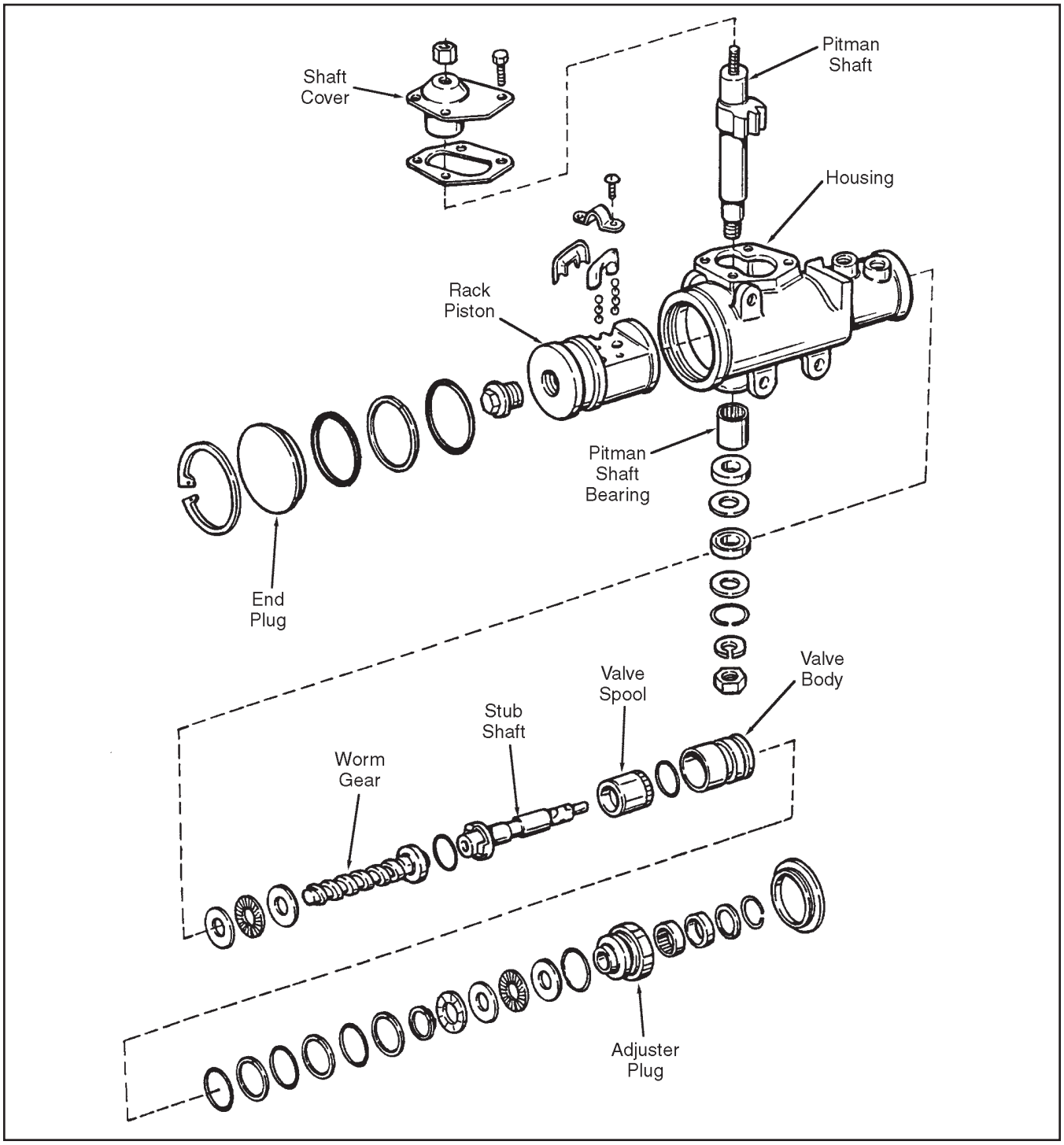

Figure 6D-1. Steering Gear Major Components

SECTION 6D. STEERING GEAR

DISASSEMBLY/REASSEMBLY

NOTE

- The following repair procedures may be accomplished with the steering gear installed on the vehicle or removed for bench repair as described in Section 6C.
- To facilitate reassembly, coat all internal parts (except covers, plugs, retaining rings and other hardware) with power steering fluid).
- After reassembly, perform the adjustment procedures at the end of Section 6D.

PITMAN SHAFT SEALS (See Figure 6D-2)

1. Remove the pitman arm from the shaft as described in Section 6C.
2. Remove the retaining ring, seals and backup washers, using a screwdriver to pry seals and washers from housing bore.
3. Using new seals and (if necessary) backup washers, coat seal lips and washer faces with anhydrous calcium grease (see Section 11).
4. Install seals and washers as shown in Figure 6D-2 and secure with retaining ring.

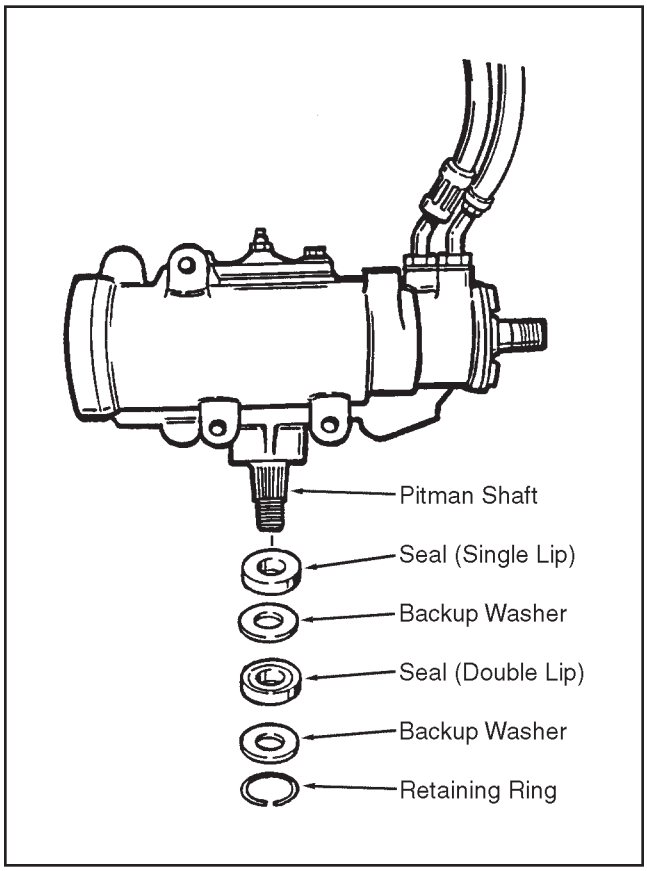

Figure 6D-2. Pitman Shaft Seals

HOUSING END PLUG O-RING (See Figure 6D-3)

1. Remove the retaining ring, end plug and O-ring.
2. Replace the O-ring and install the plug and retaining ring with the open end of the retaining ring approximately 1 inch (25 mm) from the access hole.

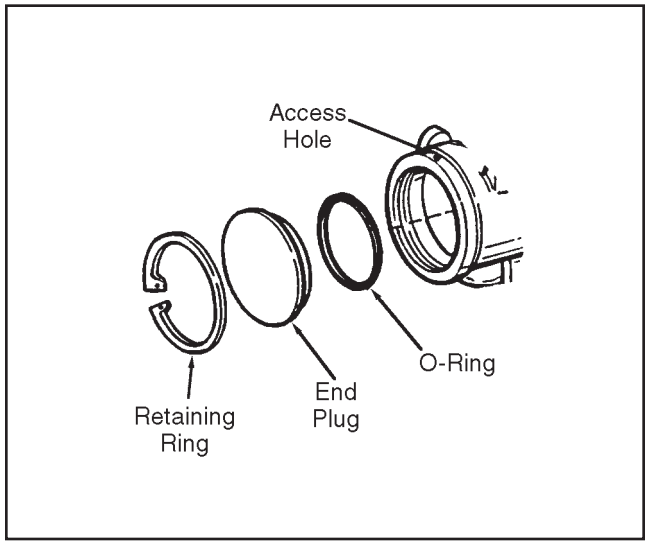

Figure 6D-3. Housing End Plug O-Ring

PITMAN SHAFT (See Figure 6D-4)

1. Remove the thrust bearing adjuster nut.
2. Remove the cover bolts, shaft cover and gasket.
3. Rotate the stub shaft until the pitman shaft gear aligns with the large portion of the hole in the housing and remove the pitman shaft.
4. Install a new gasket on the shaft cover and bend the gasket tabs around the cover edges.
5. Install pitman shaft, cover with gasket, and pitman shaft secure with cover bolts. Torque bolts to 40 ft-lbs. (60 N.m).
6. Install the thrust bearing adjuster nut.
7. Perform adjustments at end of this section.

SECTION 6D. STEERING GEAR

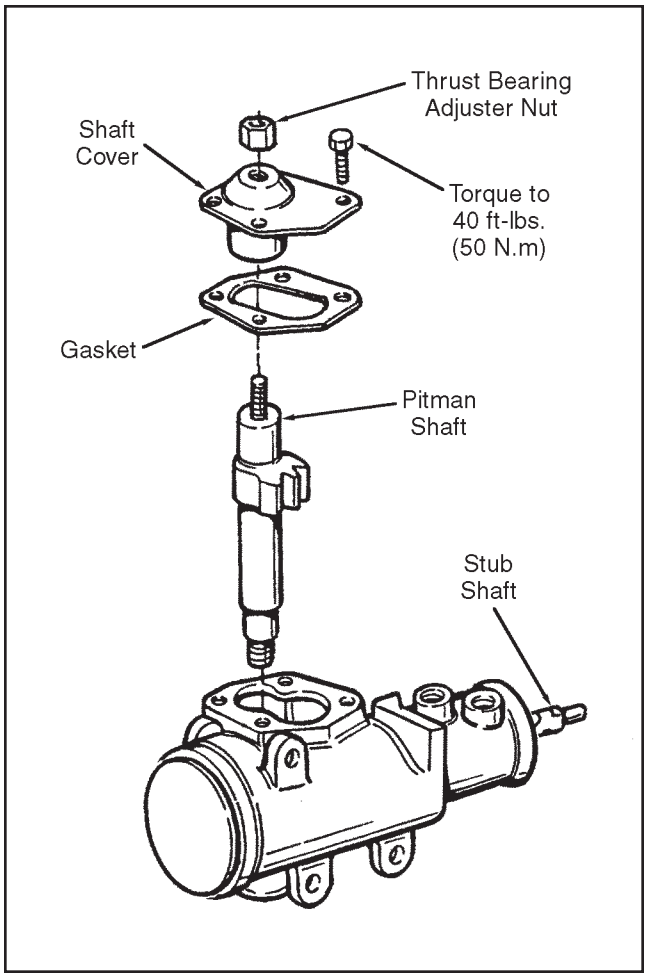

Figure 6D-4. Pitman Shaft and Cover

RACK PISTON (See Figure 6D-5)

1. Remove the retaining ring, housing end plug and O-ring.
2. Remove the rack piston plug.
3. Insert a special ball retainer tool (#J-21552, available from General Motors Saginaw Gear dealers/distributors) into the rack piston. Hold the tool tightly against worm while turning stub shaft counterclockwise. The rack piston will be forced onto the tool. Remove the rack piston and ball retainer from the gear housing together.
4. Remove the ball retainer, tool, clamp screws, clamp, ball retainer and balls from the rack piston.
5. Remove rack piston ring and O-ring. Replace O-ring and piston ring.
6. If no further disassembly is required, proceed with Steps 7 thru 14.
7. Coat the rack piston ring and O-ring with power steering fluid and install on the rack piston.
8. Insert the worm gear (see Figure 6D-1) into the rack piston. Turn the worm gear until the groove in the worm is aligned with the lower ball return guide hole (see Figure 6D-5).

NOTE

The black balls are smaller than the silver balls. The black and silver balls must be installed alternately into the rack piston and return guide to maintain rack piston to worm gear preload.

9. Lubricate balls with power steering fluid. Install balls through ball return guide hole, while rotating worm counterclockwise.
10. Alternately install the remainder of the balls in the ball retainers. Use anhydrous calcium grease to retain balls in ball retainers. Mount retainers (with bolts inserted) on rack piston and secure with clamp. Tighten clamp screws to 4 ft-lbs. (5 N.m).
11. Insert the ball retainer tool (see inset Figure 6D-5) into the rack piston. Hold the tool tightly against the worm gear while turning the stub shaft clockwise to remove the worm gear.
12. Refer to Figure 6D-7, install bearing races and thrust bearings, worm gear, stub shaft and valve assembly, removing the ball retainer tool (inset Figure 6D-5) as the worm gear is turned into the rack piston.
13. Install the rack piston plug, end plug, O-ring, end plug and retaining ring.
14. Perform adjustments at end of this section.

SECTION 6D. STEERING GEAR

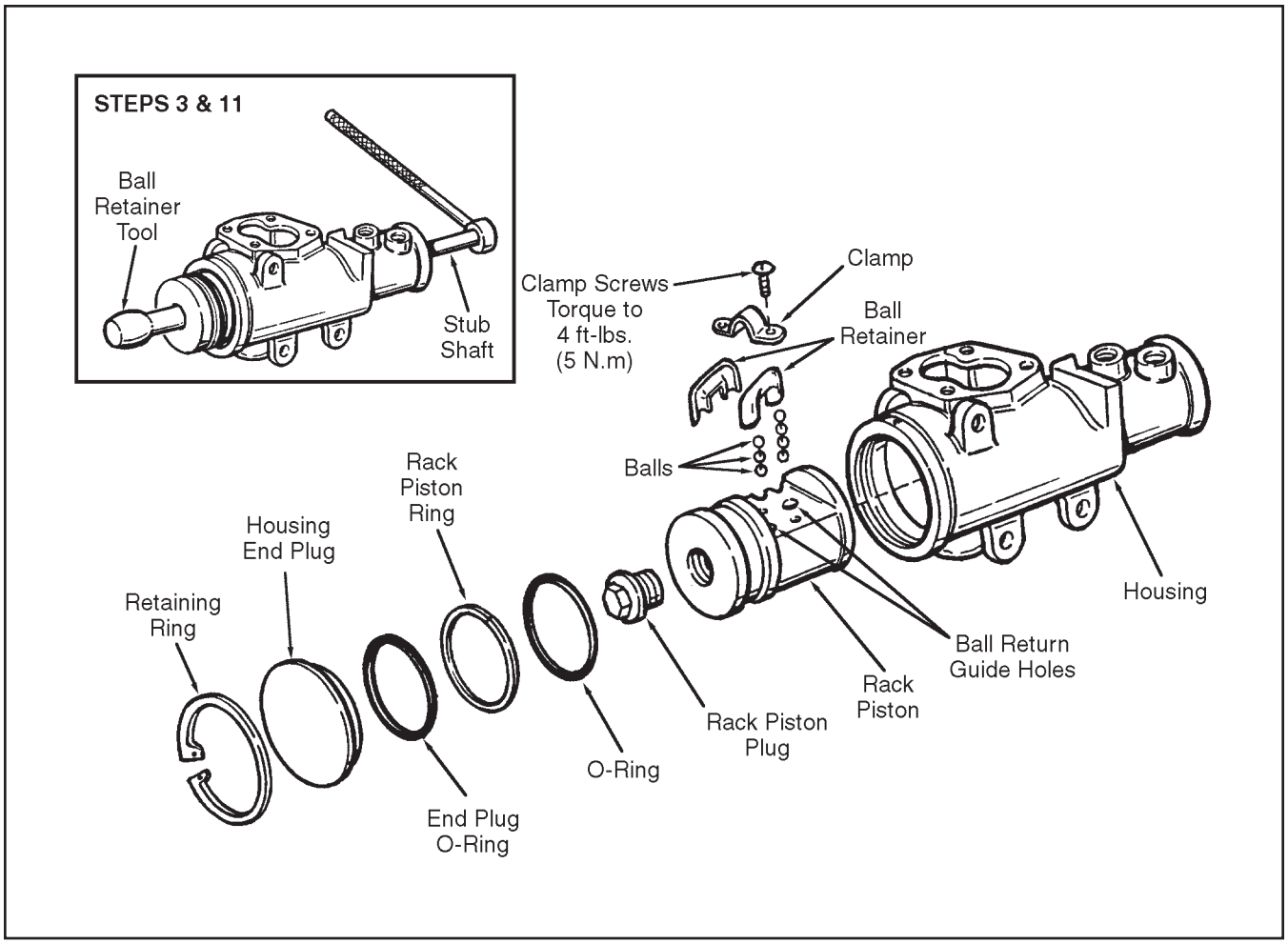

Figure 6D-5. Rack Piston

SECTION 6D. STEERING GEAR

ADJUSTER PLUG (See Figure 6D-6)

1. Remove lock nut and use spanner wrench to turn out adjuster plug assembly.
2. Disassemble adjuster plug assembly as shown in Figure 6D-6. Remove the retaining ring and use a screwdriver to pry the thrust bearing retainer (at raised areas) from the adjuster plug and a mandrel and mallet to drive the needle bearing and seals out of the adjuster plug.
3. Assemble new O-rings, seals, needle bearing and thrust bearing retainer to adjuster plug. If necessary, install new thrust bearings and bearing races. Use a bearing driver to seat needle bearing and seals in adjuster plug.
4. Install assembled adjuster plug in housing and secure with lock nut. Torque lock nut to 80 ft-lbs. (108 N.m).
5. Perform adjustments at end of this section.

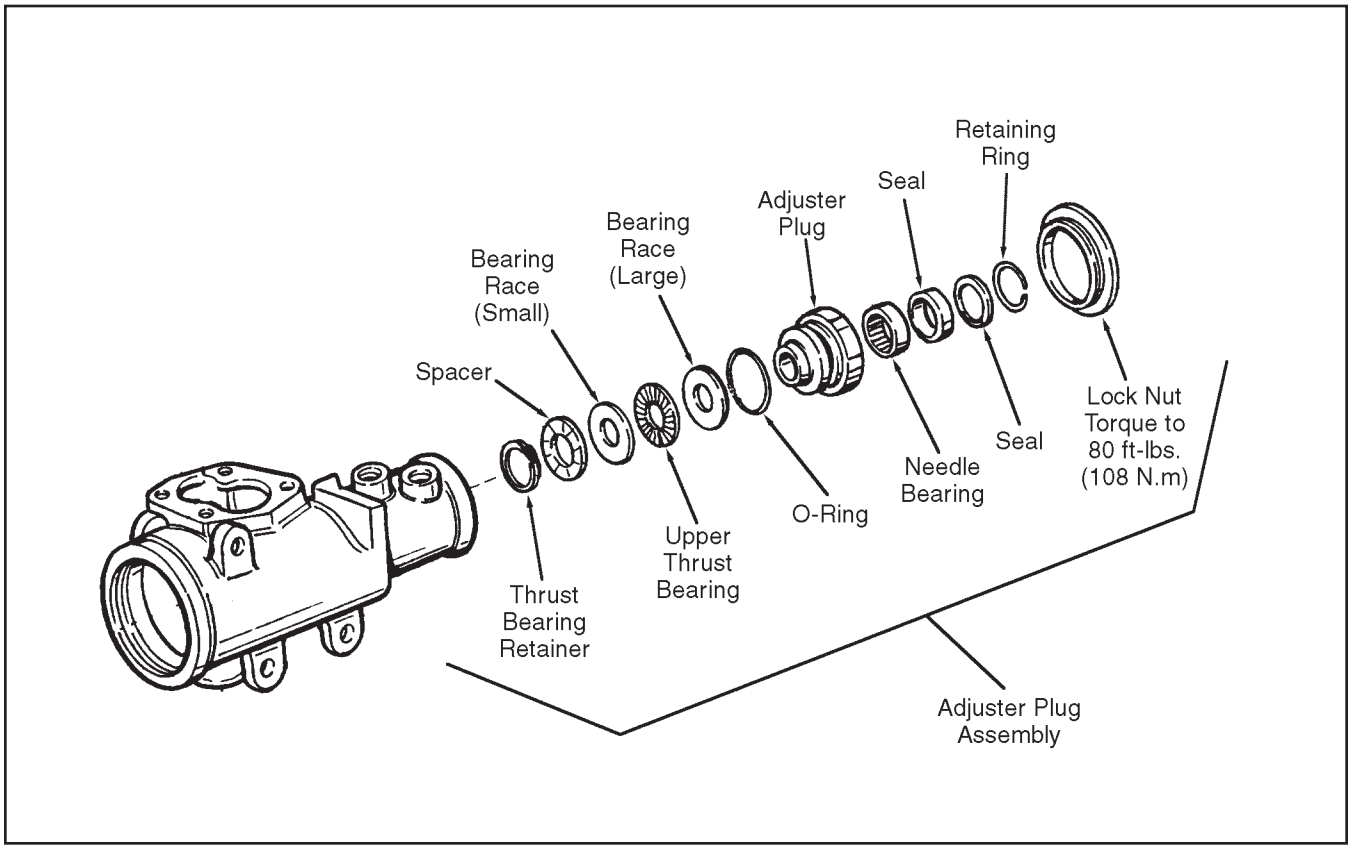

Figure 6D-6. Adjuster Plug

SECTION 6D. STEERING GEAR

VALVE, THRUST BEARINGS AND WORM GEAR (See Figure 6D-7)

NOTE

Rotate the valve spool during disassembly and reassembly.

1. Remove the adjuster plug assembly as described in “ADJUSTER PLUG” (Steps 1 and 2).
2. Grasp the end of the stub shaft and pull components shown in Figure 6D-7 out of the housing as an assembly.
3. Note and mark how the pin in the worm gear fits in the slot in the valve body. Pull the valve assembly off the worm.
4. Disengage the pin on the stub shaft from the hole in the valve spool and disassemble the valve assembly as shown in Figure 6D-7.
5. Replace O-rings, seals, backup rings and (if necessary) thrust bearing and bearing races.
6. Lubricate all parts with power steering fluid and reassemble as shown in Figure 6D-7.
7. Install the adjuster plug assembly as described in the previous paragraphs (Steps 3 and 4).
8. Perform adjustments at end of this section.

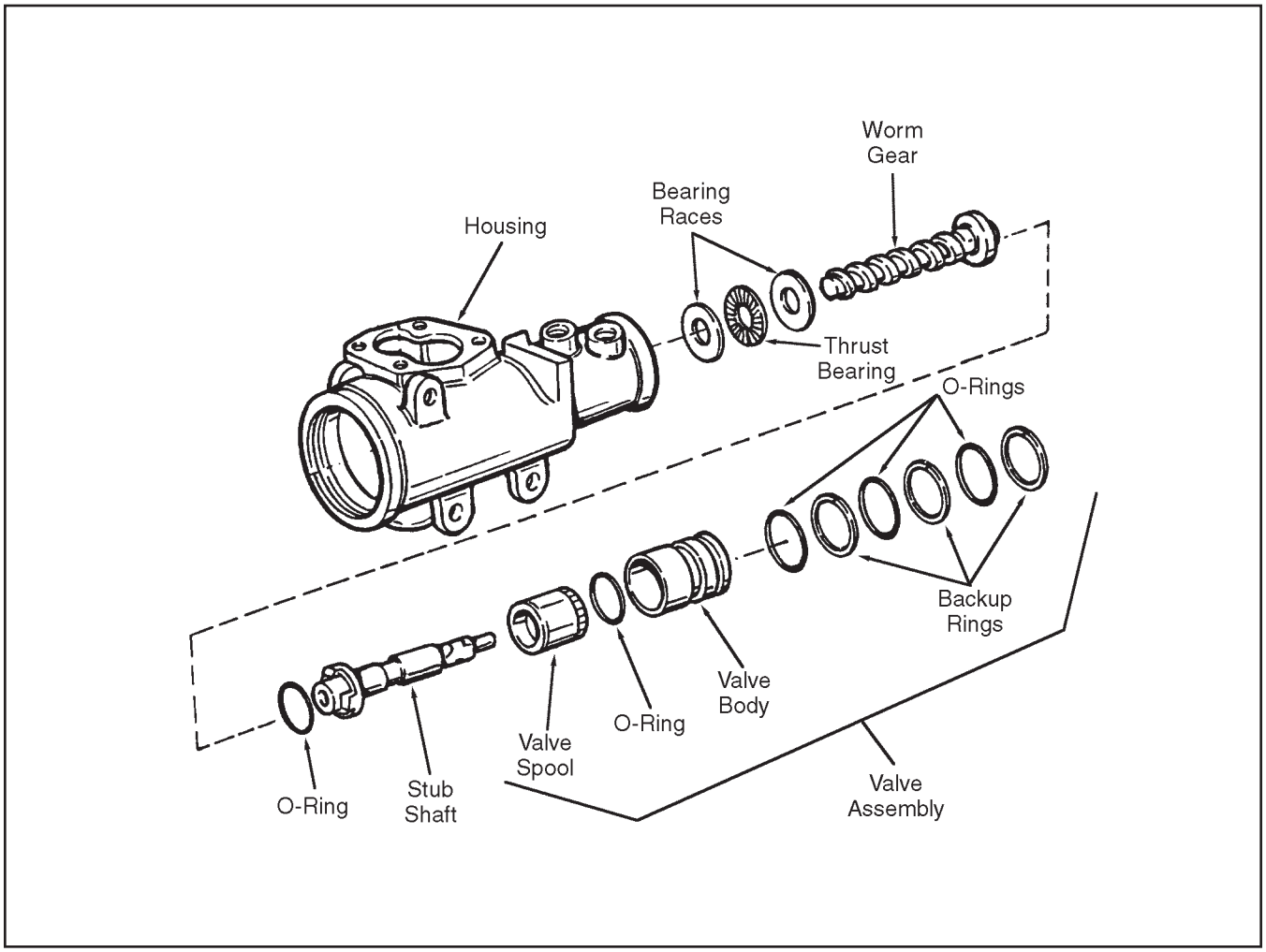

Figure 6D-7. Valve, Thrust Bearings and Worm Gear

SECTION 6D. STEERING GEAR

PITMAN SHAFT BEARING

NOTE

This procedure requires removal of the steering gear as described in Section 6C.

1. Remove the pitman shaft seals, pitman shaft, rack piston, adjuster plug, valve, thrust bearings and worm gear as described in previous paragraphs in this section.
2. Use a mandrel and mallet to drive the needle bearing out of the housing as shown in Figure 6D-8.
3. Replace the bearing and coat the new bearing with power steering fluid and seat in the housing using a plastic tube or bearing installer as shown in Figure 6D-8.
4. Replace worm gear, thrust bearing, valve, adjuster plug, rack piston, pitman shaft and pitman shaft seals as described in previous paragraphs in this section.
5. Perform adjustments in the following paragraphs.

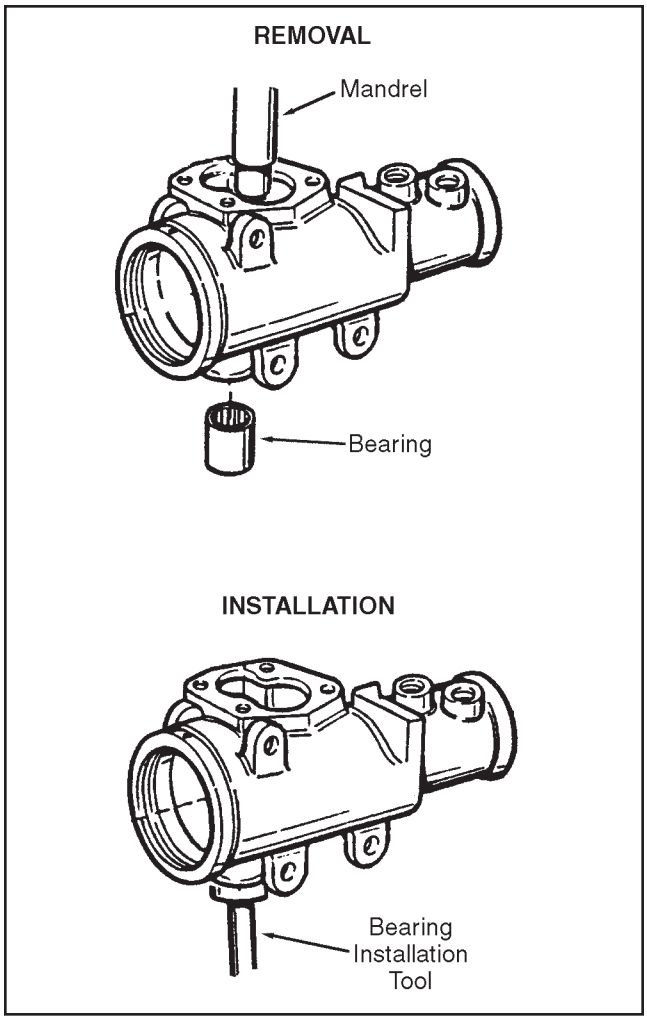

Figure 6D-8. Pitman Shaft Bearing

ADJUSTMENTS

THRUST BEARING PRELOAD (See Figure 6D-9)

1. Before adjusting bearing preload, rotate the stub shaft back and forth to drain all oil from gear.
2. Use a spanner wrench to tighten the adjuster plug to 22 ft-lbs. (27 N.m) firmly seating the thrust bearing.
3. Make alignment marks on the housing and face of the adjuster plug.
4. From this mark, measure back (counterclockwise) 1/2 inch (13 mm) on the housing and make a second mark on the housing.

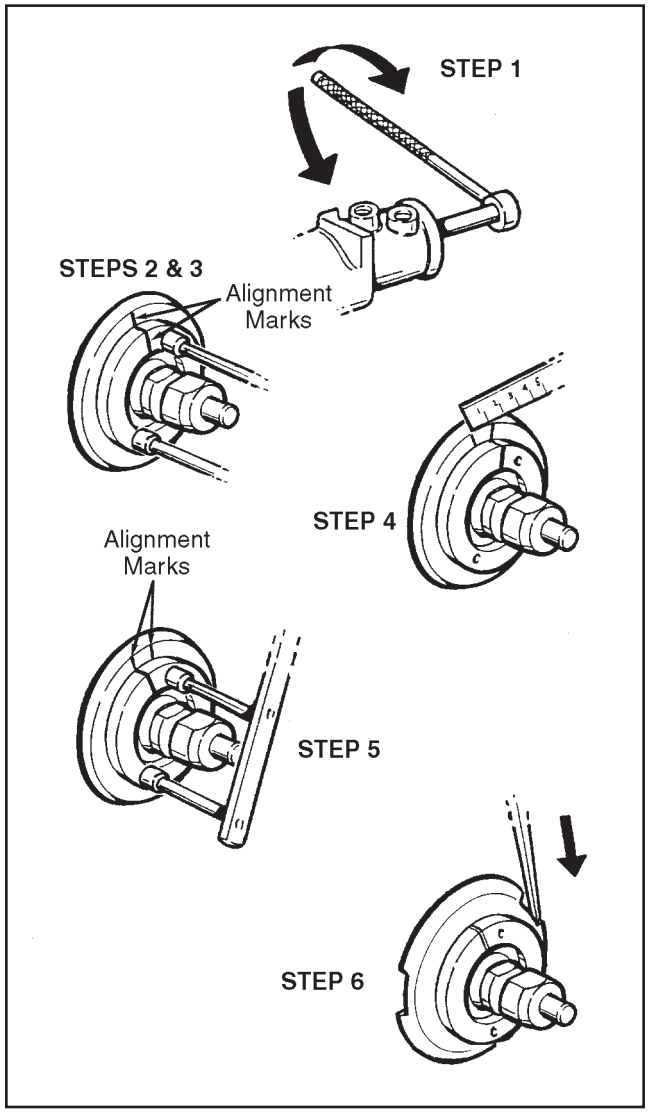

Figure 6D-9. Thrust Bearing Preload Adjustment

SECTION 6D. STEERING GEAR

5. Turn the adjuster plug counterclockwise until the mark on the adjuster plug aligns with the second mark on the housing (made in Step 4 above).
6. Insert a punch in the notch on the adjuster plug to hold the plug in position and tighten the lock nut securely.

PITMAN SHAFT "OVER-CENTER" SECTOR ADJUSTMENT (See Figure 6D-10)

1. The gear on the center flat of the stub shaft should be on the same side and parallel with the side cover.
2. The block tooth on the pitman shaft should be in line with the "over-center" preload adjuster plug.
3. Back off the preload adjuster plug until it stops, then turn the plug in one full turn.
4. With the gear at center of travel, use a torque wrench and record torque required to turn the stub shaft.
5. Turn the adjuster in until the torque required to turn the stub shaft is 6 to 10 in-lbs. (0.6 to 1.2 N.m) greater than the reading obtained in Step 4 above.
6. Hold the adjuster to keep it from turning and torque the adjuster lock nut to 20 ft-lbs. (27 N.m).

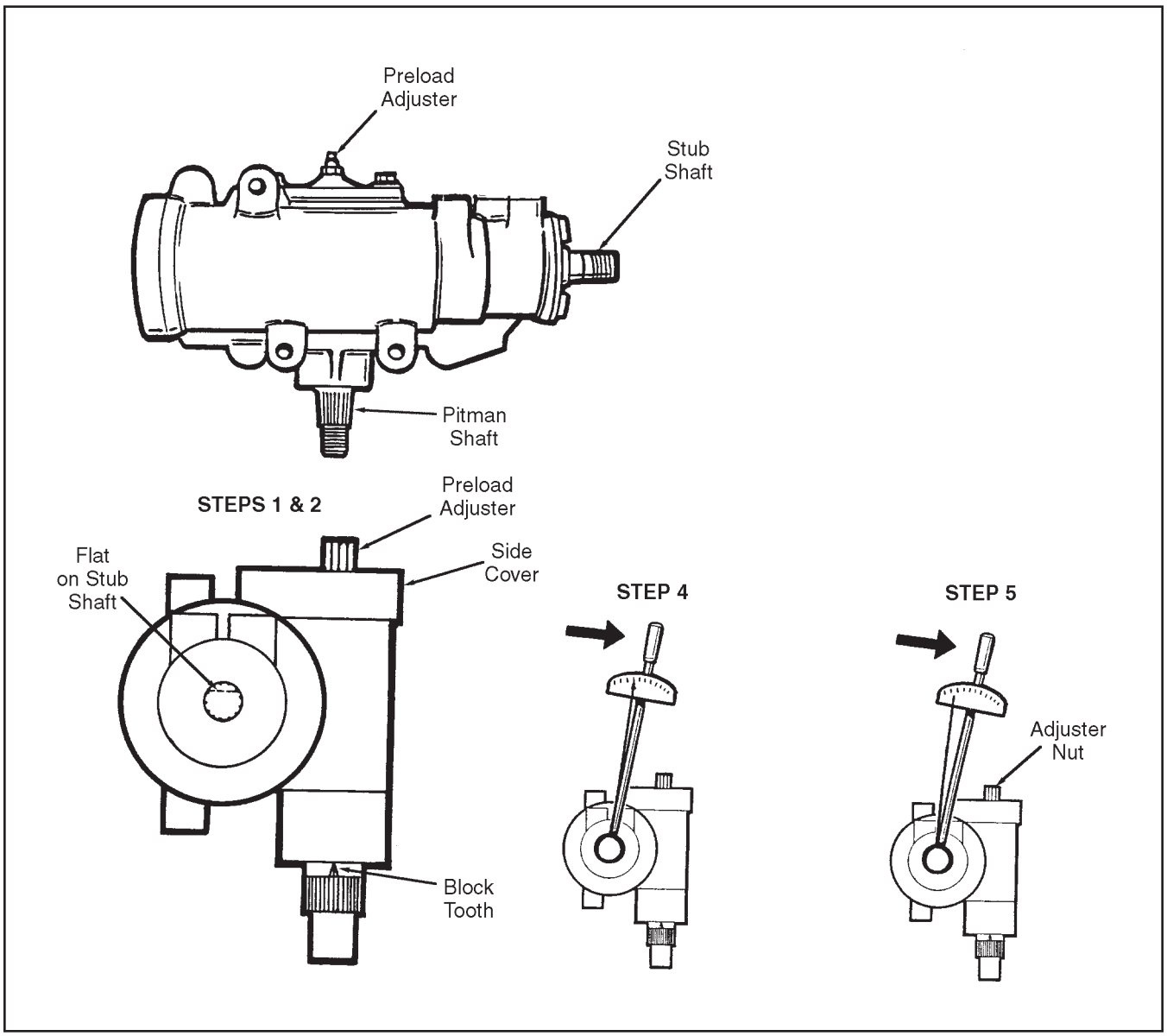

Figure 6D-10. Pitman Shaft "Over-Center" Sector Adjustment

SECTION 6E. STEERING PUMP

STEERING PUMP REMOVAL AND INSTALLATION

1. Disconnect hoses at the steering pump. Plug and cap ports and hoses.
2. Remove pump mounting hardware, disconnect drive belt, and remove and replace the steering pump as shown in Figure 6E-1.
3. Install drive belt and mount pump to mounting bracket.
4. Reconnect hoses to pump and bleed the system as described in Section 6C.

REPAIR (See Figure 6E-2)

Repair of the steering pump is limited to removal and replacement of the flow control valve, O-rings and drive shaft seal.

If the pump leaks after O-rings and seals have been replaced and fittings are tightened or if it fails tests in Section 8, it should be replaced.

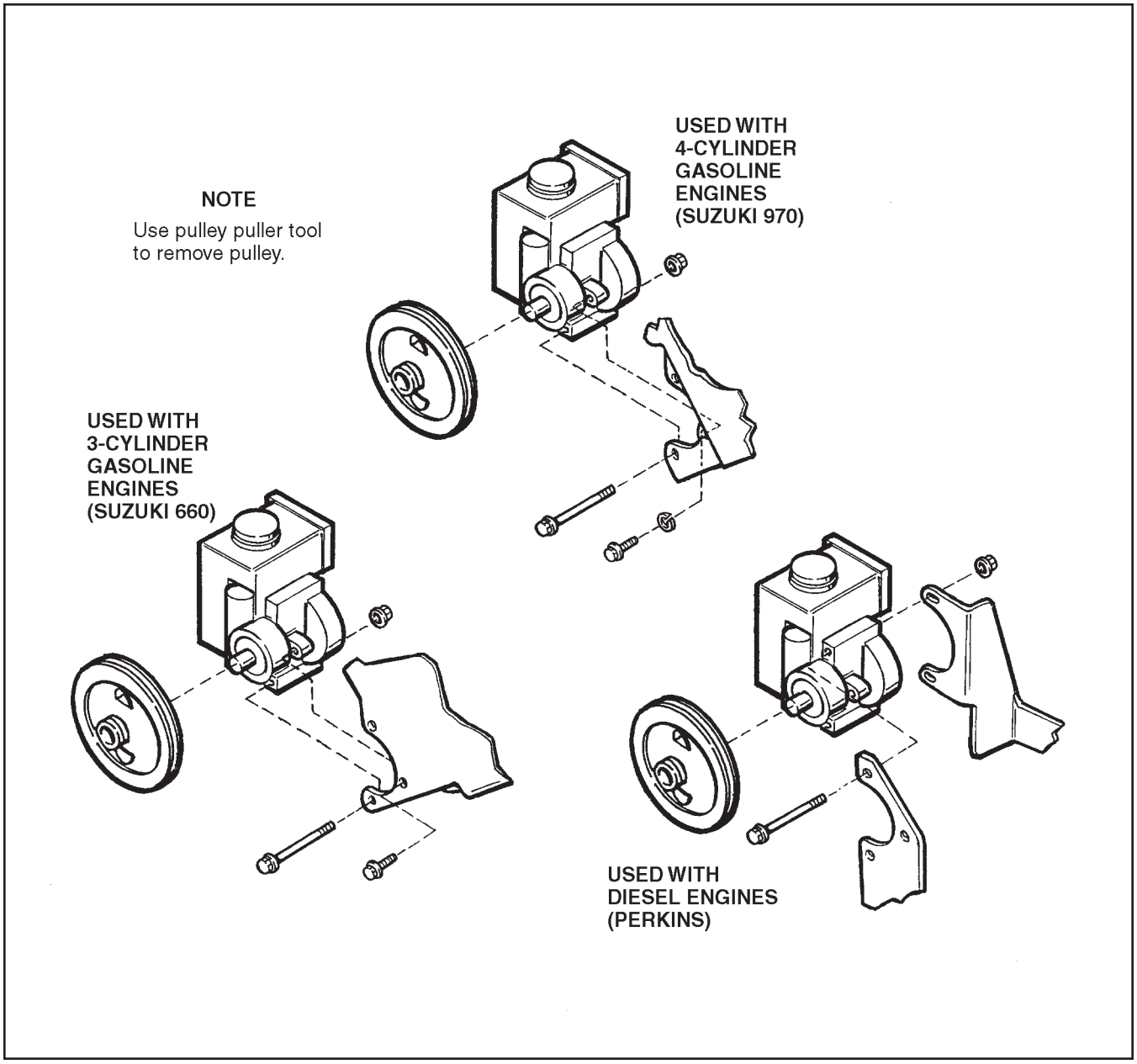

Figure 6E-1. Steering Pump Removal and Installation

SECTION 6E. STEERING PUMP

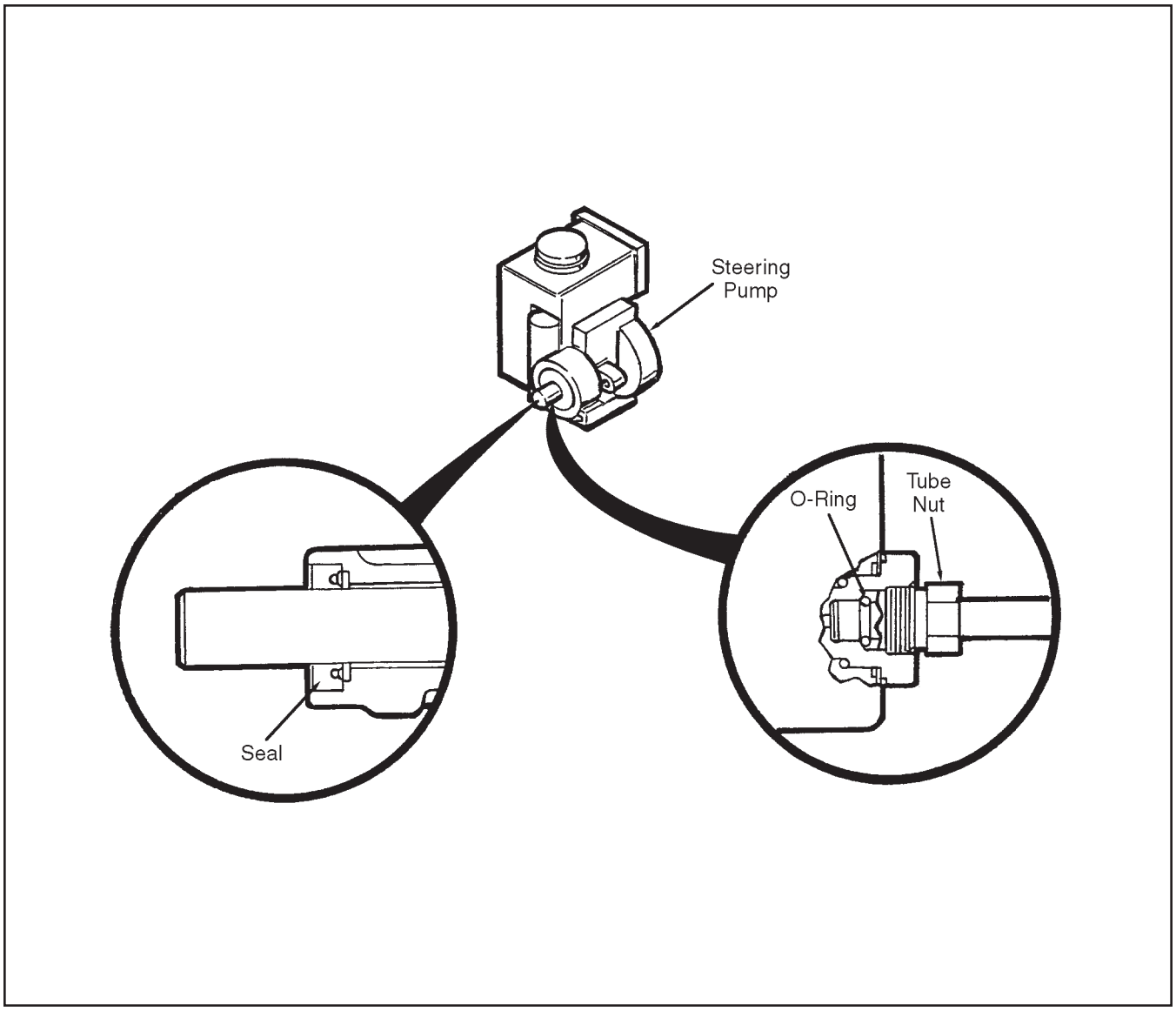

Figure 6E-2. Steering Pump Repair

SECTION 6F. WHEEL ALIGNMENT

Before aligning, check the tire pressure. The front tires should be inflated to 20 psi (138 kPa).

Check wheel lug nut for proper torque, torque to 70 to 100 ft-lbs. (95 to 140 N.m).

Due to alignment requirements, it is recommended to have an experienced automotive alignment shop perform the following adjustments (see Figure 6F-1):

1. Set wheel camber to 0° ± .5° using shims, PN 841737). Use approximately 8 shims on left side and 6 shims on right side. Each shim is equal to approximately .5° camber change.
2. Set "kingpin" caster angle to 3.5° ± .5° using shims, PN 841738. Each shim is equal to approximately .6° caster angle change.
   a. Increase caster angle by adding shims to front bolt.
   b. Decrease caster angle by adding shims to rear bolt.
   c. If more than 2 shims are added to front bolt, recheck camber angle (see Step 1 at left).
3. Set toe-in as follows:
   a. Set left tie rod to 17-3/4 inches (43.53 cm).
   b. Set right tie rod to 17-5/8 inches (43.37 cm).
   c. Turn wheels to "straight ahead" position.
   d. Making even and equal turns of both the right and left tie rods, set toe-in to 0.06 to 0.19 inch (0.15 to 4.83 mm) measured at the high point of the tire.
4. Check steering gear turns from on-center to full left turn and from on-center to full right turn. The steering gear should not contact its internal stop at either full left or right turns.

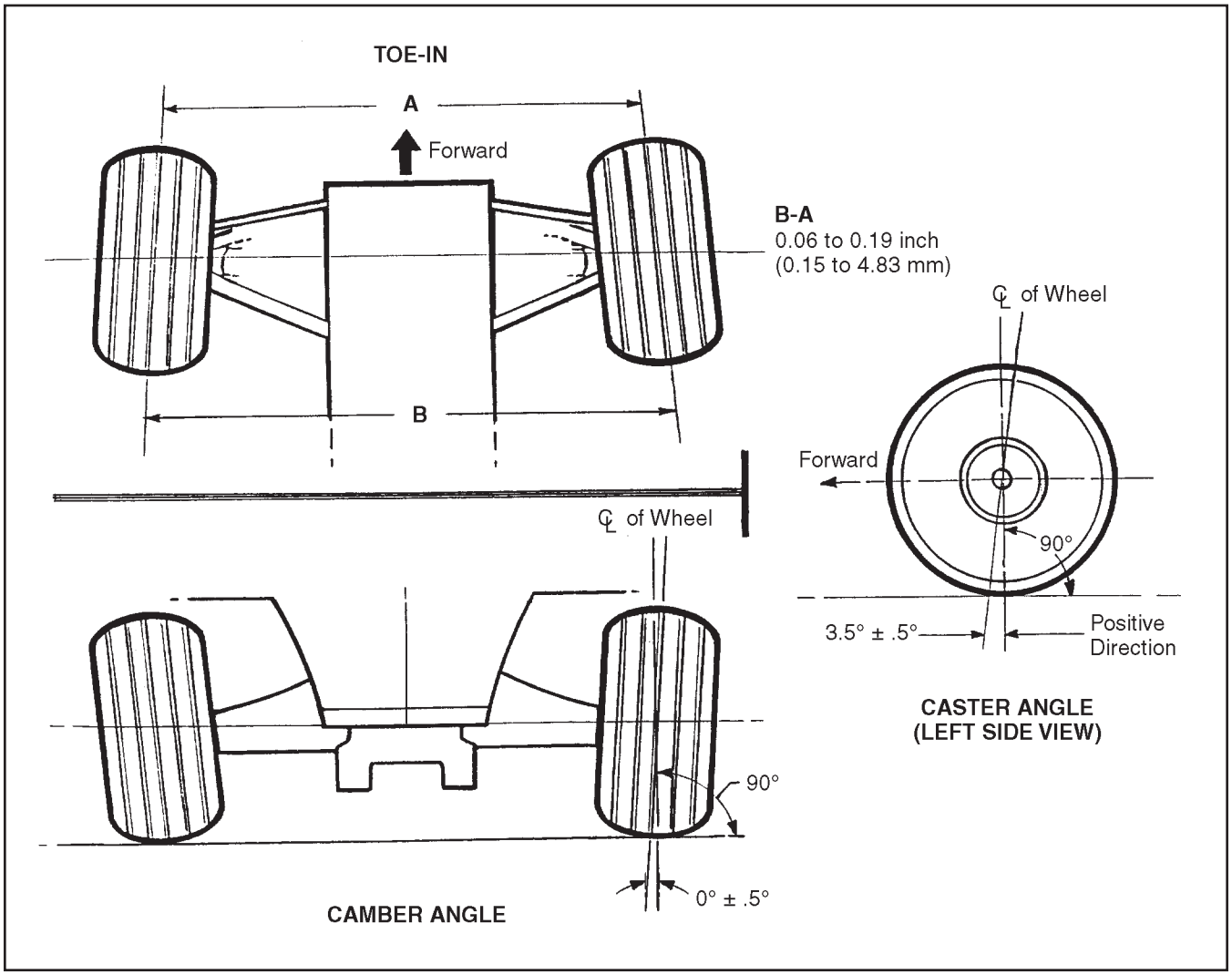

Figure 6F-1. Wheel Alignment

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SECTION 7
WHEELS AND TIRES

SECTION 7A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools.
Cleaning materials:	Stoddard solvent or equivalent.
Lubricants:	Refer to Section 11.
Other service items:	Commercially available tire sealant. Tire pressure gauge. Compressed air with tire valve fitting.

SECTION 7B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Truck rides hard.	a. Over inflated tires.	a. Reduce tire pressure to: Front 20 psi (138 kPa) Rear 15 psi (110 kPa)
2. Truck wanders.	a. Under inflated tires.	a. Inflate tires to: Front 20 psi (138 kPa) Rear 15 psi (110 kPa)
	b. Steering malfunctioning.	b. Test steering (Section 8). Repair (Section 6).
	c. Wheel nuts loose.	c. Tighten wheel nuts to 70 to 100 ft-lbs. (95 to 140 N.m).
	d. Steer wheels out of adjustment.	d. Adjust (Section 6).
3. Poor traction.	a. Over inflated tires.	a. Reduce tire pressure to: Front 20 psi (138 kPa) Rear 15 psi (110 kPa)

SECTION 7C. TIRE SERVICE

GENERAL

The 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 (steering) and rear (drive) wheels are attached directly to wheel hubs. Torque wheel nuts to 70 to 100 ft-lbs. (95 to 140 N.m).

SERVICE

Front tires are inflated to 20 psi (138 kPa) pressure. Rear tires are inflated to 15 psi (110 kPa). These pressures give the best results for average use.

If a tire is removed from the rim it should be inflated according to tire manufacturer's specifications.

This assures proper seating of the tire bead to the rim. Then reduce the pressure to the specified service 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 the repair shops.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. Repeat bead on rim by inflating the tire to tire manufacturer's specifications.
4. Rotate tire slowly to spread compound.
5. Reduce front tire pressure to 20 psi (138 kPa) and rear tire pressure to 15 psi (110 kPa).

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SECTION 8
HYDRAULICS

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SECTION 8A. REPAIR AND SERVICE TOOLS AND MATERIALS

Tools required:	Standard automotive hand tools, including torque wrench. Tachometer.
Cleaning materials:	Stoddard or equivalent solvent. Detergent and water.
Lubricants:	See Section 11.
Other service items:	Seal and Repair Kits (available Textron Turf Care and Specialty Product dealers).

SECTION 8B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
BOX CIRCUIT		
1. Box does not raise.	a. Control lever not moving valve spool.	a. Check movement of control.
	b. Lift cylinder leaking.	b. Test cylinder (Section 8J). Repair (Section 8G).
	c. Pump faulty.	c. Test (Section 8J). Repair (Section 8D).
2. Box does not lower.	a. Control lever not moving valve spool.	a. Check movement of control.
	b. Lift cylinder leaking.	b. Test cylinder (Section 8J). Repair (Section 8G).
3. Control valve spool does not stay in float.	a. Valve defective.	a. Test (Section 8J). Repair (Section 8H).
	b. Control lever not moving valve spool.	b. Check movement of control.
STEERING		
1. No steering.	a. Steering gear faulty.	a. Test (Section 8J). Repair (Section 6D).
	b. Steering gear excessive internal leakage.	b. Test (Section 8J). Repair (Section 6D).
	c. Steering pump faulty.	c. Test (Section 8J). Repair (Section 6E).
2. Noisy when steering wheel is turned.	a. Low hissing sound.	a. Normal.
	b. Relief valve squeals when steering to maximum turn.	b. Normal.
3. Steering wanders.	a. Tire pressure incorrect.	a. Properly inflate tires (Section 7C).
	b. Steering gear internal leakage.	b. Repair (Section 6D).
	c. Steer wheels out of adjustment.	c. Adjust (Section 6F).
	d. Faulty steering gear.	d. Repair/replace (Section 6D).
4. Shimmy.	a. Tire mounting nuts loose.	a. Tighten (Section 7C).
	b. Loose or worn steering linkage.	b. Tighten or replace (Section 6).
	c. Steer wheels out of adjustment.	c. Adjust (Section 6F).
5. Hard steering in one direction.	a. Internal failure of steering unit.	a. Repair (Section 6D).
	b. Loose or worn steering linkage.	b. Tighten or repair (Section 6).
6. Hard steering in both directions.	a. Tires under inflated.	a. Inflate tires (Section 7C).
	b. Low hydraulic oil level.	b. Check level (Section 11).
	c. Steering gear failure.	c. Test/repair steering gear Section 6D).
7. Lost motion at steering wheel.	a. Steering wheel loose.	a. Tighten (Section 6C).
	b. Loosen or worn steering linkage.	b. Tighten or repair (Section 6C).
	c. Steering gear internal linkage.	c. Repair (Section 6D).

SECTION 8C. GENERAL INSTRUCTIONS

GENERAL

NOTE

Component location illustrations and hydraulic system 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 motor 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 Textron 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 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 (fingertight) 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

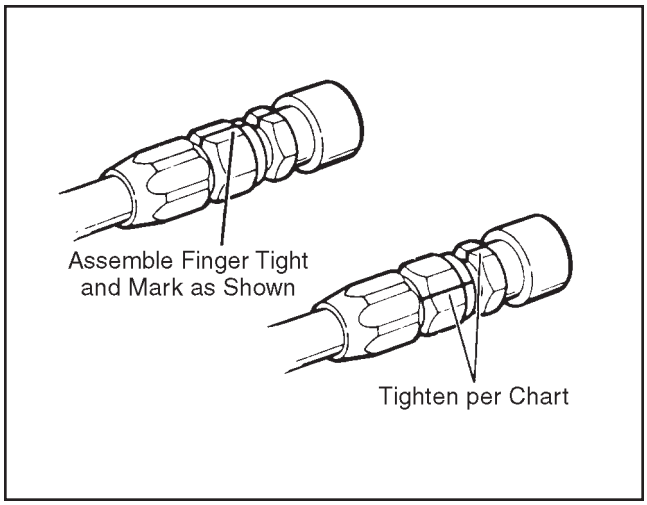


FIgure 8C-1. Reference Marking

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	3/8-24	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	1 3/8-12	0.875	1000-1100	1:1½
16	1 5/16-12	1.000	1300-1360	2¼:2¾
20	1 5/8-12	1.250	1520-1600	1¼:1¾
24	1 7/8-12	1.500	1900-2000	¾:1¼

Tube O.D. or Hose I.D.	Rotate No. of Hex Flats
3/8 inch	2
1/2 inch	2
5/8 inch	1½–2
1 inch	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 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.
1/8	5/16-24	459290
3/16	3/8-24	459291
1/4	7/16-20	339896
5/16	½-20	459293
3/8	9/16-18	339897
½	¾-16	339898
5/8	⅞-14	339899
¾	1 1/16-12	339900
⅞	1 3/16-12	459296
1	1 5/16-12	339901
1¼	1 5/8-12	339902
1½	1 7/8-12	339903
2	2½-12	459300

NOTE

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

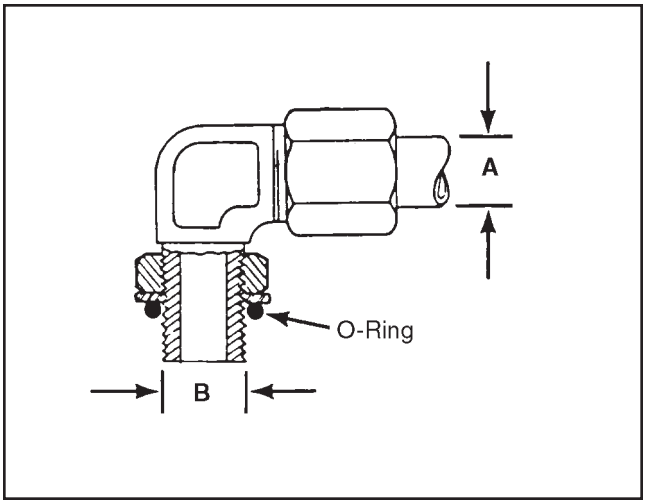


Figure 8C-2. Boss Fitting O-Ring Installation

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.

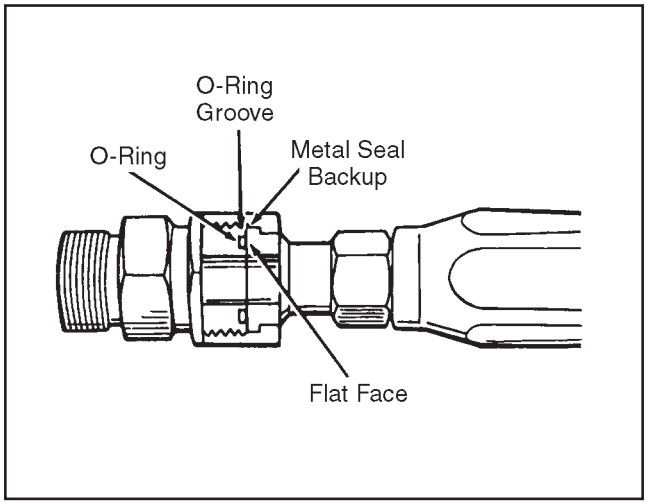


Figure 8C-3. ORS (Face Seal) Fitting

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. STANDARD HYDRAULIC PUMP

GENERAL

The standard hydraulic pump is a single section pump used when the vehicle does not have a hydraulic PTO accessory.

NOTE

Do not disassemble pump for repair unless test procedures indicate excessive wear.

REMOVAL

1. Tag and disconnect hydraulic lines from pump. Plug and cap lines and ports.
2. Remove attaching hardware and remove pump from pump bracket.

DISASSEMBLY (See Figure 8D-1)

1. Clean exterior of pump with suitable solvent before removing bolts.
2. Before disassembly mark housing and covers to ensure correct order and position of parts when reassembling.

⚠ CAUTION

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

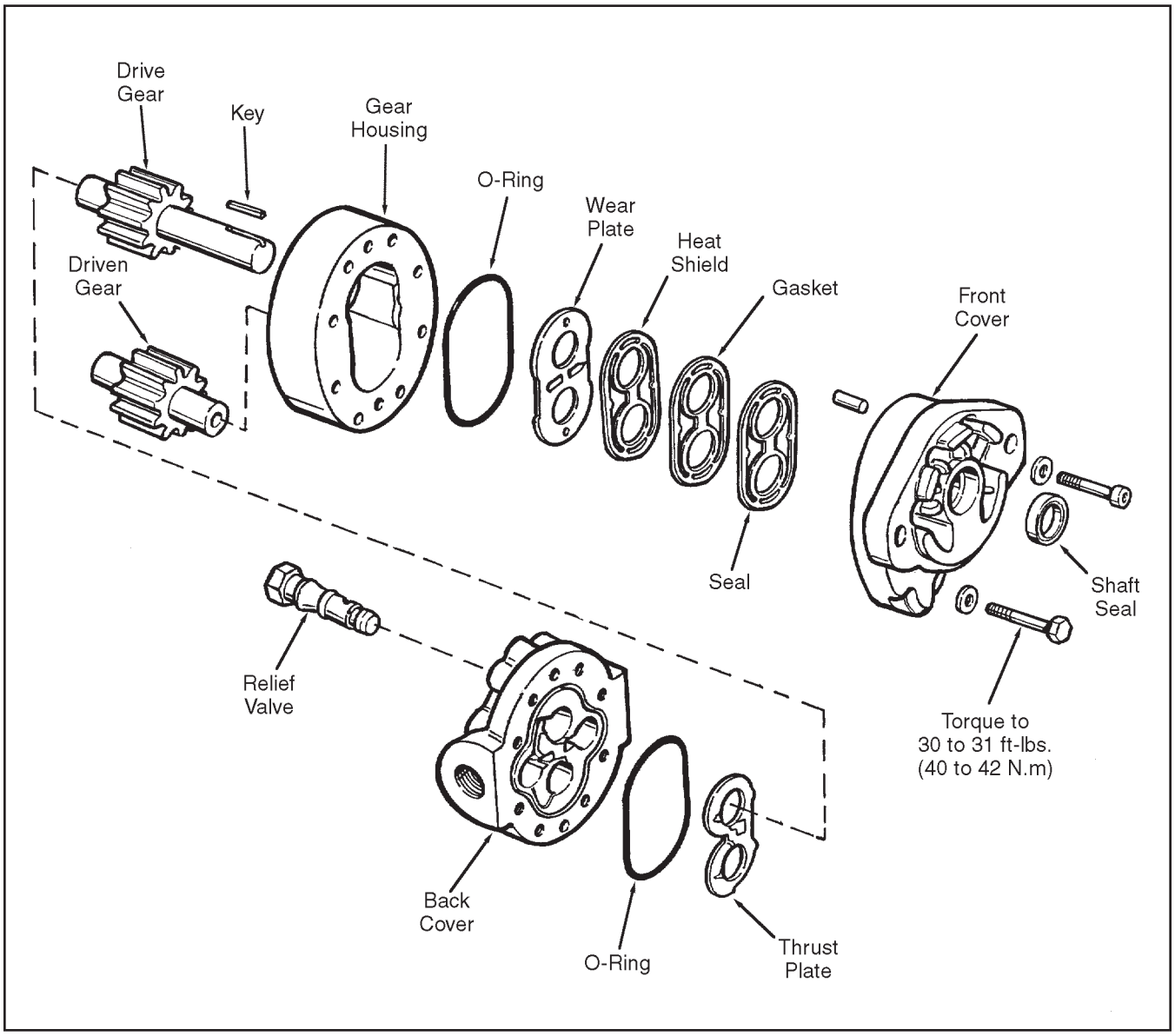
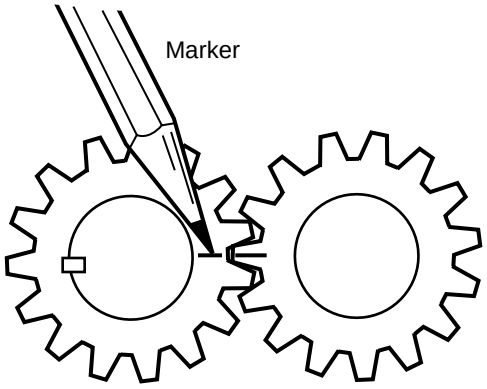


Figure 8D-1. Hydraulic Pump — Standard (Without Hydraulic PTO Accessory)

SECTION 8D. STANDARD HYDRAULIC PUMP

3. After removing bolts, disassemble pump as shown in Figure 8D-1. Before removing gears, mark a line across meshing teeth to ensure that gears are reassembled in the same position (see Figure 8D-2).
4. Place parts in assembly order, on a clean work area as they are removed.
5. Discard seals as they are removed.



Mark alignment mark across meshing teeth before disassembly.

Figure 8D-2. 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 component).
2. Inspect all parts for cracks, nicks, burrs and excessive wear. Replace parts found damaged or worn.

REASSEMBLY (See Figure 8D-1)

1. Apply a coat of clean hydraulic oil to all parts to ease assembly.
2. Assemble as shown in Figure 8D-1.
3. Use a new seal kit during assembly. Use clean grease to keep seals in position.
4. Remove alignment mark from gears after they have been installed with teeth in mesh.
5. Rotate drive shaft to make sure there is no binding between parts.
6. Use extreme care when installing shaft seal. It must seat squarely in seal bore.
7. Install the bolts and nuts fingertight and rotate drive shaft to make sure it turns freely. Tighten the bolts evenly and in steps to a final torque of 30 to 31 ft-lbs. (40 to 42 N.m).

INSTALLATION

1. Install pump on bracket and tighten attaching hardware.
2. Connect hydraulic lines.
3. Start engine. Check for leaks and hydraulic oil level. Run engine for 2 to 3 minutes before pressurizing. Apply pressure gradually for an additional five minutes but do not pressurize for longer than 5 seconds at a time.

SECTION 8E. HYDRAULIC PUMP (USED WITH HYDRAULIC PTO)

GENERAL

This two-section hydraulic pump is used when the vehicle is equipped with a hydraulic PTO accessory.

NOTE

Do not disassemble pump for repair unless test procedures indicate excessive wear.

REMOVAL

1. Tag and disconnect hydraulic lines from pump. Plug and cap lines and ports.
2. Remove attaching hardware and remove pump from pump bracket.

DISASSEMBLY (See Figure 8E-1)

1. Clean exterior of pump with suitable solvent before removing bolts.
2. Before disassembly, mark housing and covers to ensure correct order and position of parts when reassembling.

⚠ CAUTION

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

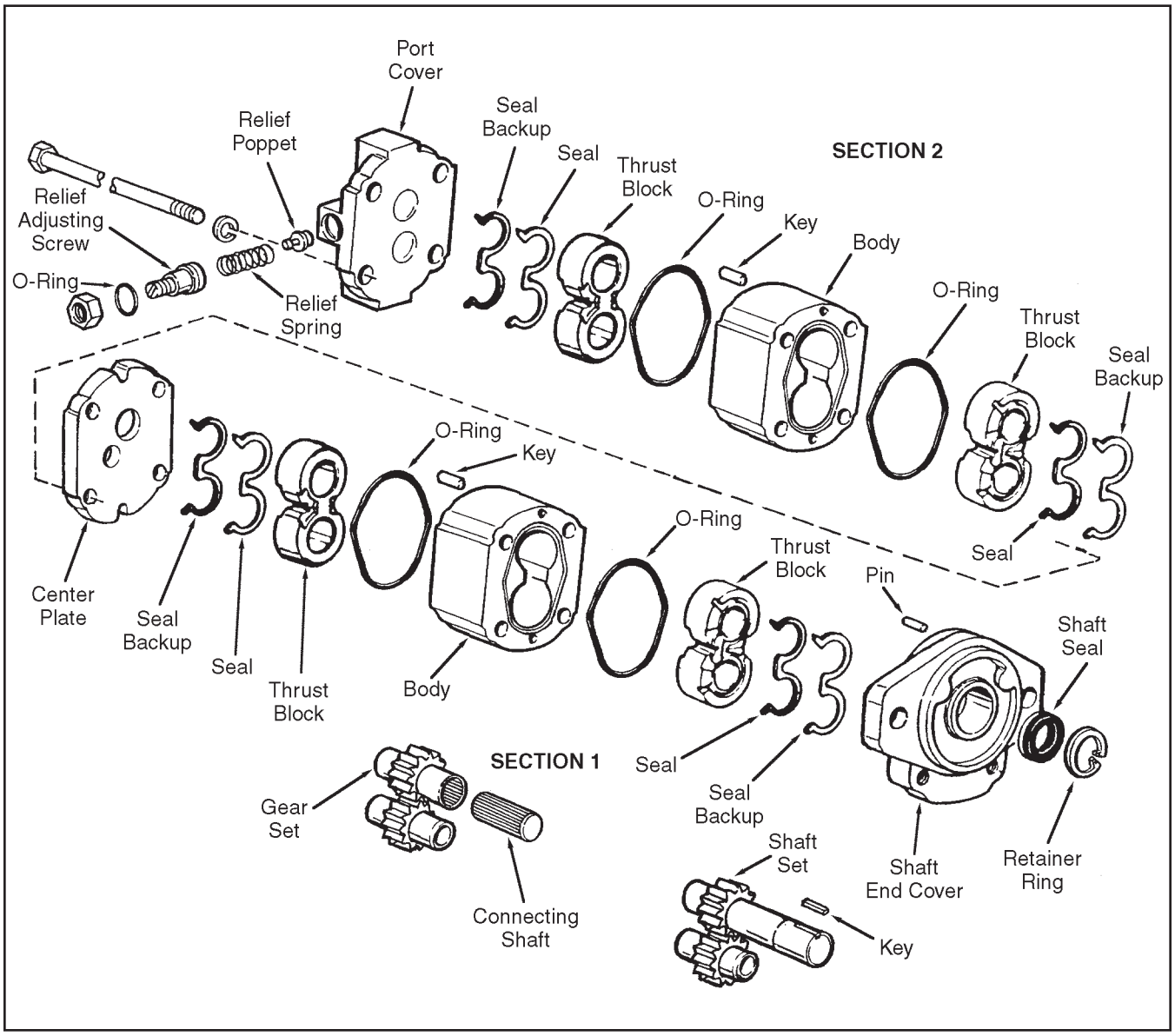
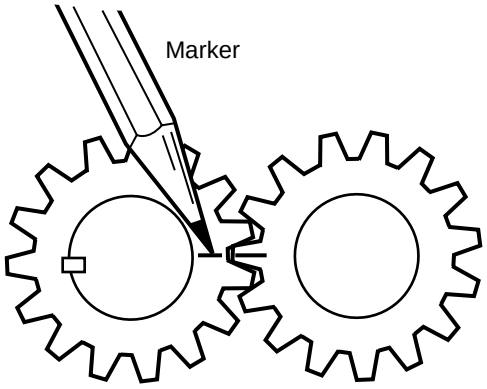


Figure 8E-1. Two-Section Hydraulic Pump for Vehicles with Hydraulic PTO Accessory

8E

SECTION 8E. HYDRAULIC PUMP (USED WITH HYDRAULIC PTO)

3. After removing bolts, disassemble pump as shown in Figure 8E-1. Before removing gears, mark a line across meshing teeth to ensure that gears are reassembled in the same position (see Figure 8E-2).
4. Place parts in assembly order, on a clean work area as they are removed.
5. Discard seals as they are removed.



Mark alignment mark across meshing teeth before disassembly.

Figure 8E-2. 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 component).
2. Inspect all parts for cracks, nicks, burrs and excessive wear. Replace parts found damaged or worn.

REASSEMBLY (See Figure 8E-1)

1. Apply a coat of clean hydraulic oil to all parts to ease assembly.
2. Assemble as shown in Figure 8E-1.
3. Use a new seal kit during assembly. Use clean grease to keep seals in position.
4. Remove alignment mark from gears after they have been installed with teeth in mesh.
5. Rotate drive shaft to make sure there is no binding between parts.
6. Use extreme care when installing shaft seal. It must seat squarely in seal bore.
7. Install the bolts and nuts fingertight and rotate drive shaft to make sure it turns freely. Tighten the bolts evenly and in steps to a final torque of 30 to 31 ft-lbs. (40 to 42 N.m).

INSTALLATION

1. Install pump on bracket and tighten attaching hardware.
2. Connect hydraulic lines.
3. Start engine. Check for leaks and hydraulic oil level. Run engine for 2 to 3 minutes before pressurizing. Apply pressure gradually for an additional five minutes but do not pressurize for longer than 5 seconds at a time.

SECTION 8F. HYDRAULIC MOTOR (USED WITH HYDRAULIC PTO)

GENERAL

The hydraulic motor is used to drive the hydraulic PTO accessory.

NOTE

Do not disassemble motor for repair unless test procedures indicate excessive wear.

REMOVAL

1. Tag and disconnect hydraulic lines from motor. Plug and cap lines and ports.
2. Remove attaching hardware and remove motor from motor mount.

DISASSEMBLY (See Figure 8F-1)

1. Clean exterior of motor with suitable solvent before removing bolts.
2. Before disassembly mark housing and covers to ensure correct order and position of parts when reassembling.

⚠ CAUTION

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

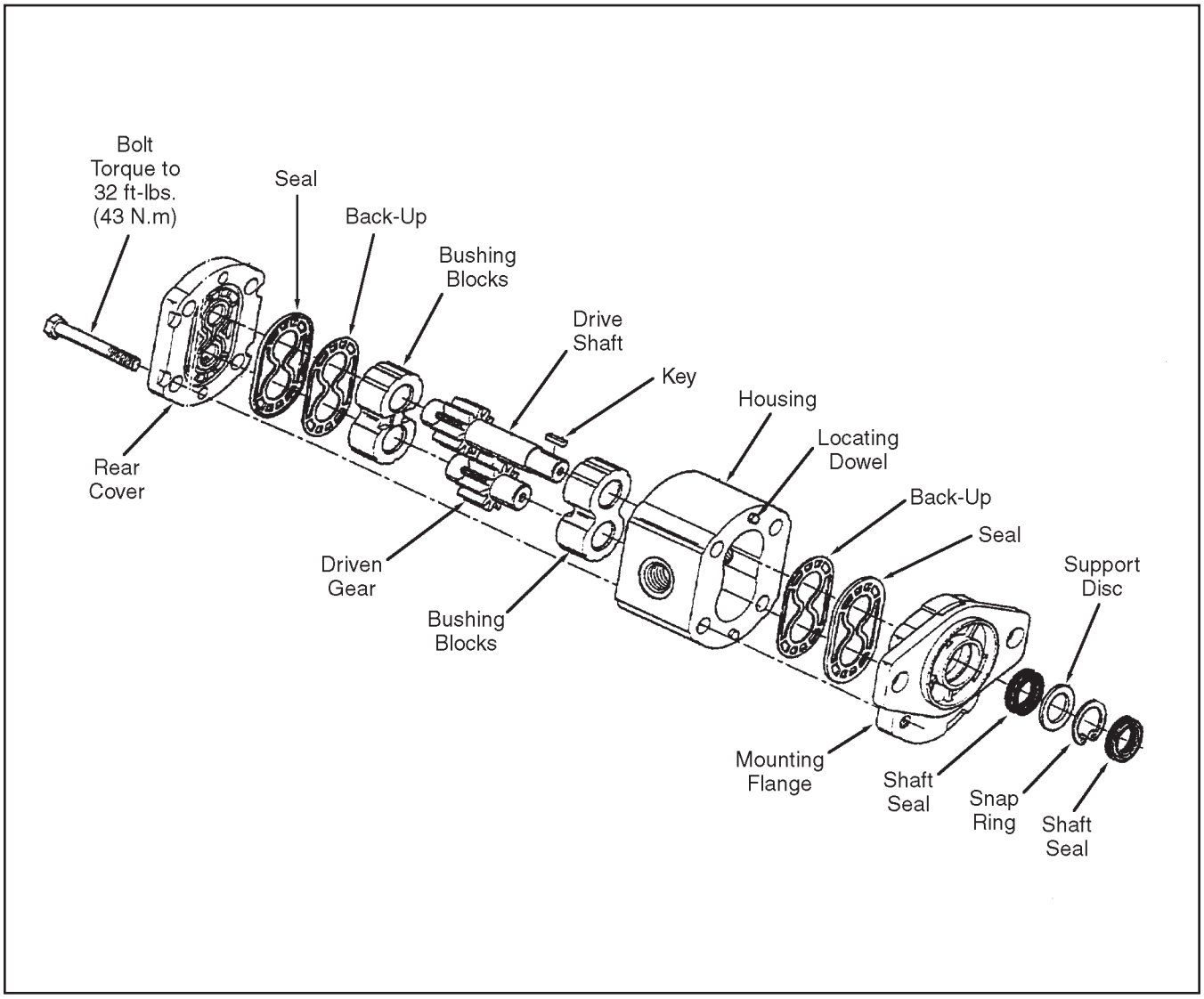
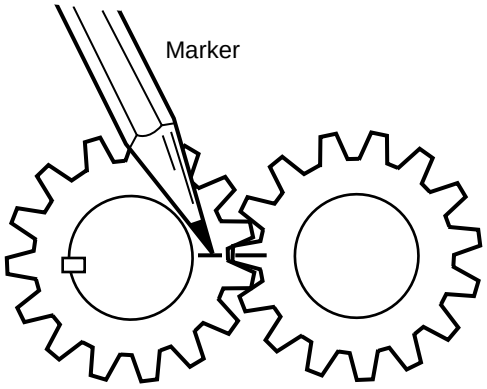


Figure 8F-1. Hydraulic Motor (For Hydraulic PTO Accessory)

SECTION 8F. HYDRAULIC MOTOR (USED WITH HYDRAULIC PTO)

3. After removing bolts, disassemble motor as shown in Figure 8F-1. Before removing gears, mark a line across meshing teeth to ensure that gears are reassembled in the same position (see Figure 8F-2).
4. Place parts in assembly order, on a clean work area as they are removed.
5. Discard seals as they are removed.



Mark alignment mark across meshing teeth before disassembly.

Figure 8F-2. 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 motor or other hydraulic component).
2. Inspect all parts for cracks, nicks, burrs and excessive wear. Replace parts found damaged or worn.

REASSEMBLY (See Figure 8F-1)

1. Apply a coat of clean hydraulic oil to all parts to ease assembly.
2. Assemble as shown in Figure 8F-1.
3. Use a new seal kit during assembly. Use clean grease to keep seals in position.
4. Remove alignment mark from gears after they have been installed with teeth in mesh.
5. Rotate drive shaft to make sure there is no binding between parts.
6. Use extreme care when installing shaft seal. It must seat squarely in seal bore.
7. Install the bolts fingertight and rotate drive shaft to make sure it turns freely. Tighten the bolts evenly and in steps to a final torque of 32 ft-lbs. (43 N.m).

INSTALLATION

1. Install motor on mount and tighten attaching hardware.
2. Connect hydraulic lines.
3. Start engine. Check for leaks and hydraulic oil level. Run engine for 2 to 3 minutes before pressurizing. Apply pressure gradually for an additional five minutes but do not pressurize for longer than 5 seconds at a time.

SECTION 8G. BOX CYLINDER

DISASSEMBLY

1. Clean and air dry the exterior of the cylinder.
2. Disconnect hydraulic lines from cylinder. Plug and cap lines and ports.
3. Drain oil from cylinder and insert cylinder in a vise.
4. Use snap ring pliers to compress snap ring. With snap ring compressed, tap rod guide in slightly to loosen and center snap ring.
5. Remove the rod assembly from the barrel, pulling in a straight line, so as not to scuff the internal parts.
6. Insert rod into a soft jawed vise so that the seal, rod guide and piston can be removed. Be sure the rod and vise are both clean before using.
7. Remove nut at the end of the rod and pull rod guide and piston off of the rod.
8. Remove the seal, O-rings and backup rings from the rod guide and piston.

INSPECTION

1. Inspect all parts for excessive wear, cracks and broken parts.
2. Discard all O-rings, seals and backup rings, replace with new seal kit parts (see Figure 8G-2).

REASSEMBLY

1. Lightly lubricate new O-rings, backup rings and seal and install as shown in Figure 8G-2.
2. Position the snap ring on the rod guide and reassemble the rod, piston and rod guide as shown in Figure 8G-1. Torque the nut to 140 ft-lbs. (190 N.m).
3. Compress the snap ring while inserting the assembled rod in the barrel until the snap ring is reseated in its groove in the barrel.
4. Manually check operation of the cylinder by pulling and pushing the rod in and out of the barrel.
5. Install cylinder on frame and box and reconnect hydraulic lines.

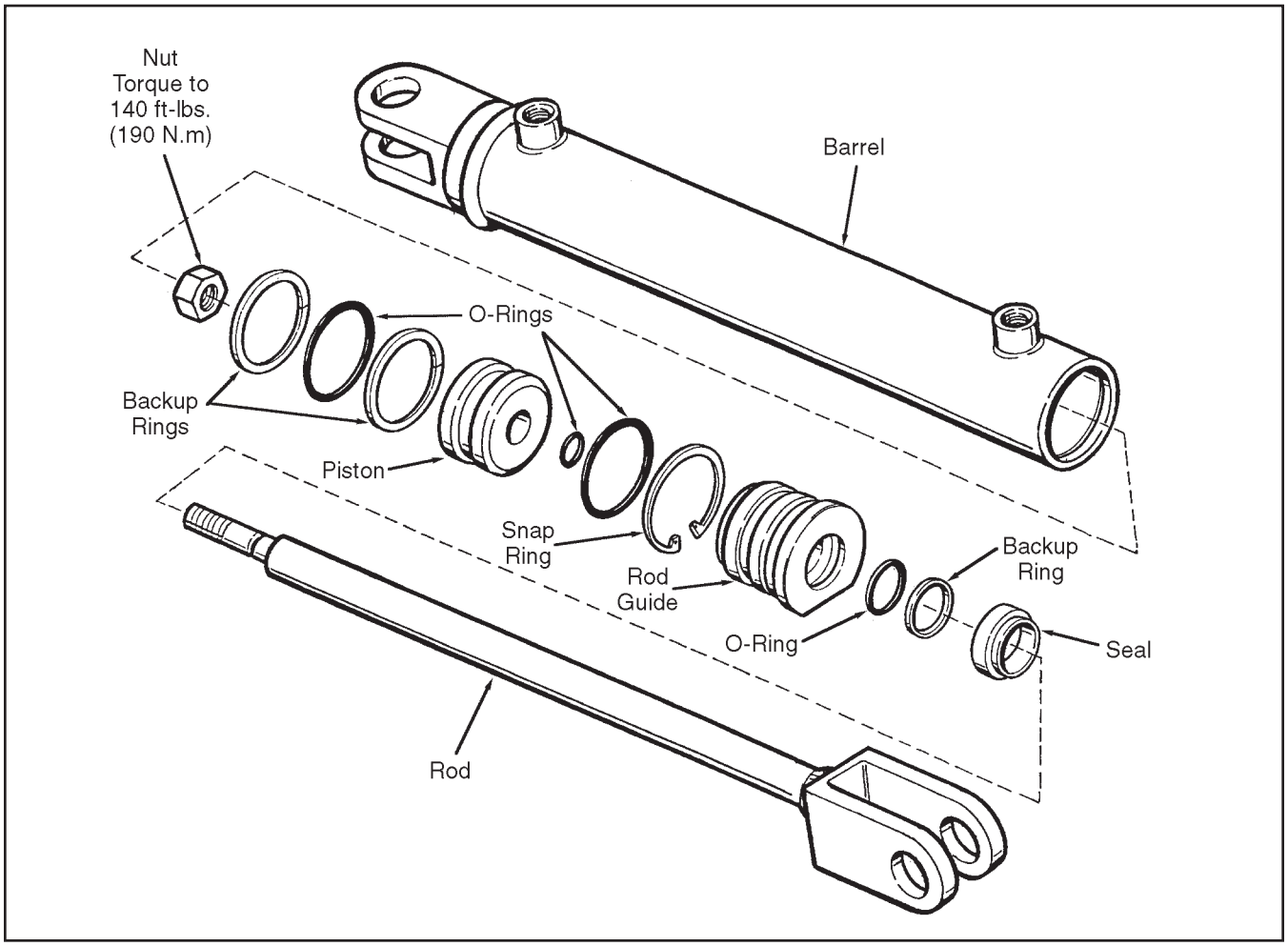


Figure 8G-1. Box Cylinder Disassembly and Reassembly

SECTION 8G. BOX CYLINDER

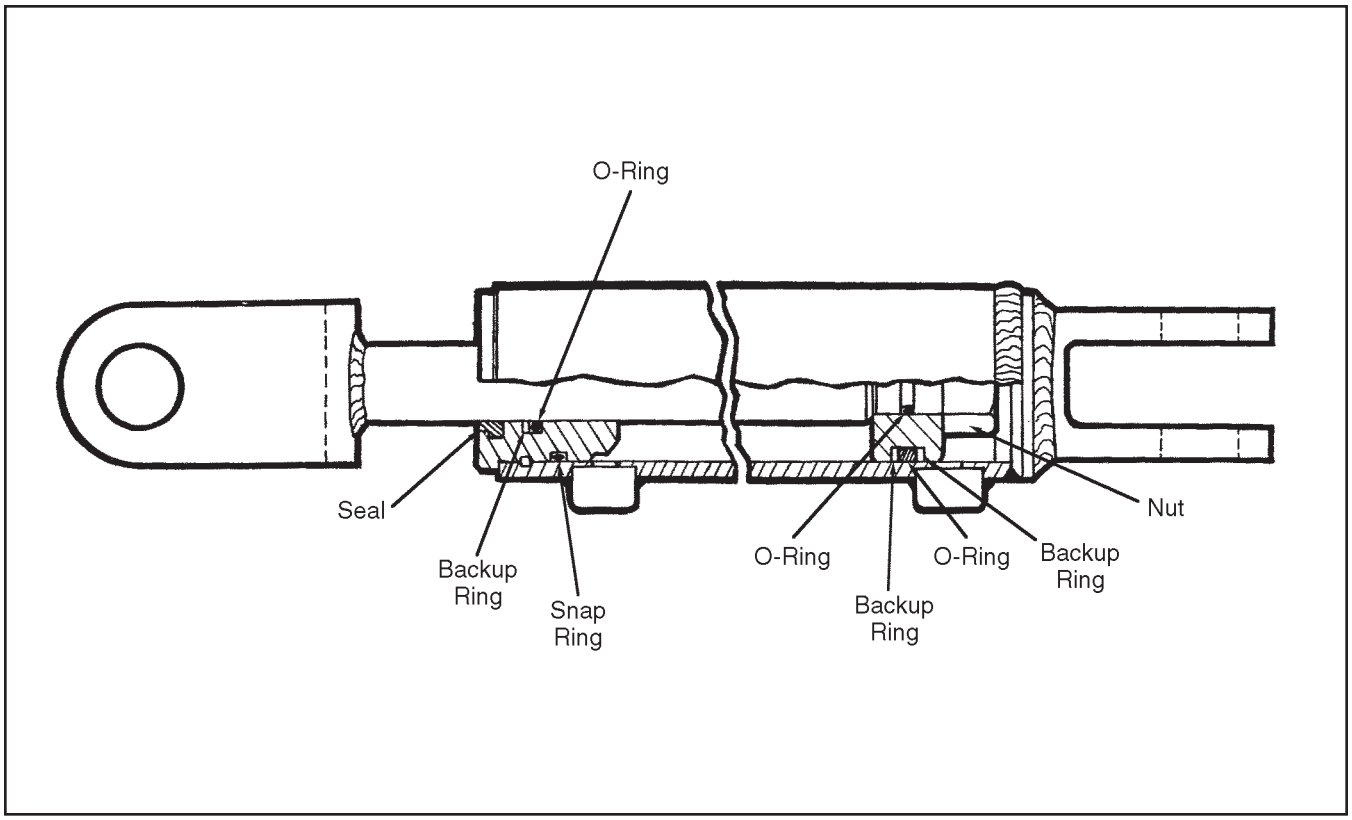


Figure 8G-2. Seal Kit Installation

SECTION 8H. CONTROL VALVE

REPAIR (See Figure 8H-1)

1. Tag and remove hydraulic lines from valve. Cap lines.
2. Disconnect and remove control handle.
3. Remove valve from mounting bracket.
4. Disassemble as shown in Figure 8H-1.
5. Replace O-rings.
6. Reassemble as shown in Figure 8H-1.
7. Install valve on mounting bracket and attach control handle.
8. Reconnect hydraulic lines.
9. Test valve operation (see Section 8).

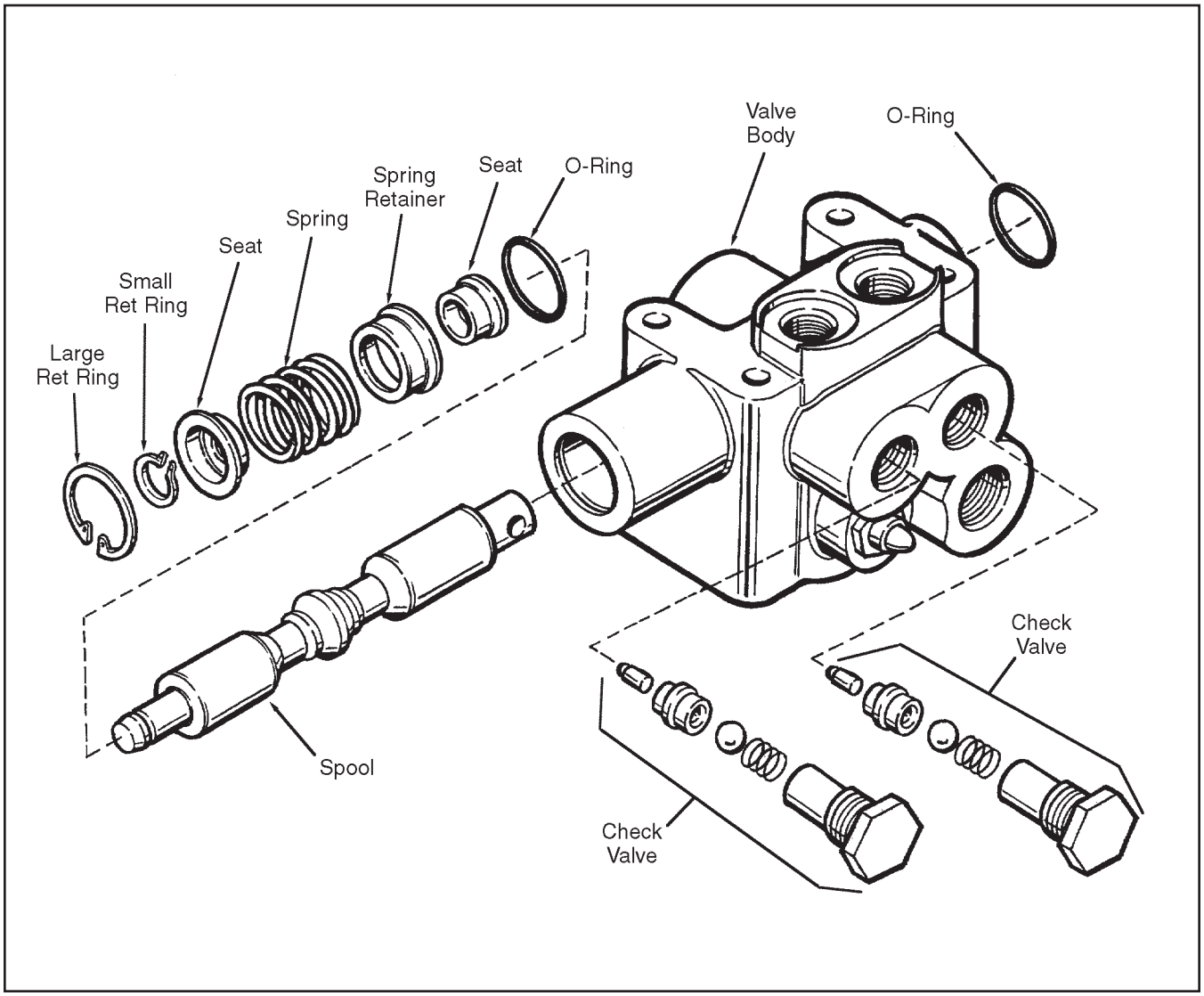


Figure 8H-1. Control Valve Repair

SECTION 8I. SELECTOR VALVE

REPAIR (See Figure 8I-1)

1. Tag and remove hydraulic lines from valve cap lines.
2. Remove valve from mounting bracket.
3. Disassemble as shown in Figure 8I-1.
4. Replace O-rings.
5. Reassemble as shown in Figure 8I-1.
6. Reconnect hydraulic lines.
7. Test valve operation (see Section 8).

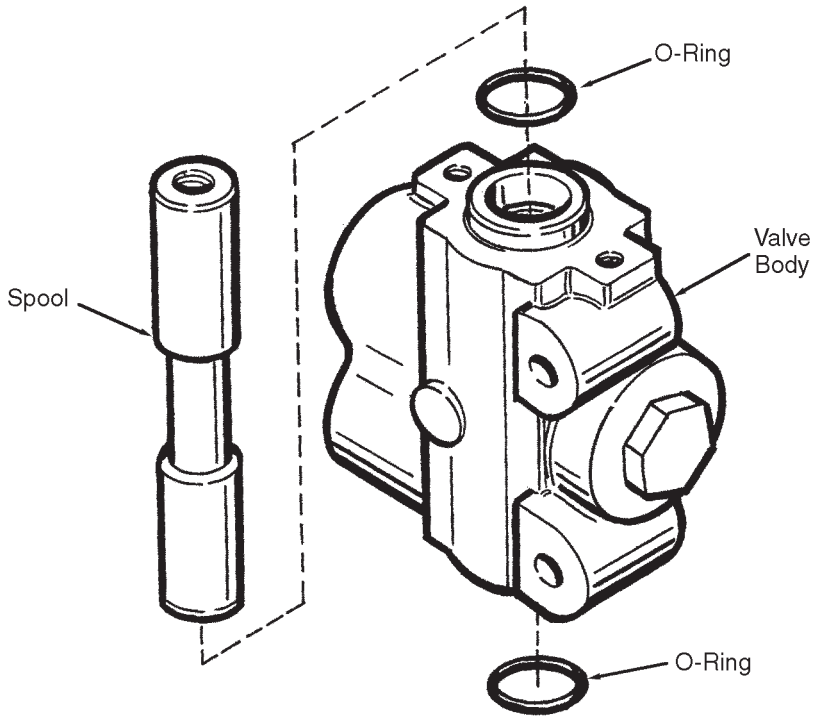


Figure 8I-1. Selector Valve Repair

SECTION 8J. 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; a Flow Test, an in-line hydraulic flow/pressure instrument is used (see Figure 8J-1). This method is more complete and will result in a final conclusion of the failure.

Make sure the truck is secured and cannot roll.

There are two hydraulic systems used on these vehicles. The first (standard system) consists of a single section pump with a single selector valve. The second is an optional High/Low System consisting of a 2 section pump and two selector valves. Units with the hydraulic PTO accessory also have a hydraulic motor. Refer to he appropriate test procedures.

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 before proceeding with the instrument tests.

IMPORTANT

All of the tests in this section are shown using an in-line tester shown in Figure 8J-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.

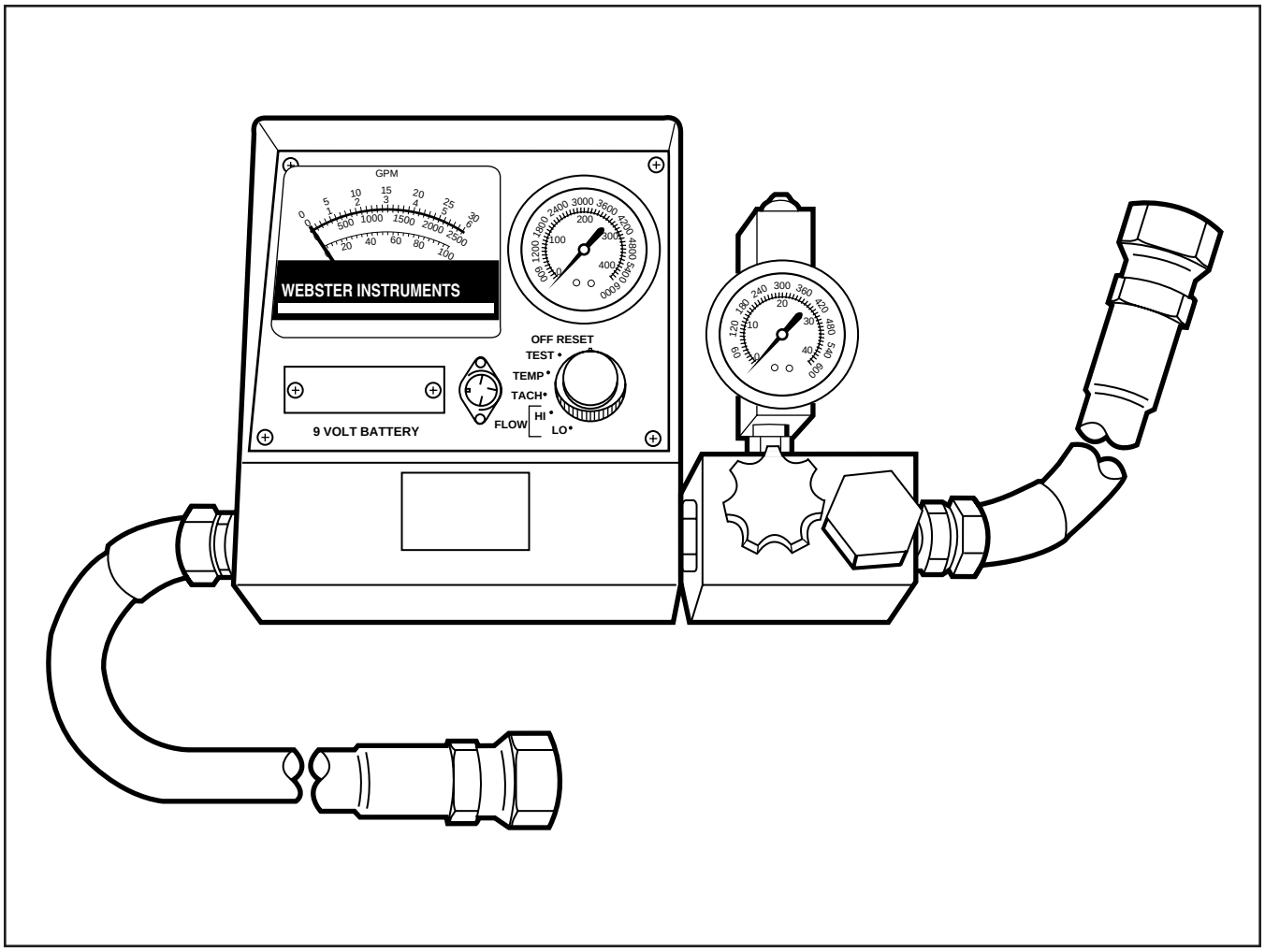


Figure 8J-1. In-Line Tester

SECTION 8J. INSTRUMENT TEST

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 50 hours of operation. Thereafter, the filter should be changed approximately every 500 hours.

2. Check all lines and fittings for leakage and tighten as necessary (see Section 8C).
3. Eliminate all possible mechanical problems first before starting the hydraulic tests.

STANDARD HYDRAULIC SYSTEM

PUMP FLOW TEST (See Figure 8J-2)

1. At the pump, remove the outlet line from pump section 1. Plug line.
2. Install a tee to pump outlet port.
3. Connect flowmeter “IN” port line to the pump tee. Cap remaining port of tee.
4. Install a 1/2-14 pipe to 7/8-14, 37° flare adapter (Aeroquip #2021-8-10 or equivalent) in the hydraulic tank fill port.
5. Connect the flowmeter “OUT” line to the adapter.
6. Completely open the flowmeter load valve.
7. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
8. Read/record no load flow. No load flow should be 4.0 gpm (15.14 lpm).
   - If flow is in specified range, proceed with Step 9.
   - If flow is lower than specified, engine RPM not correct or pump is faulty.
9. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained. Read/record flow.
10. Subtract flow in Step 9 from flow in Step 8.

    Example:

    4.0 gpm (15.14 lpm), Step 8 @ 3900 engine RPM
    3.5 gpm (13.25 lpm), Step 9
    0.5 gpm (1.89 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, pump is okay, proceed with Step 11.
    - If leakage is 1/2 to 1-1/2 gpm (1.89 to 5.68 lpm), the pump is marginal.
    - More than 1-1/2 gpm (5.68 lpm) leakage will noticeably reduce performance. The pump may have to be repaired or replaced (Section 8D).
11. Continue closing load valve until the flow drops off and pressure stays constant, read/record pressure.

CAUTION

DO NOT exceed 3000 psi (20685 kPa) during this test.

- Relief valve is set at 2500 psi ± 10% (15514 to 18962 kPa), proceed with Step 12.
- If relief valve does not open in specified range, pump should be replaced.

12. Open the flowmeter load valve and shut down engine. Proceed with Step 13, “SELECTOR VALVE TEST”.

SECTION 8J. INSTRUMENT TEST

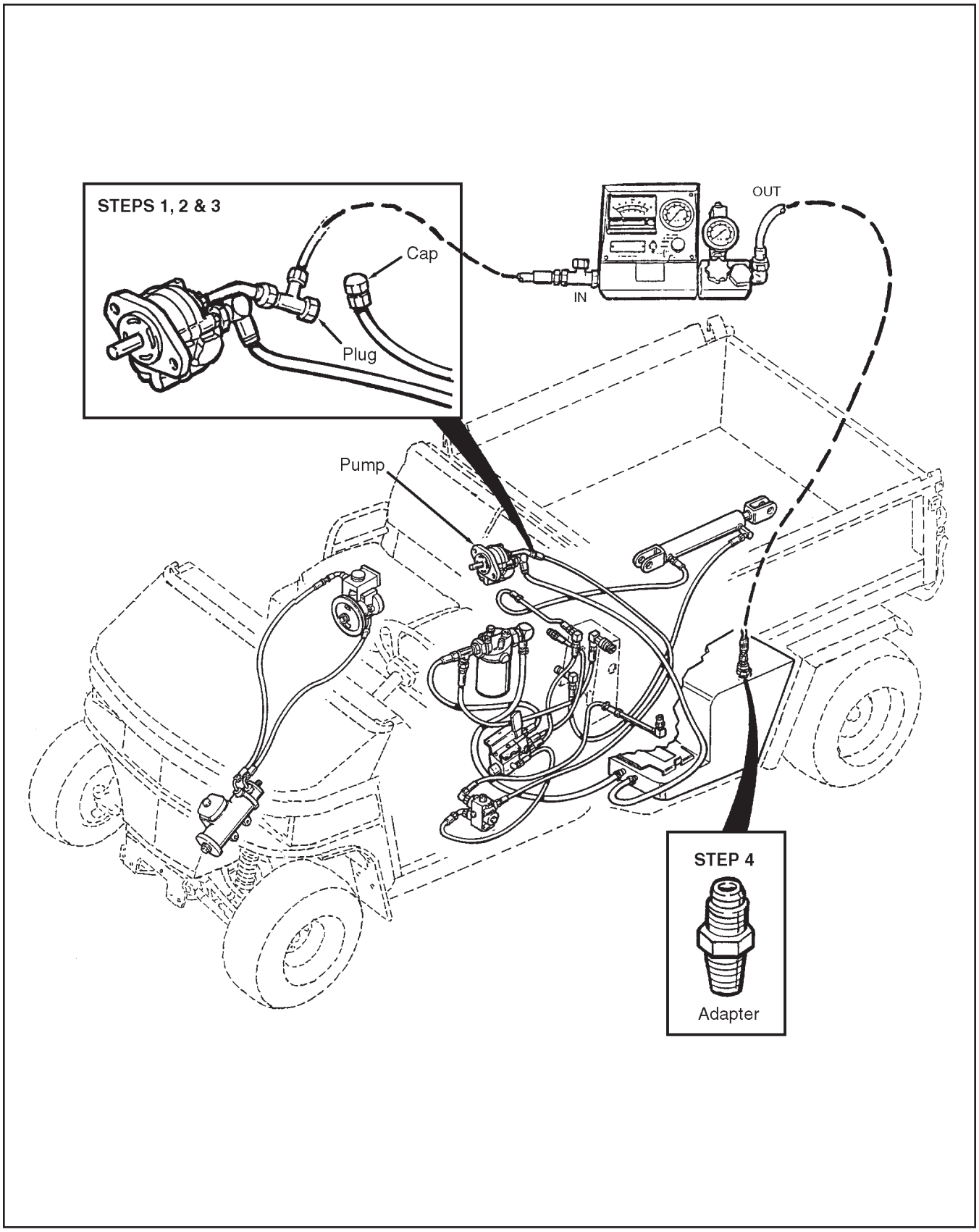


Figure 8J-2. Standard Hydraulic System Pump Flow Test

SECTION 8J. INSTRUMENT TEST

SELECTOR VALVE TEST (See Figure 8J-3)

NOTE

A pump test should be performed before proceeding with a selector valve test.

13. Reconnect pump section 1 outlet line to tee.
14. At connection manifold, disconnect hose from port 7.
15. Pull selector valve knob up.
16. Completely open the flowmeter load valve.
17. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
18. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained. Record gpm flow.
19. Subtract flow in Step 18 from flow in Step 9.

    Example:

    3.5 gpm (13.25 lpm), Step 9 @ 3900 engine RPM
    3.5 gpm (13.25 lpm), Step 18
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, valve is okay, proceed with Step 20.
    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm) the valve is marginal.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The valve may have to be replaced.
20. Completely open tester load valve and shut down engine. Proceed with Step 21.

(See Figure 8J-4)

21. At the connection manifold, connect line 8 to port 7.
22. At selector valve remove line from bottom port. Cap valve port and plug line.
23. Push selector valve knob down.
24. Completely open the flowmeter load valve.
25. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
26. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained.
27. Subtract flow in Step 26 from flow in Step 18.

    Example:

    3.5 gpm (13.25 lpm), Step 18 @ 3900 engine RPM
    3.5 gpm (13.25 lpm), Step 26
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, valve is okay, proceed with Step 28.
    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm) the valve is marginal.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The valve may have to be replaced.
28. Completely open tester load valve and shut down the engine.
29. Reconnect bottom line to selector valve. Proceed with Step 30, “LIFT VALVE TEST”.

SECTION 8J. INSTRUMENT TEST

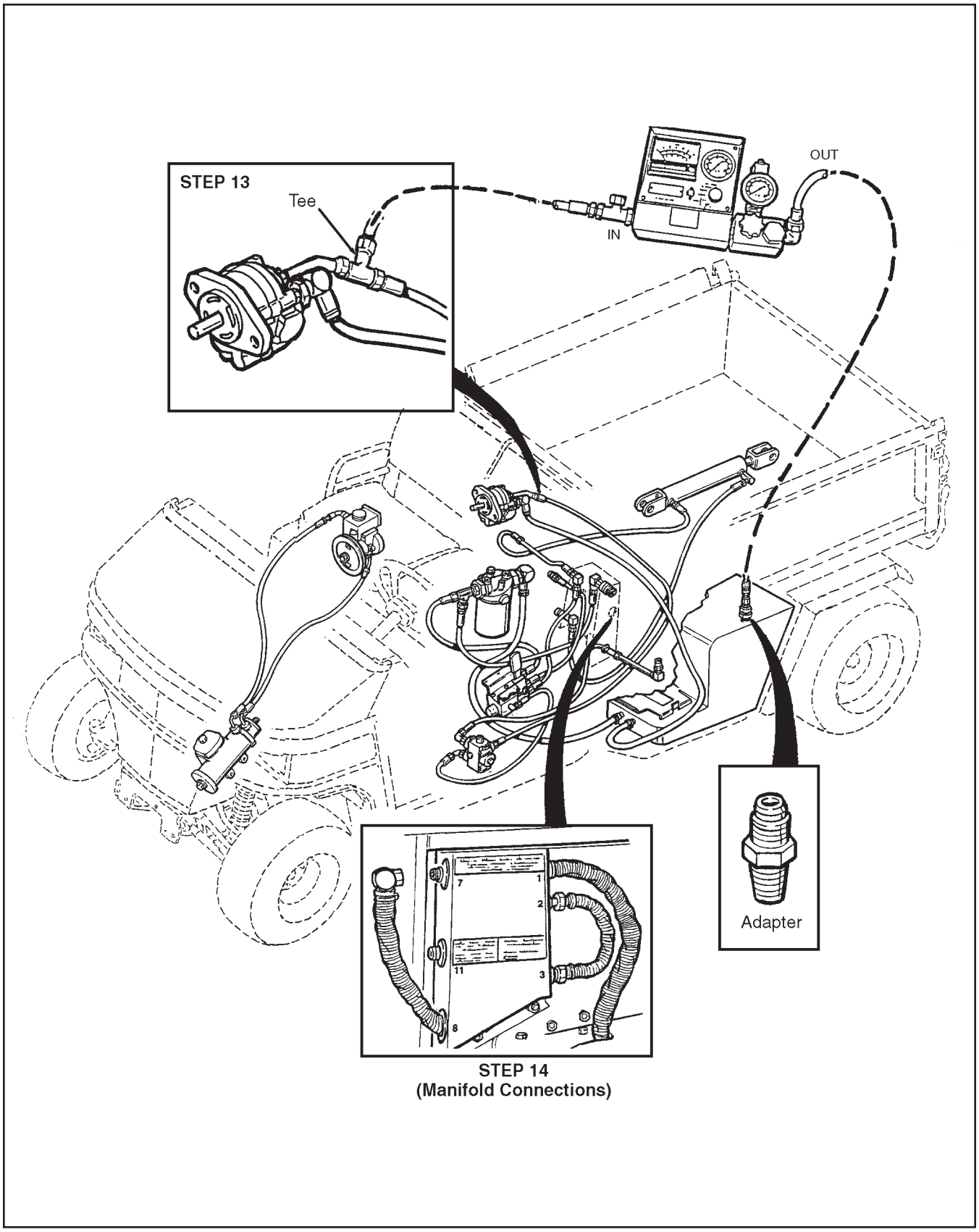


Figure 8J-3. Selector Valve Test — Steps 13 to 20

SECTION 8J. INSTRUMENT TEST

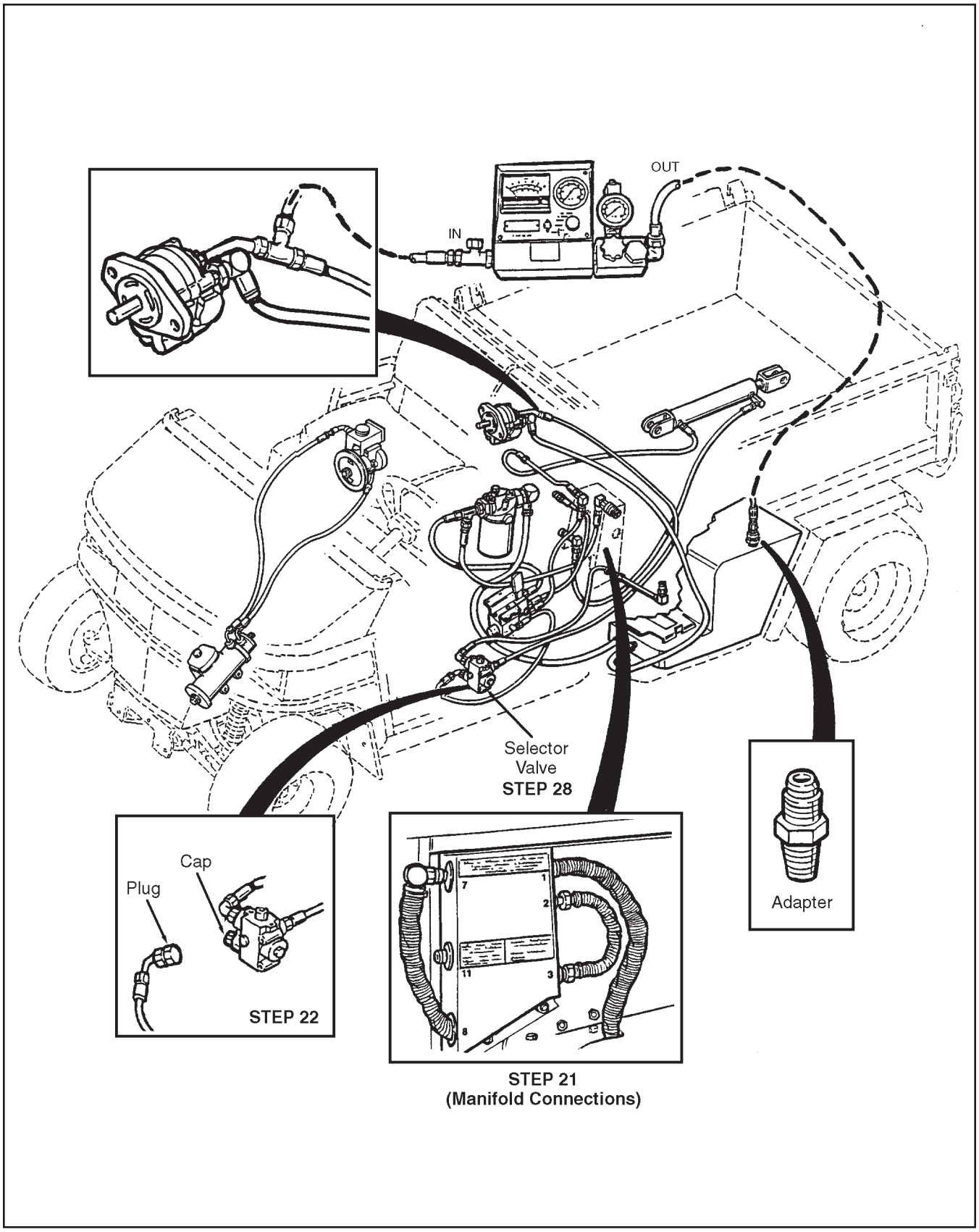


Figure 8J-4. Selector Valve Test — Steps 21 to 29

LIFT VALVE TEST (See Figure 8J-5)

NOTE

A pump flow and selector valve test should be performed before proceeding with a lift valve test.

30. At the connector manifold, disconnect lines from ports 1 and 3.
31. Open tester load valve.
32. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
33. Push lift valve lever forward into the lower position and hold.
34. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained, read/record gpm flow.
35. Subtract flow in Step 34 from flow in Step 26.

    Example:

    3.5 gpm (13.25 lpm), Step 26 @ 3900 engine RPM
    3.5 gpm (13.25 lpm), Step 34
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, valve is okay, proceed with Step 36.
    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the valve is marginal.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The pump may have to be replaced.

CAUTION

DO NOT exceed 3000 psi (20685 kPa) during this test.

36. Continue closing flowmeter load valve until flow drops off and pressure stays constant.
    - Relief valve set at 2000 psi ± 10% (12411 to 15169 kPa), proceed with Step 37.
    - Relief does not open in specified range, proceed with Step “a”.

(See Figure 8J-6)

a. Remove the acorn nut from side of valve.

b. Turn screw 1/8 turn, clockwise (CW) increases pressure or counterclockwise (CCW) to decrease pressure. Replace acorn nut.

c. Set the brake, start the engine and advance the throttle to 3900 engine RPM.

d. Push lift valve lever forward into the lower position and hold.

e. Slowly close the flowmeter load valve until flow drops off and pressure stays constant.
   - Relief should be set at 2000 psi ± 10% (12411 to 15169 kPa). Repeat Steps 36a and 36b above until correct pressure is obtained.
   - If pressure can not be obtained, valve may be faulty, replace.

37. Open tester load valve.
38. Pull lift valve lever rearward into the lift position and hold.
39. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained.
40. Subtract flow in Step 39 from flow in Step 26.

    Example:

    3.5 gpm (13.25 lpm), Step 26 @ 3900 engine RPM
    3.0 gpm (11.36 lpm), Step 39
    0.5 gpm (1.89 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, valve is okay, proceed with Step 41.
    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the valve is marginal.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The valve may have to be replaced.

41. Open tester load valve and shut down engine. Proceed with Step 42, “CYLINDER TEST”.

SECTION 8J. INSTRUMENT TEST

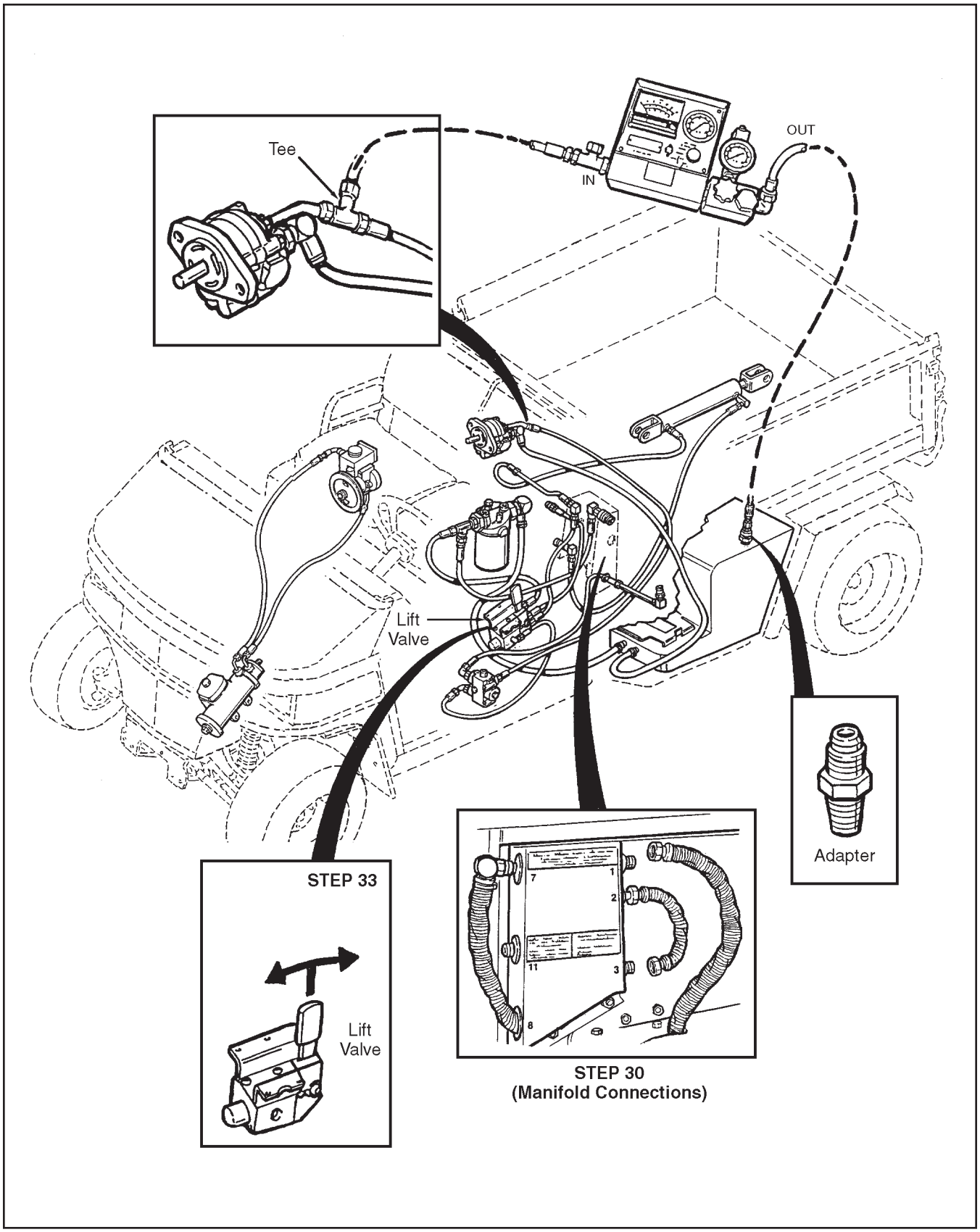


Figure 8J-5. Lift Valve Test — Steps 30 to 36

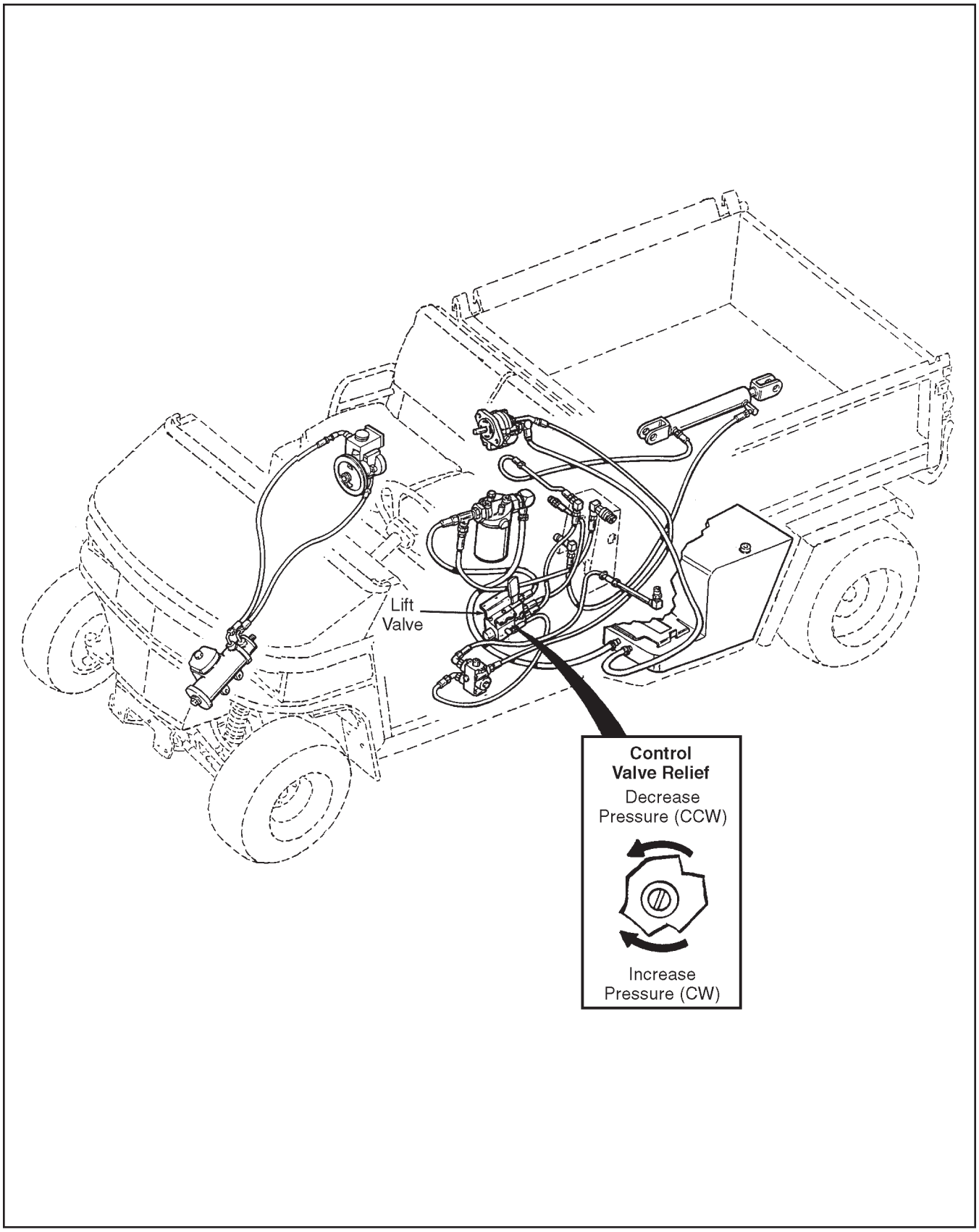


Figure 8J-6. Lift Valve Test — Steps 37 to 41

SECTION 8J. INSTRUMENT TEST

CYLINDER TEST (See Figure 8J-7)

NOTE

A pump, selector valve and lift valve test should be performed before proceeding with a lift valve test.

42. At connection manifold, connect cylinder line 4 to port 1. Connect line 2 to port 3. Connect line 8 to port 7.
43. Completely open the flowmeter load valve.
44. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
45. Push lift valve lever forward into the lower position and hold.

CAUTION

If cylinder is hooked to an implement or truck box, implement or box will move — stand clear.

46. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained.
47. Subtract gpm flow in Step 46 from flow in Step 34.

    Example:

    3.5 gpm (13.25 lpm), Step 34 @ 3900 engine RPM
    3.5 gpm (13.25 lpm), Step 46
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the cylinder is marginal, proceed with Step 48.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The cylinder may have to be rebuilt or replaced.
48. Open tester load valve.
49. Pull lift valve lever rearward into the lift position and hold.

CAUTION

If cylinder is hooked to an implement or truck box, implement or box will move — stand clear.

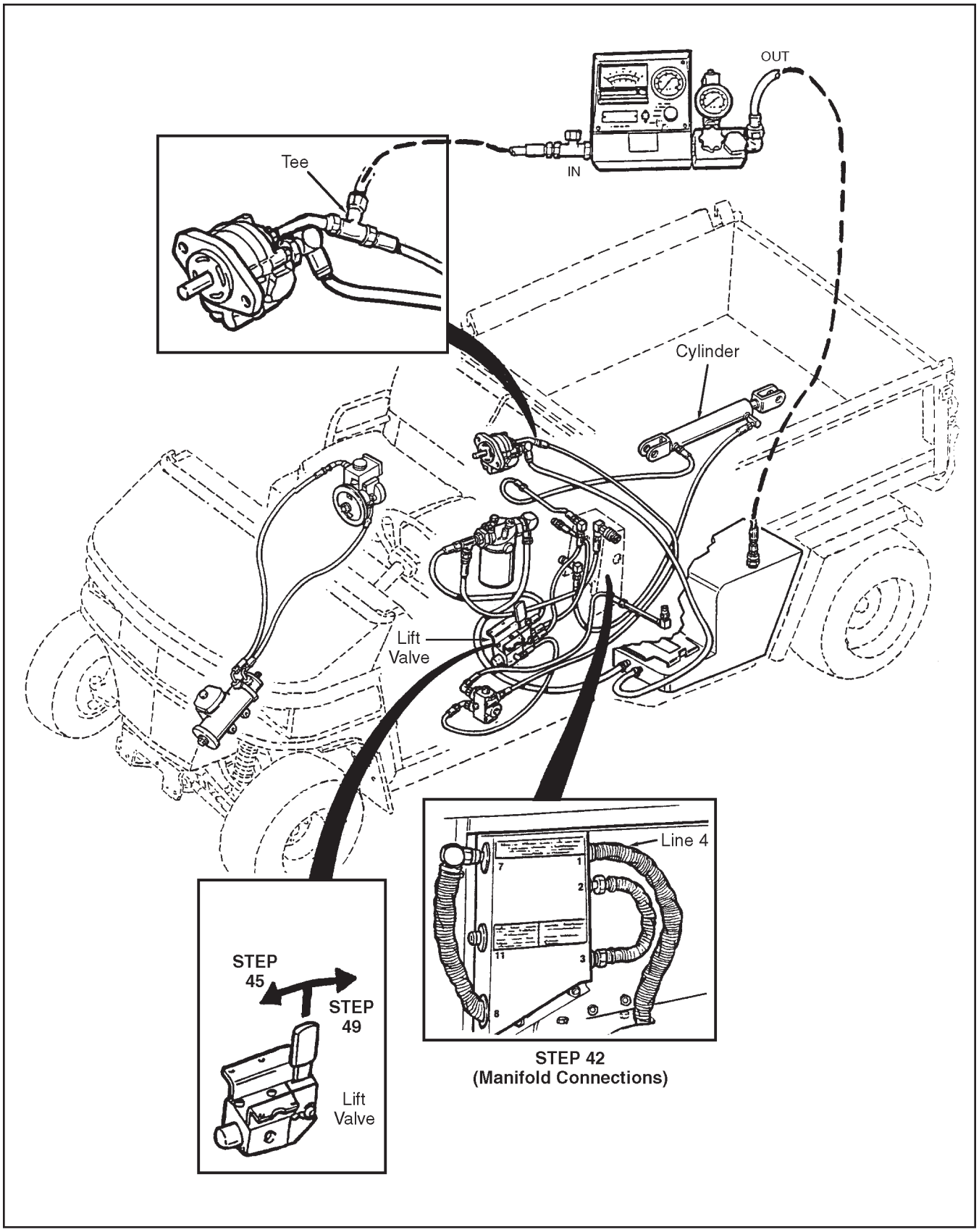
50. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained.
51. Subtract flow in Step 50 from flow in Step 39.

    Example:

    3.0 gpm (11.36 lpm), Step 39 @ 3900 engine RPM
    3.0 gpm (11.36 lpm), Step 50
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the cylinder is marginal, proceed with Step 52.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The cylinder may have to be rebuilt or replaced.
52. Open tester load valve and shut down the engine.

SECTION 8J. INSTRUMENT TEST



STEP 42
(Manifold Connections)

Figure 8J-7 Cylinder Test

SECTION 8J. INSTRUMENT TEST

OPTIONAL HIGH/LOW SYSTEM

PUMP FLOW TEST SECTION 1 (See Figure 8J-8)

1. At the pump, remove the outlet line from pump section 1. Plug line.
2. Install a tee to pump outlet port.
3. Connect flowmeter “IN” port line to the pump tee. Cap remaining port of tee.
4. Install a 1/2-14 pipe to 7/8-14, 37° flare adapter (Aeroquip #2021-8-10 or equivalent) in the hydraulic tank fill port.
5. Connect the flowmeter “OUT” line to the adapter.
6. Completely open the flowmeter load valve.
7. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
8. Read/record no load flow. No load flow should be 5.0 gpm (18.93 lpm).
   - If flow is in specified range, proceed with Step 9.
   - If flow is lower than specified, engine RPM not correct or pump is faulty.
9. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained. Record gpm flow.
10. Subtract flow in Step 9 from flow in Step 8.

    Example:

    5.0 gpm (18.93 lpm), Step 8 @ 3900 engine RPM
    5.0 gpm (18.93 lpm), Step 9
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, pump is okay, proceed with Step 11.
    - If leakage is 1/2 to 1-1/2 gpm (1.89 to 5.68 lpm), the pump is marginal.
    - More than 1-1/2 gpm (5.68 lpm) leakage will noticeably reduce performance. The pump may have to be repaired or replaced (Section 8D).
11. Open tester load valve and shut down engine. Proceed with Step 12, “BOTTOM SELECTOR VALVE TEST”.

BOTTOM SELECTOR VALVE TEST (See Figure 8J-9)

NOTE

A pump test should be performed before proceeding with a selector valve test.

12. Reconnect pump section 1 outlet line to tee.
13. At bottom selector valve, disconnect hose from inside bottom port, plug line and cap valve port.
14. Push selector valve knob down.
15. Completely open the flowmeter load valve.
16. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
17. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained. Record flow.
18. Subtract flow in Step 17 from flow in Step 9.

    Example:

    4.5 gpm (17.03 lpm), Step 9 @ 3900 engine RPM
    4.5 gpm (17.03 lpm), Step 17
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, valve is okay, proceed to Step 19.
    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the valve is marginal.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The valve may have to be replaced.
19. Completely open tester load valve and shut down engine.
20. Reconnect hose to bottom port of selector valve. Proceed with Step 21, “LIFT VALVE TEST”.

SECTION 8J. INSTRUMENT TEST

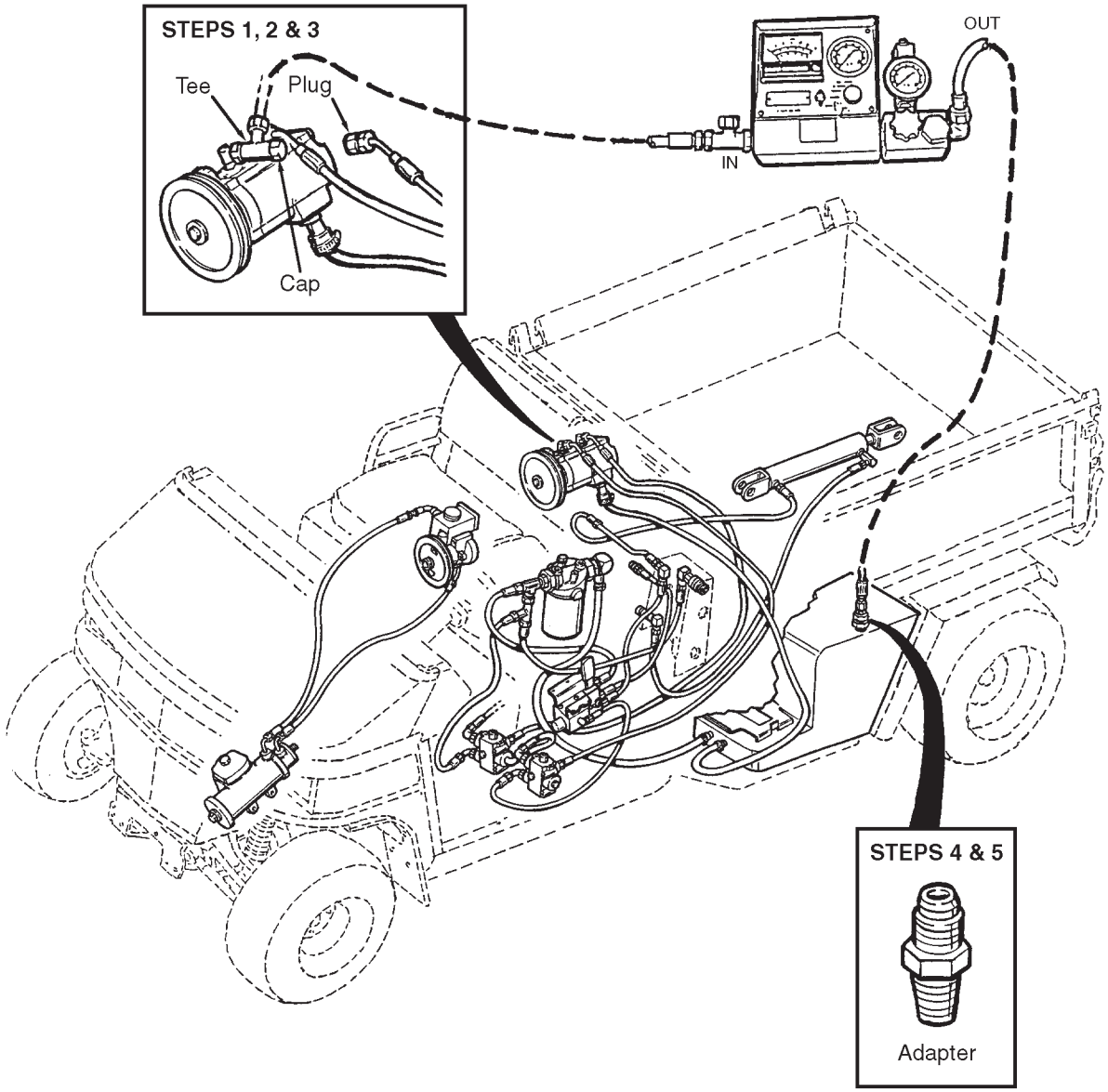


Figure 8J-8. Pump Section 1 Flow Test

SECTION 8J. INSTRUMENT TEST

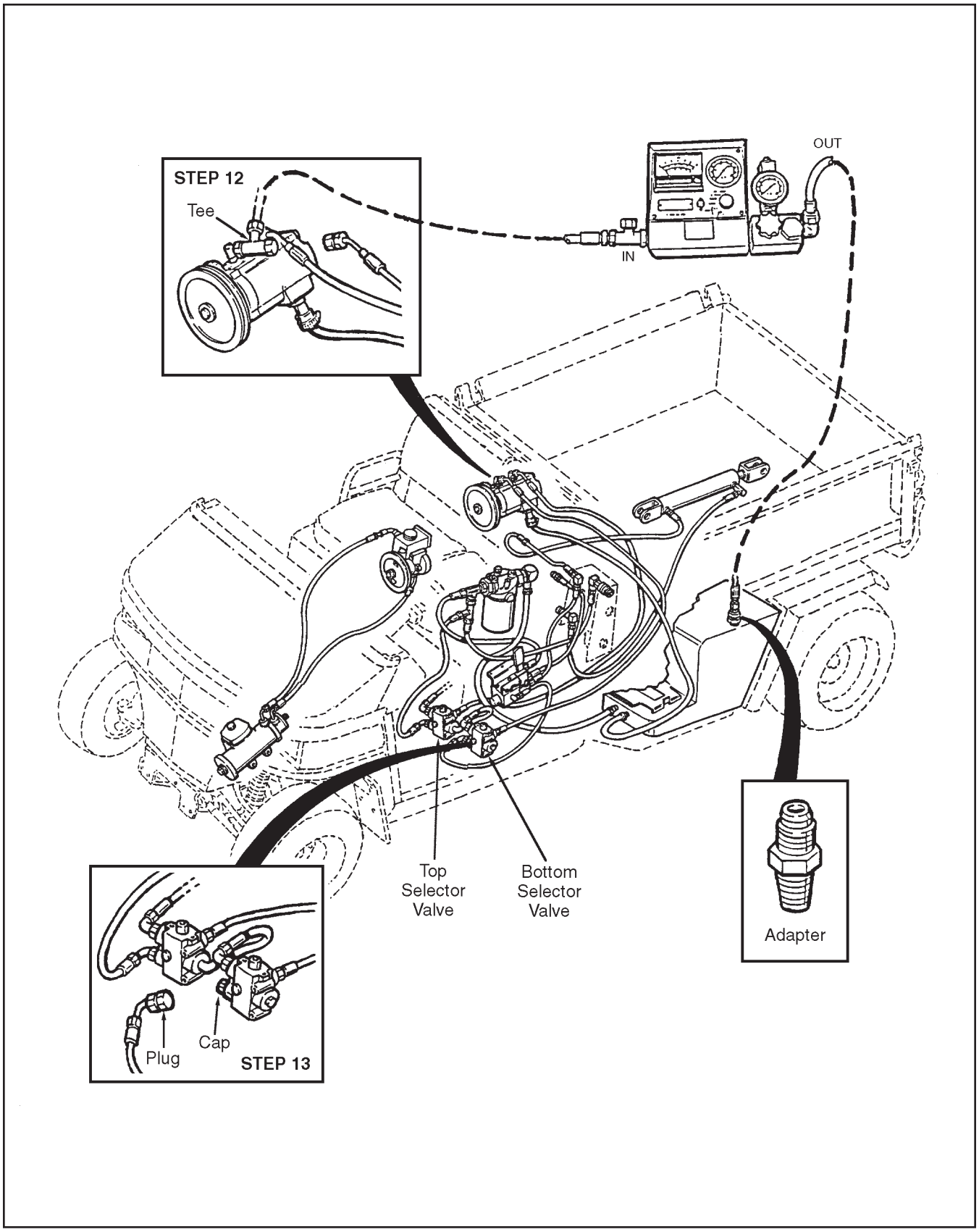


Figure 8J-9. Bottom Selector Valve Test

LIFT VALVE TEST (See Figure 8J-10)

NOTE

A pump flow and selector valve test should be performed before proceeding with a lift valve test.

21. At the connector manifold, disconnect line 4 from port 1 and line 2 from port 3.
22. Completely open the flowmeter load valve.
23. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
24. Push lift valve lever forward into the lower position and hold.
25. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained, read/record gpm flow.
26. Subtract flow in Step 25 from flow in Step 17.

    Example:

    3.0 gpm (11.36 lpm), Step 17 @ 3900 engine RPM
    3.0 gpm (11.36 lpm), Step 25
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, valve is okay, proceed with Step 27.
    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the valve is marginal.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The valve may have to be replaced.
27. Continue closing flowmeter load valve until flow drops off and pressure stays constant.

⚠ CAUTION

DO NOT exceed 2500 psi (17237 kPa) during this test.

- Relief set at 2000 psi ± 10% (12411 to 15169 kPa), relief is okay, proceed with Step 27.
- Relief does not open in specified range, proceed with Step “a” .

a. Remove the acorn nut from side of valve.

b. Turn screw 1/8 turn, clockwise (CW) increases pressure or counterclockwise (CCW) to decrease pressure. Replace acorn nut.

c. Set the brake, start the engine and advance the throttle to 3900 engine RPM.

d. Push lift valve lever forward into the lower position and hold.

e. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained, read/record gpm flow.

- Relief should be set at 2000 psi ± 10% (12411 to 15169 kPa). Repeat Steps 27a and 27b until correct pressure is obtained.
- If pressure can not be obtained, valve may be faulty, replace.

28. Open tester load valve.
29. Pull lift valve lever rearward into the lift position and hold.
30. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained.
31. Subtract flow in Step 30 from flow in Step 17.

    Example:

    3.0 gpm (11.36 lpm), Step 17 @ 3900 engine RPM
    3.0 gpm (11.36 lpm), Step 30
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, valve is okay, proceed with Step 32.
    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the valve is marginal.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The valve may have to be replaced.
32. Open tester load valve and shut down the engine.

SECTION 8J. INSTRUMENT TEST

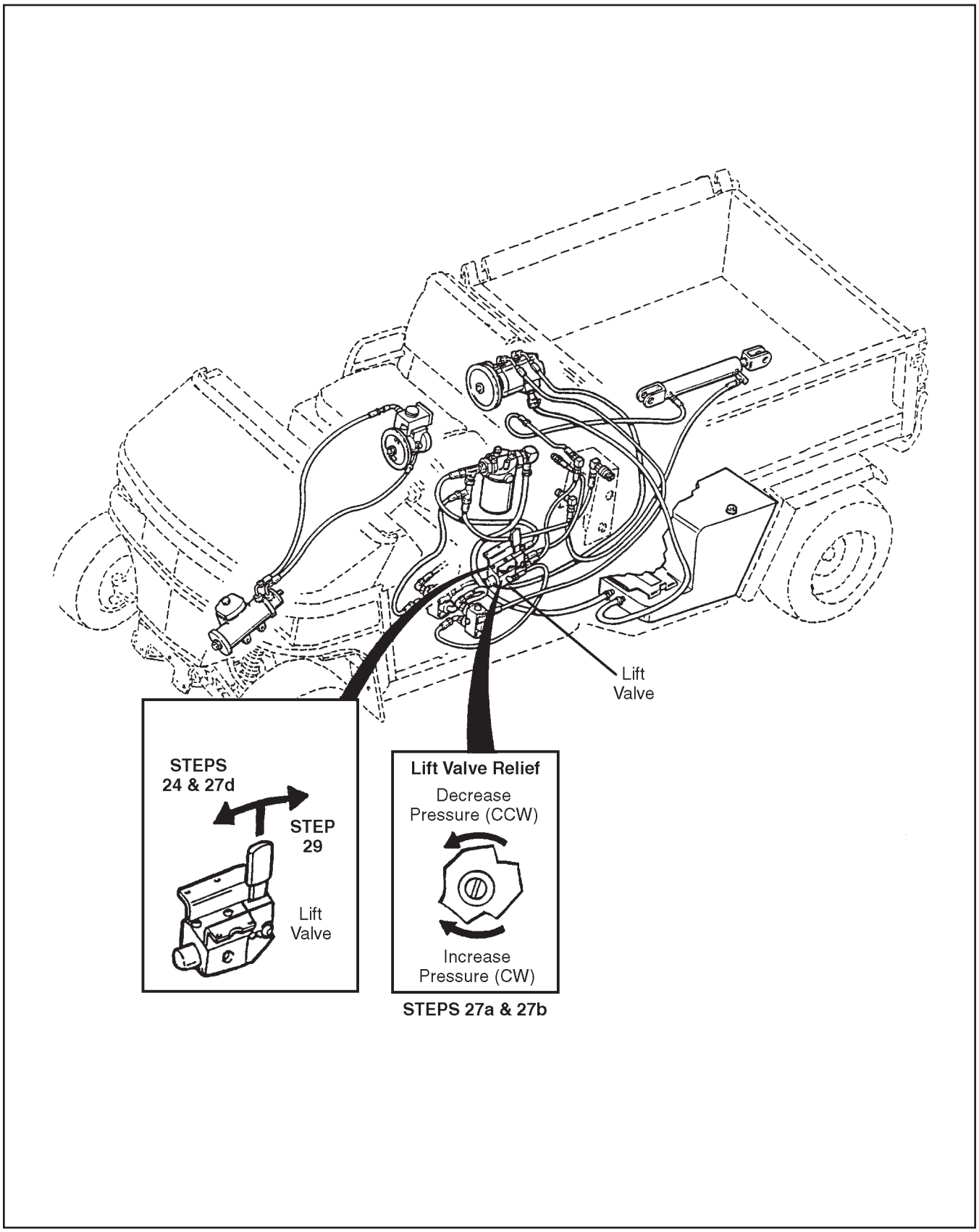


Figure 8J-10. Lift Valve Test

SECTION 8J. INSTRUMENT TEST

CYLINDER TEST (See Figure 8J-11)

NOTE

A pump, selector valve and lift valve test should be performed before proceeding with a lift valve test.

33. At connection manifold, connect cylinder line 4 to port 1. Connect line 2 to port 3.
34. Completely open the flowmeter load valve.
35. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
36. Push lift valve lever forward into the lower position and hold.

CAUTION

If cylinder is hooked to an implement or truck box, implement or box will move — stand clear.

37. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained.
38. Subtract flow in Step 37 from flow in Step 25.

    Example:

    3.0 gpm (11.36 lpm), Step 25 @ 3900 engine RPM
    3.0 gpm (11.36 lpm), Step 37
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the valve is marginal, proceed with Step 39.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The cylinder may have to be rebuilt or replaced.
39. Open tester load valve.
40. Pull lift valve lever rearward into the lift position and hold.
41. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained.
42. Subtract flow in Step 41 from flow in Step 29.

    Example:

    3.0 gpm (11.36 lpm), Step 29 @ 3900 engine RPM
    3.0 gpm (11.36 lpm), Step 41
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the valve is marginal, proceed with Step 43.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The cylinder may have to be rebuilt or replaced.
43. Open tester load valve and shut down the engine.

SECTION 8J. INSTRUMENT TEST

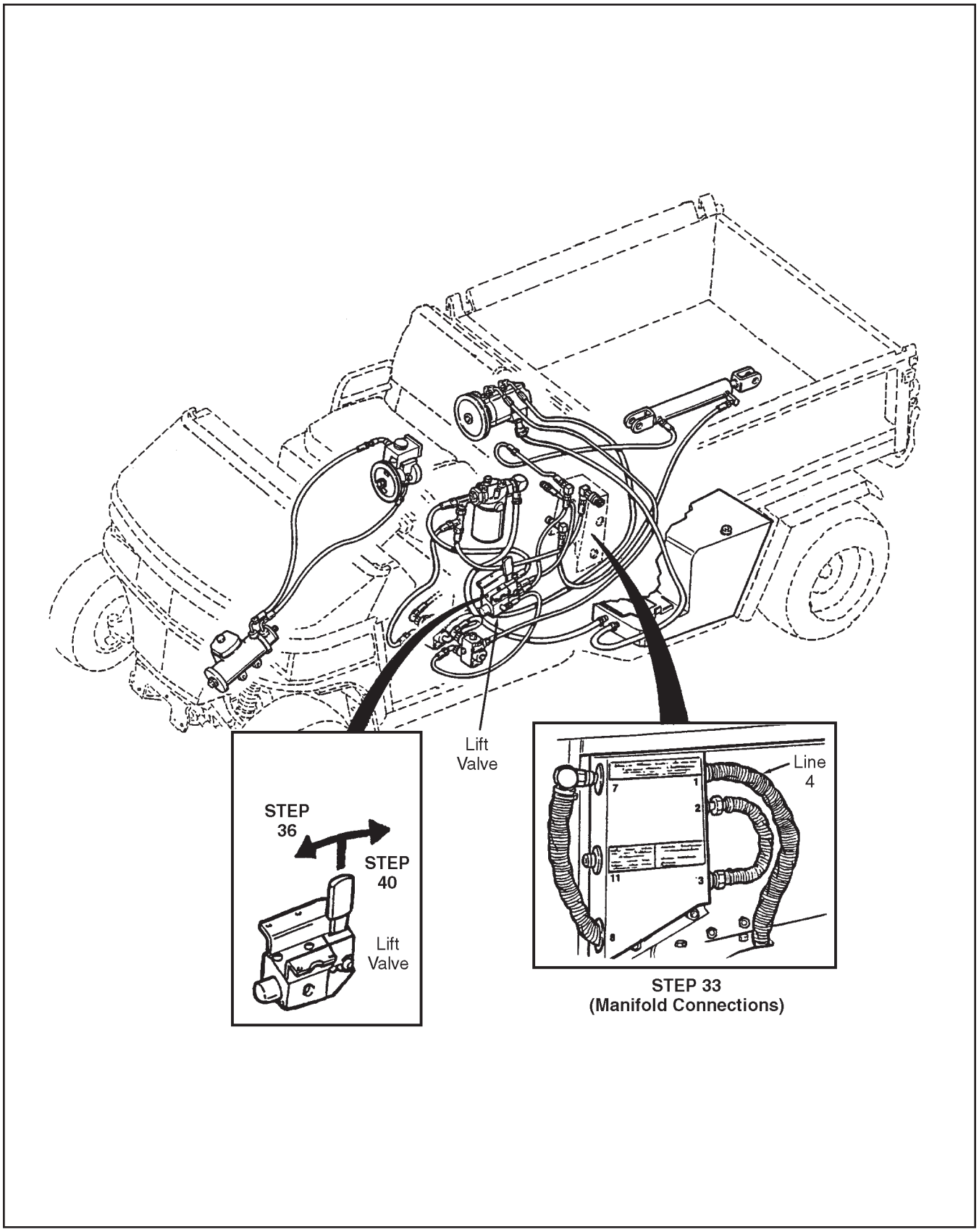


Figure 8J-11. Cylinder Test

SECTION 8J. INSTRUMENT TEST

PUMP FLOW TEST SECTION 2 (See Figure 8J-12)

1. At the pump, remove the outlet line from pump section 1. Plug line.
2. Install a tee to pump outlet port.
3. Connector flowmeter “IN” port line to the pump tee. Cap remaining port of tee.
4. Install a 1/2-14 pipe to 7/8-14, 37° flare adapter (Aeroquip #2021-8-10 or equivalent) in the hydraulic tank fill port.
5. Connect the flowmeter “OUT” line to the adapter.
6. Completely open the flowmeter load valve.
7. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
8. Read/record no load flow. No load flow should be 4.0 gpm (15.14 lpm).
   - If flow is in specified range, proceed with Step 9.
   - If flow is lower than specified, engine RPM not correct or pump is faulty.
9. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained. Record flow.
10. Subtract flow in Step 9 from flow in Step 8.

    Example:

    4.0 gpm (15.14 lpm), Step 8 @ 3900 engine RPM
    4.0 gpm (15.14 lpm), Step 9
    0.0 gpm (0.0 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, pump is okay, proceed with Step 11.
    - If leakage is 1/2 to 1-1/2 gpm (1.89 to 3.78 lpm), the pump is marginal.
    - More than 1-1/2 gpm (3.78 lpm) leakage will noticeably reduce performance. The pump may have to be repaired or replaced (Section 8D).
11. Continue closing flowmeter load valve until flow drops off and pressure stays constant.

CAUTION

DO NOT exceed 2500 psi (17237 kPa) during this test.

- Relief set at 2000 psi ± 10% (12411 to 15169 kPa), relief is okay, proceed with Step 12.
- Relief does not open in specified range, proceed with Step “a” below.

a. Remove the acorn nut from side of valve.

b. Turn screw 1/8 turn, clockwise (CW) increases pressure or counterclockwise (CCW) to decrease pressure. Replace acorn nut.

c. Set the brake, start the engine and advance the throttle to 3900 engine RPM.

d. Push lift valve lever forward into the lower position and hold.

e. Slowly close the flowmeter load valve until 1800 psi (2441 N.m) is obtained, read/record flow.

- Relief should be set at 2000 psi ± 10% (12411 to 15169 kPa). Repeat Steps 11a and 11b above until correct pressure is obtained.
- If pressure can not be obtained, valve may be faulty, replace.

12. Open tester load valve and shut down engine.

TOP SELECTOR VALVE TEST (See Figure 8J-13)

NOTE

A pump test should be performed before proceeding with a selector valve test.

13. Reconnect pump section 1 outlet line to tee.
14. At connection manifold, disconnect line 8 from port 7.
15. Put high/low speed selector lever in low.
16. Pull selector valve knob up.
17. Completely open the flowmeter load valve.
18. Set the brake, start the engine and advance the throttle to 3900 engine RPM.
19. Slowly close the flowmeter load valve until 1800 psi (12411 kPa) is obtained. Record flow.
20. Subtract flow in Step 19 from flow in Step 9.

    Example:

    5.0 gpm (18.93 lpm), Step 9 @ 3900 engine RPM
    4.5 gpm (17.04 lpm), Step 19
    0.5 gpm (1.89 lpm) leakage

    - If leakage is 1/2 gpm (1.89 lpm) or less, pump is okay, proceed with Step 21.
    - If leakage is 1/2 to 1 gpm (1.89 to 3.78 lpm), the pump is marginal.
    - More than 1 gpm (3.78 lpm) leakage will noticeably reduce performance. The valve may have to be replaced.
21. Open tester load valve and shut down engine.

SECTION 8J. INSTRUMENT TEST

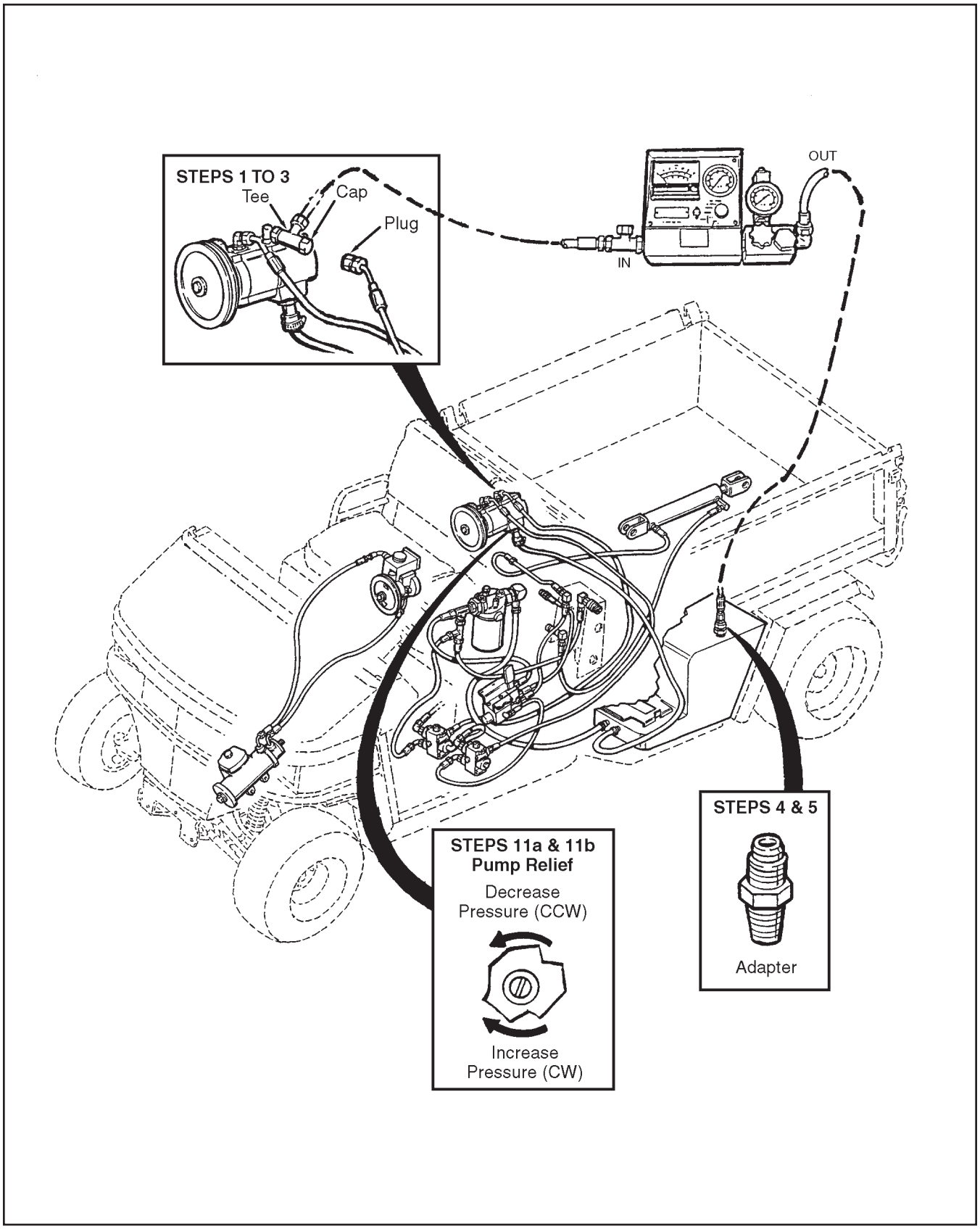


Figure 8J-12. Pump Section 2 Flow Test

SECTION 8J. INSTRUMENT TEST

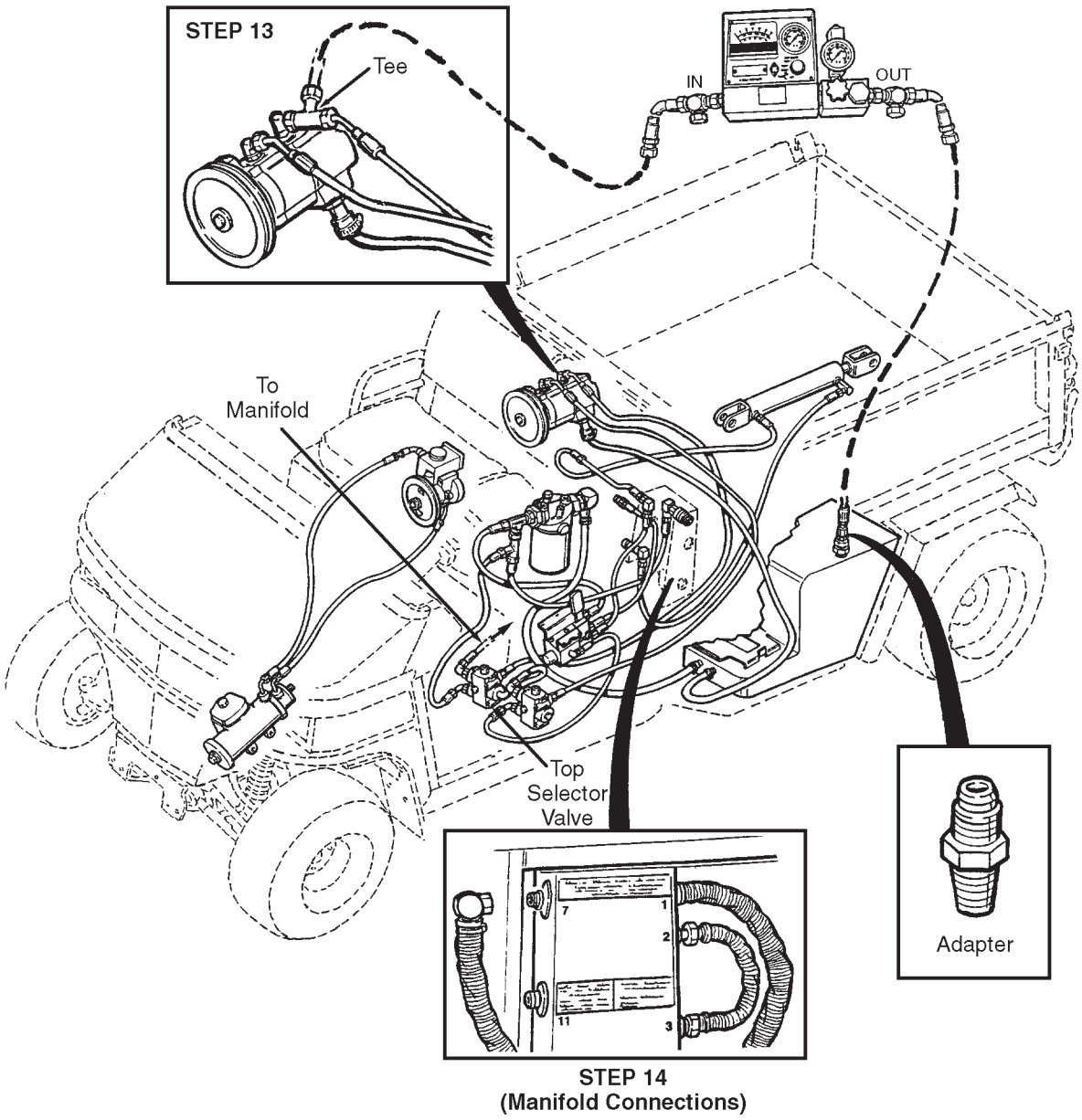


Figure 8J-13. Bottom Selector Test

SECTION 8K. HYDRAULIC DIAGRAMS AND COMPONENT LOCATIONS

HYDRAULIC GRAPHIC SYMBOLS

These are hydraulic graphic symbols commonly used in Textron Golf, Turf & Specialty Products diagrams and schematics.

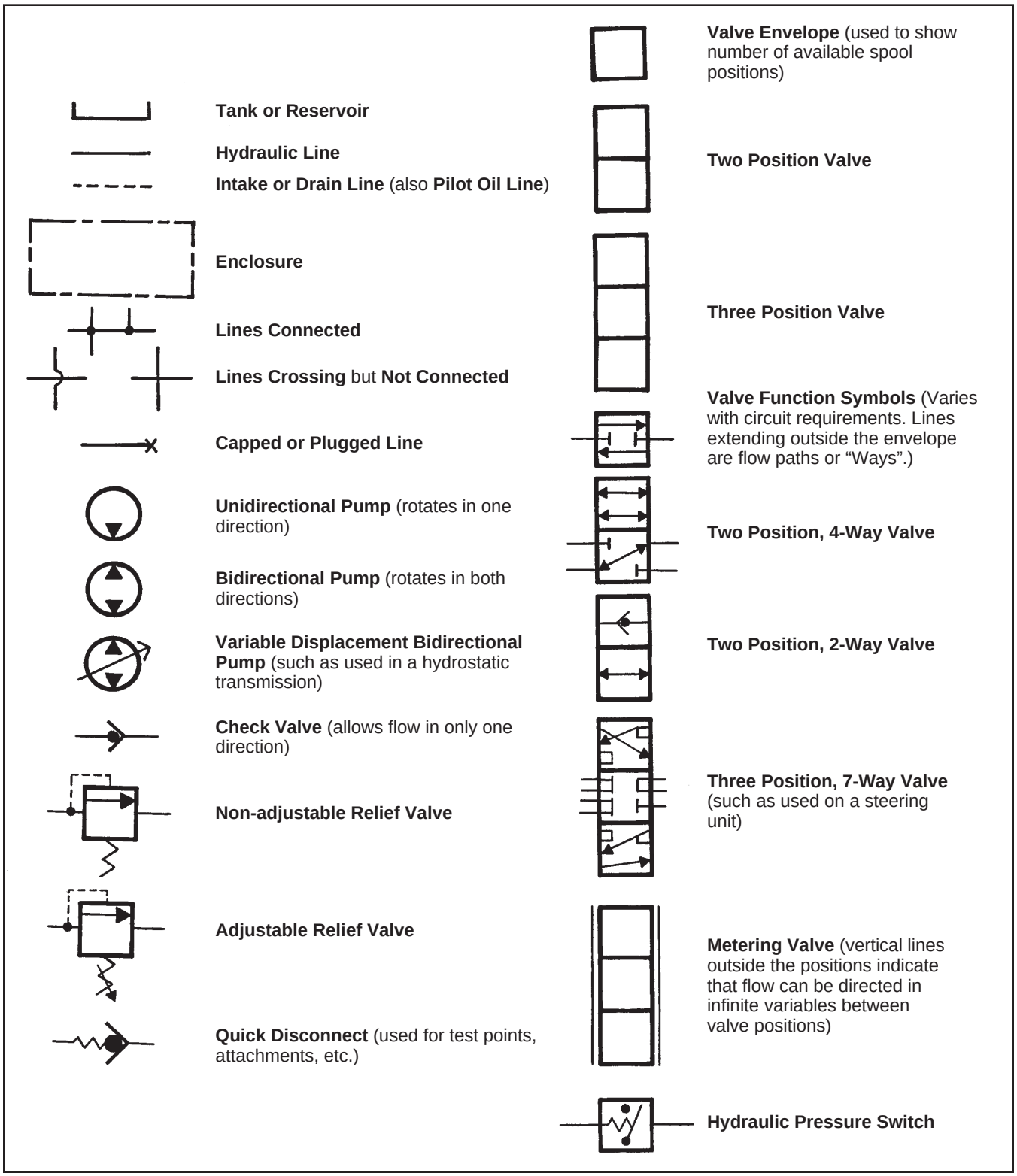


Figure 8K-1. Hydraulic Schematic Symbols (1 of 2)

SECTION 8K. HYDRAULIC DIAGRAMS AND COMPONENT LOCATIONS

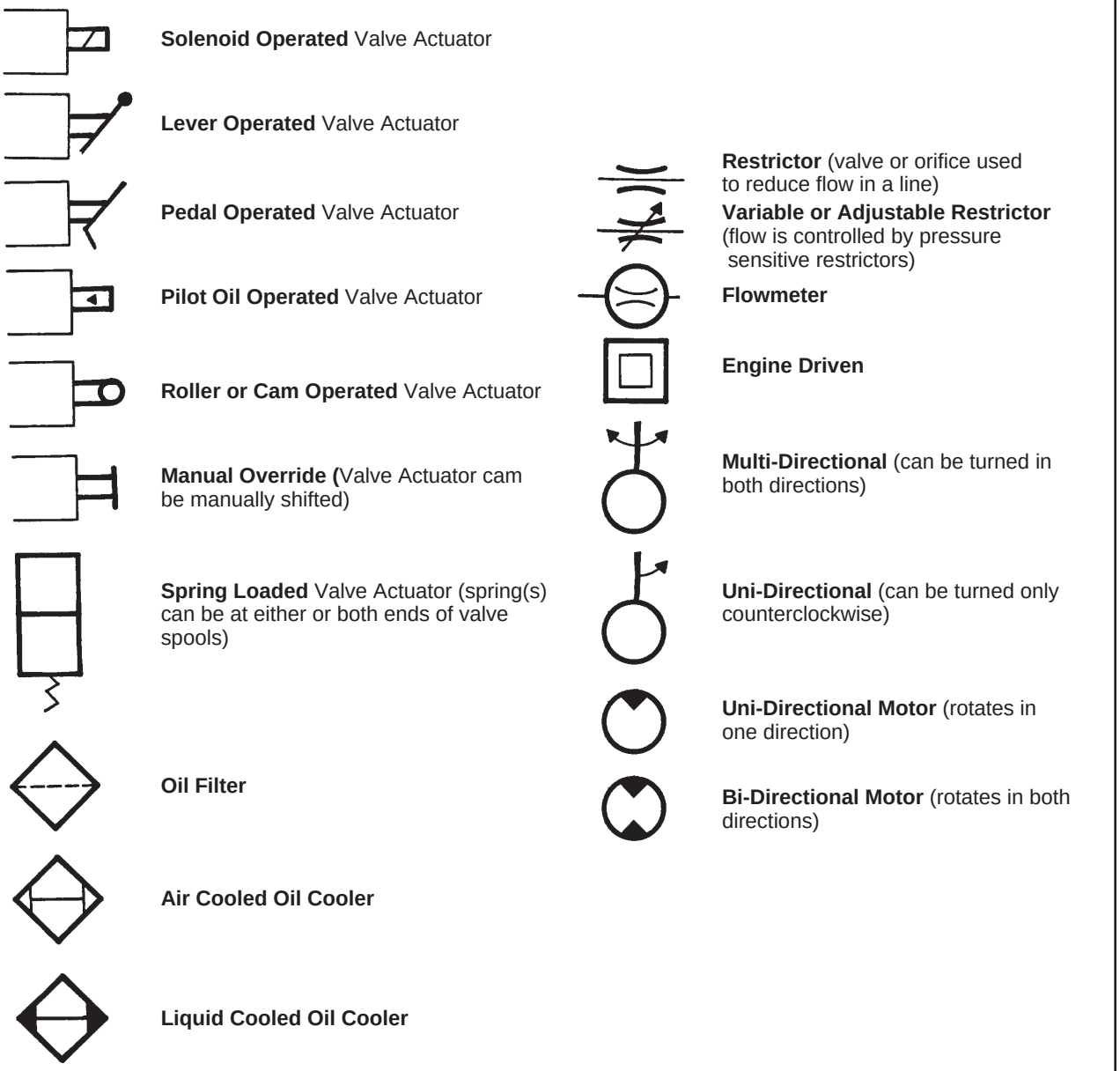


Figure 8K-1. Hydraulic Schematic Symbols (2 of 2)

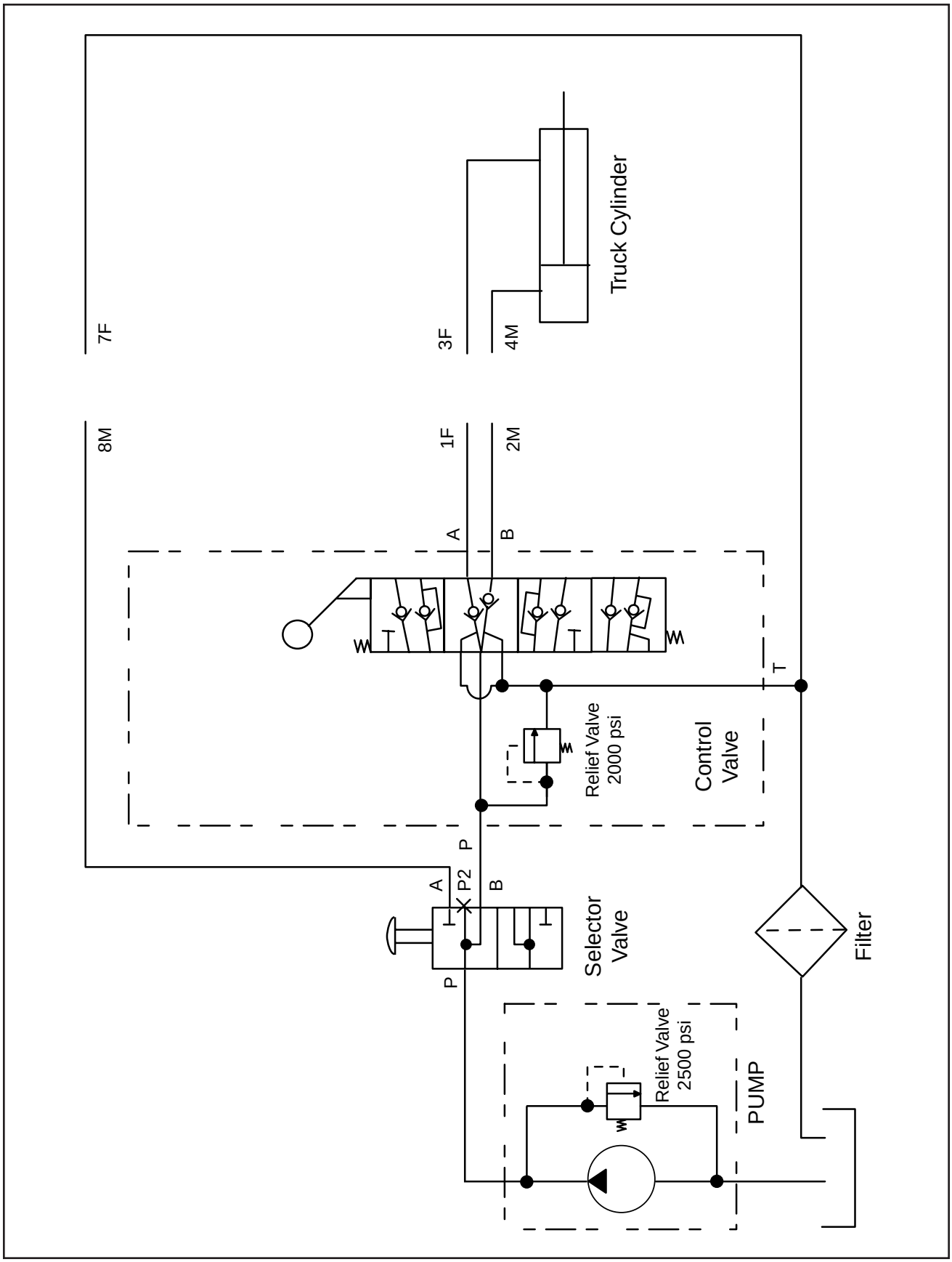


Figure 8K-2. Standard Hydraulic System Schematic

SECTION 8K. HYDRAULIC DIAGRAMS AND COMPONENT LOCATIONS

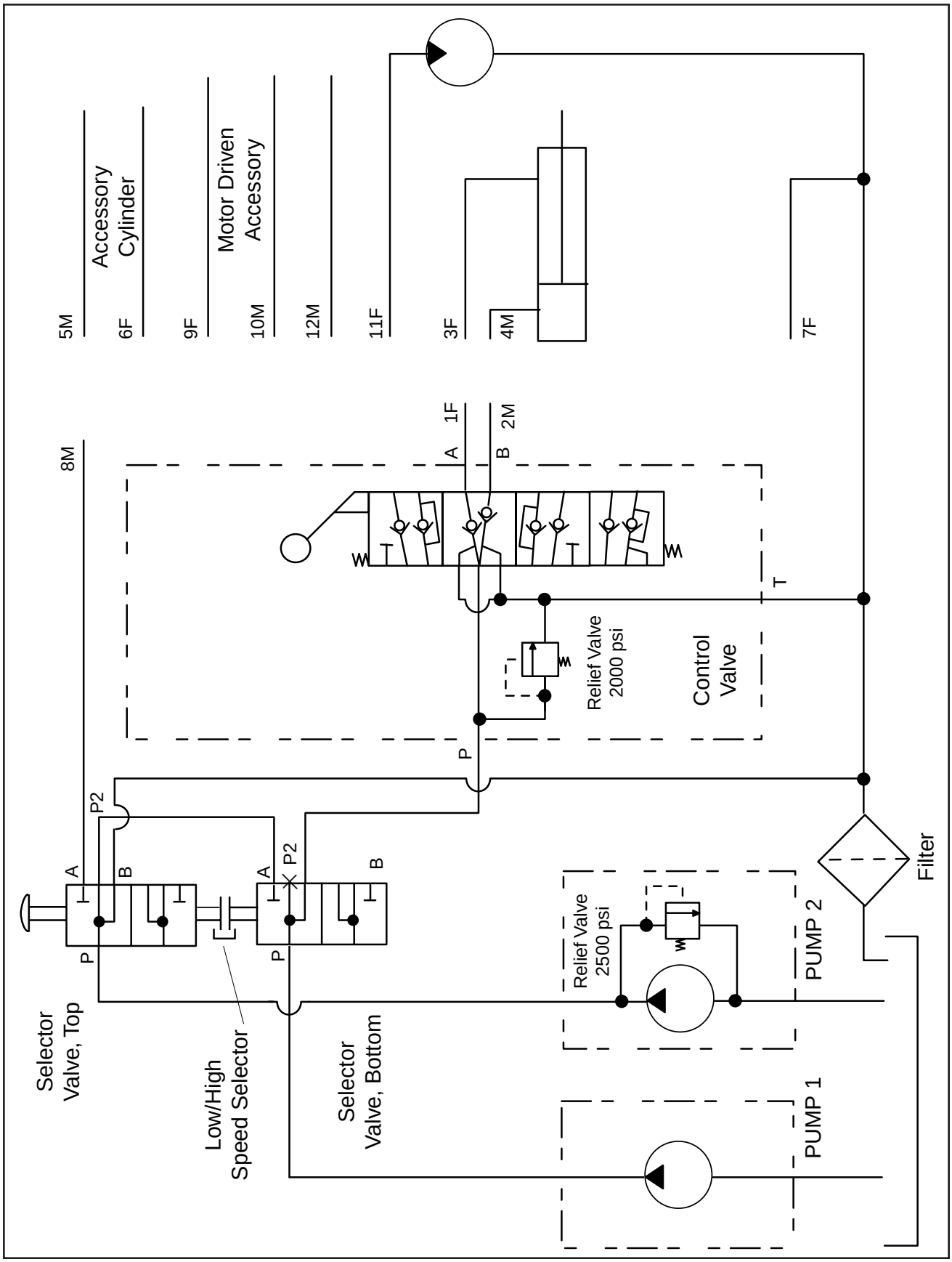


Figure 8K-3. High/Low Hydraulic System Schematic

SECTION 8K. HYDRAULIC DIAGRAMS AND COMPONENT LOCATIONS

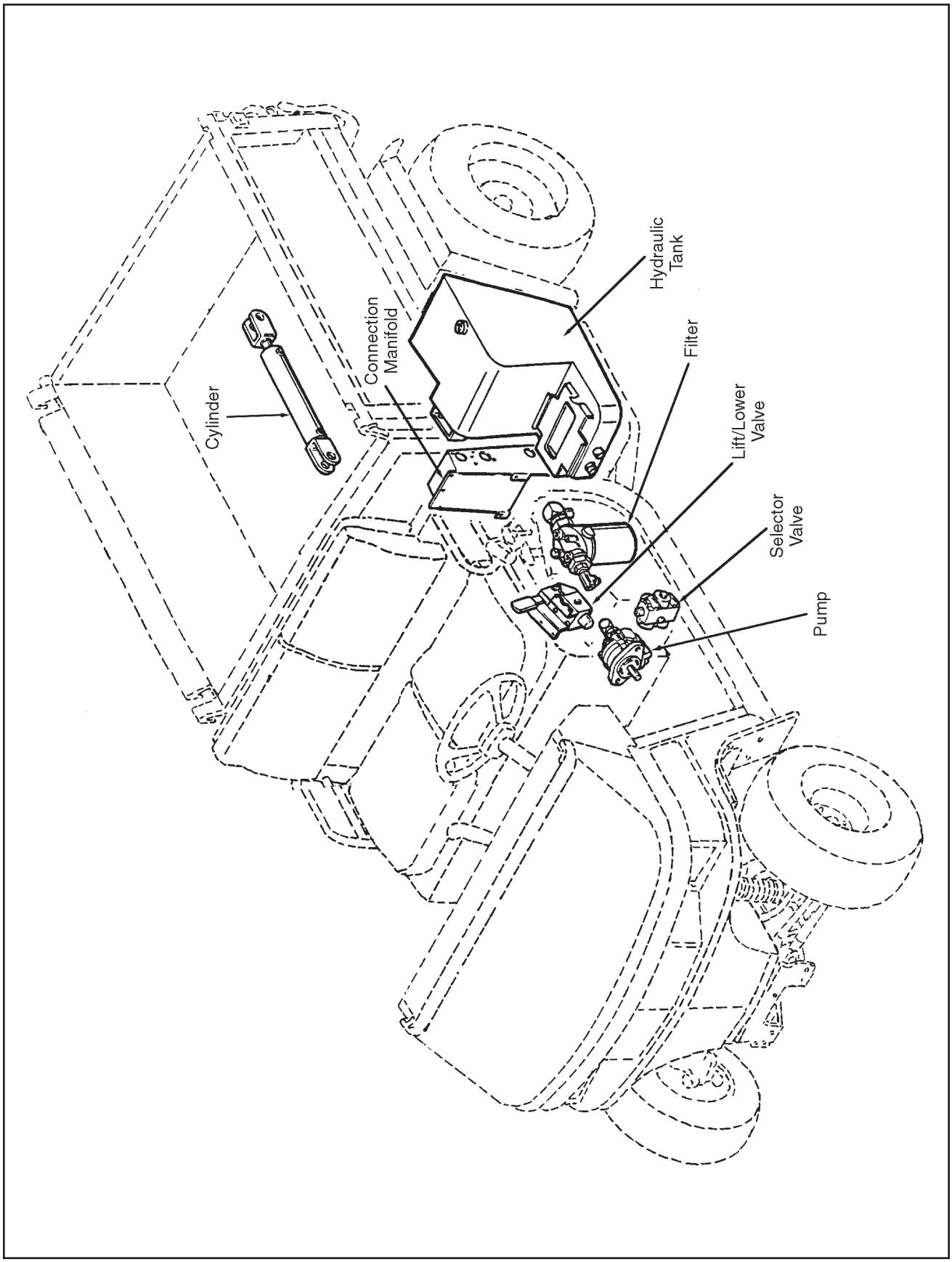


Figure 8K-4. Hydraulic Component Locations (Standard Hydraulic System)

SECTION 8K. HYDRAULIC DIAGRAMS AND COMPONENT LOCATIONS

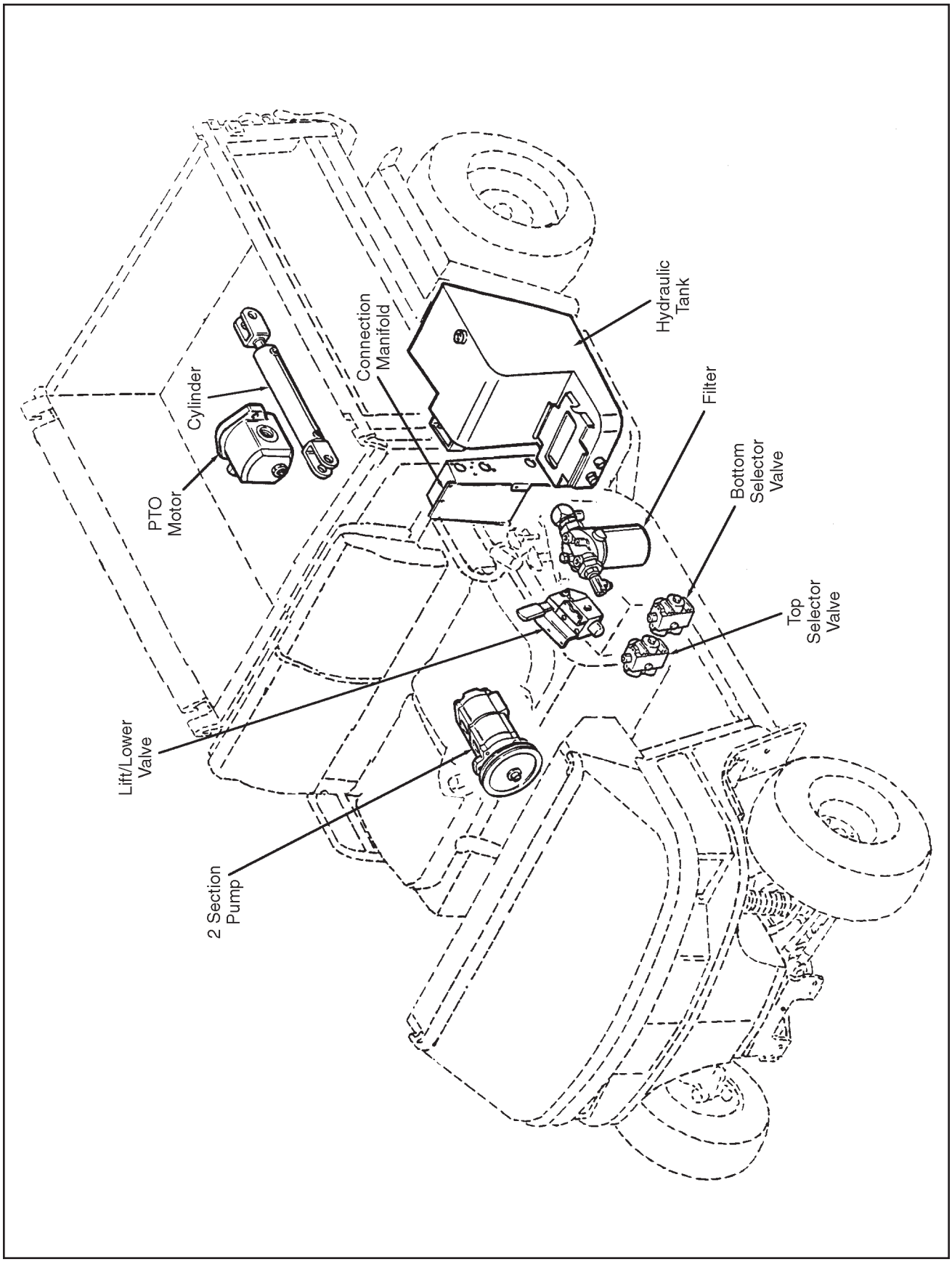


Figure 8K-5. Hydraulic Component Locations (High/Low Hydraulic System)

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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.
	Antiseize.
Lubricants:	Refer to Section 11.

SECTION 9B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Box lift/lower functions do not occur when lever is actuated.	a. Linkage is worn.	a. Replace linkage (Section 2).
	b. Hydraulic lines are kinked.	b. Replace lines (Section 8).
	c. Hydraulic pump faulty.	c. Test pump (Section 8).
	d. Hydraulic cylinder is not functioning.	d. Test/repair cylinder (Section 8).
	e. Lift and lower control valve is malfunctioning.	e. Test/repair valve (Section 8).
2. Slow or noisy lift/lower operation.	a. Low fluid level in hydraulic tank.	a. Fill tank, check for hydraulic leaks.
	b. Loose connections on hoses and to components.	b. Repair connections (Section 8C).
	c. Worn cylinder seals.	c. Replace seals (Section 8).
	d. Valves malfunctioning.	d. Test/repair valve (Section 8).

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. Position a suitable container below the tank, disconnect input and output fuel lines and drain the tank.
2. Remove attaching hardware, fuel tank and tank mounting plate.
3. Test fuel sender as described in Section 10. If necessary, replace fuel sender.
4. Replace damaged or leaking tank and install as shown in Figure 9C-1.
5. Reconnect fuel lines.
6. Fill the tank with 87 octane or higher unleaded gasoline for vehicles with gasoline engines or No. 2-D (ASTM D975) diesel fuel for vehicles with diesel engines.

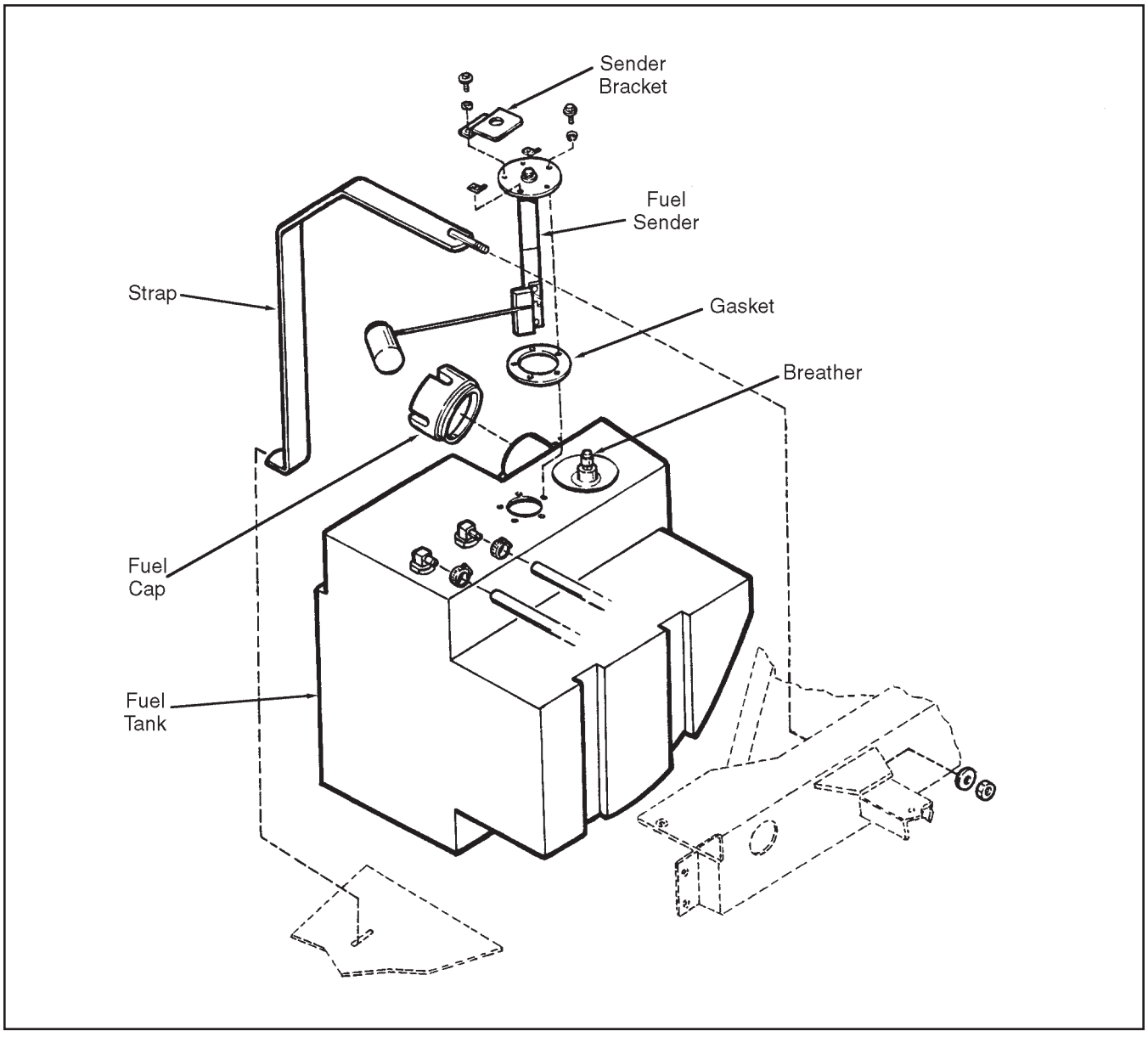

Figure 9C-1. Fuel Tank Removal and Installation

SECTION 9D. HYDRAULIC TANK

GENERAL

The hydraulic tank requires little or no service other than removing and cleaning outlet strainer and adding hydraulic oil when indicated by checking the dipstick. The hydraulic oil level should be checked daily for proper level. Use extreme care when checking oil level to prevent the entry of contaminates.

Do not check oil level when oil is hot.

Oil level should never be below the low level mark or more than 1/4 inch (6.35 mm) above the high level mark.

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 vented 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)

Remove the battery from mounting bracket on the tank.

Position an approved container below the tank, disconnected in and out hydraulic lines and drain the fluid into a suitable container and disconnect all hoses at the tank.

When installing the hydraulic tank, secure the tank with mounting hardware, connect hydraulic hoses to the tank and fill with approximately 4 gals. (15.2 liters) of Turf Protector for vehicles without hydraulic PTO option and with 7.6 gals. (28.8 liters) for vehicles with hydraulic PTO option.

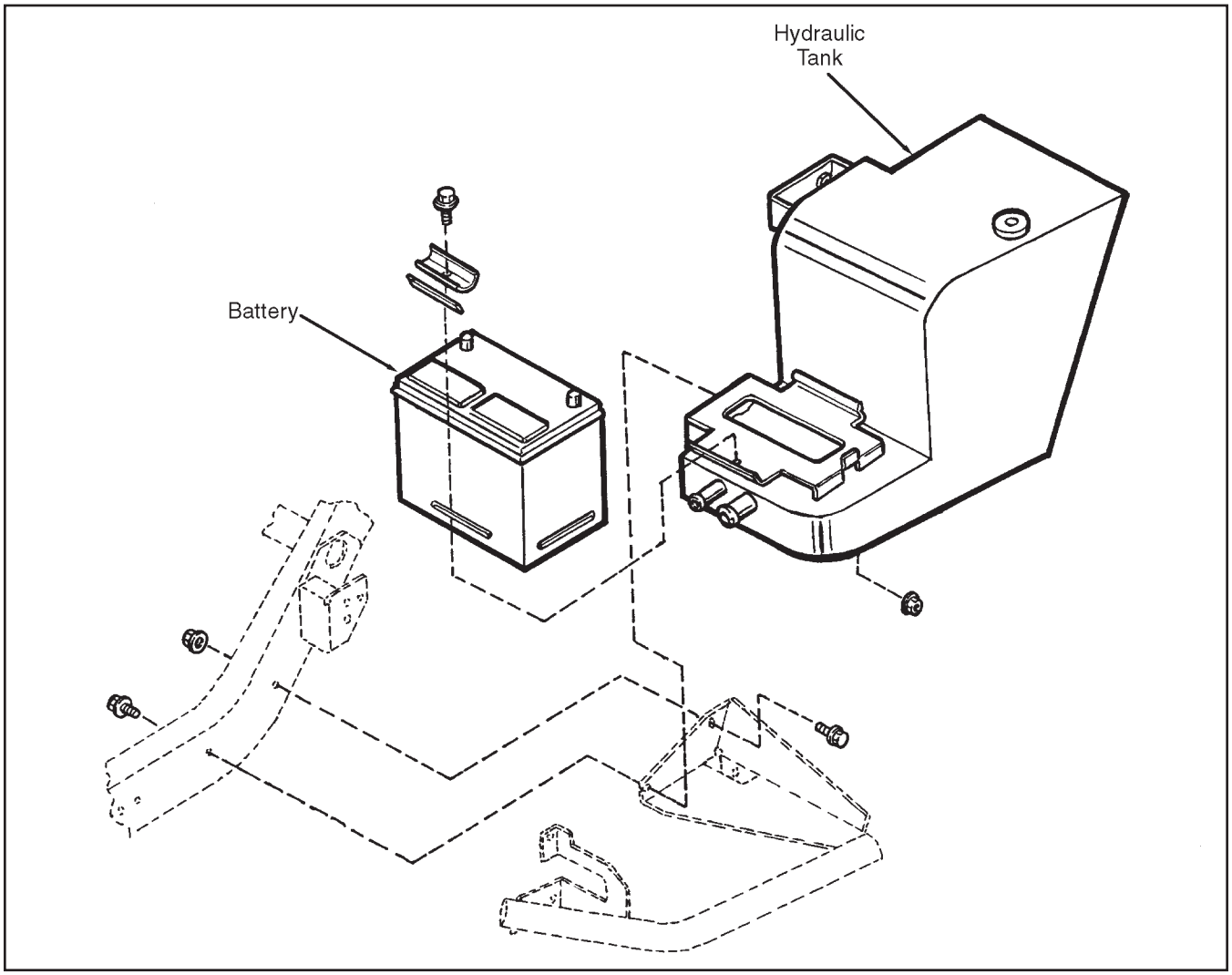

Figure 9D-1. Hydraulic Tank Removal and Installation

SECTION 9E. FRONT SUSPENSION

REPAIR (See Section 9E-1)

Remove and replace damaged shocks and other parts as shown in Figure 9E-1.

After front suspension repairs, align the front wheels as described in Section 6F.

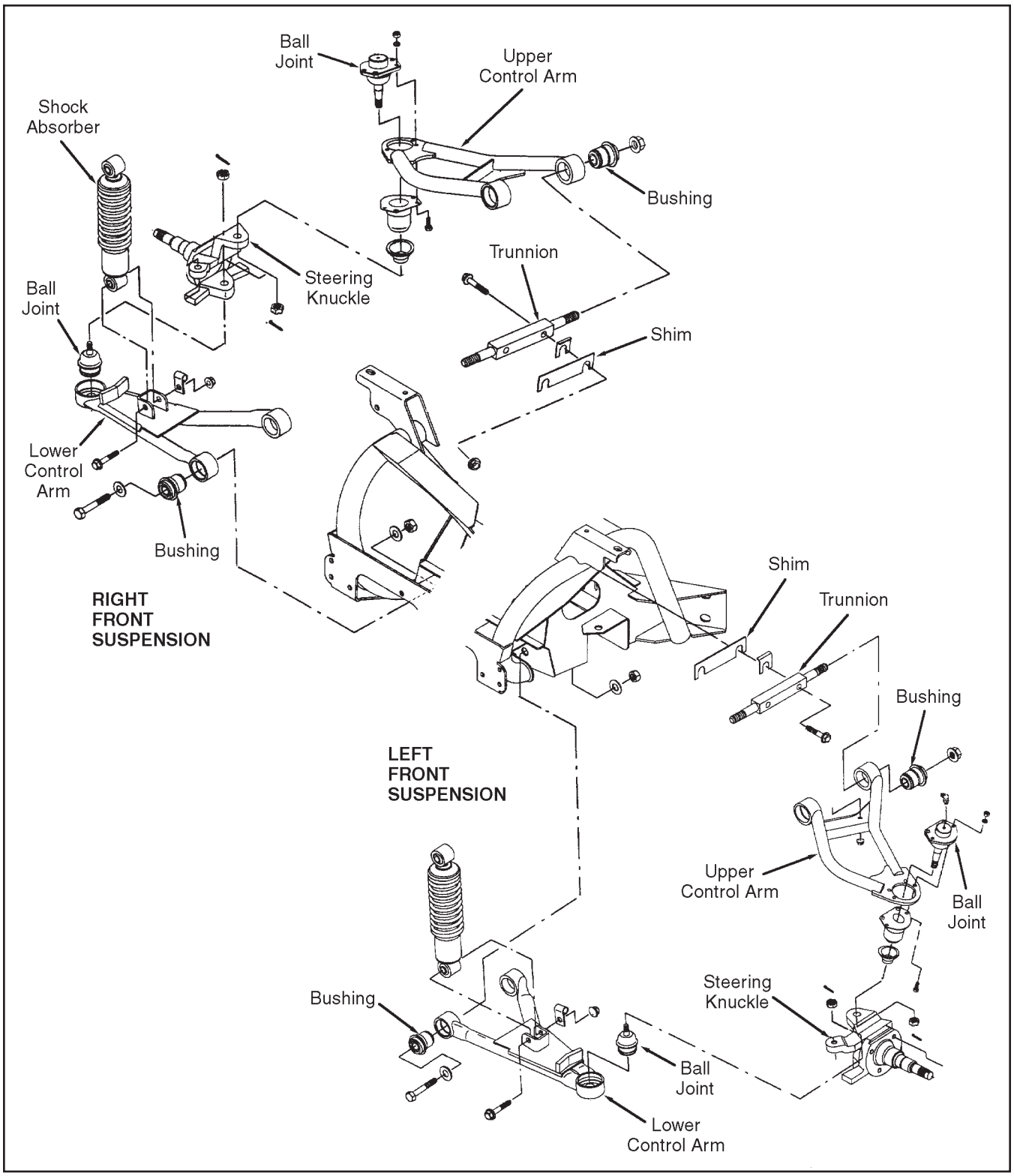

Figure 9E-1. Right and Left Front Suspension

SECTION 9F. REAR SUSPENSION

REPAIR (See Section 9F-1)

Remove and replace damaged shocks, leaf springs and other parts as shown in Figure 9F-1.

The left and right sides of the rear suspension are symmetrical. The right side is shown in Figure 9F-1.

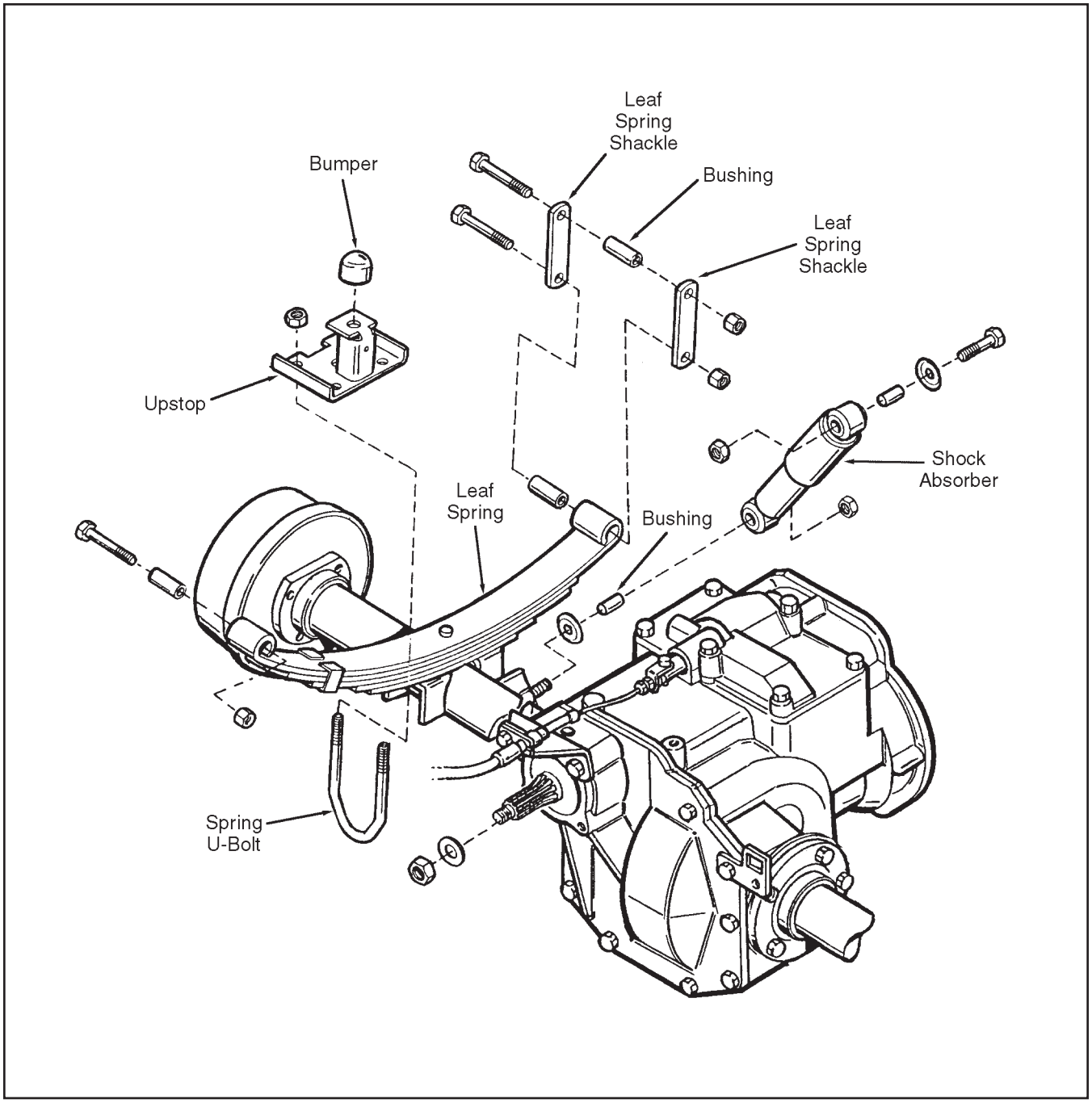

Figure 9F-1. Rear Suspension (Right Side Shown)

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SECTION 10
ELECTRICAL SYSTEM

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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 turned on.	a. Battery dead. b. Faulty starter solenoid. c. Faulty ignition switch. d. Faulty wiring or bad electrical ground.	a. Charge or replace (Section 10D). b. Test (Section 10G). c. Test (Section 10I). d. Test (Section 10C).
2. Engine turns over but will not start.	a. Battery, low charge. b. No fuel/obstructed fuel supply. c. Internal engine problem.	a. Charge or replace (Section 10D). b. Check and correct fuel level and/or obstruction. c. Refer to engine manufacturer's manual.
3. Battery does not charge.	a. Bad battery. b. No alternator output voltage.	a. Replace. b. Test (Section 10E or 10F).
4. Battery over charges.	a. Bad battery. b. Faulty alternator. c. Faulty wiring. d. Bad ground.	a. Replace. b. Test/replace (Section 10E or 10F). c. Inspect for high resistance (Section 10C). d. Test (Section 10C).

SECTION 10C. GENERAL INSTRUCTIONS

GENERAL

Repair of the electrical system, for the most part, is limited to the replacement of defective components or wiring. Wiring diagrams and Component Location illustrations are provided in Section 10O for trouble-shooting 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 the 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 wiring diagram in Section 10O.
2. Set multimeter to ohms ♪ scale and touch leads to end of wire.
   - There should be a reading (continuity) on the multimeter. If not, proceed to Step 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.

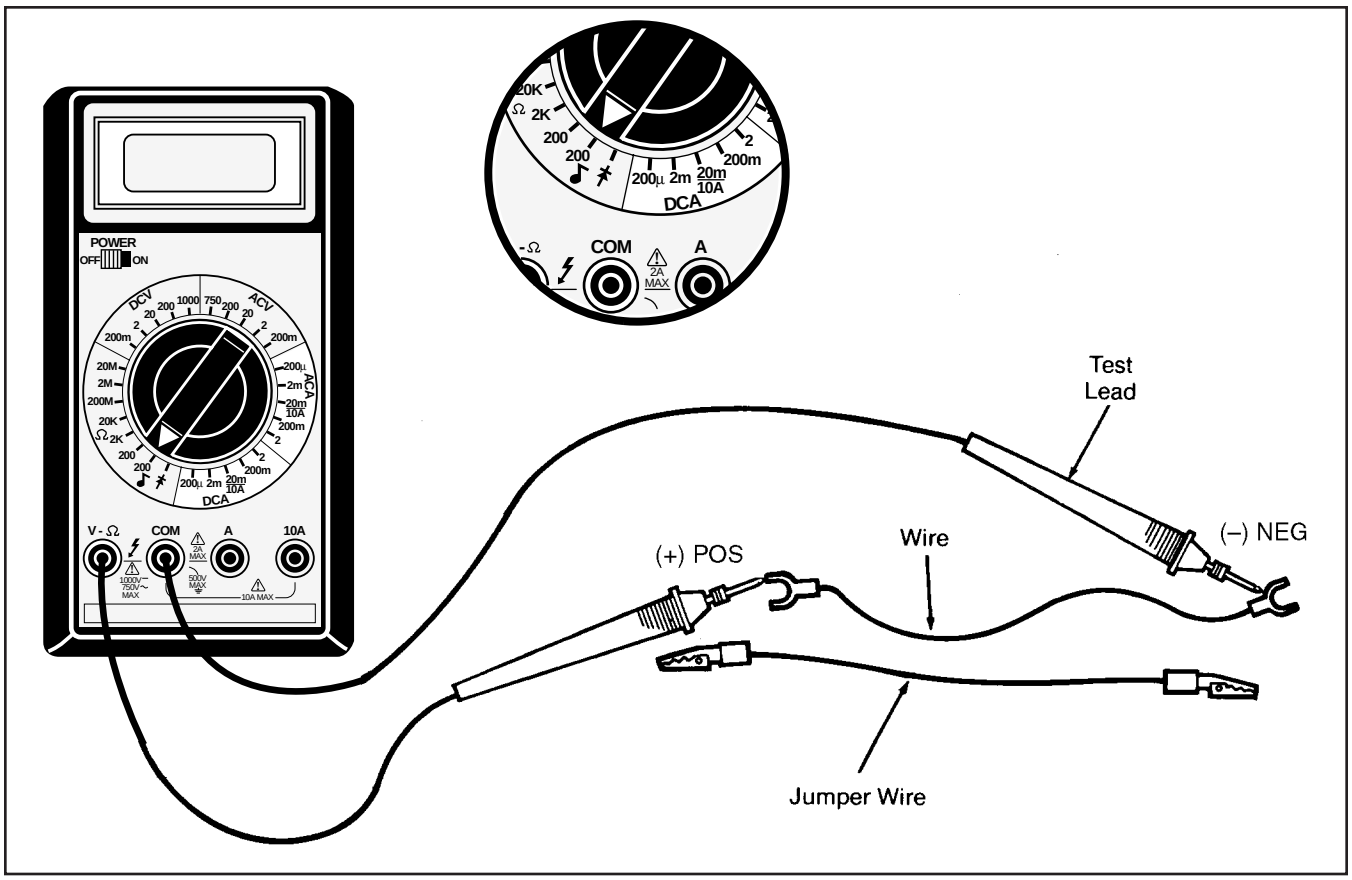


Figure 10C-1. Wire Continuity Test

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.

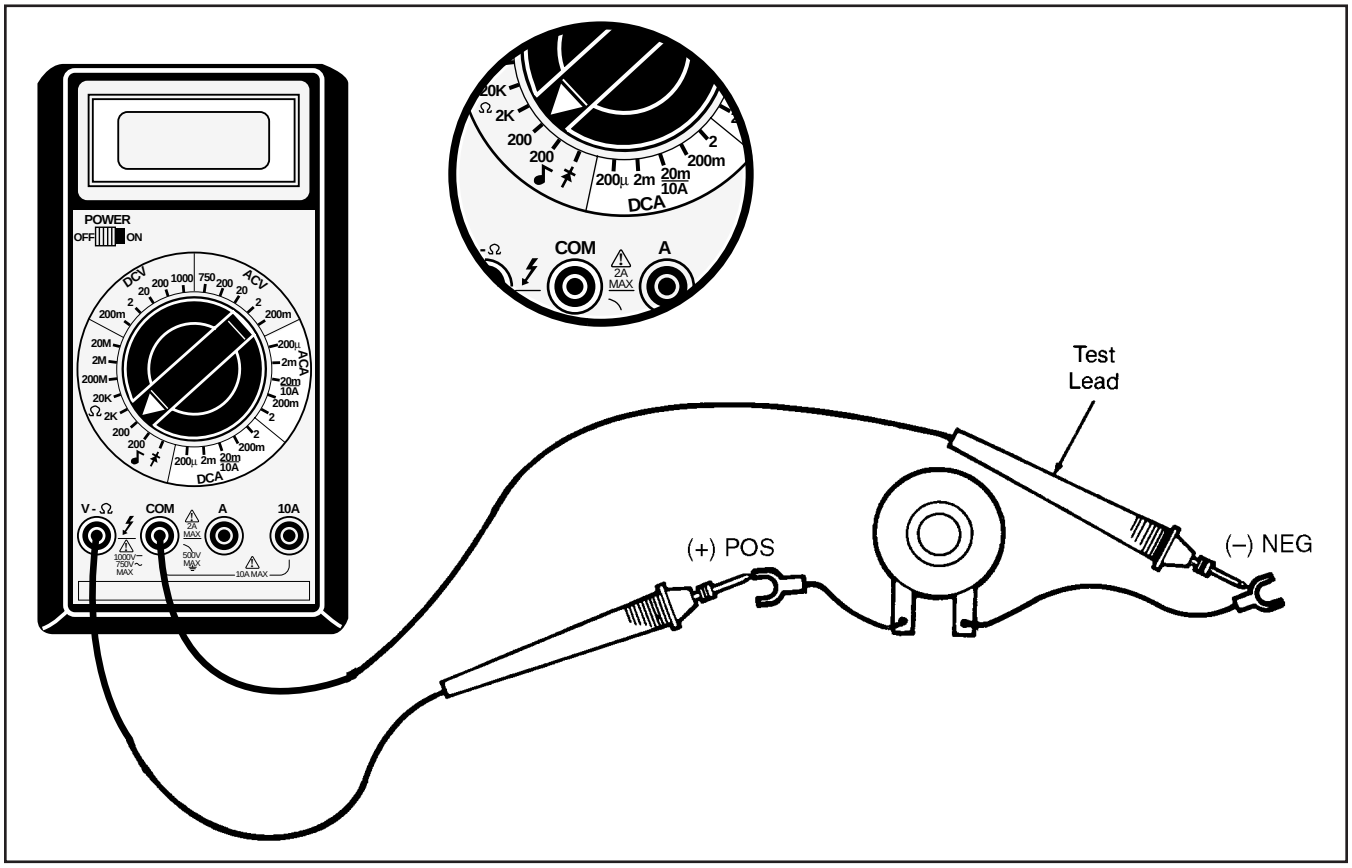


Figure 10C-2. Resistance Tests, Ohm Ω

SECTION 10D. BATTERY

GENERAL

For normal service, use a battery rated 12V, 420 cold cranking amps at 0°F (–18°C) Group BCI24.

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 installation 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 vehicle.

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.

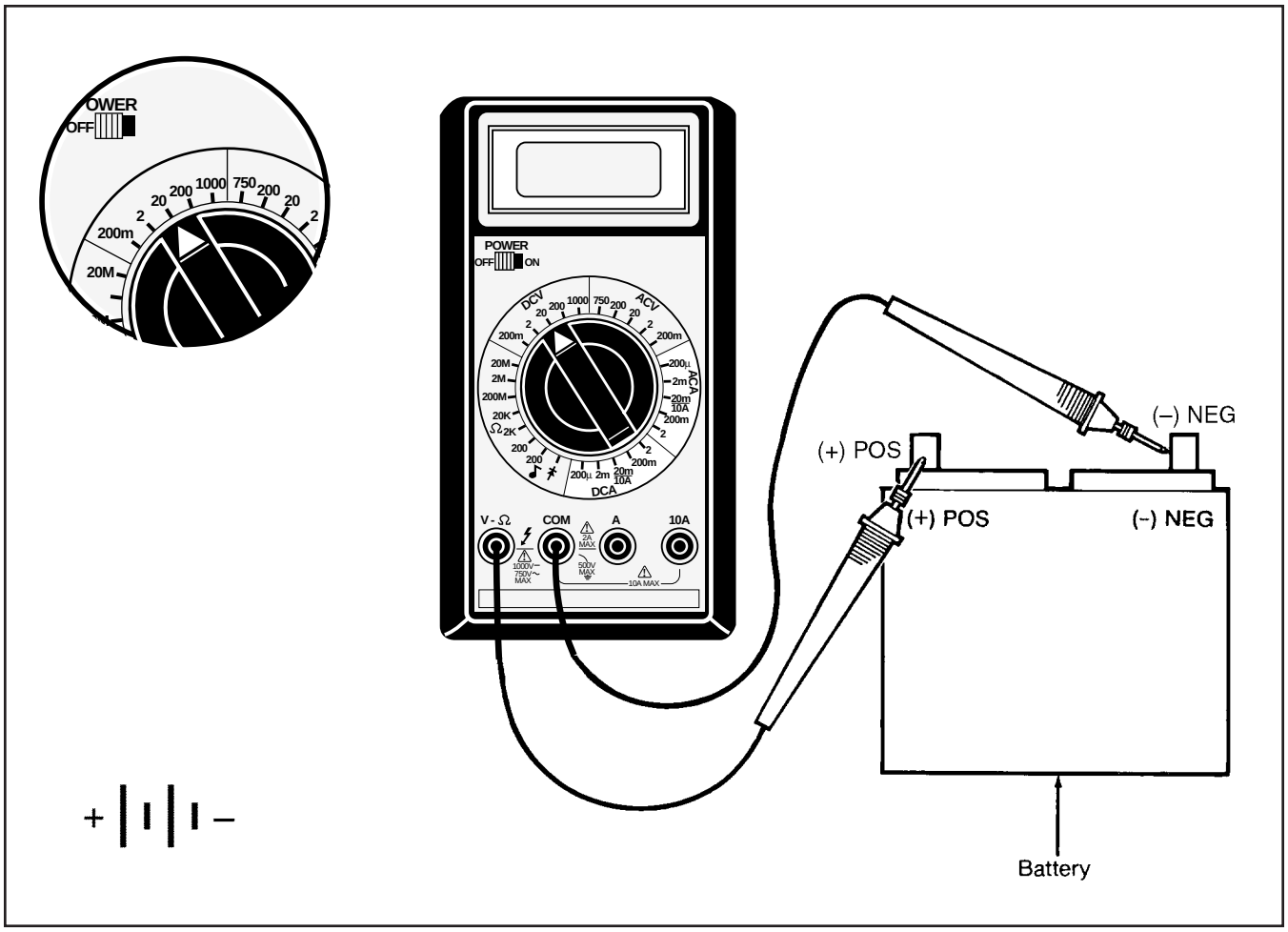


Figure 10D-1. Battery Test

SECTION 10E. CHARGING SYSTEM — 3-CYLINDER 660 GASOLINE AND DIESEL ENGINES

GENERAL

The charging system for 3-cylinder (Suzuki 660) gasoline and Perkins diesel engines consist of a 55 amp alternator.

Perform the following tests to determine if the alternator is faulty.

OUTPUT CURRENT TEST (See Figure 10E-1)

WARNING

Before installing test instruments, disconnect the NEG (–) battery cable from the battery.

1. Remove the RED wire from terminal B of the alternator.
2. Set multimeter to 20 VDC range. Connect POS (+) test lead to terminal B and NEG (–) test lead to ground.
3. Reconnect battery NEG (–) cable.
4. Start the engine.
   - As engine RPM increases, voltage should increase to 14 to 14.5 volts. Current output should increase to a maximum of 55 amps.

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, proceed with Step 5.
- If voltage and current does not start coming down after a short running period, battery is faulty.

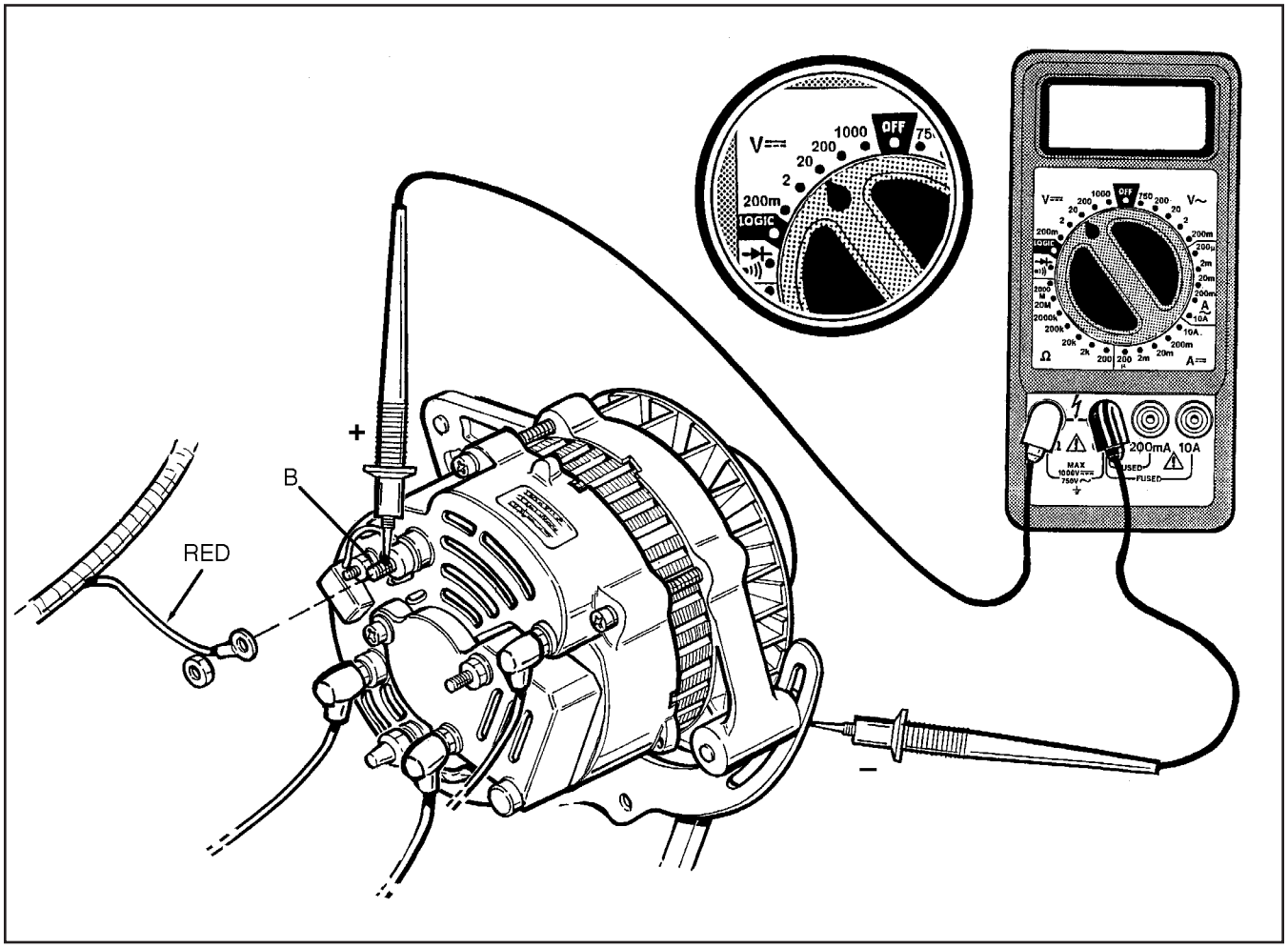


Figure 10E-1. Output Current Test

SECTION 10E. CHARGING SYSTEM — 3-CYLINDER 660 GASOLINE AND DIESEL ENGINES

5. Stop engine and replace battery with a known good battery. Reconnect multimeter test leads as shown in Figure 10E-1.
6. Start the engine.
   - As engine RPM increases, voltage should increase to 14 to 14.5 volts. Current output should increase to a maximum of 55 amps.

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, alternator is faulty.

VOLTAGE TEST (See Figure 10E-1)

1. Set multimeter to 20 VDC range.
2. Connect NEG (–) lead of the multimeter to a good ground.
3. Touch the POS (+) lead of the multimeter to the “B” terminal of alternator.
   - Should read 12 volts.
   - NO or low voltage, check battery, connections and wiring.

SECTION 10F. CHARGING SYSTEM — 4-CYLINDER 970 GASOLINE ENGINE

GENERAL

The charging system consists of a 40 amp alternator with a built-in regulator/rectifier.

With a built-in regulator/rectifier, it is necessary to disassemble the alternator to electrically test the stator, rotor and rectifier. Refer to the engine manufacturer's service manual for detailed test and repair instructions.

Before attempting to disassemble the alternator, perform the following tests to confirm the alternator is at fault.

OUTPUT CURRENT TEST (See Figure 10F-1)

WARNING

Before installing test instruments, disconnect the NEG (–) battery cable from the battery.

1. Remove the RED wire from terminal B of the alternator.
2. Connect a 60 amp ammeter and multimeter as shown.
3. Set multimeter to 20 VDC range.
4. Reconnect battery NEG (–) cable.
5. Start the engine.
   - As engine RPM increases, voltage should increase to 14 to 14.5 volts. Current output should increase to a maximum of 40 amp.

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, proceed with Step 6.
- If voltage and current does not start coming down after a short running period, battery is faulty.

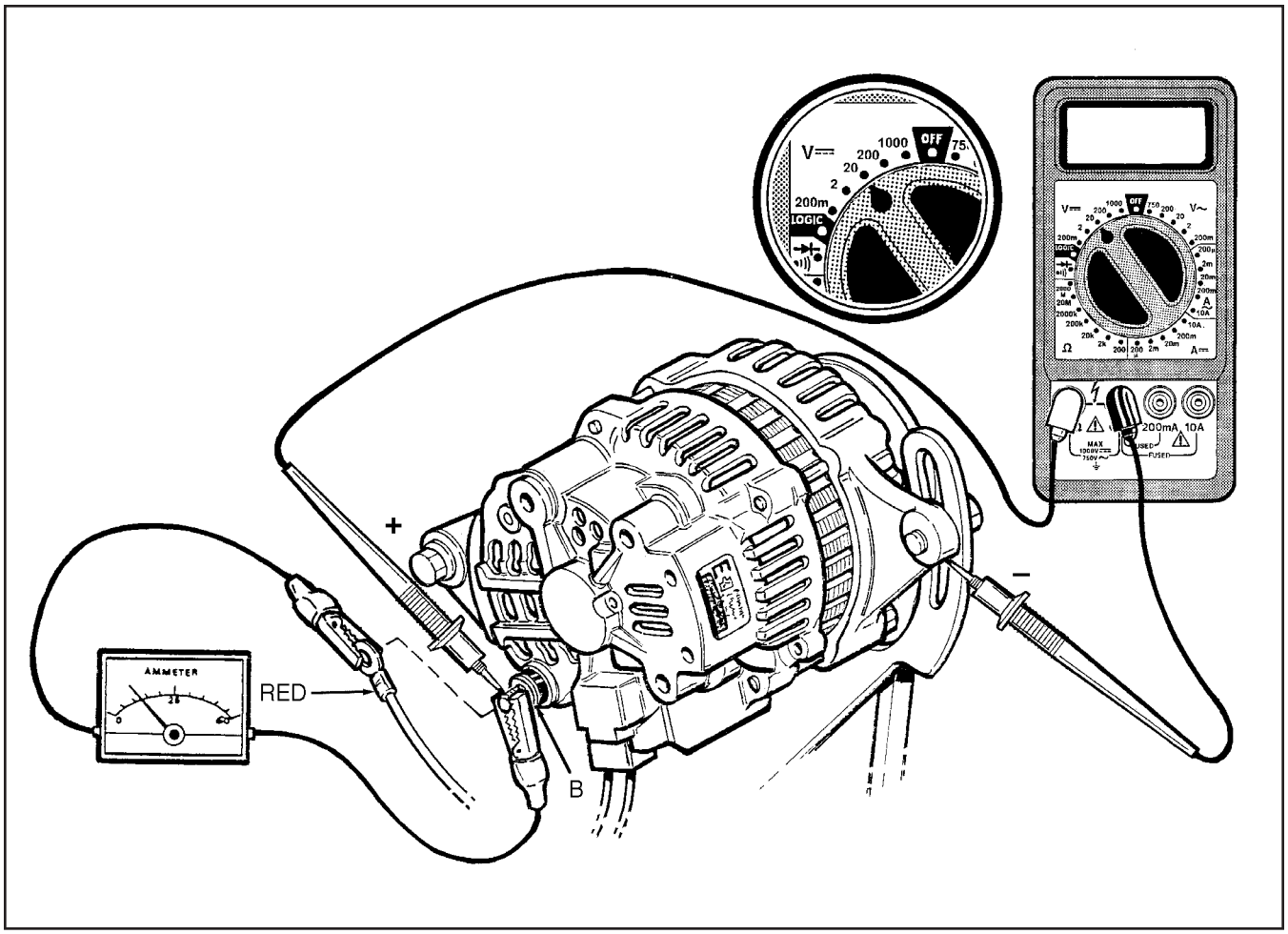


Figure 10F-1. Output Current Test

10F

6. Stop engine and replace battery with a known good battery.
7. Start the engine.
   - As engine RPM increases, voltage should increase to 14 to 14.5 volts. Current output should increase to a maximum of 40 amp.

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, alternator is faulty.

VOLTAGE TEST (See Figure 10F-2)

1. Set multimeter to 20 VDC range.
2. Disconnect RED lead from terminal B of the alternator.
3. Connect NEG (–) test lead of the multimeter to a good ground.
4. Touch the POS (+) lead of the multimeter to the "B" terminal of alternator.
   - Should read battery voltage, proceed with Step 4.
   - NO or low voltage, check battery, connections and wiring.
5. Remove plug from side of alternator.
6. Turn ignition key to the ON position.
7. Touch POS (+) lead to plug terminal of the GRN wire.
   - Should read battery voltage.
   - NO voltage, 20 amp fuse blown.

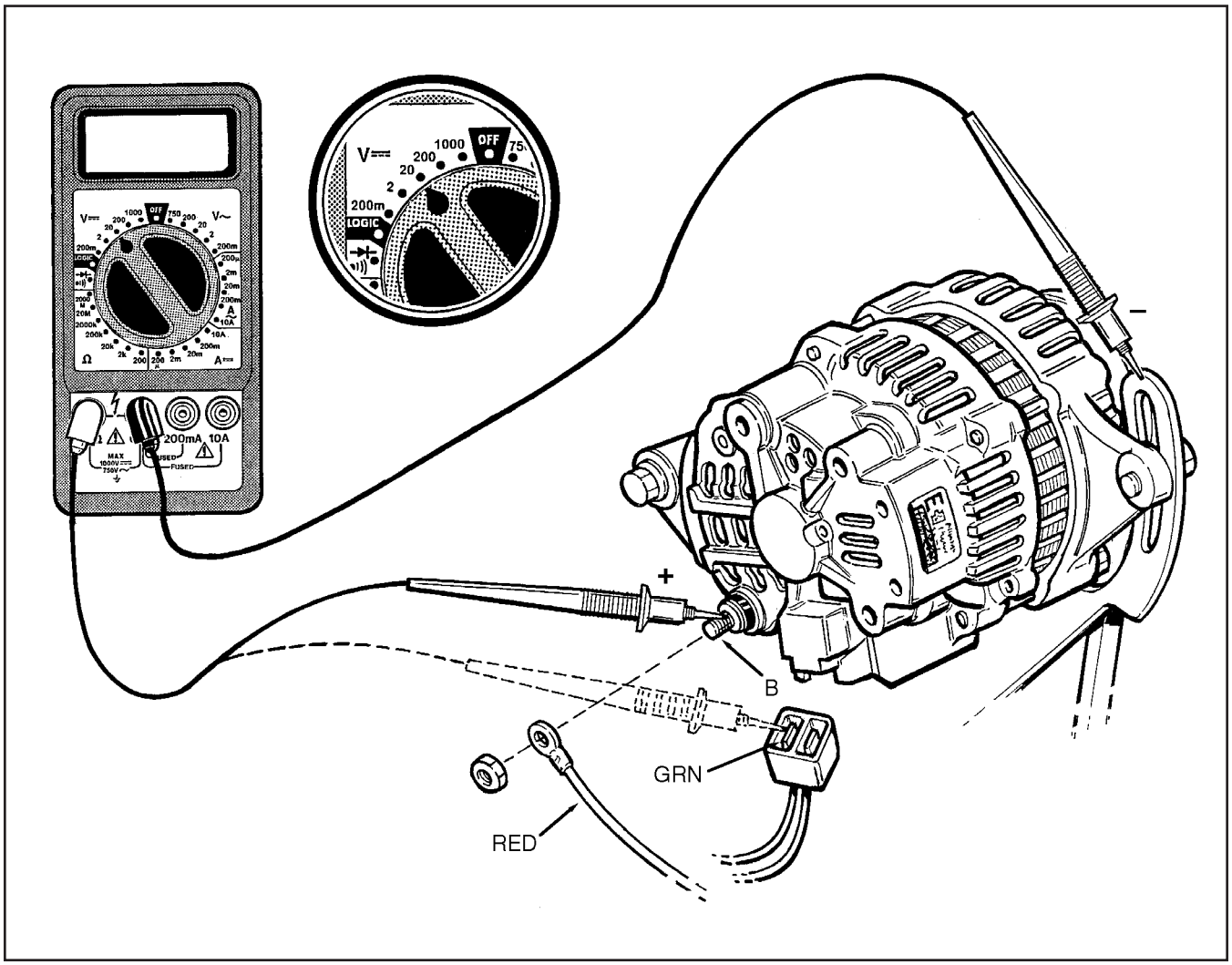


Figure 10F-2. Voltage Test

REGULATOR TEST (See Figure 10F-3)

1. With the RED lead connected to terminal B of the alternator, remove cable plug from side of alternator.
2. Set the multimeter to the continuity →⊢ test position.
3. Touch the multimeter leads to the two terminals of the alternator connector, then switch terminals.
   - Should have continuity in one direction ONLY.
   - If NO continuity or continuity in both directions, regulator may be faulty. Refer to the engine manufacturer's service manual for detailed test and repair instructions.

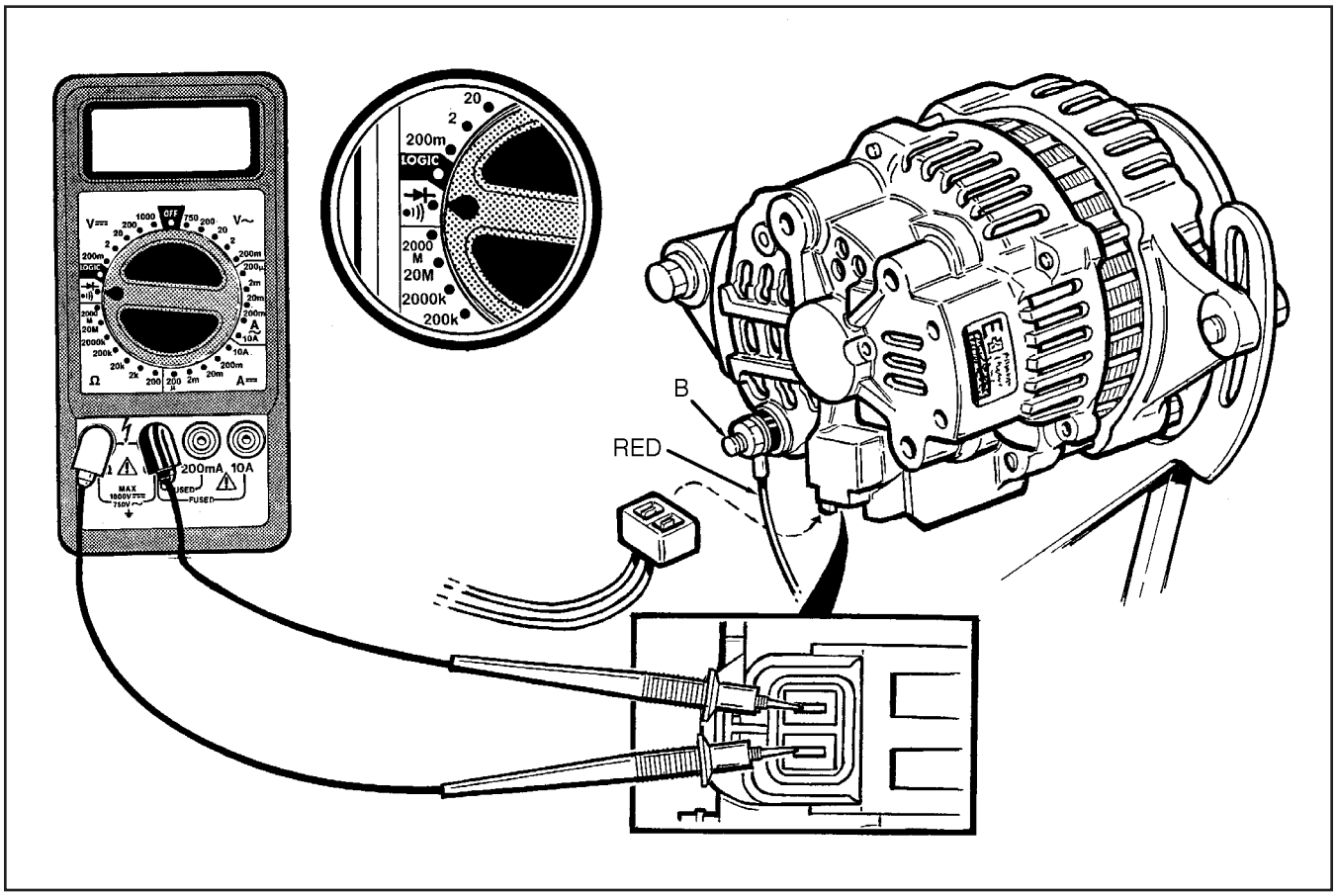


Figure 10F-3. Regulator Test

10F

SECTION 10G. STARTER

GENERAL

The repair of the starter is covered in the engine manufacturer's service manual which can be obtained through your local Textron Turf Care and Specialty Products Dealer.

STARTING CIRCUIT RESISTANCE TEST (See Figure 10G-1)

1. Remove the ignition coil connector, tape the connector end (gasoline engines only).

NOTE

This will prevent the engine from starting when performing the following test.

2. Using a suitable digital multimeter, at battery measure battery voltage. This is the base voltage for the following tests.
3. Connect tester NEG (–) test lead to NEG (–) terminal of battery, connect tester POS (+) lead to a good engine ground.
4. Crank engine, read/record voltage.
   - Voltage should not drop more than 0.58 volts from measured battery voltage.
   - If voltage drops below 0.58, a high resistance fault exists in the wiring, connections or ground of the starter circuit, proceed with Step 5.
5. Connect tester POS (+) lead connected to battery POS (+) terminal. Move tester NEG (–) lead to starter motor terminal.
6. Crank engine, read/record voltage.

⚠ CAUTION

On gasoline engine powered vehicles the following tests must be performed within 5 seconds to avoid burning out the coil.

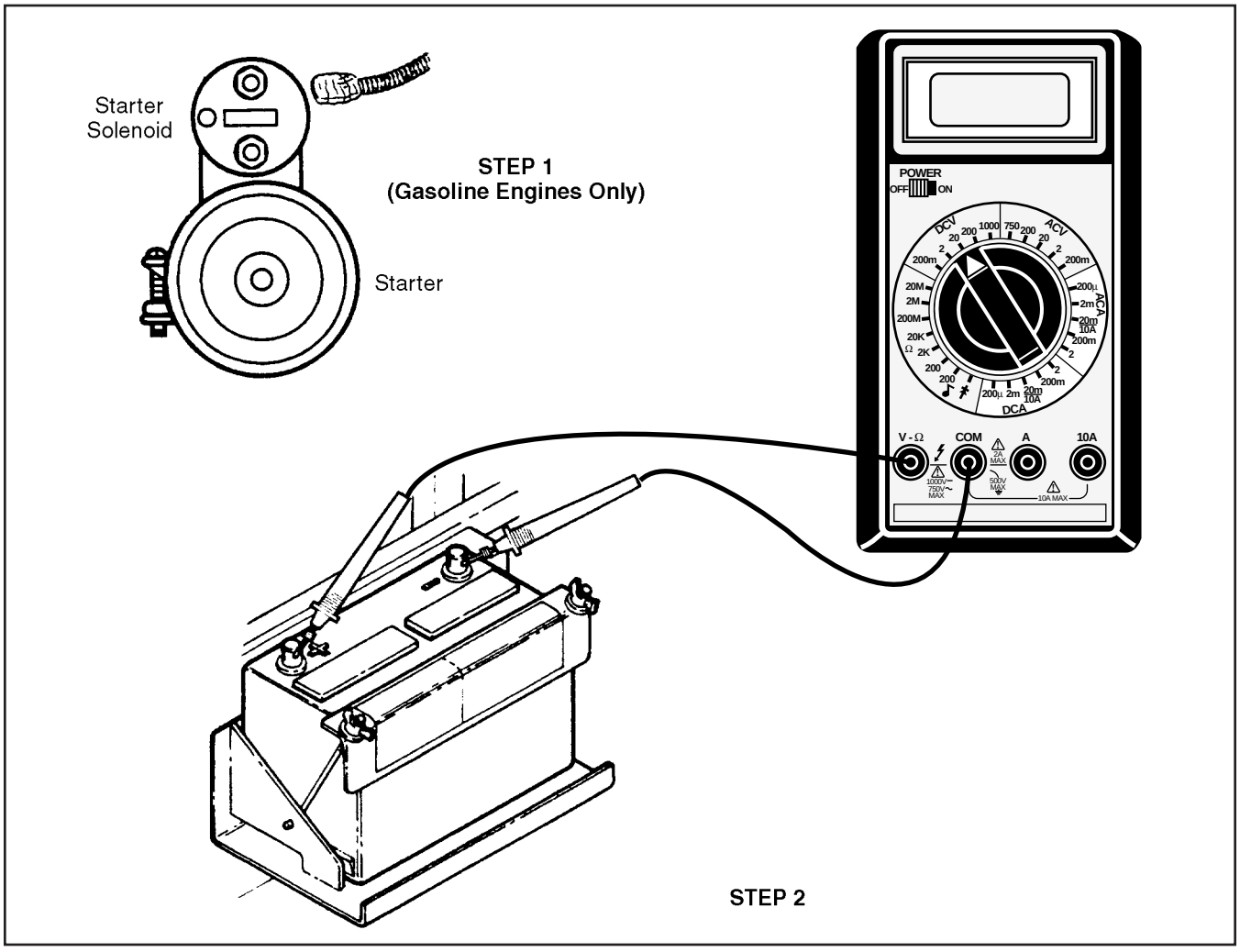


Figure 10G-1. Starting Circuit Test (1 of 2)

10G

SECTION 10G. STARTER

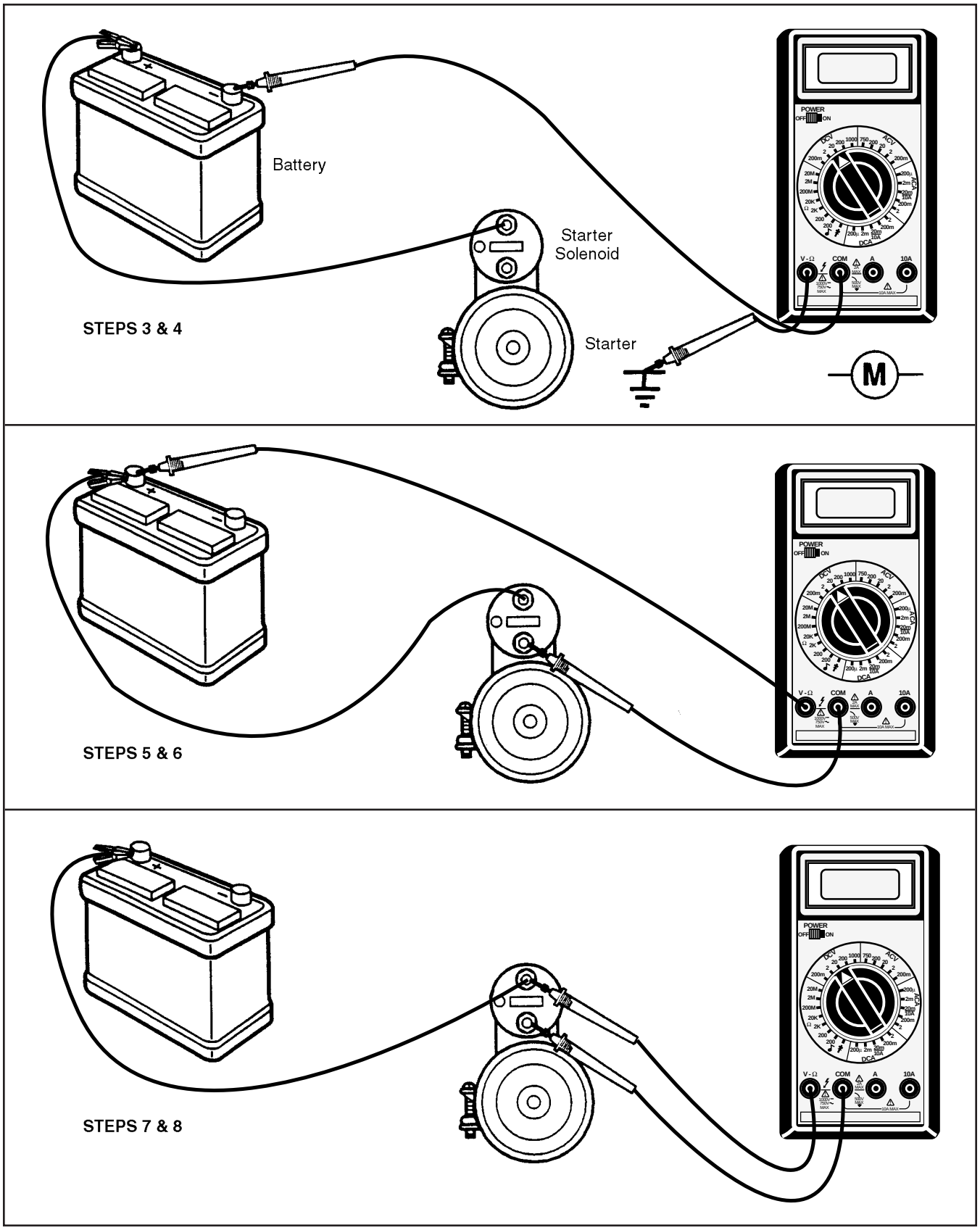


Figure 10G-1. Starting Circuit Test (2 of 2)

SECTION 10G. STARTER

STARTER SOLENOID TEST (See Figure 10G-2)

1. Disconnect battery ground cable.
2. Tag and remove wires from starter solenoid.
3. Remove field coil wire from terminal M.
4. Connect battery to starter solenoid as shown in Figure 10G-2 (Step 4). Check that pinion gear moves outward. If gear does not move, replace starter solenoid.
5. While connected as in Step 4, disconnect negative lead from terminal M. Check that gear remains out. If gear returns inward, replace starter solenoid.
6. Disconnect negative lead from starter solenoid body. Check that gear returns inward. If gear does not return, replace starter solenoid.

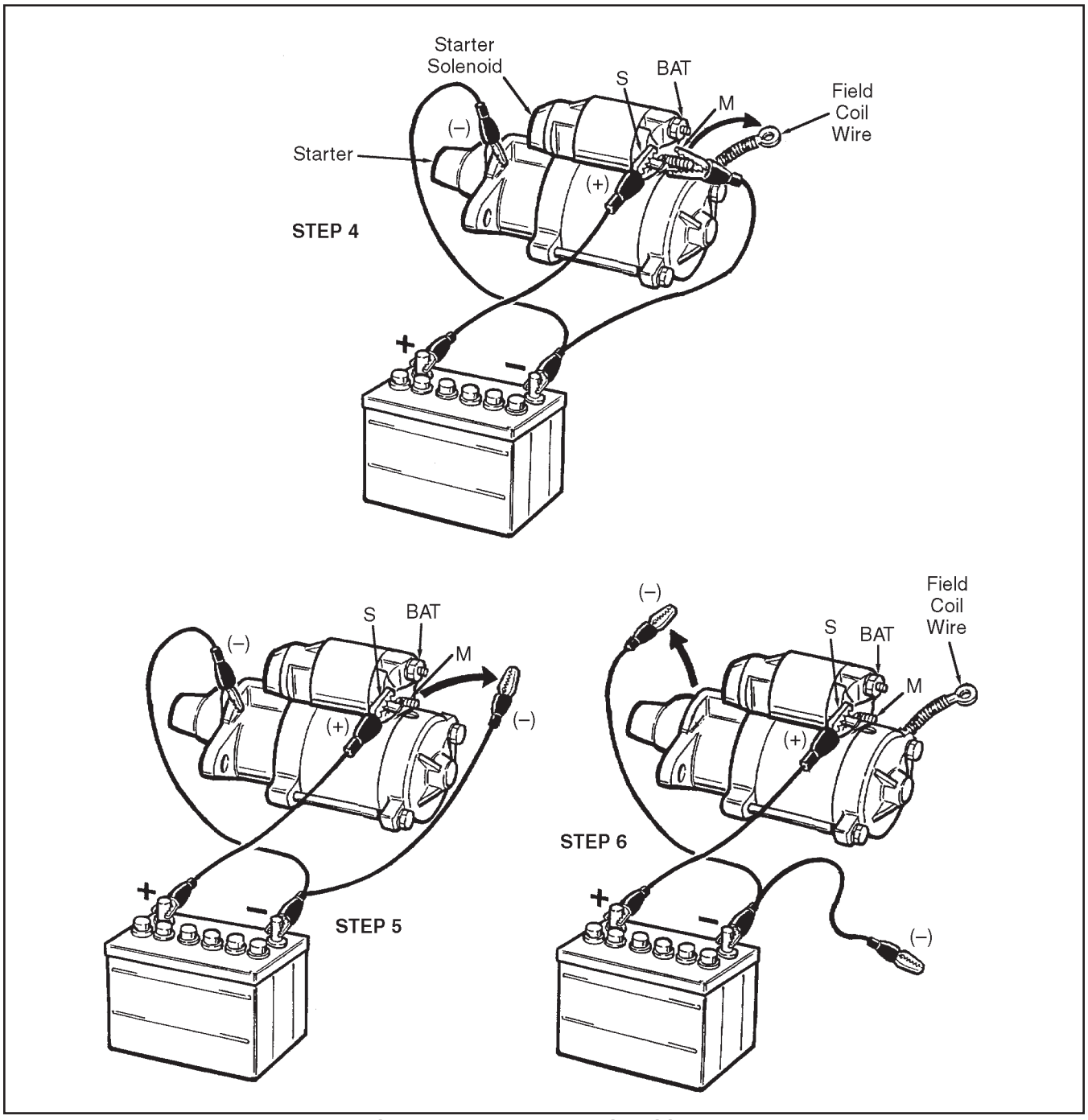


Figure 10G-2. Starter Solenoid Test

10G

SECTION 10G. STARTER

NO-LOAD TEST

1. After conducting solenoid test on previous page reconnect the ignition coil lead to terminal M (for diesel engines start with Step 2).
2. Connect the battery and an ammeter to the starter as shown in Figure 10G-3.
3. Check that starter rotates smoothly and that the pinion moves outward. Ammeter should read less than 50 amps.

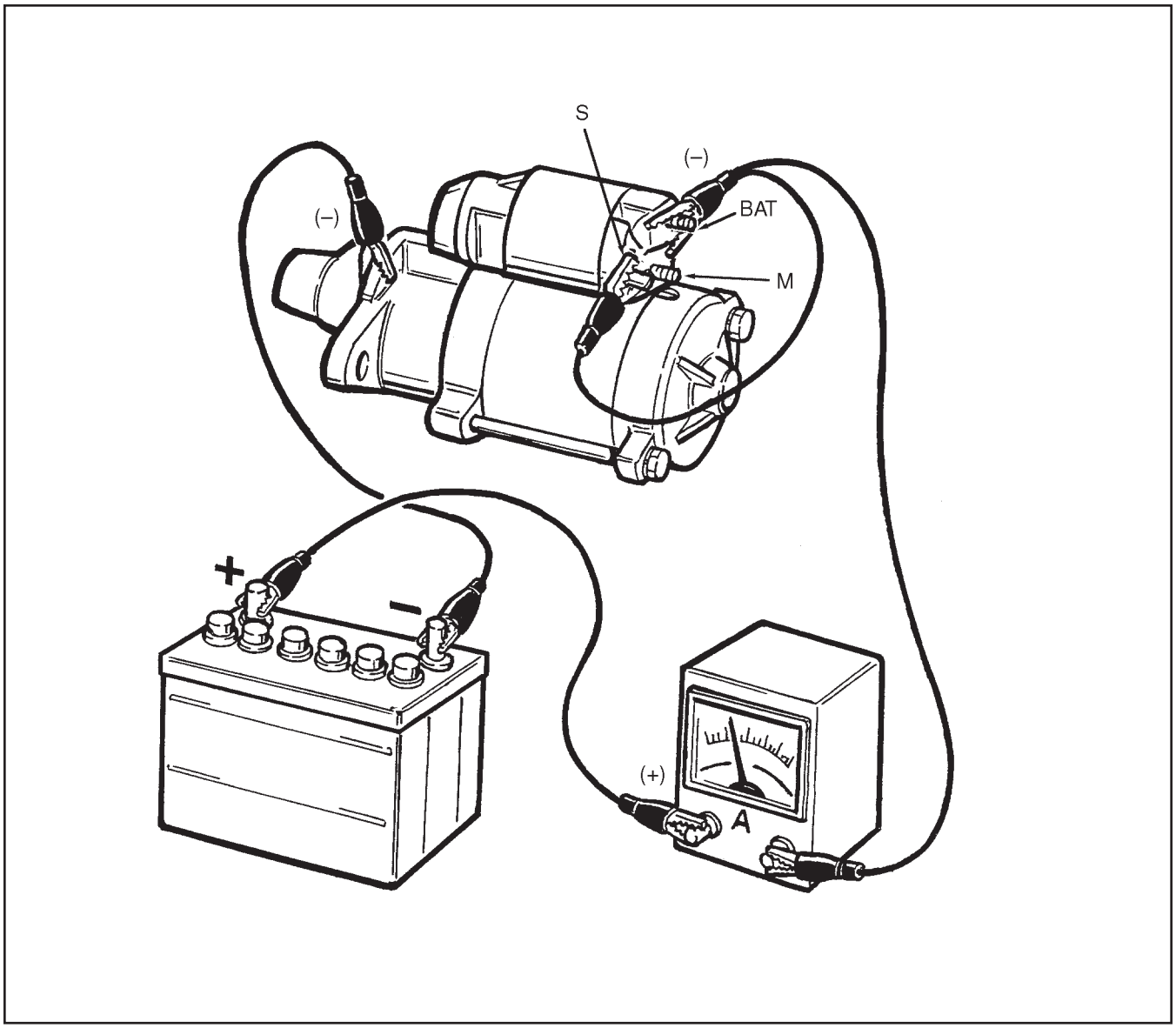


Figure 10G-3. No-Load Test

SECTION 10H. SWITCHES

IGNITION SWITCH TEST (See Figure 10H-1)

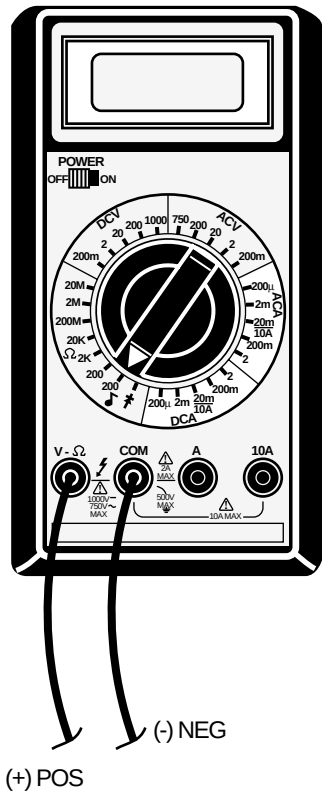
1. Disconnect NEG (–) cable at battery.
2. Disconnect wiring connections at ignition switch.
3. Set the multimeter to 200 Ω (ohms) scale.
4. Check all switch positions as follows:
   a. With key switch in OFF position, connect test leads to any of two terminals A, B, I and S.
      - There should be no reading on multimeter.

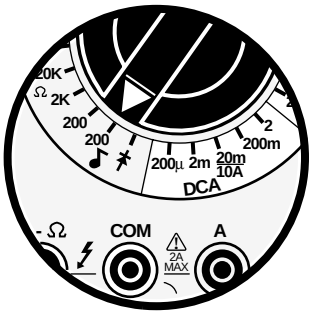
NOTE

If there is a reading of more than 0 to 0.5 Ω (ohms) in any of the following tests, the switch is faulty and must be replaced.

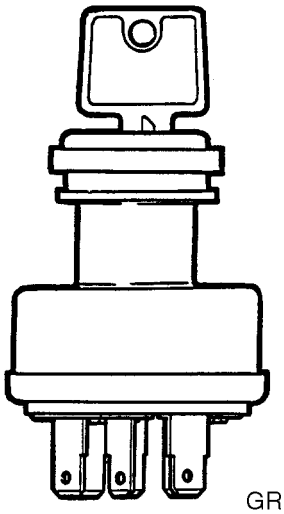
   b. With key switch in ON position, connect NEG (–) test lead to terminal A and POS (+) test lead to terminal B.
      - There should be a reading of 0 to 0.5 Ω ohms) on the multimeter.
   c. Move the POS (+) test lead to terminal I.
      - There should be a reading of 0 to 0.5 Ω ohms) on the multimeter.
   d. Hold the key switch to the START position, connect the POS (+) lead to terminal B and the NEG (–) test lead to terminal I.
      - There should be a reading of 0 to 0.5 Ω (ohms).
   e. Continue to hold switch in START position. Move the NEG (–) test lead to terminal I.
      - There should be a reading of 0 to 0.5 Ω (ohms) on the multimeter.
   f. With the key switch in the ACC (accessory) position, connect the NEG (–) test lead to terminal A and the POS (+) test lead to terminal B.
      - There should be a reading of 0 to 0.5 Ω (ohms) on the multimeter.

Replace a switch that does not meet the above test results.





Position	Continuity
ACC	A and B
OFF	None
ON	A, B and I
START	B, I and S



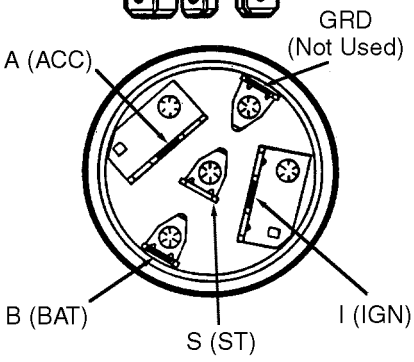
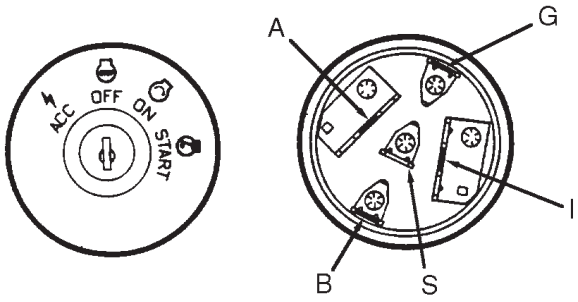


Figure 10H-1. Ignition Switch Test (1 of 2)

10H

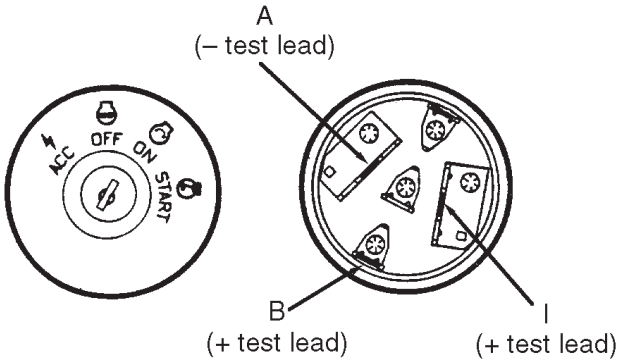
SECTION 10H. SWITCHES



STEP 4a
Contacts Open (No Continuity)

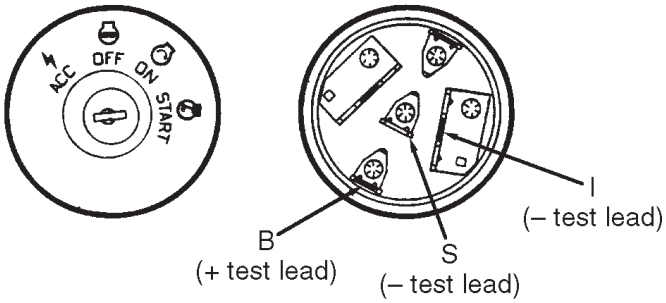
Position	Continuity
OFF	None

NOTE
G terminal not used.



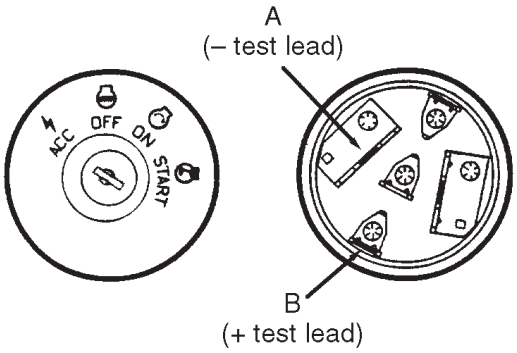
STEPS 4b & 4c
Contact 0 to 0.5 Ω (ohms)

Position	Continuity
ON	A, B and I



STEPS 4d & 4e
Contact 0 to 0.5 Ω (ohms)

Position	Continuity
START	B, S and I



STEP 4f
Contact 0 to 0.5 Ω (ohms)

Position	Continuity
ACCESSORY	A and B

Figure 10H-1. Ignition Switch (2 of 2)

SECTION 10H. SWITCHES

HORN SWITCH TEST (See Figure 10H-2)

See Figure 10H-2 and test switch as follows:

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

Replace a switch that does not meet the above test results.

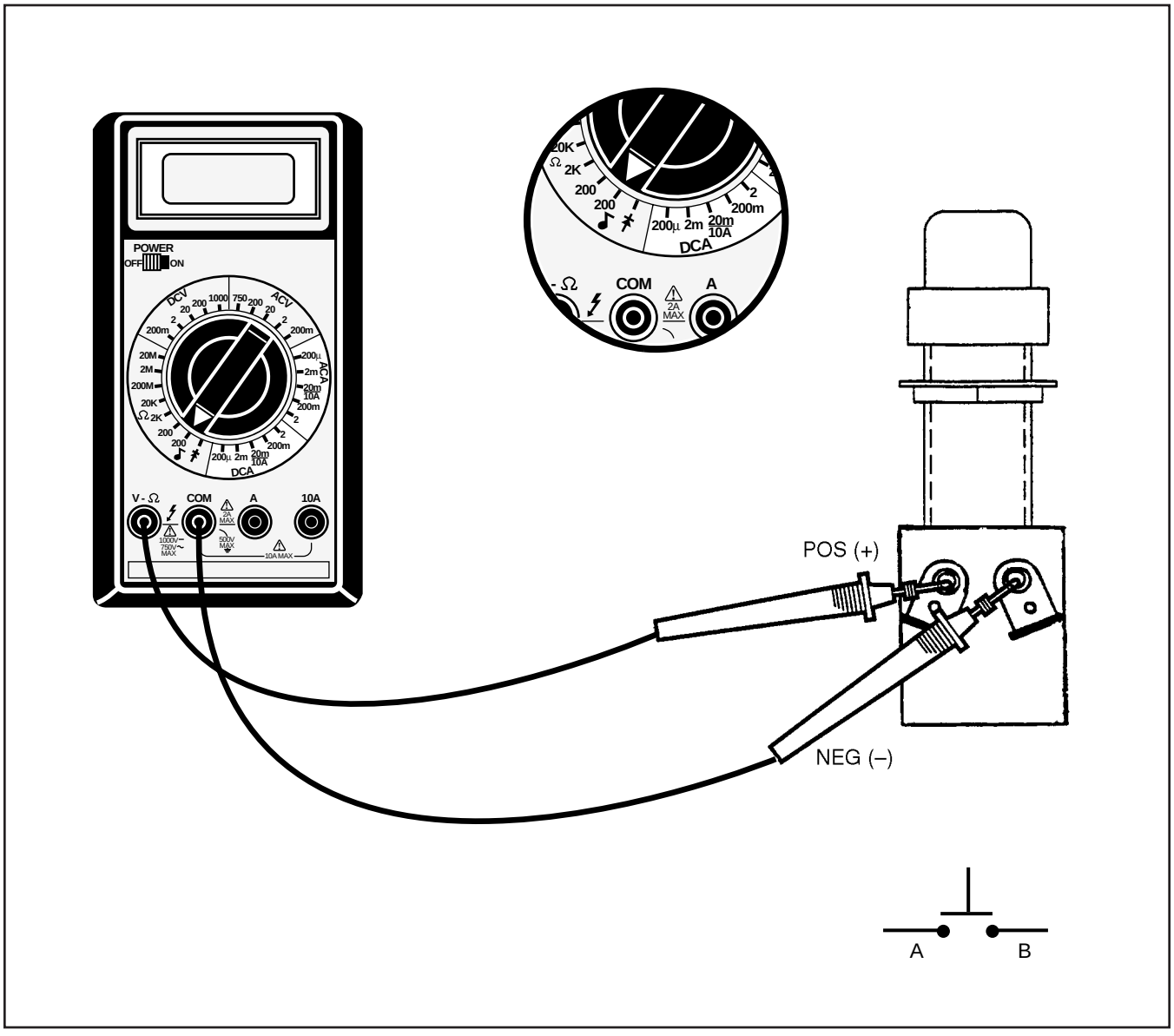


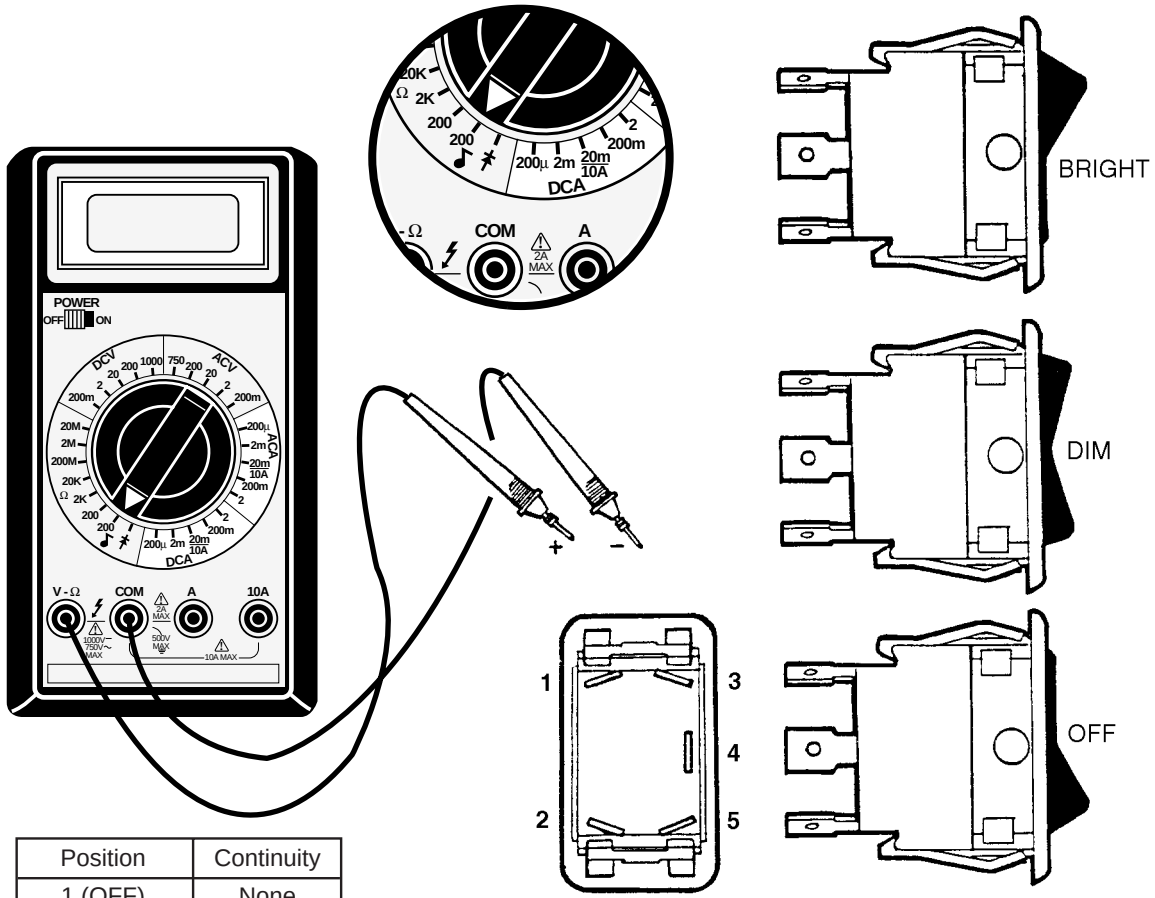
Figure 10H-2. Horn Switch Test

SECTION 10H. SWITCHES

LIGHT SWITCH TEST (See Figure 10H-3)

1. Mark and disconnect switch connectors.
2. Set the multimeter to 200 ♪ Ω (ohms) scale.
3. 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 DIM position 2 and test as follows:
   a. Check for continuity by connecting one multimeter test lead to terminal 2 and the other to terminal 4, then 5.
      - There should be 0 to 0.5 Ω (ohms) on the multimeter.
5. With switch in BRIGHT position 3, test as follows:
   a. Connect one multimeter test lead to terminal 1 and the other lead to terminal 4.
      - There should be 0 to 0.5 Ω (ohms) on the multimeter.
   b. Move one multimeter test lead to terminal 3.
      - There should be 0 to 0.5 Ω (ohms) on the multimeter.

Rep*lace a switch that does not meet all the above tests*.



Position	Continuity
1 (OFF)	None
2 (DIM)	4 and 2 4 and 5
3 (BRIGHT)	4 and 1 4 and 2

Figure 10H-3. LIght Switch Test

BACKUP LIGHT/ALARM SWITCH TEST (See Figure 10H-4)

The backup switch is normally open (NO). When the shift lever is shifted into REVERSE the switch closes.

1. Disconnect the plug as shown.
2. Set the multimeter to 200 Ω (ohms) scale.
3. Connect leads to switch as shown.
   - There should be no continuity through the switch.
4. Shift transmission into reverse.
   - There should be a reading of 0 to 0.5 Ω (ohms) at multimeter.

Replace switch that does not meet the above test results.

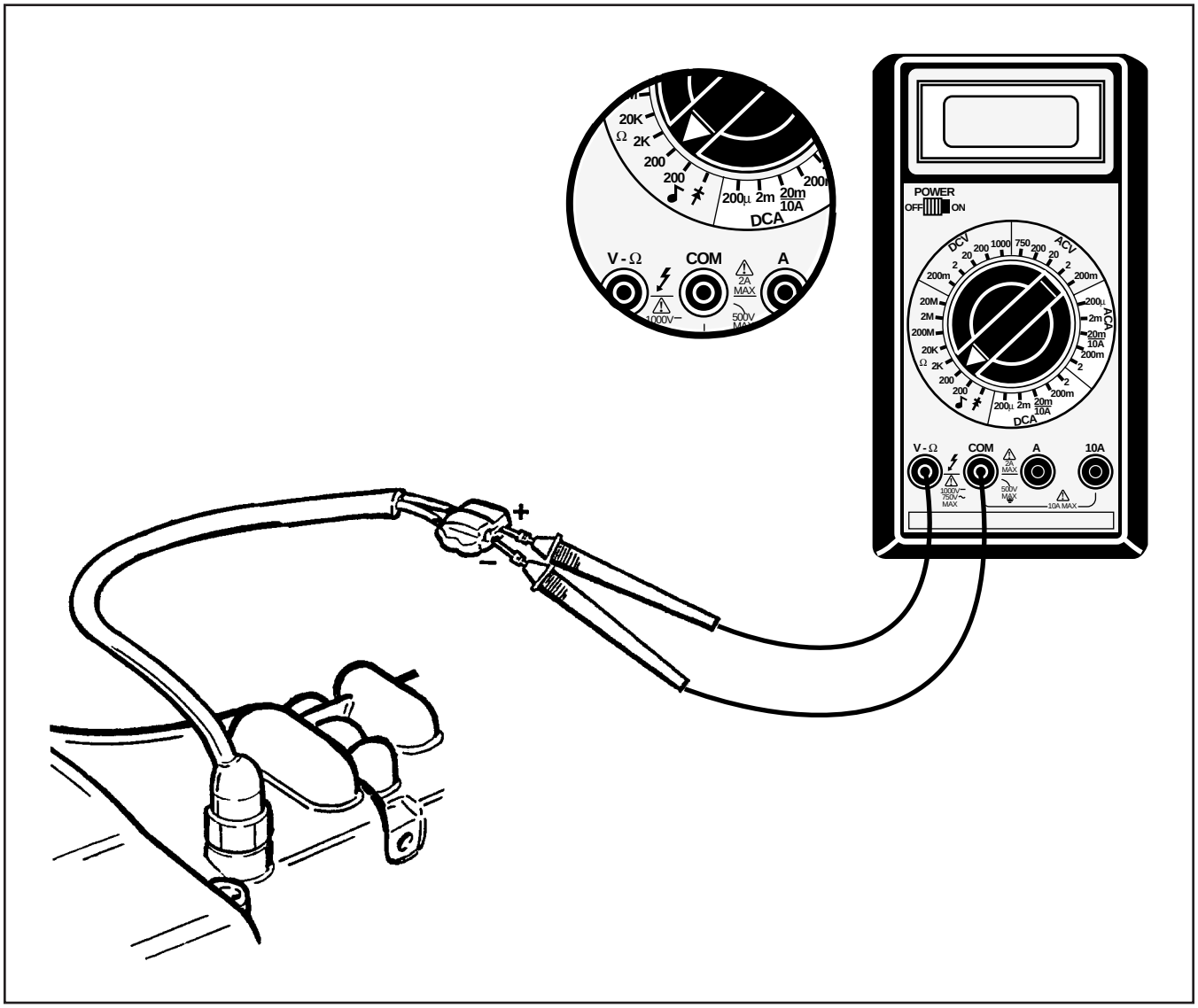


Figure 10H-4. Backup Light/Alarm Switch Test

SECTION 10H. SWITCHES

COOLING FAN SWITCH TEST (See Figure 10H-5)

This temperature switch is a normally OPEN (NO) switch. When the cooling water reaches 190°F (88°C) the switch will CLOSE.

SWITCH TEST

1. Using a suitable container, fill it with oil.
2. Heat the oil to 217°F (103°C).
3. Set the multimeter to 200 ♪ Ω (ohms) scale.
4. Connect test leads as shown.
   - There should be no continuity.
5. Immerse switch into oil. Using a suitable thermometer to monitor oil temperature, slowly heat oil.
   - At approximately 190°F (88°C) switch should CLOSE and meter should read 0 to 0.5 Ω (ohms).

⚠ CAUTION

Do not heat oil more than 230°F (110°C).

Replace a switch that does not meet the above test results.

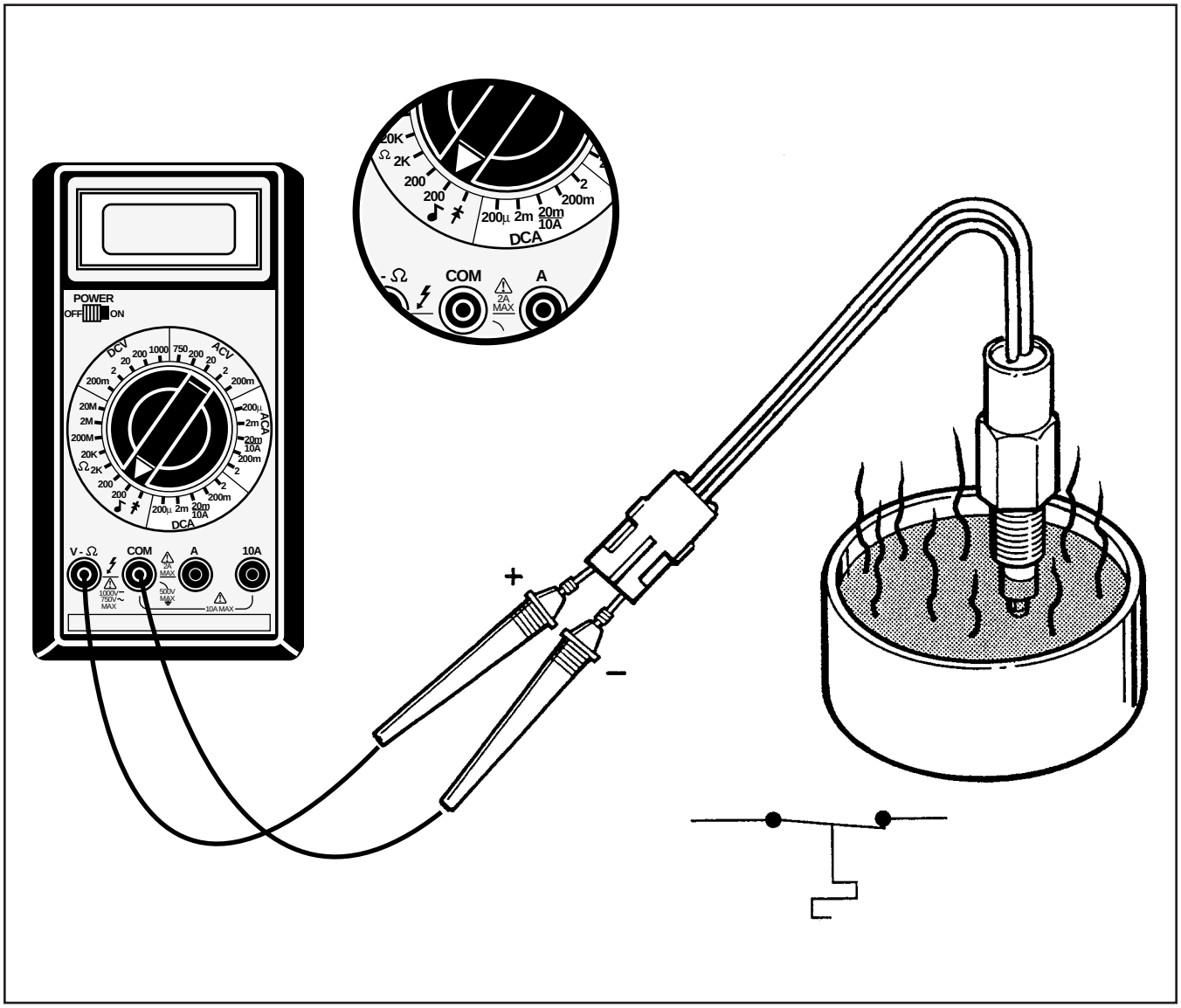


Figure 10H-5. Cooling Fan Switch Test

CLUTCH INTERLOCK AND BRAKE SWITCH TEST (See Figure 10H-6)

1. Disconnect ground cable at battery.
2. Identify (label) and disconnect electrical leads at switch.
3. Set the multimeter to 200 ♪ Ω (ohms) scale.
4. Connect leads as shown.
   - There should be a reading of 0 to 0.5 Ω (ohms) on multimeter.

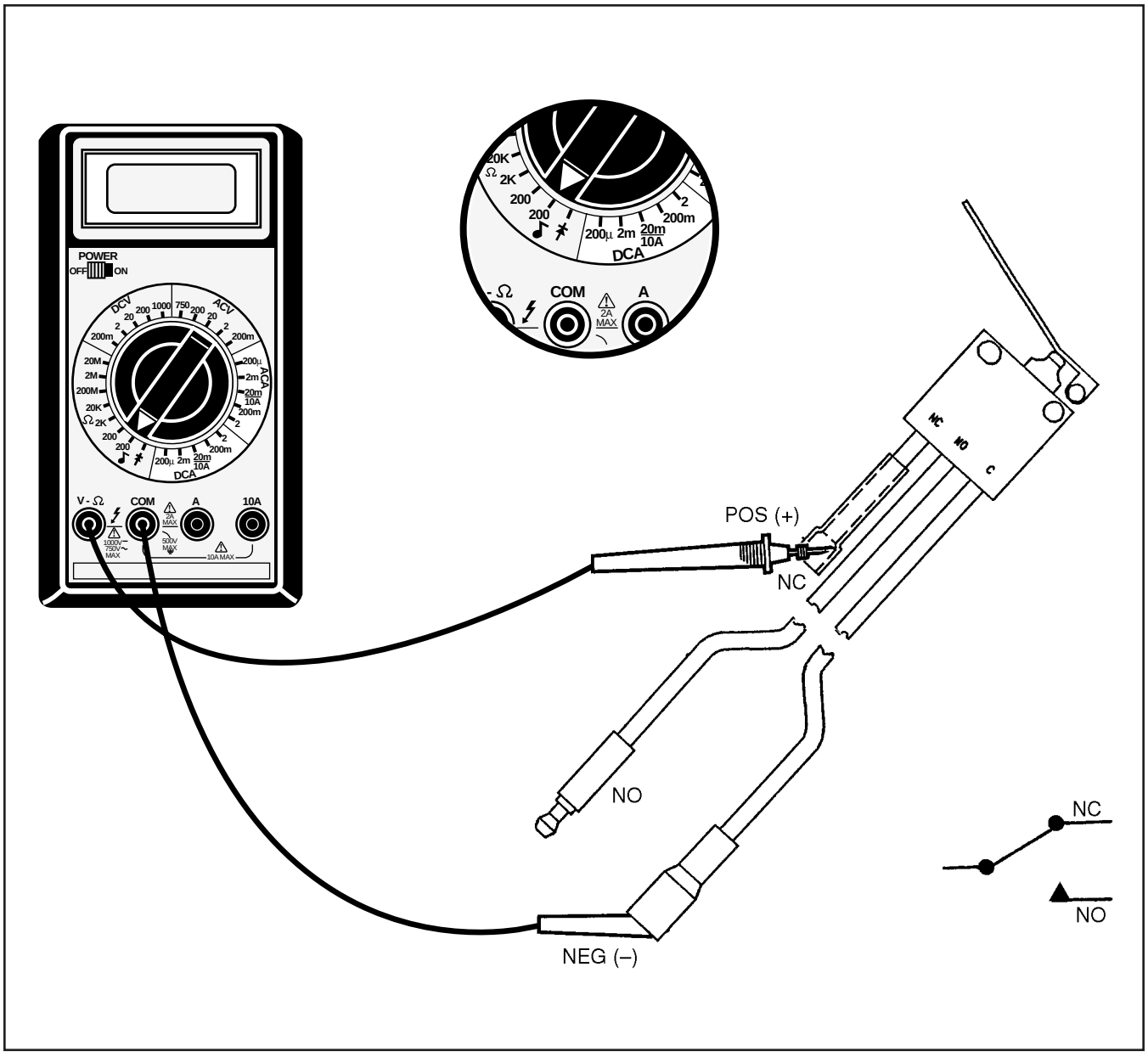


Figure 10H-6. Clutch Interlock and Brake Switch Test

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 of 0 to 0.5 Ω (ohms) on multimeter.

Replace a switch that does not meet all the above test results.

SECTION 10I. FUSES

FUSE TEST

See Figure 10I-1 and test fuse as follows:

1. Visually inspect and replace a blown fuse.
2. If fuse is not blown, check fuse as follows:
   a. Set meter to 200 Ω (ohms) scale.
   b. Connect meter leads to fuse as shown.
      - There should be a reading (continuity) on the meter scale. If not, replace fuse.

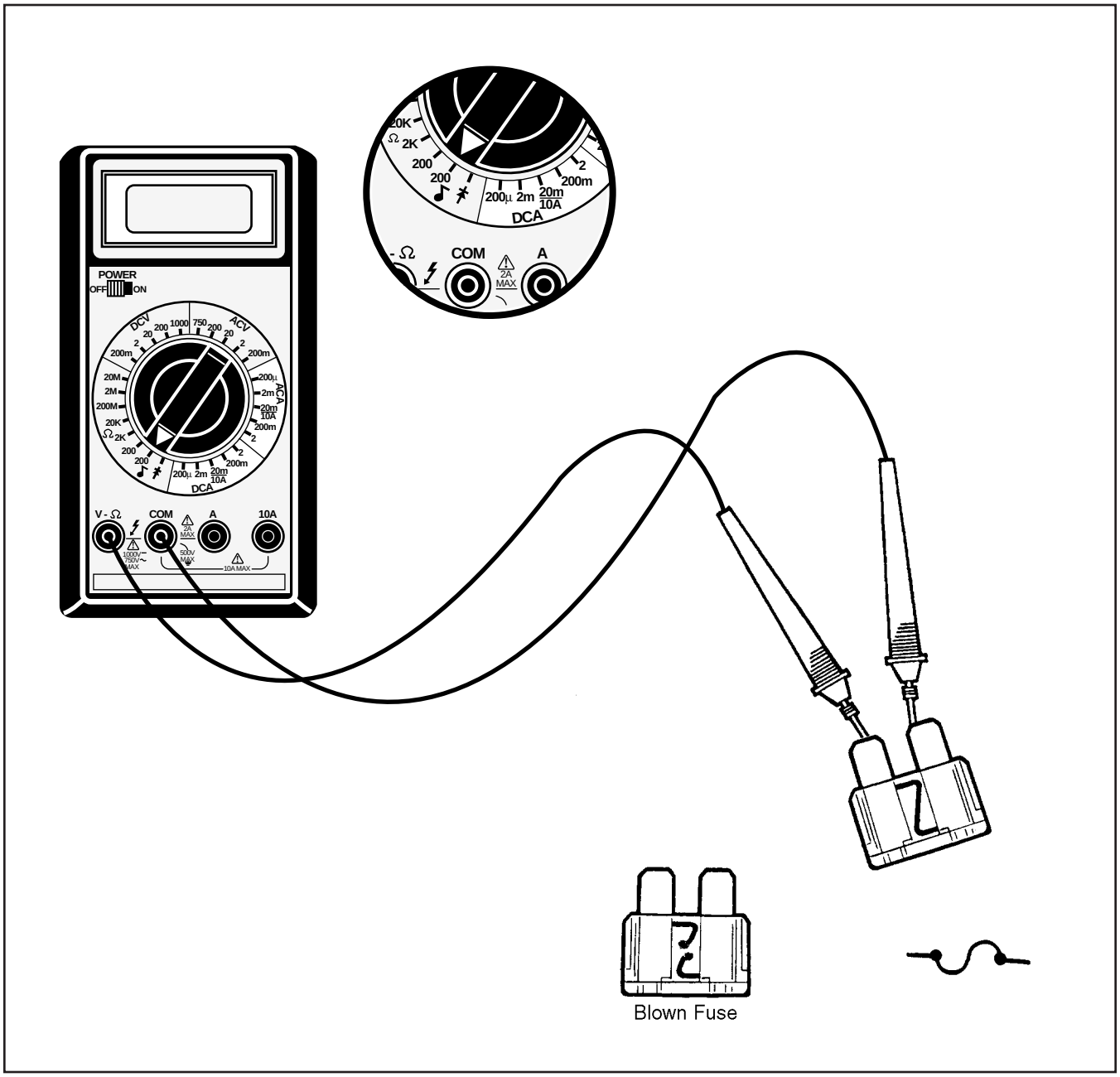


Figure 10I-1. Fuse Test

ENGINE OIL PRESSURE SWITCH TEST (See Figure 10J-1)

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 WT 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 continuity and the meter should read 0 to 0.5 Ω (ohms).
3. Increase pressure above 10 psi.
   - Switch contacts should open.

NOTE

If switch tests OK 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 tests.

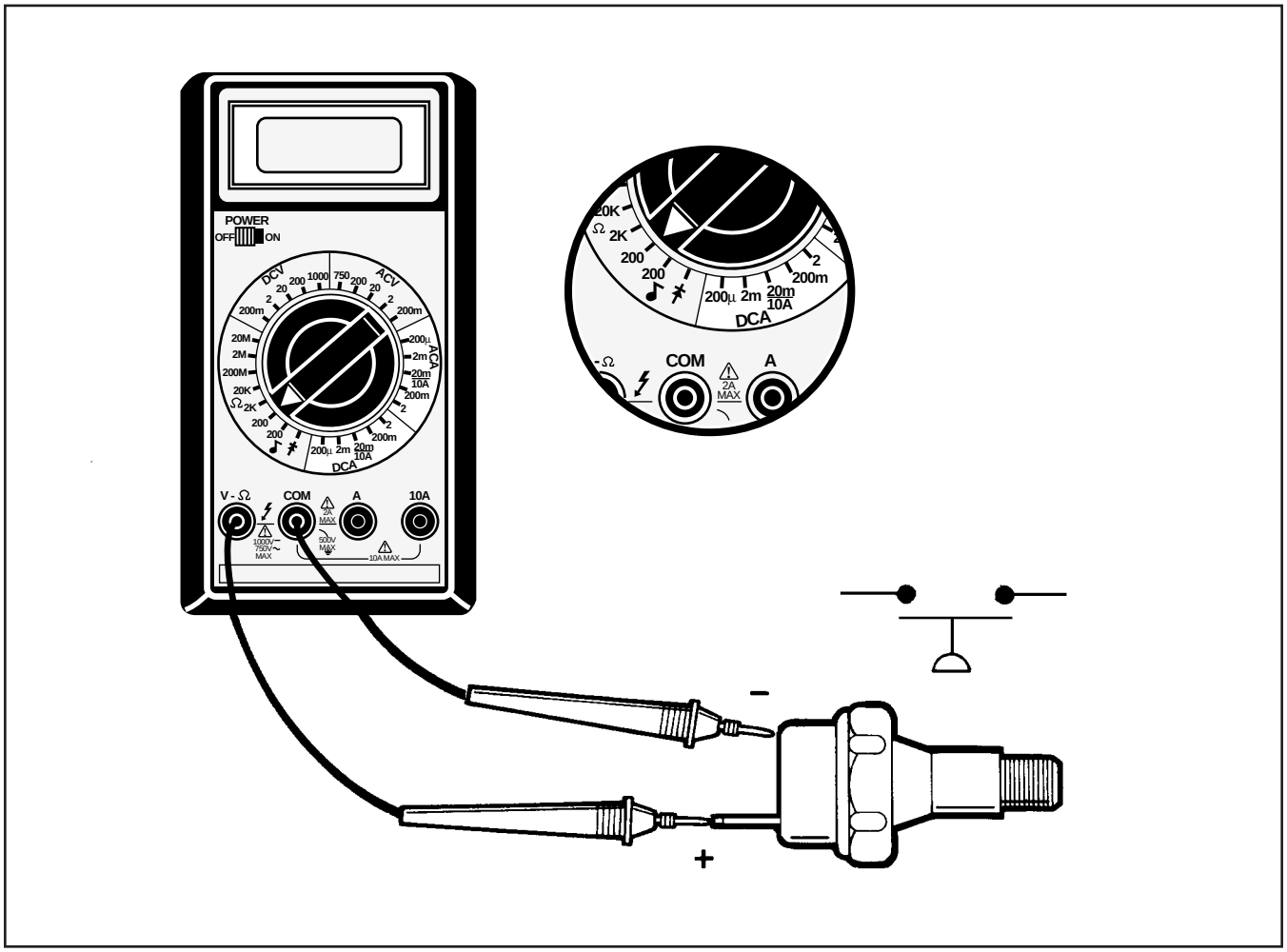


Figure 10J-1. Engine Oil Pressure Switch Test

SECTION 10J. SENDERS AND ALARMS

ENGINE COOLING WATER TEMPERATURE SENDER TEST (See Figure 10J-2)

The temperature sender is a rheostat type.

As temperature rises, resistance Ω (ohms) decreases, causing the gauge to read higher.

FIELD TEST

1. Remove DK GRN wire from sender and ground.
   - If gauge jumps to its highest reading sender is faulty.
   - If gauge does not jump to its highest reading, gauge or wiring may be faulty.

Replace a sender or gauge that does not meet all the above tests.

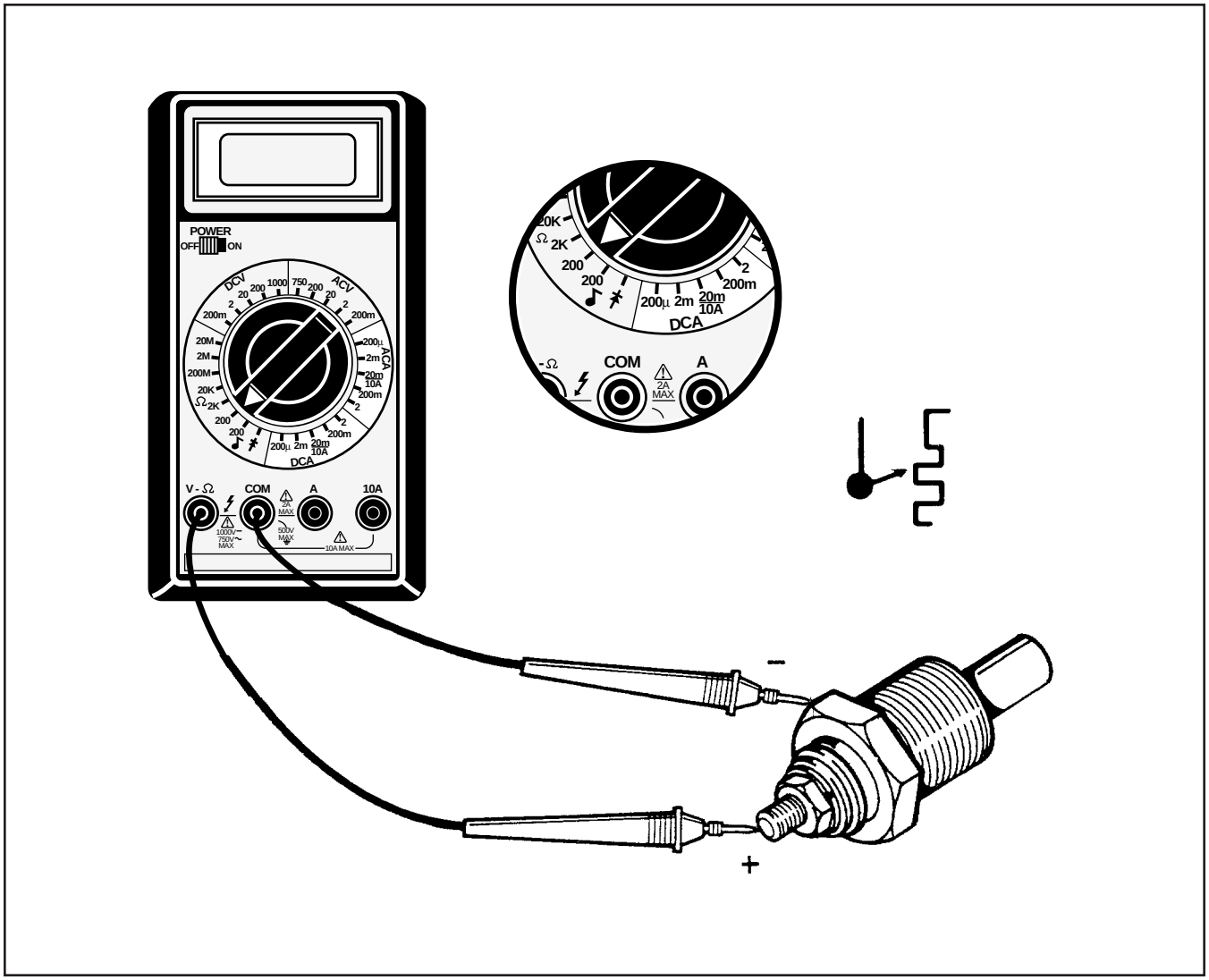


Figure 10J-2. Engine Cooling Water Temperature Sender

FUEL LEVEL SENDER TEST (See Figure 10J-3)

1. With the sender removed from the tank, connect one multimeter lead to the center terminal and the other to flat mounting plate.
2. Multimeter range settings may have to be changed during this test to read the high and low ohms. Set multimeter to the appropriate range.
3. With the float in:

   Lowest Position (tank empty) ..... 0.205 ohms
   Highest Position (tank full)..... 0.027 ohms

   - If fuel level sender tests do not fall within the above limits, replace.
   - If fuel level sender tests fall within limits, check wiring and/or gauge (see Section 10N).

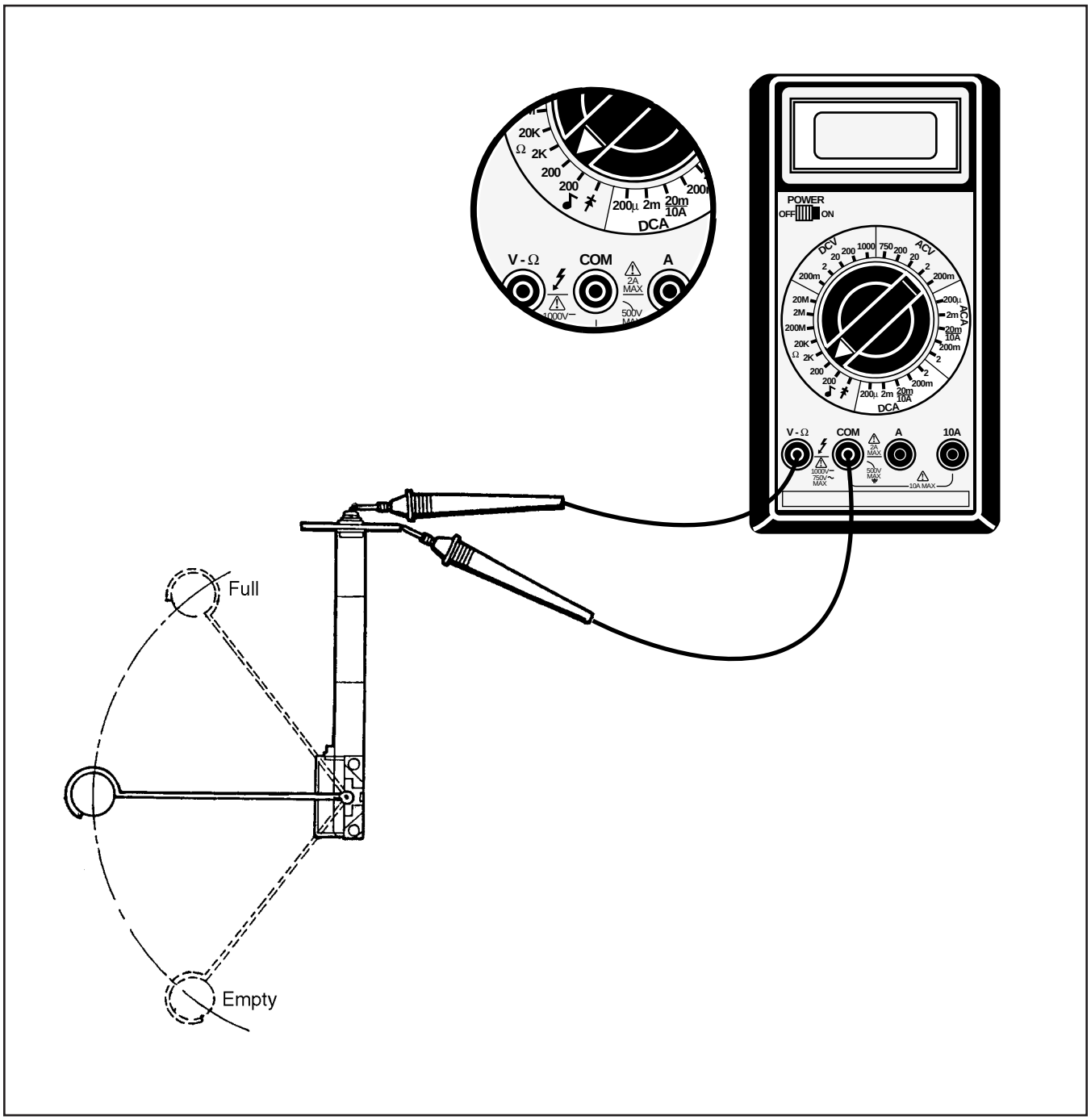


Figure 10J-3. Fuel Level Sender Test

10J

SECTION 10K. SOLENOIDS

STARTER SOLENOID TEST (See Figure 10K-1)

1. Connect the battery to terminals S and I.
   - There should be an audible “click”.
2. Set the multimeter to 200 Ω (ohms).
3. Connect multimeter test leads to terminals 1 and 2.
   - Multimeter reading should be 0 to 0.5 Ω (ohms).
4. Remove battery connections.
   - There should be no continuity on the meter.

Replace a solenoid that does not meet the above test results.

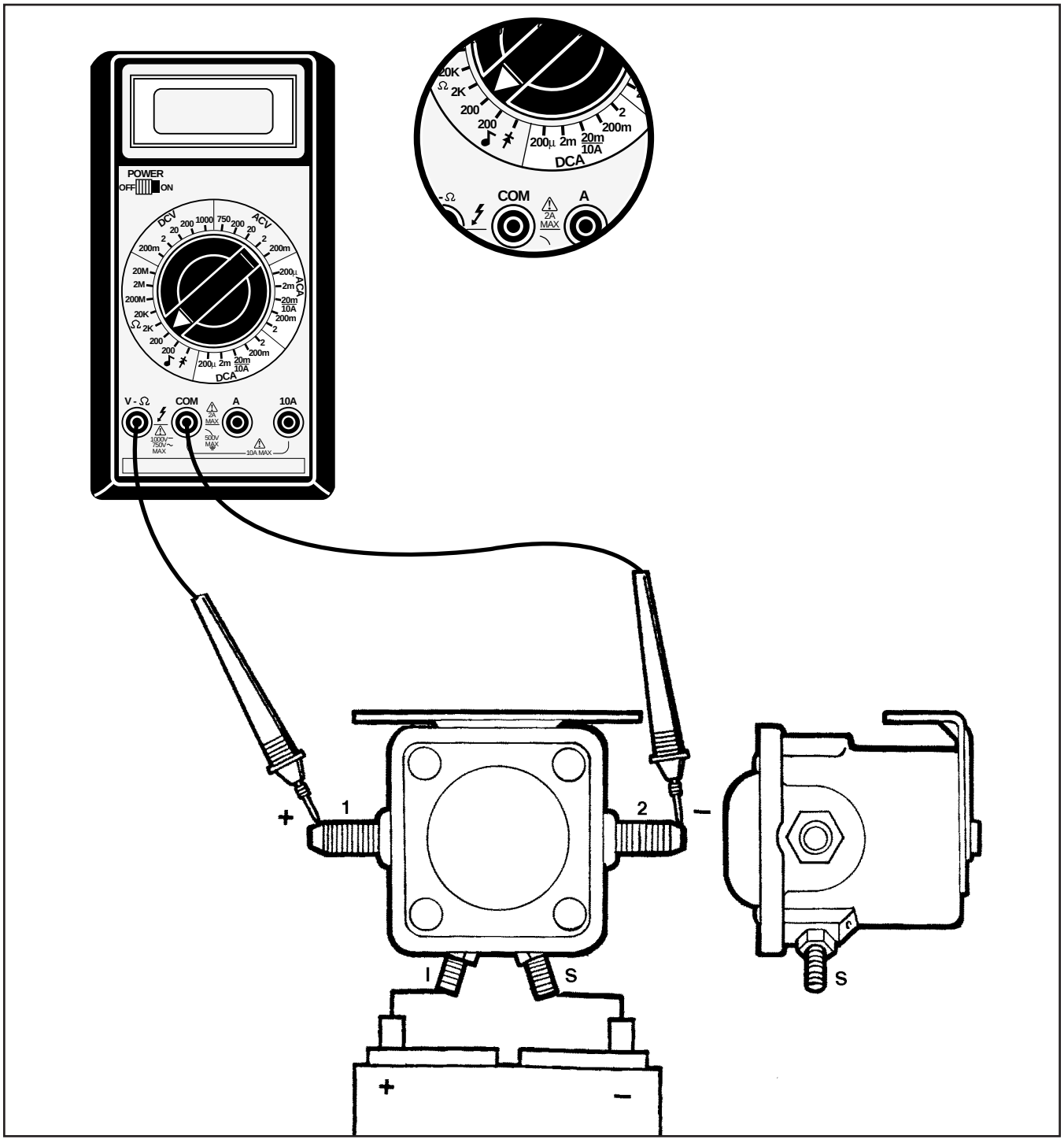


Figure 10K-1. Starter Solenoid

SECTION 10L. RELAYS

RELAY TEST (See Figure 10L-1)

See Figure 10L-1 and test relay as follows:

1. Set multimeter to 200 ♪ Ω (ohms).
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.

Replace a relay that does not meet the above tests.

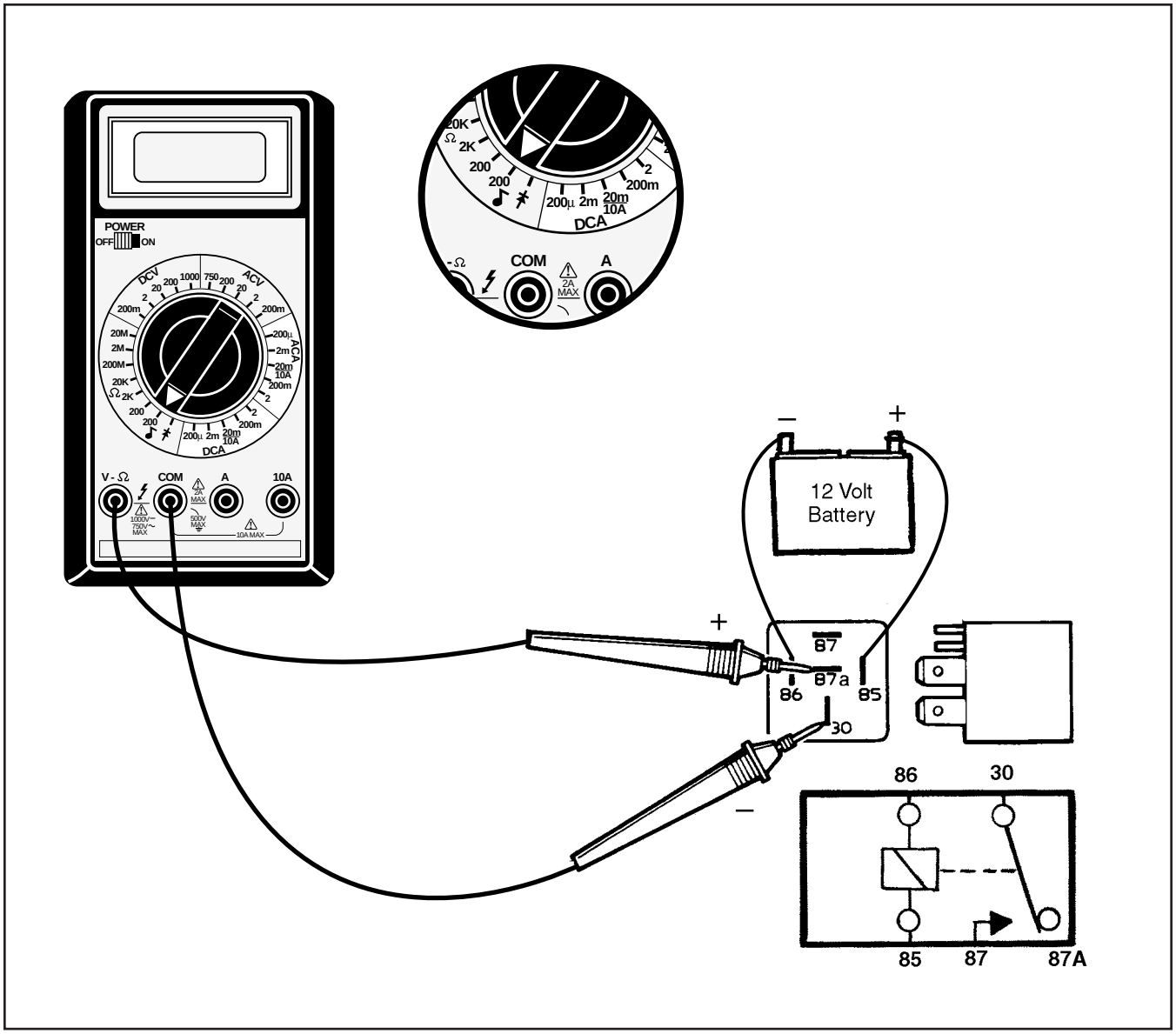


Figure 10L-1. Relay Test

10L

SECTION 10M. ELECTRICAL FUEL PUMP (DIESEL)

FUEL PUMP TEST (DIESEL) (See Figure 10M-1)

1. Disconnect the NEG (–) battery cable.
2. Disconnect RED fuel pump wire at the inlet connector.
3. Connect the NEG (–) battery cable.
4. Set the multimeter to 20 VDC and connect the POS (+) lead to the BRN wire on the wiring harness connector. Connect the NEG (–) lead to a good ground.
5. Turn the ignition switch to the ON position. (If so equipped, PTO handle must be pushed down.)
   - Multimeter should read battery voltage.
   - If no voltage is measured, check for faulty switches or wiring.
   - If battery voltage is measured, fuel pump may be faulty.

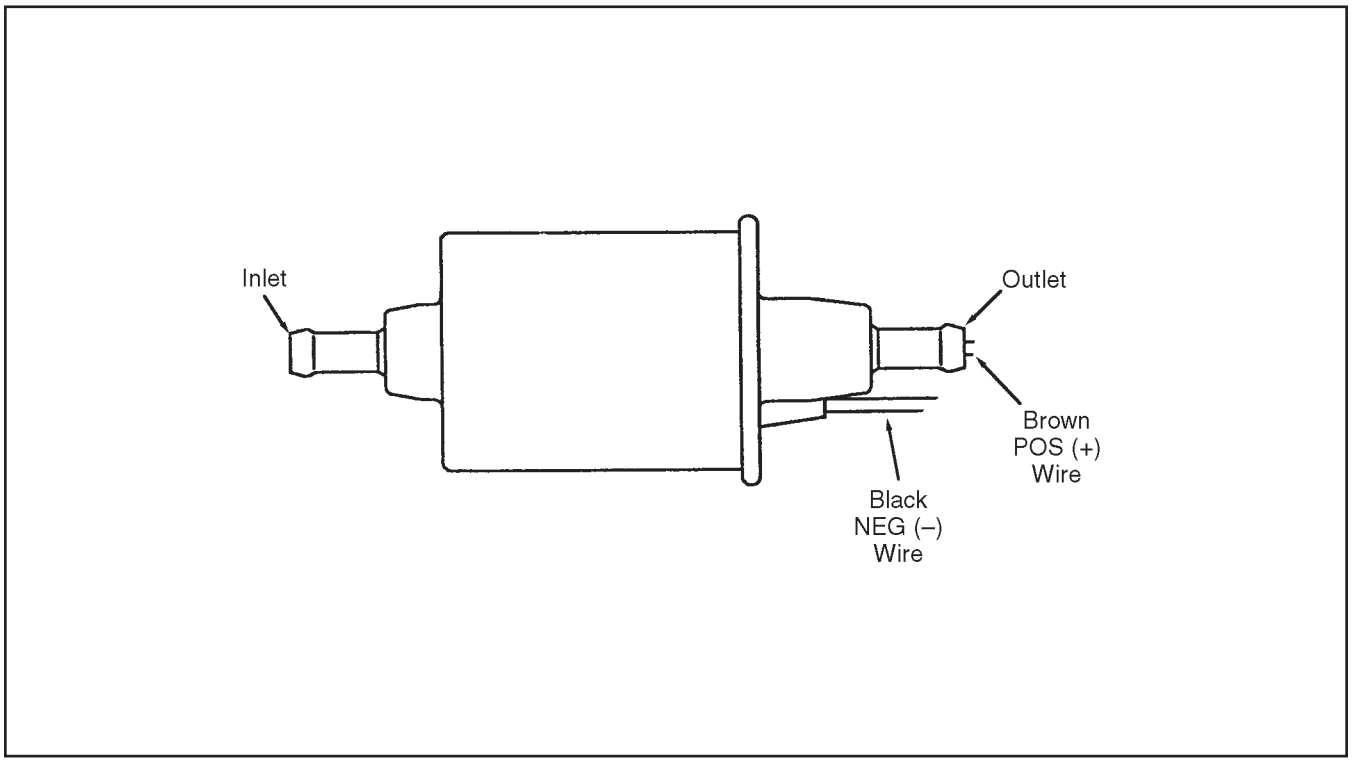


Figure 10M-1. Fuel Pump

SECTION 10N. GLOW PLUGS

GLOW PLUG TEST (DIESEL ONLY) (See Figure 10N-1)

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).
4. Connect one multimeter test lead to glow plug terminal and the other to housing.
   - The multimeter reading should be approximately 1.6 ± 0.16 Ω (ohms) (cold). If the reading is at infinity or 0 Ω (ohms) the glow plug is faulty and must be replaced.

Replace *a glow plug that does not meet the above* tests.

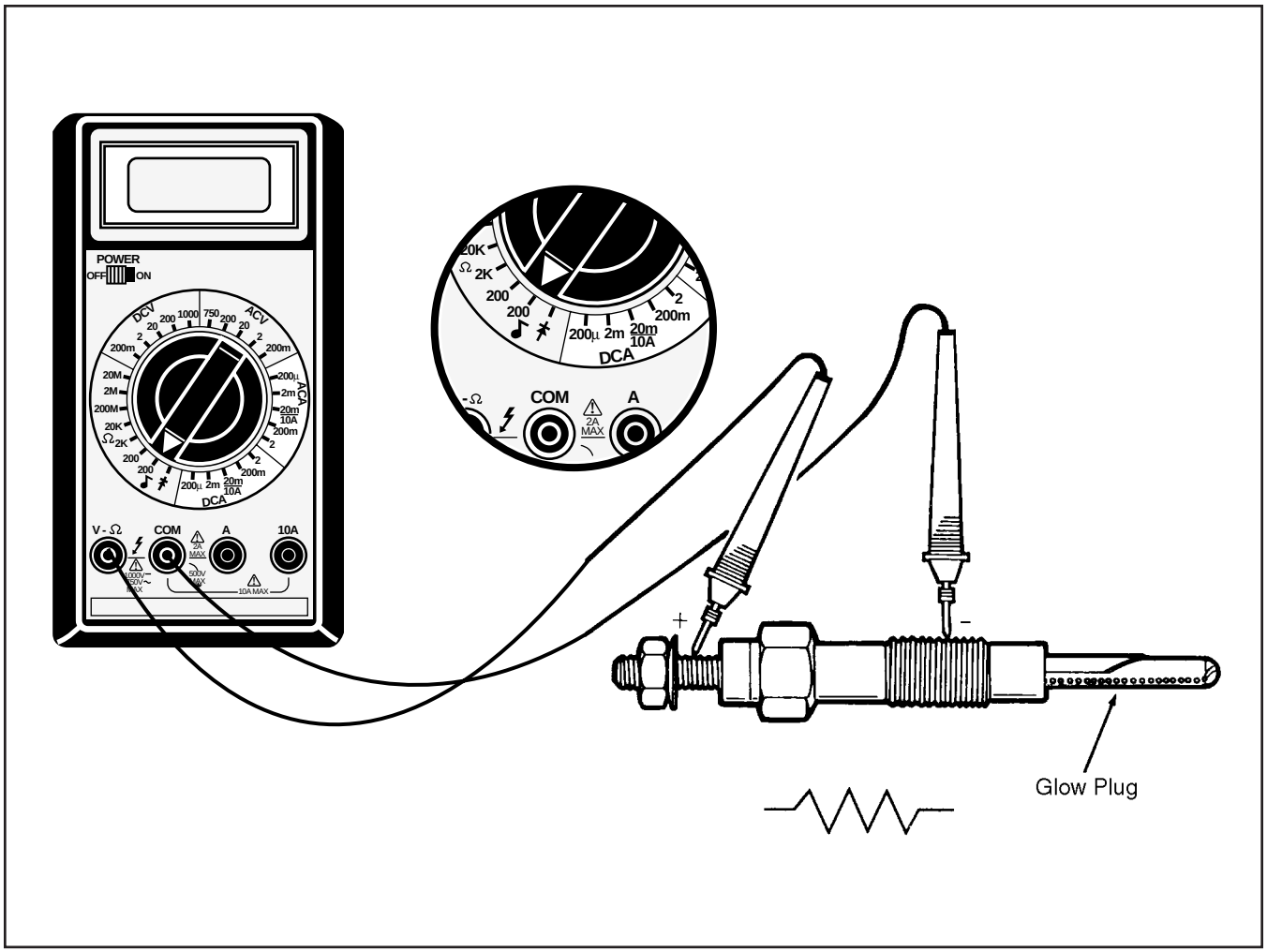


Figure 10N-1. Glow Plug Test

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATION ILLUSTRATIONS

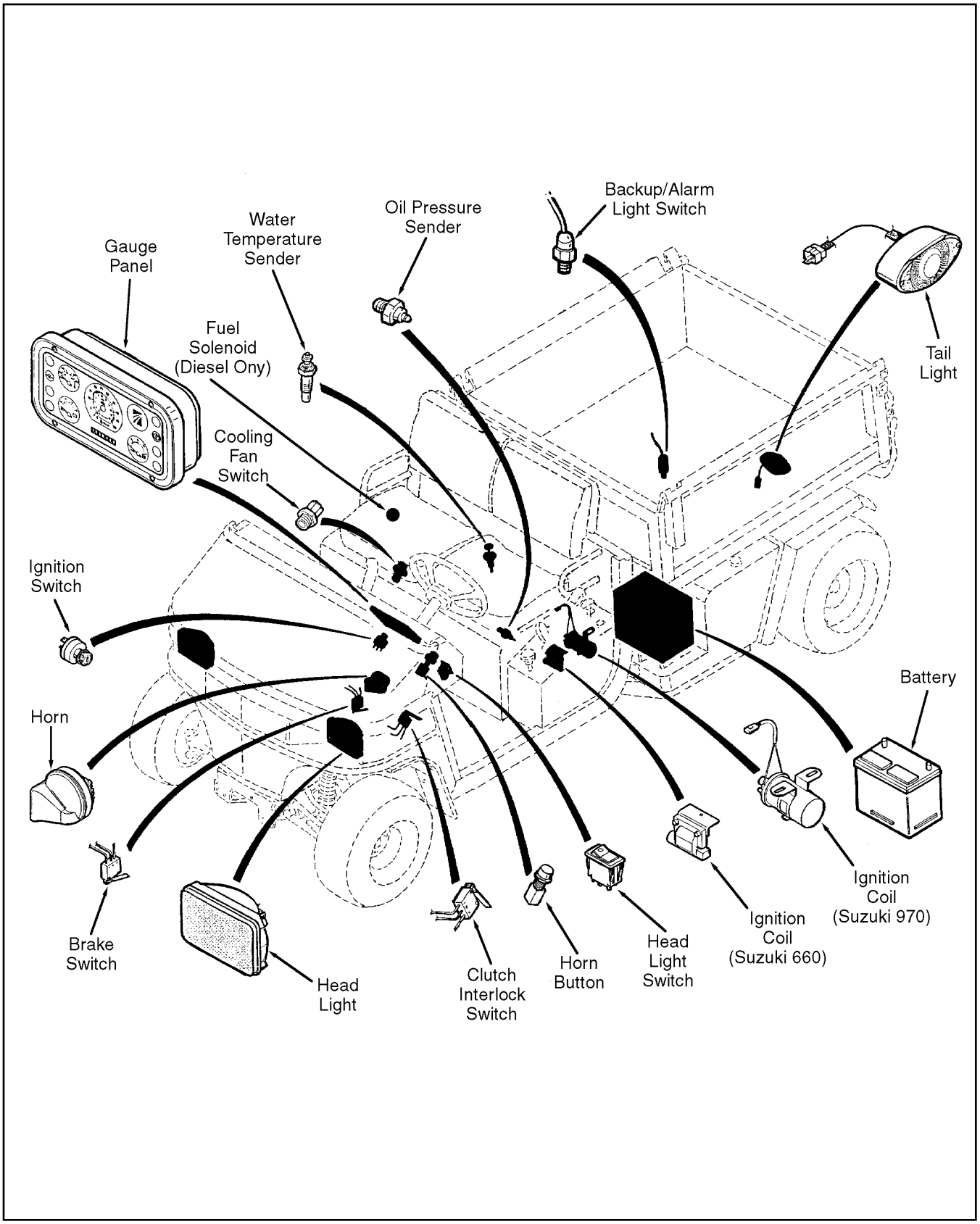


Figure 10O-1. Electrical Component Locations

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATION ILLUSTRATIONS

ELECTRICAL GRAPHIC SYMBOLS

These are electrical graphic symbols commonly used in Textron Golf, Turf & Specialty Products diagrams and schematics.

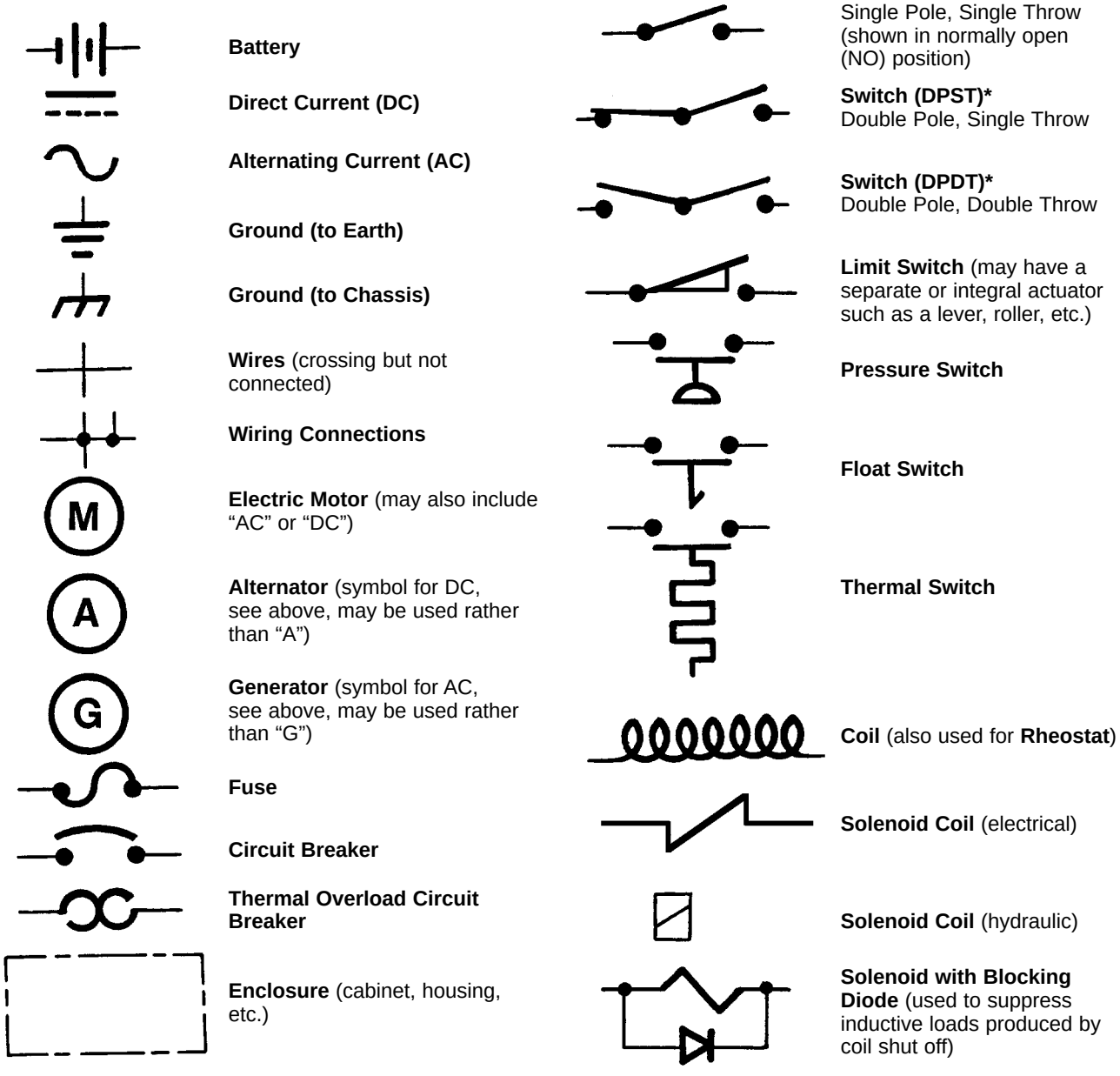
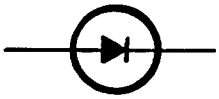


Figure 10O-2. Electrical Schematic Symbols (1 of 2)

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATION ILLUSTRATIONS

Diode

Light Emitting Diode (LED)
(see also below)

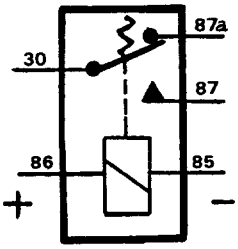


Light Emitting Diode (LED)
(alternative symbol)

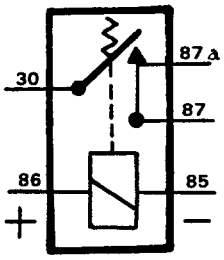
Resistor or **Glow Plug**

Adjustable Resistor

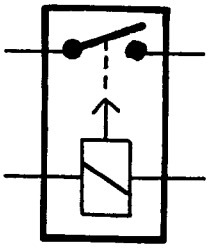
Potentiometer (POT) (a variable resistor with a fixed reference)



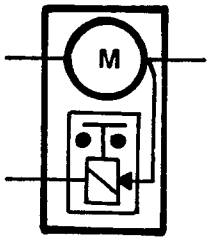
Normally Closed Relay



Normally Open Relay



Time Delay Relay
(opening delay)



Motor with Solenoid

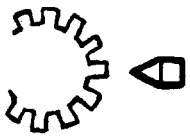
Light (see also below)

Light (alternate symbol)

Horn

Connector

Ignition Switch (number of and labeling of terminals varies, consult schematics for specific arrangement)



Magnetic Pickup (used for tachometers, engine ignition timing, etc.)

Figure 10O-2. Electrical Schematic Symbols (2 of 2)

ELECTRICAL SYSTEM

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATION ILLUSTRATIONS

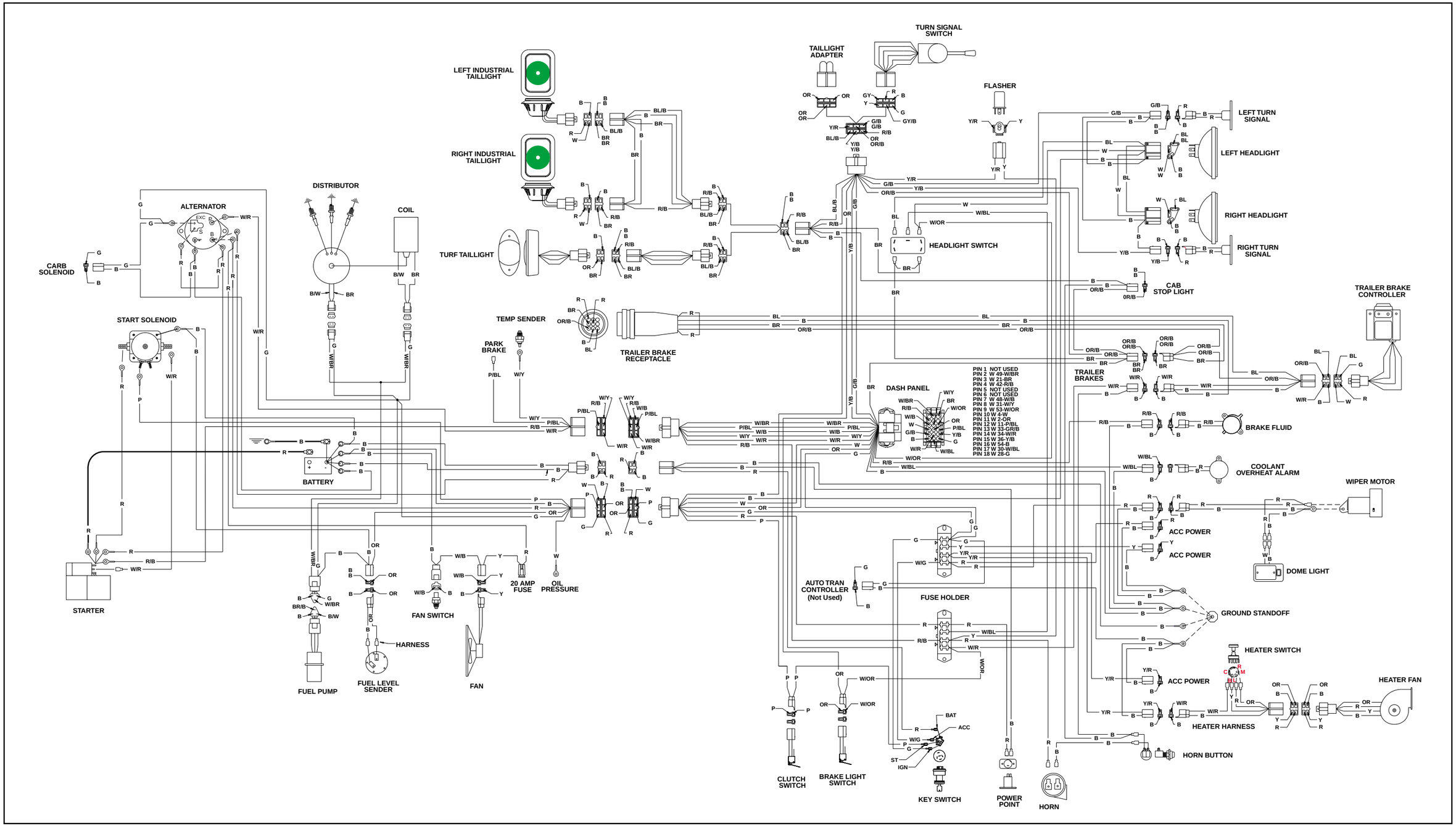


Figure 10O-3. Truckster with 660 Gasoline Engine Electrical Diagram

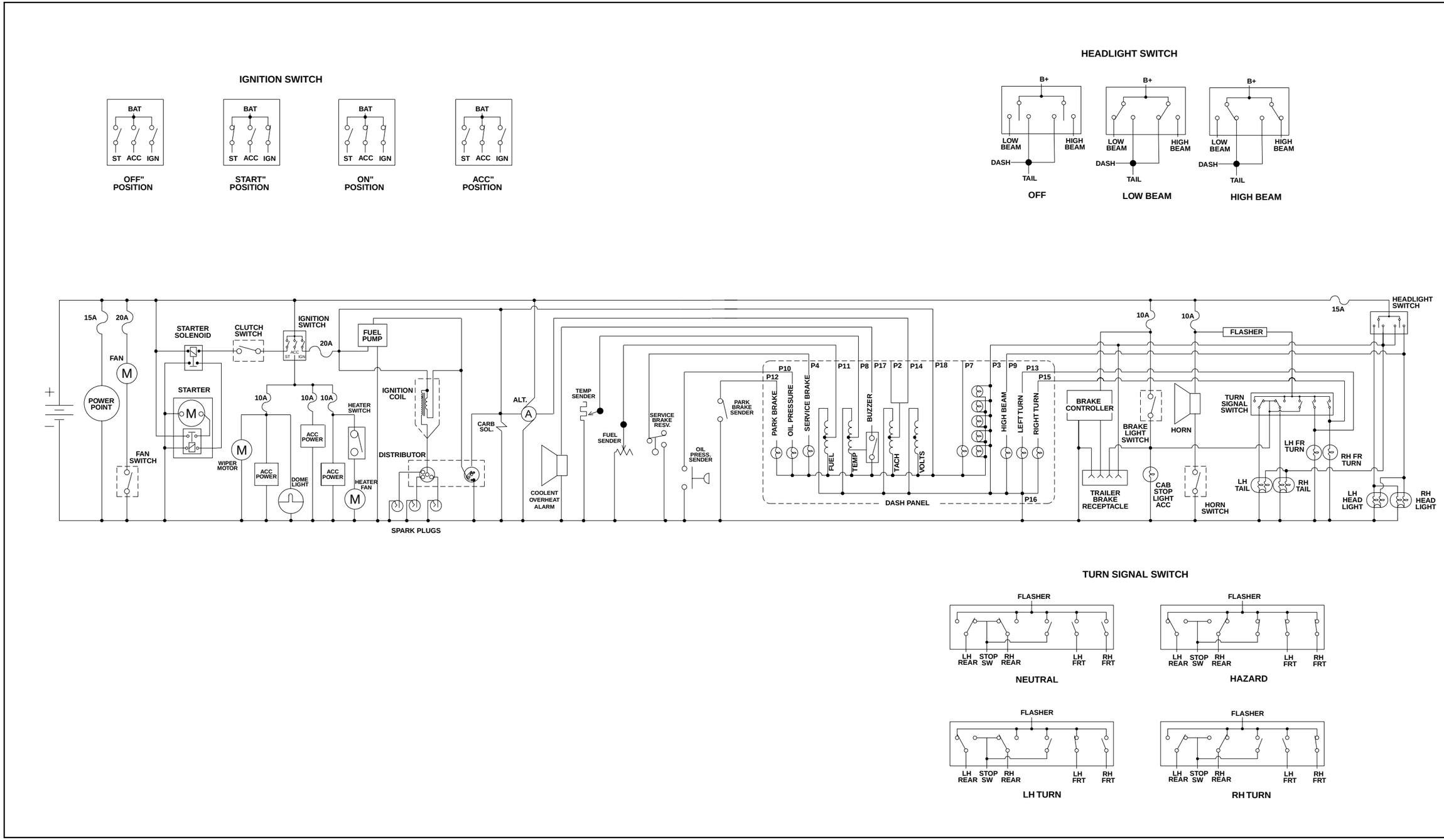


Figure 10O-4. Truckster with 660 Gasoline Engine Electrical Schematic

10O

ELECTRICAL SYSTEM

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATION ILLUSTRATIONS

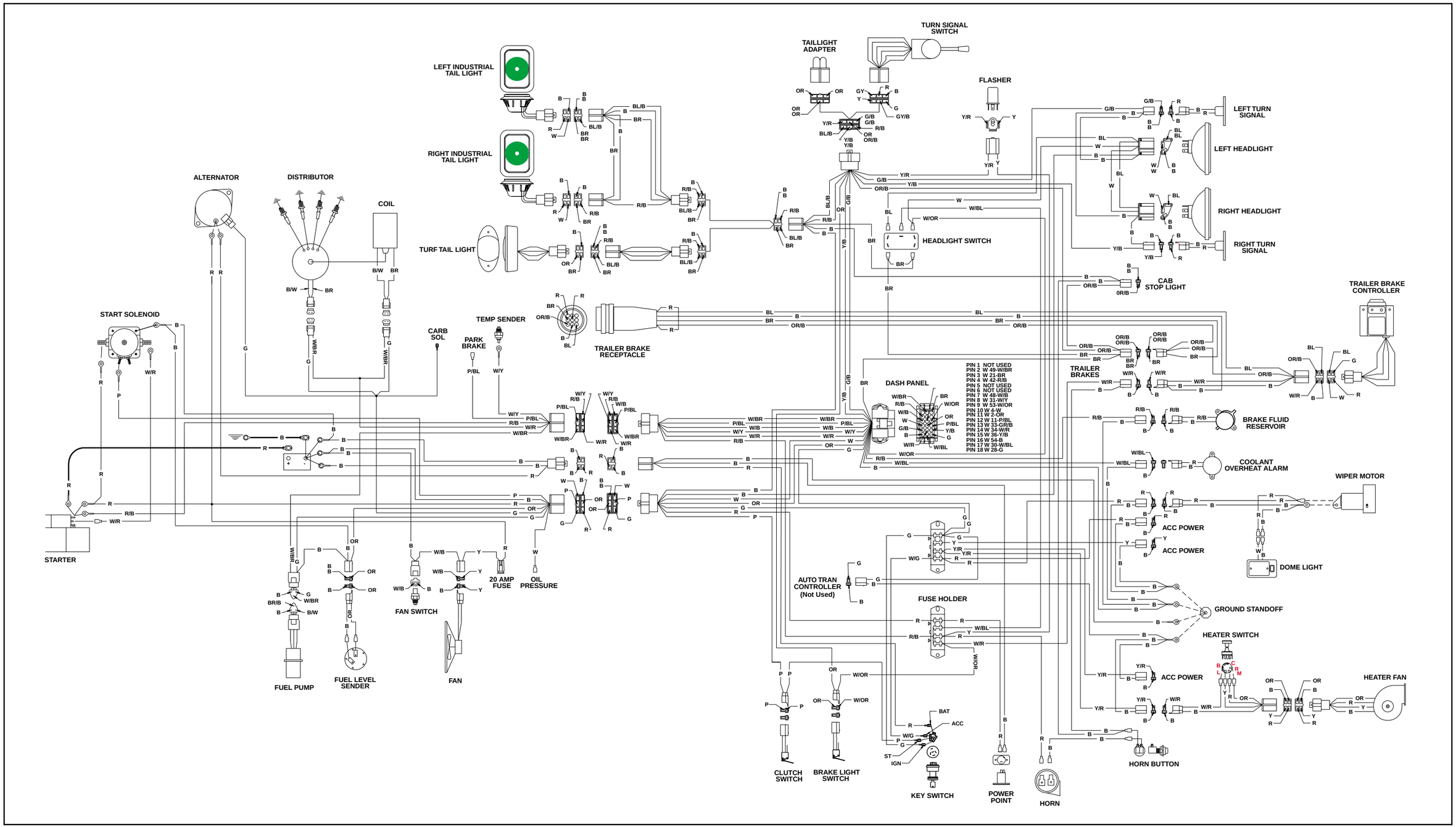


Figure 10O-5. Truckster with 970 Gasoline Engine Electrical Diagram

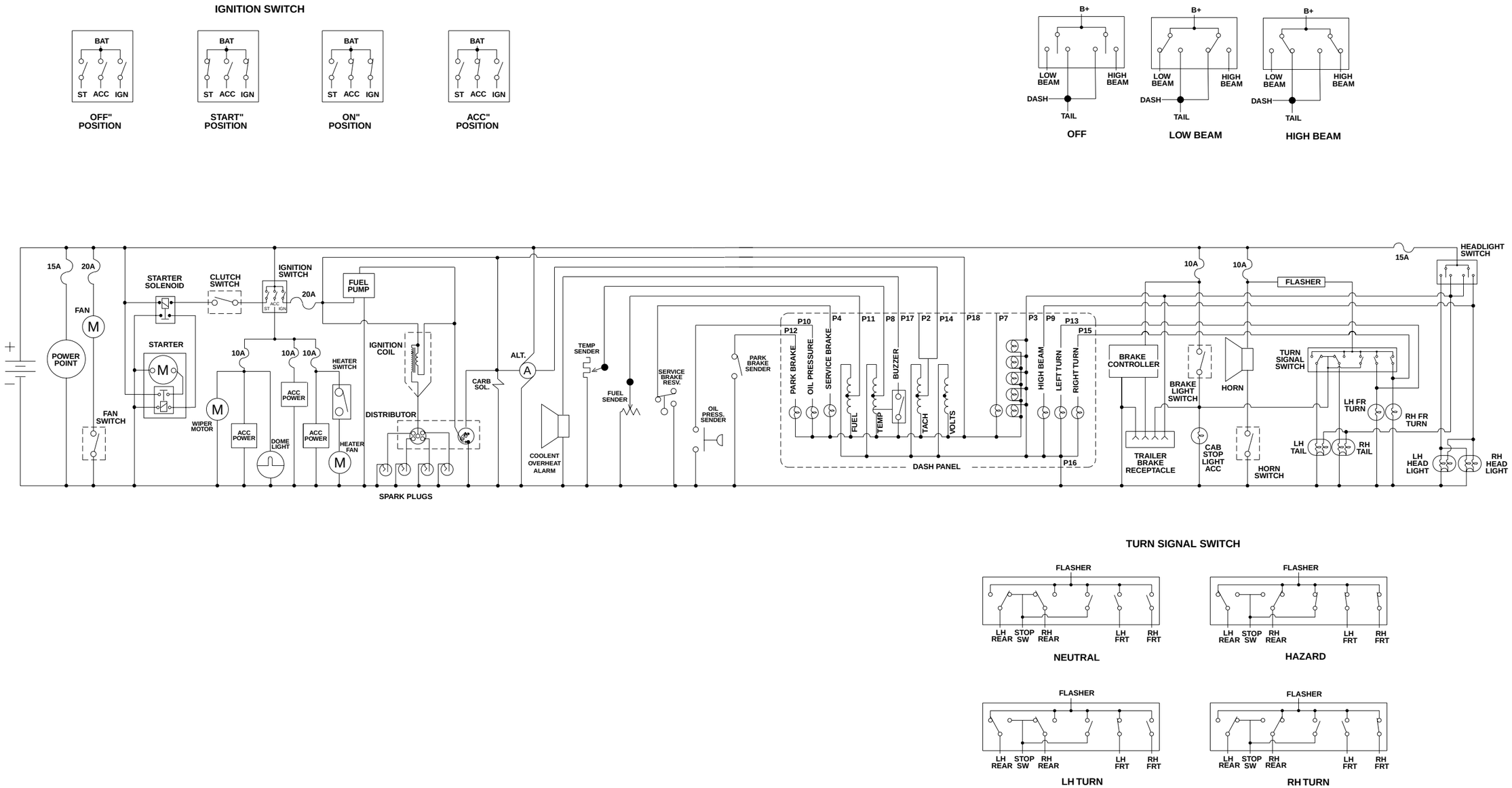


Figure 10O-6. Truckster with 970 Gasoline Engine Electrical Schematic

10O

ELECTRICAL SYSTEM

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATION ILLUSTRATIONS

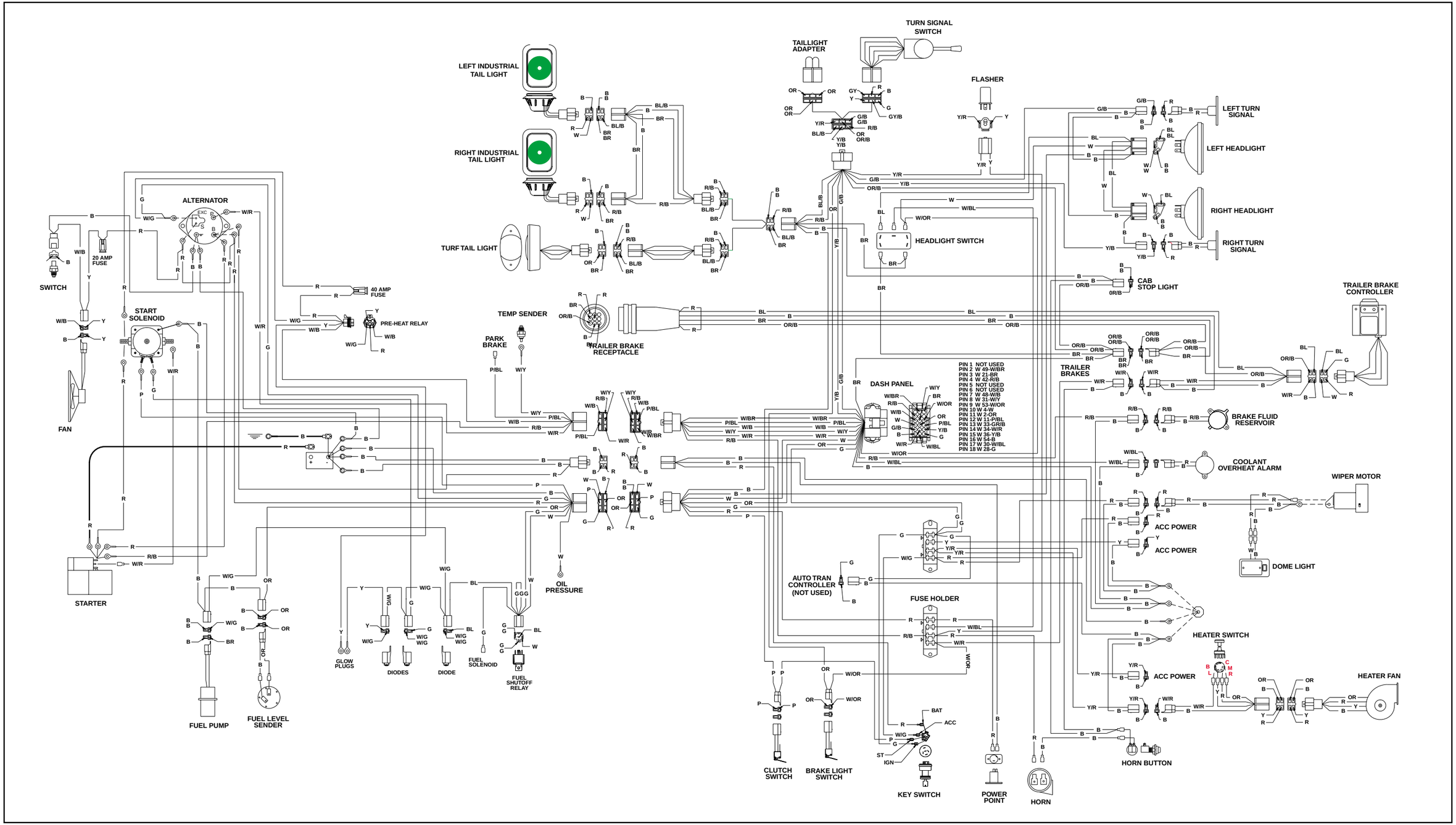
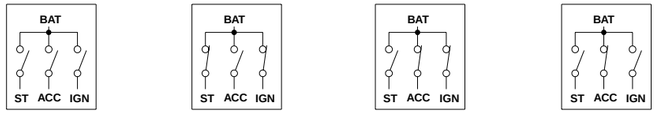
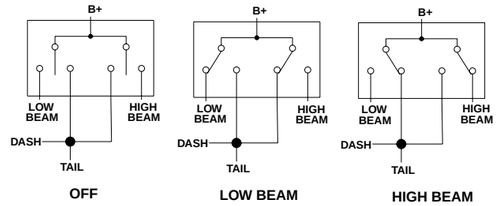


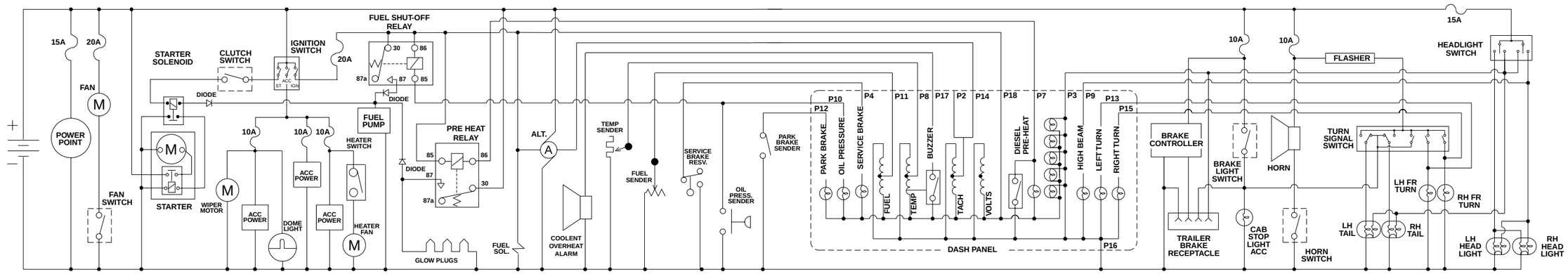
Figure 10O-7. Truckster with Diesel Engine Electrical Diagram

IGNITION SWITCH

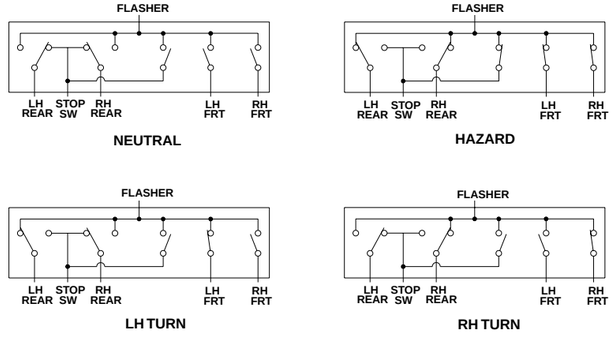


HEADLIGHT SWITCH





TURN SIGNAL SWITCH



10O

Figure 10O-8. Truckster with Diesel Engine Electrical Schematic

RETURN TO MAIN
TABLE OF CONTENTS

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 vehicle in the shop for necessary repairs.

ADMINISTRATION

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

Textron 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 Textron Golf, Turf & Specialty Products Dealer/Distributor.

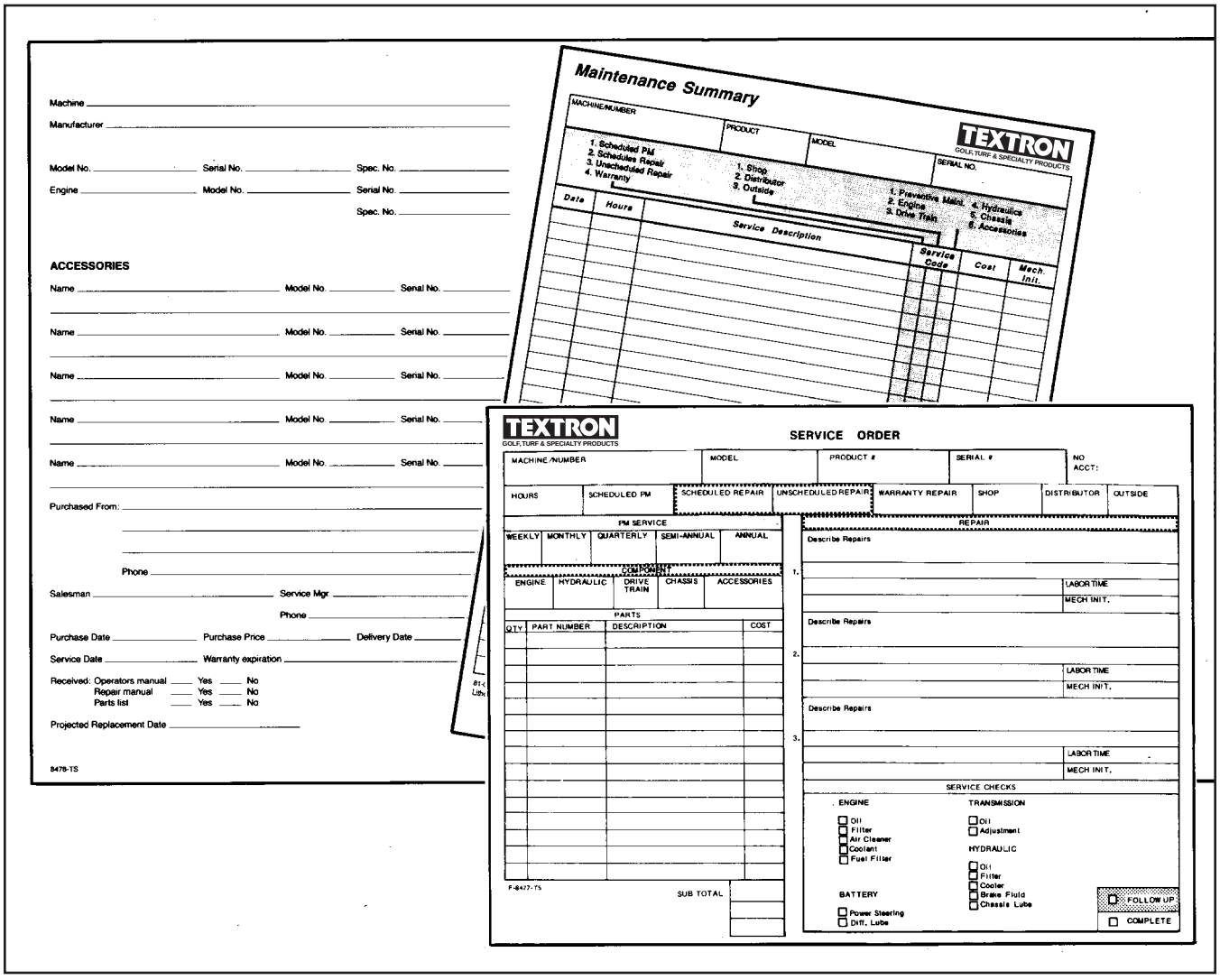


Figure 11A-1. PMMRS Kit Order Forms

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	_____	_____

TEXTRON
GOLF, TURF & SPECIALTY PRODUCTS

Textron Golf, Turf & Specialty Products
P.O. Box 7708
11524 Wilmar Blvd.
Charlotte, NC 28273

_____
Authorized Signature

Price subject to change, contact your Textron 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
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	_____	_____

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SECTION 11B. LUBRICATION AND MAINTENANCE SCHEDULES

GENERAL

Intervals are based on operating hours. These are suggested intervals only. As experience is gained in operating this machine, the schedule can be tailored to your operating time.

CAUTION

Do NOT use compressed air grease guns.

Over greasing will produce high loads on bearings and pivot points reducing performance of the machine.

LUBRICATION SCHEDULE (See Figure 11B-1)

Clean grease fittings before greasing. Apply grease to fittings with hand grease gun only and fill slowly.

LUBE CHART

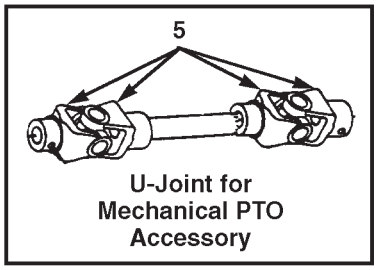
100 HOURS (or Every 3 Months)
1a Differential Drive Shaft
2a Upper Ball Joints
3a Lower Ball Joints
4a Tie Rods
5a Mechanical PTO (accessory drive shaft)

600 HOURS (or Annually)
6b Repack Front and Rear Wheel Bearings

FOOTNOTES

a Use a good quality NLGI Grade 2 grease (use manual grease gun).

b Pack gearings with NLGI Grade 2 grease.



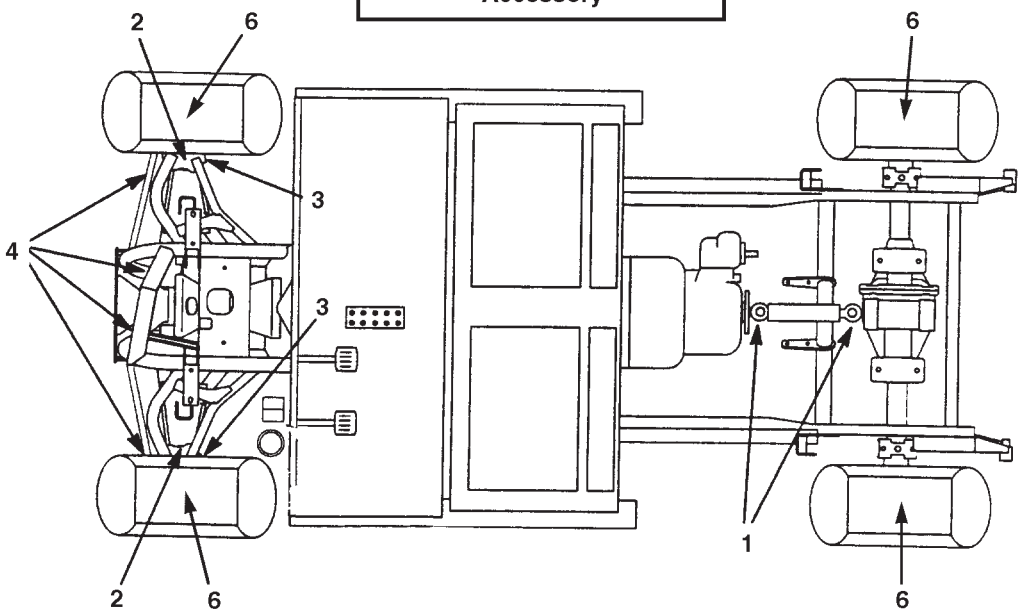
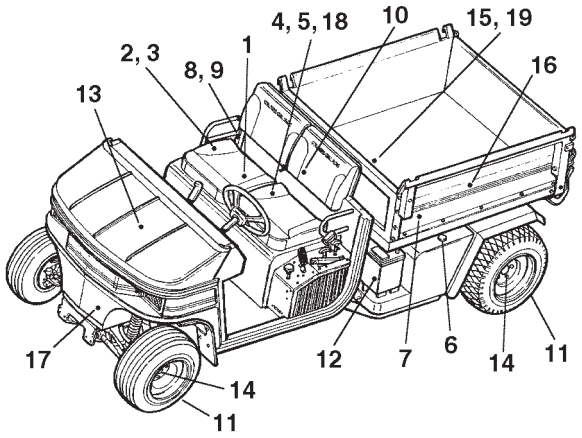


Figure 11B-1. Lubrication Schedule

11B

SECTION 11B. LUBRICATION AND MAINTENANCE SCHEDULES

MAINTENANCE SCHEDULE (See Figure 11B-2)



FOOTNOTES

a Fill overflow bottle to approximately 4 inches (102 mm). Make a 50/50 (never more than 50% antifreeze) mixture of antifreeze and water in separate container.

Cooling system capacities for gasoline engines are 3.3 qts. (3.1 L) and 5.0 qts. (4.7 L) for diesel engines.

When completely changing the coolant, pour mixture directly into the radiator until it reaches approximately 1/4 inch (6 mm) from the bottom of the filler neck, then fill overflow reservoir as described above.

b Engine oil level should always be between the "add" and "full" mark on the dipstick (with engine cool or warn, not hot). Use SAE 10W-30. Capacities are:

- 3-cylinder gasoline (Suzuki 660) engine — 3.3 qts. (3.1 L).
- 4-cylinder gasoline (Suzuki 970) engine and Perkins diesel engine — 3.7 qts. (3.5 L).

c Fill oil plug opening with SAE 20W engine oil. Governor capacity is 1.5 oz. (44 ml).

d Use Turf Protector Biodegradable. Capacity for standard hydraulic systems is 4 gal. (15.2 L) and for systems with "Hi-Lo" (hydraulic PTO) accessories the capacity is 7.6 gal. (28.8 L). **CAUTION: Do not overfill the reservoir. Severe damage may result.**

e Fuel tank capacity is 6.5 gal. (24.6 L). For gasoline engines, use 87 octane (or higher) unleaded. For diesel engines, use No. 2 diesel fuel (ASTM D975). When the temperature is below 20°F (–7°C) use ASTM No. 1 diesel fuel.

f Transmission capacity is 1.35 qts. (1.28 L) for vehicles with 4-cylinder (Suzuki 970) gasoline or diesel engines and 1.05 qts. (0.9 L) for 3-cylinder (Suzuki 660) gasoline engines. Use SAE EP 80-90 gear oil. Fluid level must be level with bottom of filler plug hole.

Ref.	Description	Every Day (8 to 10 Hours)	Every 2 Months (75 Hours)	Every 3 Months (100 Hours)	Every 6 Months (200 Hours)	Annually (600 Hours)	Remarks
1	Air Cleaner Element				X		Replace
2	Radiator Screen	X					Check, clean.
2	**a** Cooling System	X					Check coolant level, replenish.
2	**a** Coolant					X	Change coolant.
2	Radiator Hoses	X					Inspect/change as required.
3	Belts					X	Check for cracks and tension. Adjust if necessary.
4	**b** Engine Oil and Filter (Gasoline Engines)	X		X			Check level daily, change every 100 hours.
4	**b** Engine Oil and Filter (Diesel Engines)	X	X				Check level daily, change every 75 hours.
4	**c** Engine Governor Oil (Gasoline Only)			X			Change every 100 hours.
5	Diesel Engine Water Separator	X					Drain as required.
6	**d** Hydraulic Reservoir			X		X	Check every 100 hours, change annually.
7	Hydraulic System Filter					X	Replace filter.
8	**e** Fuel Level	X					Check, replenish.
9	Fuel Filter					X	Change.
9	Fuel Hoses and Clamps					X	Check, replace as necessary.
10	Muffler/Exhaust				X		Inspect/replace if necessary.
11	Tires	X					Check pressure. If necessary, fill fronts to 20 psi (138 kPa) and rears to 15 psi (110 kPa).
12	Battery					X	Clean cables and terminals.
13	Brake Fluid			X			Check/replenish with DOT 3 brake fluid.
14	Brake Linings					X	Check, replace if necessary.
14	Brake Adjustment			X		X	Check/adjust as required.
15	**f** Transmission Fluid			X		X	Check level and replenish every 100 hours. Drain and change annually.
16	Differential Oil			X		X	Check level and replenish every 100 hours. Change annually and after first 100 hours of operation. Capacity is 2.6 qts. (2.46 L). Use SAE EP80-90 gear oil.
17	Steering Fluid			X			Change fluid after first 35 hours of operation. Check and fill with General Motors fluid (G.M. Part No. 1050017).
18	Spark Plugs (Gasoline Engines)					X	Check/clean and gap if required.
18	Glow Plugs (Diesel Engines)					X	Test/replace if required.
18	Injection Pump (Diesel Only)					X	Test/adjust timing if required.
19	Clutch				X		Check/adjust if required.

Figure 11B-2. Maintenance Schedule

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SECTION 12
ATTACHMENTS

SECTION 12A. 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. Antiseize.
Lubricants:	Refer to Section 11.

SECTION 12B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Noisy operation.	a. Worn bearings.	a. Replace (Section 12C).
	b. PTO sprockets misaligned (mechanical PTOs).	b. Align (Section 12C)
	c. Loose chain or broken sprocket (mechanical PTOs).	c. Repair/replace (Section 12C).
2. No PTO output while vehicle is moving.	a. Broken chain or sprocket (mechanical PTOs).	a. Replace (Section 12C).
	b. Governor control lever not depressed all the way.	b. Push lever all the way down (Section 2).
	c. Broken or loose shaft.	c. Repair/replace (Section 12C or 12B).
3. No PTO output while vehicle is stationary.	a. Broken chain or sprocket (mechanical PTOs).	a. Replace (Section 12C).
	b. Hi-Lo differential speed control in neutral.	b. Move control to Hi or Lo (Section 2).
	c. Broken or loose shaft.	c. Repair/replace (Section 12C or 12D).
	d. PTO is overloaded.	d. Disconnect driven unit from output shaft. Check output shaft rotation. If okay, reduce load.
	e. Hose misconnected (hydraulic PTOs).	e. Check connections (Sections 8 and/or 12D).
	f. Cut or loose hose (hydraulic PTOs).	f. Tighten/replace (Section 8C).
	g. Faulty pump or motor (hydraulic PTOs).	g. Test/repair (Section 8).

SECTION 12C. MECHANICAL PTO

GENERAL

The mechanical Power Take-Off (PTO) accessory transmits power from the transmission through a series of shafts to a PTO output shaft at the rear of the vehicle (see Figure 12C-1).

NOTE

Some vehicles may be equipped with a hydraulic powered PTO which is covered in Sections 8 and 12D of this manual.

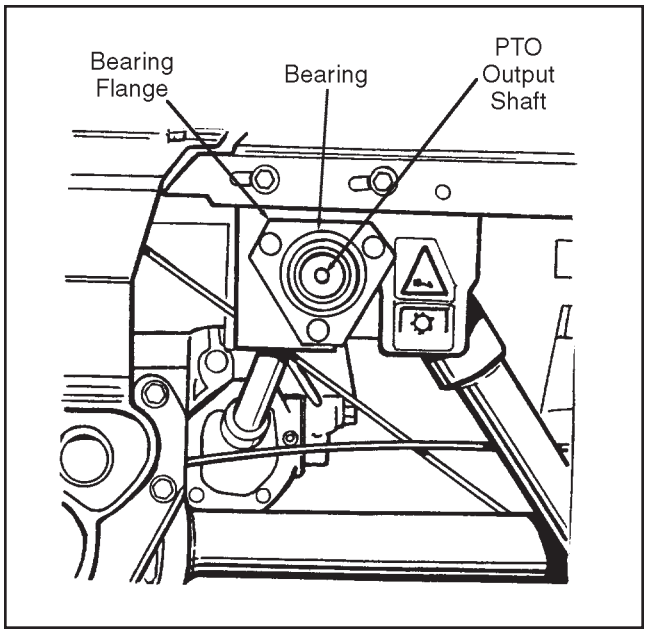


Figure 12C-1. PTO Output Shaft

The operation of the PTO is controlled by a cable attached to a lever on the transmission. The cable control handle is located on the operator's control panel.

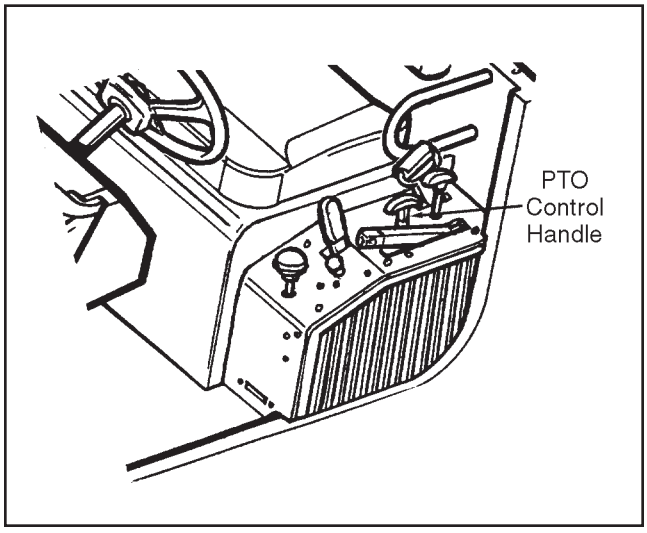


Figure 12C-2. PTO Control Handle

Vehicles equipped with the mechanical PTO have modified transmissions and were built after January 1999. These vehicles have either 4-cylinder (Suzuki 970) gasoline engines starting with vehicle Serial No. 98007587 or Perkins diesel engines starting with Serial No. 98009982 (see Section 1, Figure 1-1 for serial number location). Repair of these modified transmissions is covered in Section 4G.

Installation of a new mechanical PTO system as an addition to a vehicle not so equipped is covered in a separate publication (Part No. 845385).

A Complete exploded view of the mechanical PTO assembly is shown in Figure 12C-3. Specific repair procedures are covered in the following paragraphs.

PREPARATION FOR REPAIR

⚠ WARNING

- DO NOT perform any service or maintenance on or around the engine area until the area has had time to cool. Severe burns are possible if the area has not been allowed to properly cool.
- If the vehicle needs to be raised, DO NOT rely solely on mechanical or hydraulic jacks for support. Use appropriate jack stands or equivalent for supporting the vehicle. If using a hoist, raise the vehicle to appropriate height and support using jack stands or equivalent.

1. Place vehicle on a hard level surface, remove the ignition key and apply the park brake. If the vehicle will be raised, place blocks in front of the front wheels. Use jack stands or equivalent to support the vehicle.
2. Remove the engine intake screen (see Figure 3D-2 of this manual), PTO front and rear shields, and PTO cover (see Figure 12C-3) to gain access to components to be repaired.

NOTE

The PTO cover is spring loaded. Make sure to disconnect spring prior to cover removal and reconnect it after installation.

3. Disconnect the control cable from the lever at the transmission (see Figure 12C-3).

SECTION 12C. MECHANICAL PTO

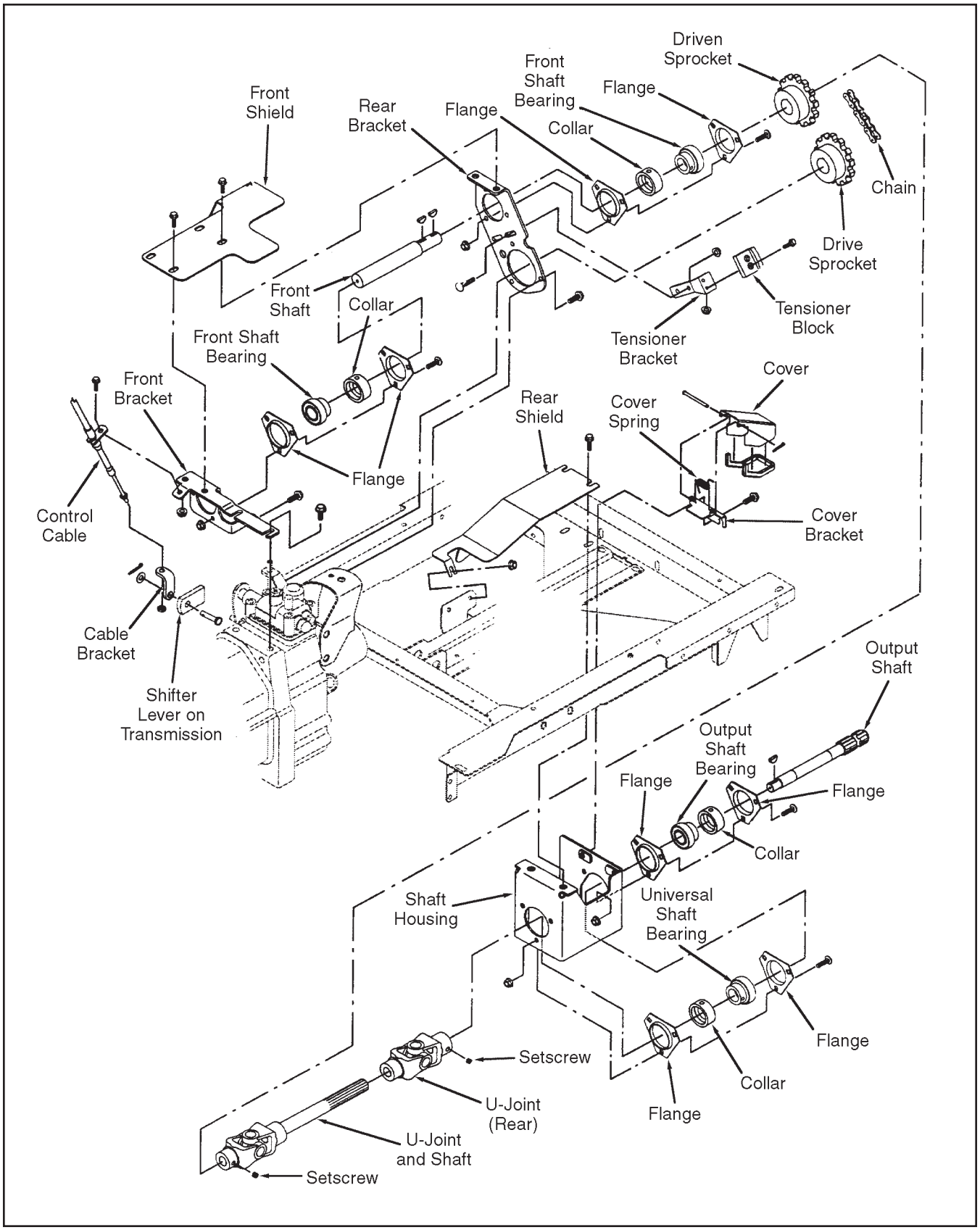


Figure 12C-3. Mechanical PTO Exploded View

SECTION 12C. MECHANICAL PTO

CONTROL CABLE
(See Figures 12C-1 and 12C-3)

Whenever the PTO cable must be replaced, make sure the cable remains clear of moving parts or parts which can become hot (also, on diesel models, keep clear of the fuel filter). Secure the cable to one of the park brake cables using the wire tie provided (make sure the cable does not make contact with the access panel when it is installed).

OUTPUT SHAFT AND UNIVERSAL SHAFT
(See Figure 12C-4)

1. Remove the output shaft and universal shaft as shown in Figure 12C-4.
2. Repair the universal shaft, if necessary, following the same procedures as for the vehicle drive shaft (see Section 4C).
3. Replace worn bearings.
4. When installing the universal shaft, slide the rear U-joint onto the splined universal shaft. (The splined shaft has one spline which is marked with a blue line. Align this spline with the blue mark on the face of the U-joint.)
5. After the universal shaft has been installed, use a lithium based grease to grease the three grease fittings (two on the universal shaft and one on the rear U-joint.

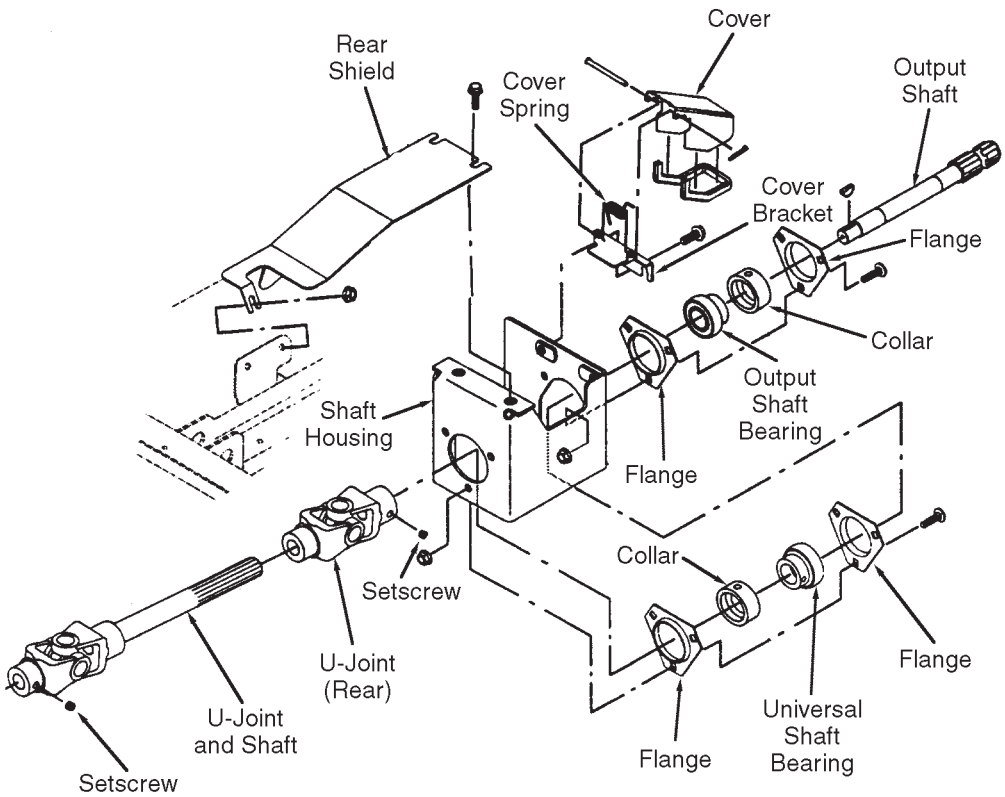


Figure 12C-4. PTO Output Shaft and Universal Shaft

12C

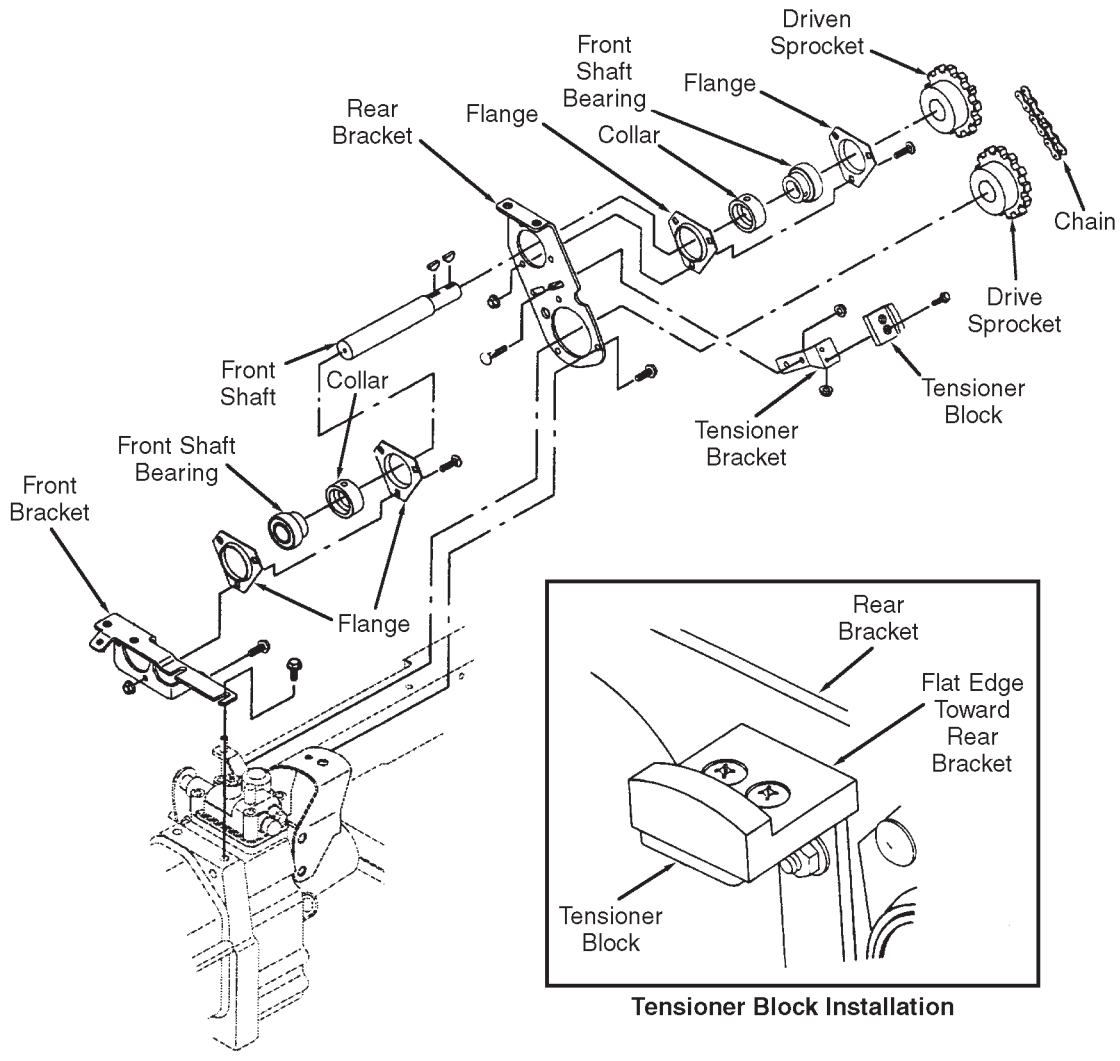
SECTION 12C. MECHANICAL PTO

DRIVE SHAFT, SPROCKETS, CHAIN AND TENSIONER (See Figure 12C-5)

1. The drive chain has one removable link. Rotate the chain to locate the link and remove the link and chain.
2. Remove keys from their respective shafts and remove the drive sprocket and driven sprocket.
3. Replace worn bearings.
4. Tighten the hardware securing bearing flanges to the front and rear PTO brackets. After the hardware has been secured, rotate the front shaft making sure it rotates freely. If necessary, loosen the hardware on the mounting brackets just enough to allow movement of the bracket, adjust them as necessary to allow the shaft to rotate freely.
5. When installing or replacing the sprockets, make sure the setscrews in the collars are turned out to free the collars on the shafts. Then, install a key on the slot in the upper (driven) shaft and install the sprocket onto the drive shaft until the sprocket hub contacts the shoulder of the drive shaft bearing.
6. Repeat Step 5 for the lower (drive) sprocket.
7. Place a straight edge on the face of the drive and tensioner sprocket and align them accordingly. Slide the front shaft and sprocket until the sprockets are aligned. When the sprockets are properly aligned, tighten the locking collars.

NOTE

If the sprockets are not aligned properly, the PTO will make excessive noise.



Tensioner Block Installation

Figure 12C-5. Drive Shaft, Sprockets, Chain and Tensioner

8. Remove the removable link from the chain and wrap the chain around the sprockets (see Figure 12C-6).

Snug the bolts securing the wear tensioner bracket just enough to allow the bracket to move. Slide the bracket and wear block against the chain to remove excess slack from chain.

There should be approximately 1/4 inch (6 mm) of deflection to the chain with 20 lbs. (9 kg) of pressure.

DO NOT over-tighten chain. If the chain is too tight, the PTO may make excessive noise when engaged.

Tighten nuts A and B when alignment and tension is correct (see Figure 12C-6).

NOTE

Chain rollers MUST contact full surface of wear tension block. The tension block will actually be positioned between the chain links, making contact only with the chain rollers.

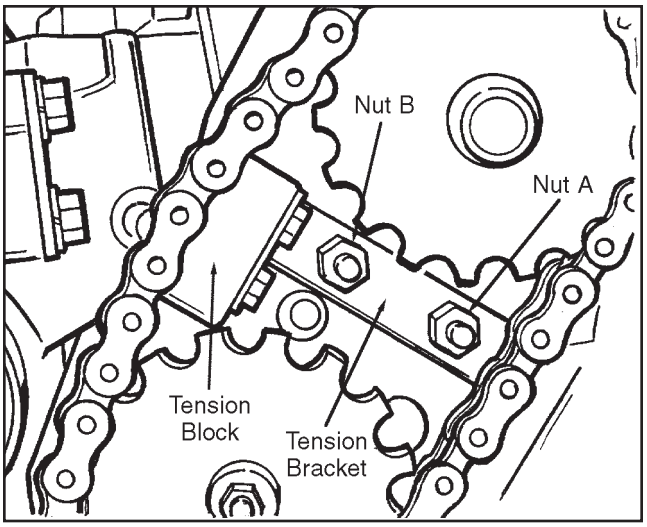


Figure 12C-6. Chain and Tensioner

SECTION 12D. HYDRAULIC PTO

GENERAL

The hydraulic Power Take-Off (PTO) accessory transmits power from a two section hydraulic pump to a hydraulic motor which drives a PTO output shaft at the rear of the vehicle (see Figure 12D-1).

NOTE

Some vehicles may be equipped with a mechanical PTO which is covered in Section 12C of this manual.

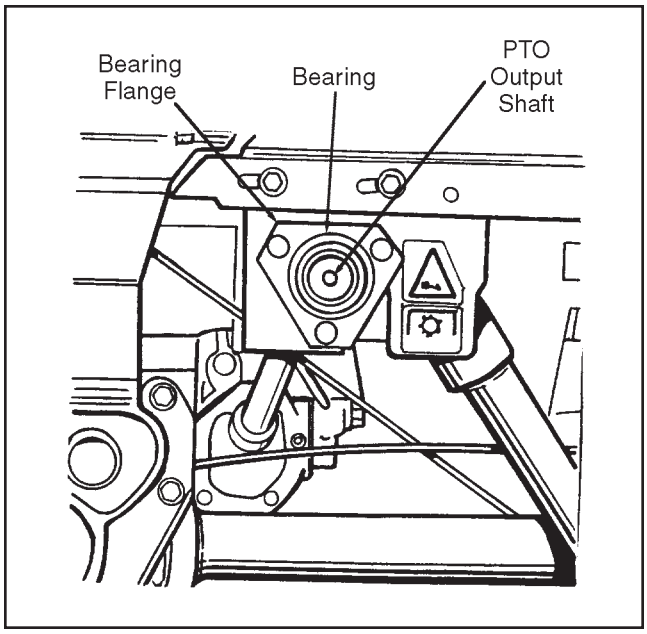


Figure 12D-1. PTO Output Shaft

The operation of the PTO is controlled by a cable attached to a lever on the transmission. The cable control handle is located on the operator's control panel.

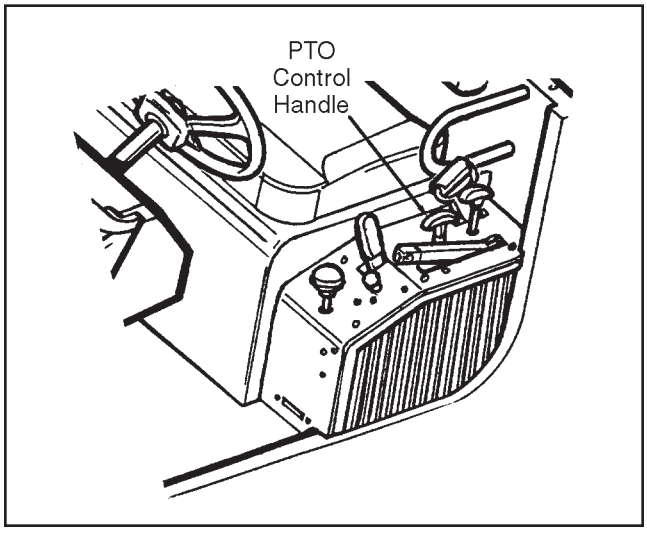


Figure 12D-2. PTO Control Handle

Installation of a new hydraulic PTO system as an addition to a vehicle not so equipped is covered in a separate publication (Part No. 845385).

A Complete exploded view of the hydraulic PTO assembly is shown in Figure 12D-3. Specific repair procedures are covered in the following paragraphs.

PREPARATION FOR REPAIR

WARNING

- DO NOT perform any service or maintenance on or around the engine area until the area has had time to cool. Severe burns are possible if the area has not been allowed to properly cool.
- If the vehicle needs to be raised, DO NOT rely solely on mechanical or hydraulic jacks for support. Use appropriate jack stands or equivalent for supporting the vehicle. If using a hoist, raise the vehicle to appropriate height and support using jack stands or equivalent.

1. Place vehicle on a hard level surface, remove the ignition key and apply the park brake. If the vehicle will be raised, place blocks in front of the front wheels. Use jack stands or equivalent to support the vehicle.
2. Remove the engine intake screen (see Figure 3D-2 of this manual), PTO front and rear shields, and PTO cover (see Figure 12C-3) to gain access to components to be repaired.

NOTE

The PTO cover is spring loaded. Make sure to disconnect spring prior to cover removal and reconnect it after installation.

3. Disconnect the control cable from the lever at the transmission (see Figure 12D-3).

HYDRAULIC MOTOR AND COUPLINGS (See Figure 12D-3)

NOTE

Do not disassemble or replace the motor unless it fails tests in Section 8.

1. Disconnect hydraulic lines from motor. Plug and cap ports and hoses.
2. Remove the motor and couplings as shown in Figure 12D-3.
3. Repair the motor as described in Section 8F.

SECTION 12D. HYDRAULIC PTO

4. Install couplings and motor as shown in Figure 12D-3.
5. Reconnect hydraulic lines.

OUTPUT SHAFT (See Figure 12D-3)

1. Remove the output shaft as shown in Figure 12D-3.
2. Replace worn bearings.
3. Install output shaft as shown in Figure 12D-3.

HYDRAULIC MOTOR (See Figure 12D-3)

1. Tag and disconnect hydraulic hoses from the hydraulic motor. Plug and cap ports and hoses.
2. Remove the motor as shown in Figure 12D-3.
3. If necessary, repair the motor as described in Section 8.
4. Install motor and reconnect hydraulic lines.
5. Test motor as described in Section 8.

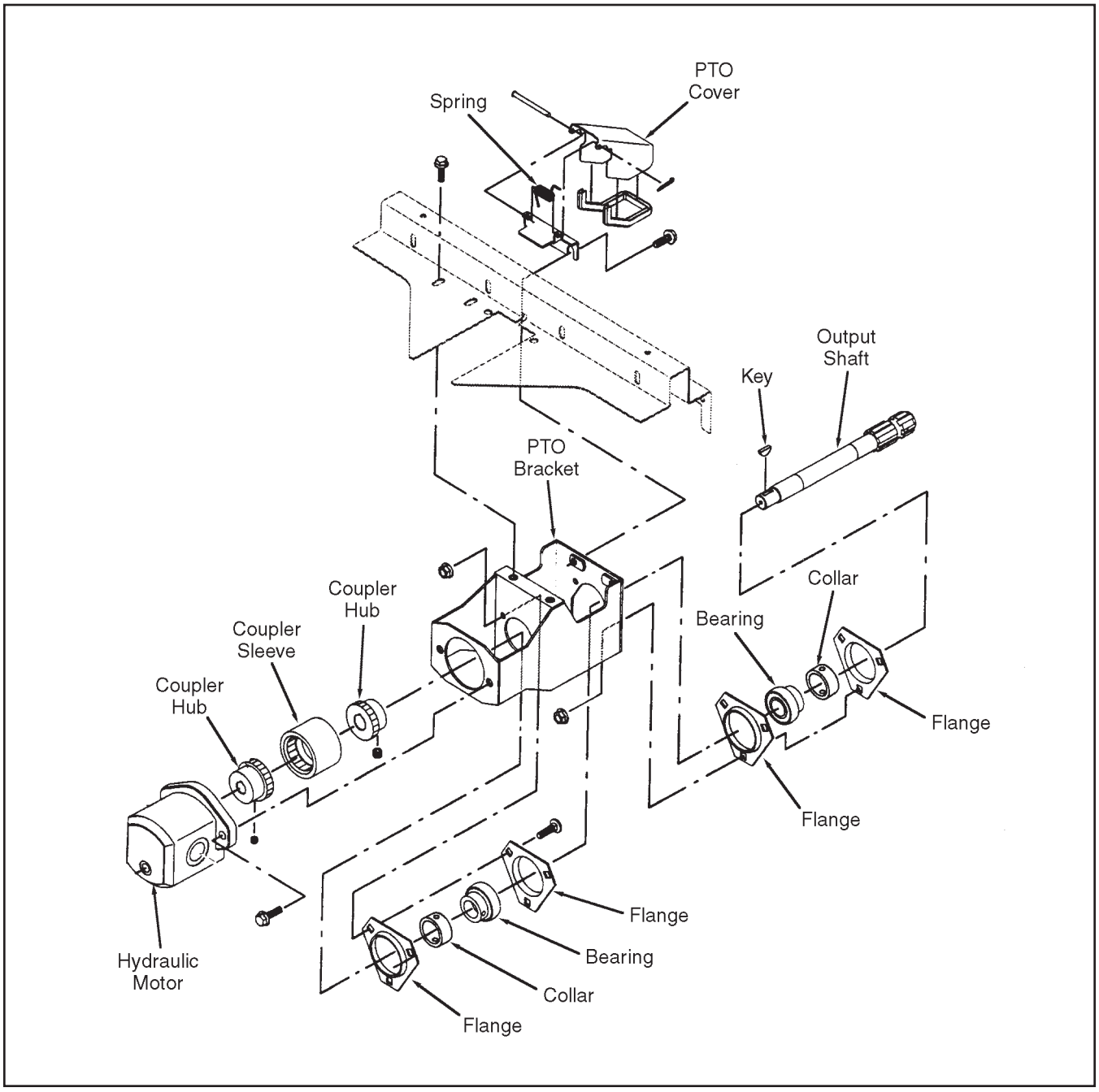


Figure 12D-3. PTO Output Shaft

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SECTION 13
OPTIONS

Options for Truckster® vehicles are covered in separate publications listed below and available from Textron dealers/distributors.

OPTION	PUBLICATION
TD 1500	Manual 844910
DS175 Sprayer	Manual 845205
Envirojet	Manual 843655
GA 60 Aerator	Manual 834619
Core Harvester	Manual 841074 and Installation Instructions 844934
Fifth Wheel Top Dresser	Manual 835749
Vicon Spreader Model	Installation Instruction 844790

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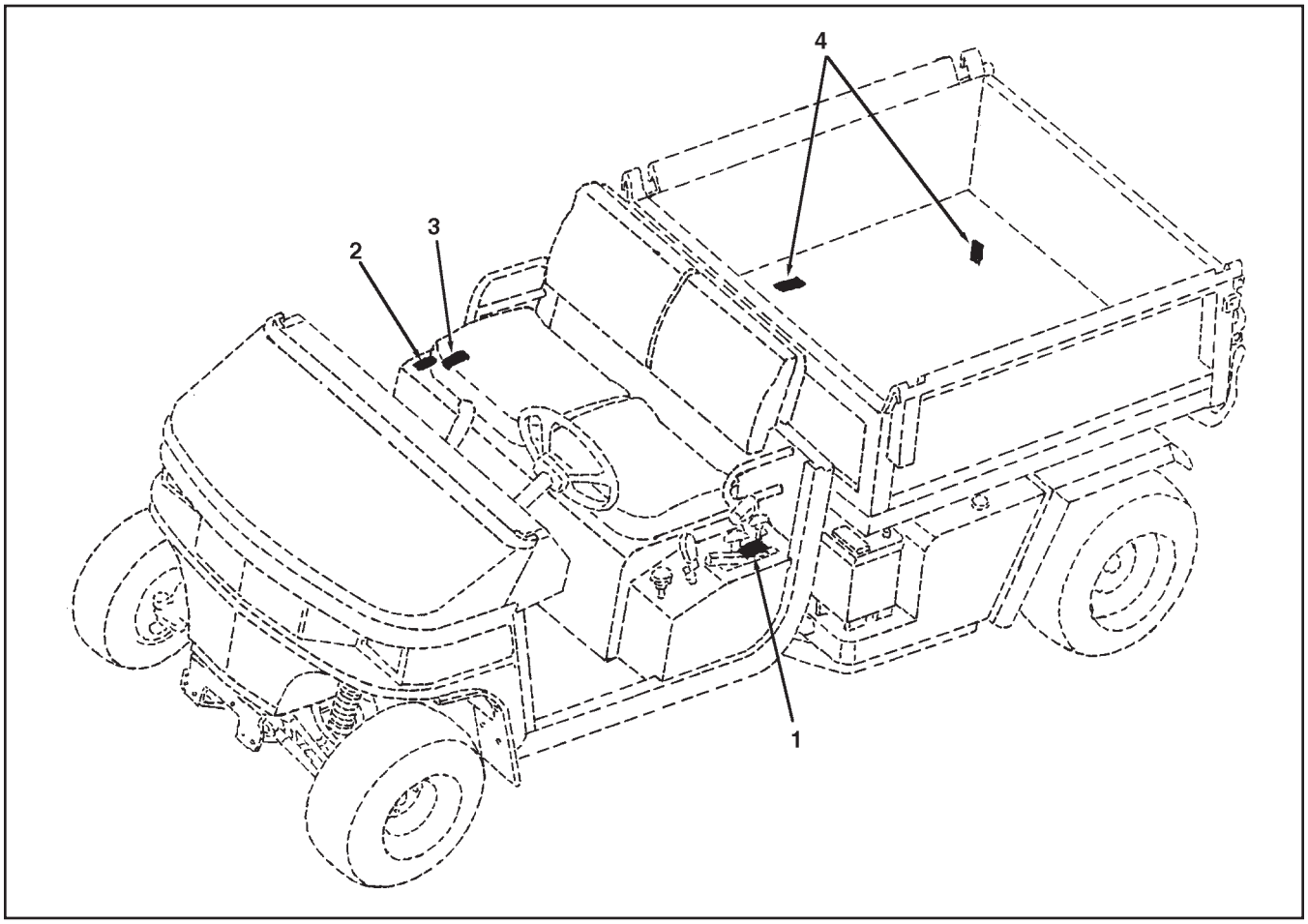
SECTION 14
MISCELLANEOUS

SECTION 14A. PRECAUTION DECAL LOCATIONS

PRECAUTION DECAL LOCATIONS



SECTION 14A. PRECAUTION DECAL LOCATIONS

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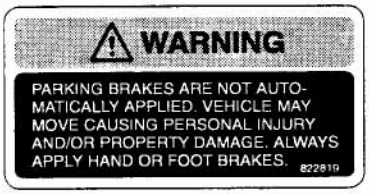

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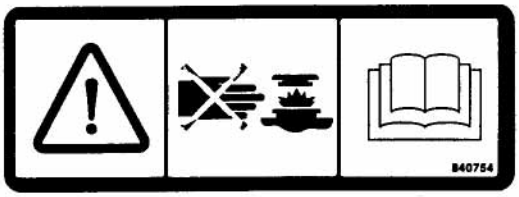
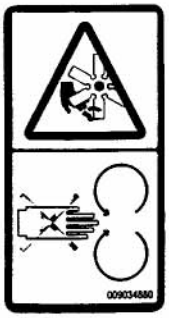


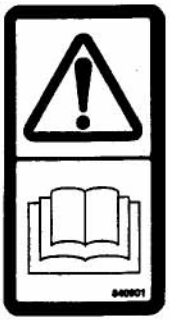
3 Part No. 009034880



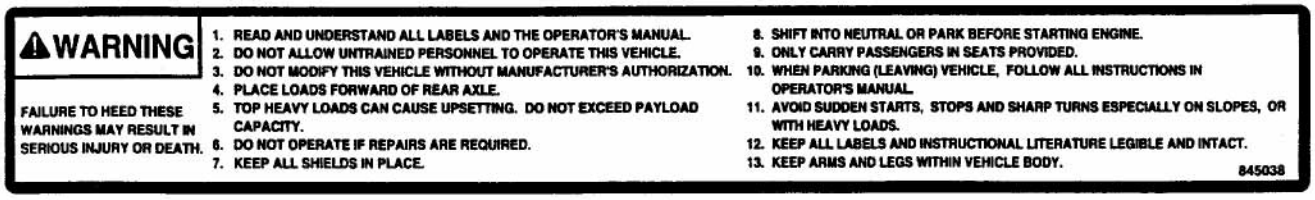
4 Part No. 844643

5 Part No. 845027

6 Part No. 840901



7 Part No. 845038



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
		0.590	14.9860
0.010	0.2540		
0.020	0.5080		
0.030	0.7620		
0.040	1.0160	0.600	15.2400
0.050	1.2700	0.610	15.4940
0.060	1.5240	0.620	15.7480
0.070	1.7780	0.630	16.0020
0.080	2.0320	0.640	16.2560
0.090	2.2860	0.650	16.5100
		0.660	16.7640
0.100	2.5400	0.670	17.0180
0.110	2.7940	0.680	17.2720
0.120	3.0480	0.690	17.5260
0.130	3.3020		
0.140	3.5560		
0.150	3.8100		
0.160	4.0640	0.700	17.7800
0.170	4.3180	0.710	18.0340
0.180	4.5720	0.720	18.2880
0.190	4.8260	0.730	18.5420
		0.740	18.7960
0.200	5.0800	0.750	19.0500
0.210	5.3340	0.760	19.3040
0.220	5.5880	0.770	19.5580
0.230	5.8420	0.780	19.8120
0.240	6.0960	0.790	20.0660
0.250	6.3500		
0.260	6.6040		
0.270	6.8580	0.800	20.3200
0.280	7.1120	0.810	20.5740
0.290	7.3660	0.820	20.8280
		0.830	21.0820
0.300	7.6200	0.840	21.3360
0.310	7.8740	0.850	21.5900
0.320	8.1280	0.860	21.8440
0.330	8.3820	0.870	22.0980
0.340	8.6360	0.880	22.3520
0.350	8.8900	0.890	22.6060
0.360	9.1440		
0.370	9.3980		
0.380	9.6520		
0.390	9.9060	0.900	22.8600
0.400	10.1600	0.910	23.1140
0.410	10.4140	0.920	23.3680
0.420	10.6680	0.930	23.6220
0.430	10.9220	0.940	23.8760
0.440	11.1760	0.950	24.1300
0.450	11.4300	0.960	24.3840
0.460	11.6840	0.970	24.6380
0.470	11.9380	0.980	24.8920
0.480	12.1920	0.990	25.1460
0.490	12.4460	1.000	25.4000

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	Multiply 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	0.069
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