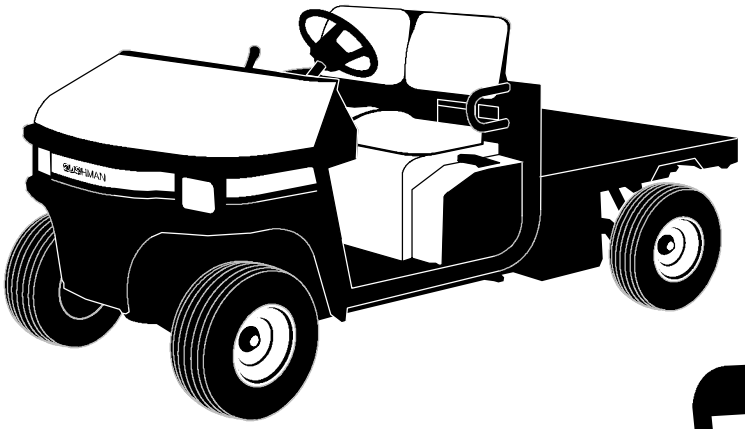
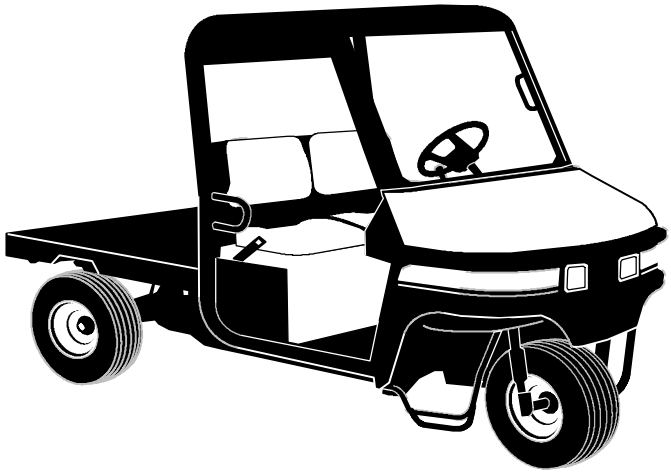
CUSHMAN
A Textron Company

36117G01

SERVICE & REPAIR
INSTRUCTION MANUAL





HAULSTERS®

VOLUME 2

Always Think Safety!

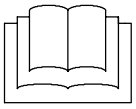
Thank you for purchasing a Cushman product. You are one of our many customers who have voted their confidence in our company by purchasing our products.

This is one of the best designed and built pieces of commercial industrial equipment available. Many safety features have been designed and built into this product. Please ***Do Not*** **remove or defeat any safety features,** as they were installed for your protection.

The useful life and good service you obtain from your vehicle depends to a large extent on the way it is **maintained and operated.**

Treat your equipment properly, lubricate and adjust it as instructed in this manual and it will give you many years of reliable service.

See your Cushman dealer for service and parts. Genuine Cushman parts are manufactured with the same precision and skill as the original parts.



IMPORTANT!

This manual will aid you in the safe operation and proper maintenance of your equipment. Read manual thoroughly before attempting operation. If any portion is not clearly understood, contact an authorized dealer for clarification.

GENERAL INFORMATION

This symbol is used throughout the manual to alert you to information about unsafe actions or situations, and will be followed by the word **DANGER, WARNING,** or **CAUTION. DANGER** indicates immediate hazards that may result in severe injury or death. **WARNING** indicates unsafe actions or situations that may cause severe injury, death and/or major equipment or property damage. **CAUTION** indicates unsafe actions or situations that may cause injury, and/or minor equipment or property damage.

NOTE: This symbol appears next to information or instructions which will help you operate and maintain your equipment the right way.

WARNING

- **The information and instructions included in this manual alert you to certain things you should do very carefully. If you do not, you could:**
  - **hurt yourself or others**
  - **hurt the next person who operates the equipment**
  - **damage the equipment.**

CUSHMAN

TEXTRON

SERVICE & REPAIR INSTRUCTIONS

HAULSTER®

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.

SRI-HAULSTER

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. Inch/pound Torque Wrench.

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 misaligned. 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) 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.

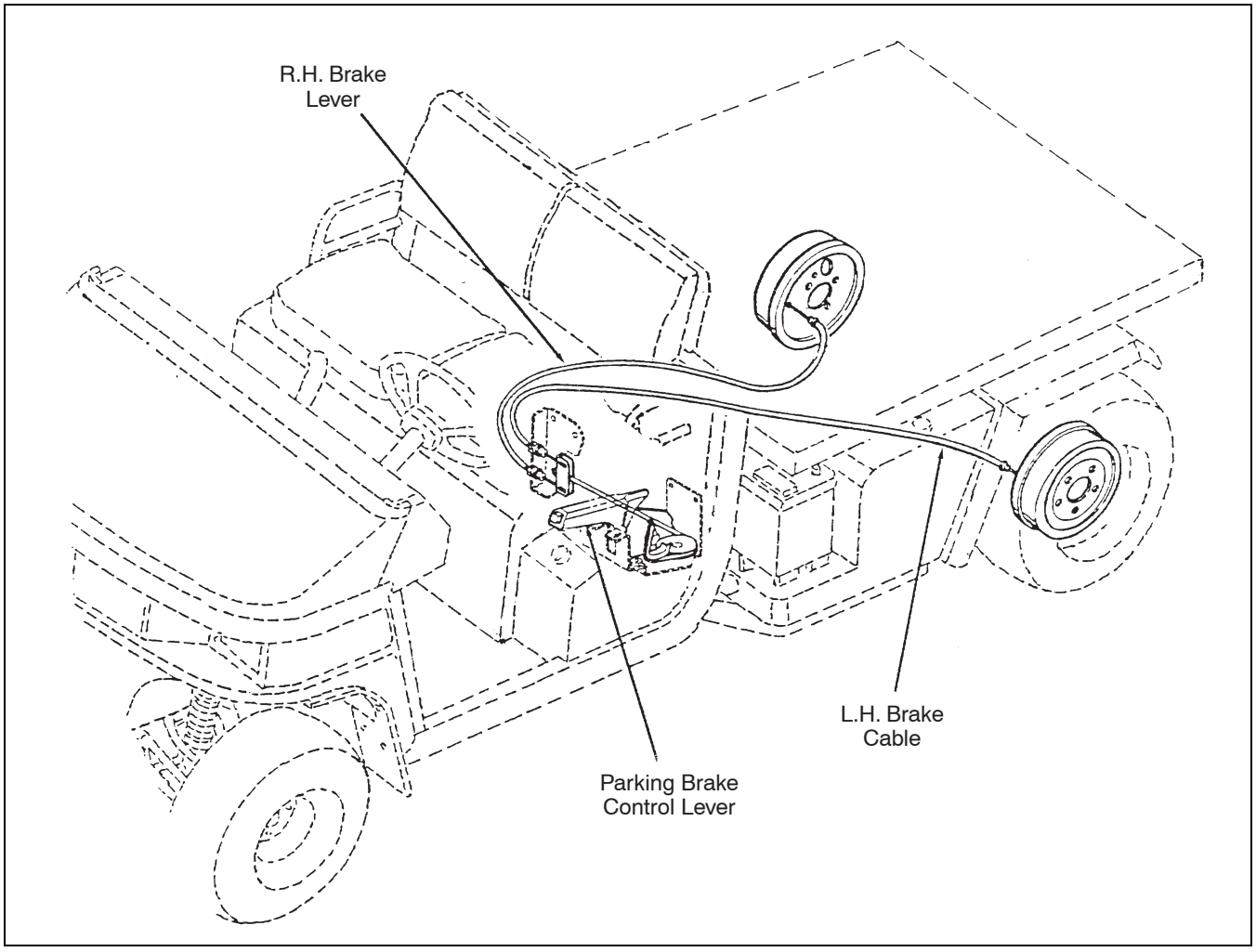


Figure 5C-1. Parking Brake Arrangement

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.

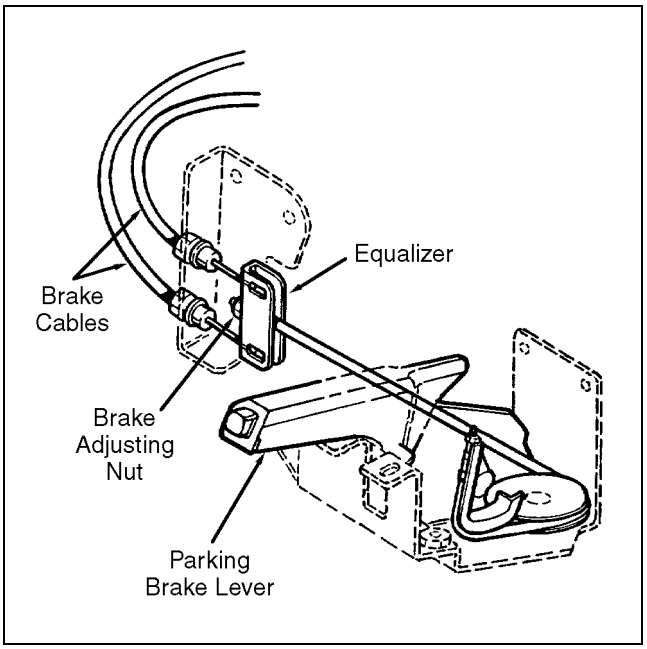


Figure 5C-2. Parking Brake Adjustment

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 ìrun-dryî, 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.

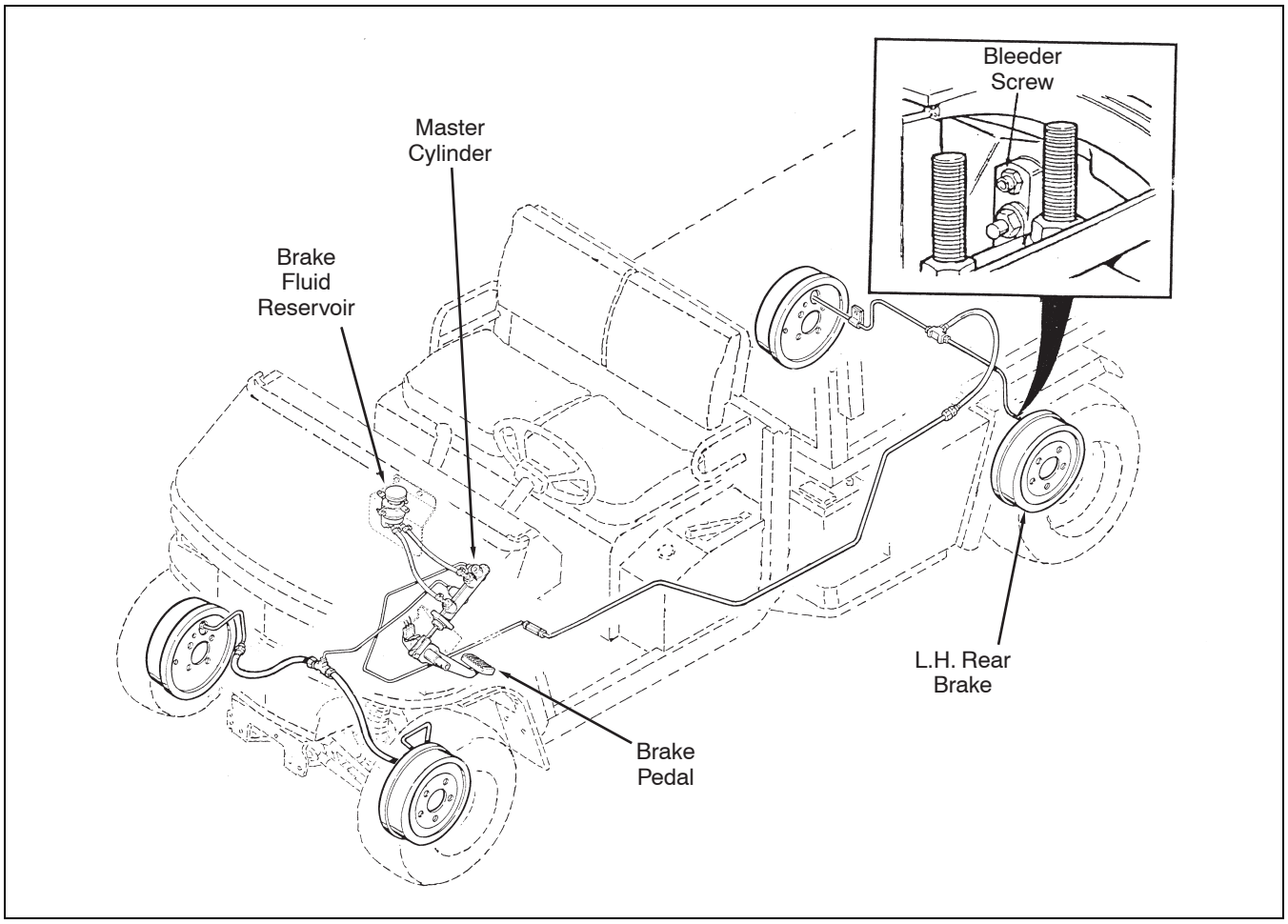


Figure 5D-1. Service Brake System

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.

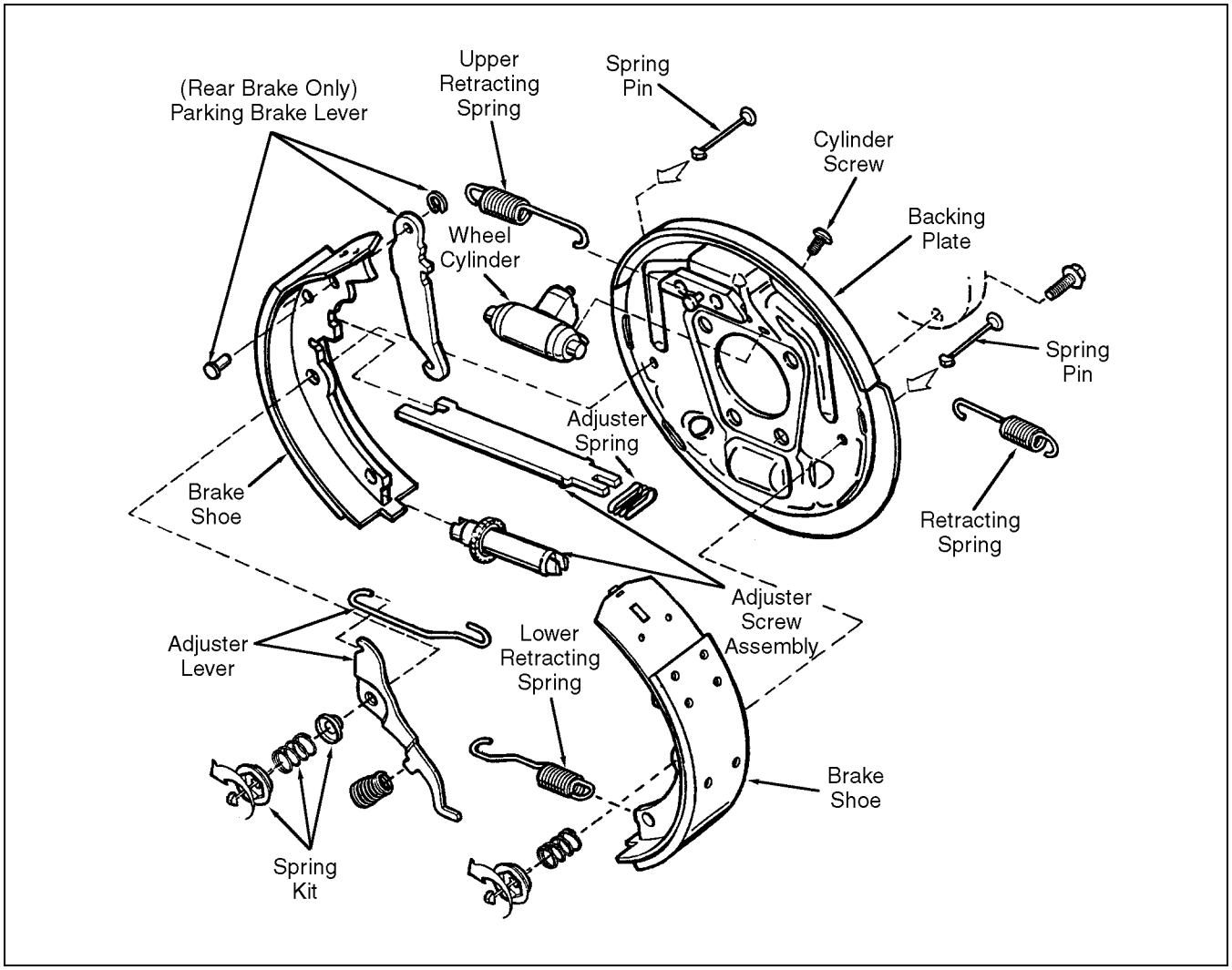


Figure 5D-2. Service Brake Disassembly

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.

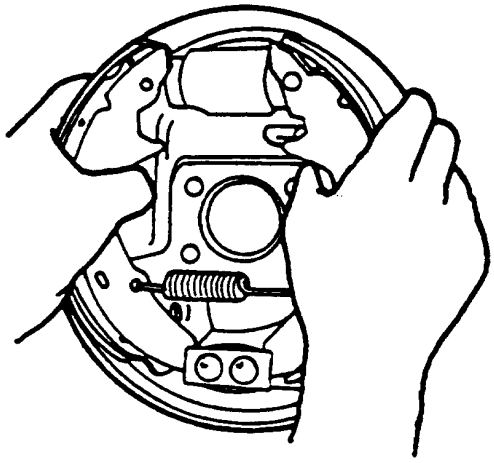
Inspect cylinder bore, hone if necessary.

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

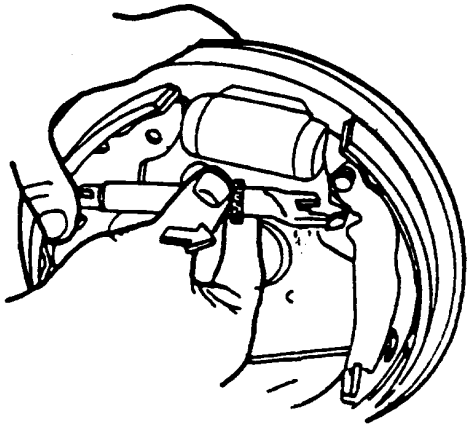
On rear brakes only, assemble parking brake cable to trailing shoe and parking brake lever.

STEP 2

Install lower retracting spring to leading-trailing shoes.

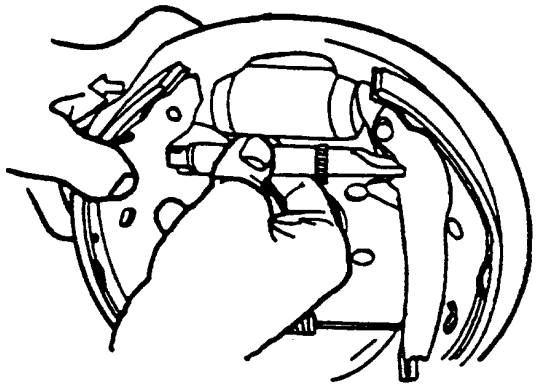
STEP 3

Install this assembly to backing plate.



STEP 4

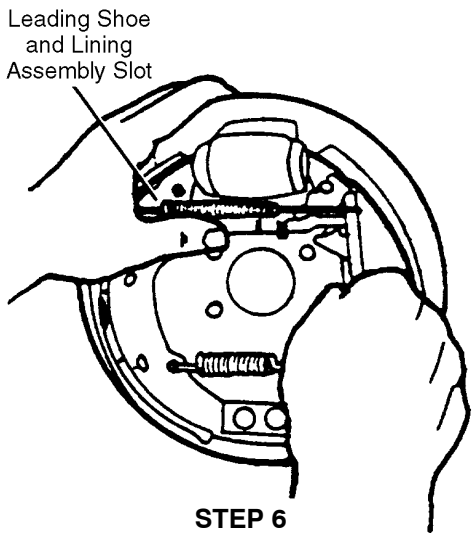
Install adjuster screw assembly.



STEP 5

Install adjuster screw to leading shoe and lining assembly.

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

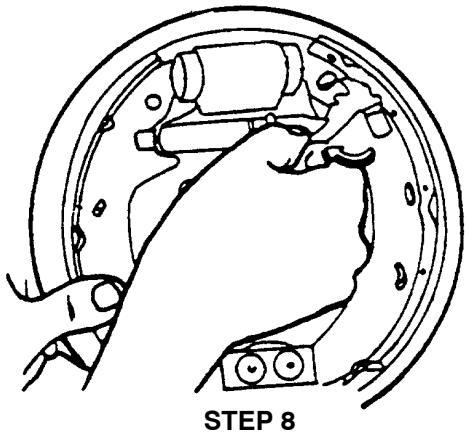


STEP 6

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 ó Steps 6 thru 9

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 ìBRAKE DISASSEMBLYî.

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

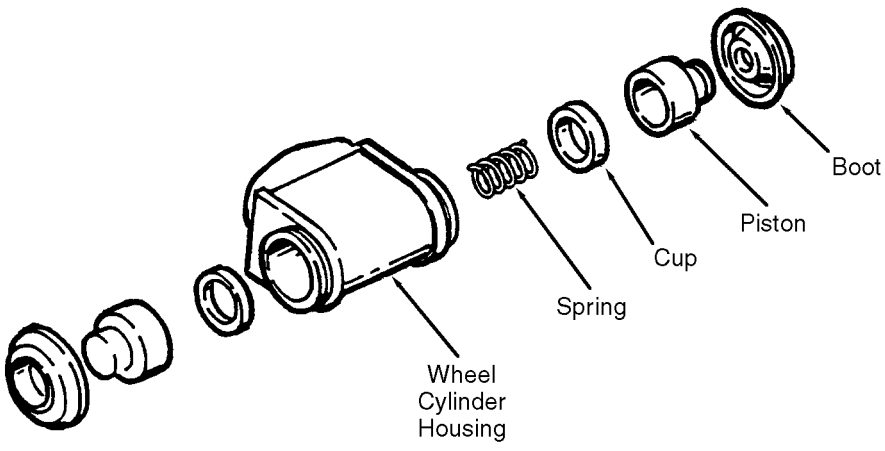


Figure 5D-5. Wheel Cylinder

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.

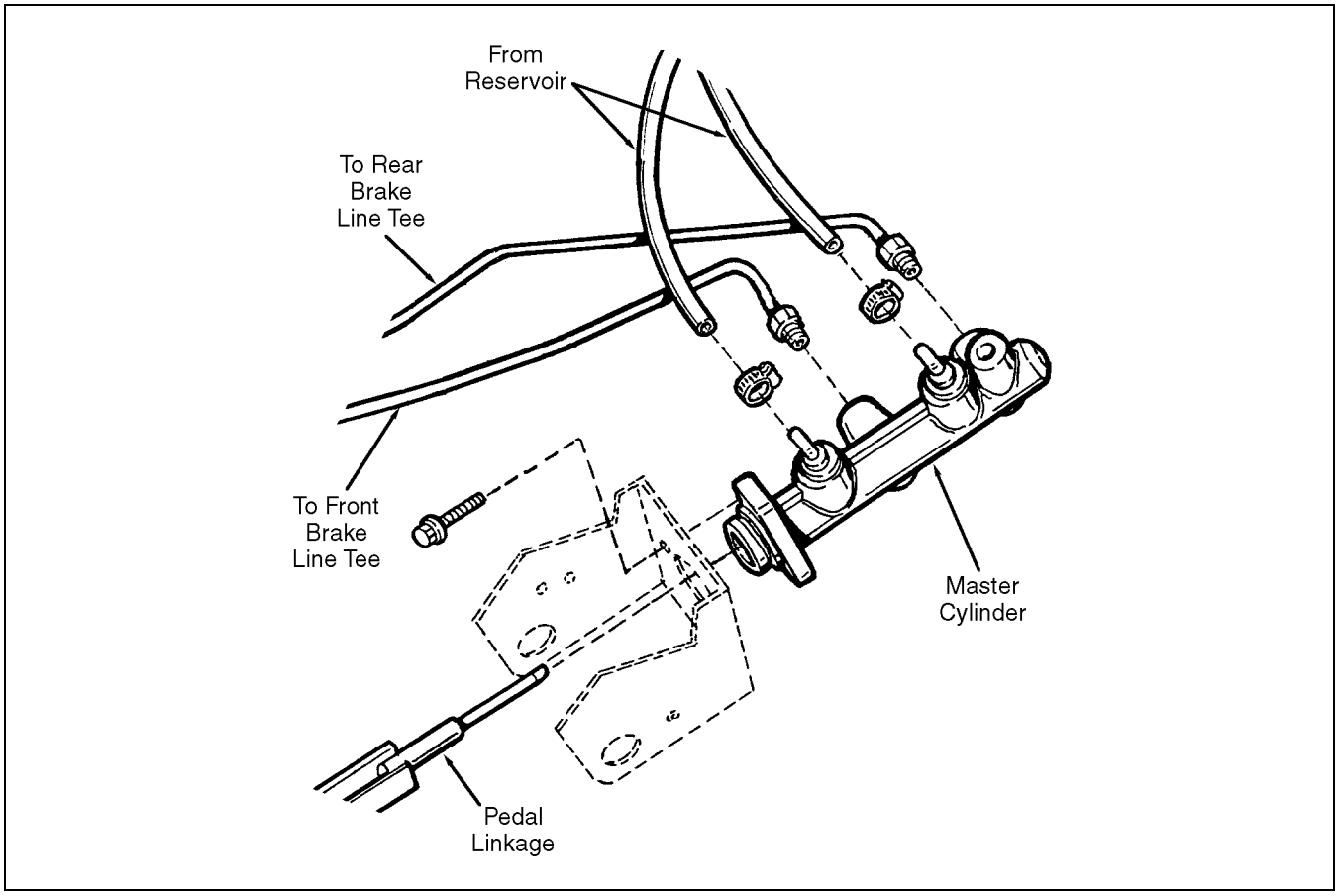


Figure 5E-1. Master Cylinder Removal and Replacement

SECTION 5E. MASTER CYLINDER

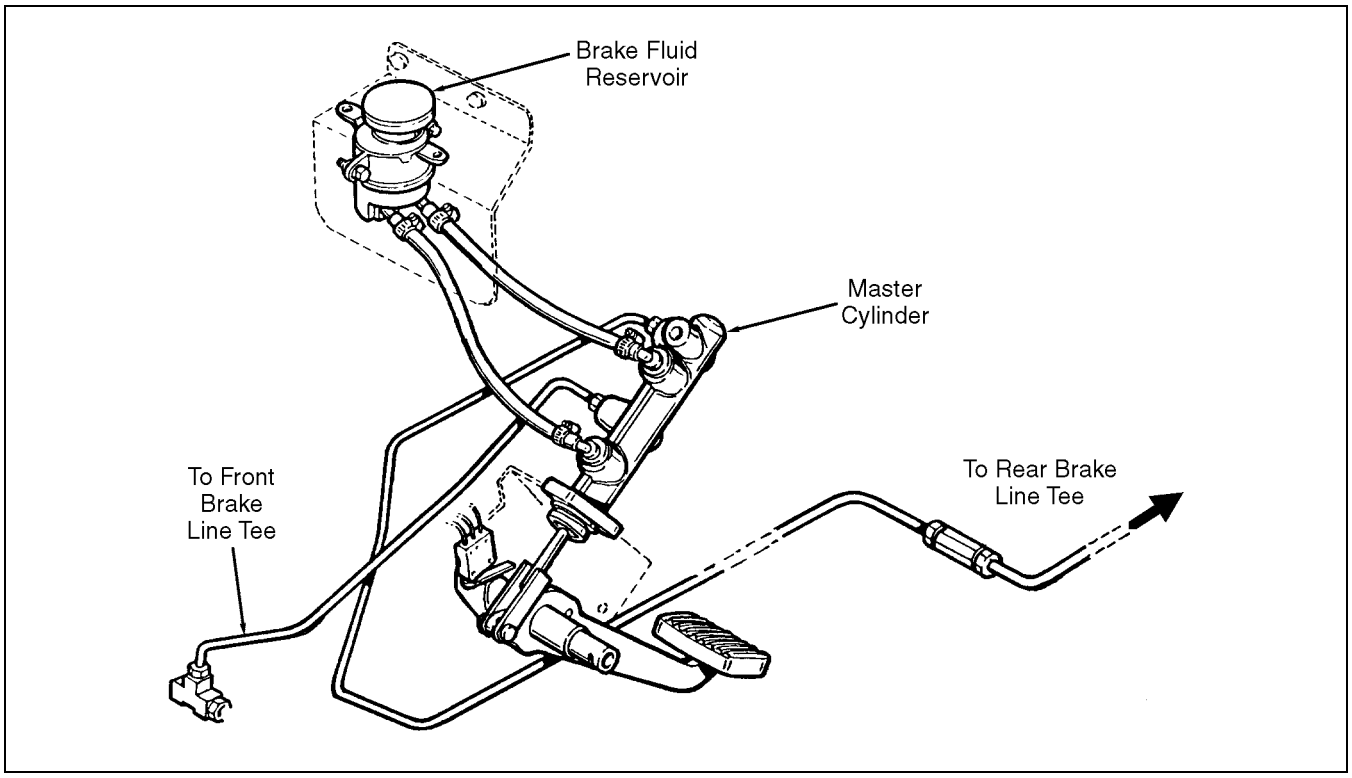


Figure 5E-2. Master Cylinder Connections

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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).
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. b. Faulty steering pump. c. Broken pump drive belt.	a. Test. Repair (Section 6D). b. Repair (Section 6E). c. Replace belt.
2. Noisy when steering wheel is turned.	a. Low hissing sound. b. Steering gear squeals when steering to maximum turn. c. Steering gear squeals while turning. d. Low oil level or air in system.	a. Normal. b. Normal. c. Repair steering gear (Section 6D). d. Check, bleed, fill reservoir (Section 6C).
3. Steering wanders.	a. Tire pressure incorrect. b. Loose pitman arm. c. Steering gear internal leakage. d. Steering wheels out of adjustment. e. Faulty steering gear.	a. Properly inflate tires (Section 7C). b. Tighten nuts (Section 6C). c. Repair (Section 6D). d. Adjust (Section 6F). e. Repair/replace (Section 6D).
4. Shimmy.	a. Tire mounting nuts loose. b. Loose or worn steering linkage. c. Steering wheels out of alignment.	a. Tighten (Section 7). b. Tighten or replace (Section 6C). c. Adjust (Section 6F).
5. Hard steering in one direction.	a. Internal failure of steering gear. b. Loose or worn steering linkage.	a. Repair (Section 6D). b. Tighten or repair (Section 6C).
6. Hard steering in both directions.	a. Tires under inflated. b. Low hydraulic oil level. c. Low hydraulic oil pressure. d. Steering gear or pump failure.	a. Inflate tires (Section 7). b. Check level (Section 6C). c. Repair leaks at steering pump. d. Repair (Sections 6C and 6D).
7. Lost motion at steering wheel.	a. Steering wheel loose. b. Loose or worn steering linkage. c. Steering gear internal leakage. d. Steering pump internal leakage.	a. Tighten (Section 6C). b. Tighten or repair (Section 6C). c. Repair (Section 6D). 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 ìpower steeringî 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.

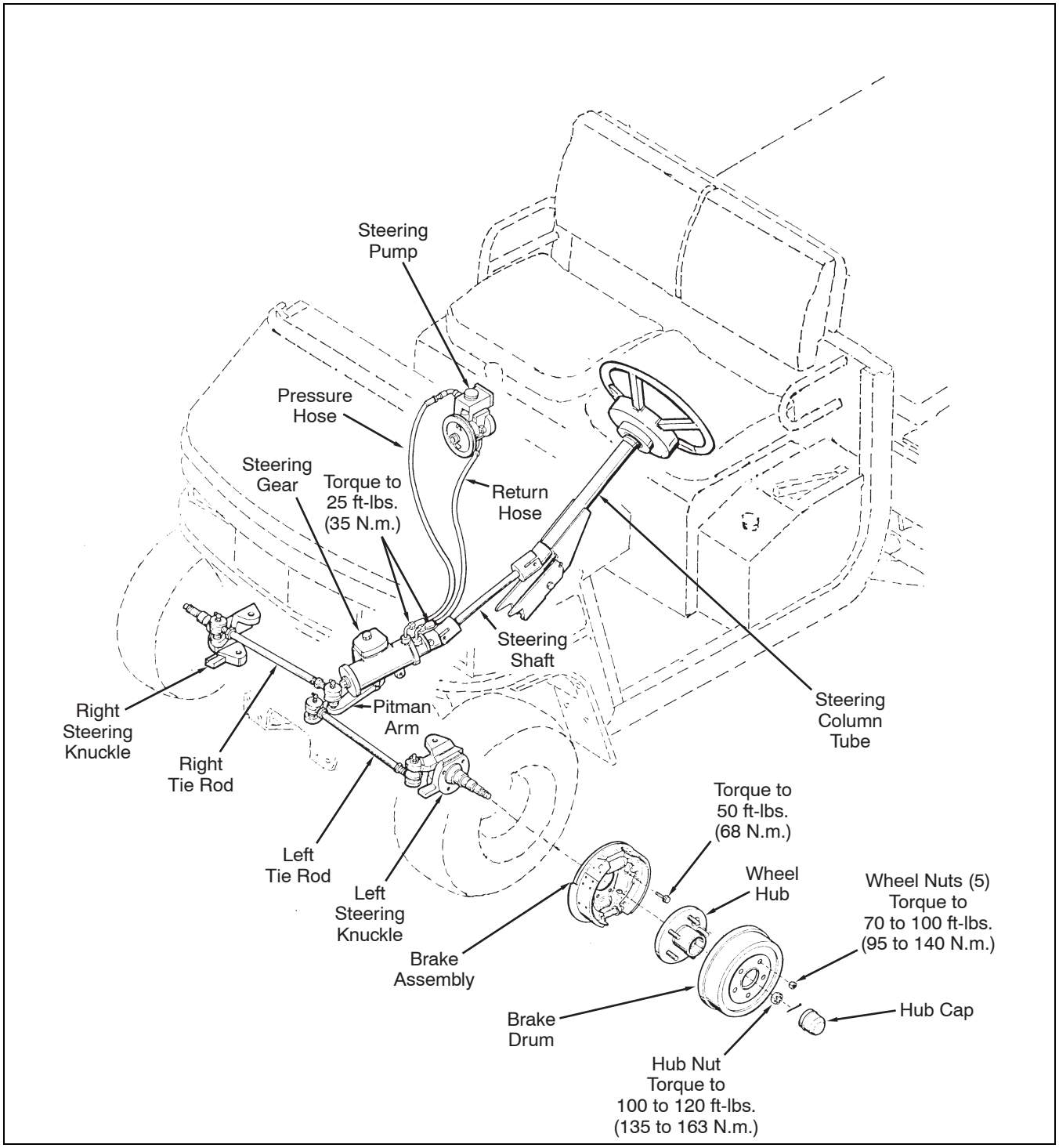

Figure 6C-1. Steering System Arrangement

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.

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.

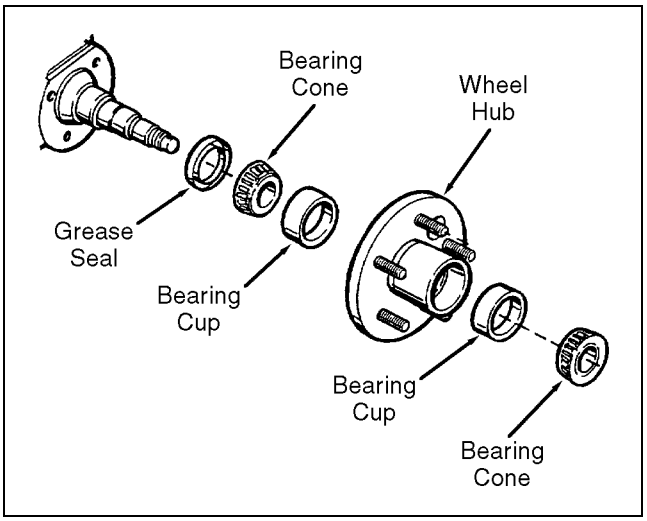

Figure 6C-2. Front Wheel Bearings

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.

SECTION 6C. STEERING SYSTEM

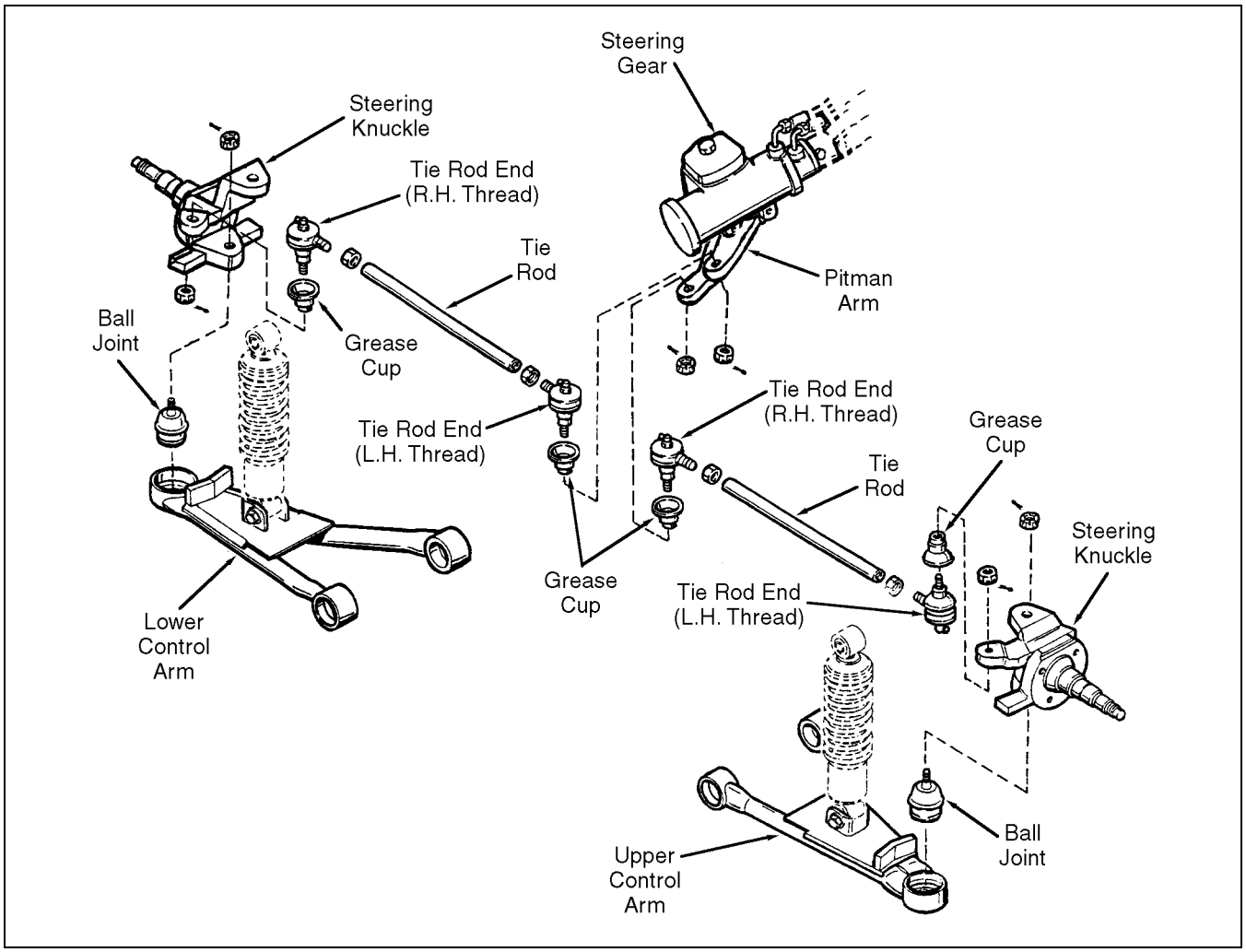

Figure 6C-3. Tie Rods and Steering Knuckles

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

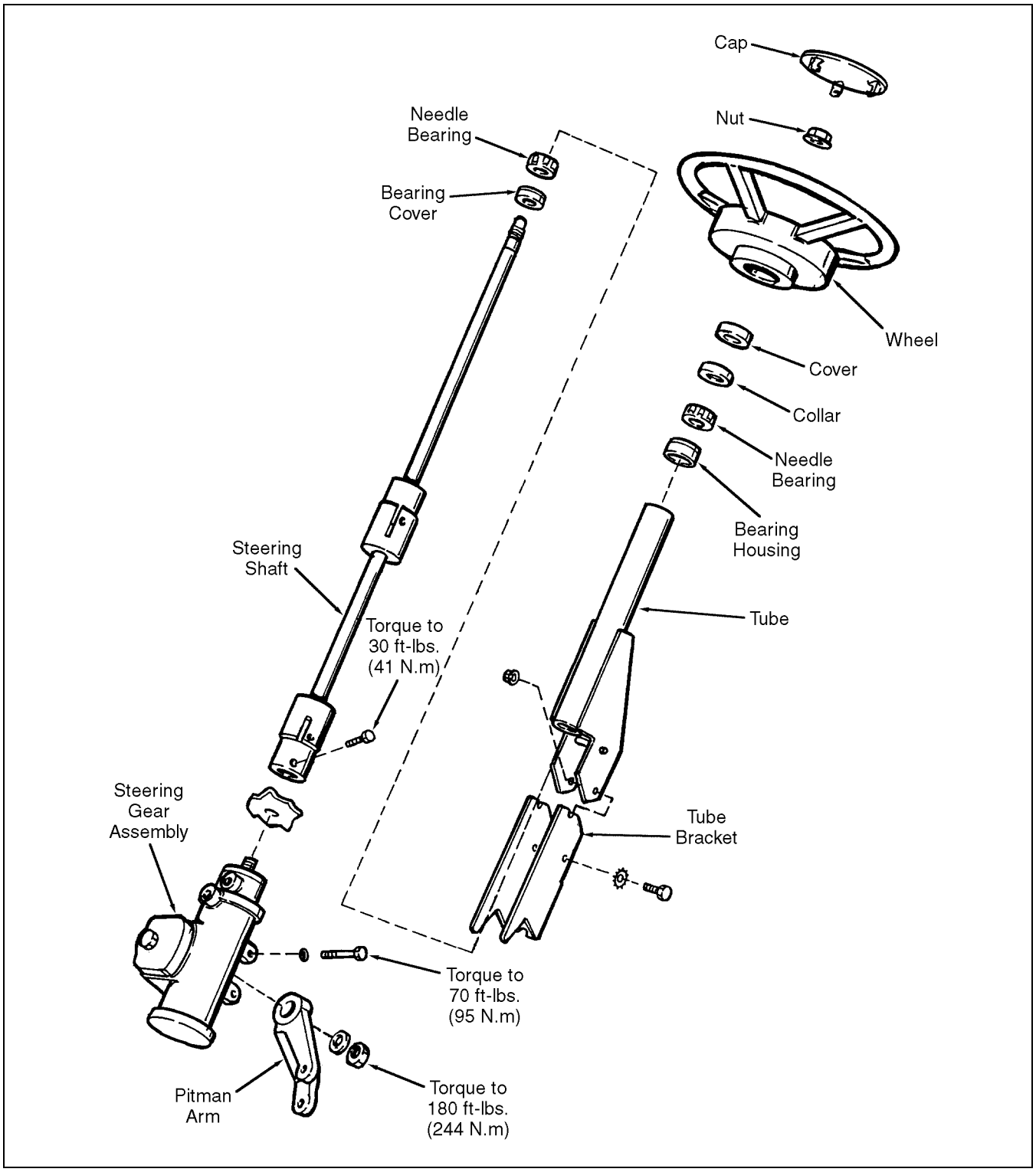

Figure 6C-4. Steering Column

SECTION 6C. STEERING SYSTEM

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

If a problem evaluation (SECTION 6B) indicates 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.
4. Remove steering gear mounting screws and nuts and steering gear assembly.
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.
8. Connect the pitman arm to the steering gear assembly and torque nut.
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.

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.
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 ìcoldî 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 ìcoldî and ìhotî 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 ìdî 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. 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 to isolate problems to the steering gear assembly.

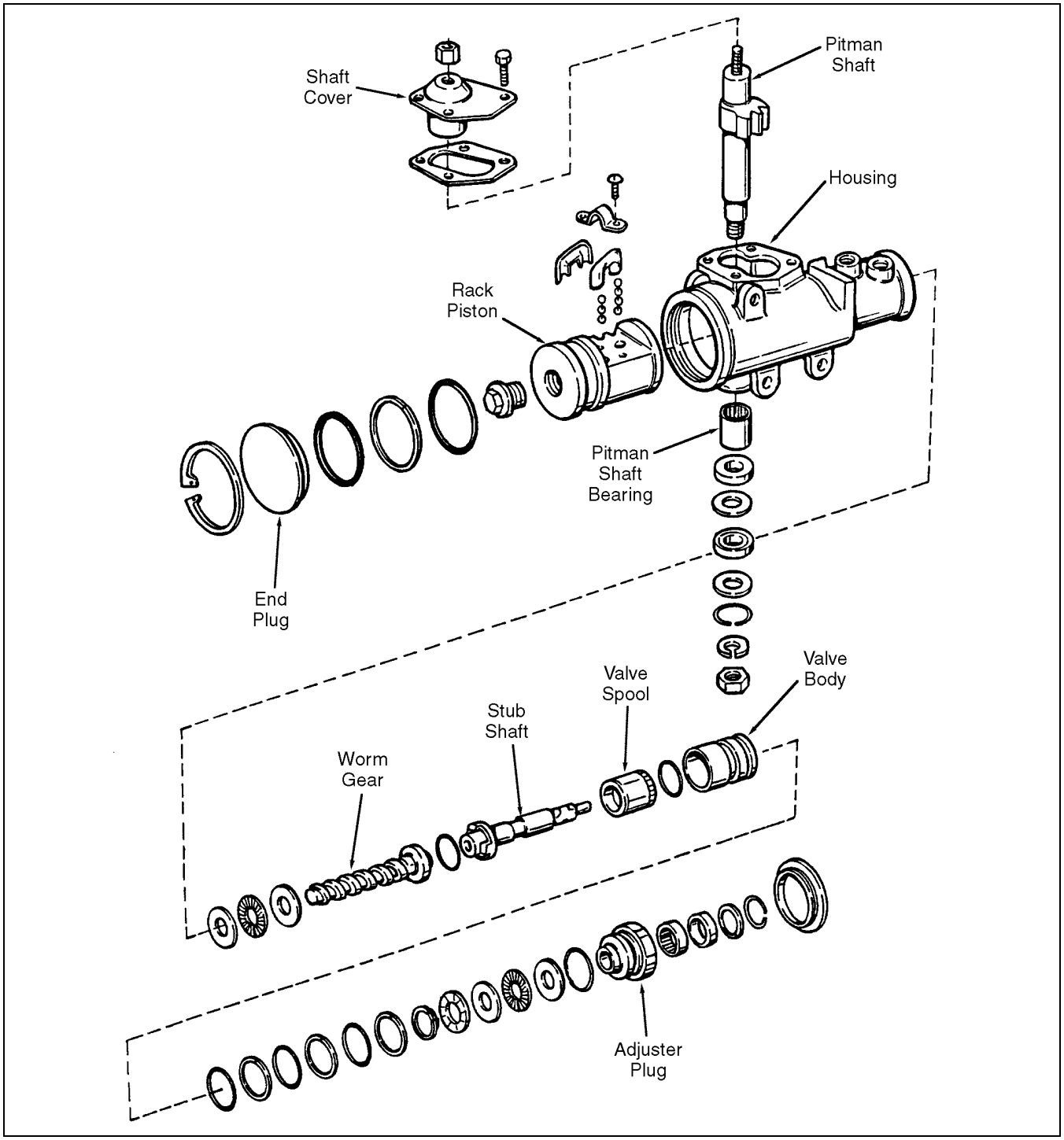

Figure 6D-1. Steering Gear Major Components

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.

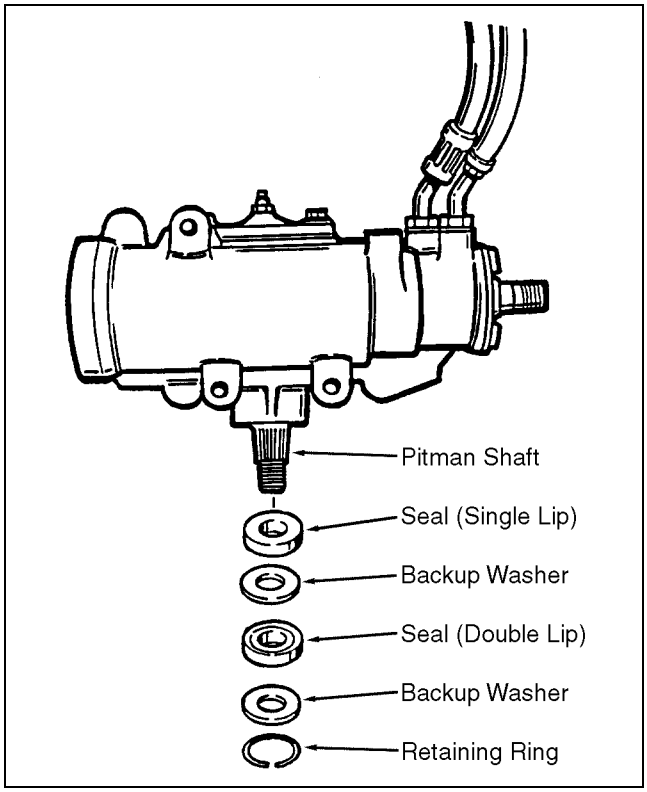

Figure 6D-2. Pitman Shaft Seals

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.

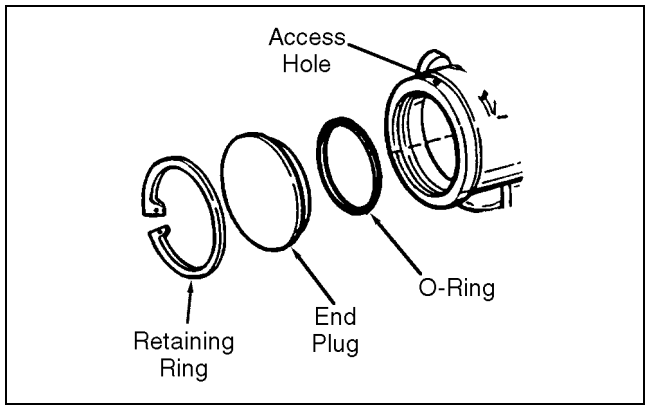

Figure 6D-3. Housing End Plug O-Ring

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

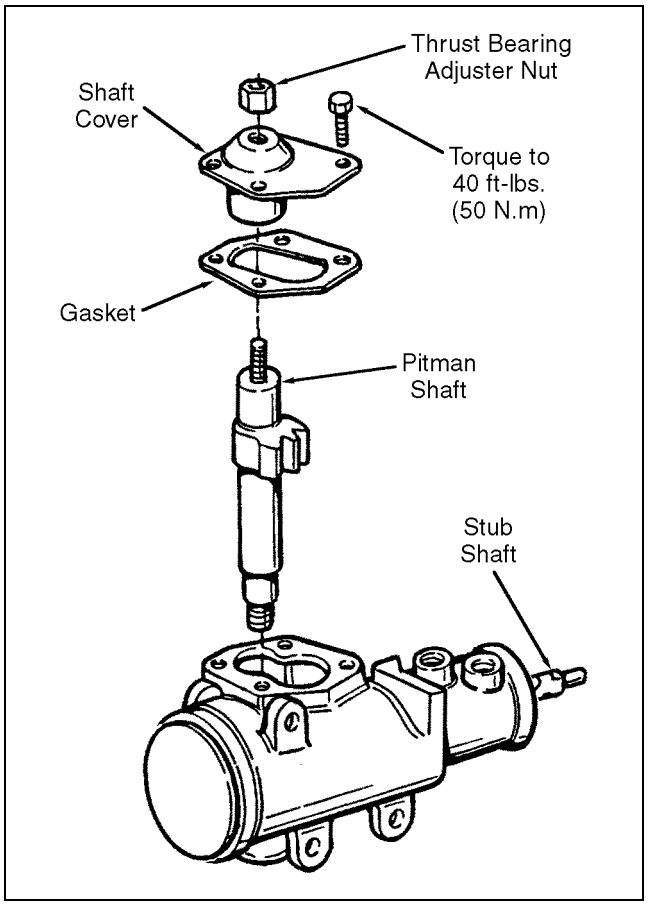

Figure 6D-4. Pitman Shaft and Cover

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

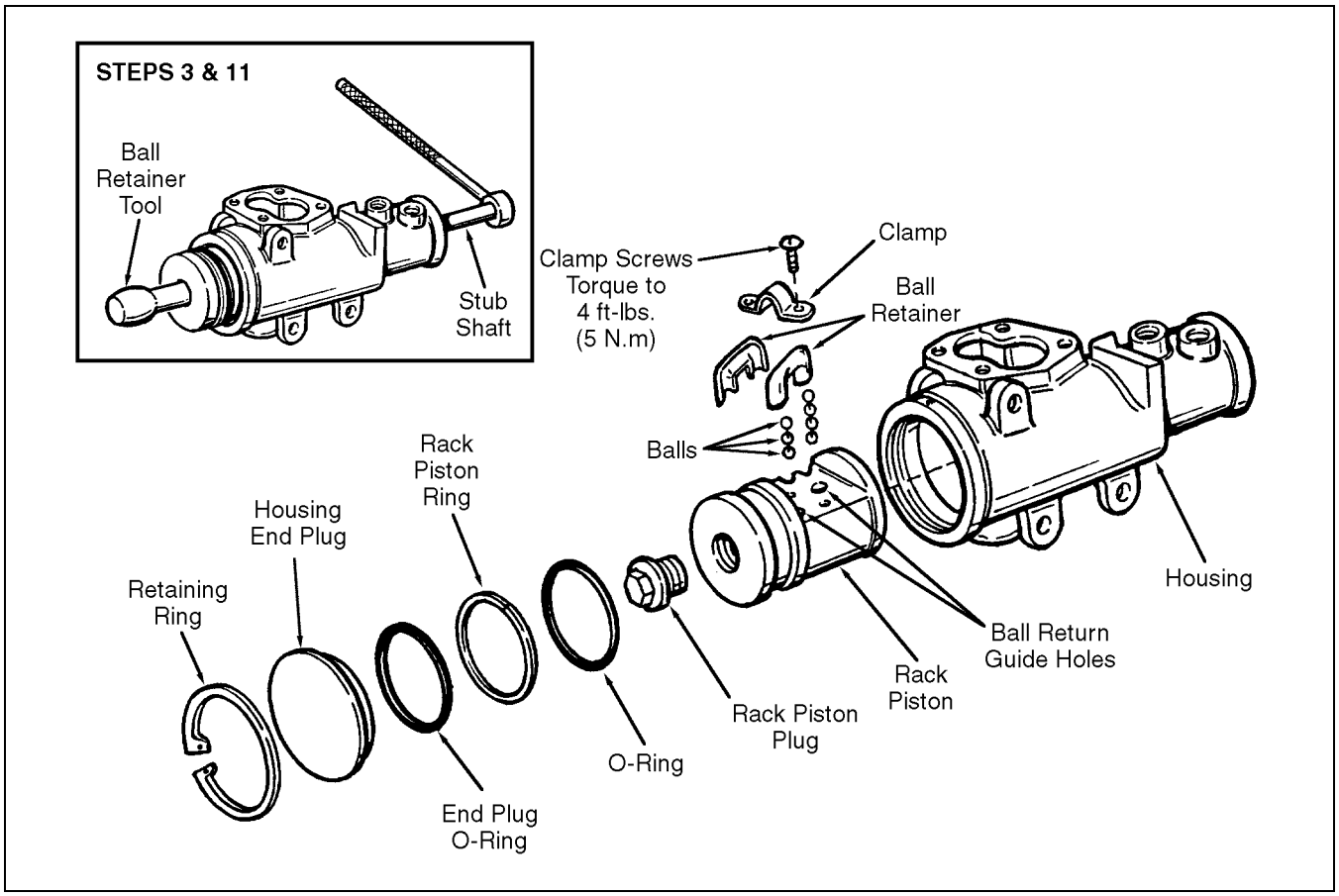

Figure 6D-5. Rack Piston

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.

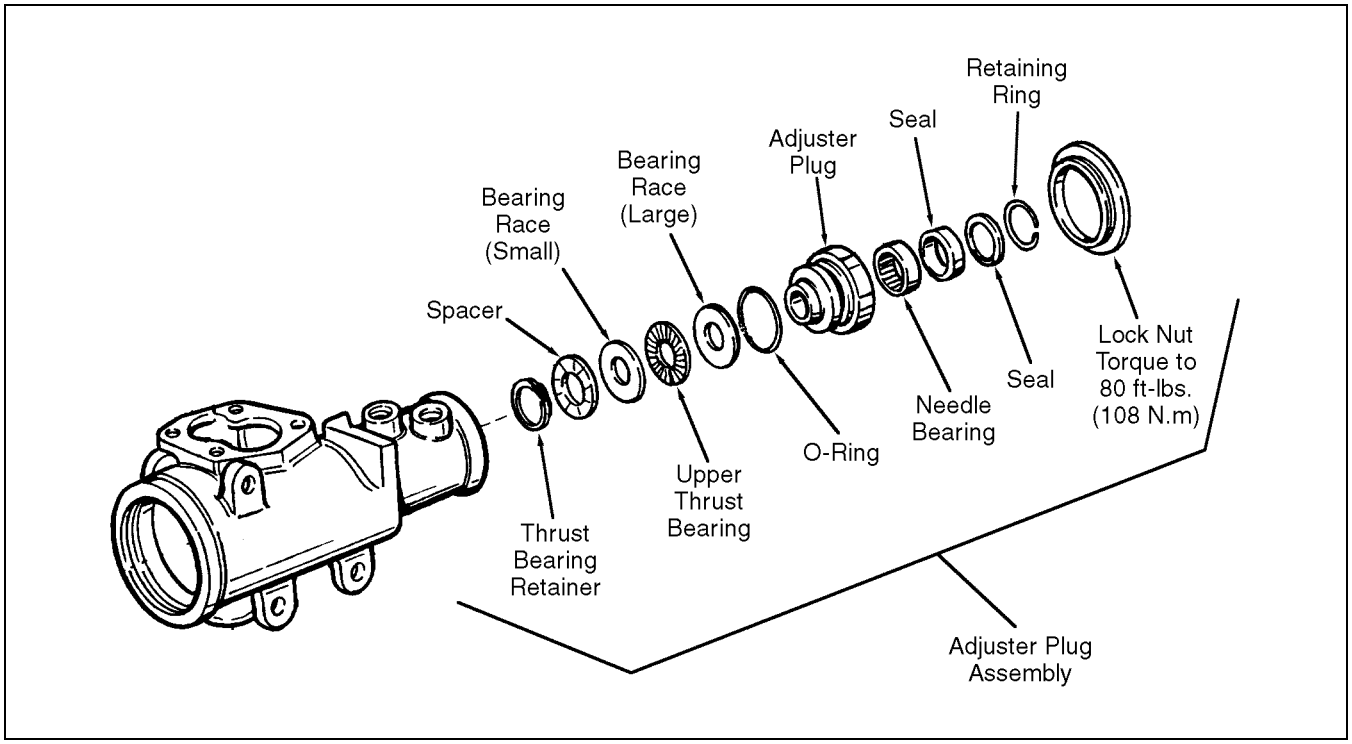

Figure 6D-6. Adjuster Plug

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 ìADJUSTER PLUGî (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.

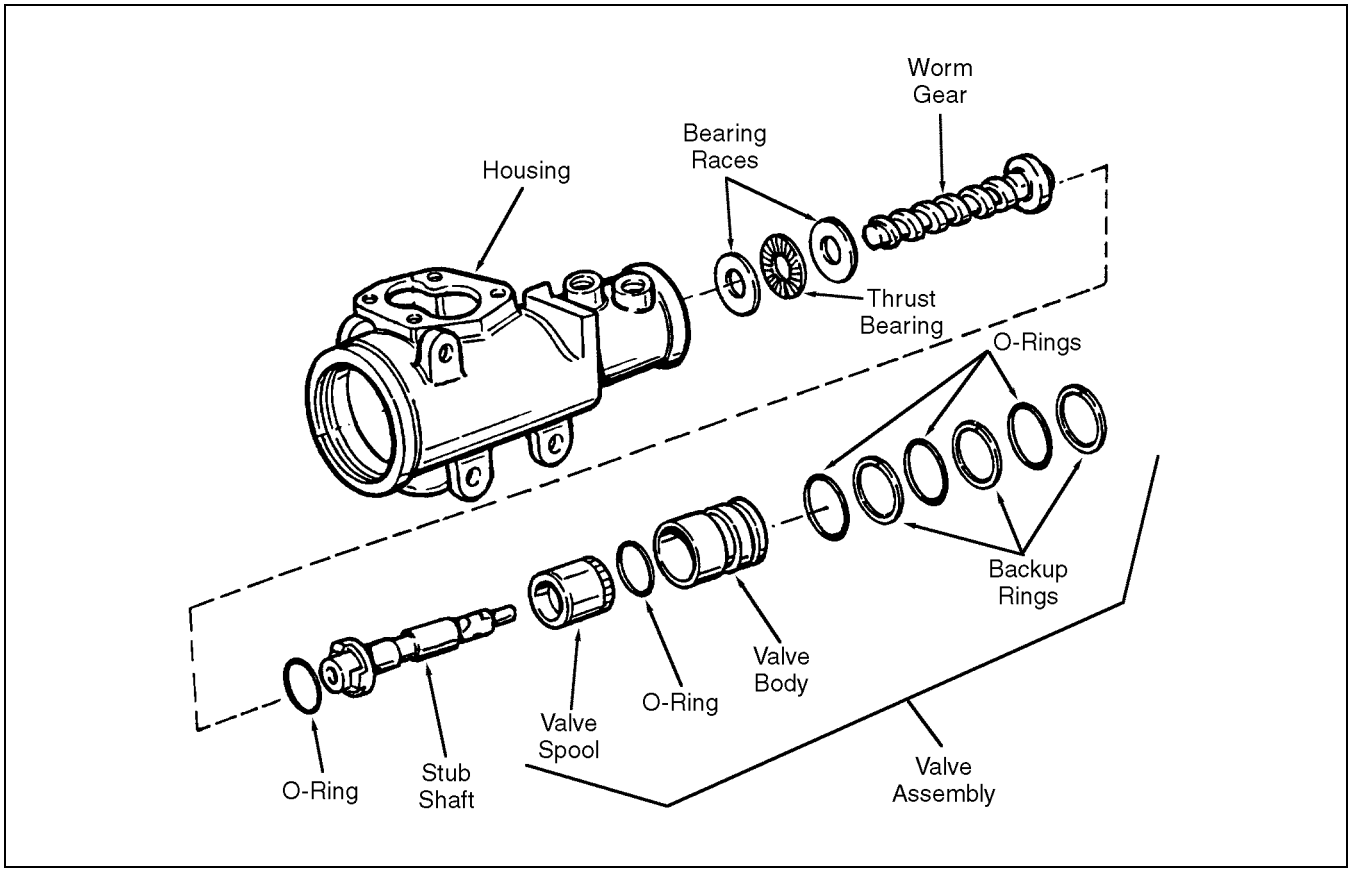

Figure 6D-7. Valve, Thrust Bearings and Worm Gear

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.

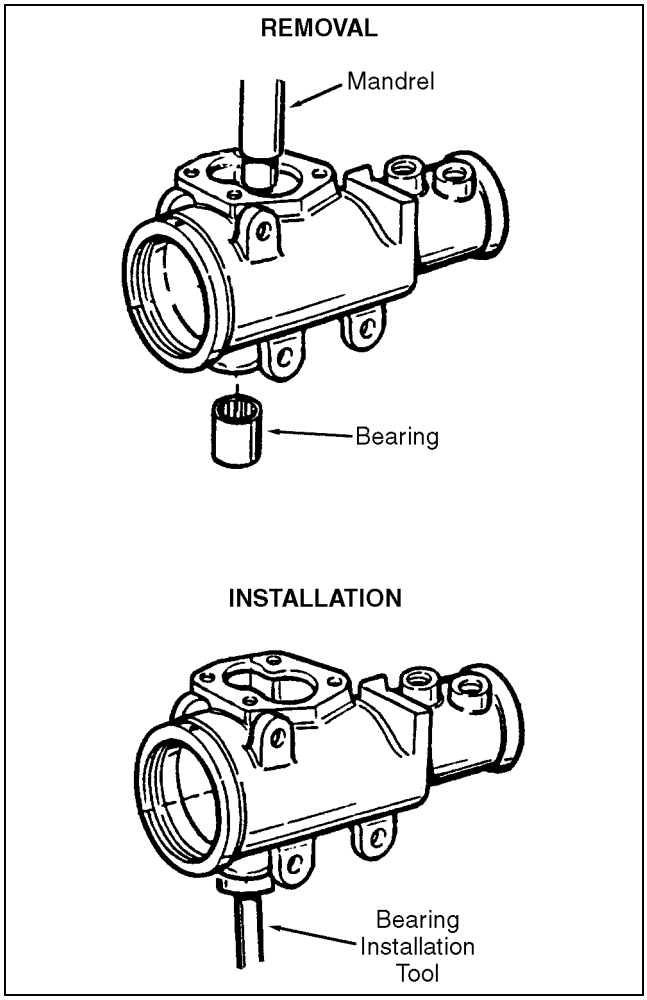

Figure 6D-8. Pitman Shaft Bearing

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.

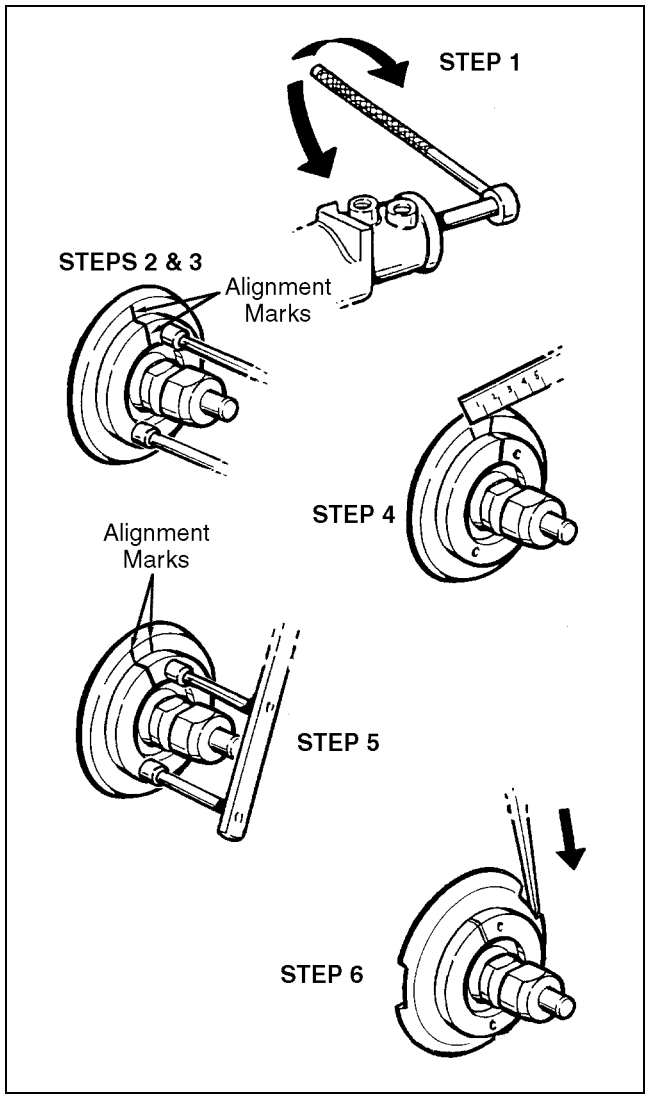

Figure 6D-9. Thrust Bearing Preload Adjustment

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 ì OVER-CENTERî 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 ìover-centerî 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).

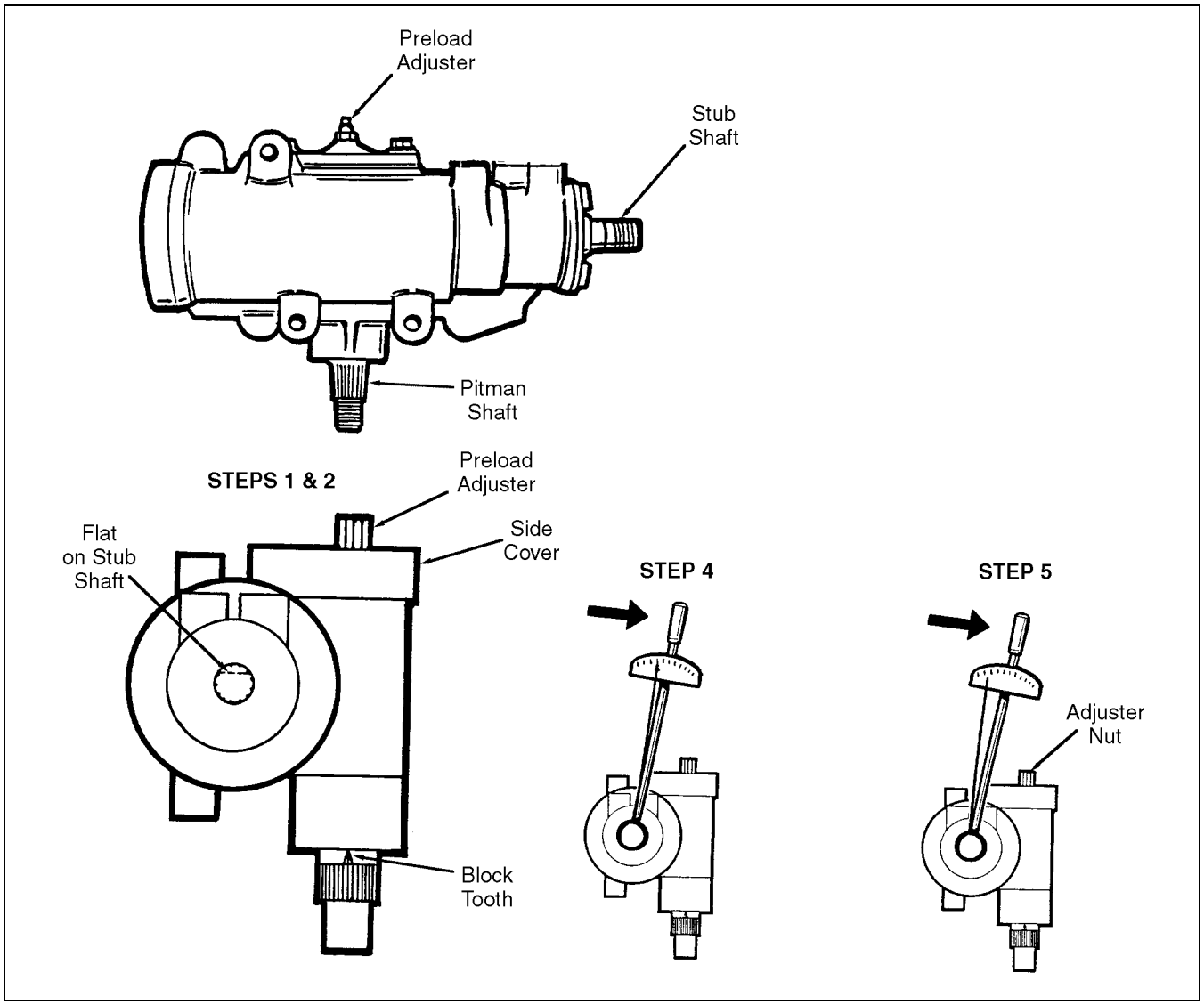

Figure 6D-10. Pitman Shaft ì Over-Centerî Sector Adjustment

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, it should be replaced.

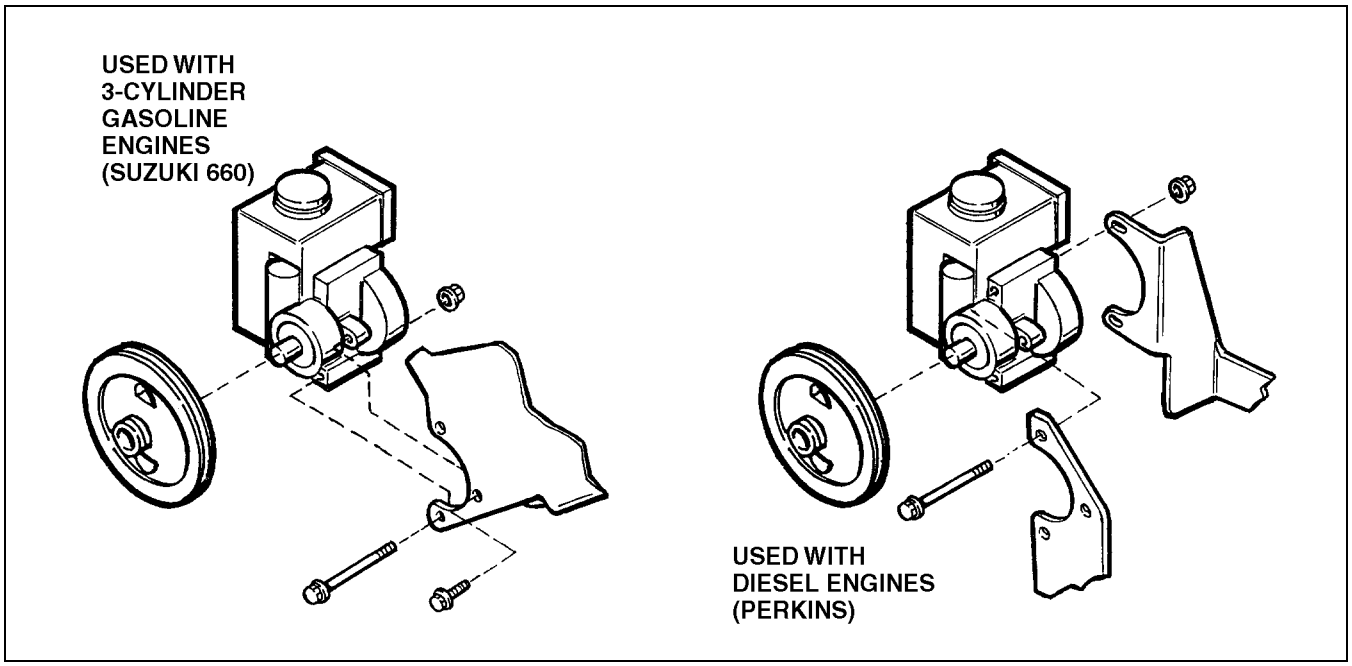

Figure 6E-1. Steering Pump Removal and Installation

SECTION 6E. STEERING PUMP

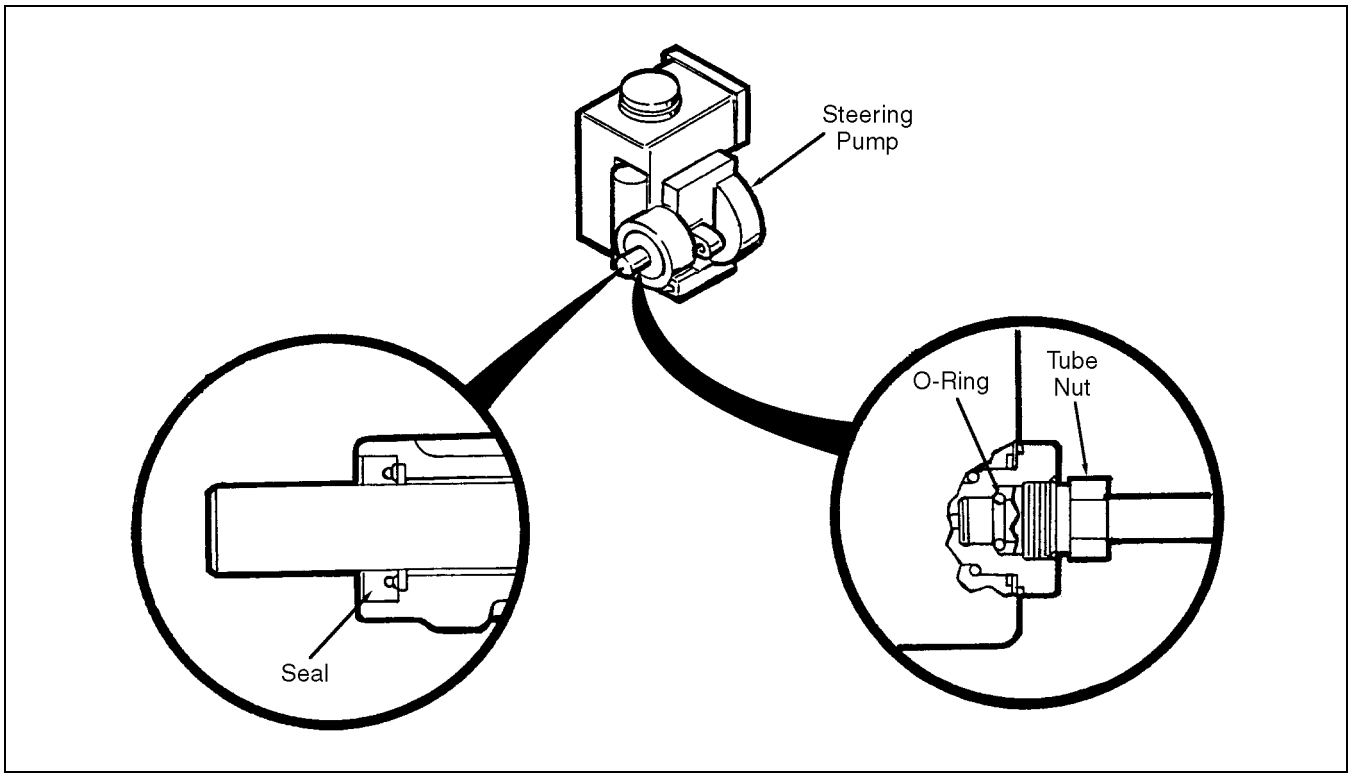

Figure 6E-2. Steering Pump Repair

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∞ ± 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 0.5∞camber change.
2. Set ìkingpinî caster angle to 3.5∞ ± 0.5∞ using shims, PN 841738. Each shim is equal to approximately 0.6∞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 ìstraight aheadî 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.

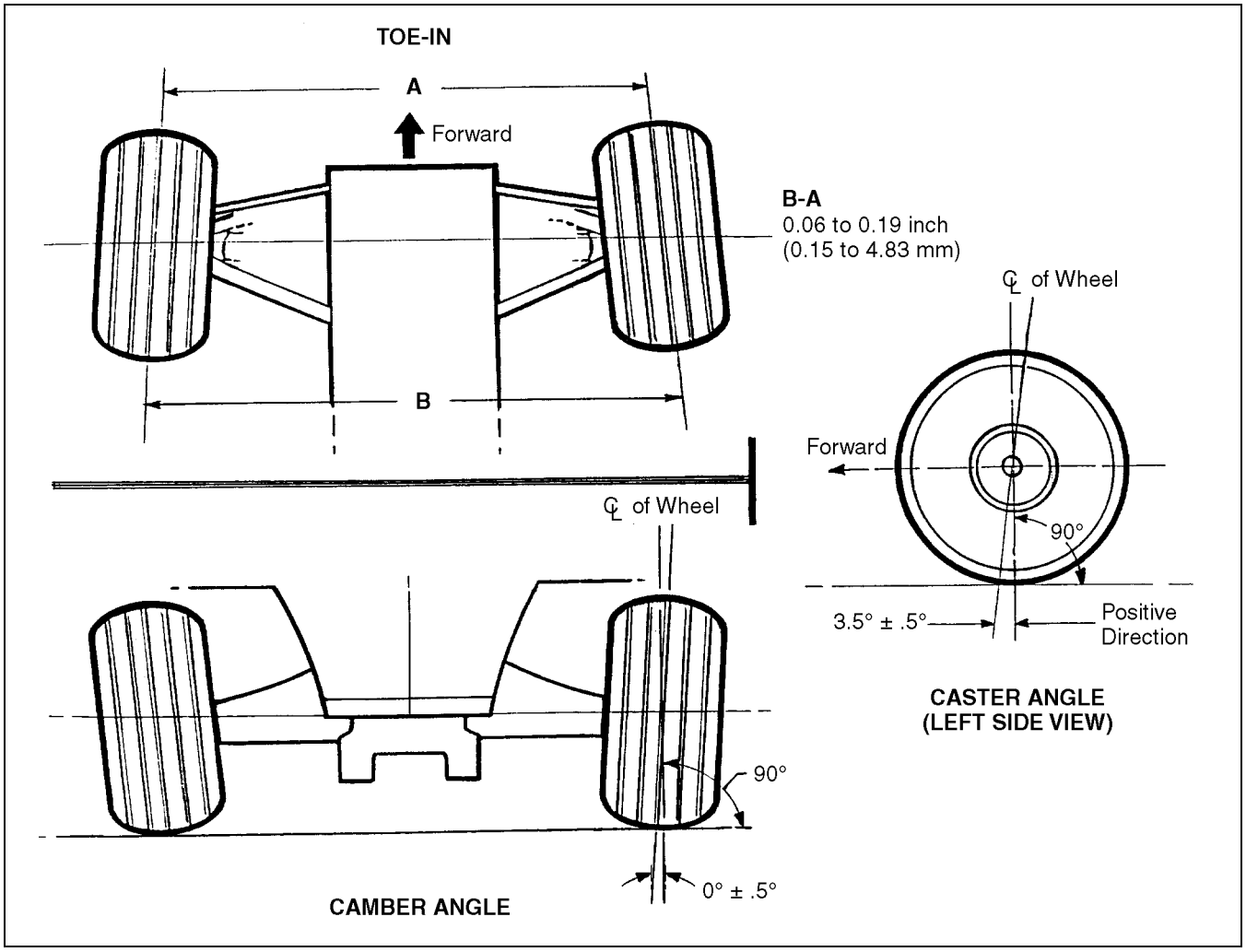

Figure 6F-1. Wheel Alignment

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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 (128 kPa) Rear 15 psi (110 kPa)
2. Truck wanders.	a. Under inflated tires.	a. Inflate tires to: Front 20 psi (128 kPa) Rear 15 psi (110 kPa)
	b. Steering malfunctioning.	b. Test steering. 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 (128 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 manufacturerís 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 manufacturerís 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).

SECTION 8
HYDRAULICS

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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. Squeaks from suspension.	a. Lack of lubricants.	a. See SECTION 11B for Maintenance Schedule.
2. Vehicle bounces or wheels bounce off ground when driving.	a. Shock absorbers faulty or worn out.	a. Replace.

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.

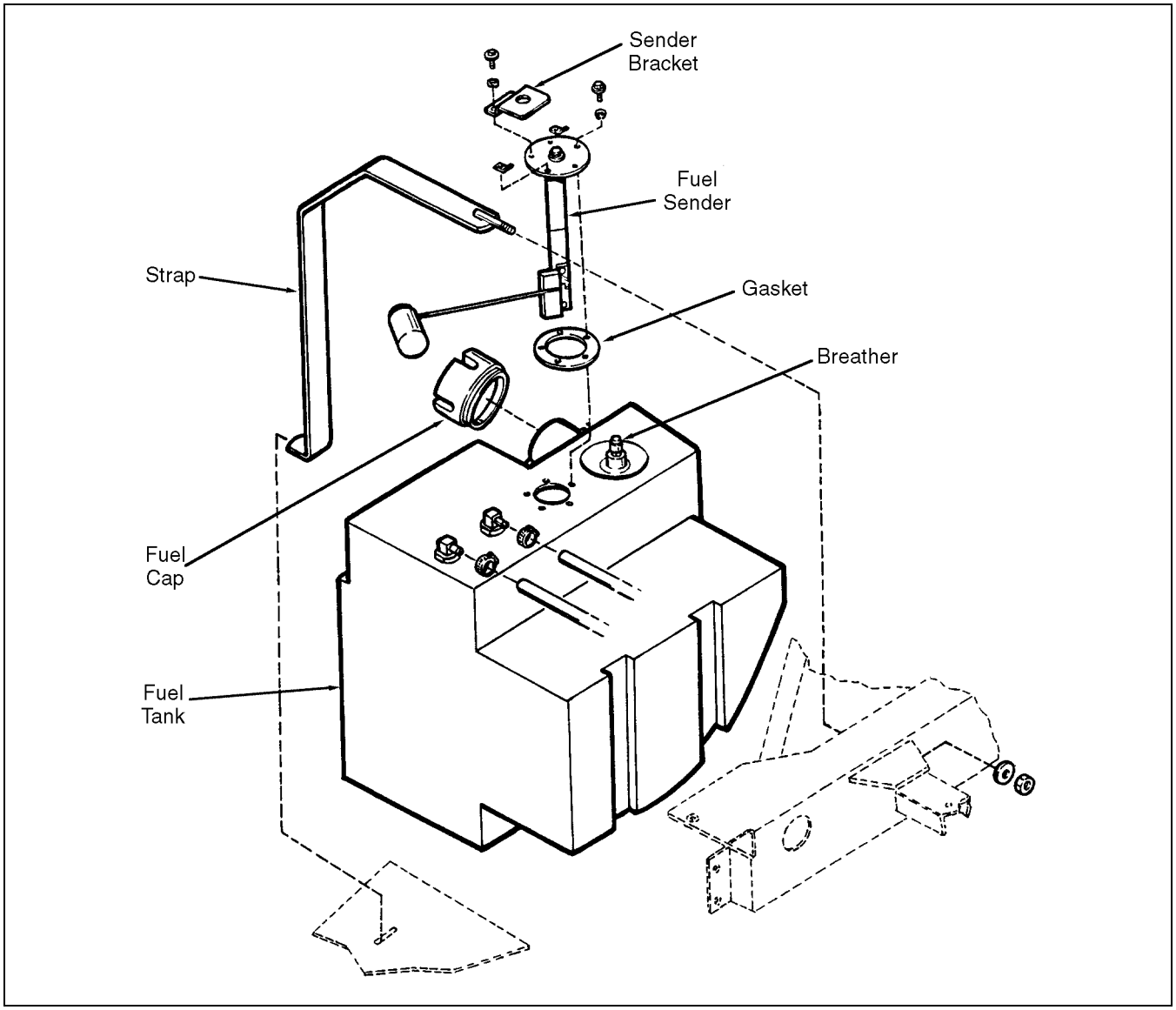

Figure 9C-1. Fuel Tank Removal and Installation

SECTION 9D. FRONT SUSPENSION

REPAIR (See Figure 9D-1)

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

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

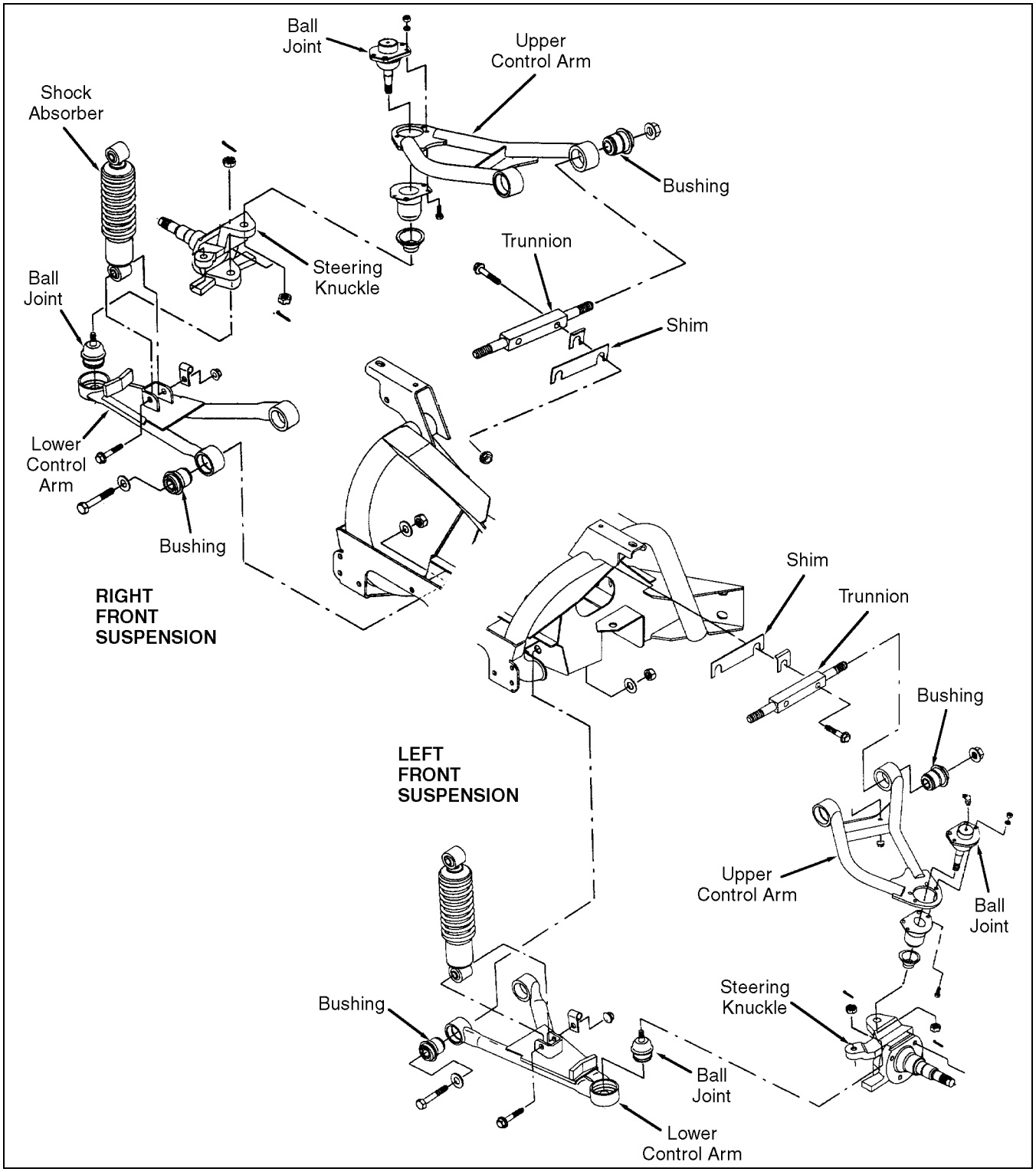

Figure 9D-1. Right and Left Front Suspension

SECTION 9E. REAR SUSPENSION

REPAIR (See Figure 9E-1)

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

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

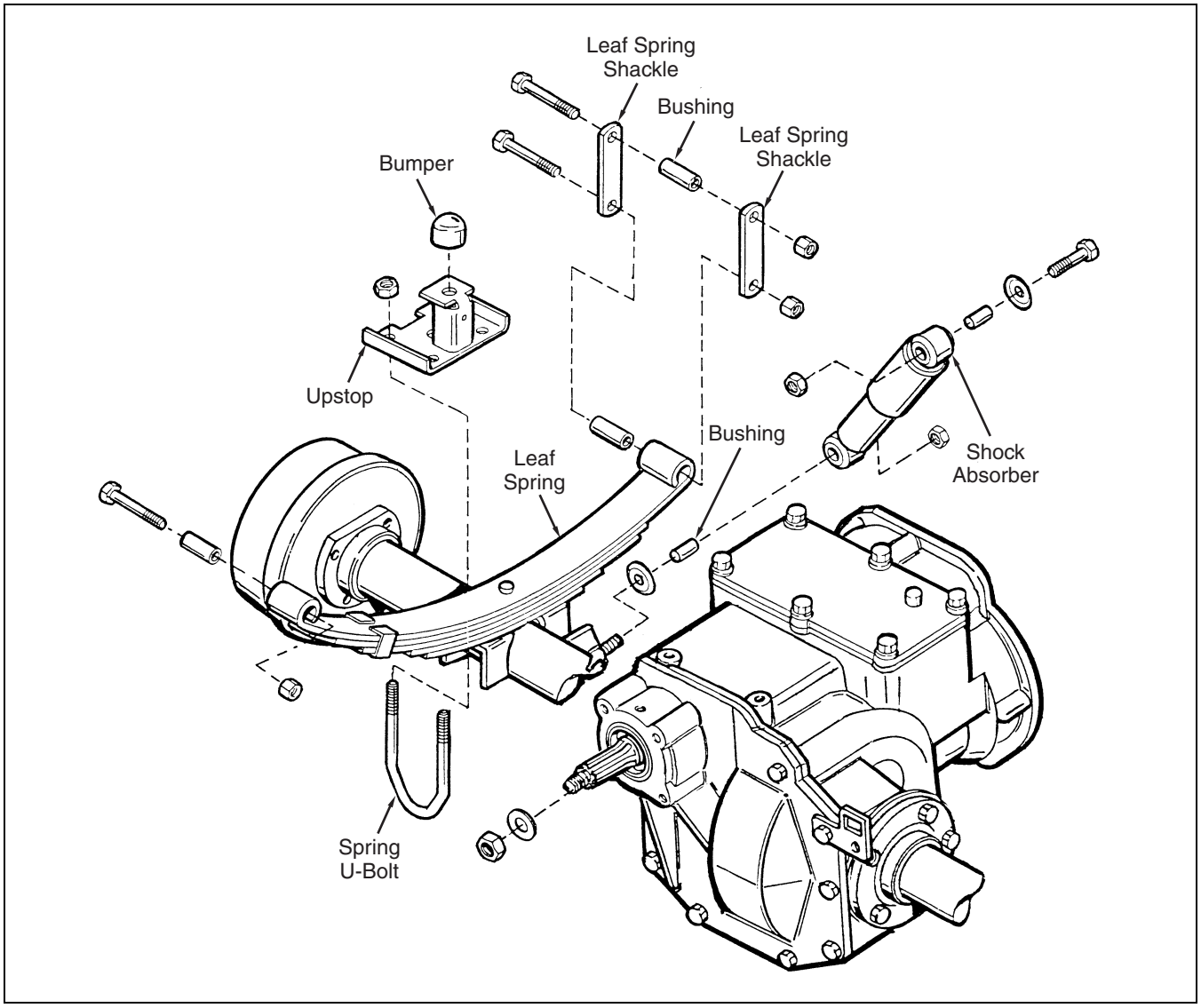

Figure 9E-1. Rear Suspension (Right Side Shown)

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SECTION 10
ELECTRICAL SYSTEM

ELECTRICAL SYSTEM

SECTION 10A. REPAIR AND SERVICE TOOLS AND MATERIALS

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

SECTION 10B. FAILURE ANALYSIS

PROBLEM	PROBABLE CAUSE	REMEDY
1. Engine will not turn over when ignition switch is 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 10F). c. Test (Section 10H). 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 manufacturerís manual.
3. Battery does not charge.	a. Bad battery. b. No alternator output voltage.	a. Replace. b. Test (Section 10E).
4. Battery over charges.	a. Bad battery. b. Faulty alternator. c. Faulty wiring. d. Bad ground.	a. Replace. b. Test/replace (Section 10E). 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 troubleshooting and/or testing the electrical system. Specific repair and replacement instructions, where applicable, are also provided in this section.

NOTE

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

NOTE

See engine manufacturerís 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 Ω 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.

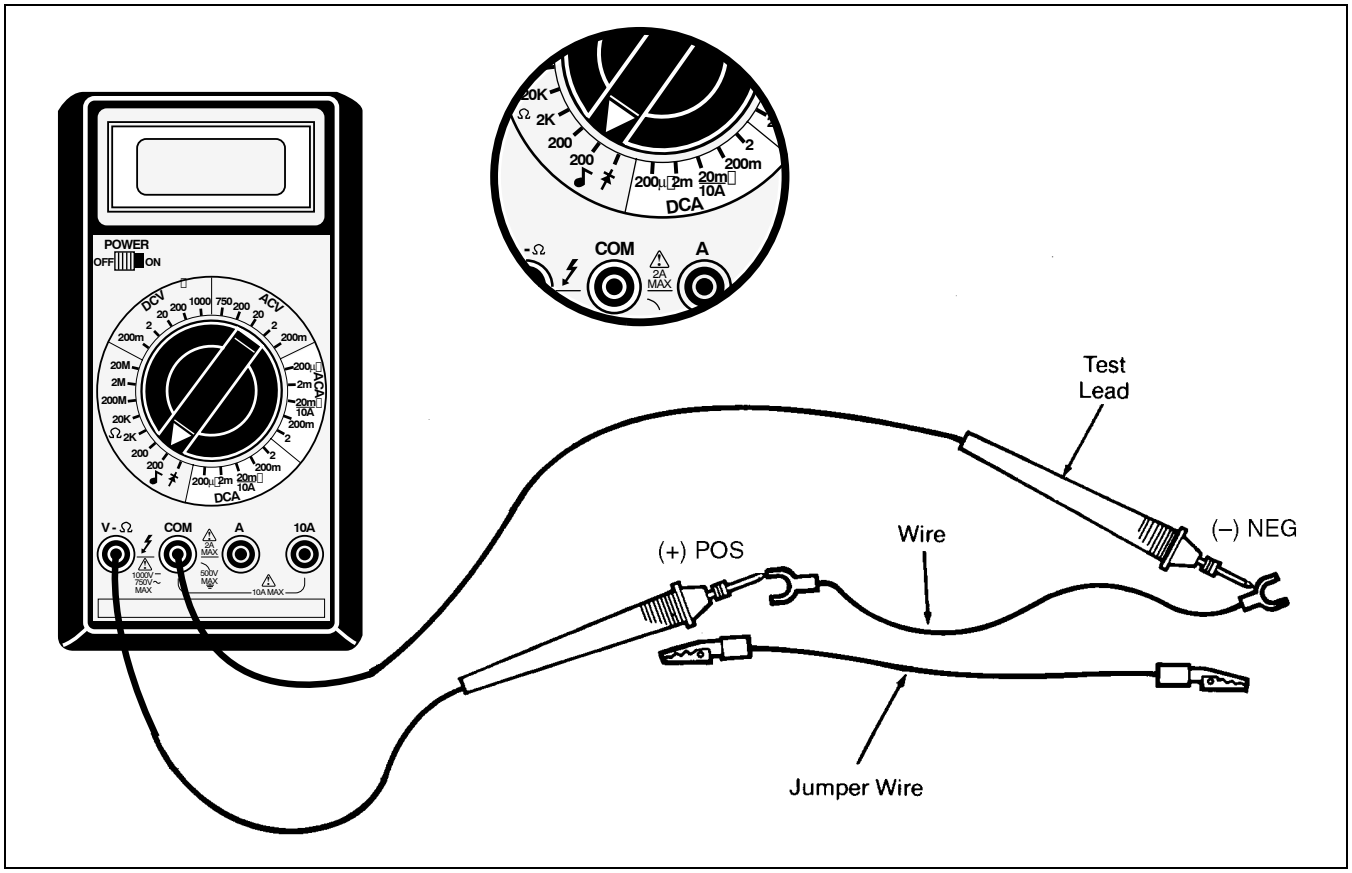


Figure 10C-1. Wire Continuity Test

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.

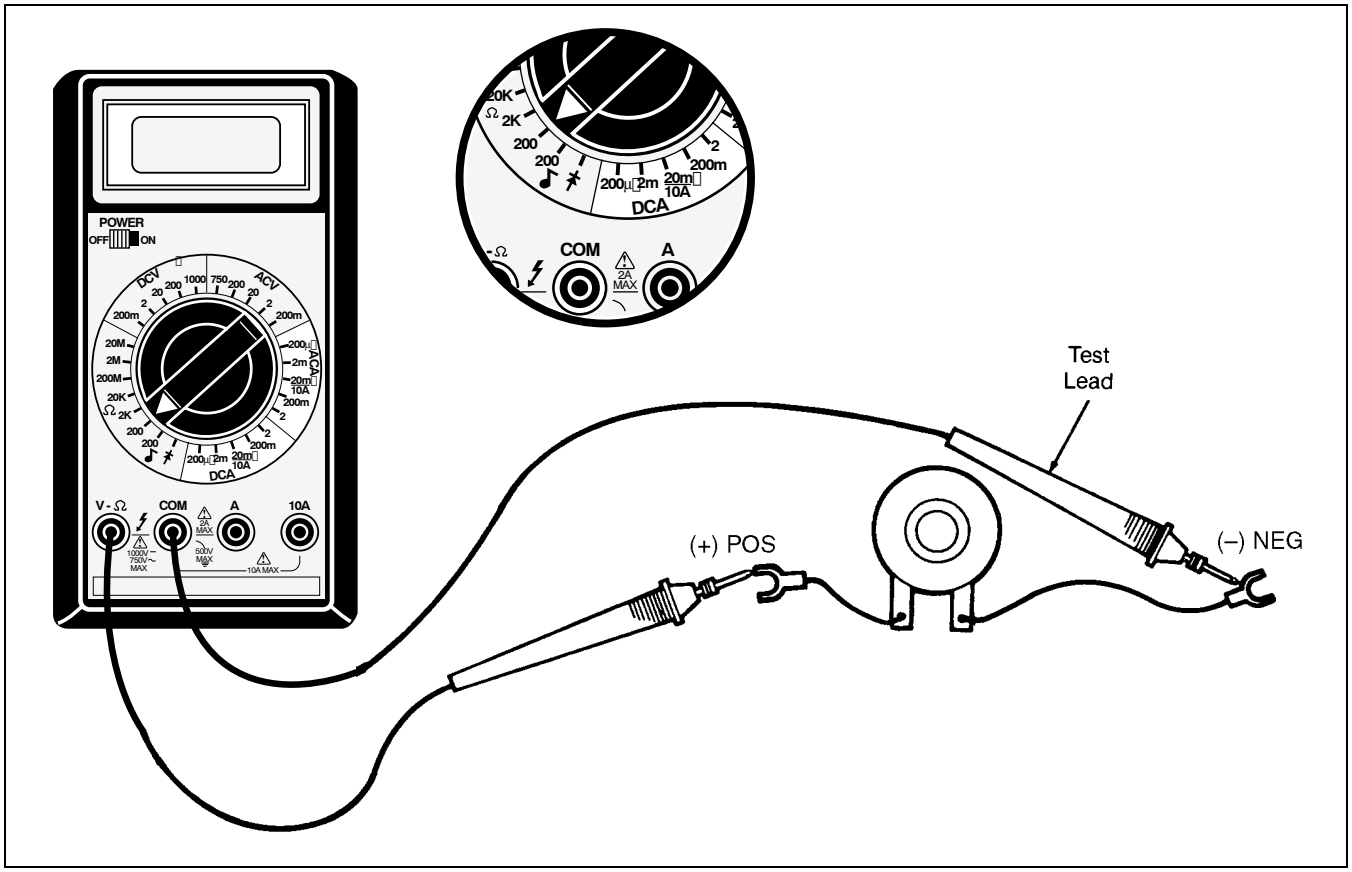


Figure 10C-2. Resistance Tests, Ohm Ω

SECTION 10D. BATTERY

GENERAL

For normal service, use a battery rated 12V, 420 cold cranking amps at 0∝F (ñ18∝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 manufacturerís instructions on safety, maintenance and installation procedures.

CAUTION

Always connect the ìgroundî (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 ìOffî.
2. Connect charger leads to battery. Connect the positive (+) connector from the charger to the positive battery terminal. Connect the negative (ñ) 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 manufacturerís instructions on the charger.

Slow Charge	Fast Charge
10 hours @ 5 amps 5 hours @ 10 amps	2-1/2 hours @ 20 amps 1-1/2 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 ó 125∝F (52∝C), reduce or temporarily halt charging to avoid damaging the battery.
5. Always turn charger to ìOffî 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 ó add water as necessary to maintain level above plates ó 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 ó if battery voltage falls below 9 volts while cranking, the battery is run-down or faulty. Charge and perform test again.

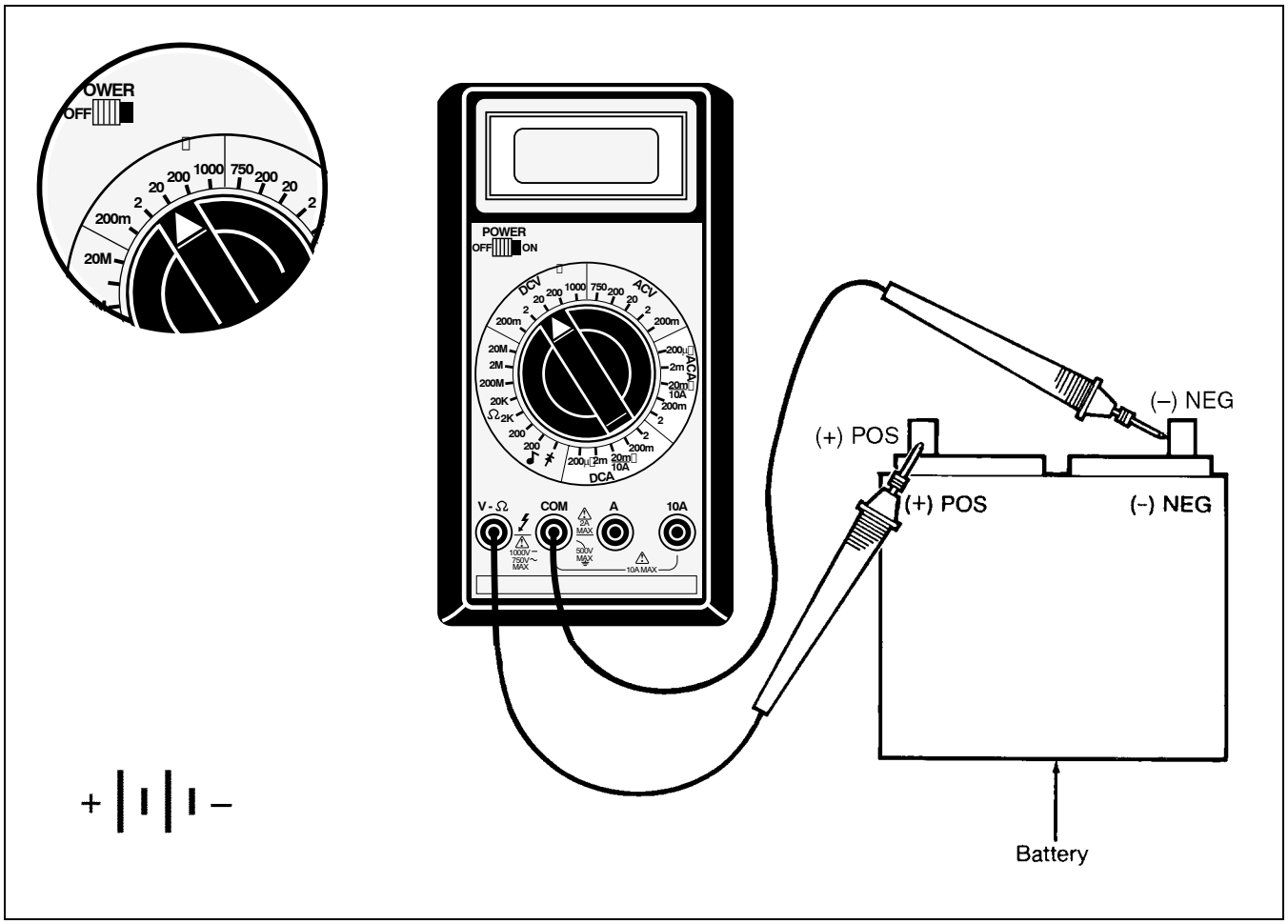


Figure 10D-1. Battery Test

SECTION 10E. CHARGING SYSTEM (3-CYL. 660 GASOLINE & DIESEL ENGINE)

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 (ñ) 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 (ñ) test lead to ground.
3. Reconnect battery NEG (ñ) 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.

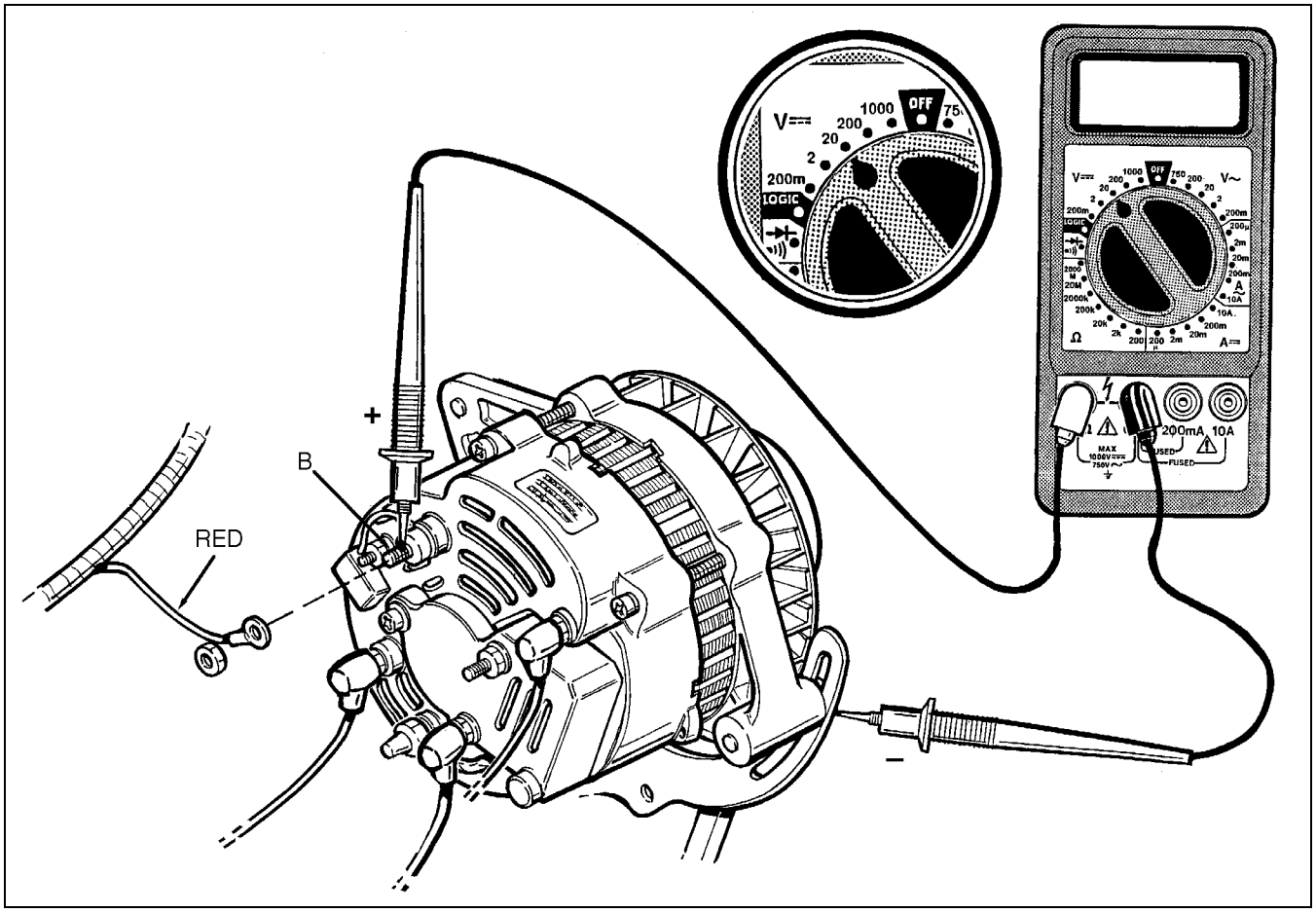


Figure 10E-1. Output Current Test

10E

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 (ñ) lead of the multimeter to a good ground.
3. Touch the POS (+) lead of the multimeter to the ìBî terminal of alternator.
   - Should read 12 volts.
   - NO or low voltage, check battery, connections and wiring.

SECTION 10F. STARTER

GENERAL

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

STARTING CIRCUIT RESISTANCE TEST (See Figure 10F-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 (ñ) test lead to NEG (ñ) 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 (ñ) 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.

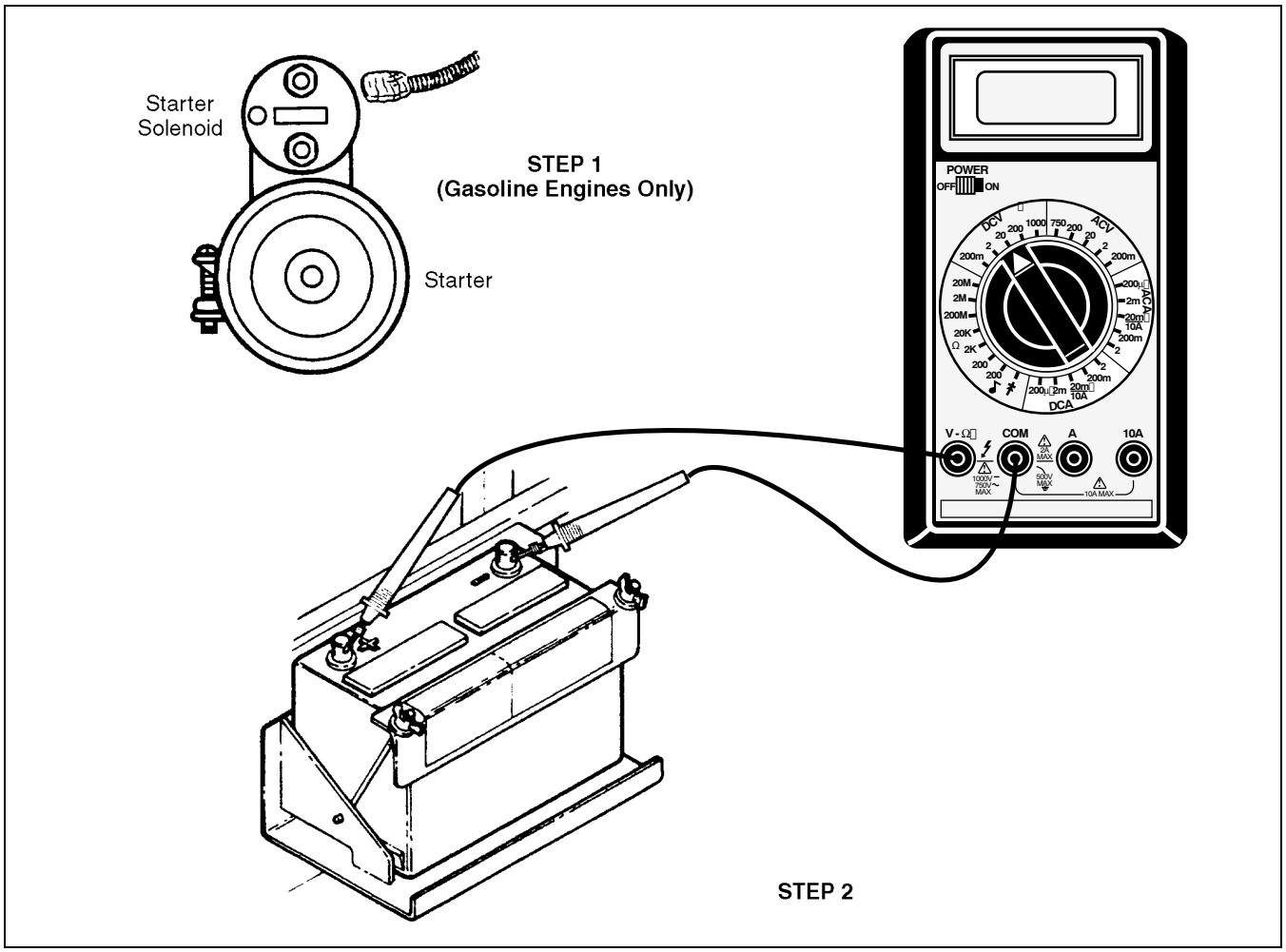


Figure 10F-1. Starting Circuit Test (1 of 2)

10F

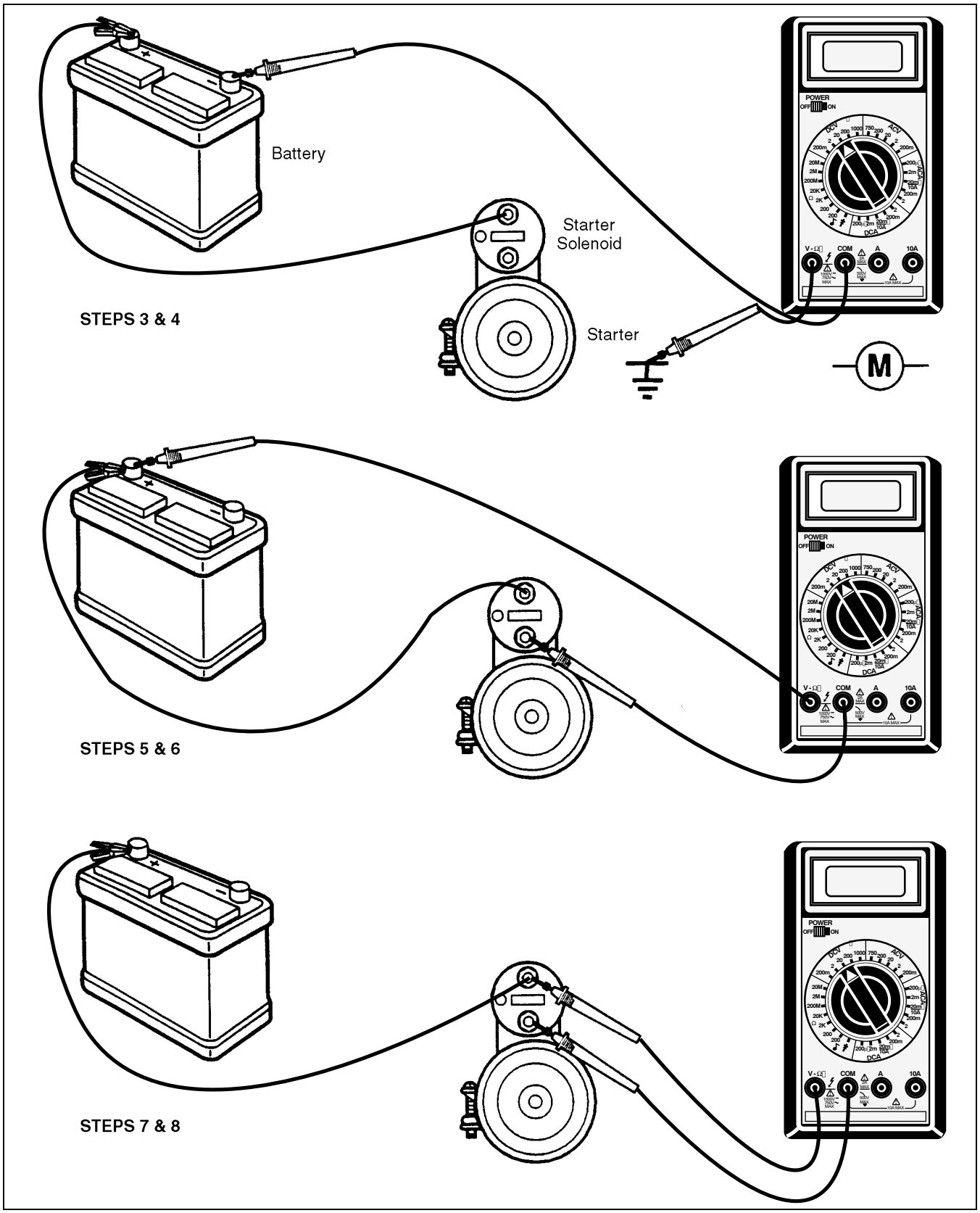


Figure 10F-1. Starting Circuit Test (2 of 2)

SECTION 10F. STARTER

STARTER SOLENOID TEST (See Figure 10F-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 10F-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.

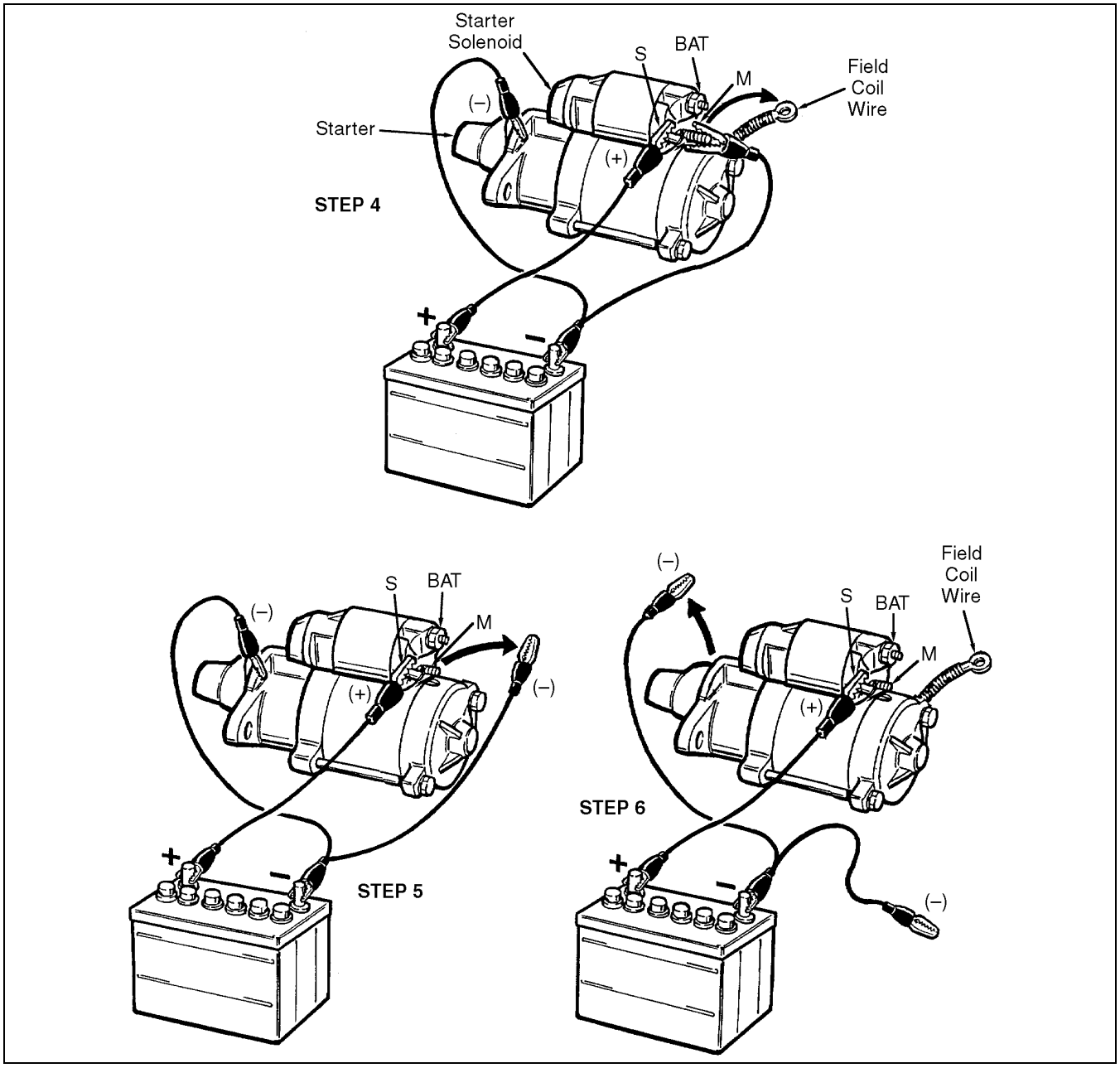


Figure 10F-2. Starter Solenoid Test

SECTION 10F. 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 **10F-3**.
3. Check that starter rotates smoothly and that the pinion moves outward. Ammeter should read less than 50 amps.

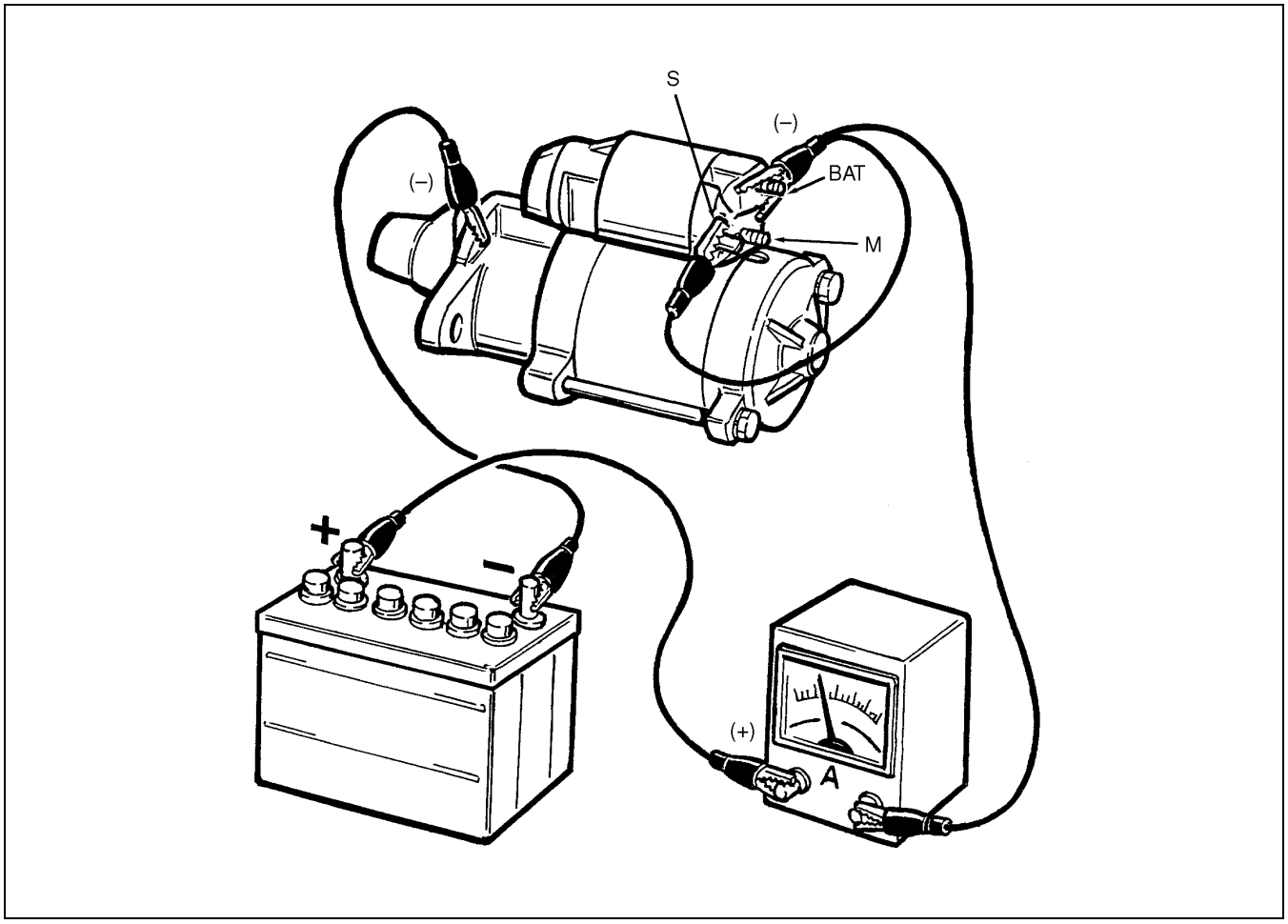


Figure 10F-3. No-Load Test

SECTION 10G. SWITCHES

IGNITION SWITCH TEST (See Figure 10G-1)

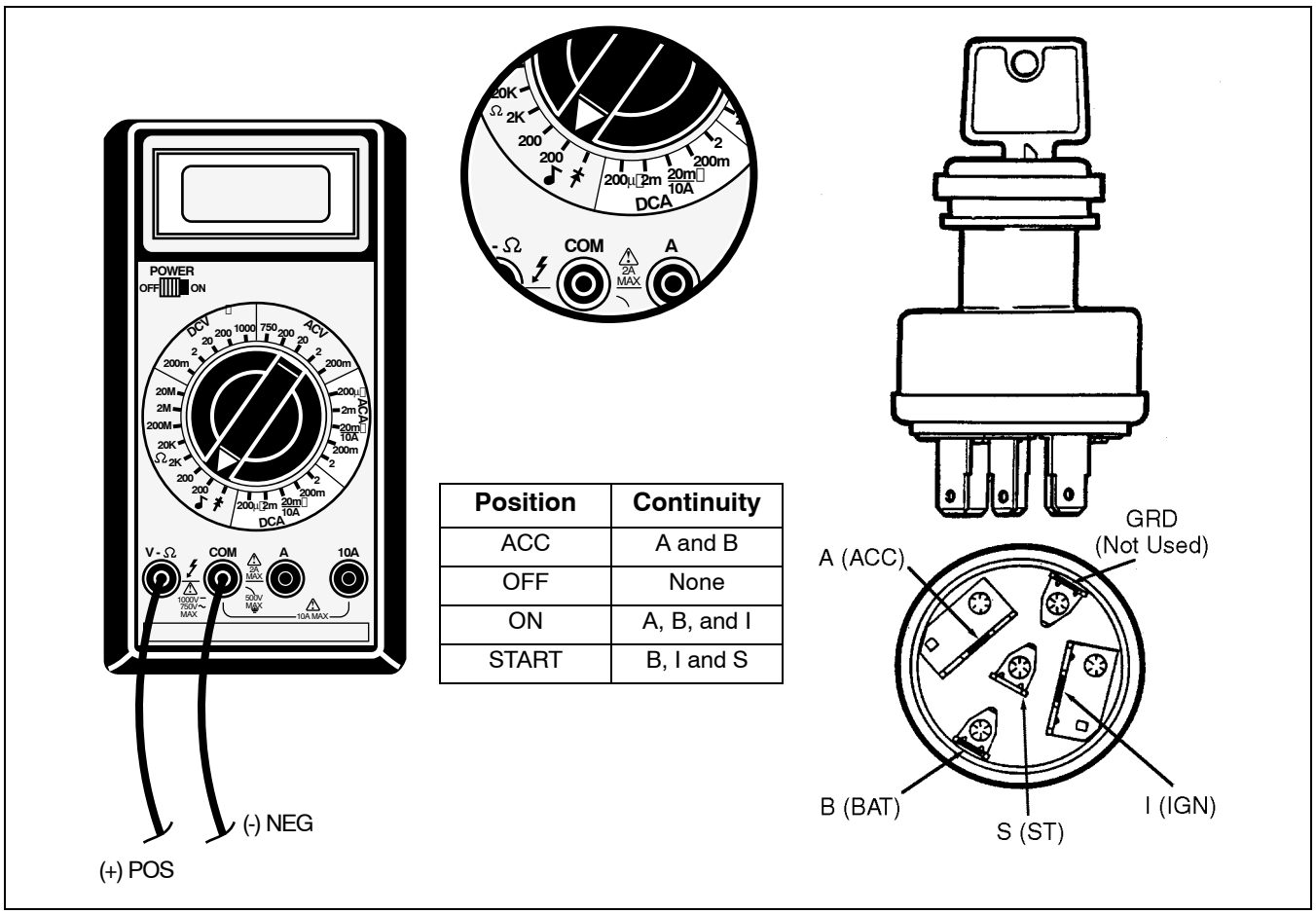
1. Disconnect NEG (ñ) cable at battery.
2. Disconnect wiring connections at ignition switch.
3. Set the multimeter to 200 Ω (ohms) scale.
4. Check all switch positions as follows:
   a. With key switch in OFF position, connect test leads to any of two terminals A, B, I and S.
      - There should be 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.

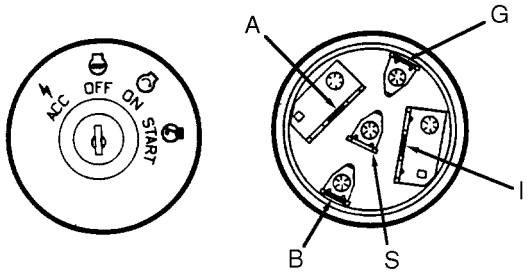
   b. With key switch in ON position, connect NEG (ñ) test lead to terminal A and POS (+) test lead to terminal B.
      - There should be a reading of 0 to 0.5 Ω ohms) on the multimeter.
   c. Move the POS (+) test lead to terminal I.
      - There should be a reading of 0 to 0.5 Ω ohms) on the multimeter.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

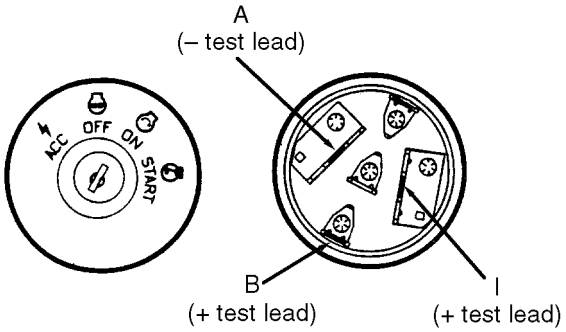
Figure 10G-1. Ignition Switch Test (1 of 2)



STEP 4a
Contacts Open (No Continuity)

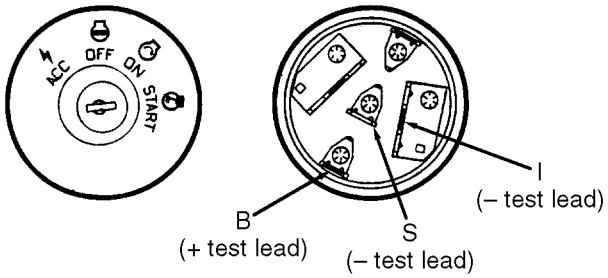
Position	Continuity
OFF	None

NOTE
G terminal not used.



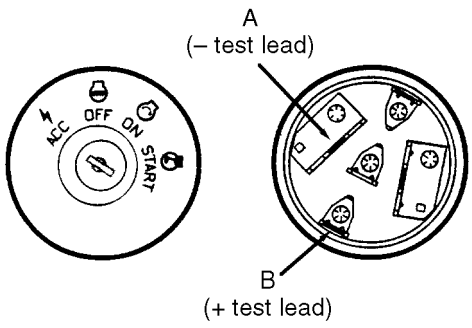
STEPS 4b & 4c
Contact 0 to 0.5 Ω (ohms)

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 10G-1. Ignition Switch (2 of 2)

HORN SWITCH TEST (See Figure 10G-2)

See Figure **10G-2** and test switch as follows:

1. Disconnect leads at switch.
2. Set the multimeter to 200 $\dot{E}$ 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.

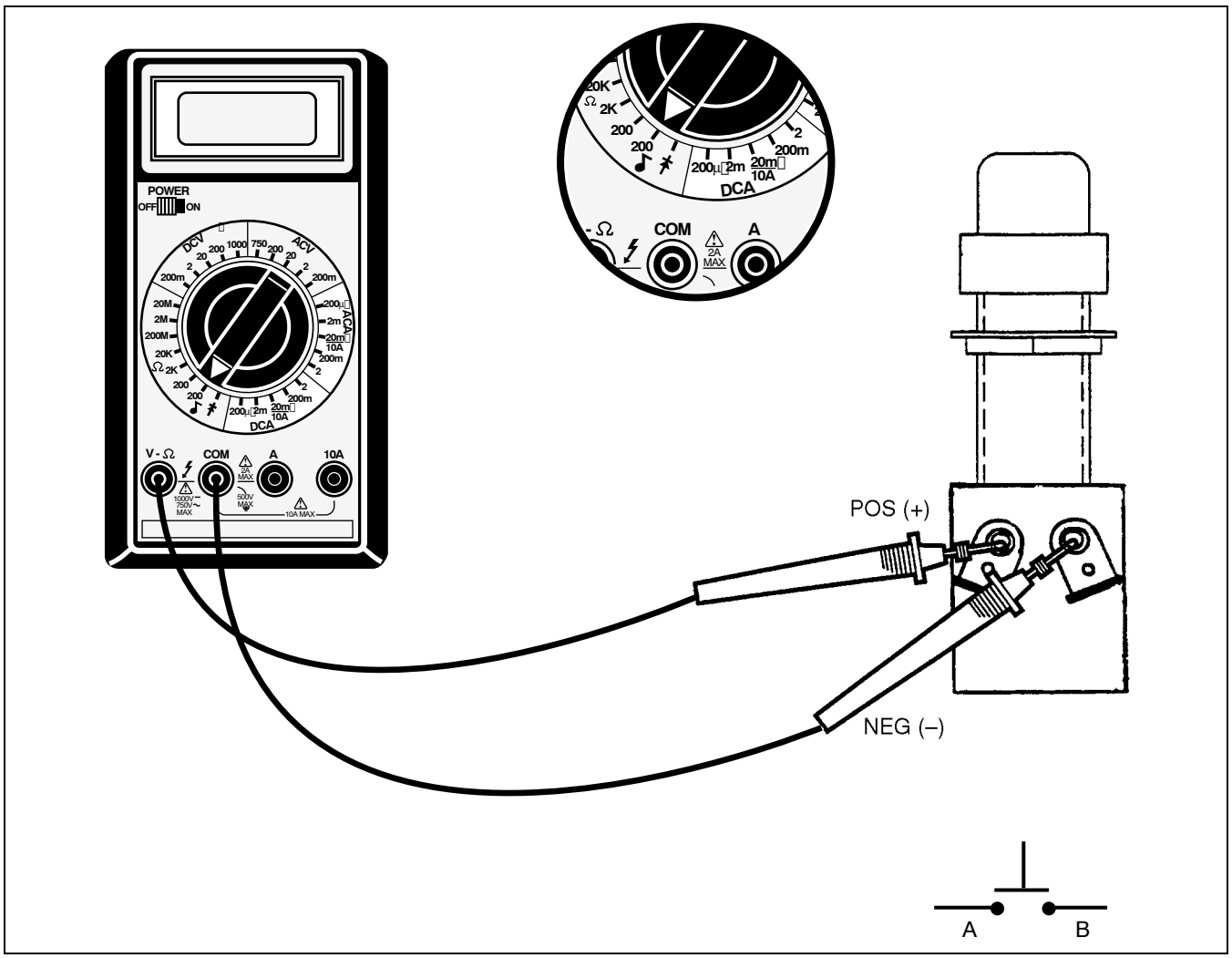


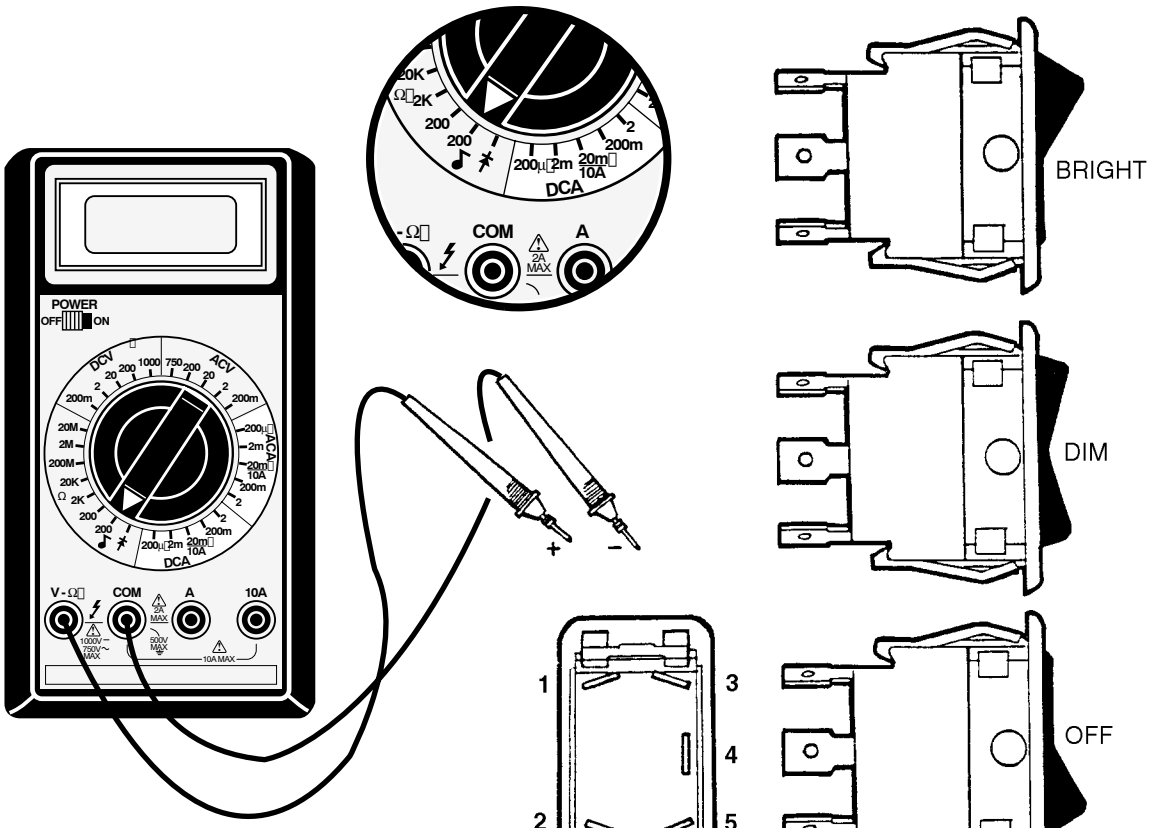
Figure 10G-2. Horn Switch Test

SECTION 10G. SWITCHES

LIGHT SWITCH TEST (See Figure 10G-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:
   b. 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.
   c. Move one multimeter test lead to terminal 3.
      - There should be 0 to 0.5 Ω (ohms) on the multimeter.

Replace 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 10G-3. Light Switch Test

BACKUP LIGHT/ALARM SWITCH TEST (See Figure 10G-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.

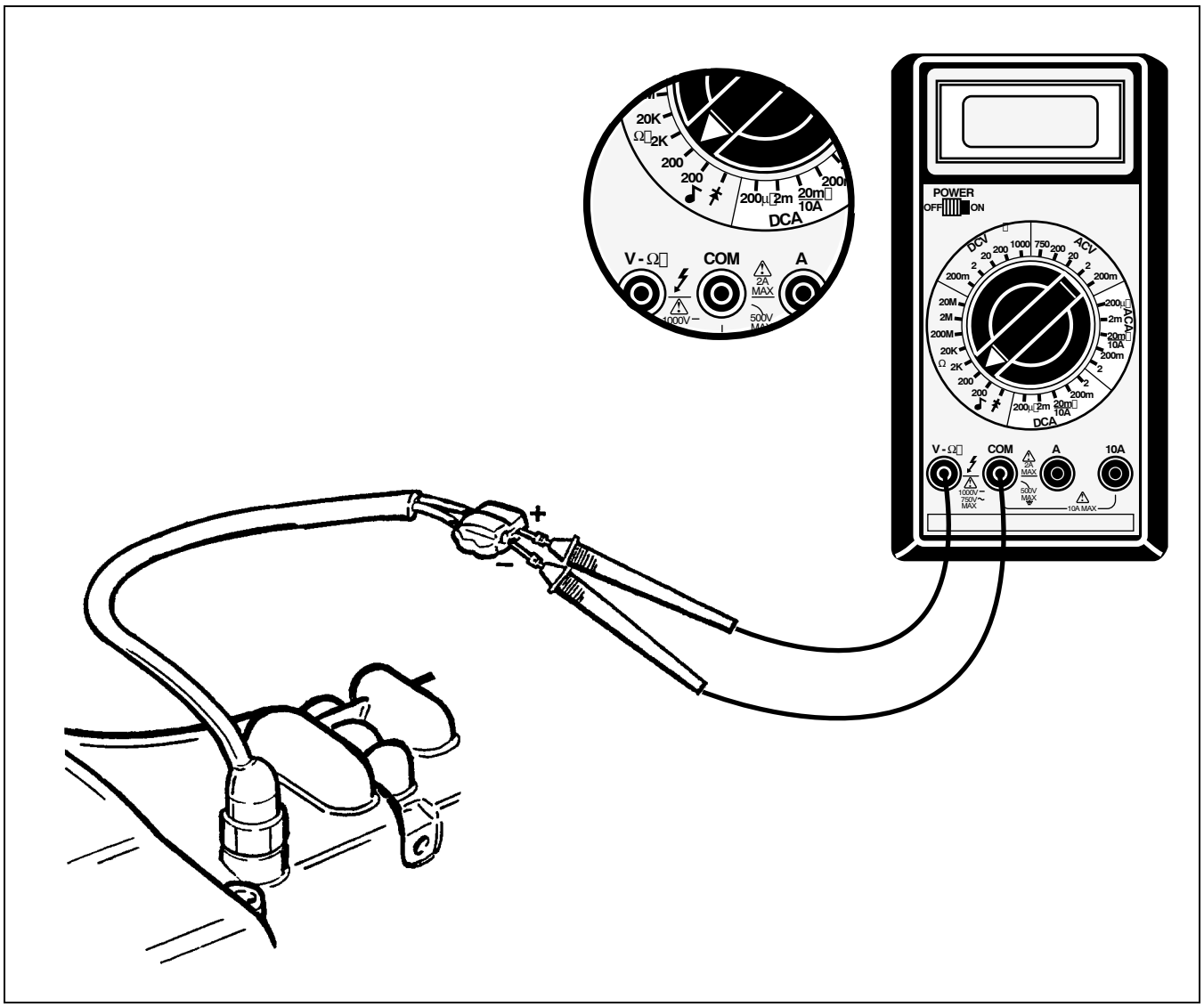


Figure 10G-4. Backup Light/Alarm Switch Test

SECTION 10G. SWITCHES

COOLING FAN SWITCH TEST (See Figure 10G-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 tap water.
2. Heat the water 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 water. 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 water more than 230°F (110°C).

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

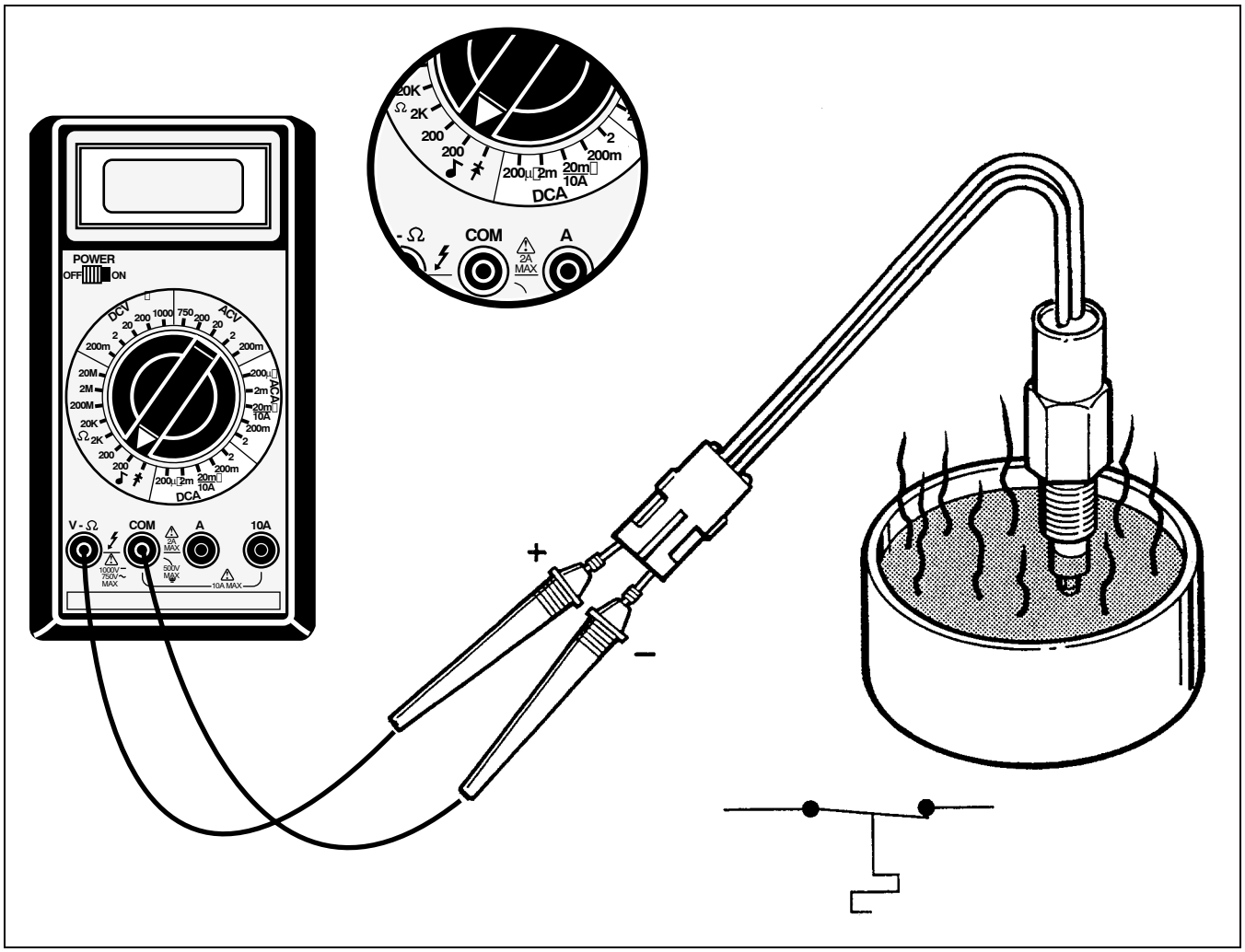


Figure 10G-5. Cooling Fan Switch Test

CLUTCH INTERLOCK AND BRAKE SWITCH TEST (See Figure 10G-6)

1. Disconnect ground cable at battery.
2. Identify (label) and disconnect electrical leads at switch.
3. Set the multimeter to 200 É Ω (ohms) scale.
4. Connect leads as shown.
   - There should be a reading of 0 to 0.5 Ω (ohms) on multimeter.
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.

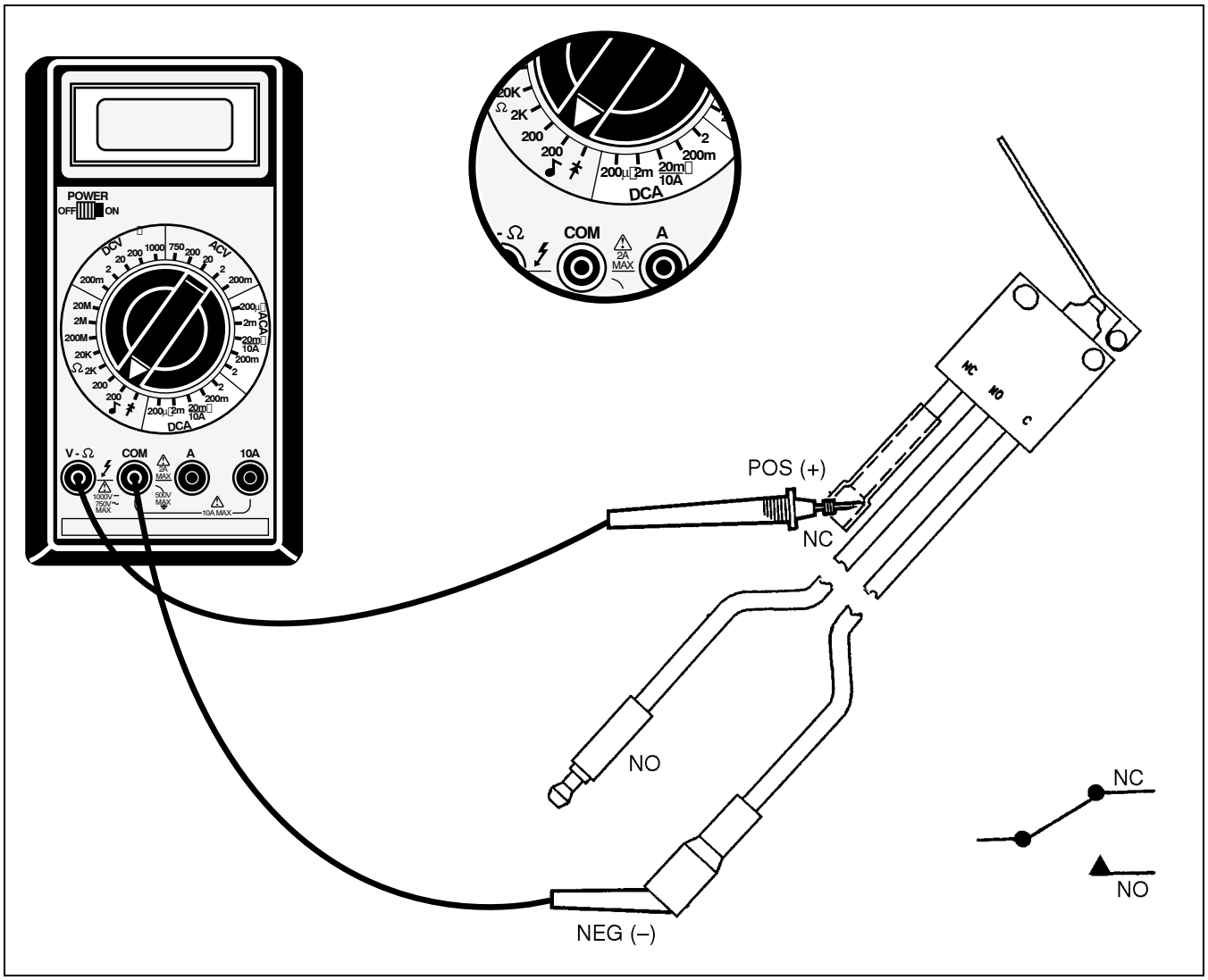


Figure 10G-6. Clutch Interlock and Brake Switch Test

SECTION 10H. FUSES

FUSE TEST

See Figure **10H-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.

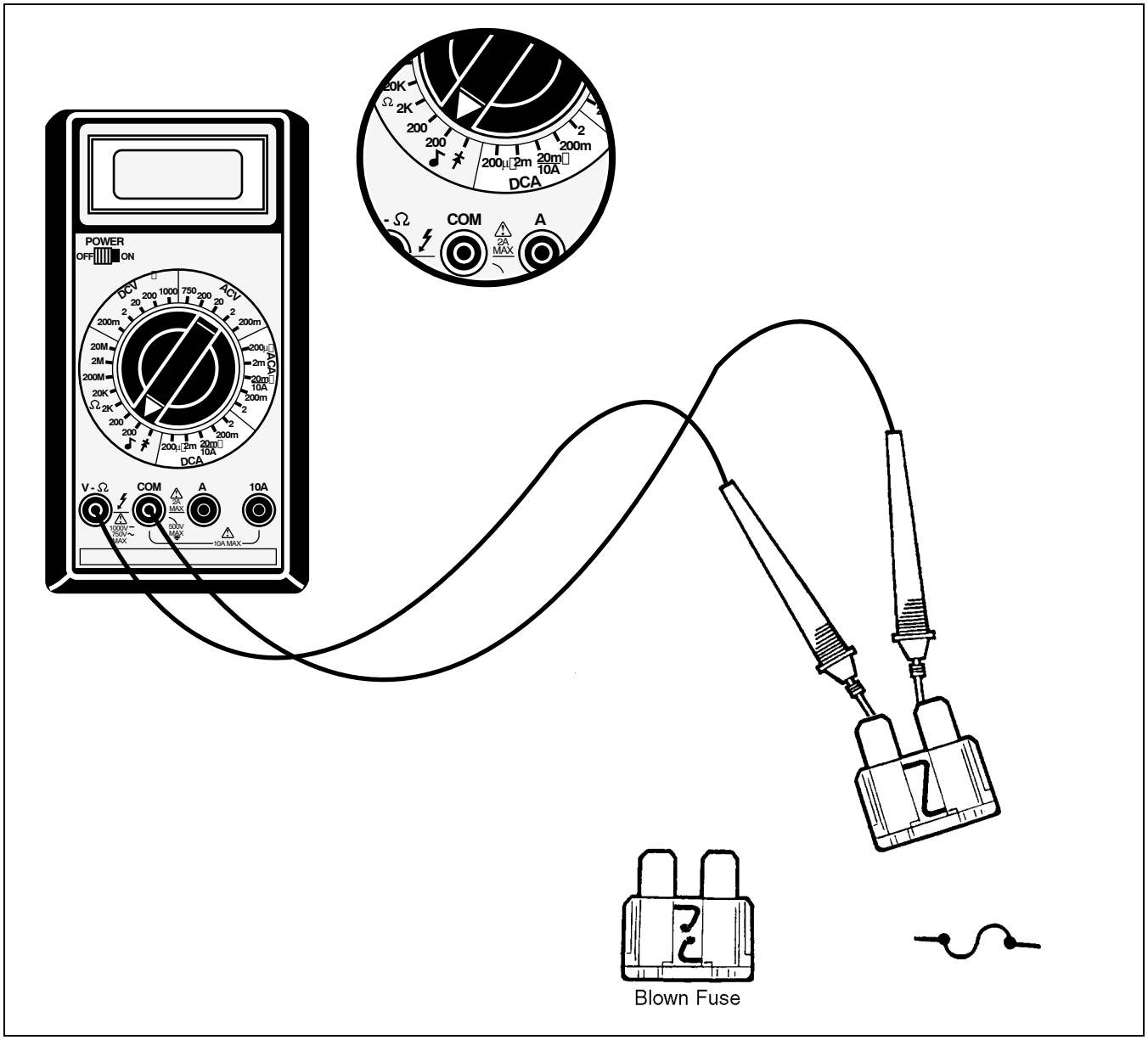


Figure 10H-1. Fuse Test

ENGINE OIL PRESSURE SWITCH TEST (See Figure 10I-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.

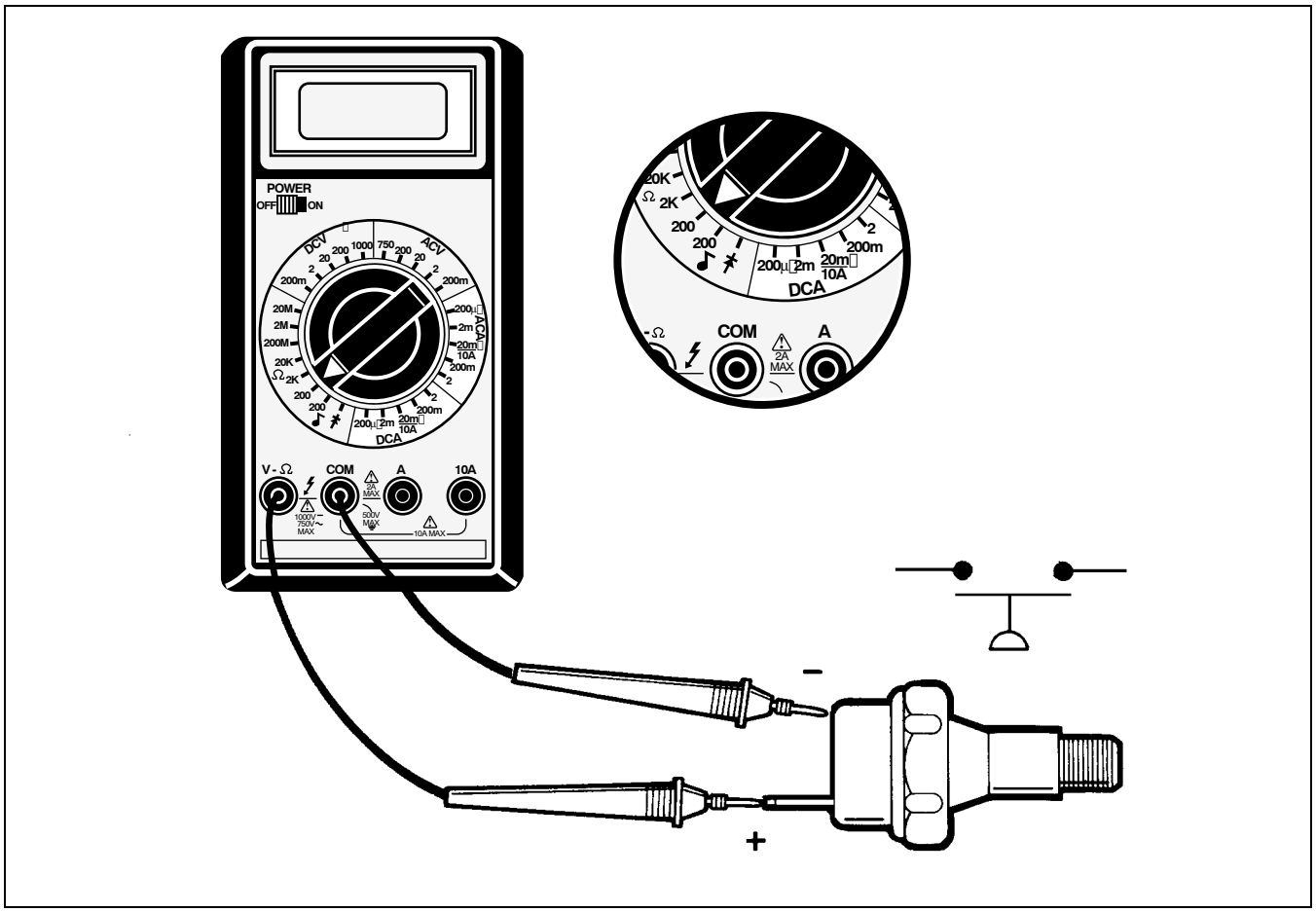


Figure 10I-1. Engine Oil Pressure Switch Test

SECTION 10I. SENDERS AND ALARMS

ENGINE COOLING WATER TEMPERATURE SENDER TEST (See Figure 10I-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.

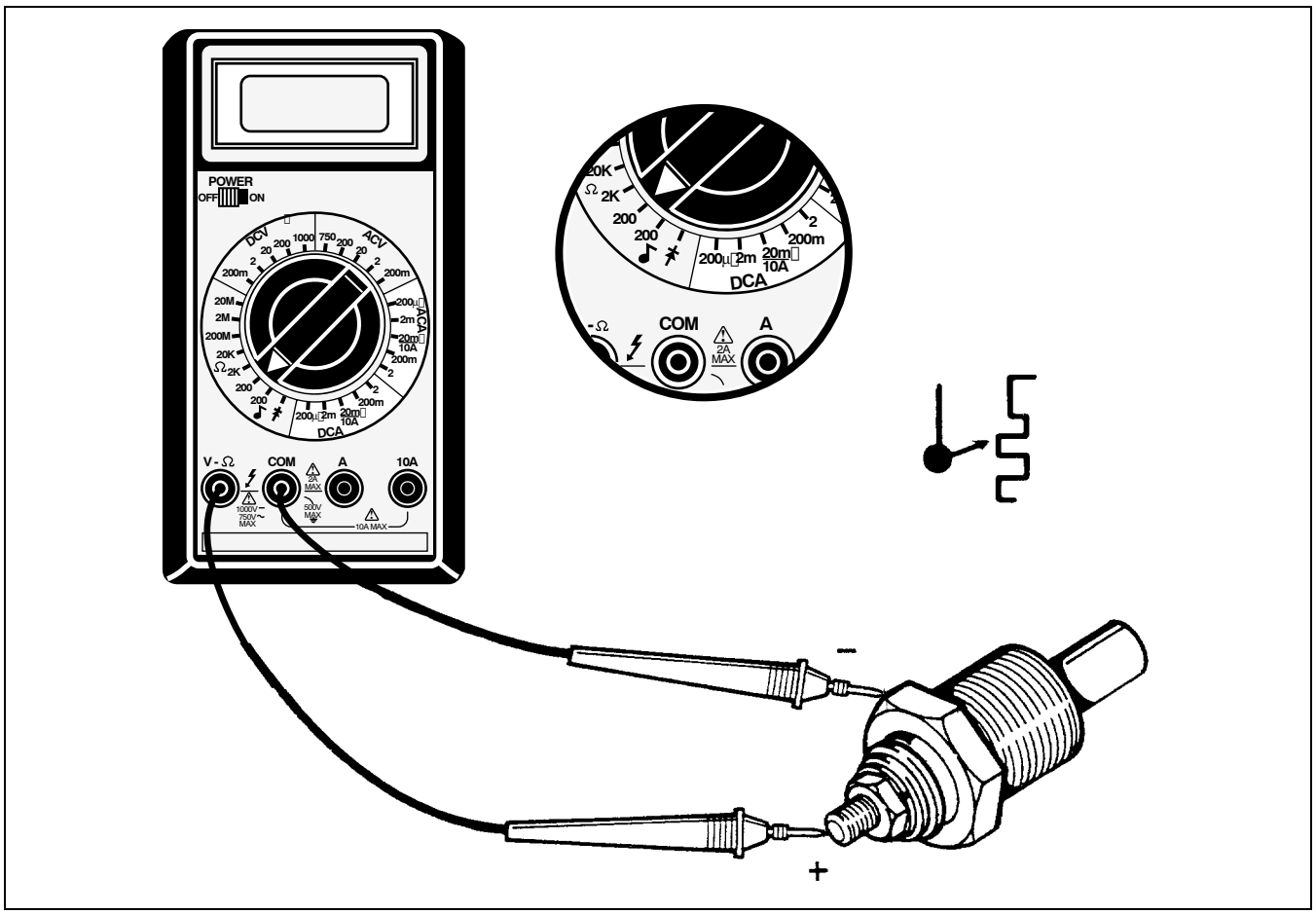


Figure 10I-2. Engine Cooling Water Temperature Sender Test

FUEL LEVEL SENDER TEST
(See Figure 10I-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 10M).

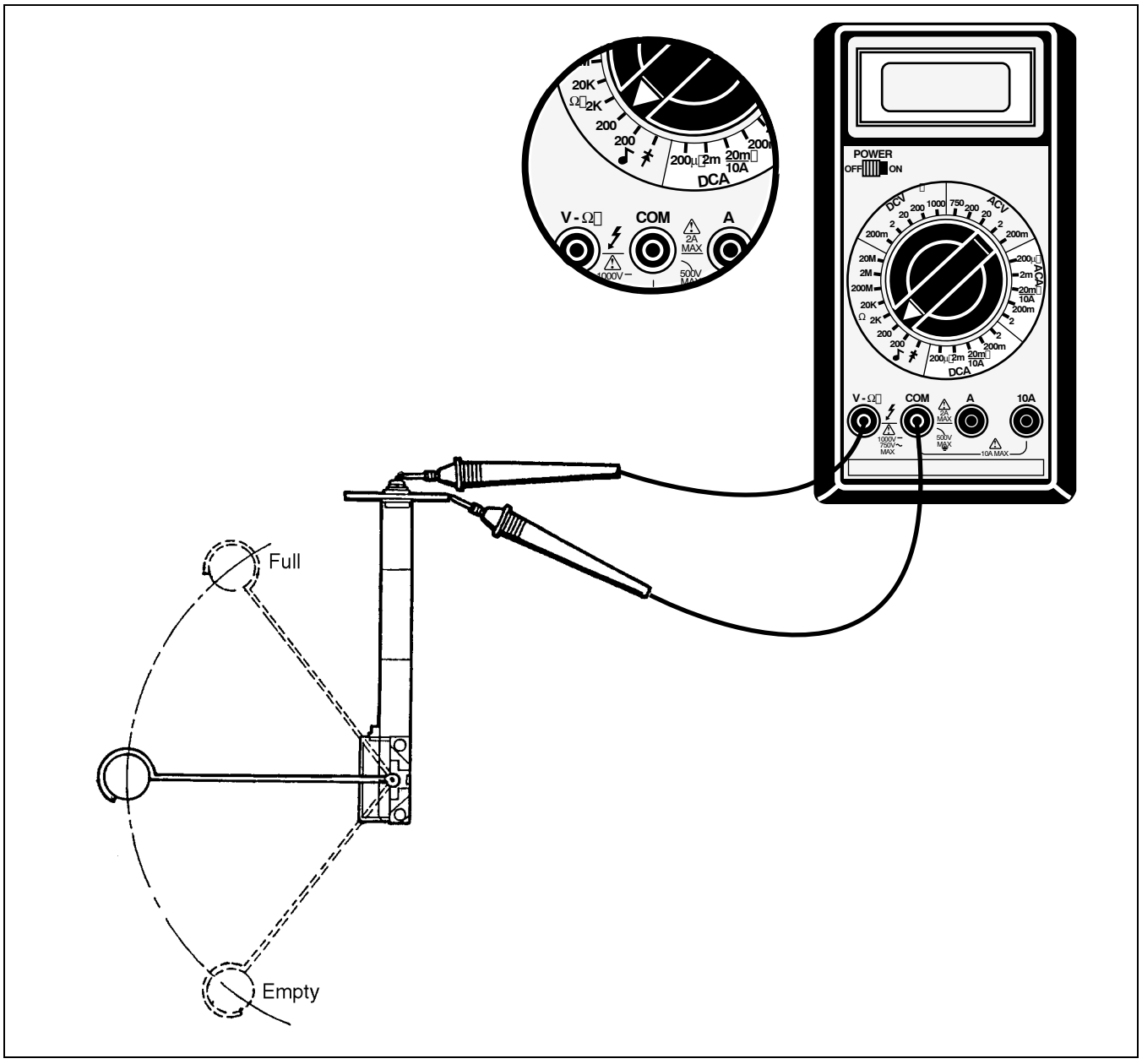


Figure 10I-3. Fuel Level Sender Test

SECTION 10J. SOLENOIDS

STARTER SOLENOID TEST (See Figure 10J-1)

1. Connect the battery to terminals S and I.
   - There should be an audible ìclickî.
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.

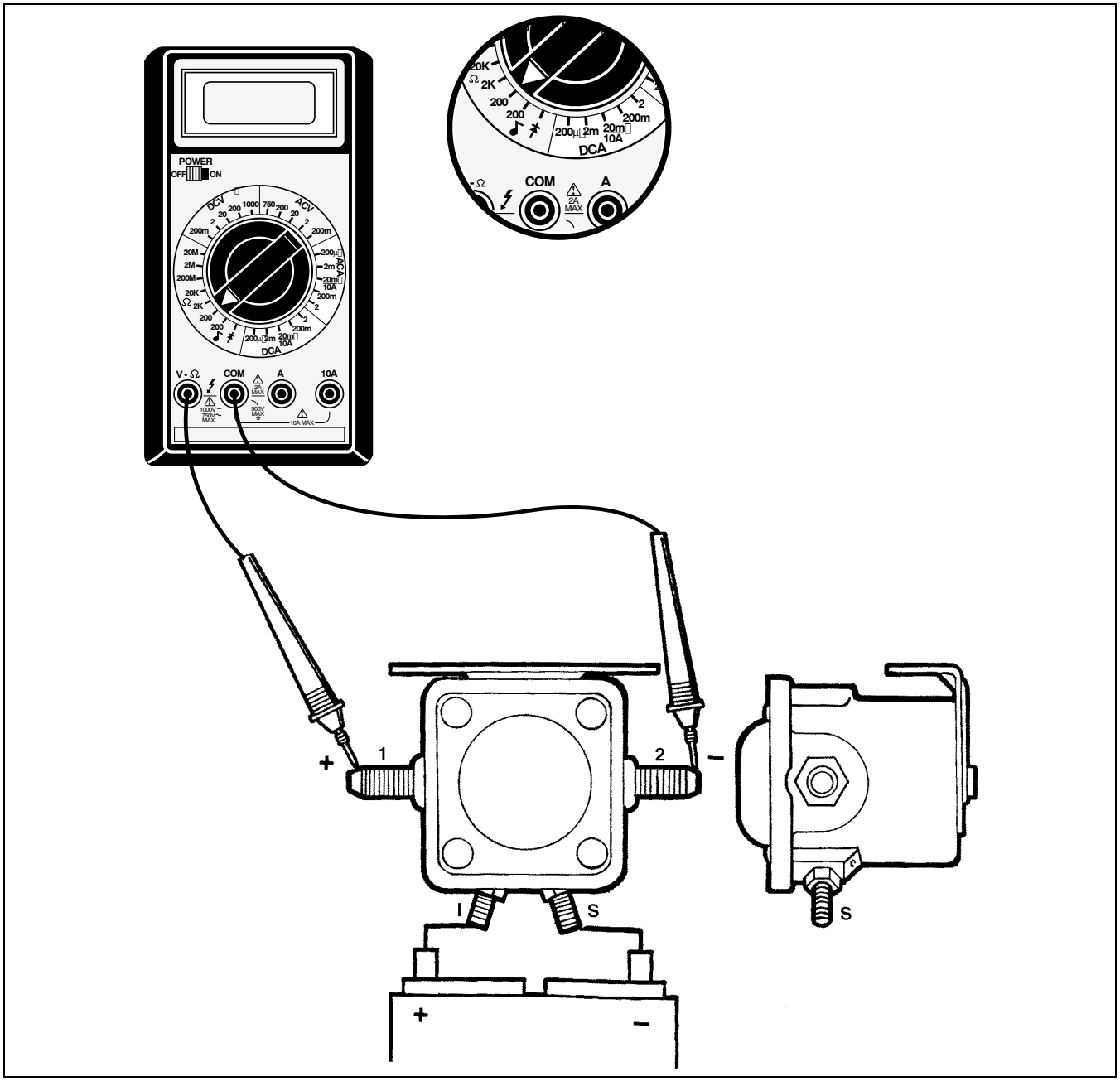


Figure 10J-1. Starter Solenoid

SECTION 10K. RELAYS

RELAY TEST (See Figure 10K-1)

See Figure **10K-1** and test relay as follows:

1. Set multimeter to 200 É Ω (ohms).
2. Connect black NEG (ñ) 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 ìclickî.
6. Connect black NEG (ñ) 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.

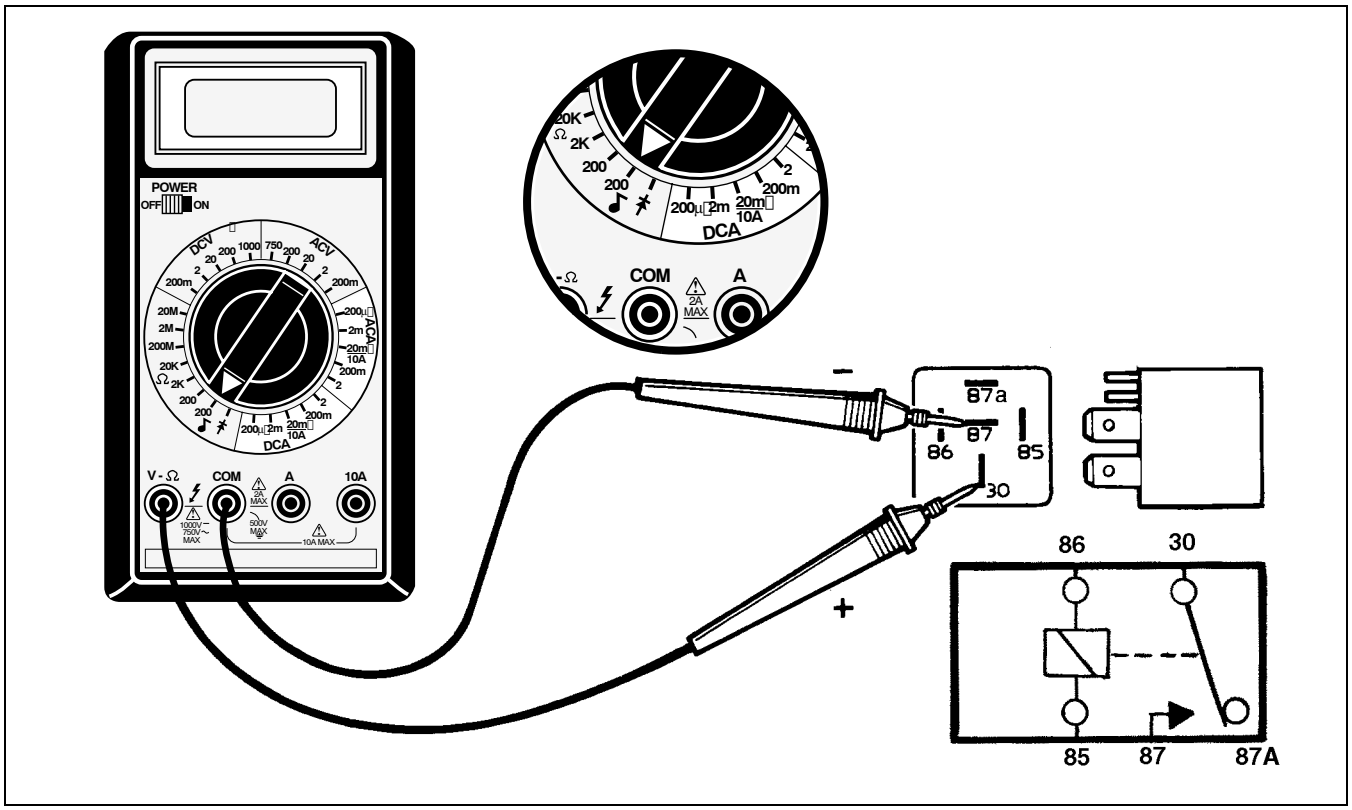


Figure 10K-1. Relay Test

10K

SECTION 10L. ELECTRICAL FUEL PUMP (DIESEL)

FUEL PUMP TEST (DIESEL) (See Figure 10L-1)

1. Disconnect the NEG (ñ) battery cable.
2. Disconnect RED fuel pump wire at the inlet connector.
3. Connect the NEG (ñ) 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 (ñ) 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.

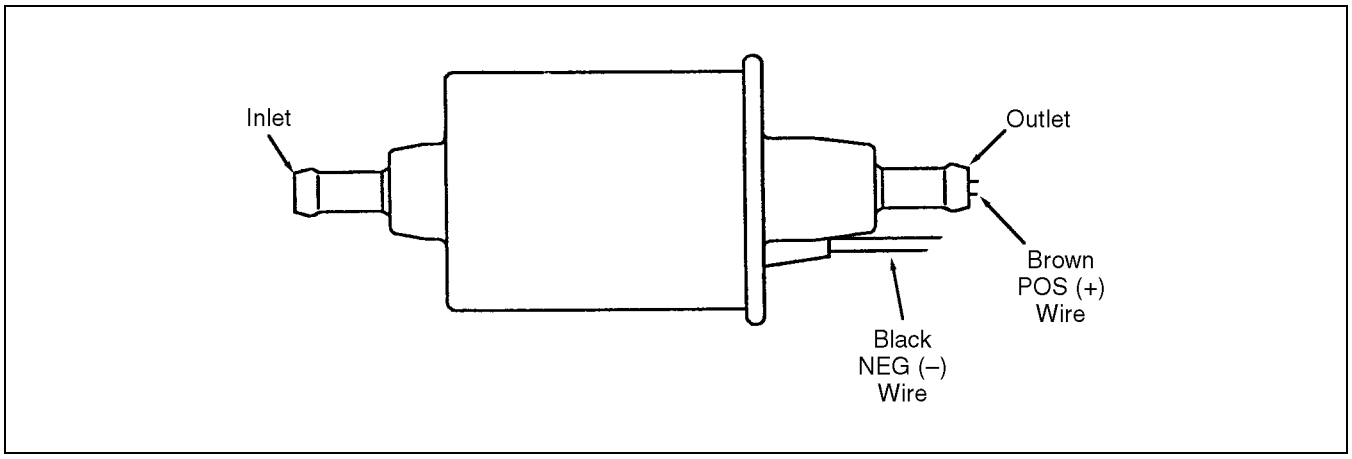


Figure 10L-1. Fuel Pump

SECTION 10M. GLOW PLUGS (DIESEL)

GLOW PLUG TEST (DIESEL ONLY) (See Figure 10M-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.

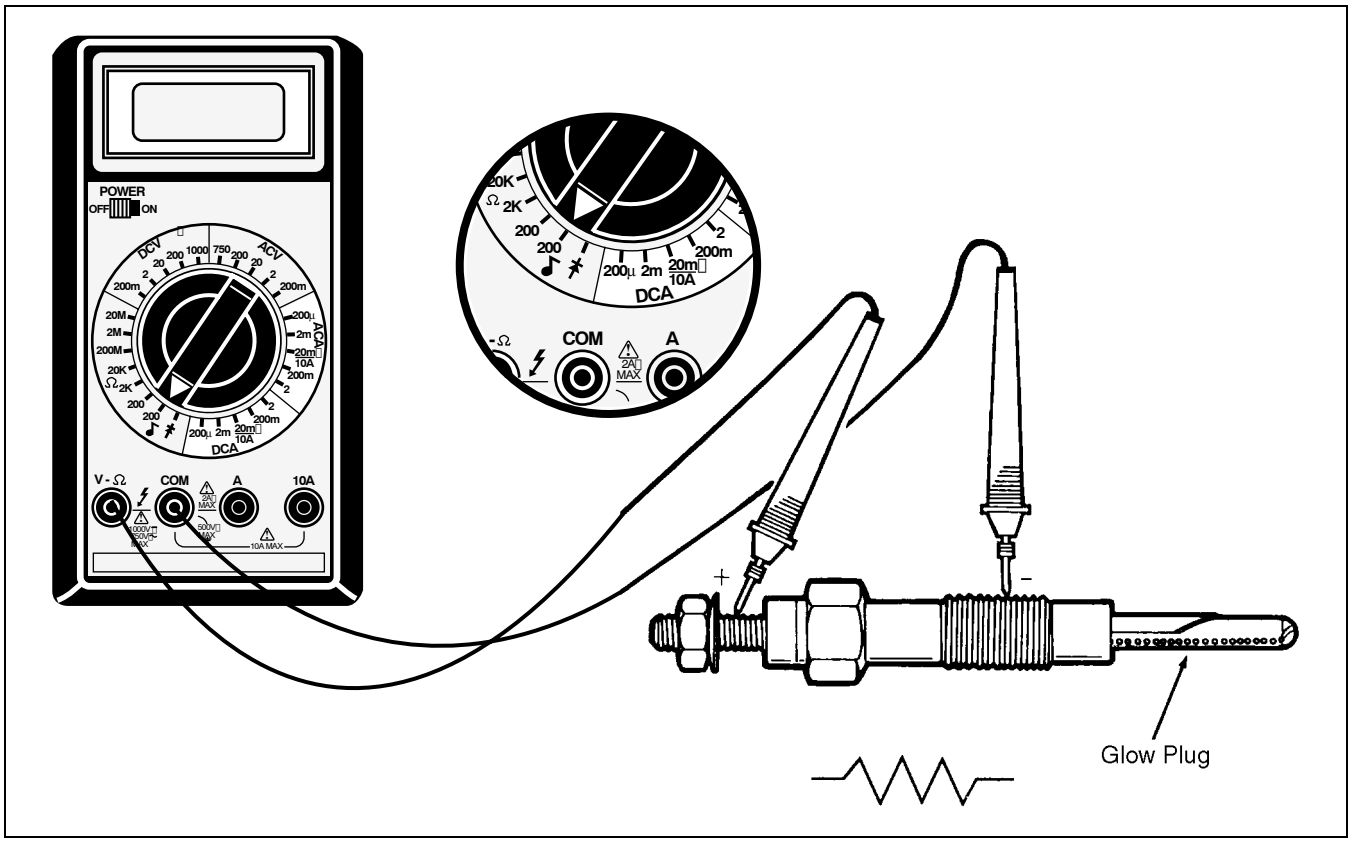


Figure 10M-1. Glow Plug Test

10M

SECTION 10N. DIAGNOSTIC JUMPER

GENERAL (See Figure 10N-1)

The electrical system is equipped with a plug-in connector which, when used with a diagnostic jumper accessory (P/N 2700912) will perform diagnostic checks on various electrical circuits and components.

The jumper and plug-in connector are located under the front cowl beneath the brake fluid reservoir. The diagnostic code LED is located in the lower left corner of the gauge panel. This LED is also the brake fluid level warning light.

DIAGNOSTIC CHECKS (See Figure 10N-1)

1. Place gear selector in **P**, apply the parking brake and turn the ignition switch to the OFF position.
2. Open the front cowl and connect the diagnostic jumper to the plug-in connector.
3. Turn the ignition switch ON and watch the diagnostic code LED. The light will flash a code number to let you know that everything is normal (Code 12) or which circuit or component needs further testing or repair. This light will flash once to correspond to the first digit of the code, then flash again for the second digit.

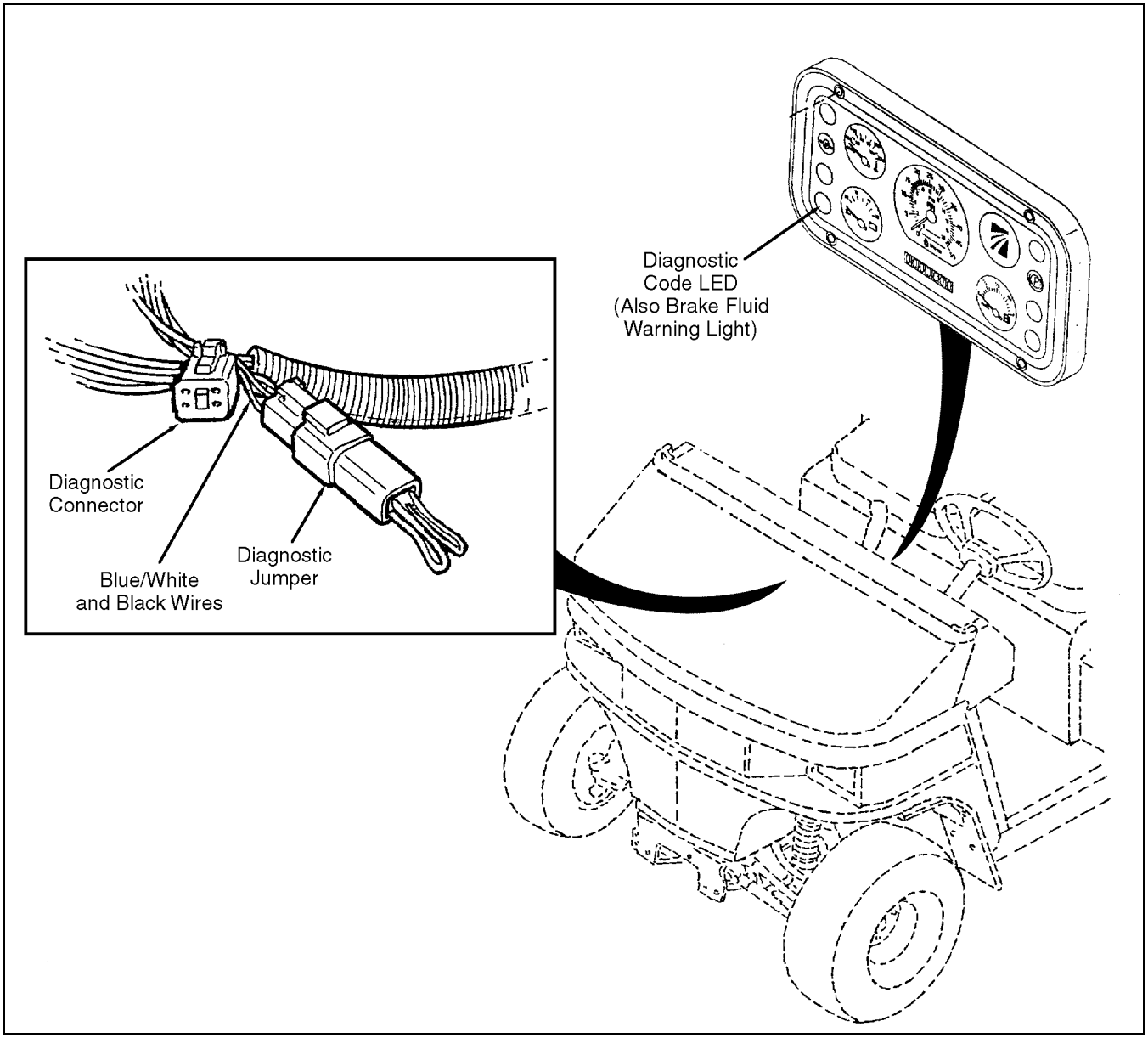


Figure 10N-1. Diagnostic Jumper

For example:

- A Code 14 would turn the light on for 0.3 seconds then off for one second (long pause), then on-off, on-off, on-off, on-off (the last four flashes will be short quick flashes).
- If a Code 43 were present the light would ó flash then pause,Ö flash then pause,Ö flash then pause,Ö flash then pause, then flash, flash, flash (four long pauses followed by three quick flashes).
- The code will continue to repeat itself until the ignition switch is turned off.

NOTE

If there are multiple faults, each code will be displayed three times starting with the lowest numbered code.

4. Turn the ignition switch OFF, then back ON each time you want to take a reading.

CODES

The following list shows the code numbers which correspond to particular components and lists possible causes for each fault.

DIAGNOSTIC CODES

11¸ Pressure Sensor ó Voltage at pin 25 (green/yellow wire) of the 34 pin engine control unit 9ECU connector is either higher than 4.5V or lower than 0.19V.

12¸ Normal ó System operating normally.

13¸ Throttle Sensor ó Voltage at pin 33 (gray/yellow wire) of the 34 pin ECU connector is either higher than 4.73V or lower than 0.25V.

14¸ O2 Sensor ó No signal for a length of time at pin 24 of the 34 pin ECU connector.

15¸ Crank Angle Sensor ó While in starting mode, no signal is seen at pin 16 (brown/red wire) of the 34 pin ECU connector.

16¸ Vehicle Speed Sensor ó No signal for a length of time at pin 16 (orange wire) of the 26 pin ECU connector.

19¸ Water Temperature Sensor ó Voltage at pin 32 (green/white wire) of the 34 pin ECU connector is either higher than 4.85V or lower than 0.15V.

41¸ Shift Solenoid No. 1 ó Open or short circuit at pin 27 (blue/black wire) of the 34 pin ECU connector, should be ìonî if gear selector is in ìLî (ìonî meaning there should be 12 volts going through this wire).

42¸ Shift Solenoid No. 2 ó Open or short circuit at pin 28 (blue/white wire) of the 34 pin ECU connector, should be ìonî if gear selector is in ìLî or ì2î (ìonî meaning there should be 12 volts going through this wire).

43¸ Shift Solenoid No. 3 ó Open or short circuit at pin 29 (blue/red wire) of the 34 pin ECU connector.

46¸ Shift Switch ó No signal at pin 18 (green/pink wire) of the 26 pin ECU connector, **and** no signal at pin 19 (orange/blue wire) of the 26 pin ECU connector, **and** no signal at pin 20 (orange/green wire) of the 26 pin ECU connector, **and** no signal at pin 24 (green/blue wire) of the 26 pin ECU connector, **and** no signal at pin 25 (green wire) of the 26 pin ECU connector, **and** no signal at pin 26 (red wire) of the 26 pin ECU connector.

OR

Signal present at more than one of pins 18, 19, 20, 24, 25 and 26 of the 26 pin ECU connector.

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATIONS

COMPONENT LOCATION

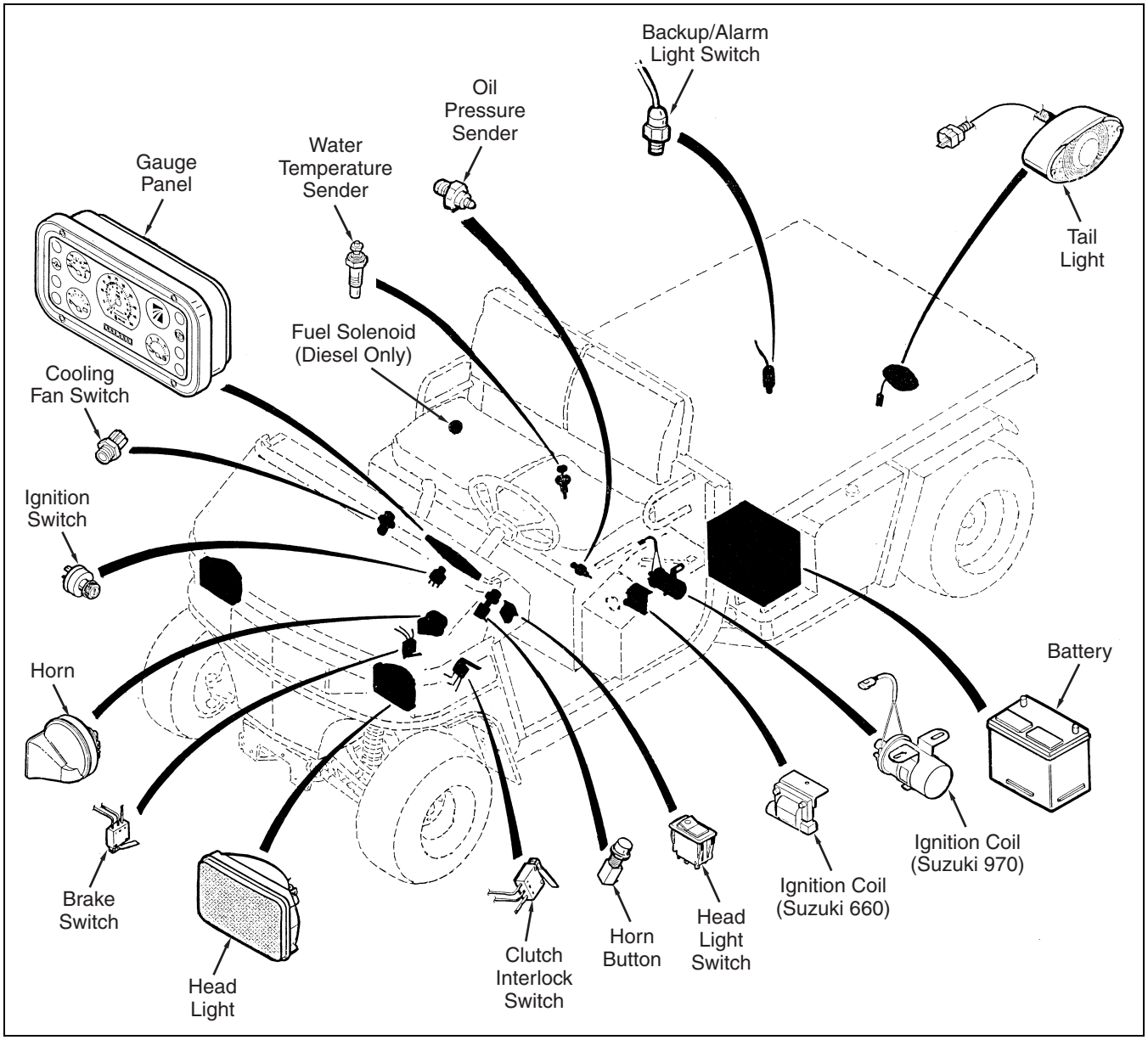


Figure 10O-1. Electrical Component Locations

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATIONS

ELECTRICAL GRAPHIC SYMBOLS

These are electrical graphic symbols commonly used in Textron Turf Care and Specialty Products diagrams and schematics.

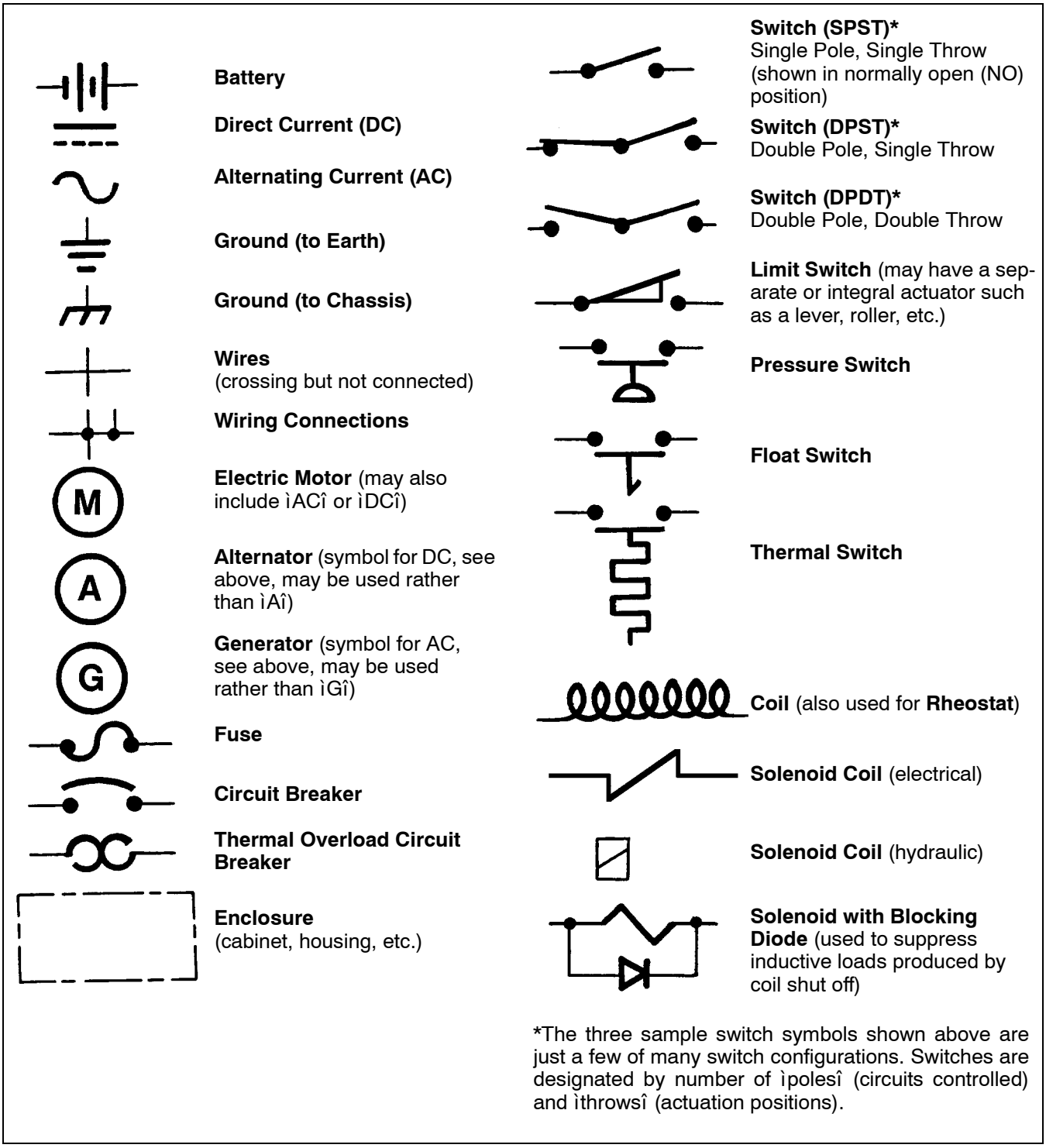


Figure 10O-2. Electrical Schematic Symbols (1 of 2)

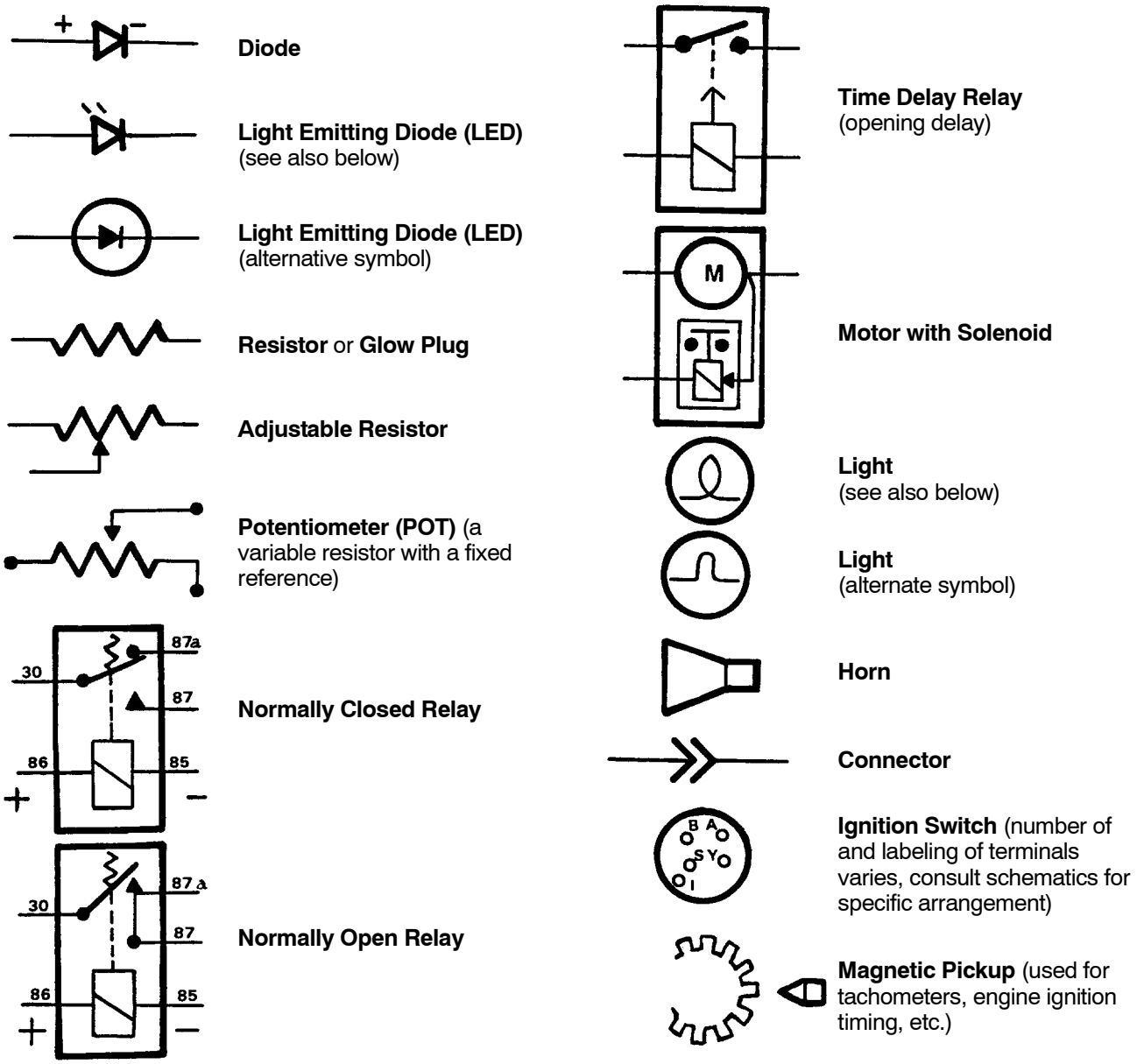


Figure 10O-3. Electrical Schematic Symbols (2 of 2)

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATIONS

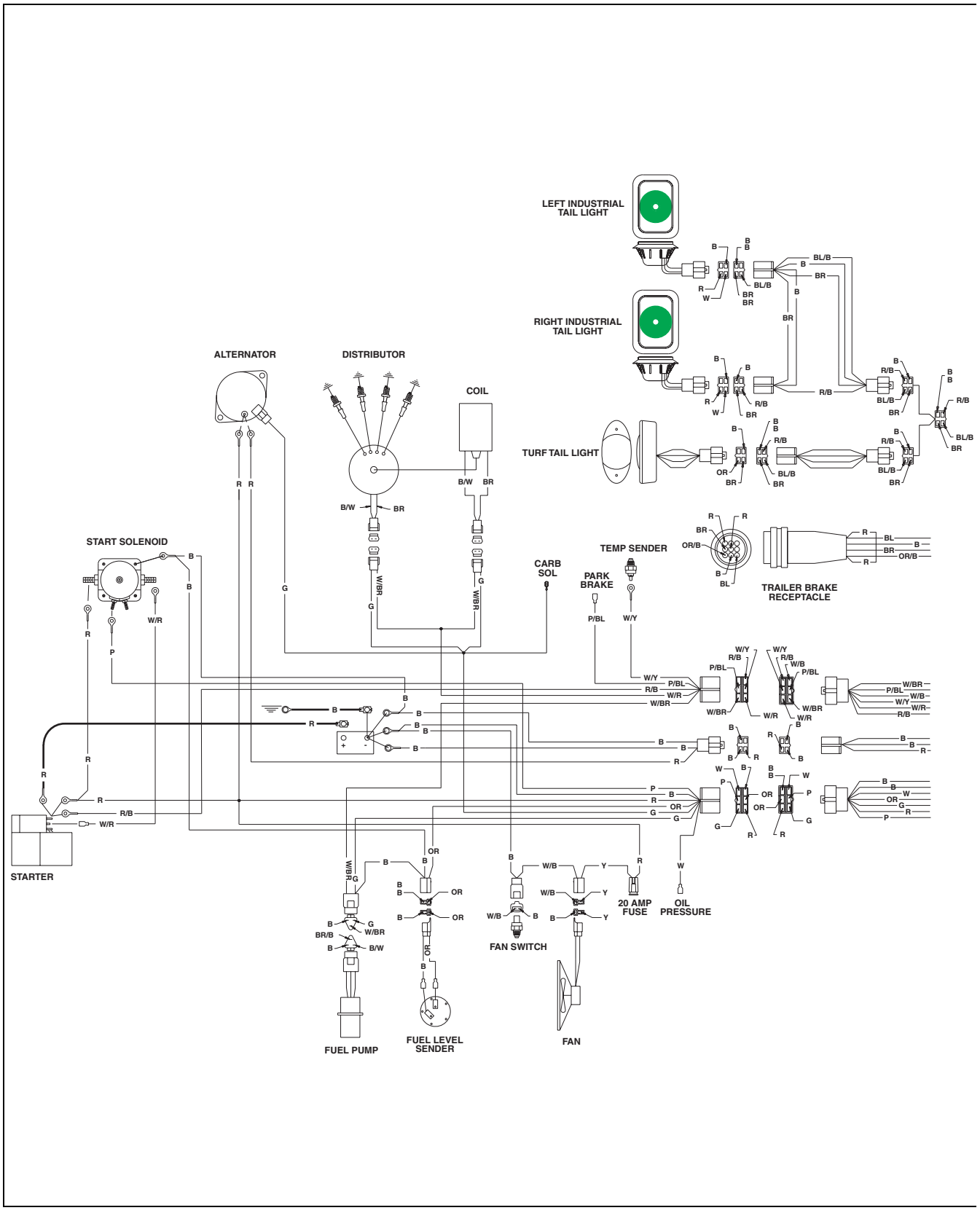


Figure 10O-1. Gasoline Engine Electrical Diagram (1 of 2)

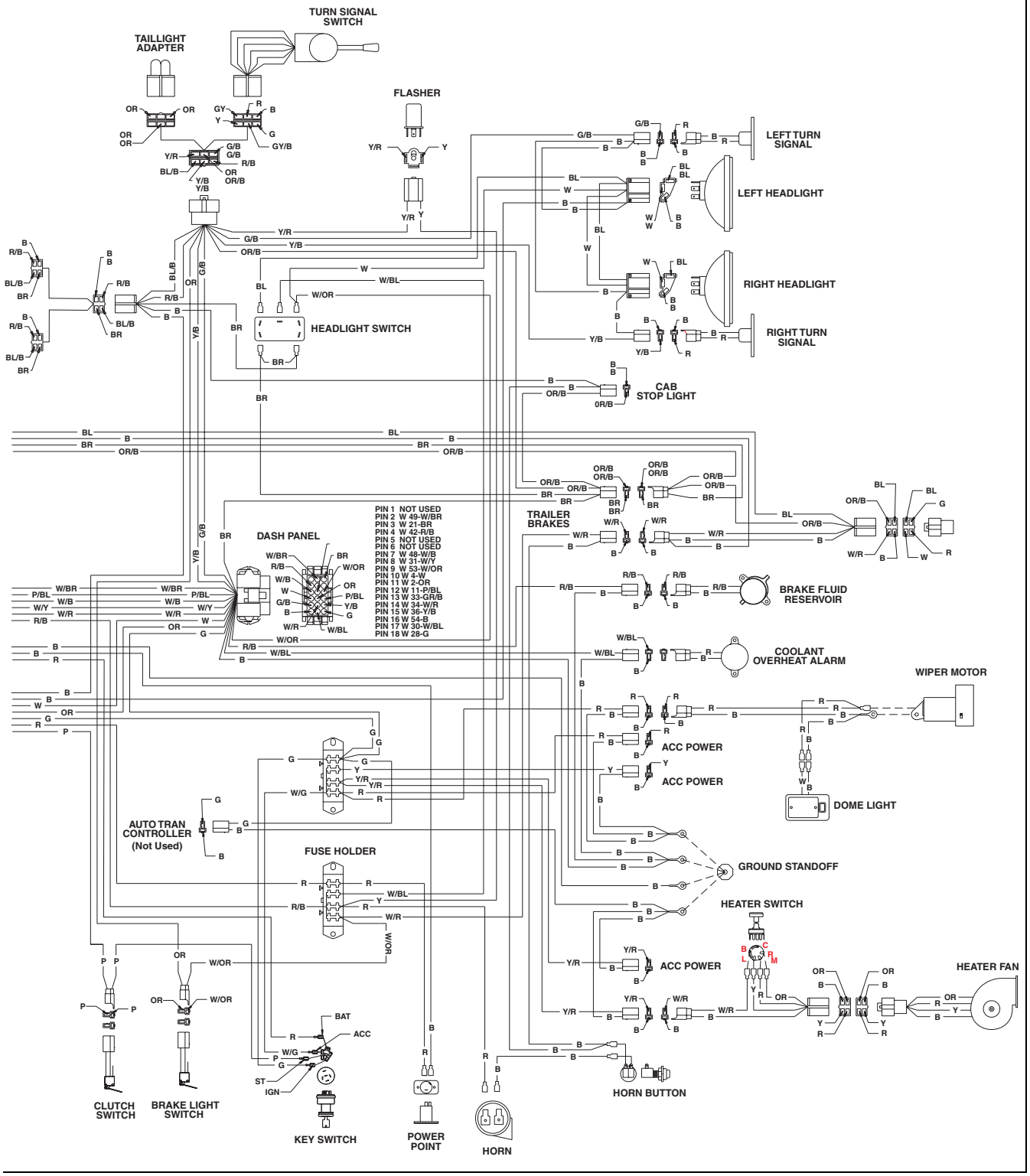


Figure 10O-2. Gasoline Engine Electrical Diagram (2 of 2)

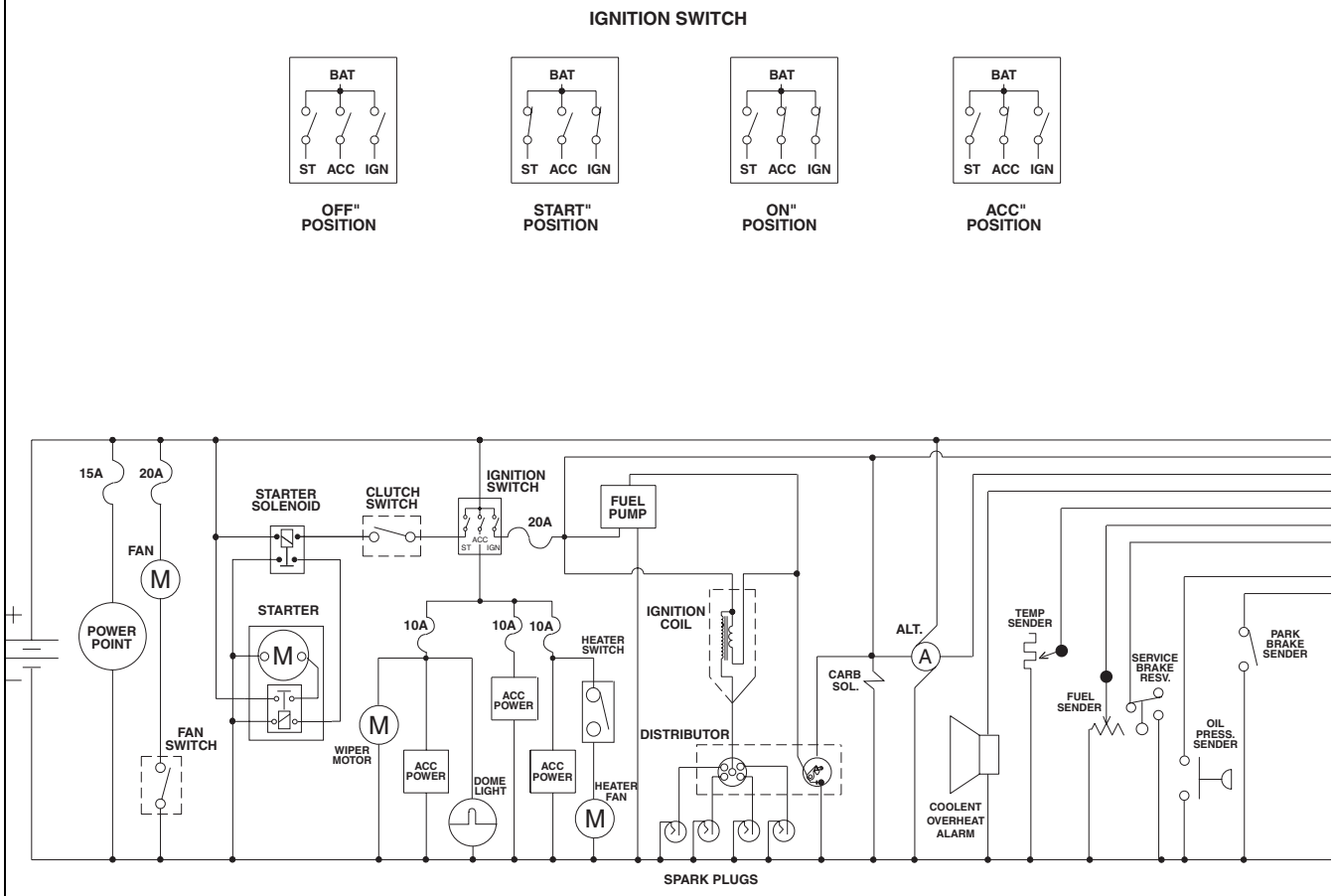


Figure 10O-3. Gasoline Engine Electrical Schematic (1 of 2)

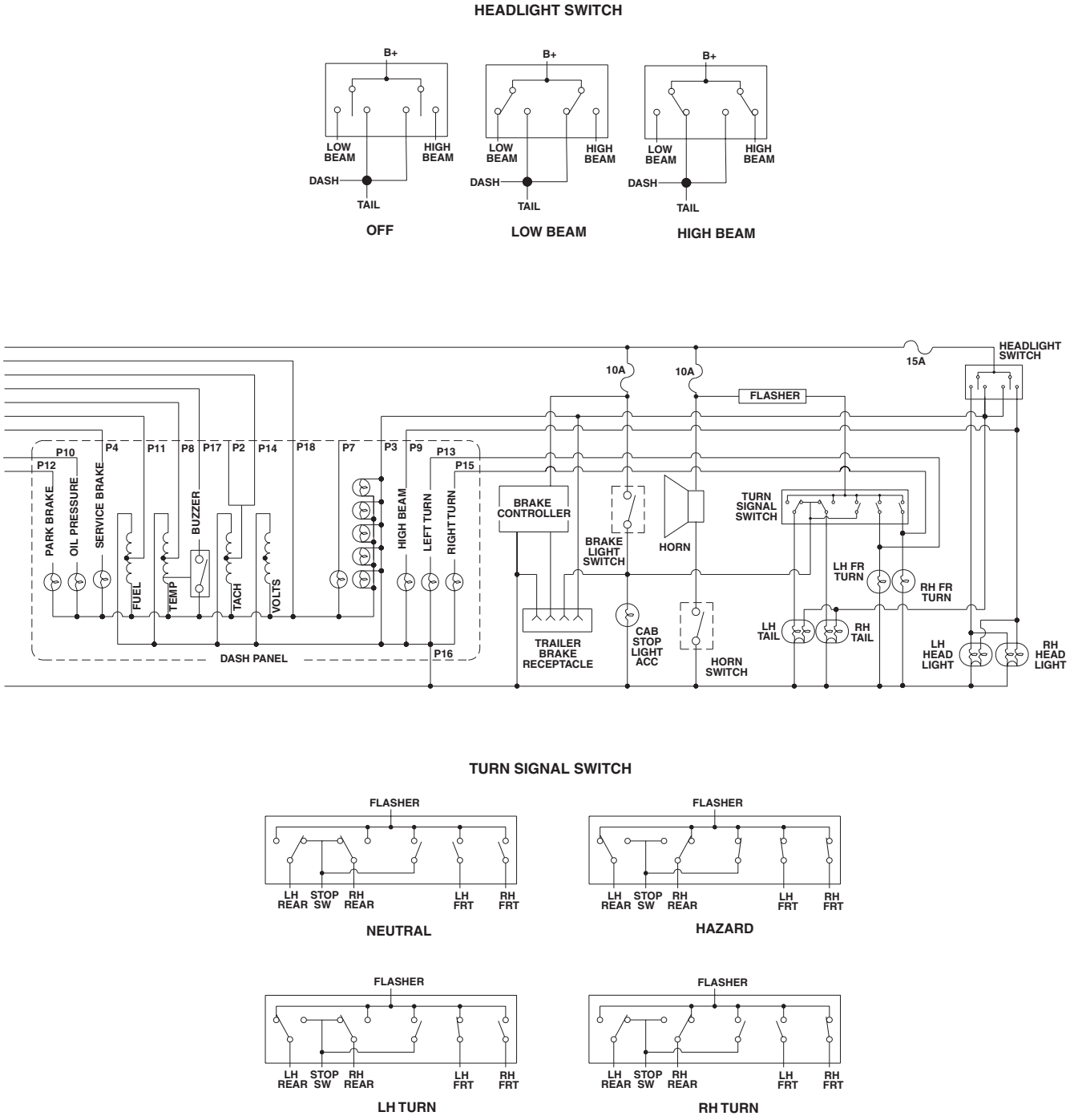


Figure 10O-4. Gasoline Engine Electrical Schematic (2 of 2)

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATIONS

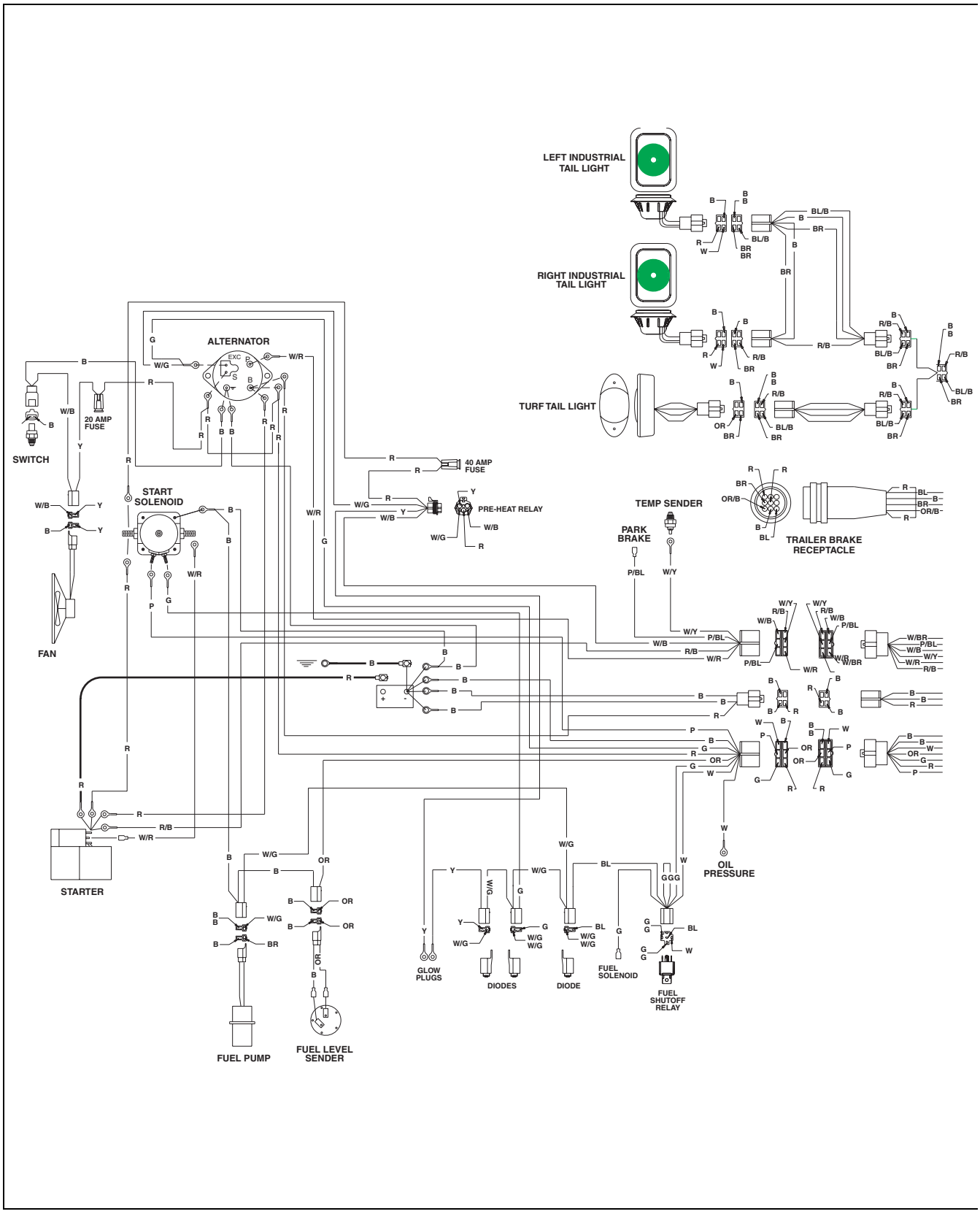


Figure 10O-5. Diesel Engine Electrical Diagram (1 of 2)

SECTION 10O. WIRING DIAGRAMS AND COMPONENT LOCATIONS

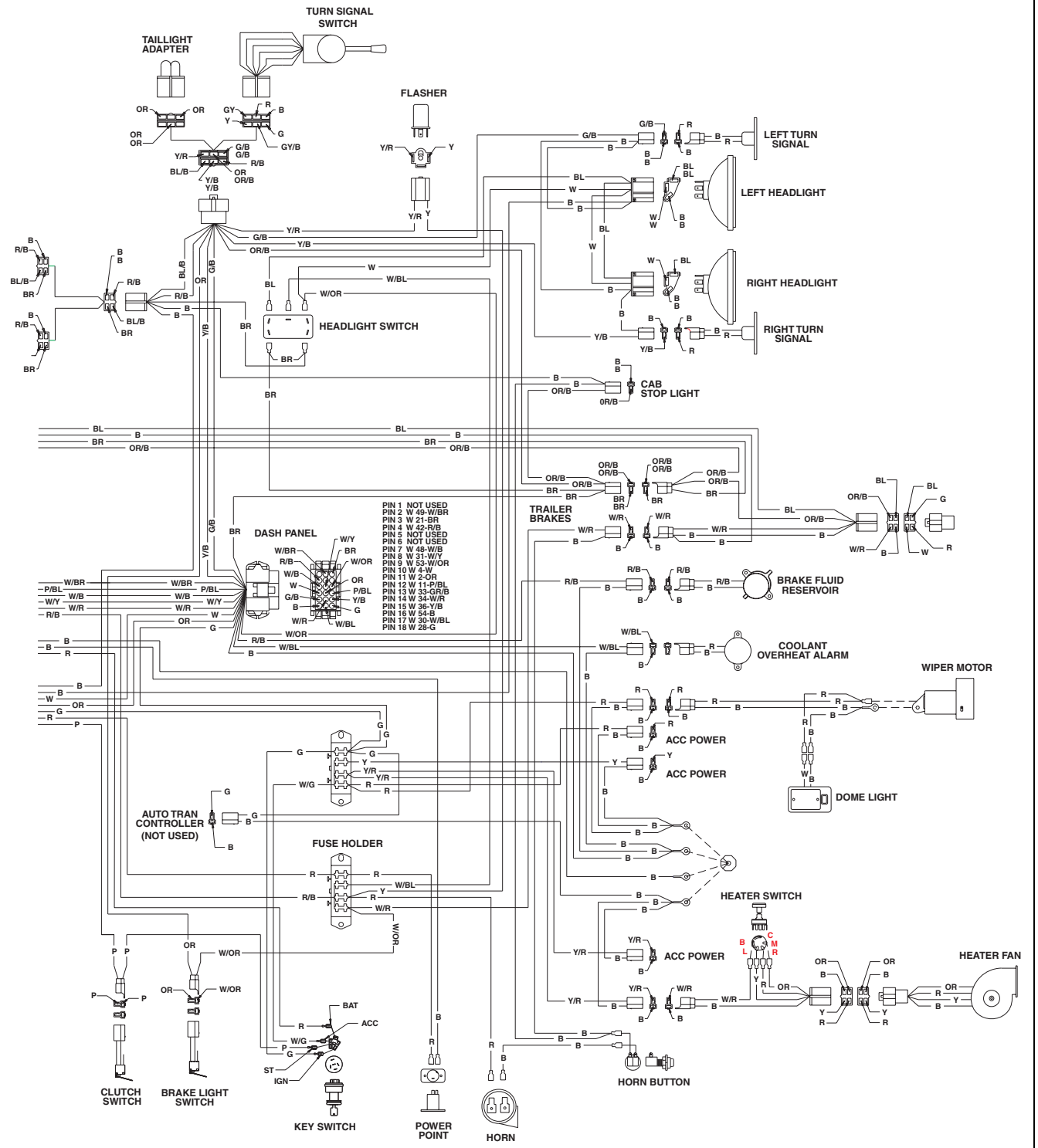


Figure 10O-6. Diesel Engine Electrical Digram (2 of 2)

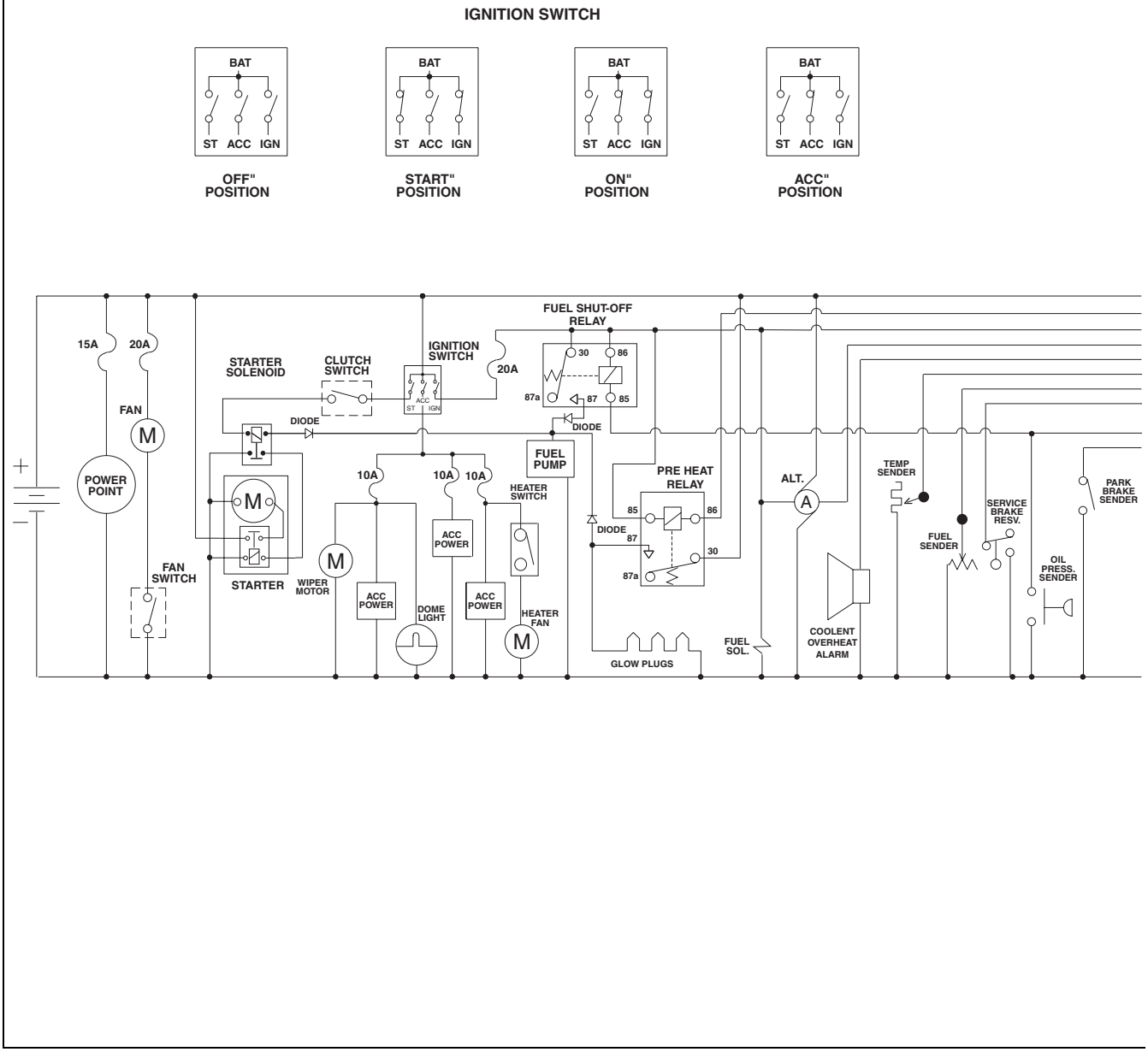


Figure 10O-7. Diesel Engine Electrical Schematic (1 of 2)

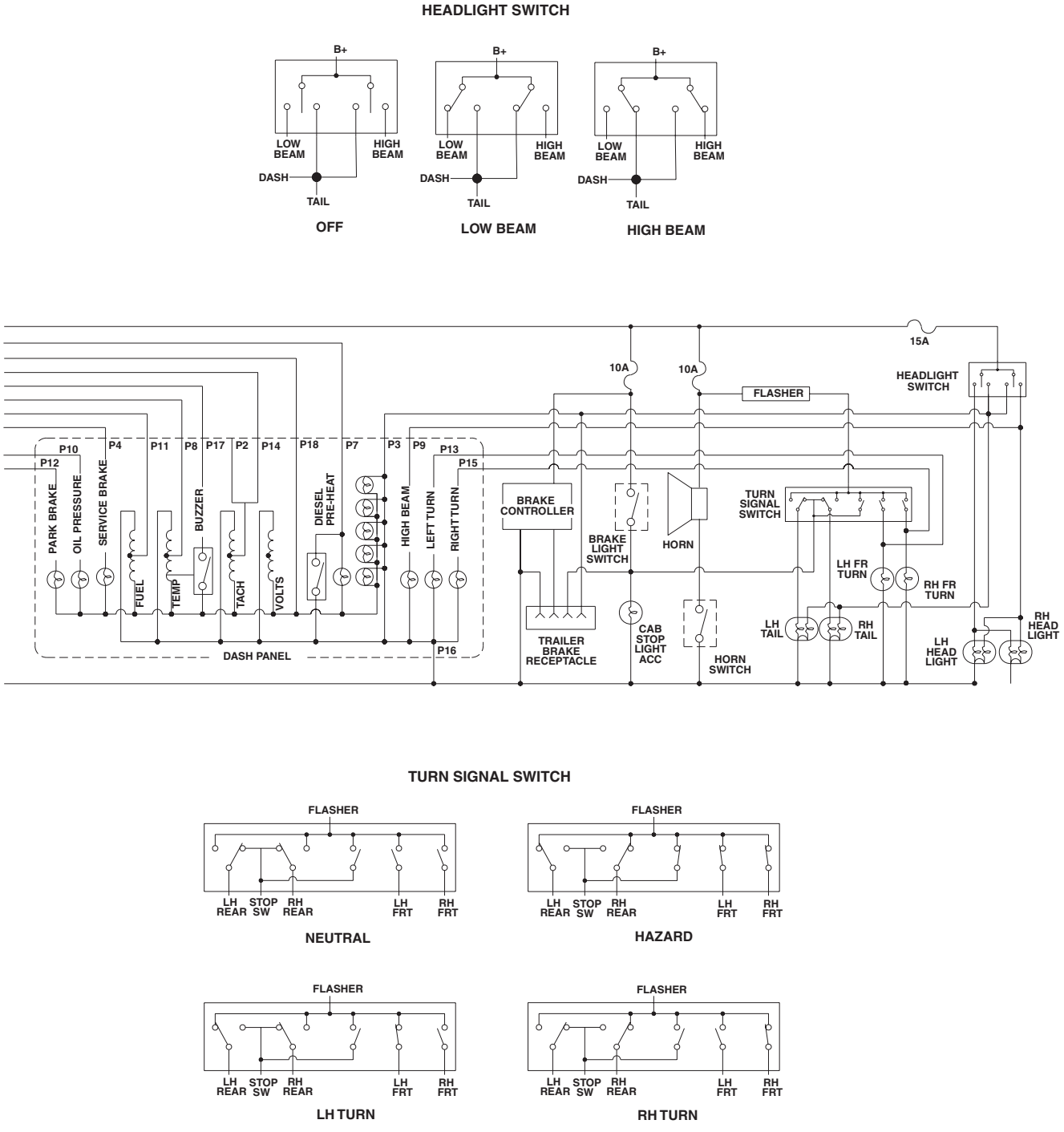


Figure 10O-8. Diesel Engine Electrical Schematic (2 of 2)

SECTION 11
PREVENTIVE MAINTENANCE

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 manufacturerís 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.

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)

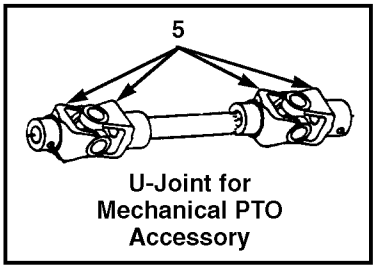
1a Differential Drive Shaft
2a Upper Ball Joints
3a Lower Ball Joints
4a Tie Rods
5a Mechanical PTO (accessory drive shaft)

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.



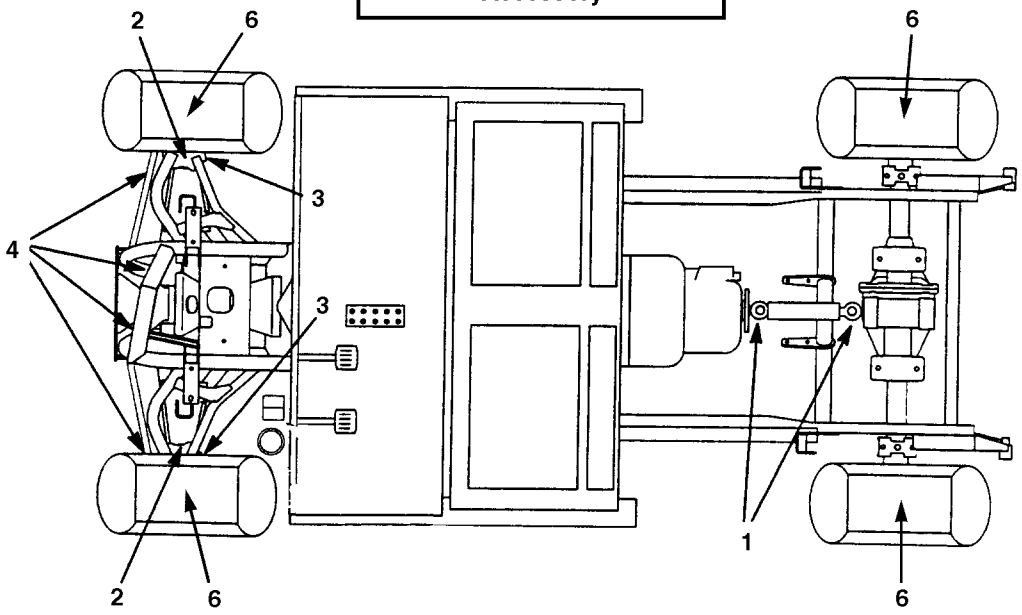
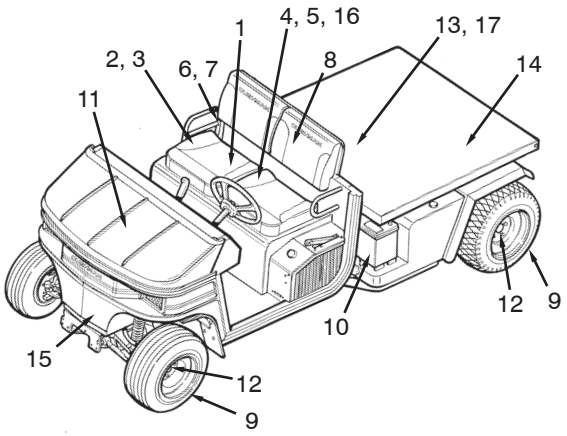


Figure 11B-1. Lubrication Schedule

11B

SECTION 11B. LUBRICATION AND MAINTENANCE SCHEDULES

MAINTENANCE SCHEDULE (See Figure 11B-2)



Note: Same for 3-wheel

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 ìaddî and ìfullî mark on the dipstick (with engine cool or warn, not hot). Use SAE 10W-30. Capacities are:

ï 3-cylinder gasoline (Suzuki 660) engine ó 3.3 qts. (3.1 L).

ï 4-cylinder gasoline (Suzuki 970) engine and Perkins diesel engine ó 3.7 qts. (3.5 L).

c Fill with SAE 20W engine oil. Governor capacity is 4.5 oz (44 ml).

d 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.

e Transmission capacity is 1.35 qts. (1.28 L) for vehicles with 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.

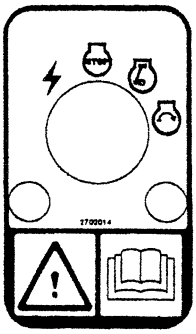
Ref	Description	Every Day (8 to 10 Hours)	Every 2 Months (75 Hours)	Every 3 Months (100 Hours)	Every 6 Months (200 Hours)	Annually (600 Hours)	Remarks
1	Air Cleaner Element				X		Replace.
2	Radiator Screen	X					Check, clean.
2	**a** Cooling System	X					Check coolant level, replenish.
2	**a** Coolant					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** Fuel Level	X					Check, replenish.
7	Fuel Filter					X	Change.
7	Fuel Hoses and Clamps					X	Check, replace as necessary.
8	Muffler/Exhaust				X		Inspect/replace if necessary.
9	Tires	X					Check pressure. If necessary, fill fronts to 20 psi (138 kPa) and rears to 15 psi (110 kPa).
10	Battery					X	Clean cables and terminals.
11	Brake Fluid			X			Check/replenish with DOT 3 brake fluid.
12	Brake Linings					X	Check, replace if necessary.
12	Brake Adjustment			X		X	Check/adjust as required.
13	**e** Transmission Fluid			X		X	Check level and replenish every 100 hours. Drain and change annually.
14	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.
15	Steering Fluid			X			Change fluid after first 35 hours of operation. Check and fill with General Motors fluid (G.M. Part No. 1050017).
16	Spark Plugs (Gasoline Engines)					X	Check/clean and gap if required.
16	Glow Plugs (Diesel Engines)					X	Test/replace if required.
16	Injection Pump (Diesel Only)					X	Test/adjust timing if required.
17	Clutch				X		Check/adjust if required.

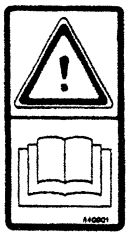
Figure 11B-2. Maintenance Schedule

SECTION 12
MISCELLANEOUS

SECTION 12A. PRECAUTION DECAL LOCATIONS

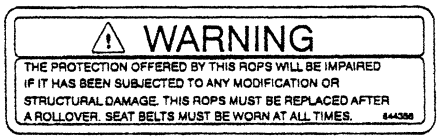
PRECAUTION DECAL LOCATIONS





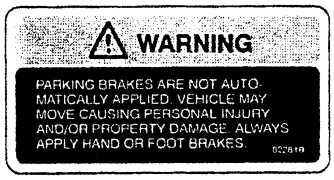
Operatorís Manual/Key Switch

This decal instructs the operator to read and understand the Operatorís Manual before operating this vehicle and also shows the ignition key positions (some vehicles may have the Operatorís Manual decal shown on the right).



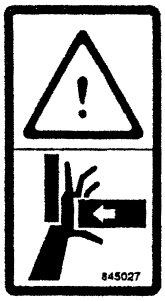
ROPS & Seat Belt Warning

These decals are found on the upper ROPS frame. They inform the operator to wear seat belts at all times when operating a ROPS equipped vehicle. It also informs the operator a ROPS structure is suitable for this vehicle application.



Park Brake Warning

This decal warns the operator that the park brake ***is not*** automatically applied.

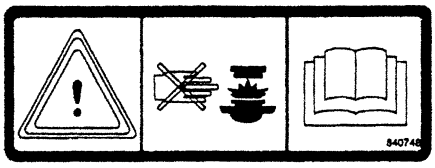


Pinch Point Warning

This decal is used with the tailgate & box sides. It warns of areas which are capable of pinching the fingers or other body parts.

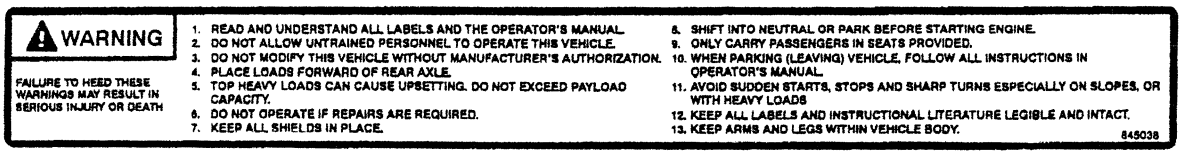
Electric Cooling Fan Warning

This decal warns the operator that the cooling fan may start at any time even with the ignition key in the OFF position.



Radiator Coolant Warning

This decal warns the operator not to remove the radiator cap when the engine is hot. Refer to the Cooling System Section in this manual for proper safety and operating instructions.



Vehicle Operation

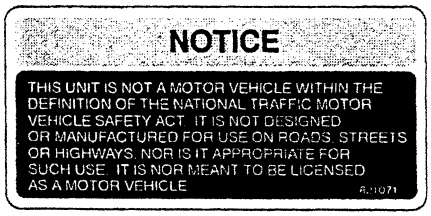
This decal informs the operator of proper procedures for safely operating the vehicle. Read and understand this manual completely to become aware of other safety issues and operating procedures which will help you operate this vehicle in a safe and responsible manner.

Figure 12A-1. Precaution Decals ó Vehicle Location

SECTION 12A. PRECAUTION DECAL LOCATIONS

Engine Oil Pressure Light

This light will come on when the ignition key is turned to the ON position and when the engine is started (it will shut off once the engine is running). Its main function is to warn the operator if the oil pressure gets too low. If this light comes on during normal vehicle operation, stop the vehicle and check for problems.

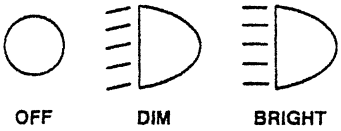


Motor Vehicle Compliance

This decal lets the operator know that the vehicle is not defined as a motor vehicle and therefore should not be driven on streets, roads or highways.

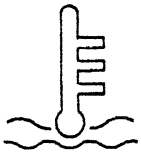
Park Brake Indicator Light

This light will come on when the park brake is applied.



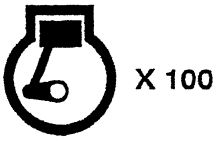
Headlight Switch Positions

These symbols appear on the light switch. As indicated, each one represents the headlightís



Water Temperature Gauge

This symbol appears on the water temperature gauge. This gauge warns the operator if the coolant system is overheating.

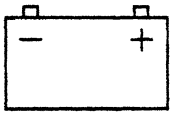


Engine RPM

This symbol appears on the tachometer. It indicates engine RPMís.

Fuel Level Indicator

This symbol appears on the fuel gauge. The fuel gauge indicates the amount of fuel in the fuel tank.



Battery (Voltmeter) Charging

This symbol appears on the voltmeter gauge. This gauge indicates the charging of the battery.

Figure 12A-2. Precaution Decals ó Detailed Views

SECTION 12B. 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	0.09078
	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	1.52144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	Subtract 32∞AND Multiply by 5/9

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A Textron Company

Cushman Products
P.O. Box 388 Augusta, Georgia 30903-0388 USA
Inside USA Phone: 1-800-241-5855, FAX: 1-800-448-8124
Outside USA Phone: 010-1-706-798-4311, FAX: 010-1-706-771-4609