

**2001-2002
MAINTENANCE
SERVICE**



**TURF 272 AND CARRYALL 272
GASOLINE VEHICLES**

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FOREWORD

Club Car vehicles are designed and built to provide the ultimate in performance efficiency; however, proper maintenance and repair are essential for achieving maximum service life and continued safe and reliable operation.

This manual provides detailed information for the maintenance and repair of the Turf/Carryall 272 vehicle, and should be thoroughly reviewed prior to servicing the vehicle. The procedures provided must be properly implemented, and the DANGER, WARNING, and CAUTION statements must be heeded.

This manual was written for the trained technician who already possesses knowledge and skills in electrical and mechanical repair. *If the technician does not have such knowledge and skills, attempted service or repairs to the vehicle may render the vehicle unsafe.* For this reason, Club Car advises that all repairs and/or service be performed by an authorized Club Car distributor/dealer representative or by a Club Car factory-trained technician.

It is the policy of Club Car, Inc. to assist its distributors and dealers in continually updating their service knowledge and facilities so they can provide prompt and efficient service for vehicle owners. Regional technical representatives, vehicle service seminars, periodic service bulletins, maintenance and service manuals, and other service publications also represent Club Car's continuing commitment to customer support.

This manual covers all aspects of typical vehicle service; unique situations, however, do sometimes occur when servicing a vehicle. If it appears that a service question is not answered in this manual, you may write to us at: Club Car, Inc.; P.O. Box 204658; Augusta, GA 30917; Attention: Technical Services, or contact a Club Car Technical Service Representative at (706) 863-3000, ext. 3580.

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WARNING

- **Read Section 1 – Safety before attempting any service on this vehicle.**
- **Before servicing vehicle, read complete section(s) and any referenced information that may be relevant to the service or repair to be performed.**

NOTE: *This manual represents the most current information at the time of publication. Club Car, Inc., is continually working to further improve our vehicles and other products. These improvements may affect servicing procedures. Any modification and/or significant change in specifications or procedures will be forwarded to all Club Car dealers and will, when applicable, appear in future editions of this manual.*

Club Car, Inc., reserves the right to change specifications and designs at any time without notice and without the obligation of making changes to units previously sold.

There are no warranties expressed or implied in this manual. See the limited warranty found in the vehicle owner's manual or write to Club Car, Inc., P.O. Box 204658, Augusta, GA 30917-4658 USA, Attention: Warranty Department.

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SECTION ib – INDEX FOR FE350 PEDAL-START VEHICLES

SECTION 1 – SAFETY

To ensure the safety of those servicing Club Car vehicles, and to protect the vehicles from damage resulting from improper service or maintenance, the procedures in this manual must be followed. It is important to note that throughout this manual there are statements contained within headings labeled DANGER, WARNING, CAUTION, or NOTE. These special statements relate to specific safety issues, and must be read, understood, and heeded before proceeding.

▲ DANGER

- A DANGER indicates an immediate hazard that will result in severe personal injury or death.

▲ WARNING

- A WARNING indicates an immediate hazard that could result in severe personal injury or death.

▲ CAUTION

- A CAUTION indicates a hazard or unsafe practice that could result in product or property damage or minor personal injury.

GENERAL WARNING

The following safety statements must be heeded whenever the vehicle is being operated, repaired, or serviced. Service technicians should become familiar with these general statements, which can be found throughout this manual. Also, other specific safety statements appear throughout this manual and on the vehicle.

▲ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - External: Flush with water. Call a physician immediately.
 - Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.
 - Eyes: Flush with water for 15 minutes. Call a physician immediately.
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

▲ WARNING

- Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.
- Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.

WARNING CONTINUED ON NEXT PAGE...

 WARNING

- Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.
- To avoid unintentionally starting the vehicle:
 - Disconnect battery cables, negative (–) cable first (Figure 1-1, Page 1-3).
 - Disconnect the spark plug wire from the spark plug.
- Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.
- Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.
- Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.
- Moving parts! Do not attempt to service the vehicle while it is running.
- Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.
- Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.
- Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.
- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

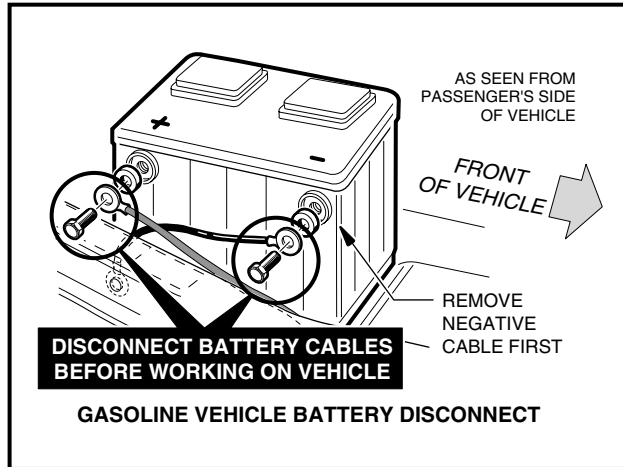


Figure 1-1 Battery

SECTION 2 – VEHICLE SPECIFICATIONS

GENERAL INFORMATION

SPECIFICATIONS	FE350 ENGINE	FE400 ENGINE
POWER SOURCE		
Engine: 4-cycle OHV, 351 cc, 11 hp rated, single-cylinder, air-cooled, with pressure lubrication system	•	
Engine: 4-cycle OHV, 400 cc, 13 hp rated, single-cylinder, air-cooled, with pressure lubrication system		•
Fuel system: Side-draft carburetor with float bowl, fixed jets, fuel filters, and impulse fuel pump	•	•
Governor: Automatic ground-speed sensing, internally geared in unitized transaxle	•	•
Ignition: Transistor electronic ignition with electronic RPM limiter	•	•
Unitized transaxle, MC012C-AS00: Fully synchronized forward and reverse with neutral (14.9:1 forward, 20.5:1 reverse) and differential lock feature	•	•
Unitized transaxle, MC010C-BS00: Fully synchronized forward and reverse with neutral (15.1:1 forward, 20.6:1 reverse) and differential lock feature	•	
Electrical system: 12 volt, 500 cca at 0 °F (-17.8 °C), 650 at 32 °F (0 °C). 105-minute reserve capacity and 35-amp charging capacity	•	•
Torque converter: Automatic, variable-speed, dry type	•	•
STEERING/SUSPENSION/BRAKES		
Steering: Self-adjusting rack and pinion, Ackerman	•	•
Suspension: Front: Independent A-arms with coil-over shocks Rear: Semi-independent suspension with multi-leaf springs and dual hydraulic shocks	•	•
Brakes: Hydraulic brake system – self-adjusting drum brakes on each wheel with separate hand-operated park brake	•	•
BODY/CHASSIS		
Frame/Chassis: Twin I-Beam welded aluminum	•	•
Side and rear body: All aluminum with aluminum box bed	•	•
Front body: ABS/DR acrylic cap	•	•
Tires: 23 x 10.50 - 12 tubeless, 4 ply rated load range, front and rear	•	•
DIMENSIONS/WEIGHT		
Overall length (with box bed)	120 in. (305 cm)	
Overall width	54 in. (137 cm)	
Overall height (at steering wheel)	51 in. (130 cm)	
Overall height (at light bar)	75.3 in. (191 cm)	
Wheelbase	80 in. (203 cm)	
Ground clearance: (under differential) (under foot platform)	6.6 in (17 cm) 11.4 in (29 cm)	
Front wheel tread	43 in. (109 cm)	
Rear wheel tread, MC012C-AS00 transaxle	44.5 in. (113 cm)	44.5 in. (113 cm)
Rear wheel tread, MC010C-BS00 transaxle	43.5 in. (111 cm)	
Specifications continued on next page...		

SPECIFICATIONS	FE350 ENGINE	FE400 ENGINE
Weight (dry): (with all-terrain tread) (with turf tread)	1100 lb. (499.0 kg) 1060 lb. (480.8 kg)	1106 lb. (501.7 kg) 1066 lb. (477.2 kg)
Forward speed	17-19 mph (27-31 km/h)	
Governed RPM	3800 (±30) RPM	3850 (±30) RPM
Curb clearance circle (diameter)	24 ft. 1 in. (734 cm)	
Turning radius (per SAE J 695)	139.6 in. (355 cm)	
Intersecting aisle clearance	112.2 in. (285 cm)	
Floorboard height	17 in. (43 cm)	
Seat height (at seat bottom)	35 in. (89 cm)	
Load bed height	31.1 in. (79 cm)	
Load bed size (box bed inside dimensions)	48.0 x 49.8 x 9.3 in. (121.9 x 126.4 x 24 cm)	
Load bed size (flat bed dimensions)	46.9 x 48.3 in. (119 x 123 cm)	
Vehicle rated capacity (level surface only)	1200 lb. (544 kg)	
Bed load capacity (level surface only)	800 lb. (363 kg)	
Standard seating capacity	2	
LIQUID CAPACITIES		
Engine crankcase without filter	32 oz. (.95 liters)	
Engine crankcase with filter	38 oz. (1.12 liters)	
Unitized transaxle, MC012C-AS00	29 oz. (.85 liters)	29 oz. (.85 liters)
Unitized transaxle, MC010C-BS00	31 oz. (.92 liters)	
Master cylinder	8 oz. (240 ml)	
Fuel tank (unleaded gasoline only)	7 gallons (26.5 liters)	
TIRE PRESSURE		
All terrain tread (standard)	Front: 7-11 psi (.48-.76 Bars) Rear: 14-18 psi (.97-1.24 Bars)	
Turf tread (optional)	Front: 12-16 psi (.83-1.10 Bars) Rear: 16-20 psi (1.10-1.38 Bars)	
Traks Max II tread (optional)	Front: 14-16 psi (.97-1.10 Bars) Rear: 18-20 psi (1.24-1.38 Bars)	

SECTION 3 – GENERAL INFORMATION

GENERAL INFORMATION

Refer to the owner's manual provided with the vehicle for information on the following topics:

- Vehicle Feature Identification
- Controls and Indicators
- Driving Instructions
- Loading and Unloading
- Towing with the Vehicle
- Transporting on a Trailer
- Accessory Equipment
- Subsequent Owner Registration
- Warranties

ENGINE AND TRANSAXLE IDENTIFICATION

Read **DANGER** and **WARNING** in Section 1 - Safety.

Throughout this manual, important vehicle information and features are highlighted. It is designed to include information on both the FE350 engine with pedal-start operation, and the FE400 engine with key-start and neutral "rev" operation. Where applicable, specific information is provided on two transaxle designs, highlighted as MC010C-BS00 and MC012C-AS00. Throughout this manual references are made to these designations.

Pedal-Start Vehicles: refers to the method used to start and run the engine. The key switch on the pedal-start vehicle serves as an ON/OFF switch, but does not engage the engine starting process. The accelerator engages the engine starting process and operation of the vehicle.

Key-Start Vehicles: refers to the method used to start the engine, and operates similarly to an automobile. The key switch on a key-start vehicle acts as both an ON/OFF switch and an engine START. Turning the key switch to START engages the engine starting process. The accelerator provides for the running of the engine and the operation of the vehicle.

The MC010C transaxle is designed with the wheel hub and axle as one integral assembly. The MC012C transaxle provides for the wheel bolt flange to be removed from the axle at a splined joint utilizing a castle nut and cotter pin for attachment. All vehicles with FE400 engines are equipped with MC012C transaxles. Vehicles with FE350 engines may have either MC010C or MC012C transaxles.

A bar code and identification label is attached to each transaxle on the left axle tube, as viewed from the rear of the vehicle. This label identifies the design of the transaxle and any model changes that may have been made to that specific model (Examples: MC010C-BS00 or MC012C-AS00). When contacting a Club Car, Inc. service department, distributor, or dealer it is important to include the specific information provided on these labels. **See General Information, Section 6a, Page 6a-2 or see General Information, Section 6b, Page 6b-2.**

We urge the technician and owner/operator to read, watch for, and understand these specific designations.

SERIAL NUMBER IDENTIFICATION

The serial number of each 272 vehicle is printed on a bar code decal mounted on the frame directly above the accelerator pedal (Example: AD0201-583947) (**Figure 3-1, Page 3-2**). There is also a second serial number decal mounted on the front body frame behind the dash panel. The dashboard must be removed to view this number. **See following NOTE.**

NOTE: Always have the vehicle serial number at hand when ordering parts or making inquiries (**Figure 3-1, Page 3-2**).



Figure 3-1

STORAGE

Read **DANGER** and **WARNING** in Section 1 – Safety.

DANGER

- Do not drain gasoline when the engine is hot or while it is running.
- Be sure to clean up any spilled gasoline before operating the vehicle.
- Store gasoline in an approved gasoline container only. Store in a well-ventilated area away from sparks, open flames, heaters or heat sources.
- Keep gasoline out of the reach of children.
- Do not siphon gasoline from the vehicle.

WARNING

- Turn key switch OFF, remove the key, and leave the Forward/Reverse handle in the NEUTRAL position during storage. This is to prevent unintentionally starting the vehicle or fire hazard.
- Do not attempt to charge a battery if it is frozen or if the case is bulged due to freezing. Discard the battery. Frozen batteries can explode.
- Turn fuel shut-off valve to closed (OFF) (**Figure 3-5, Page 3-4**).

CAUTION

- Batteries in a low state of charge will freeze at low temperatures.

Preparing The Vehicle For Extended Storage

1. Store vehicle in a cool, dry place. This will minimize battery self-discharge. If the battery appears to be weak, charge it using an automotive-type 12-volt battery charger rated at 10 amps or less.
2. Unload the vehicle so that only minimum vehicle weight will be placed on the tires.
3. Drain carburetor and seal the fuel tank.
 - 3.1. **Pedal-Start Vehicles:**
 - 3.1.1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL.
 - 3.1.2. Lift the passenger side seat and access the engine compartment.
 - 3.1.3. Place the neutral lockout cam in the SERVICE position (**Figure 3-2, Page 3-3**).
 - 3.1.4. Turn the fuel shut-off valve to the closed (OFF) position (**Figure 3-5, Page 3-4**) and run the engine until fuel remaining in the carburetor and fuel lines is depleted and the engine stalls. **See DANGER "Do not operate gasoline vehicle..." in General Warning, Section 1, Page 1-1.**
 - 3.1.5. Return the neutral lockout cam to the OPERATE position (**Figure 3-3, Page 3-3**). Proceed to step 4.

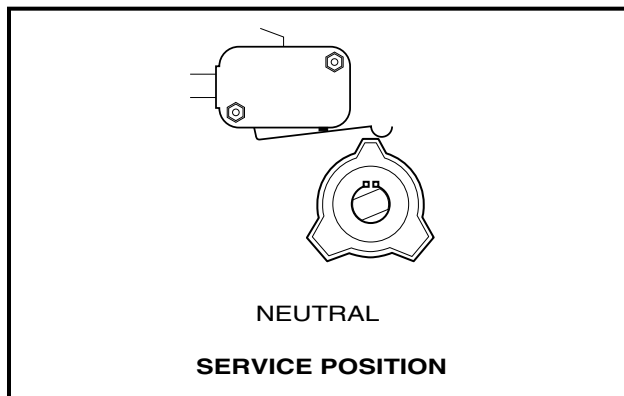


Figure 3-2 Neutral Lockout – Service Position for Pedal-Start Vehicles

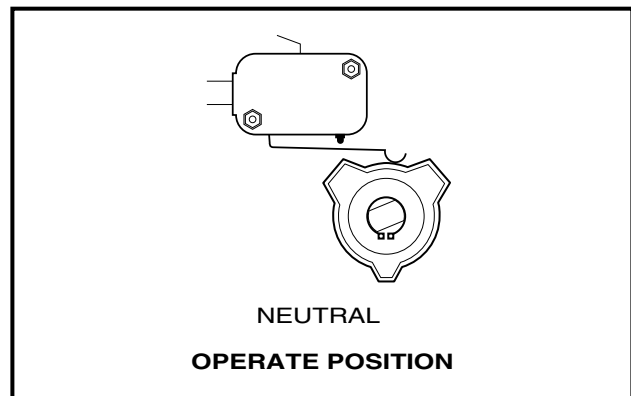


Figure 3-3 Neutral Lockout – Operate Position for Pedal-Start Vehicles

3.2. Key-Start Vehicles:

- 3.2.1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL.
- 3.2.2. Lift the passenger side seat and access the engine compartment.
- 3.2.3. Turn the fuel shut-off valve to the closed (OFF) position (**Figure 3-5, Page 3-4**) and run the engine until fuel remaining in the carburetor and fuel line is depleted and the engine stalls. **See DANGER "Do not operate gasoline vehicle..." in General Warning, Section 1, Page 1-1.**
4. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." in General Warning, Section 1, Page 1-1.**
 - 4.1. Tilt the bed and ensure that the prop rod is properly engaged.
5. Loosen, but do not remove, the carburetor drain screw and drain fuel remaining in bowl into a small, clean container, then pour the fuel from the container into vehicle fuel tank. Tighten the carburetor drain screw.
6. Fill fuel tank to about 1 inch (2.5 cm) from top of fuel tank and, following manufacturer's directions, add a commercially available fuel stabilizer (such as Sta-Bil®).
 - 6.1. Disconnect vent tube from fuel tank vent (**Figure 3-4, Page 3-4**).
 - 6.2. Plug the fuel tank vent nipple so that it is air tight. We recommend using a slip-on vinyl cap.
7. Disconnect battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**

Preparing The Vehicle For Extended Storage, Continued:

8. Batteries should be clean and free of corrosion. Wash tops and terminals of batteries with a solution of baking soda and water (1 cup) (237 mL) baking soda per (1 gallon)(3.8 L) of water. Rinse solution off batteries. Do not allow this solution to enter the batteries. Be sure terminals are tight. Let the terminals dry and then coat them with Battery Terminal Protector Spray (CCI P/N 1014305).
9. To protect the engine, remove spark plug and pour 1/2 ounce of SAE 10 weight oil into the engine through the spark plug hole. Rotate engine crankshaft by hand several times, then install spark plug and tighten to 20 ft-lb (27 N·m).
10. Adjust tires to rated capacities. **See General Information, Section 8, Page 8-2.**
11. Lubricate front suspension and do all other semiannual periodic lubrication. **See Periodic Lubrication Schedule, Section 10, Page 10-5.**
12. Thoroughly clean body, seats, cargo bed, engine compartment and underside of vehicle.
13. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." in General Warning, Section 1, Page 1-1.**
14. Do not engage the park brake. Chock the wheels to prevent the vehicle from rolling.

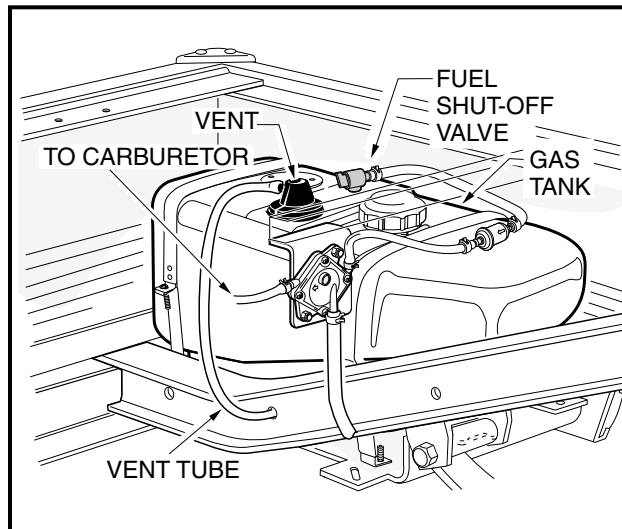


Figure 3-4 Gasoline Tank

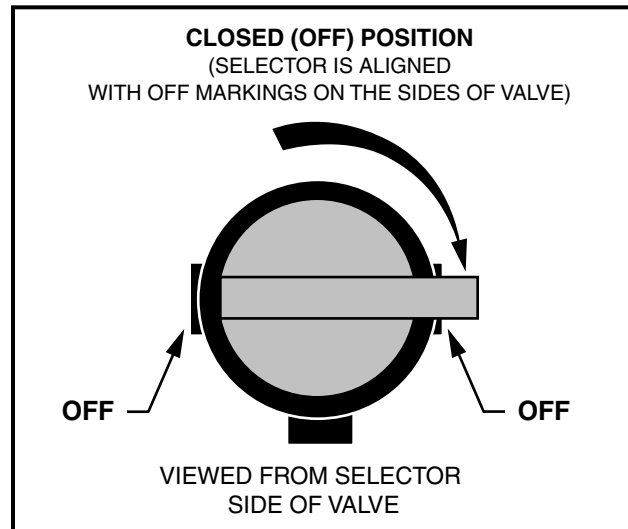


Figure 3-5 Fuel Shut-off Valve – Closed

RETURNING THE STORED VEHICLE TO SERVICE

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL.
2. Lift the passenger side seat and access the engine compartment.
3. Restore fuel system to operation.
 - 3.1. Remove plug from fuel tank vent.
 - 3.2. Connect vent tube to fuel tank vent (**Figure 3-4, Page 3-4**).
4. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." in General Warning, Section 1, Page 1-1.**
 - 4.1. Tilt the bed and ensure that the prop rod is properly engaged.
5. Connect battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

6. Completely open fuel shut-off valve (**Figure 3-6, Page 3-5**). Make sure the valve is fully open. A partially closed fuel valve (**Figure 3-7, Page 3-5**) combined with the use of the choke, can result in a fouled spark plug and engine failure.

6.1. **Pedal-Start Vehicles:**

- 6.1.1. Place the neutral lockout cam to the SERVICE position (**Figure 3-2, Page 3-3**).
- 6.1.2. Crank the engine until fuel is pumped into the carburetor and fuel lines and the engine starts. Turn the engine off.
- 6.1.3. Return the neutral lockout cam to the OPERATE position (**Figure 3-3, Page 3-3**). See following **NOTE**.

6.2. **Key-Start Vehicles:**

- 6.2.1. Make sure the Forward/Reverse handle is in NEUTRAL.
- 6.2.2. Crank the engine until fuel is pumped into the carburetor and fuel lines, and the engine starts. Turn the engine off. See following **NOTE**.

NOTE: Due to the oil added to the engine in preparation for storage, engine may smoke excessively for a short while when running it for the first time after storage.

7. Lower the cargo bed. See **WARNING "For vehicles with cargo beds..."** in **General Warning, Section 1, Page 1-1**.
8. Lower the passenger side seat.
9. Adjust tires to recommended tire pressure. See **General Information, Section 8, Page 8-2**.

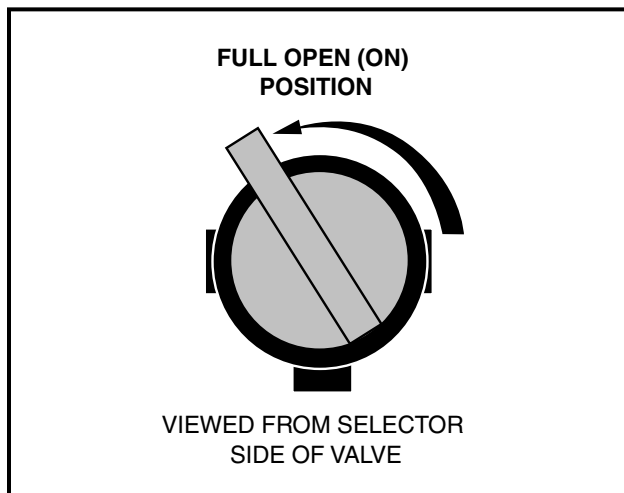


Figure 3-6 Fuel Shut-off Valve – Open

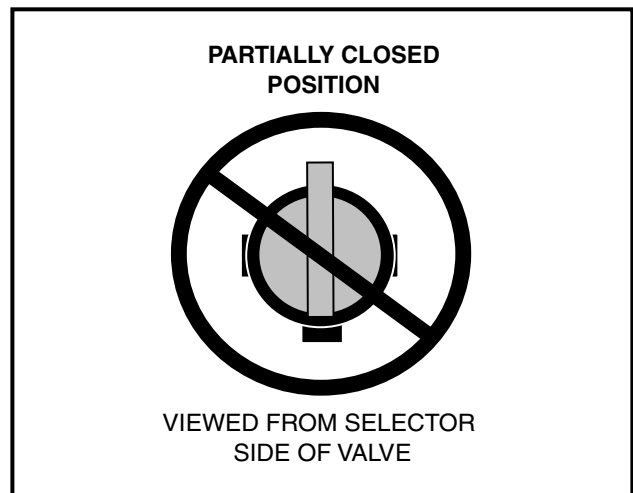


Figure 3-7 Fuel Shut-off Valve – Partially Closed Position

SECTION 4 – BODY AND TRIM

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

⚠ CAUTION

- Do not use detergents or cleaning solvents that contain ammonia, aromatic solvents, or alkali materials on body panels or seats.
- Do not allow battery acid to drip on body panels. Battery acid will cause permanent damage. Wash spilled battery acid from body panels immediately.

CLEANING THE VEHICLE

Read DANGER, WARNING, and CAUTION on page 4-1.

Each vehicle is equipped with an ABS/DR acrylic cap front body, an aluminum frame, and an all-aluminum cargo bed. Use a commercially available automotive cleaning solution with a sponge or soft cloth for normal cleaning or Vehicle Care Kit (CCI P/N AM10021). A garden hose at normal residential water pressure is adequate if needed. To remove oxidation or discoloration from aluminum, use a commercially available aluminum cleaner paste and fine grade (No. 00) steel wool.

Club Car does not recommend any type of pressure washing or steam cleaning. Such a process will expose electrical components to moisture. Moisture entering electrical components can result in water damage and subsequent component failure.

Battery acid, fertilizers, tars, asphalt, creosote, paint, or chewing gum should be removed immediately to prevent possible stains.

The front body is made with an ABS/DR acrylic cap material similar to the material used to manufacture hot tubs and shower/tub units. Cleaning and repair techniques for the front body are the same as those used on conventional acrylic sheet. Repair kits, cleaning and polishing products may be purchased at any hardware store where ABS/DR acrylic (hot tubs and shower/tub units) are sold.

The seats of the vehicle will last longer with proper cleaning. Use a solution of 10% liquid soap and warm water applied with a soft cloth. For embedded dirt, a soft bristle brush may be used. For heavy soiling, difficult stains, or scratches, blemishes, or other body damage, see Seat on page 4-6. **See following NOTE.**

NOTE: *Dispose of waste water properly.*

FRONT BODY REPAIR

Read **DANGER, WARNING, and CAUTION** on page 4-1.

ABRASIONS AND HAZE

The original gloss can be restored by hand buffing with "Novus Plastic Polish", "Mirror Glaze Professional Formula Number 17", Club Car's Vehicle Care Kit (CCI P/N AM10021), or similar polishing compounds. A buffing wheel with a small amount of automotive type paste wax applied to the pad may also be used. Remember to use a very light touch, as ABS/DR acrylic polishes easily. Johnson's® "J-Wax" or "Kit" may be applied as a final treatment.

LIGHT SCRATCHES

Ajax cleanser applied dry and hand-rubbed will rapidly smooth moderate scratches. Use a soft polishing compound to restore gloss.

Scratches (up to 10 mils; the equivalent thickness of an average business card) can be removed by light sanding. Start with wet silicone carbide abrasive paper (320 grit or finer). Use progressively finer grits (i.e. 400, 600, 800) to reduce sanding marks. Use Ajax cleanser (or equivalent) for final smoothing. A "Micro Mesh" acrylic polishing kit with abrasive papers from 1800 to 8000 grit will provide the best final finish. Restore gloss with soft polishing compound, or Club Car's Vehicle Care Kit (CCI P/N AM10021). It is not the intent of any of these processes to 'fill-in' material removed due to light scratches but rather to blend the finish of the surrounding area and the scratch together.

LARGE SCRATCHES AND ABRASIONS

Touch-up is not recommended. Replace the entire body part or have it repaired by a professional paint and body repair shop with experience repairing ABS/DR acrylic bodies.

TUBE BUMPER

Read **DANGER, WARNING, and CAUTION** on page 4-1.

TUBE BUMPER REMOVAL

1. Remove the two truss-head screws (14) and nuts (15) that secure the tube bumper to the vehicle frame (**Figure 4-2, Page 4-7**).

TUBE BUMPER INSTALLATION

1. Installation is the reverse of removal. Tighten the two nuts (15) to 15 ft-lb (20.3 N·m) (**Figure 4-2, Page 4-7**).

FRONT BODY COMPONENTS

Read **DANGER, WARNING, and CAUTION** on page 4-1.

DASHBOARD REMOVAL

1. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 4-1.**
2. To remove the dash panel:

Dashboard Removal, Continued:

- 2.1. Loosen the seven Tuflok[®] screws around the panel, but do not remove the screws completely, as shown in Detail A (**Figure 4-1, Page 4-5**).
- 2.2. Remove Tuflok screws from dash panel as shown in Detail B.
- 2.3. Pull forward on top of dash panel to access back side of panel and key switch mounting hardware. There is sufficient slack in the wiring to allow for this, as shown in Detail C.
3. Disconnect the wiring from components mounted in the dash panel.
4. Remove five caps (1) from top of dashboard (2) (**Figure 4-2, Page 4-7**).
5. Using a Torx #T-30 driver, remove screws (3) and special plastic washers (4) from top of dashboard (2).
6. Using a 5/16 nut driver, remove five screws (5) from underside of dashboard and pull dashboard away from front body (6).
7. Remove the steering wheel. **See Steering Wheel Removal, Section 7, Page 7-2.**
8. Remove dashboard from vehicle.

Dash Panel Removal

1. Remove the dash panel. **See step 2 of Dashboard Removal on page 4-3.**
2. Disconnect the wiring from the components mounted in the dash panel.

Dash Panel Installation

1. Reconnect the wiring to the back of the components mounted in the dash panel.
2. Reinstall the dash panel in reverse order of removal.

DASHBOARD INSTALLATION

1. Install dashboard (2) and tighten screws (5) to 11 in-lb (1.2 N·m) (**Figure 4-2, Page 4-7**).
2. Using a Torx #T-30 driver, secure dashboard to front body with five Torx-head screws (3) and special plastic washers (4). Tighten screws to 45 in-lb (5.1 N·m).
3. Install five caps (1).
4. Install dash panel.
 - 4.1. Connect wiring to the back of the components mounted in the dash panel.
 - 4.2. Position dash panel around steering column and align with fastener locations.
 - 4.3. Push Tuflok screws into fastening hole locations.
 - 4.4. Gently turn the Tuflok fasteners 1/4 turn to secure the dash panel.
5. Install steering wheel. **See Steering Wheel Installation, Section 7, Page 7-4.**

FRONT BODY REMOVAL

1. Remove five caps (1) from top of dashboard (2) (**Figure 4-2, Page 4-7**).
2. Using a Torx #T-30 driver, remove the Torx-head screws (3) and washers (4) from top of front body (6).
3. Using a 5/16 nut driver, remove five screws (5) from underside of dashboard (2) and gently slide dashboard away from front body (6).
4. Using a phillips head screwdriver, remove the six Tuflok fasteners (7) from sides and two (7) from front of front body (6).

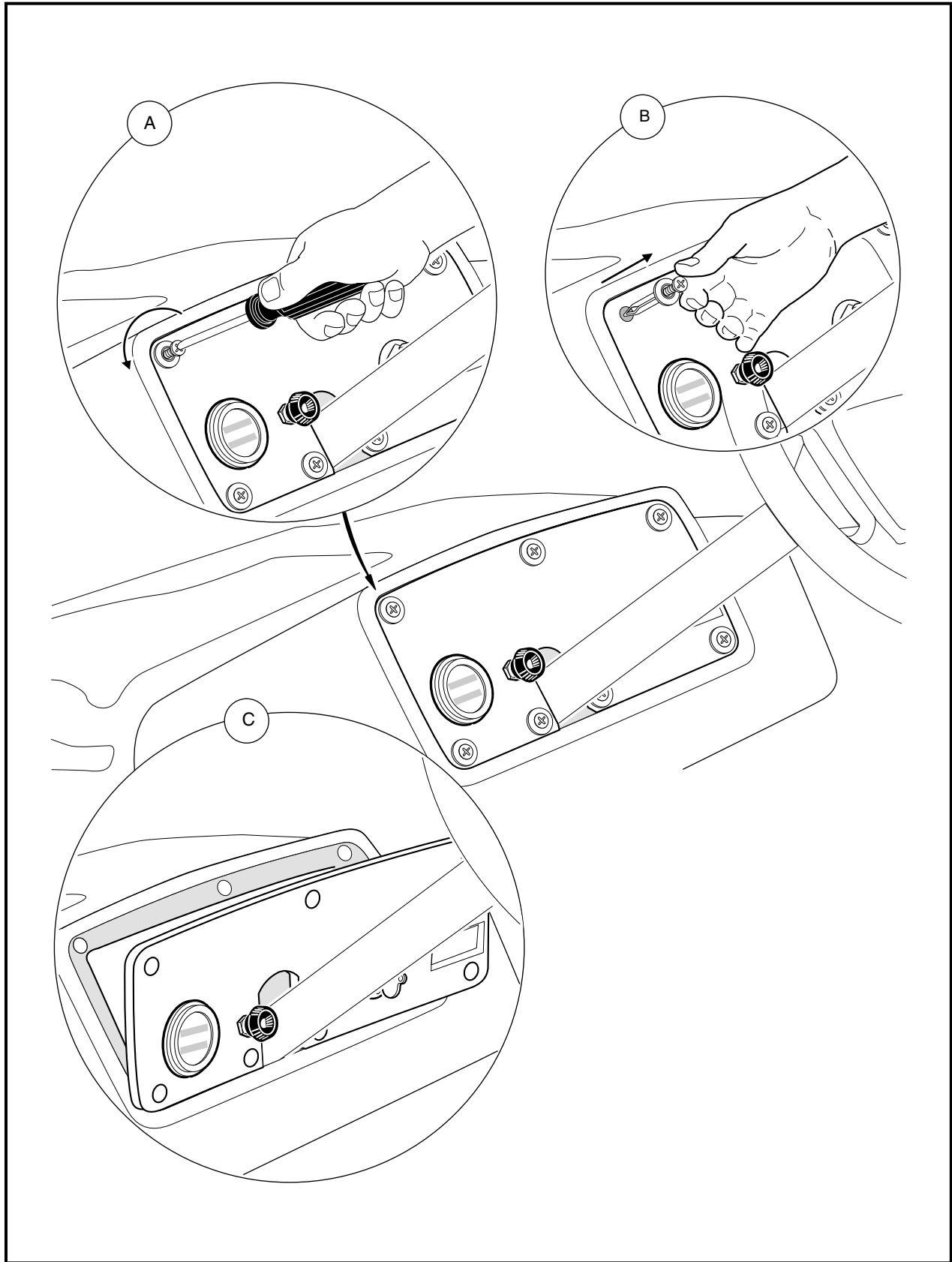


Figure 4-1 Dash Panel Removal

Front Body Removal Continued:

5. Disconnect lighting wiring harness from each headlight assembly.
6. Lift the back edge of the body up and pull front body forward to clear dashboard, and lift off vehicle (**Figure 4-2, Page 4-7**).

FRONT FENDER REMOVAL

1. Remove front body (6) (**Figure 4-2, Page 4-7**). See **Front Body Removal on page 4-4**.
2. Pull back floor mat to access rivets securing front fender (9) to frame. Drill out two 3/16 x 5/8 pop rivets (10) and remove two washers (11).
3. Using a 3/8 hex-head socket, remove two screws (12) from fender frame support.
4. Remove fender from front body assembly.

FRONT FENDER INSTALLATION

1. Reverse removal procedure to install front fender by locating the fender on the vehicle, aligning the fender panel with the pop rivet hole locations on the frame (**Figure 4-2, Page 4-7**).
2. Tighten two screws (12) using a 3/8 hex-head driver to 50 in-lb (5.7 N·m) (**Figure 4-2, Page 4-7**).
3. Pop rivet fender to frame using two 3/16 x 5/8 pop rivets (10) and two 3/16 rivet washers (11).
4. Re-adjust floor mat to cover pop rivet attachments.
5. Install front body. See **Front Body Installation on page 4-6**.

FRONT BODY INSTALLATION

1. Place front body (6) onto vehicle and connect the lighting wire harness to each headlight assembly (**Figure 4-2, Page 4-7**).
2. Using a Torx #T-30 driver, secure front body to dashboard with five Torx-head screws (3) and special plastic washers (4). Tighten screws to 45 in-lb (5.1 N·m).
3. Install five caps (1).
4. Secure front body to fenders with eight Tuflok fasteners (7). To install the Tuflok fasteners, insert into hole and push the head in until it snaps in place.

SEAT**Read DANGER, WARNING, and CAUTION on page 4-1.**

To preserve seat appearance, clean regularly with mild soap or detergent applied with a sponge or soft cloth and use Club Car's Vehicle Care Kit (CCI P/N AM10021) to preserve the fabric. Use a bristle brush to clean areas that are especially soiled. For other cleaning use the following guidelines:

 CAUTION

- To prevent damage to the vehicle when removing difficult stains or heavy soiling, remove the seat from the vehicle first.

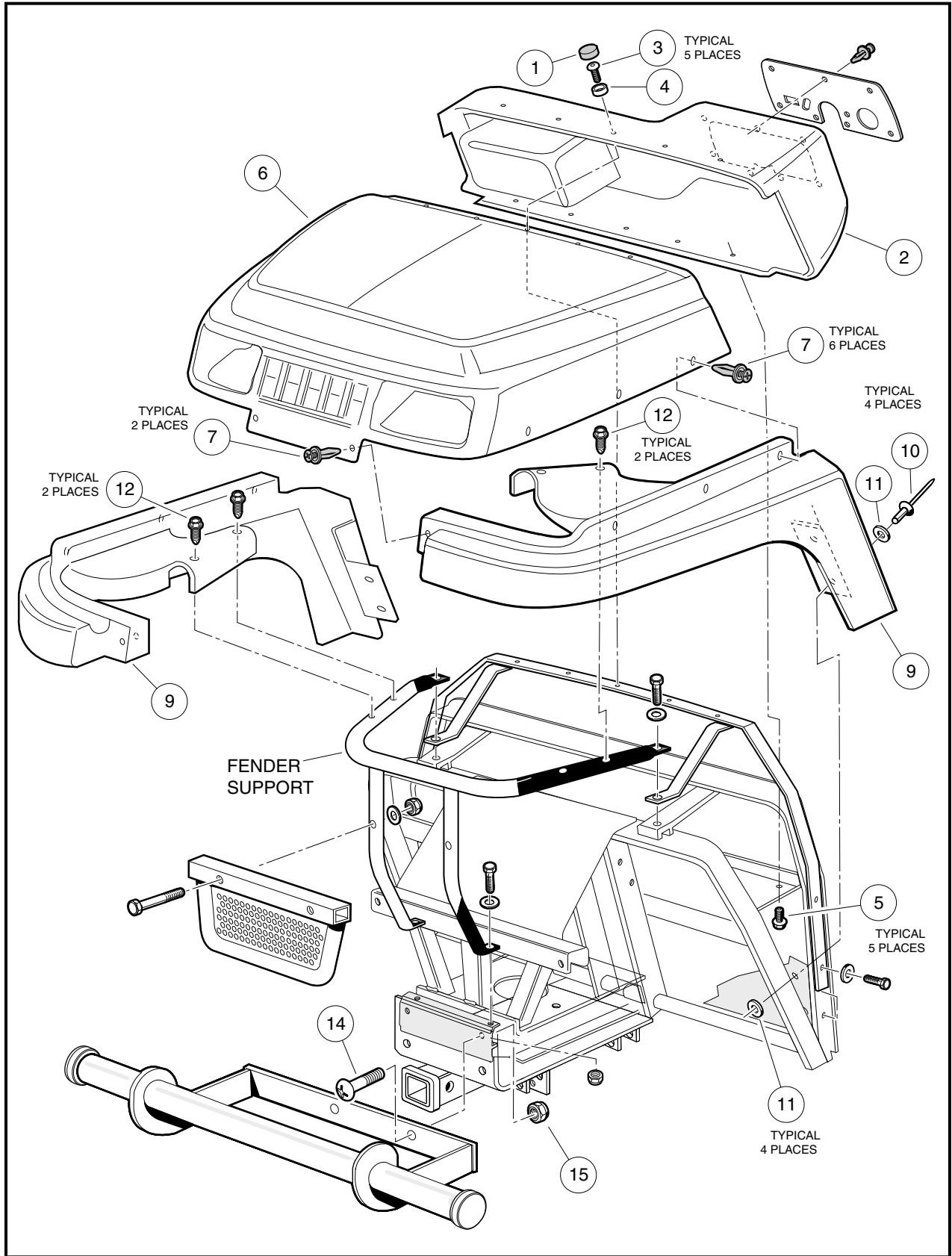


Figure 4-2 Front Body Assembly

Seat, Continued:

Light Soiling – A solution of 10% liquid dish soap and warm water applied with a soft, damp cloth is recommended. A soft bristle brush may be used if necessary. Wipe off any residue with a water dampened cloth.

Difficult Stains – Dampen a soft, white cloth with a solution of 10% household bleach (sodium hypochlorite) and 90% water. Rub gently to remove stain, then rinse with a water dampened cloth to remove bleach concentration. Use Club Car's Vehicle Care Kit (CCI P/N AM10021) to recondition the fabric.

For More Difficult Stains – Perform previous procedure using full-strength bleach, or allow bleach to puddle on affected area for approximately 30 minutes. Rinse with a water dampened cloth to remove any remaining bleach concentration. Use Club Car's Vehicle Care Kit (CCI P/N AM10021) to recondition the fabric.

SEAT REMOVAL

1. Pull seat (2) forward and lift up to remove from seat support (1) (**Figure 4-3, Page 4-10**).

Seat Adjustment

1. Remove seat (2) from vehicle.
2. Disassemble seat (2) from seat panel (3) by removing four bolts (4) and lock washers (5) (**Figure 4-3, Page 4-10**).
3. Adjust seat to preferred position. Align holes in seat panel (3) with holes in seat (2) and secure with four bolts (4) and lock washers (5). Tighten bolts to 96 in-lb (10.8 N·m).

SEAT INSTALLATION

1. Insert seat hinge plates into body hinge plates on seat panel. Lower seat and press down to lock in place. **See following WARNING.**

 WARNING

- **Make sure seat hinges and latch are securely engaged before operating vehicle.**

SEAT SUPPORT

Read DANGER, WARNING, and CAUTION on page 4-1.

SEAT SUPPORT REMOVAL

The style of transaxle determines the following procedures. Transaxle styles are illustrated at the beginning of Sections 6a and 6b.

1. Completely remove both seats (2) from the vehicle (**Figure 4-3, Page 4-10**).
2. For procedures not common to both transaxles:
 - 2.1. **MC012C-AS00 transaxle:**
 - 2.1.1. Remove park brake equalizer cable from park brake handle. **See Equalizer Cable Removal, Section 6a, Page 6a-37.**
 - 2.1.2. Disconnect cable from differential lock control. **See step 5.5 in Unitized Transaxle Removal, Section 16a, Page 16a-9.**
 - 2.2. **MC010C-BS00 transaxle:**

- 2.2.1. Remove park brake equalizer cable from park brake handle. **See Equalizer Cable Removal, Section 6b, Page 6b-36.**
- 2.2.2. Disconnect cable from differential lock control. **See step 5.5 in Unitized Transaxle Removal, Section 16b, Page 16b-9.**
3. Remove four hex-head bolts (8), eight washers (9) and four lock nuts (10) from the seat support **(Figure 4-3, Page 4-10).**
4. Remove the two armrests (11 and 12) from the seat support (1) **(Figure 4-3, Page 4-10).**
5. Lift seat support (1) from vehicle.

SEAT SUPPORT INSTALLATION

1. Position the seat support (1) onto the frame and locate armrests (11 and 12) for installation **(Figure 4-3, Page 4-10).**
2. Assemble four 5/16-18 x 2-1/4 hex-head bolts (8), eight 5/16 flat washers (9), and four 5/16-18 nylon lock nuts (10) to both the seat support and armrests (11 and 12). Tighten bolts (8) to 13 ft-lb (17.6 N·m) **(Figure 4-3, Page 4-10).**
3. For procedures not common to both transaxles:
 - 3.1. **MC012C-AS00 transaxle:**
 - 3.1.1. Reconnect differential lock cable end to the differential lock handle. **See step 33 of Unitized Transaxle Installation, Section 16a, Page 16a-48.**
 - 3.1.2. Install park brake equalizer cable. **See Equalizer Cable Installation, Section 6a, Page 6a-38.**
 - 3.2. **MC010C-BS00 transaxle:**
 - 3.2.1. Reconnect differential lock cable end to the differential lock handle. **See step 33 of Unitized Transaxle Installation on page 16b-47.**
 - 3.2.2. Install park brake equalizer cable. **See Equalizer Cable Installation, Section 6b, Page 6b-37.**

ARMREST REMOVAL

1. Perform steps 1, 3 and 4 in Seat Support Removal on page 4-8. **See following WARNING.**

WARNING

- **Both armrests must be installed before operating the vehicle, unless the vehicle is fitted with a structural cab.**

ARMREST INSTALLATION

1. Perform steps 1 and 2 in Seat Support Installation on page 4-9.

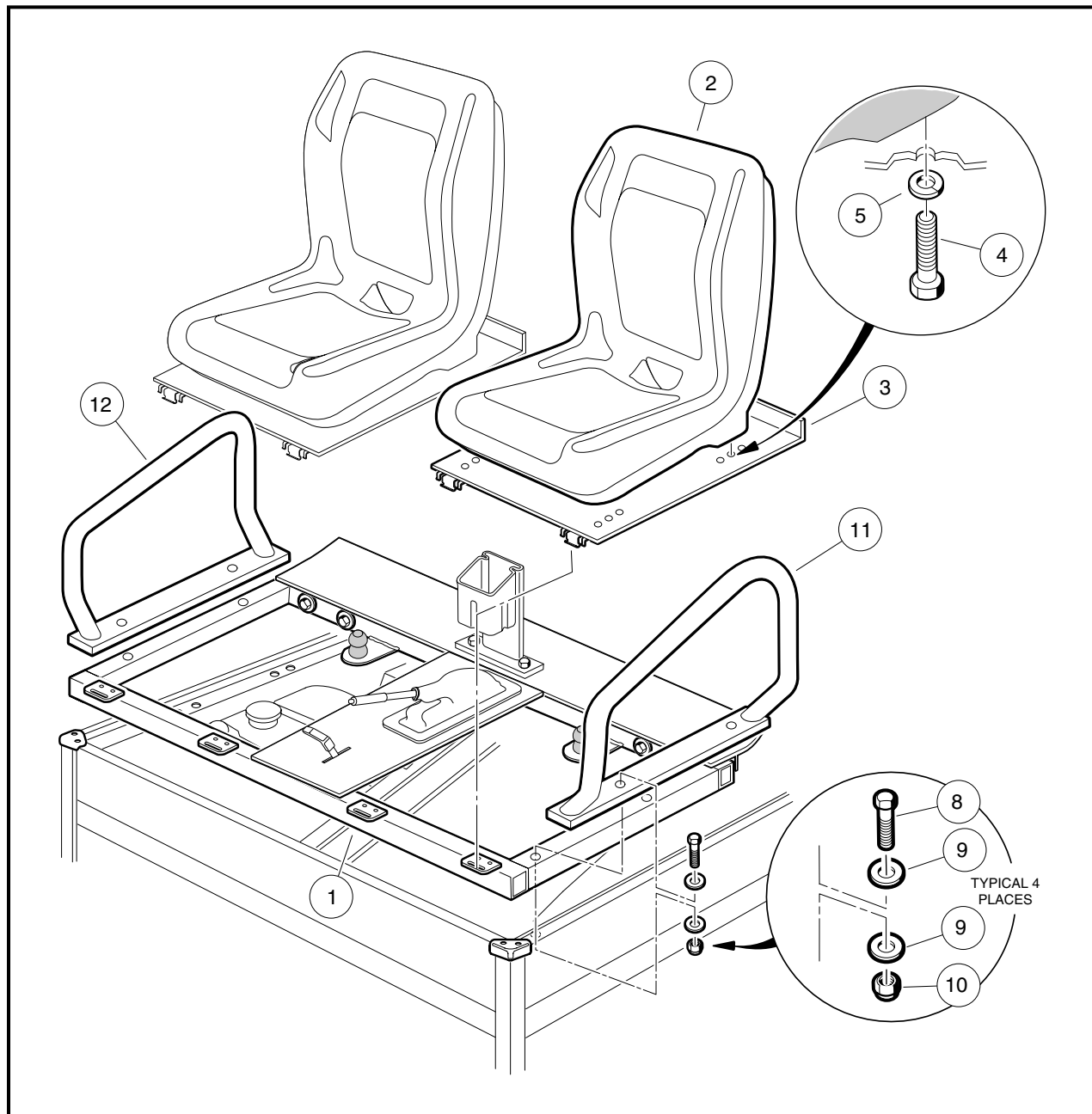
CARGO BED

Read DANGER, WARNING, and CAUTION on page 4-1.

CARGO BED REMOVAL

NOTE: *Cargo bed removal and installation will be easier with a helper.*

1. Raise bed and ensure that the prop rod (1) is secured in the prop rod track (2). Hold bed securely in an upright position. Remove cotter pin (3) and flat washer (4) from top end of prop rod where prop rod attaches to bed. Remove prop rod (1) from bed and place prop rod between prop rod track (2) and rear body panel. Lower bed onto vehicle frame **(Figure 4-4, Page 4-13).**

Cargo Bed Removal, Continued:**Figure 4-3 Seat Support**

2. Remove two 3/8-16 nylon lock nuts (8) from left and right tilt bed hinge/bolt assemblies.
3. Apply slight upward pressure (by hand) on the rear of the bed to relieve pressure on the hinges, and remove the 3/8 x 3-3/8-inch hinge bolts (9) from the hinge assemblies.
4. Raise rear edge of bed approximately 6 inches (15.2 cm) and pull bed assembly toward rear of vehicle (approximately 3 inches)(7.6 cm) to release bed latch assembly (10) from latch plate (11).
5. Lift bed from vehicle.

CARGO BED INSTALLATION

NOTE: Cargo bed removal and installation will be easier with a helper.

1. Hold bed at a slight angle (front of bed lower than rear of bed) to vehicle and place front edge of bed onto vehicle frame. Bed latches (10) should engage with latch plates (11) (**Figure 4-4, Page 4-13**).
2. Lower rear edge of bed onto vehicle and align frame hinge brackets (14) with bed hinge brackets (15).
3. Start the 3/8-16 x 3-3/8 bolts (9) into left and right hinge assemblies. (It may be necessary to use an alignment tool to align holes in hinge bracket with steel bushing in hinge assembly) (**Figure 4-4, Page 4-13**).
4. Use a small hammer to lightly tap bolts through hinge assembly.
5. Install a 3/8-16 nylon lock nut (8) on each bolt (9) and tighten to 15 ft-lb (21 N·m) (**Figure 4-4, Page 4-13**).
6. Lift bed from bed latch and with prop rod in a slot notch, place prop rod (1) in bed mounting hole and install a 3/8 inch flat washer (4) and a new cotter pin (3) through hole in prop rod (**Figure 4-4, Page 4-13**).
7. Proceed to Bed Stop Bumper Adjustment.

BED STOP BUMPER ADJUSTMENT

1. Adjust the two front bumpers (16) by loosening the 1/4-20 nylon lock nuts (17) and positioning the bumper in the slot so that when the tilt bed is lowered, the bumpers are centered on the bed frame weldment at each position (**Figure 4-4, Page 4-13**).
2. Tighten the lock nuts (17) to 20 in-lb (2.3 N·m).
3. Adjust the two rear bumpers (18) by tightening or loosening the nuts (19) until a 1/8-inch gap between the bottom of the bumper head and the frame weldment is achieved. These bumpers are not to be tightened to the frame. There is a wave washer between the bumper and frame so that the bumper will "float." Weldments on the frame should rest on these two bumpers.

REAR FENDER

Read **DANGER, WARNING, and CAUTION** on page 4-1.

The style of transaxle determines which fender removal procedure will apply. See **Transaxle Identification, Section 6a, Page 6a-2**.

REAR FENDER REMOVAL

1. **MC012C-AS00 transaxle:**
 - 1.1. Remove one 1/4-20 nylon lock nut (5), fender washers (4) and 1/4-20 x 1-inch hex-head bolt (3) from the top, and underneath, of fender (1) (**Figure 4-5, Page 4-16**).
 - 1.2. Remove the two 1/4-20 nylon lock nuts (5), fender washers (4) and 1/4-20 x 1-inch hex-head bolts (3) from the front surface of the fender (1).
 - 1.3. Remove the two 1/4-20 nylon lock nuts (5), fender washers (4) and 1/4-20 x 1-inch hex-head bolts (3) attaching the fender wall (1) to the vehicle frame.
 - 1.4. Remove fender (1) from the vehicle.
 - 1.5. Repeat steps 1.1 through 1.4 for removal of the opposite fender if necessary.

Rear Fender Removal, Continued:**2. MC010C-BS00 transaxle:**

- 2.1. Remove the two 1/4-20 nylon lock nuts (5), fender washers (4) and 1/4-20 x 1-inch hex-head bolts (3) from the front surface of the fender (1) (**Figure 4-6, Page 4-17**).
- 2.2. Remove the two 1/4-20 nylon lock nuts (7), fender washers (8) and 1/4-20 x 1-inch hex-head bolts (9) from the top, and underneath, of fender (1).
- 2.3. Remove the two 1/4-20 nylon lock nuts (27), fender washers (26) and 1/4-20 x 1-inch hex-head bolts (25) attaching the metal guard plate (28) and fender (1) to the vehicle frame.
- 2.4. Remove fender (1) from the vehicle.
- 2.5. Repeat steps 2.1 through 2.4 for removal of the opposite fender if necessary.

REAR FENDER INSTALLATION

The style of transaxle determines which rear fender installation procedure will apply. **See Transaxle Identification, Section 6a, Page 6a-2.**

1. MC012C-AS00 transaxle:

- 1.1. Reverse removal procedure to install rear fender. Tighten all bolts securing the fender to the vehicle to 35 in-lb (4.0 N·m) (**Figure 4-5, Page 4-16**). **See following NOTE.**

2. MC010C-BS00 transaxle:

- 2.1. Reverse removal procedure to install rear fender. Tighten all bolts securing the fender to the vehicle to 35 in-lb (4.0 N·m) (**Figure 4-6, Page 4-17**). **See following NOTE.**

NOTE: Use new nylon lock nuts when performing this assembly procedure.

The rear fender with the warning decal should be installed on the passenger side of the vehicle. The decal should be plainly visible when the cargo bed is raised.

TAILSKIRT

Read DANGER, WARNING, and CAUTION on page 4-1.

TAILSKIRT REMOVAL

The style of transaxle determines which tailskirt removal procedure will apply. **See Transaxle Identification, Section 6a, Page 6a-2.**

1. MC012C-AS00 transaxle:

- 1.1. Remove the two thread-forming screws (7) and flat washers (19) from the tailskirt (6) and slide tailskirt from under the back edge of the rear of the body and vehicle frame (**Figure 4-5, Page 4-16**).

2. MC010C-BS00 transaxle:

- 2.1. Remove the two thread-forming screws (12) and flat washers (19) from the tailskirt (13) and slide tailskirt from under the back edge of the rear of the body and vehicle frame (**Figure 4-6, Page 4-17**).

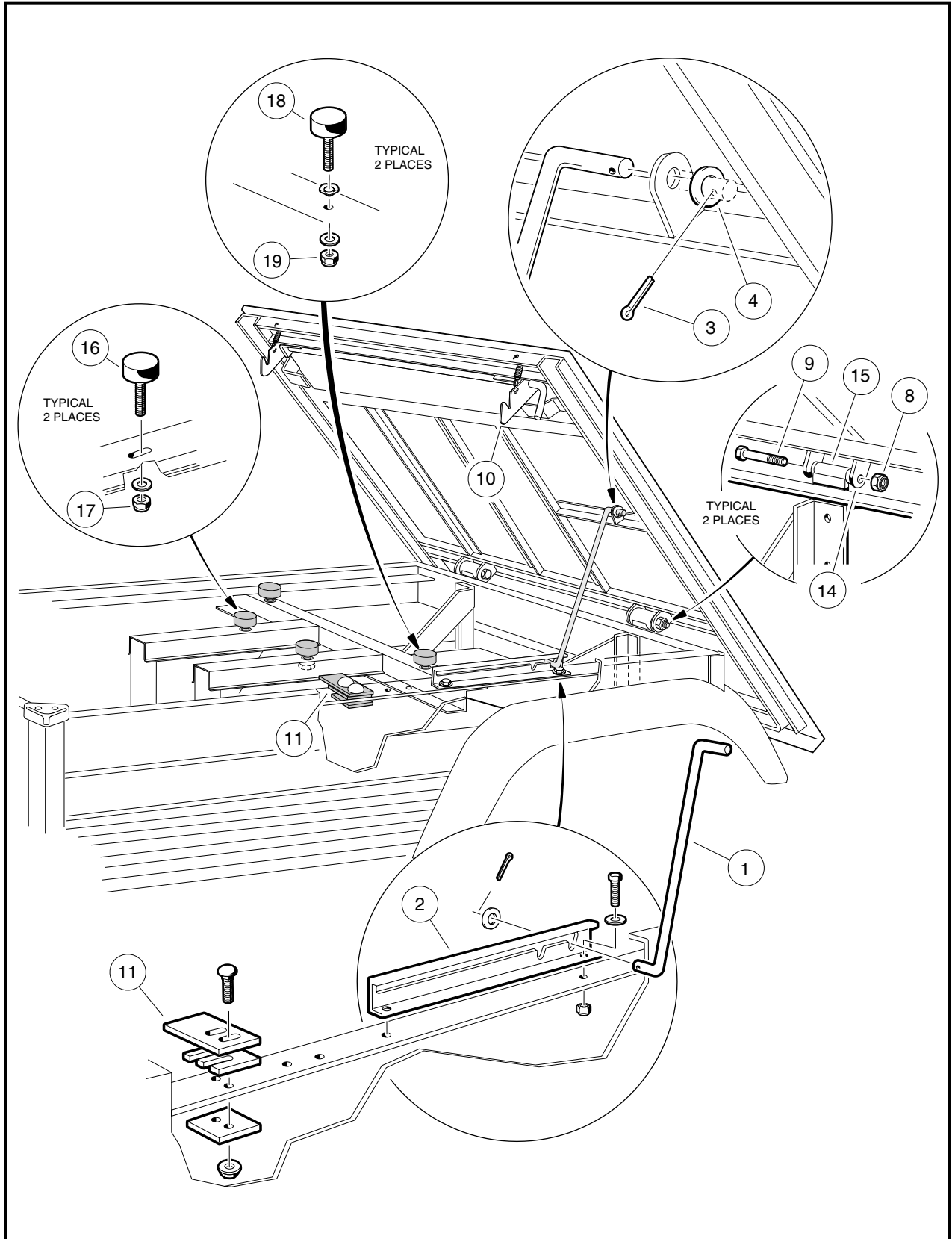


Figure 4-4 Tilt Bed

TAILSKIRT INSTALLATION

The style of transaxle determines which tailskirt installation procedure will apply. **See Transaxle Identification, Section 6a, Page 6a-2.**

1. MC012C-AS00 transaxle:

- 1.1. Insert upper edge of tailskirt (6) under, and in front of, back edge of rear body (**Figure 4-5, Page 4-16**).
- 1.2. Installation is in reverse order of removal. Tighten hardware to 55 in-lb (6.2 N·m).

2. MC010C-BS00 transaxle:

- 2.1. Insert upper edge of tailskirt (13) under, and in front of, back edge of rear body (**Figure 4-6, Page 4-17**).
- 2.2. Installation is in reverse order of removal. Tighten hardware to 55 in-lb (6.2 N·m).

TRAILER HITCH

Read **DANGER, WARNING** and **CAUTION** on page 4-1.

TRAILER HITCH REMOVAL

The style of transaxle determines which trailer hitch removal procedure will apply. **See Transaxle Identification, Section 6a, Page 6a-2.**

1. MC012C-AS00 transaxle:

- 1.1. Remove the tailskirt. **See Tailskirt Removal on page 4-12.**
- 1.2. Remove two 5/16-18 hex nuts (20), lock washers (21), flat washers (22) and 5/16-18 x 1-inch bolts (23) from hitch brace (10) and hitch frame (8) (**Figure 4-5, Page 4-16**).
- 1.3. Remove two 5/16-18 hex nuts (13), lock washers (12), flat washers (11) and 5/16-18 x 1-inch bolts (18) where the hitch frame (8) mounts to the vehicle frame (**Figure 4-5, Page 4-16**).
- 1.4. Remove hitch (8) from vehicle.

2. MC010C-BS00 transaxle:

- 2.1. Remove the tailskirt. **See Tailskirt Removal on page 4-12.**
- 2.2. Remove two 5/16-18 hex nuts (24), lock washers (23), flat washers (22) and 5/16-18 x 1-inch bolts (21) from hitch brace (20) and hitch frame (14) (**Figure 4-6, Page 4-17**).
- 2.3. Remove two 5/16-18 hex nuts (15), lock washers (16), flat washers (17) and 5/16-18 x 1-inch bolts (18) where the hitch frame (14) mounts to the vehicle frame (**Figure 4-6, Page 4-17**).
- 2.4. Remove hitch (14) from vehicle.

TRAILER HITCH INSTALLATION

The style of transaxle determines which trailer hitch installation procedure will apply. **See Transaxle Identification, Section 6a, Page 6a-2.**

1. MC012C-AS00 transaxle:

- 1.1. Reverse removal procedures to install hitch frame (8) to vehicle frame, then hitch frame (8) to hitch braces (10). Tighten all hardware to 15 ft-lb (20.3 N·m) (**Figure 4-5, Page 4-16**).

2. MC010C-BS00 transaxle:

- 2.1. Reverse removal procedures to install hitch frame (14) to vehicle frame, then install the hitch frame (14) to the hitch braces (20). Tighten all hardware to 15 ft.-lb (20.3 N·m) (**Figure 4-6, Page 4-17**).

FLOOR MAT

Read **DANGER**, **WARNING**, and **CAUTION** on page 4-1.

FLOOR MAT REMOVAL

1. Remove the brake and accelerator pedals. **See Accelerator Pedal Removal, Section 5, Page 5-4. Also see Brake Pedal Removal, Section 5, Page 5-2.**
2. Remove the top edge of the floor mat from the overlapping flange under the dash, and remove the mat.

FLOOR MAT INSTALLATION

1. Install the floor mat in the reverse order of removal.
2. Install the brake and accelerator pedals. **See Brake Pedal Installation, Section 5, Page 5-3. Also see Accelerator Pedal Installation, Section 5, Page 5-5.**

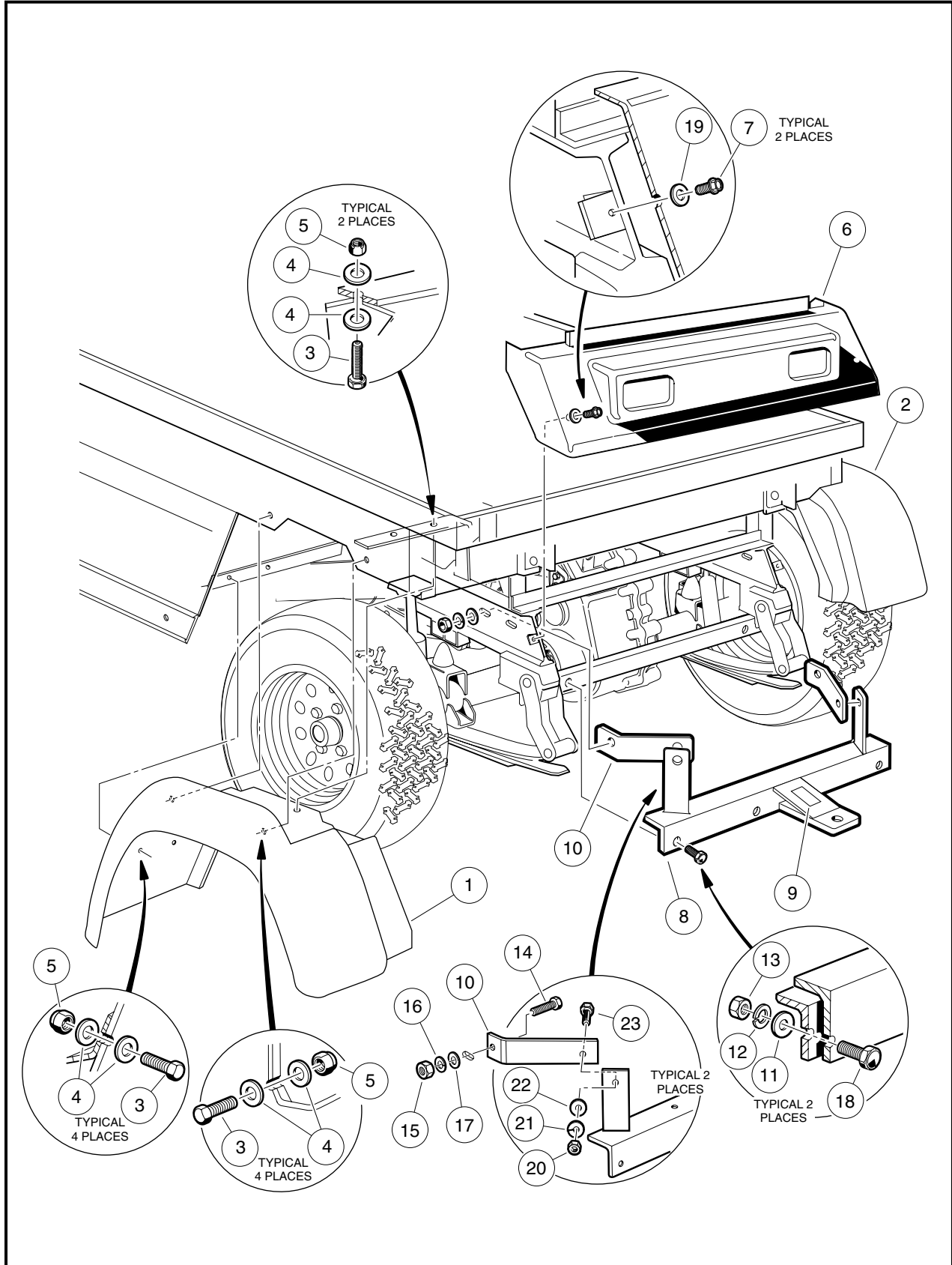


Figure 4-5 Rear Fender, Tailskirt, and Hitch – Vehicle with MC012C-AS00 Transaxle

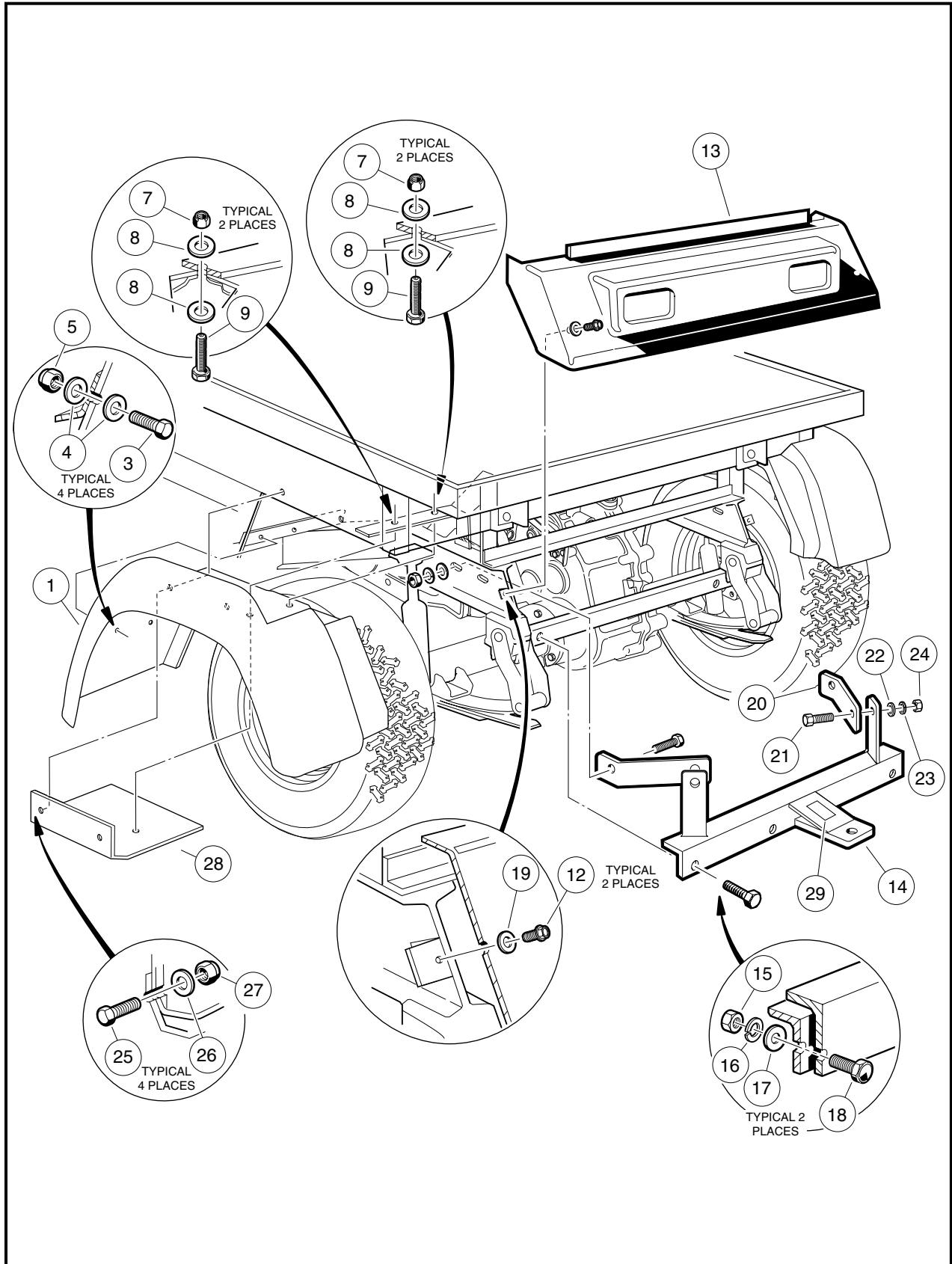


Figure 4-6 Rear Fender, Tailskirt, and Hitch – Vehicle with MC010C-BS00 Transaxle

SECTION 5 – ACCELERATOR AND BRAKE PEDAL ASSEMBLIES

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

BRAKE PEDAL

Read **DANGER** and **WARNING** on page 5-1.

BRAKE PEDAL REMOVAL

1. Make sure key switch is OFF and the Forward/Reverse handle is in NEUTRAL.
2. Access the engine compartment. **See WARNING "To avoid unintentionally starting..." on page 5-1.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 5-1.**
4. Disconnect spark plug. **See WARNING "To avoid unintentionally starting..." on page 5-1.**
5. Place chocks under rear wheels and lift front end of vehicle with a chain hoist or floor jack. Place jack stands under the outer front I-beam of the vehicle frame and lower the vehicle onto the jack stands (**Figure 5-2, Page 5-4**). **See following WARNING.**

⚠ WARNING

- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
6. Remove the brake pedal assembly.
 - 6.1. Remove the bolt (9) and nut (19) from the brake pedal weldment (**Figure 5-1, Page 5-3**).
 - 6.2. Remove nuts (4), flat washers (6), bolts (7), and mounting blocks (5). If the mounting blocks (5) show signs of excessive wear, or are damaged, they must be replaced with new ones before installing pedal assembly (**Figure 5-1, Page 5-3**).
 - 6.3. Remove the nut (3) and brake stop bumper (2) (**Figure 5-1, Page 5-3**).
 - 6.4. Lift pedal assembly (1) through the floorboard (**Figure 5-3, Page 5-4**).

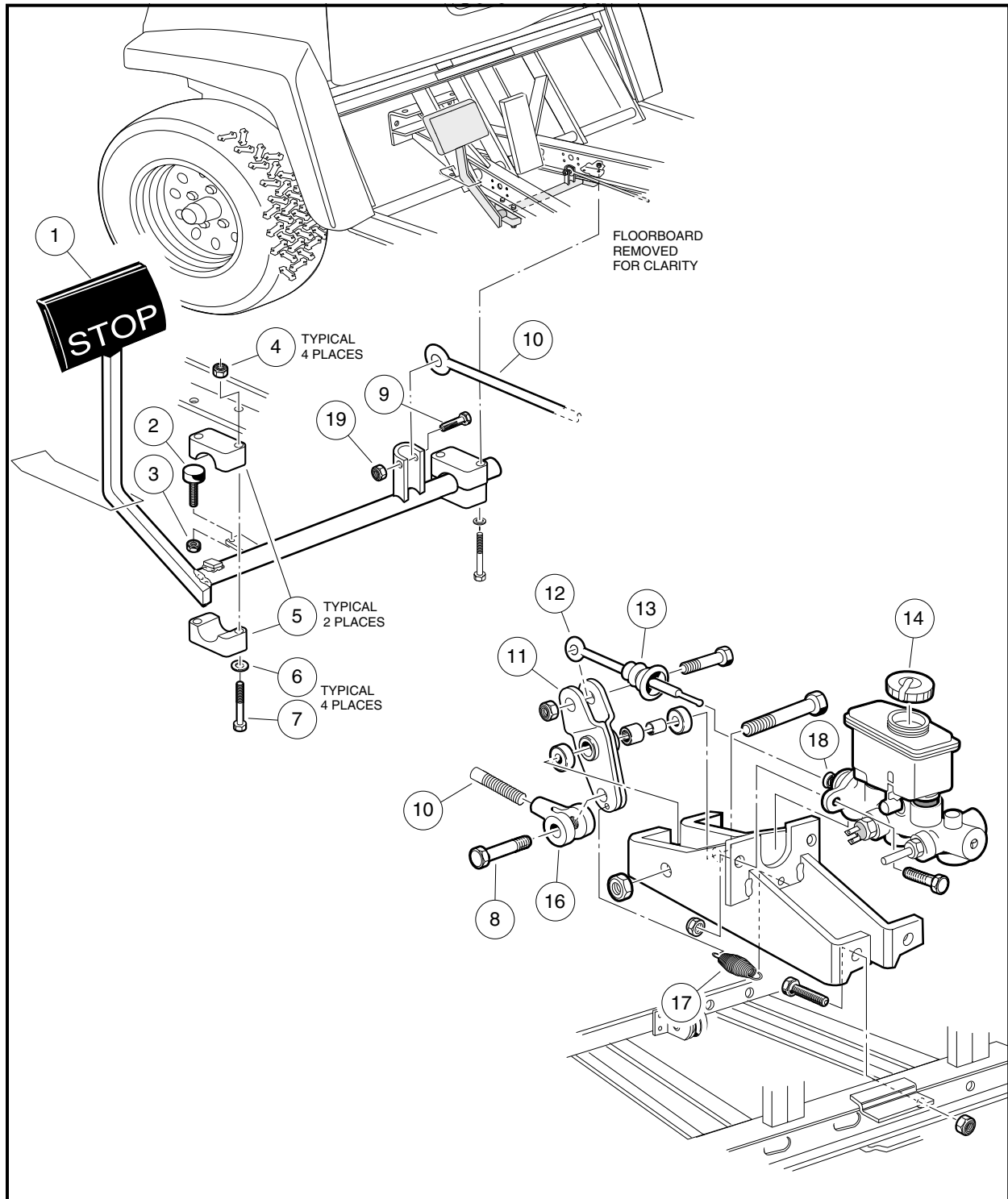


Figure 5-1 Brake Pedal Assembly

BRAKE PEDAL INSTALLATION

1. From the top side of the floorboard, insert the brake pedal weldment assembly (1) through the opening in the floor as shown (**Figure 5-3, Page 5-4**) and install the brake pedal stop bumper (2) and nut (3) (**Figure 5-1, Page 5-3**) on the brake pedal assembly, but do not tighten the jam nut at this time.

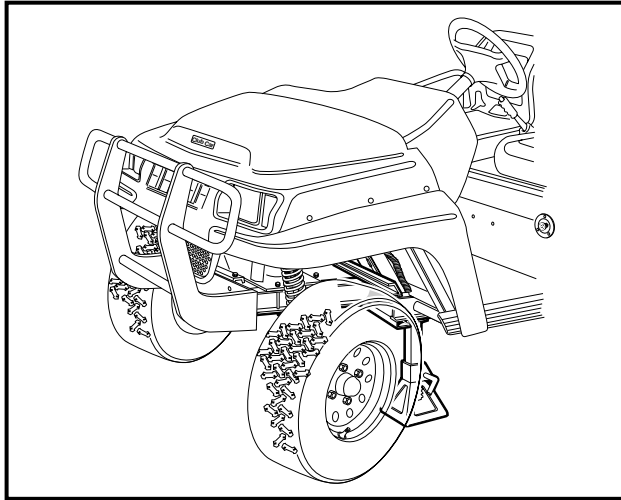
Brake Pedal Installation, Continued:

Figure 5-2 Jack Stand Location on I-Beam

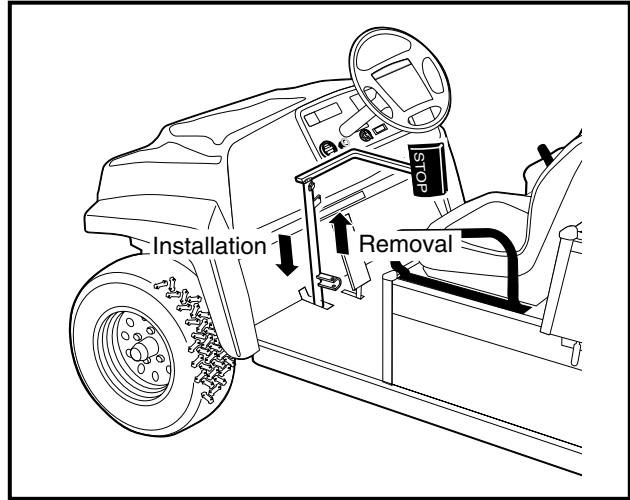


Figure 5-3 Brake Pedal Weldment Through Floor

2. Attach the equalizer rod (10) to the brake pedal weldment assembly (1) as shown (**Figure 5-1, Page 5-3**). Tighten to 17 in-lb (1.9 N·m).
3. Position and attach brake pedal assembly and mounting blocks (5) with bolts (7), washers (6), and lock nuts (4) to vehicle frame as shown. Tighten to 70 in-lb (7.91 N·m) (**Figure 5-1, Page 5-3**).
4. Pull the brake pedal toward the rear of the vehicle until the brake stop bumper will not allow the pedal to travel any further (**Figure 5-5, Page 5-6**).
5. Adjust the brake pedal. **See Brake Pedal Adjustment on page 5-6.**

ACCELERATOR PEDAL

Read **DANGER** and **WARNING** on page 5-1.

ACCELERATOR PEDAL REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL.

⚠ WARNING

- **Disconnect both battery cables, negative (–) cable first.**
2. Disconnect the spark plug. **See WARNING "To avoid unintentionally starting..." on page 5-1.**
 3. Place chocks under the rear wheels and lift the front end of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front I-beam of the vehicle frame and lower the vehicle onto the jack stands.
 4. Using a 9/16-inch socket and 9/16-inch wrench, remove the nut (23), two washers (25), and bolt (4) securing the accelerator pedal (1) to the pivot rod (6) (**Figure 5-11, Page 5-10**).

5. Disconnect the accelerator rod assembly (17, 18 and 19) (**Figure 5-11, Page 5-10**) at the front and rear ball studs and remove it from the vehicle.
6. Remove the nut (10) and ball stud (16) from the accelerator pivot rod (6) and spring retainer (11) assembly.
7. Slide the spring retainer (11) off of the accelerator pivot rod (**Figure 5-11, Page 5-10**).
8. Inspect the pivot support bearing (9), inside the spring retainer, for wear and replace if necessary.
9. Remove lock nut (26) from the accelerator pivot shaft.
10. Move the brake pedal slightly and then slide the spacer (24) toward end of accelerator pivot rod, releasing the splined fit between the two. Rotate the spacer (24) and remove from the pivot rod (6) (**Figure 5-11, Page 5-10**).
11. Loosen, but do not remove, the four bolts (22) and lock nuts (15) to make removal of the pivot rod easier.
12. Slide the pivot rod (6) from the accelerator pivot rod supports (21), nylon spacer (20), and accelerator (1). Remove both the pivot rod (6) and the accelerator pedal (1) from the vehicle.

NOTE: The accelerator will release to the top side of the floor board.

13. Inspect the accelerator pivot rod support bearings (21) for wear or damage and replace as necessary.
14. Inspect all parts for wear and damage. Replace as necessary.

ACCELERATOR PEDAL INSTALLATION

NOTE: The following procedure will be easier with the help of an additional person.

1. If the accelerator pivot rod supports were replaced, position the supports (21) on the vehicle frame and loosely install the four bolts (22), flat washers (8), and lock nuts (15) and finger-tighten (**Figure 5-11, Page 5-10**).
2. With the assistance of an additional person, position accelerator pedal (1) through the floorboard and slide the accelerator pivot rod (6) through the upper hole in pedal through the nylon spacer (20), and through the two pivot rod supports (21).
3. Tighten the four bolts (22) (**Figure 5-11, Page 5-10**) attaching the pivot rod supports to the frame to 75 in-lb (8.5 N·m).
4. Install the spacer (24), aligning the splined area in both parts, and attach the nylon lock nut (26). Tighten the nut to 18 ft-lb (24.5 N·m).
5. Insert bolt (4) through a washer (25) and through the lower hole in the pedal, then through the adjacent slotted hole in the pivot rod (6). Attach the remaining washer (25) and nut (23). Finger-tighten nut. **See Accelerator Pedal Adjustment on page 5-7.**
6. Insert pivot support bearing (9) into spring retainer (11) and onto the boss of the pivot rod plate.
7. Install the ball stud bolt (16) through the pivot rod (6) and pivot support bearing (9). Secure these parts with nut (10) (**Figure 5-11, Page 5-10**). Tighten nut to 50 in-lb (5.5 N·m).
8. Install the accelerator rod assembly (17, 18 and 19) (**Figure 5-11, Page 5-10**).
9. Adjust the accelerator pedal and accelerator rod. **See Accelerator Pedal Adjustment on page 5-7.**

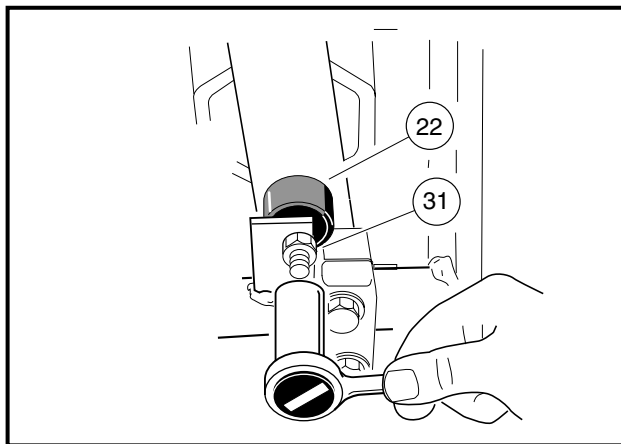
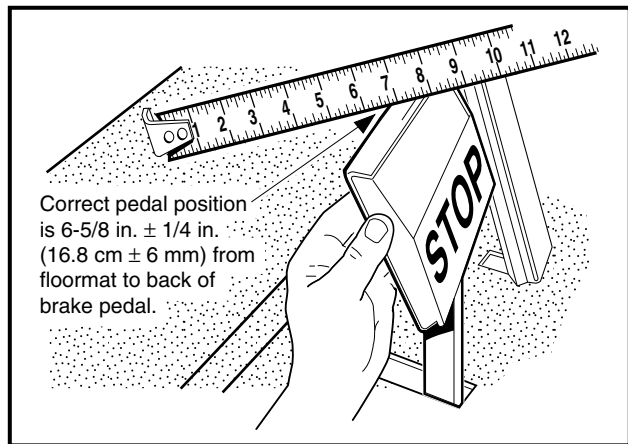
NOTE: For proper vehicle operation, it is important that the accelerator pedal, governor linkage, and throttle adjustments are done correctly and in the proper sequence. **See Engine Control Linkage, Section 14, Page 14-10.**

Accelerator Pedal Installation, Continued:

10. Connect the spark plug wire to the spark plug.
11. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27 N·m).

BRAKE PEDAL ADJUSTMENT**Read DANGER and WARNING on page 5-1.**

1. Chock wheels and release the park brake.
2. Remove the rod retaining bolt (8) and remove the clevis (16) from the bell crank assembly (11) (**Figure 5-1, Page 5-3**).
3. Loosen, but do not remove, the brake stop jam nut (31) (**Figure 5-4, Page 5-6**).
4. Pull the brake pedal toward the rear of the vehicle until the brake stop bumper will not allow the pedal to travel any further (**Figure 5-5, Page 5-6**).
5. While holding the brake pedal in this position, measure the distance from the back of the brake pedal to the floorboard (**Figure 5-5, Page 5-6**). If the measured distance is between 6-3/8 inches (16.2 cm) and 6-7/8 inches (17.5 cm), proceed to step 9.
6. Adjust the brake stop bumper (22) up or down (**Figure 5-4, Page 5-6**). Adjusting the bumper upward decreases the distance between the pedal and the floorboard. Adjusting the bumper downward increases the distance between the pedal and the floorboard. Proper brake pedal height is 6-5/8 inches \pm 1/4 inch (16.8 cm \pm 6 mm) (**Figure 5-5, Page 5-6**).

**Figure 5-4 Adjust Brake Pedal Height****Figure 5-5 Measure Brake Pedal Height**

7. Tighten the jam nut (31) to 8 ft-lb (9.5 N·m) (**Figure 5-4, Page 5-6**).
8. Adjust the clevis (16) by rotating it clockwise or counterclockwise so that the rod retaining bolt (8) can easily be placed through the clevis (16) and the bottom hole in the bell crank assembly (11) (**Figure 5-1, Page 5-3**).

NOTE: The spring (17) should not be under tension while the brake pedal is at rest (**Figure 5-1, Page 5-3**).

9. Install the rod retaining bolt (8) through the clevis (16) and the bell crank (11). Tighten the bolt to 14 ft-lb (19 N·m) (**Figure 5-1, Page 5-3**).

10. Observe the push rod while pressing the brake pedal. There should be at least 1/8 inch of free play (at the push rod) before the push rod begins to depress the master cylinder piston (**Figure 5-6, Page 5-7**). An accurate measurement is not necessary, but it must be a minimum of 1/8-inch (4.44 mm) so that the push rod does not contact the master cylinder piston when the pedal is at rest.

NOTE: Brake pedal free play is the distance the push rod (12) travels before the master cylinder piston (18) is depressed (**Figure 5-1, Page 5-3**). Also see **Figure 5-6, Page 5-7**.

11. Perform all of the brake system inspections in Section 6a or 6b to ensure that both the hydraulic brake system and the park brake system are adjusted correctly and are operating correctly before placing the vehicle into service. See **Brake System Inspection, Section 6a, Page 6a-3**. Also see **Brake System Inspection, Section 6b, Page 6b-3**

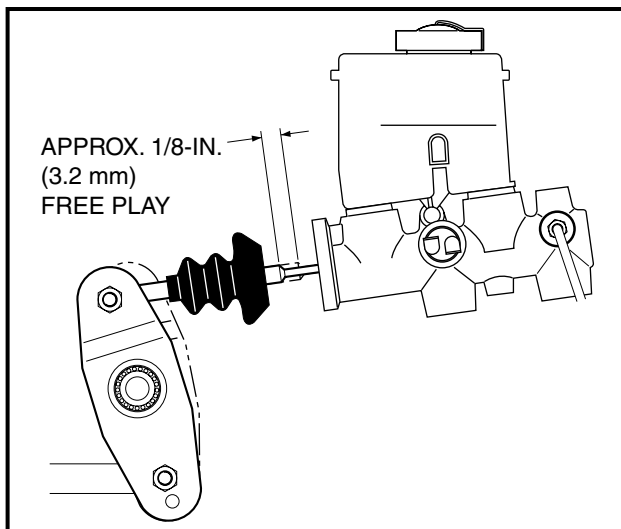


Figure 5-6 Push Rod Free Play

ACCELERATOR PEDAL ADJUSTMENT

Read **DANGER** and **WARNING** on page 5-1.

1. Measure the distance from the top of the accelerator pedal to the floorboard. If the distance is within the range of 5-3/4 inches \pm 1/4 inch (14.6 cm \pm 6mm) (**Figure 5-7, Page 5-8**), adjusting the accelerator pedal is not necessary. If adjustment is not necessary, check to make sure the nylon lock nut (23) is tightened to 26 ft-lb (35.3 N-m) (**Figure 5-11, Page 5-10**) and proceed to step 7.1. If adjustment is necessary, proceed to step 2.
2. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL.
3. Access the engine compartment. See **WARNING "For vehicles with cargo beds..."** on page 5-1.
 - 3.1. Tilt the bed and ensure that the prop rod is properly engaged.

▲ WARNING

- **Disconnect both battery cables, negative (-) cable first.**
4. Disconnect the spark plug. See **WARNING "To avoid unintentionally starting..."** on page 5-1.
 5. Loosen the nut and bolt securing the accelerator pedal to the pivot plate (**Figure 5-8, Page 5-8**).
 6. If using an accelerator pedal adjustment tool to make adjustment:
 - 6.1. Clamp the accelerator pedal adjustment tool (CCI P/N 101871001) to the accelerator pedal, with the end marked **accelerator pedal height** closest to the floorboard (**Figure 5-9, Page 5-8**).

Accelerator Pedal Adjustment, Continued:

- 6.2. Depress the accelerator pedal until the end of the tool rests against the floorboard. Using a rubber strap, hold pedal in position against the floorboard and tighten nut to 26 ft-lb (35.3 N·m) (**Figure 5-9, Page 5-8**).
7. If using a tape measure to make adjustment:
 - 7.1. Place the end of the tape measure against the floormat and adjust the pedal so the distance from the floormat to the back of the accelerator pedal is 5-3/4 inches \pm 1/4 inch (14.6 cm \pm 6mm) (**Figure 5-7, Page 5-8**).

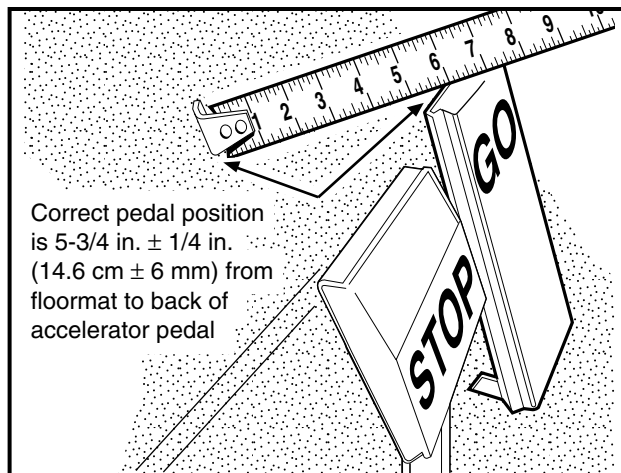


Figure 5-7 Accelerator Pedal Height

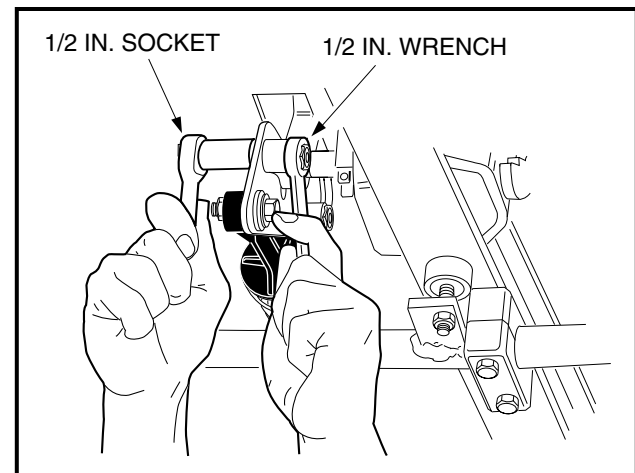


Figure 5-8 Accelerator Pedal Adjustment

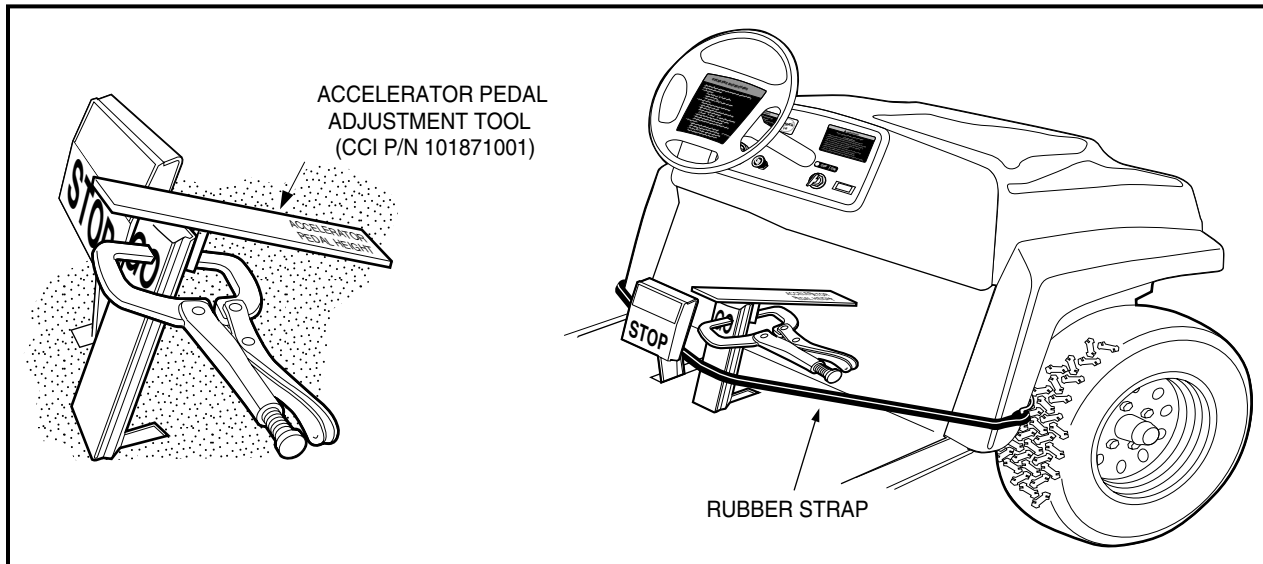


Figure 5-9 Accelerator Pedal Height Adjustment

8. To adjust the accelerator rod:
 - 8.1. Remove the electrical box screw and cover (**Figure 5-10, Page 5-9**). See the preceding **WARNING**.
 - 8.2. Loosen the jam nuts (18) and disconnect the accelerator rod (17) at the accelerator pedal (**Figure 5-11, Page 5-10**). Adjust the length of the rod so that the indicated cam edge is parallel with the edge of the electrical component box as shown (**Figure 5-10, Page 5-9**). See following **CAUTION**.

⚠ CAUTION

- After accelerator rod adjustment, make sure approximately the same amount of thread is exposed at each end of the rod.
- If lever on the limit switch in the electrical box is bent, replace limit switch.
- When loosening jam nuts on the accelerator rod with one end disconnected, hold the disconnected accelerator rod with locking pliers.
- When tightening jam nuts on the accelerator rod, hold the disconnected ball joint with locking pliers.

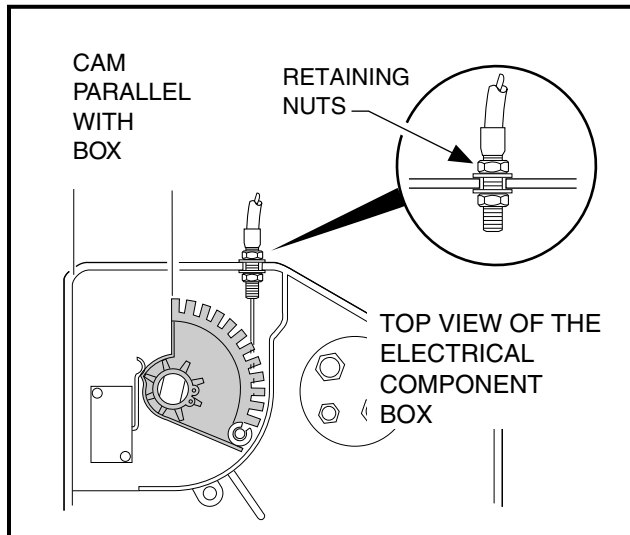


Figure 5-10 Accelerator Cable and Electrical Box

8.3. Reconnect the accelerator rod at the accelerator pedal (**Figure 5-11, Page 5-10**).

8.4. **Key-Start vehicles:**

8.4.1. Before tightening jam nuts on accelerator rod, depress accelerator pedal and make sure the carburetor throttle actuates when the pedal is depressed approximately 8° to 12°.

8.5. **Pedal-Start vehicles (refer to chart below):**

EVENT	APPROXIMATE PEDAL TRAVEL
Solenoid activation	4° to 8°
Carburetor throttle actuation	8° to 12°

NOTE: After the accelerator pedal and rod are adjusted, the final governed engine RPM should be set to:

FE350 Engine: 3800 (±30) RPM

FE400 Engine: 3850 (±30) RPM

See Engine RPM Adjustment, Section 14, Page 14-14.

- 8.6. Hold the ball joint at each end of the accelerator rod (17) with pliers and tighten the accelerator rod jam nuts (18) against each ball joint.
- 8.7. Ensure that the events occur as described in step 8.4 or 8.5 above.
- 8.8. Install the electrical box cover and screw.
- 8.9. Connect the spark plug wire to the spark plug.
- 8.10. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m).

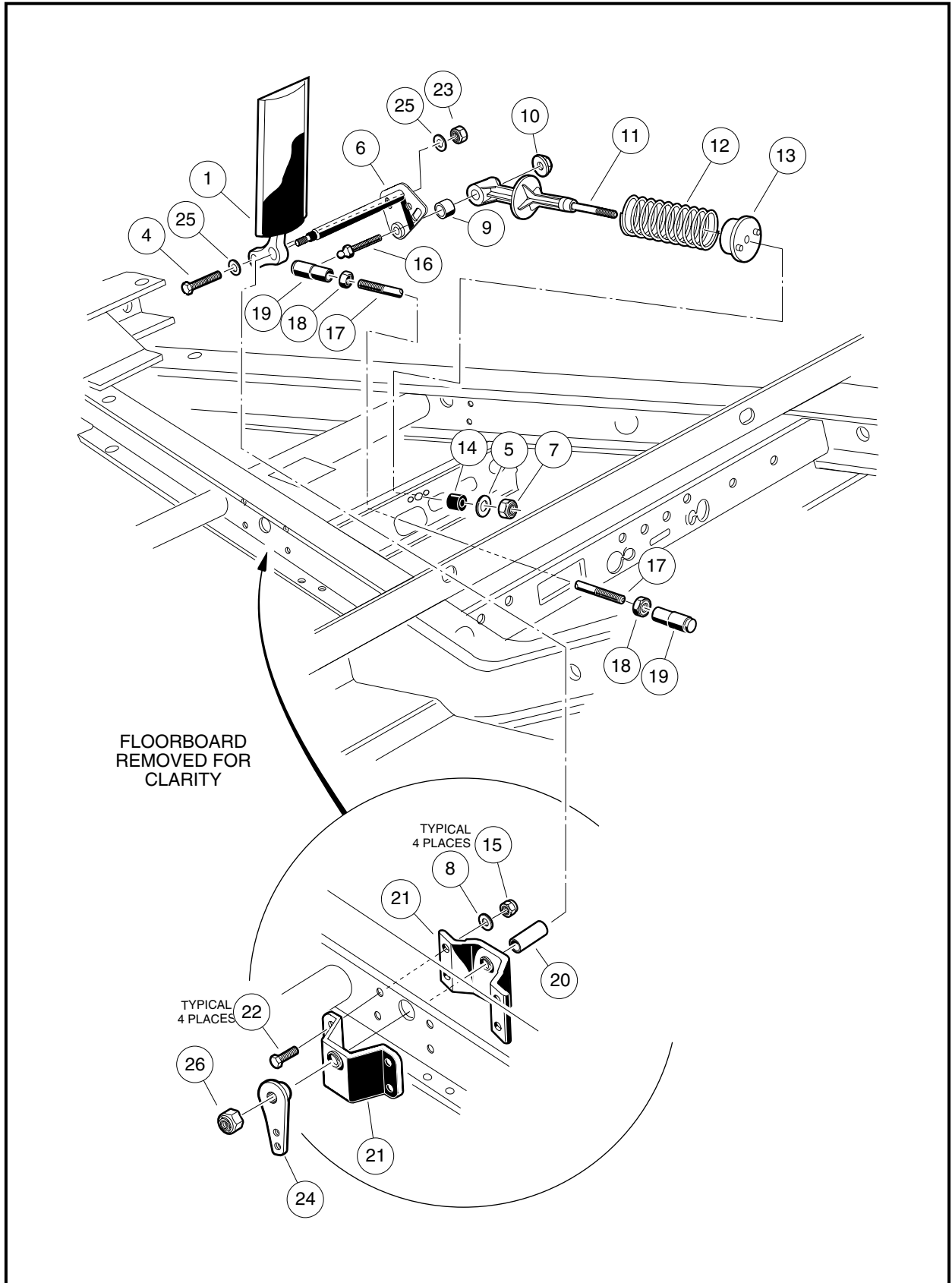


Figure 5-11 Accelerator Pedal Assembly

SECTION 6A – MC012C-AS00 TRANSAXLE: HYDRAULIC AND PARK BRAKE SYSTEMS

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Some aftermarket brake shoes contain asbestos fiber and asbestos dust is created when these brake mechanisms are handled. Wear approved eye and respiratory protection when disassembling and cleaning brake mechanisms. Inhalation of asbestos could result in severe personal injury or death. Do not use compressed air or aerosol sprays to clean the brake mechanism. Clean brake mechanisms using the negative pressure enclosure/HEPA vacuum system or low pressure/wet cleaning method per OSHA/29 cfr -1910.1001.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

The 272 vehicle is equipped with two types of shoe drum braking systems: a hydraulic, four-wheel braking system for normal stopping, and a hand-activated mechanical rear-wheel park brake system for retaining the vehicle when it is stationary.

The hydraulic brake system consists of a hydraulic brake cluster on each wheel and a master cylinder. Each cluster utilizes a hydraulic cylinder and two brake shoes. The wheel cylinders' dual-piston design ensures an even distribution of force on each pair of brake shoes. Each brake cluster utilizes a leading-trailing design.

TRANSAXLE IDENTIFICATION

The rear-wheel hydraulic brake system maintenance and service will vary slightly, depending on the type of transaxle provided on the vehicle. See **MC012C-AS00 Transaxle (Figure 6a-1, Page 6a-3)** and **MC010C-BS00 Transaxle (Figure 6a-2, Page 6a-3)**. Section 6a deals specifically with the MC012C transaxle. Section 6b deals specifically with the MC010C transaxle. See **Section 6b – MC010C-BS00 Transaxle: Hydraulic and Park Brake Systems**.

The mechanical park brake system for both the MC010C and MC012C transaxles on the 272 vehicle utilizes a hand-activated park brake. The park brake handle is located between the driver and passenger seats. It is provided with a brake cable equalizer and two park brake cables.

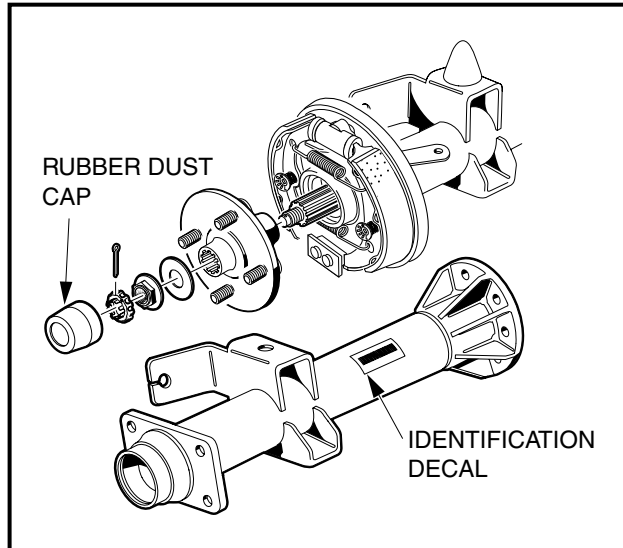


Figure 6a-1 MC012C-AS00 Transaxle

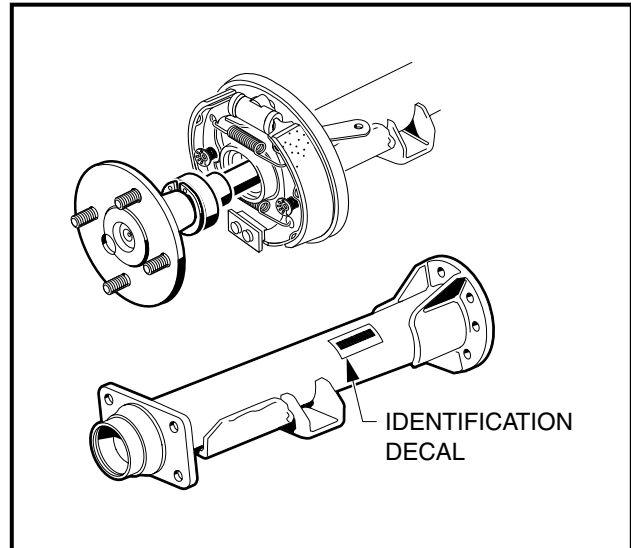


Figure 6a-2 MC010C-BS00 Transaxle

BRAKE SYSTEM INSPECTION

Read **DANGER** and **WARNING** on page 6a-1.

The hydraulic brake system and park brake system should be inspected immediately after any service to either of the brake systems.

Brake Pedal Inspection

- When driving the vehicle and pressing the brake pedal, the vehicle should come to a smooth, straight stop.
- Apply and release the brake pedal several times. If noise or binding occurs, the brake pedal or hydraulic brake system may be in need of service. Pedal movement should be smooth, and when the pedal is released, it should return quickly and quietly.
- Move the brake pedal from side to side to check for worn parts. Excessive side movement indicates worn or loose pedal mounting parts. If worn parts are found, replace the worn parts, then adjust the brake pedal. **See Brake Pedal Adjustment, Section 5, Page 5-6.**
- Apply heavy pressure to the pedal and check for sponginess and excessive pedal travel. The pedal should be firm, and the back of the brake pedal should be a minimum of 2 inches from the floor. If the brake pedal feels “spongy”, perform the brake bleeding procedure. **See Bleeding the Hydraulic Brake System on page 6a-33.**
- Hold the brake pedal depressed with medium foot pressure (25 to 35 lb.) for 15 seconds. The pedal should not continue dropping when pressed with a steady amount of pressure. If the pedal goes to the floor, inspect the hydraulic system for leaks and repair any worn or damaged components. After repair, bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6a-33.**

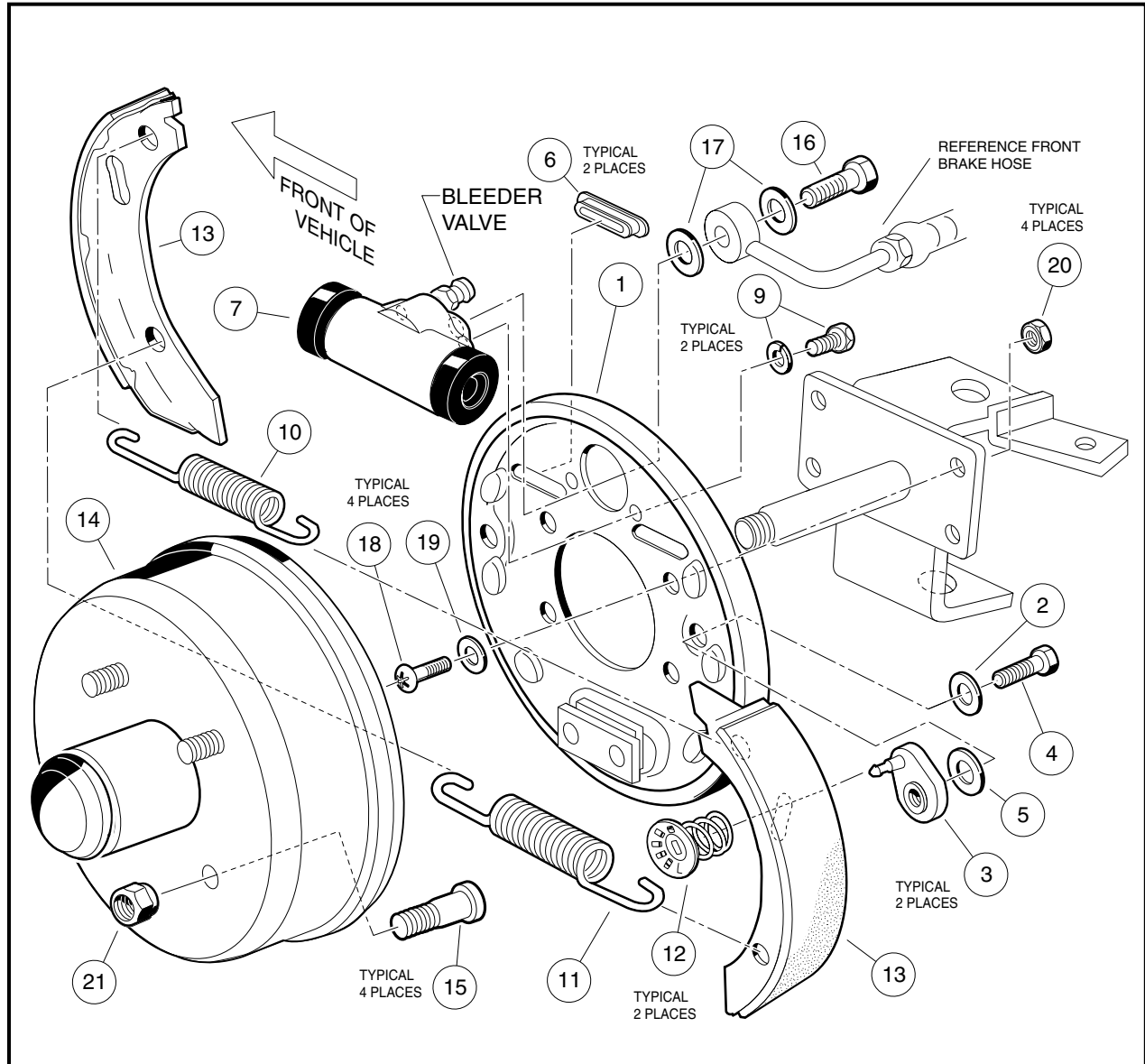


Figure 6a-3 Front Hydraulic Brake Cluster Assembly

Master Cylinder Inspection

- Inspect the exterior of the master cylinder. The presence of brake fluid on the exterior of the master cylinder indicates a brake fluid leak. Replace any leaking components and bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6a-33.**
- Check the brake fluid level. **See Brake Fluid, Section 10, Page 10-6.**
- Remove the reservoir cap and inspect the brake fluid. The brake fluid should be clean with no residue in the bottom of the reservoir or any other evidence of contamination. If brake fluid is contaminated, purge the brake fluid and refill the hydraulic system. **See Park Brake System on page 6a-37.**
- Check the vent holes in the reservoir cap. The vent holes should be clean and open. If the vent holes are not clean and open, clean or replace the cap.
- Check the diaphragm inside the reservoir cap. The diaphragm should not have holes or other damage. If the diaphragm is damaged, replace it before placing the vehicle in service.

Brake Line and Hose Inspection

- Inspect the brake lines. The brake lines should not be kinked, dented or damaged in any way. There should be no leakage from the brake lines or fittings. If a leak is discovered, replace the brake line. **See Hydraulic Line and Hose Replacement on page 6a-27.**
- Inspect the brake hoses. Hoses must be flexible and free from leaks, cuts, cracks or bulges. If the hoses do not pass inspection, replace as necessary. **See Hydraulic Line and Hose Replacement on page 6a-27.**
- Inspect the brake hoses at the front wheels. When turning the steering wheel all the way from left to right and back again, the hoses should not come in contact with any components, especially the wheels or tires.
- Check the back side of each brake cluster backing plate. The backing plates should be free from brake fluid and grease. If a brake hose or wheel cylinder shows signs of leaking, determine the cause of the leak and replace the brake hose or wheel cylinder. **See Wheel Cylinder Replacement on page 6a-23. Also See Hydraulic Line and Hose Replacement on page 6a-27.**

Park Brake Inspection

- Apply moderate pressure to the park brake handle. Tension should increase as the handle is pulled. When latched, the park brake should lock the wheels and hold the vehicle stationary (on incline of 20% or less). If the park brake does not function as described, adjust the park brake. **See Park Brake Adjustment on page 6a-39.**
- Check the park brake cables, equalizer and linkage. The cables should not be corroded, frayed or damaged and should move freely within the cable sheathing. The cables should not come in contact with either of the rear wheels or tires.

Brake Drum and Shoe Inspection

- Remove and inspect each brake drum. The drum should not be cracked or warped, or have excessive scores or heat checks.
- Inspect the brake shoes. Shoes should not be distorted, cracked or have broken welds.
- Check the condition of the brake shoe linings. The brake shoe lining should not be glazed or soiled with grease or brake fluid. There should be a minimum of 1/32-inch (0.8 mm) of usable lining remaining at the thinnest point.

WARNING

- **Use only approved replacement brake drums designed for your vehicle. For MC012C-AS00 transaxles, use CCI P/N 102264701.**

Brake Cluster Assembly Inspection

- Check each wheel cylinder (7) by pulling back the edge of each dust boot (**Figure 6a-3, Page 6a-4 or Figure 6a-21, Page 6a-25**). There should be no accumulation of brake fluid in the boot. Brake fluid in the boot indicates a leaking wheel cylinder. If there is fluid in the boot, replace the wheel cylinder. **See Wheel Cylinder Replacement on page 6a-23.**
- Inspect the shoe hold-down parts and springs. Shoe hold-down pins, springs and cups must be properly installed and not damaged.
- Inspect the automatic brake adjuster parts. If the adjusters (3) are frozen (requiring more than 65 in-lb (7.4 N·m) to turn freely), worn or loose, replace the adjuster assemblies in pairs (**Figure 6a-3, Page 6a-4**).

BRAKE SYSTEM TROUBLESHOOTING

With normal scheduled maintenance and replacement of worn parts, the hydraulic and park brake systems should provide trouble-free operation. In the event that a problem does occur, the following troubleshooting guide will be helpful in identifying operating difficulties. The guide includes the symptom, probable cause(s) and suggested checks. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Low pedal – Pedal may go to the floor	Excessive clearance between the drums and shoe linings	Front - Perform step 19 of Front Wheel Brake Drum Installation on page 6a-18. Rear - Perform step 4 of Rear Wheel Brake Drum Installation on page 6a-20.
	Automatic adjusters are not working	Make several forward and reverse brake stops; if the pedal does not come up, replace the automatic adjusters. See Brake Shoe Adjuster Replacement on page 6a-26.
	Bent or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Leak in the hydraulic system	Check the master cylinder, brake lines and hoses for leaks. Replace all damaged parts.
	Air in the hydraulic system	See Bleeding the Hydraulic Brake System on page 6a-33.
	Weak (bulging) brake hose	Replace the worn hose. See Hydraulic Line and Hose Replacement on page 6a-27.
	Improperly adjusted master cylinder push rod	See Brake Pedal Adjustment, Section 5, Page 5-6.
Springy or spongy brake pedal – Brake pedal has soft, springy or spongy feel when depressed	Bent or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Cracked or thin drums	Replace brake drums. See Brake Drum Removal on page 6a-9.
	Poor quality brake fluid (low boiling point)	Purge hydraulic fluid and fill with approved DOT 5 (silicone) brake fluid. See Purging the Hydraulic System on page 6a-35.
	Weak (bulging) brake hoses that expand under pressure	Check the master cylinder, brake lines and hoses for leaks or bulges. Replace all damaged parts.
	Air in the hydraulic system	See Bleeding the Hydraulic Brake System on page 6a-33.
Hard pedal – Excessive pedal pressure is required to stop the vehicle	Brake fade	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Grease or brake fluid on the brake shoe linings	Replace hub or axle seal and replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Glazed brake shoe linings	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Hard pedal, continued	Damaged or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Scored or barrel-shaped brake shoe drums	Replace the brake drums. See Brake Drum Removal on page 6a-9.
	Clogged master cylinder lines or hoses	Replace brake lines or hoses as required. See Hydraulic Line and Hose Replacement on page 6a-27.
	Frozen master cylinder piston	Replace master cylinder. See Master Cylinder Removal on page 6a-32.
Over-aggressive braking	Incorrect or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Grease or brake fluid on the brake shoe linings	Replace hub, axle seal or wheel brake cylinder and replace brake shoes. See Brake Shoe Removal on page 6a-11.
	Loose or distorted brake backing plate	Tighten or replace the back plate and/or hardware.
	Scored or warped brake drums	Replace the brake drums. See Brake Drum Removal on page 6a-9.
	Corroded master cylinder bore	Replace master cylinder. See Master Cylinder Removal on page 6a-32.
	Binding brake pedal linkage	Lubricate and adjust. See Section 5 – Accelerator and Brake Pedal Assemblies.
Vehicle pulls to one side	Incorrect or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Grease or brake fluid on the brake shoe linings	Replace hub, axle seal or wheel cylinder and replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Loose or distorted brake cluster backing plate	Tighten or replace the backing plate and/or hardware.
	Scored or warped brake drums	Replace the brake drums. See Brake Drum Removal on page 6a-9.
	Water on the brake shoe linings	Apply the brakes several times to dry the brake shoe linings.
	Sticking wheel cylinder piston	Replace the wheel cylinder. See Wheel Cylinder Replacement on page 6a-23.
	Faulty suspension parts	See Section 7 – Steering and Front Suspension or Section 9 – Rear Suspension.
Pulsating brake pedal	Warped brake drums	Replace the brake drums. See Brake Drum Removal on page 6a-9.
	Bent axle	Replace the axle. See Section 16a – MC012C-AS00 Unitized Transaxle with Differential Lock.
	Worn or damaged front wheel bearings	Replace bearings. See Section 7 – Steering and Front Suspension.
Decreasing brake pedal travel	Weak or broken brake shoe return springs	Replace return springs.
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Decreasing brake pedal travel, continued	Sticking wheel cylinder piston	Replace the wheel cylinder. See Wheel Cylinder Replacement on page 6a-23.
	Overly adjusted brake adjusters	Adjust brake adjusters. See Brake Shoe Adjuster Replacement on page 6a-26.
	Improperly adjusted park brake	Adjust park brake. See Park Brake Adjustment on page 6a-39.
Noise and chatter – Squealing, clicking or scraping sound upon brake application	Bent, damaged or incorrect brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Worn out brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Foreign material embedded in brake shoe linings	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Broken brake shoe return springs or hold down springs	Replace damaged parts.
	Rough, grooved or dry brake shoe ledges or backing plate bosses	Lubricate the bosses of the brake cluster backing plate, and/or replace the brake shoes. See Brake Cluster Inspection and Cleaning on page 6a-12. See Brake Shoe Removal on page 6a-11.
	Brake drums are cracked or scored	Replace the brake drums. See Brake Drum Removal on page 6a-9.
All brakes drag	Binding brake pedal	Lubricate and adjust. See Section 5 – Accelerator and Brake Pedal Assemblies.
	Soft or swollen rubber parts caused by incorrect or contaminated brake fluid	Replace master cylinder. See Master Cylinder Removal on page 6a-32.
Rear brakes drag	Binding park brake cables	Adjust or replace cables and adjust.
	Improper brake adjustment	Adjust shoes and repair the brake shoe adjusters if necessary. See Brake Cluster Inspection and Cleaning on page 6a-12.
One brake drags	Weak or broken brake shoe return springs	Replace the return springs.
	Improper brake shoe adjustment	Adjust shoes and repair the brake shoe adjusters if necessary. See Brake Cluster Inspection and Cleaning on page 6a-12.
	Sticking wheel cylinder pistons	Replace the wheel cylinder. See Wheel Cylinder Replacement on page 6a-23.
	Swollen wheel cylinder cups	Replace the wheel cylinder and purge the hydraulic system. See Wheel Cylinder Replacement on page 6a-23 and Purging the Hydraulic System on page 6a-35.
	Bent or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6a-11.
	Loose or worn front wheel bearings	Adjust or replace front wheel bearings. See Section 7 – Steering and Front Suspension.
	Damaged brake line or hydraulic line	Replace brake lines or tubes as required. See Hydraulic Line and Hose Replacement on page 6a-27.

BRAKE DRUM REMOVAL

Read **DANGER** and **WARNING** on page 6a-1.

FRONT WHEEL BRAKE DRUM REMOVAL

▲ WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6a-33.

1. To remove the front brake drums, place chocks at the rear wheels, release the park brake, loosen the front wheel lug nuts and lift the front of the vehicle with a chain hoist or floor jack.
2. Place jack stands under the outer front frame I-beams of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands. **See Figure 5-2, Section 5, Page 5-4.**
3. Remove the lug nuts and remove the front wheel.
4. To remove the front wheel brake drum:
 - 4.1. Remove the dust cover (1) (**Figure 6a-4, Page 6a-9**).
 - 4.2. Remove the cotter pin (2) (**Figure 6a-4, Page 6a-9**).
 - 4.3. Remove the castle nut (3), large flat washer (4), wheel bearing (5) and drum (8) from spindle (**Figure 6a-4, Page 6a-9**).
5. If the brake drum was easily removed, proceed to step 7. **See following NOTE.**

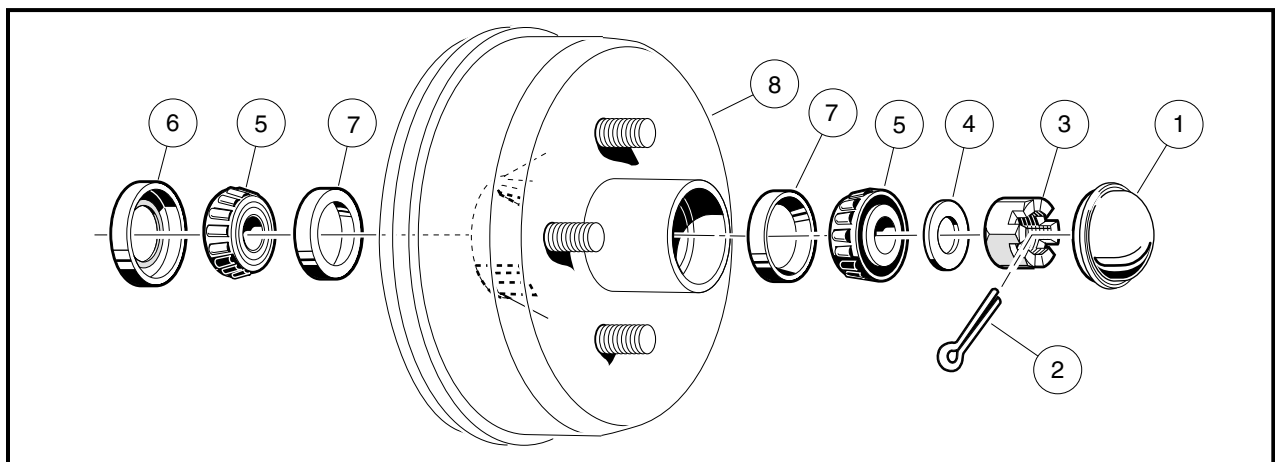


Figure 6a-4 Front Spindle and Brake Drum Assembly

6. To remove tight brake drums:
 - 6.1. On the back of each brake cluster assembly, locate the heads of the two brake shoe adjusters.
 - 6.2. Using a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts in order to increase the clearance between the brake shoe lining and the brake shoe drum (**Figure 6a-5, Page 6a-10**). **See following NOTE.**

Front Wheel Brake Drum Removal, Continued:

NOTE: If the adjusters require more than 65 in-lb (7.3 N-m) of force to rotate, they must be replaced. See **Brake Shoe Adjuster Replacement on page 6a-26.**

- Repeat steps 1 through 6 for the opposite front wheel if necessary.

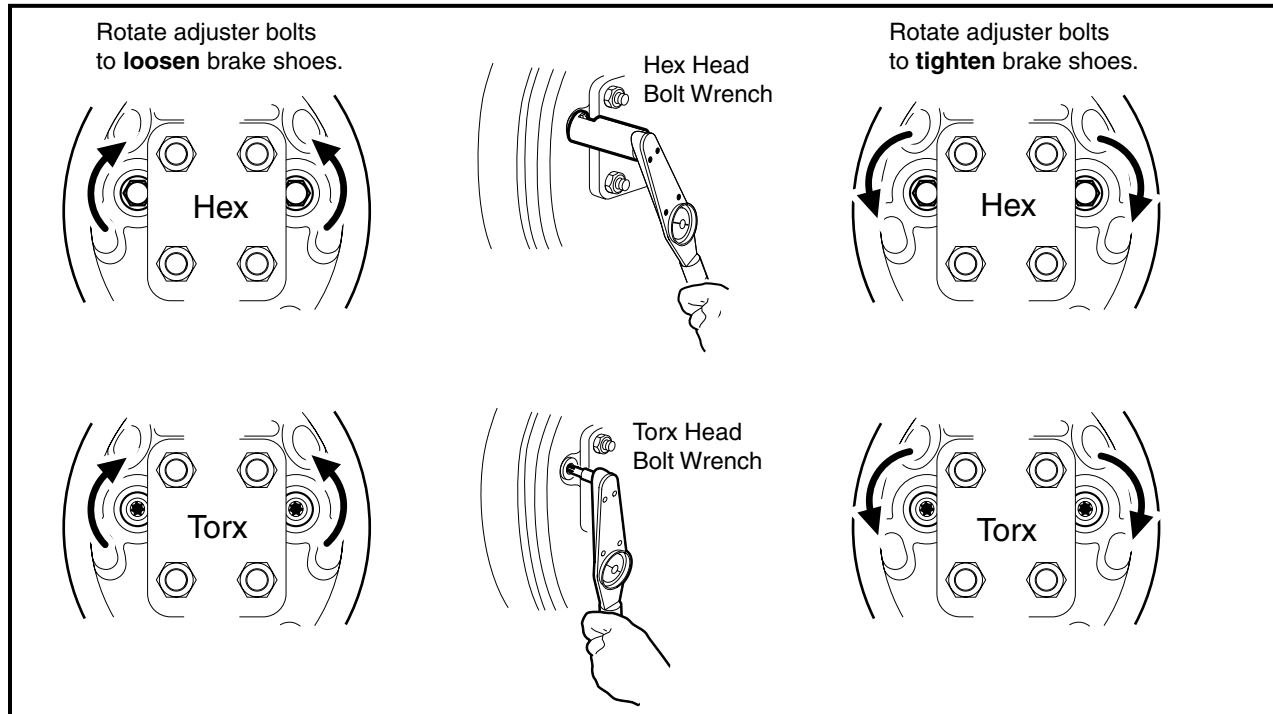


Figure 6a-5 Loosen or Tighten Brake Adjusters

REAR WHEEL BRAKE DRUM REMOVAL**⚠ WARNING**

- Use only approved replacement brake drums designed for your vehicle. For MC012C-AS00 transaxles, use CCI P/N 102264701.
- To remove the rear brake drums, place chocks at the front wheels, release the park brake, loosen the rear wheel lug nuts and lift the rear of the vehicle with a chain hoist or floor jack.
 - Place jack stands under the axle tubes to support the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.
 - Remove the lug nuts and remove rear wheel.
 - Remove the brake drum. If the brake drum was easily removed, proceed to step 6.
 - To remove tight brake drums:
 - On the back of each brake cluster assembly, locate the bolt heads of the two brake shoe adjusters.
 - Using a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts in order to increase the clearance between the brake shoe lining and the brake drum (**Figure 6a-5, Page 6a-10**). See following **NOTE**.

NOTE: If the adjusters require more than 65 in-lb (7.3 N-m) of force to rotate, they must be replaced. See **Brake Shoe Adjuster Replacement on page 6a-26.**

- 5.3. Rotate the brake drum slightly to remove it from the brake shoe cluster assembly.
6. Repeat steps 3 through 5 for the opposite rear wheel if necessary.

BRAKE SHOE REMOVAL

Read **DANGER** and **WARNING** on page 6a-1.

WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6a-33.

FRONT BRAKE SHOE REMOVAL

1. Brake drum removal is necessary prior to removing front brake shoes. See **Front Wheel Brake Drum Removal** on page 6a-9.
2. To remove front brake shoes:
 - 2.1. Use pliers or a brake tool and rotate the cup washer and compression spring assembly 90°. Remove the cup and spring from each brake shoe (**Figure 6a-6, Page 6a-12**).

NOTE: The brake shoes are under spring tension and can release suddenly when cup and spring assemblies are removed.

 - 2.2. Grasp both brake shoes and pull them and tensioning springs out of the brake cluster assembly (**Figure 6a-9, Page 6a-12**).
3. Repeat steps 1 and 2 for the opposite front wheel if necessary.

REAR BRAKE SHOE REMOVAL

1. Brake drum removal is necessary prior to removing the rear brake shoes. See **Rear Wheel Brake Drum Removal** on page 6a-10.
- NOTE:** It is recommended that the wheel bolt flange (22) be removed prior to brake shoe removal (**Figure 6a-7, Page 6a-12**).
2. Remove the rear wheel bolt flange on the MC012C transaxle.
 - 2.1. Remove rubber boot (26) from large flat washer (23) (**Figure 6a-7, Page 6a-12**).
 - 2.2. Remove cotter pin (25) from locking nut cap (27).
 - 2.3. Remove the locking nut cap (27) from the flanged nut (24).
 - 2.4. Remove the flanged nut (24) and large flat washer (23) from the axle end.
 - 2.5. Slide the wheel bolt flange (22) off of the splined axle end.
 3. Using pliers or a brake tool, rotate the cup washer and compression spring assembly 90° and remove the cup and spring from each brake shoe (**Figure 6a-8, Page 6a-12**).
- NOTE:** The brake shoes are under spring tension and can release suddenly when cup and spring assemblies are removed.
4. Grasp both brake shoes and pull them and the tensioning springs out of the brake cluster assembly (**Figure 6a-9, Page 6a-12**).
 5. Repeat steps 1 through 4 for the opposite rear wheel if necessary.

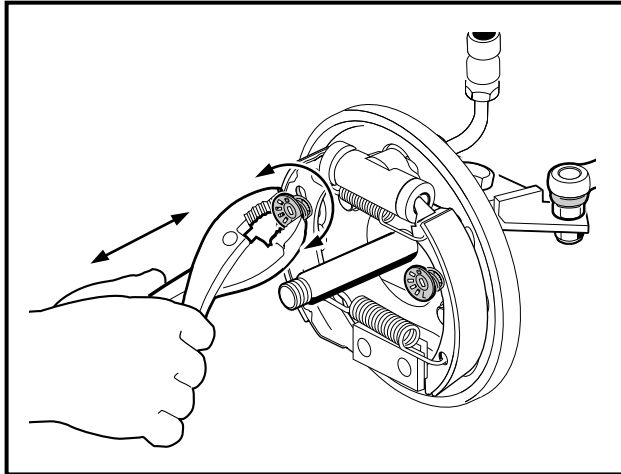


Figure 6a-6 Rotate Front Spring Cups

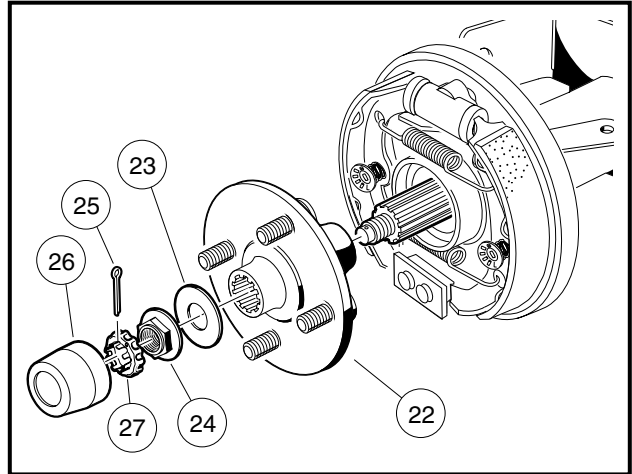


Figure 6a-7 Rear Wheel Bolt Flange Assembly

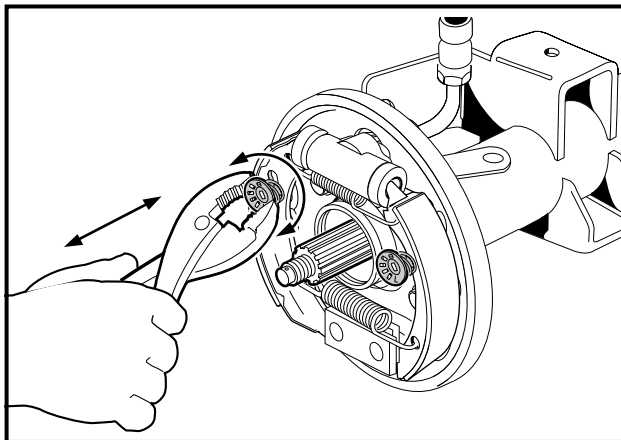


Figure 6a-8 Rotate Rear Spring Cups

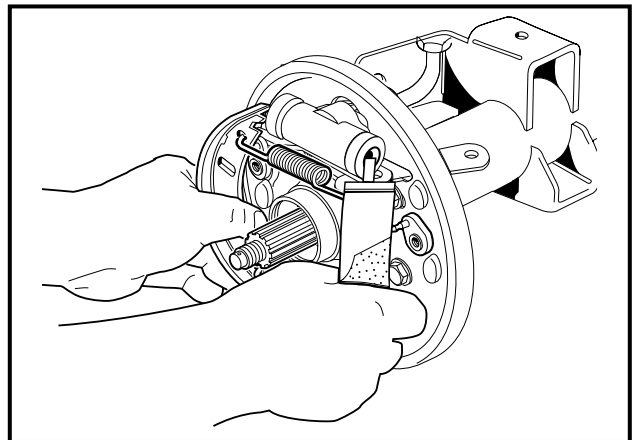


Figure 6a-9 Remove Brake Shoes

BRAKE CLUSTER INSPECTION AND CLEANING

Read **DANGER** and **WARNING** on page 6a-1.

⚠ WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6a-33.

NOTE: Factory installed brake shoes have non-asbestos linings (CCI P/N 102050201). When replacing brake shoes, Club Car, Inc., recommends non-asbestos replacement parts.

1. Remove the brake drum. See **Front Wheel Brake Drum Removal** on page 6a-9, and **Rear Wheel Brake Drum Removal** on page 6a-10.
2. Remove the brake shoes. See **Front Brake Shoe Removal** on page 6a-11, and **Rear Brake Shoe Removal** on page 6a-11.

3. Clean the brake cluster back plate and all of the brake cluster components.
4. Check the brake shoe adjusters in each brake cluster assembly for proper operation.
 - 4.1. With the brake shoes removed, use a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), and gently rotate the adjuster bolts (**Figure 6a-5, Page 6a-10**). See following **NOTE**.

NOTE: If the adjusters require more than 65 in-lb (7.3 N·m) of force to rotate, they must be replaced. See **Brake Shoe Adjuster Replacement on page 6a-26**.

5. Check the wheel cylinder for signs of leakage. If there are signs of leakage, replace the wheel cylinder. See **Wheel Cylinder Replacement on page 6a-23**.
6. Check all springs for loss of compression or tension and damage. Replace weak springs and any damaged or badly worn parts.
7. If a brake cluster assembly shows signs of excessive wear or damage, replace the cluster assembly. See **Brake Cluster Assembly Replacement on page 6a-20**.

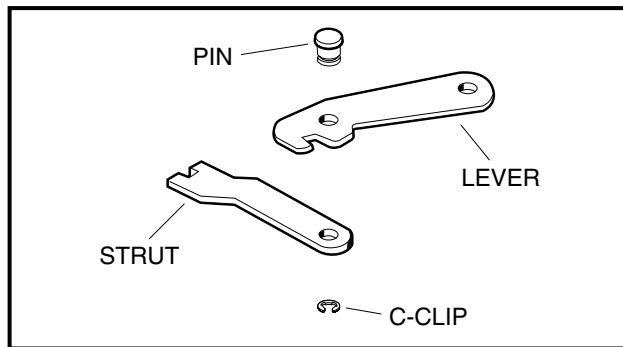
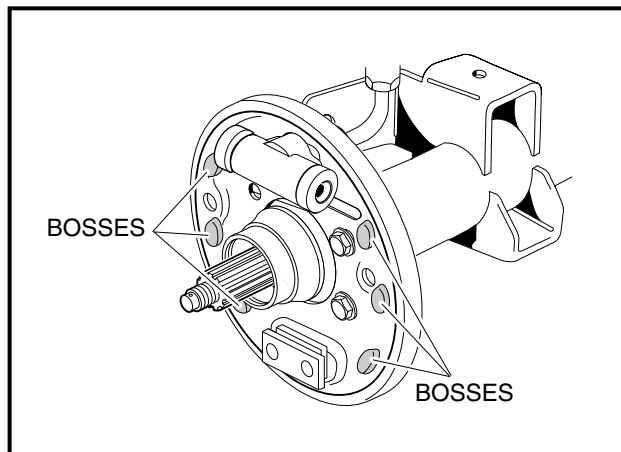
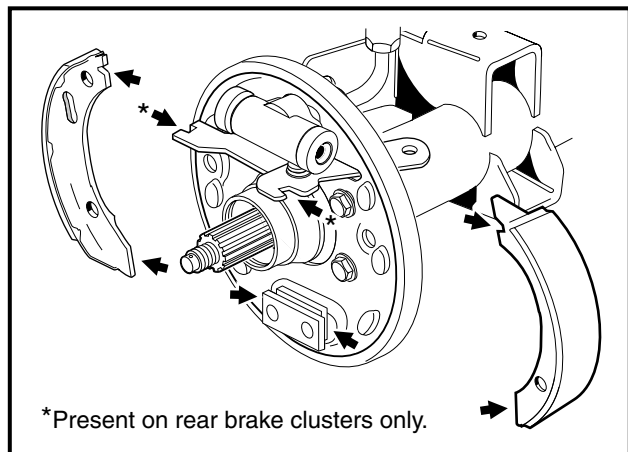


Figure 6a-10 Park Brake Lever and Strut

8. For the rear brake clusters, ensure that the park brake lever and strut assembly (14) can be easily moved by hand (**Figure 6a-21, Page 6a-25**). If the assembly can be easily moved by hand, proceed to step 10. If the assembly cannot be easily removed by hand, cleaning and lubrication will be necessary.
9. Clean and lubricate the rear park brake lever and strut.
 - 9.1. Remove the park brake cable hair spring clip (1), hair spring cotter pin (2), and clevis pin (3) from the cable clevis and strut (**Figure 6a-18, Page 6a-22**).
 - 9.2. Remove the lever and strut (14) from the brake cluster assembly (**Figure 6a-21, Page 6a-25**).
 - 9.3. Disassemble the lever and strut by removing the C-clip and pin (**Figure 6a-10, Page 6a-13**).
 - 9.4. Use a wire brush to remove corrosion and contaminants from the contact areas of the strut and lever.
 - 9.5. Use a small brush to carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning® BR2-Plus or equivalent) to the pin and contact surfaces and reassemble the lever and strut. See following **WARNING**.

▲ WARNING

- Make sure the C-clip is properly seated in the groove of the pin. An improperly installed C-clip could result in a non-functioning park brake.
- Apply grease carefully when performing the following steps. Do not allow any grease to get on the friction surfaces of the brake shoe pads. Failure to heed this warning could cause diminished brake performance, possibly resulting in property damage or severe personal injury.

Brake Cluster Inspection and Cleaning, Continued:**Figure 6a-11 Lubricate Raised Bosses****Figure 6a-12 Lubricate Rear Brake Cluster**

10. Use a small brush to carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning BR2-Plus or equivalent) on each of the six raised bosses on the brake cluster back plate (**Figure 6a-11, Page 6a-14**). **See preceding WARNING.**
11. Use a small brush to carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning BR2-Plus or equivalent) to each end of both brake shoes and into the slots in the brake shoe mounting block as shown. For rear brake clusters, apply grease to the notches in the mechanical park brake mechanism as shown (**Figure 6a-12, Page 6a-14**). **See preceding WARNING.**
12. Repeat steps 1 through 11 for the remaining brake cluster assemblies if necessary.

BRAKE SHOE INSTALLATION

Read **DANGER** and **WARNING** on page 6a-1.

⚠ WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6a-33.

NOTE: Unlike some other brake systems, the 272 vehicle uses a pair of identical brake shoes in each front and rear brake cluster. While a brake shoe may be installed on either the left-hand or right-hand side of the brake cluster assembly, the shoe must be positioned so that the adjuster pin is inserted into the slot of the brake shoe as illustrated (**Figure 6a-13, Page 6a-15**).

FRONT BRAKE SHOE INSTALLATION

1. Install one front brake shoe onto the brake cluster back plate, positioning the bottom tip of the shoe into the brake shoe mounting block, and the top tip of the shoe into the wheel cylinder piston.

2. Install the cup washer and compression spring assembly (12) onto the pin of the adjuster assembly (3) of the brake shoe (**Figure 6a-3, Page 6a-4**). Compress the cup and spring with a pair of pliers or a brake tool and rotate 90° to secure the brake shoe to the brake cluster back plate (**Figure 6a-8, Page 6a-12**).

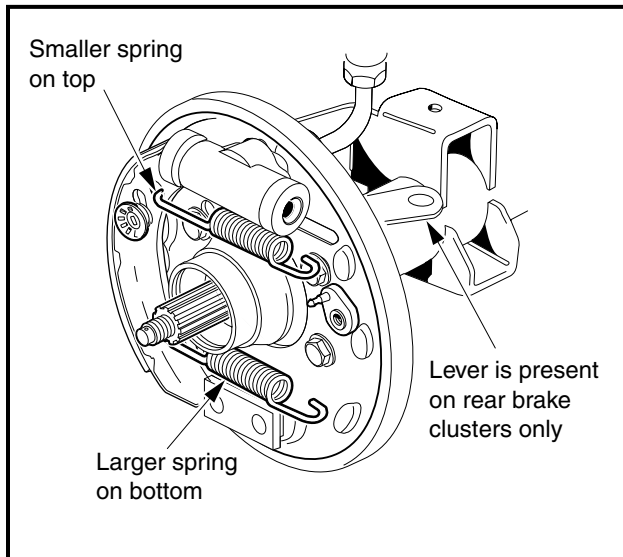


Figure 6a-13 Brake Shoe Tensioning Springs

3. Attach the tensioning springs onto the shoe already installed, with the smaller spring on top and the larger spring on the bottom. Make sure that the park brake strut and lever are engaged into the slots provided in each shoe, located immediately above the smaller spring attachment holes (**Figure 6a-13, Page 6a-15**).
4. Position the bottom tips of both shoes into the brake shoe mounting block, the top tips of the shoes into the slots in the wheel cylinder pistons, and the park brake lever and strut into the slots in the shoes located just below the top, smaller spring. Attach the free ends of the tensioning springs to the loose shoe and push the shoe into place (**Figure 6a-14, Page 6a-15**).

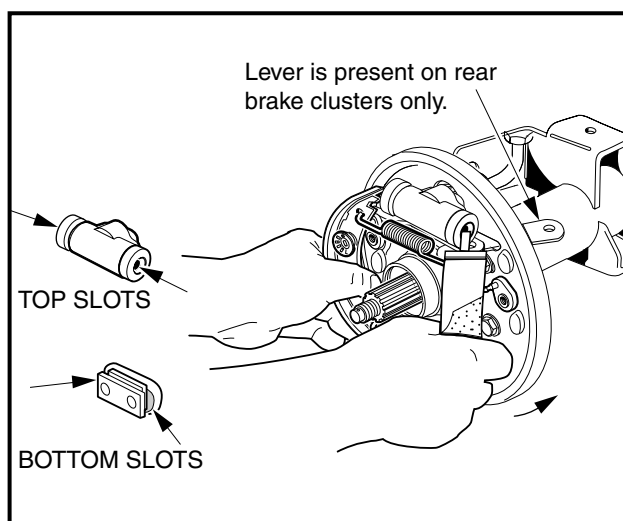


Figure 6a-14 Brake Shoe Installation

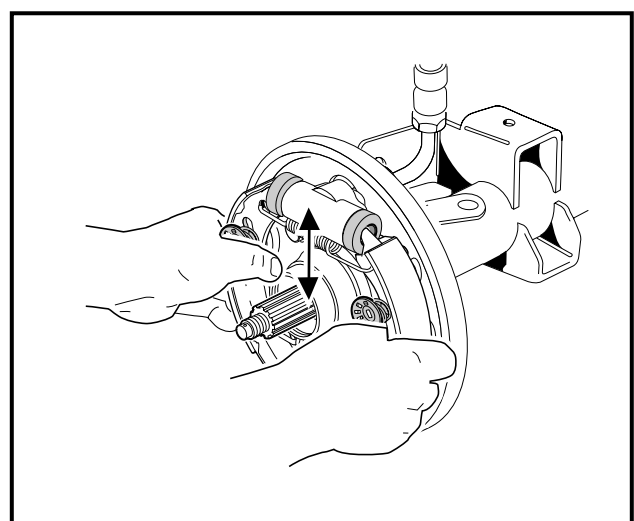


Figure 6a-15 Slide Brake Shoes

Front Brake Shoe Installation, Continued:

5. Install the remaining cup washer and compression spring assembly (12) onto the pin of the adjuster (3) of the brake shoe (**Figure 6a-6, Page 6a-12**) described in step 2 above.
6. After the shoes are installed, move them together up and down approximately 1/4 to 3/8-inch (6.3 to 9.5 mm) to make sure that they will slide easily without binding (**Figure 6a-15, Page 6a-15**).
7. Install the front wheel brake drum. **See Front Wheel Brake Drum Installation on page 6a-17.**
8. Repeat steps 1 through 7 for the remaining front wheel if necessary.
9. Bleed the front brakes as instructed. **See Bleeding the Hydraulic Brake System on page 6a-33.**
10. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

REAR BRAKE SHOE INSTALLATION

1. Install rear brake shoes on MC012C transaxle.
 - 1.1. Install one rear brake shoe onto the brake cluster back plate, positioning the bottom tip of the shoe into the brake shoe mounting block, and the top tip of the shoe into the wheel cylinder piston.
 - 1.2. Install the cup washer and compression spring assembly (12) onto the pin of the adjuster assembly (3) of the brake shoe (**Figure 6a-21, Page 6a-25**). Compress the cup and spring (12) with a pair of pliers or a brake tool and rotate 90°, securing the brake shoe to the brake cluster back plate (**Figure 6a-8, Page 6a-12**).
 - 1.3. Attach the tensioning springs onto the shoe already installed (**Figure 6a-13, Page 6a-15**).
 - 1.4. Position the bottom tip of the remaining shoe into the brake shoe mounting block, and the top tip of the shoe into the slot in the wheel cylinder piston. Attach the free ends of tensioning springs to the shoe and push the shoe into place (**Figure 6a-14, Page 6a-15**).
 - 1.5. Install the remaining cup washer and compression spring assembly (12) onto the pin of the adjuster assembly (3) of the brake shoe (**Figure 6a-21, Page 6a-25**) described in step 1.2 above.
 - 1.6. After the shoes are installed, move them together up and down to make sure that they will slide easily approximately 1/4 to 3/8-inch (6.3 to 9.5 mm) without binding (**Figure 6a-15, Page 6a-15**).
2. Repeat step 1 for the remaining rear wheel if necessary.
3. Install the wheel bolt flange on MC012C transaxle. **See following NOTE.**

NOTE: Clean splined area in the wheel bolt flange and on the splined end of axle before installation. Use a small brush to carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning BR2-Plus or equivalent) to both prior to assembly.

- 3.1. Slide wheel bolt flange (22) onto splined axle (**Figure 6a-7, Page 6a-12**).
- 3.2. Slide the large flat washer (23) onto the end of the axle and up against the wheel bolt flange. **See following NOTE.**

NOTE: It is recommended that a light film of white lithium NLGI Number 2 grease (Dow Corning BR2-Plus or equivalent) be applied to both surfaces of the large washer (23) before the flanged nut (24) is installed and torqued to specification.

- 3.3. Attach the flanged nut (24) and tighten to 150 ft-lb (203 N·m).
- 3.4. Install the locking nut cap (27) onto the flanged nut (24).
- 3.5. Position the locking nut cap (27) to provide clear passage for a new cotter pin (27).
- 3.6. Install a new cotter pin (25) through the locking nut cap and axle, bending the split ends of the pin to secure the locking nut cap (27). **See following WARNING.**

▲ WARNING

- **Make sure to install and bend the cotter pin. Failure to bend the cotter pin could result in the separation of the wheel bolt flange from the splined end of the axle. Loss of vehicle control could result, causing severe personal injury.**

3.7. Install the rubber boot (26) onto the large washer (23).

NOTE: Push the rubber boot onto the washer so that the washer edge fits into the boot-lip groove.

4. Install rear wheel brake drum. **See Rear Wheel Brake Drum Installation on page 6a-19.**
5. Repeat steps 3 through 4 for the remaining rear wheel if necessary.
6. Bleed the rear brakes as instructed. **See Bleeding the Hydraulic Brake System on page 6a-33.**
7. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

BRAKE DRUM INSTALLATION

Read **DANGER** and **WARNING** on page 6a-1.

▲ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6a-33.**
- **Worn or damaged brake drums cannot be machined. Replace as necessary.**
- **Use only approved replacement brake drums designed for your vehicle. For MC012C-AS00 transaxles, use CCI P/N 102264701.**

FRONT WHEEL BRAKE DRUM INSTALLATION

NOTE: Prior to installing the brake drum, inspect the brake lines, hoses, drums and brake cluster assemblies. **See Brake System Inspection on page 6a-3.**

Clean any residual grease from the friction area of the brake drum prior to installation.

1. Clean the wheel bearings (5) (**Figure 6a-4, Page 6a-9**). **See following NOTE.**

NOTE: Do not use compressed air to dry wheel bearings after cleaning. Spinning the wheel bearings at accelerated speeds, for purposes of drying, can damage bearings and bearing race.

- 1.1. Inspect the wheel bearings (5) for damage, pitting, or wear.
- 1.2. Inspect the wheel bearings to make sure there is no dirt or debris trapped in the rollers.
2. Replace wheel bearings if they are damaged, pitted, or show signs of uneven wear areas. **See following NOTE.**

NOTE: If the wheel bearings must be replaced, new bearing cups must be provided. New bearing cups are only available as an assembled part of each wheel hub. Refer to the illustrated parts manual for replacement part number of the wheel hub (**Figure 6a-4, Page 6a-9**).

Front Wheel Brake Drum Installation, Continued:

3. Inspect the bearing cups (7) for wear or damage. If they are worn or pitted they must be replaced, along with their respective wheel hub as an assembly.
4. Pack the wheel bearings (5) and lubricate the bearing cups (7) with Chassis Lube (EP NLGI Grade 2). Make sure the grease is forced between the rollers.
5. Lubricate spindle shaft with grease.
6. Install a new seal (6) and grease packed wheel bearing (5) into rear of hub (8) (**Figure 6a-4, Page 6a-9**).
7. Carefully apply grease around the seal (6) inner lip before installation. Do not allow grease to touch the brake shoe linings nor the brake shoe surface of the drum hub.
8. Place the brake drum hub (8) onto the spindle and brake cluster assembly.
9. If the brake drum is difficult to push over the brake shoes, use the following procedure:
 - 9.1. On the back of each brake cluster assembly, locate the bolt heads of the two brake shoe adjusters.
 - 9.2. Using a torque wrench and a Torx #27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts to increase the clearance between the brake shoe lining and the brake drum (**Figure 6a-16, Page 6a-19**). **See following NOTE.**

NOTE: *If the adjusters require more than 65 in-lb (7.3 N·m) of force to rotate, they must be replaced. See **Brake Shoe Adjuster Replacement on page 6a-26.***

10. Fill the brake drum hub cavity with grease.
11. Install the outside bearing (5) onto the spindle (**Figure 6a-4, Page 6a-9**).
12. Install the flat washer (4) up against the bearing race.
13. Install the castle nut (3) onto the spindle finger-tight.
14. Rotate the brake drum slowly while gently tightening the castle nut (3) until the drum hub and bearings are properly seated.
15. Tighten the castle nut (3) to 10 ft-lb (13.6 N·m) in order to fully seat the bearing and cup.
16. Loosen the castle nut 1/2 turn and retighten the nut to 14 in-lb (1.6 N·m).
17. Install a new cotter pin (2), bending the split ends of the pin to secure the castle nut. **See following WARNING, CAUTION, and NOTE.**

 WARNING

- **Make sure to install and bend the cotter pin. Failure to bend the cotter pin could result in the separation of the wheel from the spindle. Loss of vehicle control could result, causing severe personal injury.**

 CAUTION

- **Use a new cotter pin when installing the drum/hub assembly.**

NOTE: *If the cotter pin does not line up with the hole in the spindle when the castle nut is properly tightened, rotate the castle nut back until the next available notch allows the cotter pin to be installed.*

18. Install the dust cover (1) (**Figure 6a-4, Page 6a-9**).
19. With the brake drum properly seated and secured, use a torque wrench with a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), and gently adjust the clearance between the brake shoe lining and brake drum by turning each of the two adjuster bolt heads on the back of the brake cluster plate as shown (**Figure 6a-16, Page 6a-19**). **See following CAUTION.**

▲ CAUTION

- Do not apply more than 65 in-lb (7.3 N-m) of torque to any of the adjuster bolts. Overtightening the adjuster bolts could result in damage to the brake cluster components or the separation of the bolt (4) from the adjuster (3) (Figure 6a-3, Page 6a-4 or Figure 6a-21, Page 6a-25).

20. Install the wheel and finger-tighten the lug nuts (21) (Figure 6a-3, Page 6a-4).
21. Repeat steps 1 through 20 for the opposite front wheel as required.
22. Lower the vehicle and finish tightening the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N-m).
23. Check the front wheel free play. **See Front Wheel Free Play Inspection, Section 7, Page 7-21.**
24. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted correctly and are operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

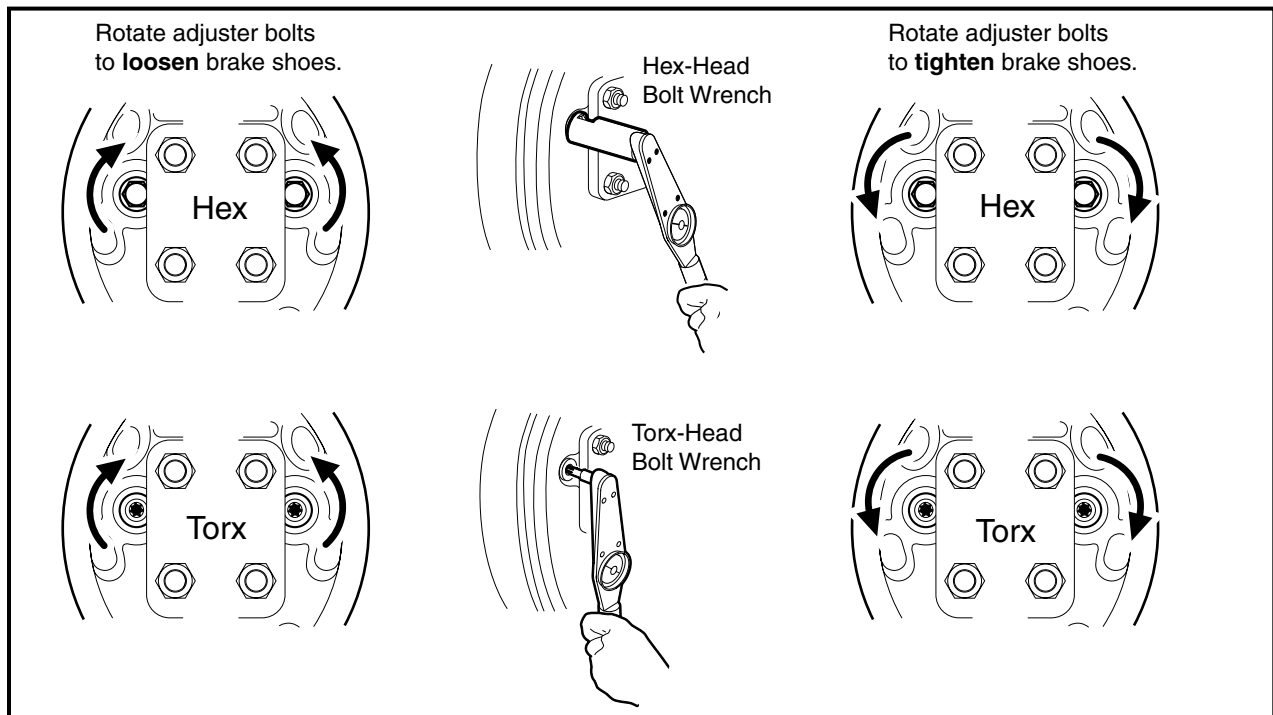


Figure 6a-16 Loosen or Tighten Brake Adjusters

REAR WHEEL BRAKE DRUM INSTALLATION

NOTE: Prior to installing the brake drum, inspect the brake lines, hoses, drums and brake cluster assemblies. **See Brake System Inspection on page 6a-3.**

▲ WARNING

- Use only approved replacement brake drums designed for your vehicle. For MC012C-AS00 transaxles, use CCI P/N 102264701.

1. Place the brake drum (15) onto the wheel bolt flange and brake cluster (Figure 6a-21, Page 6a-25).

Rear Wheel Brake Drum Installation, Continued:

NOTE: If brake drum installation is difficult, the brake shoes may need to be adjusted vertically in the mounting slots.

- Using a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts to increase the clearance between the brake shoe lining and the brake drum (Figure 6a-16, Page 6a-19). See following NOTE.

NOTE: If the adjusters require more than 65 in-lb (7.3 N·m) of force to rotate, they must be replaced. See **Brake Shoe Adjuster Replacement on page 6a-26.**

- Rotate and gently press the brake drum to ensure that the drum is properly seated.
- With the brake drum properly seated and secured, use a torque wrench with a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), and gently adjust the clearance between the brake shoe lining and brake drum by turning each of the two adjuster bolt heads on the back of the brake cluster plate as shown (Figure 6a-16, Page 6a-19). See following CAUTION.

 CAUTION

- Do not apply more than 65 in-lb (7.3 N·m) of torque to any of the adjuster bolts. Overtightening the adjuster bolts could result in damage to the brake cluster components or the separation of the bolt (4) from the adjuster (3) (Figure 6a-3, Page 6a-4 or Figure 6a-21, Page 6a-25).
- Install the wheel and finger-tighten the lug nuts (21) (Figure 6a-21, Page 6a-25).
 - Repeat steps 1 through 5 for the opposite rear wheel as required.
 - Lower the vehicle and finish tightening the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
 - Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. See **Brake System Inspection on page 6a-3.**

BRAKE CLUSTER ASSEMBLY REPLACEMENT

Read **DANGER** and **WARNING** on page 6a-1.

 WARNING

- To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System on page 6a-33.**
- Worn or damaged brake drums must not be machined. Replace as necessary.
- Use only approved replacement brake drums designed for your vehicle. For MC012C-AS00 transaxles, use CC P/N 102264701.

FRONT BRAKE CLUSTER ASSEMBLY REMOVAL

- Remove front wheel brake drum. See **Front Wheel Brake Drum Removal on page 6a-9.**
- Remove the banjo bolt (16) and copper washers (17) from the brake cluster front hose assembly (Figure 6a-3, Page 6a-4).

- To avoid spilling brake fluid, lift the hose above the brake cluster assembly and place a plastic bag over the hose fitting to keep dirt and debris from entering the hydraulic brake system (**Figure 6a-17, Page 6a-21**).
- Using a Torx #T-40 driver, remove the four Torx-head bolts (18), washers (19) and lock nuts (20) that secure the brake cluster and back plate assembly to the front spindle plate (**Figure 6a-3, Page 6a-4**).

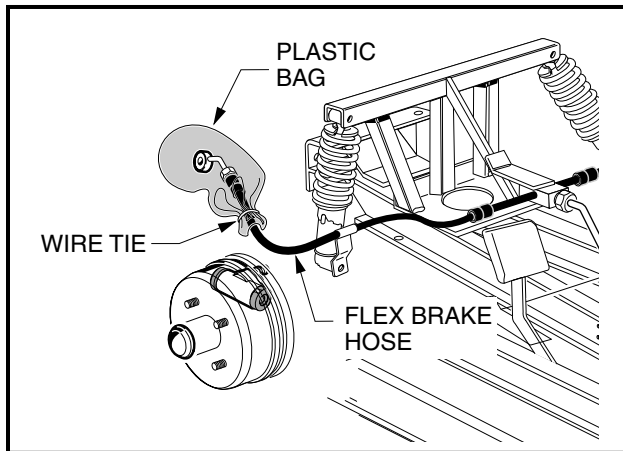


Figure 6a-17 Front Brake Hose With Plastic Bag

FRONT BRAKE CLUSTER ASSEMBLY INSTALLATION

- Use only new hardware for this step. Install the brake cluster back plate to the front spindle flange using four Torx-head bolts (18), washers (19) and lock nuts (20). Using a torque wrench with Torx #T-40 driver, tighten all four bolts to 76 in-lb (8.6 N-m) (**Figure 6a-3, Page 6a-4**).

⚠ CAUTION

- Do not substitute hex-head bolts for Torx-head bolts. Hex-head bolts can interfere with the proper operation of the brake shoe adjusters.
- Install a new banjo bolt (16) and new copper washers (17) to the front brake cluster wheel cylinder (7). Position the elbow of the brake hose toward the rear of the vehicle. Tighten the banjo bolt to 13 ft-lb (17.6 N-m) (**Figure 6a-3, Page 6a-4**).
 - Install front wheel brake drum. **See Front Wheel Brake Drum Installation on page 6a-17.**
 - Bleed the front wheel brakes. **See Bleeding the Hydraulic Brake System on page 6a-33.**
 - Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

REAR BRAKE CLUSTER ASSEMBLY REMOVAL

- Remove rear brake drum. **See Rear Wheel Brake Drum Removal on page 6a-10.**
- Remove rear brake shoes. **See Rear Brake Shoe Removal on page 6a-11.**
- Remove park brake cable clip (1), hair spring cotter pin (2) and clevis pin (3) (**Figure 6a-18, Page 6a-22**).
- Remove the cable from the cable support bracket (**Figure 6a-18, Page 6a-22**).

Rear Brake Cluster Assembly Removal, Continued:

5. Slide the cable so that the coiled spring wire, covering the cable wire, can be fed through the slot in the support bracket, and then removed.
6. Using a 3/8-inch flare nut wrench, remove the brake hose fitting from the rear brake cluster wheel cylinder (Figure 6a-19, Page 6a-22).
7. To avoid spilling brake fluid, lift the hose above the brake cluster assembly and place a plastic bag over the hose fitting to keep dirt and debris from entering the hydraulic braking system (Figure 6a-20, Page 6a-22).
8. Using a Torx #T-40 driver, remove the four Torx-head bolts (16), washers (17), and lock nuts (18) that secure the brake cluster back plate to the axle tube flange (Figure 6a-21, Page 6a-25).
9. Repeat steps 1 through 8 for the opposite rear wheel if necessary.

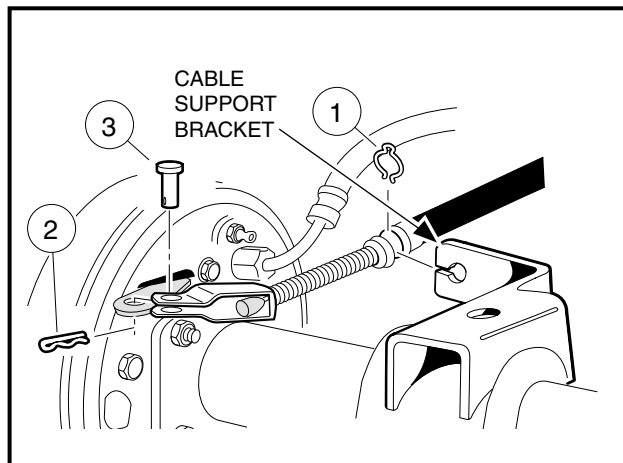


Figure 6a-18 Park Brake Cable

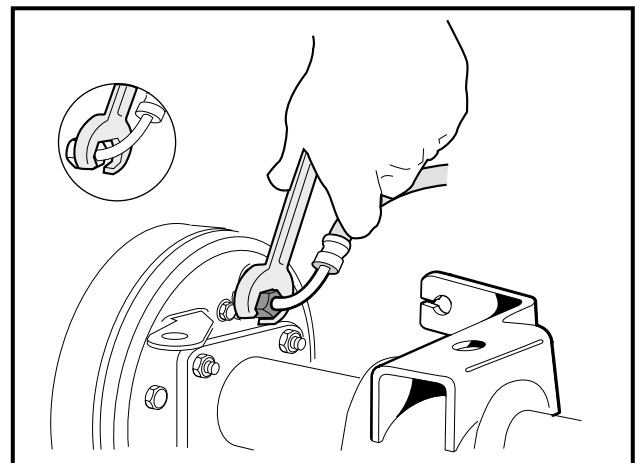


Figure 6a-19 Rear Brake Hose Flare Nut

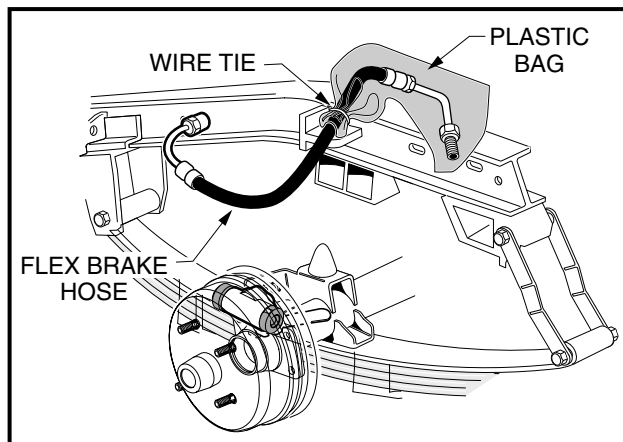


Figure 6a-20 Rear Brake Hose With Plastic Bag

REAR BRAKE CLUSTER ASSEMBLY INSTALLATION

1. Use only new hardware for this step. Install the brake cluster back plate to the axle tube flange with four Torx-head bolts (16), washers (17), and lock nuts (18). Using a torque wrench with Torx #T-40 driver, tighten all four bolts to 76 in-lb (8.6 N·m) (Figure 6a-21, Page 6a-25). **See following CAUTION.**

▲ CAUTION

- **Do not substitute hex-head bolts for Torx-head bolts. Hex-head bolts can interfere with the proper operation of the brake shoe adjusters.**
2. Connect the brake hose fitting to the brake cluster wheel cylinder with a 3/8-inch flare nut wrench. Tighten the flare nut fitting to 11 ft-lb (14.9 N·m) (**Figure 6a-21, Page 6a-25**).
 3. Install the park brake cable into the cable support bracket by sliding the coiled spring wire through the slot in the bracket and feed the clevis end to the park brake lever (**Figure 6a-18, Page 6a-22**).
 4. Install the park brake cable clip (1), clevis pin (3) and hair spring cotter pin (2) (**Figure 6a-18, Page 6a-22**).
 5. Install rear brake shoes. **See Rear Brake Shoe Installation on page 6a-16.**
 6. Install rear wheel brake drum. **See Rear Wheel Brake Drum Installation on page 6a-19.**
 7. Repeat steps 1 through 6 for the opposite rear wheel if necessary.
 8. Bleed the rear wheel brakes. **See Bleeding the Hydraulic Brake System on page 6a-33.**
 9. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

WHEEL CYLINDER REPLACEMENT

Read **DANGER** and **WARNING** on page 6a-1.

▲ WARNING

- **To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6a-33.**

FRONT WHEEL CYLINDER REMOVAL

1. Remove front brake drum. **See Front Wheel Brake Drum Removal on page 6a-9.**
2. Remove front brake shoes. **See Front Brake Shoe Removal on page 6a-11.**
3. Remove the banjo bolt (16) and two copper washers (17) from the front brake cluster wheel cylinder (7) (**Figure 6a-3, Page 6a-4**).
4. To avoid spilling brake fluid, lift the hose above the brake cluster assembly and place a plastic bag over the hose fitting to keep dirt and debris from entering the hydraulic brake system (**Figure 6a-17, Page 6a-21**).
5. Remove two bolts (9) and lock washers that secure the wheel cylinder to the brake cluster back plate (1), and remove the wheel cylinder (7) (**Figure 6a-3, Page 6a-4**).
6. Repeat steps 1 through 5 for the remaining front wheel if necessary.

FRONT WHEEL CYLINDER INSTALLATION

1. Install wheel cylinder (7) with two (9) bolts and lock washers to the brake cluster back plate (1) (**Figure 6a-3, Page 6a-4**). Tighten the two bolts to 120 in-lb (13 N·m). **See following NOTE.**

NOTE: *It is recommended that new bolts be used for installation of the wheel cylinder. Use M6 x 10 mm bolts.*

Front Wheel Cylinder Installation, Continued:

2. Install a new banjo bolt (16) and new copper washers (17) to the front brake cluster wheel cylinder (7). Position the elbow of the brake hose toward the rear of the vehicle. Tighten the banjo bolt to 13 ft-lb (17.6 N·m) (**Figure 6a-3, Page 6a-4**).
3. Install front brake shoes. **See Front Brake Shoe Installation on page 6a-14.**
4. Install front wheel brake drum. **See Front Wheel Brake Drum Installation on page 6a-17.**
5. Repeat steps 1 through 4 for the remaining front wheel if necessary.
6. Bleed the front wheel brakes. **See Bleeding the Hydraulic Brake System on page 6a-33.**
7. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

REAR WHEEL CYLINDER REMOVAL

1. Remove rear wheel brake drum. **See Rear Wheel Brake Drum Removal on page 6a-10.**
2. Remove rear brake shoes. **See Rear Brake Shoe Removal on page 6a-11.**
3. Using a 3/8-inch flare nut wrench, remove the brake hose fitting from the rear brake cluster wheel cylinder (**Figure 6a-19, Page 6a-22**).
4. To avoid spilling brake fluid, lift the hose above the brake cluster assembly and place a plastic bag over the hose fitting to keep dirt and debris from entering the hydraulic brake system (**Figure 6a-20, Page 6a-22**).
5. Remove two bolts (9) and lock washers that secure the wheel cylinder to the brake cluster mounting plate (1), and remove the wheel cylinder (7) (**Figure 6a-21, Page 6a-25**).
6. Repeat steps 1 through 5 for the remaining rear wheel if necessary.

REAR WHEEL CYLINDER INSTALLATION

1. Install wheel cylinder (7) with two bolts (9) and lock washers to the brake cluster assembly mounting plate (1) (**Figure 6a-21, Page 6a-25**). Tighten the two bolts to 120 in-lb (13 N·m). **See following NOTE.**

NOTE: *It is recommended that new bolts be used for installation of the wheel cylinder. Use M6 x 10 mm bolts.*

2. Using a 3/8-inch flare nut wrench, attach the brake hose fitting to the brake cluster wheel cylinder (**Figure 6a-19, Page 6a-22**).
3. Install rear brake shoes. **See Rear Brake Shoe Installation on page 6a-16.**
4. Install rear wheel brake drum. **See Rear Wheel Brake Drum Installation on page 6a-19.**
5. Repeat steps 1 through 4 for the remaining rear wheel if necessary.
6. Bleed the rear wheel brakes. **See Bleeding the Hydraulic Brake System on page 6a-33.**
7. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

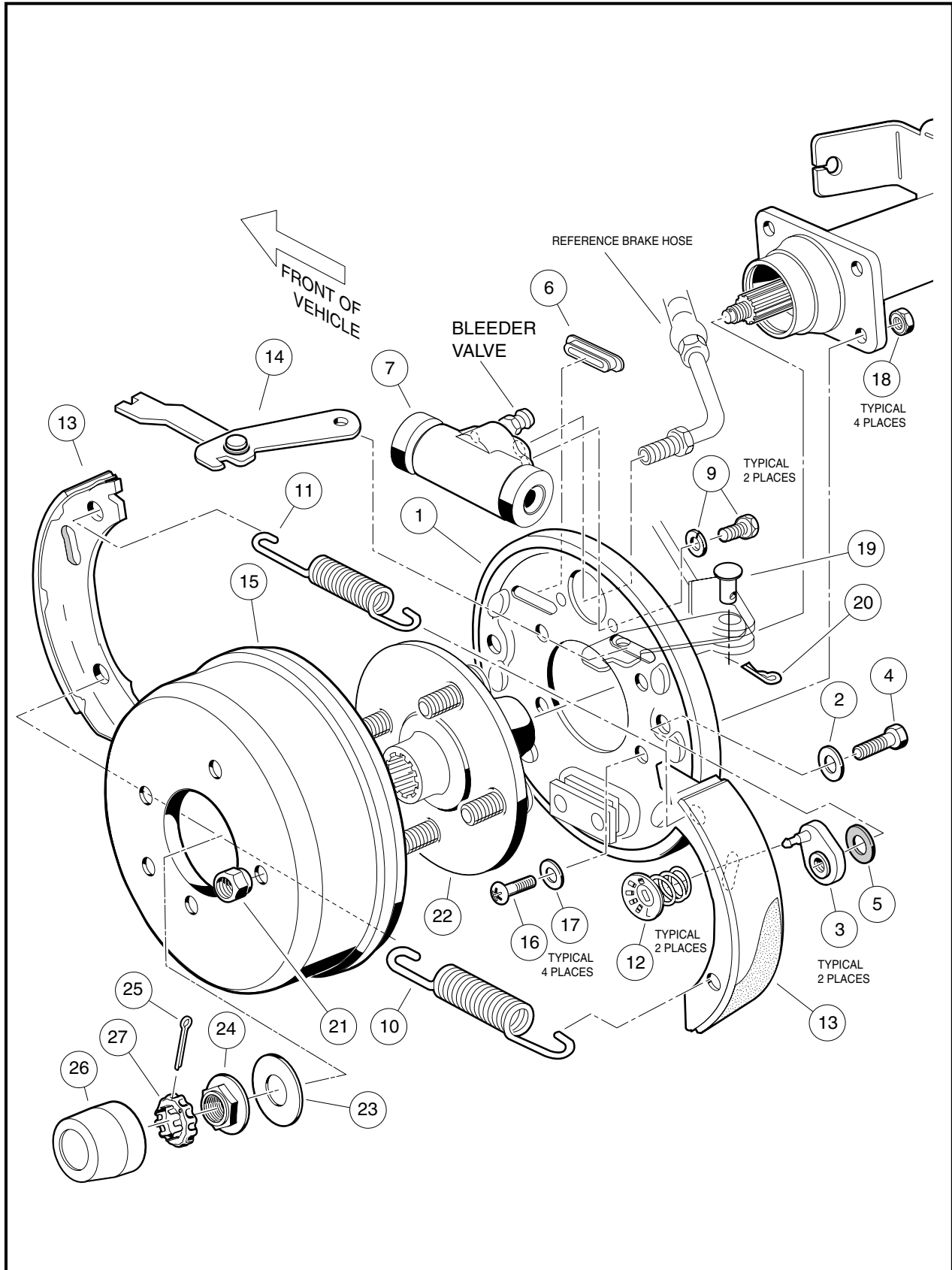


Figure 6a-21 Rear Hydraulic Brake Cluster Assembly

BRAKE SHOE ADJUSTER REPLACEMENT

Read **DANGER** and **WARNING** on page 6a-1.

⚠ WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6a-33.

FRONT BRAKE SHOE ADJUSTER REMOVAL

1. Remove front wheel brake drum. See **Front Wheel Brake Drum Removal** on page 6a-9.
2. Remove front brake shoes. See **Front Brake Shoe Removal** on page 6a-11.
3. Remove front brake cluster assembly. See **Front Brake Cluster Assembly Removal** on page 6a-20.
4. With the back plate removed, grip adjuster arm (3) with a pair of locking pliers. Use a Torx #T-27 driver or 7/16-inch socket to remove the bolt (4), flat washer (2), and Bellville washer (5) from the brake cluster back plate (1) (**Figure 6a-3, Page 6a-4**). Remove remaining adjuster assembly and discard all adjuster components (3, 4, 2, and 5) for both assemblies.
5. Clean the back plate surfaces that contact the adjusters.
6. Repeat steps 1 through 5 for the remaining front wheel if necessary.

FRONT BRAKE SHOE ADJUSTER INSTALLATION

NOTE: The adjusters must be replaced as pairs using new hardware.

1. Install bolt (4) through flat washer (2) and through the brake cluster back plate (1) (**Figure 6a-3, Page 6a-4**).
2. Apply a light coat of grease to the Bellville washer (5) and install the washer onto the bolt (4) and against the inside surface of the back plate (1) (**Figure 6a-3, Page 6a-4**).
3. Carefully apply Loctite® 222 to the threaded portion of the bolt (4) and attach the adjuster arm (3). Position adjuster so that the brake mounting post is to the top of the back plate. (**Figure 6a-3, Page 6a-4**).
4. Grip adjuster arm (3) with a pair of locking pliers. Use a Torx #T-27 driver or 7/16-inch socket to tighten the bolt (4) to 115 in-lb (13 N·m) (**Figure 6a-3, Page 6a-4**).
5. Repeat steps 1 through 4 for the remaining adjuster.
6. Install front brake cluster assembly. See **Front Brake Cluster Assembly Installation** on page 6a-21.
7. Install front brake shoes. See **Front Brake Shoe Installation** on page 6a-14.
8. Install front wheel brake drum. See **Front Wheel Brake Drum Installation** on page 6a-17.
9. Repeat steps 1 through 8 for the opposite front wheel if necessary.
10. Bleed the front brakes. See **Bleeding the Hydraulic Brake System** on page 6a-33.
11. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. See **Brake System Inspection** on page 6a-3.

REAR BRAKE SHOE ADJUSTER REMOVAL

1. Remove rear wheel brake drum. **See Rear Wheel Brake Drum Removal on page 6a-10.**
2. Remove rear brake shoes. **See Rear Brake Shoe Removal on page 6a-11.**
3. Remove rear brake cluster assembly. **See Rear Brake Cluster Assembly Removal on page 6a-21.**
4. With the back plate removed, grip adjuster arm (3) with a pair of locking pliers. Use a Torx #T-27 driver, or 7/16-inch socket and remove the bolt (4), flat washer (2), and Bellville washer (5) from the brake cluster back plate (1) (**Figure 6a-21, Page 6a-25**). Remove remaining adjuster assembly and discard all adjuster components (3, 4, 2, and 5) for both assemblies.
5. Clean the back plate surfaces that contact the adjusters.
6. Repeat steps 1 through 5 for the remaining rear wheel if necessary.

REAR BRAKE SHOE ADJUSTER INSTALLATION

NOTE: The adjusters must be replaced as pairs using new hardware.

1. Install bolt (4) through flat washer (2) and through the brake cluster back plate (1) (**Figure 6a-21, Page 6a-25**).
2. Apply a light coat of grease to the Bellville washer (5) and install the washer onto the bolt (4) and against the inside surface of the back plate (**Figure 6a-21, Page 6a-25**).
3. Carefully apply Loctite 222 to the threaded portion of bolt (4) and attach the adjuster arm (3). Position adjuster so that the brake mounting post is to the top of the back plate (**Figure 6a-21, Page 6a-25**).
4. Grip the adjuster arm (3) with a pair of locking pliers. Use a Torx #T-27 driver or 7/16-inch socket to tighten the bolt (4) to 115 in-lb (13 N·m) (**Figure 6a-21, Page 6a-25**).
5. Repeat steps 1 through 4 for the remaining adjuster.
6. Install rear brake cluster assembly. **See Rear Brake Cluster Assembly Installation on page 6a-22.**
7. Install rear brake shoes. **See Rear Brake Shoe Installation on page 6a-16.**
8. Install rear brake drum. **See Rear Wheel Brake Drum Installation on page 6a-19.**
9. Repeat steps 1 through 8 for the opposite rear wheel if necessary.
10. Bleed the rear brakes. **See Bleeding the Hydraulic Brake System on page 6a-33.**
11. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

HYDRAULIC LINE AND HOSE REPLACEMENT

Read **DANGER** and **WARNING** on page 6a-1.

⚠ WARNING

- To perform any of the following procedures, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. **See Bleeding the Hydraulic Brake System on page 6a-33.**
- Prior to servicing hydraulic brakes, thoroughly clean the vehicle, paying particular attention to areas immediately surrounding hydraulic connections, to prevent dirt or debris from entering system.

FRONT BRAKE LINE REMOVAL

1. Place chocks at the rear wheels, release the park brake and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands. **See Figure 5-2, Section 5, Page 5-4.**
2. Drill the rivet (8) securing the brake line (4) to the vehicle frame (**Figure 6a-22, Page 6a-29**).
3. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following step.
4. Using a 7/16-inch flare nut wrench, remove the flare nut of the front brake line (4) from the master cylinder (**Figure 6a-22, Page 6a-29**).
5. Using a 3/8-inch flare nut wrench, remove brake line (4) from the T-manifold block (1) (**Figure 6a-22, Page 6a-29**).

FRONT BRAKE LINE INSTALLATION

1. Connect the 7/16-inch flare nut of the brake line (4) to the master cylinder and tighten finger-tight (**Figure 6a-22, Page 6a-29**).
2. Connect the 3/8-inch flare nut of the brake line (4) to the T-manifold block (1) and tighten finger-tight (**Figure 6a-22, Page 6a-29**).
3. Secure the brake line to the vehicle frame with the P-clamp (7), new 3/6 x 3/4-inch aluminum pop rivet (8), and two 3/16-inch rivet washers (14) (**Figure 6a-22, Page 6a-29**).
4. Using a 7/16-inch flare nut wrench, tighten the flare nut from the brake line (4) to the master cylinder to 11 ft-lb (14.9 N·m) (**Figure 6a-22, Page 6a-29**).
5. Using a 3/8-inch flare nut wrench, tighten the flare nut from the brake line (4) to the T-manifold block (1) to 11 ft-lb (14.9 N·m) (**Figure 6a-22, Page 6a-29**).
6. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6a-33.**
7. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are in correct adjustment and are operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

FRONT BRAKE HOSE ASSEMBLY REMOVAL

NOTE: If either of the two front brake hoses or the T-manifold block (1) are found to be damaged, the entire assembly must be replaced (**Figure 6a-22, Page 6a-29**).

1. Place chocks at the rear wheels, release the park brake and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands. **See Figure 5-2, Section 5, Page 5-4.**
2. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following steps.
3. Remove the banjo bolt (16) and two copper washers (17) from each of the front brake wheel cylinder assemblies (**Figure 6a-3, Page 6a-4**). Discard the copper washers (17).
4. Remove the bolt (2), lock nut (3), front hose bracket and weldment steering stop (34) from where the bottom of the shock connects to each of the front A-arms. **See Figure 7-29, Section 7, Page 7-18.**
5. Using a 3/8-inch flare nut wrench, remove the brake line (4) from the T-manifold block (1) (**Figure 6a-22, Page 6a-29**).
6. Remove the bolt (2), washer (13) and lock nut (3) that secure the T-manifold block (1) to the shock tower and remove the front brake hose assembly (**Figure 6a-22, Page 6a-29**).

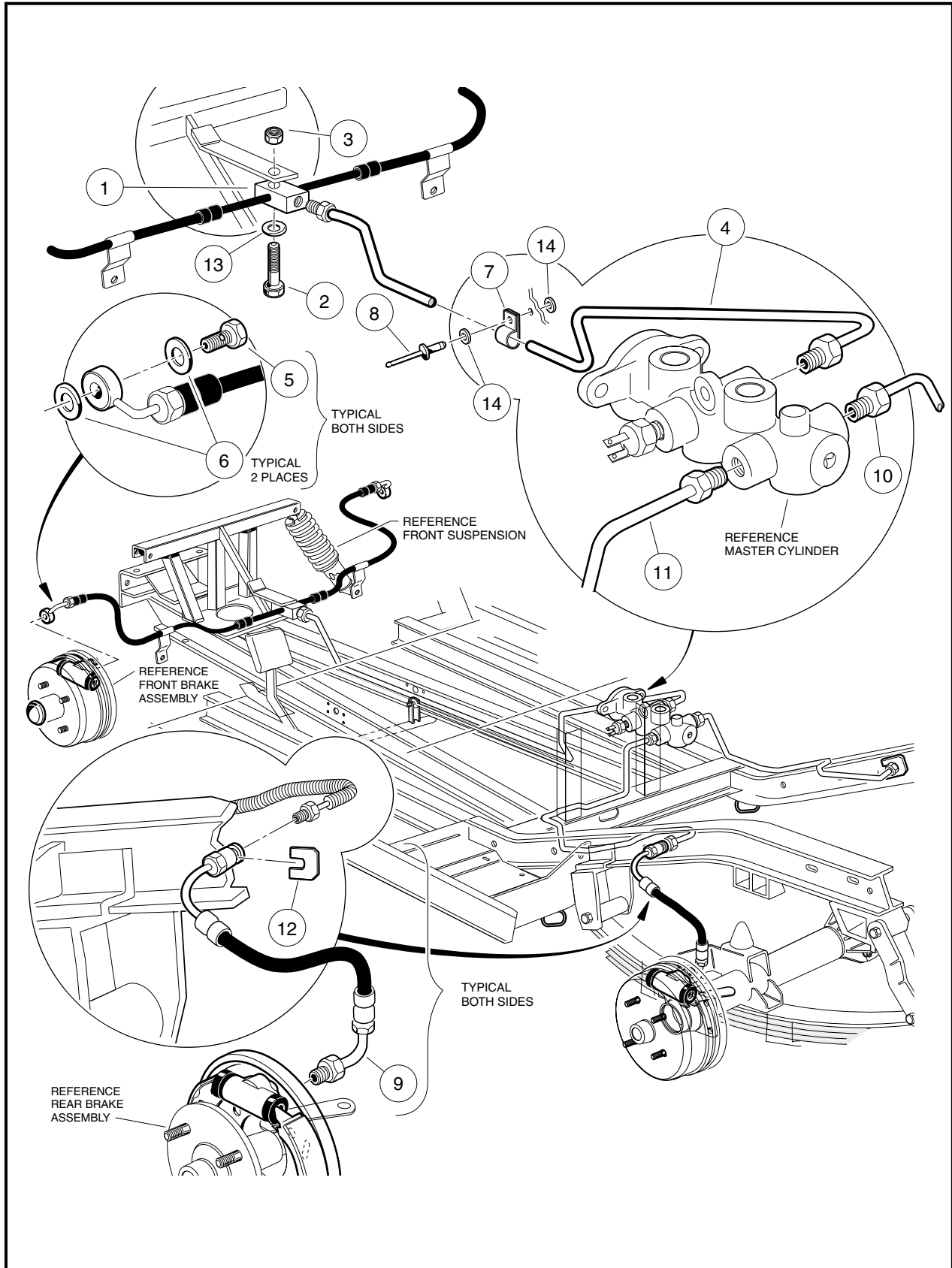


Figure 6a-22 Four-Wheel Hydraulic Brake System

FRONT BRAKE HOSE ASSEMBLY INSTALLATION

1. Install the 1/4-20 x 1-1/4-inch hex-head bolt (2) through washer (13) and through the T-manifold block (1) and frame bracket. Install and tighten the nylon lock nut (3) to 76 in-lb (8.6 N·m) (**Figure 6a-22, Page 6a-29**).
2. Connect the brake hose assemblies to each of the front brake wheel cylinders, using new copper washers (17) and banjo bolts (16). Position the elbow of each hose toward the rear of the vehicle. Tighten bolts to 13 ft-lb (17.6 N·m) (**Figure 6a-3, Page 6a-4**).
3. Assemble each front hose bracket, weldment steering stop (34), and lower shock absorber mount using bolt (2), and lock nut (3). Position each hose bracket in-line with each shock absorber and tighten the bolt to 20 ft-lb (27 N·m). **See Figure 7-29, Section 7, Page 7-18.**
4. Using a 3/8-inch flare nut wrench, connect the flare fitting on the front brake line (4) to the T-manifold block (1). Tighten to 11 ft-lb (14.9 N·m) (**Figure 6a-22, Page 6a-29**).
5. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6a-33.**
6. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

REAR BRAKE LINE REMOVAL

1. Place chocks at the front wheels, release the park brake and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the rear axle tubes to support the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.
2. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following step.
3. Using a 3/8-inch flare nut wrench, remove brake line (10 or 11) from the master cylinder (**Figure 6a-22, Page 6a-29**).
4. Using a 3/8-inch flare nut wrench, remove the same brake line (10 or 11) from the rear brake hose at the I-beam of the vehicle frame and remove from the vehicle (**Figure 6a-22, Page 6a-29**).
5. Repeat steps 3 through 4 for the opposite rear brake line if necessary.

REAR BRAKE LINE INSTALLATION

1. Using a 3/8-inch flare nut wrench, install brake line (10 or 11) to rear brake hose at the I-beam of the vehicle frame (**Figure 6a-22, Page 6a-29**). Tighten to 11 ft-lb (14.9 N·m).
2. Using a 3/8-inch flare nut wrench, install the opposite end of the brake line to the master cylinder. Tighten the flare nut fitting to 11 ft-lb (14.9 N·m) (**Figure 6a-22, Page 6a-29**).
3. Repeat steps 1 through 2 for the opposite rear brake line if necessary.
4. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6a-33.**
5. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

REAR BRAKE HOSE REMOVAL

1. Place chocks at the rear wheels, release the park brake and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the rear axle tubes to support the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.
2. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following steps.
3. Using a 3/8-inch flare nut wrench, remove the brake hose from the rear brake wheel cylinder assembly (**Figure 6a-19, Page 6a-22**).
4. Using a 3/8-inch flare nut wrench, remove the rear brake line (10 or 11) from the rear brake hose at the I-beam of the vehicle frame (**Figure 6a-22, Page 6a-29**).
5. Remove the horseshoe clip (12) that secures the rear brake hose (9) to the I-beam frame (**Figure 6a-22, Page 6a-29**) and remove brake hose (9) through the D-shaped hole in the vehicle I-beam.
6. Repeat steps 3 through 5 for the opposite rear brake hose if necessary.

REAR BRAKE HOSE INSTALLATION

1. Install brake hose (9) through the D-shaped hole in I-beam, and install the horseshoe clip (12) that secures the brake hose to the I-beam frame (**Figure 6a-22, Page 6a-29**).
2. Using a 3/8-inch flare nut wrench, attach the flare nut fitting the rear brake hose to the rear brake wheel cylinder (**Figure 6a-19, Page 6a-22**). Tighten to 11 ft-lb (14.9 N·m).
3. Using a 3/8-inch flare nut wrench, install the rear brake line (10 or 11) to the rear brake hose (9) at the I-beam of the vehicle frame (**Figure 6a-22, Page 6a-29**). Tighten to 11 ft-lb (14.9 N·m).
4. Repeat steps 1 through 3 for the opposite rear brake hose if necessary.
5. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6a-33.**
6. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

MASTER CYLINDER AND BELL CRANK REPLACEMENT

Read **DANGER** and **WARNING** on page 6a-1.

BELL CRANK REMOVAL

1. Chock the wheels and release the park brake. Raise the passenger seat for access to the master cylinder bell crank.
2. Remove the brake rod clevis bolt (6) and clevis (16) from the bell crank assembly (13) (**Figure 6a-23, Page 6a-34**).
3. Remove the spring (18) from the bell crank (13) and master cylinder mounting bracket (19) (**Figure 6a-23, Page 6a-34**).
4. Remove the push rod clevis bolt (20) and lock nut (21) from the bell crank (13) (**Figure 6a-23, Page 6a-34**).
5. Remove the bell crank bolt (9) and nylon lock nut (11) from the master cylinder mounting bracket (19) and remove bell crank (13) and two centering spacers (12) (**Figure 6a-23, Page 6a-34**).

Bell Crank Removal, Continued:

6. Inspect the needle bearing (14) and the inner race (15) for damage or wear and replace if necessary (**Figure 6a-23, Page 6a-34**).

NOTE: The needle bearing (14) is press fitted to the bell crank. If replacement is necessary, the bearing must be pressed out and replaced (**Figure 6a-23, Page 6a-34**).

BELL CRANK INSTALLATION

1. Install the bell crank bolt (9) through the two centering spacers (12) and bell crank inner bearing race (15). Tighten nut (11) to 25 ft-lb (40 N·m) (**Figure 6a-23, Page 6a-34**).
2. Install bolt (20) through push rod (3) and bell crank (13) and attach nylon lock nut (21). Tighten to 14 ft-lb (19 N·m) (**Figure 6a-23, Page 6a-34**).
3. Install brake rod clevis bolt (6) through clevis (16) and bell crank (13) and tighten to 19 ft-lb (25.8 N·m) (**Figure 6a-23, Page 6a-34**).
4. Install spring (18) as shown (**Figure 6a-23, Page 6a-34**).
5. Adjust the brake pedal as instructed in Section 5. **See Brake Pedal Adjustment, Section 5, Page 5-6.**
6. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

MASTER CYLINDER REMOVAL** WARNING**

- To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6a-33.

1. Chock the wheels and release the park brake. Raise the passenger seat for access to the master cylinder.
2. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following steps.
3. Remove the two wires from the master cylinder pressure switch (4) (**Figure 6a-23, Page 6a-34**).
4. Using a 7/16-inch flare nut wrench, remove the brake line (4) from the master cylinder (**Figure 6a-22, Page 6a-29**).
5. Using a 3/8-inch flare nut wrench, remove the brake lines (10 and 11) from the master cylinder (**Figure 6a-22, Page 6a-29**).
6. Cover the flare nut fittings on the three brake lines with plastic bags and wire ties to keep any dirt or debris from entering the hydraulic brake system.
7. Remove the two bolts (7) and nylon lock nuts (8) that secure the master cylinder (1) to the master cylinder mounting bracket (19) (**Figure 6a-23, Page 6a-34**).
8. Remove master cylinder (1) from mounting bracket (19), push rod (3) and rubber boot (2).

MASTER CYLINDER INSTALLATION

1. Install master cylinder (1) into mounting bracket (19) and insert push rod (3), then seat boot (2) (**Figure 6a-23, Page 6a-34**).
2. Install the two bolts (7) and nylon lock nuts (8) that secure the master cylinder (1) to the master cylinder mounting bracket (19). Tighten to 14 ft-lb (19 N·m) (**Figure 6a-23, Page 6a-34**).
3. Using a 7/16-inch flare nut wrench, attach brake line (4) to master cylinder and tighten flare nut fitting to 11 ft-lb (14.9 N·m) (**Figure 6a-22, Page 6a-29**).
4. Using a 3/8-inch flare nut wrench, attach brake lines (10 and 11) to master cylinder and tighten flare nut fittings to 11 ft-lb (14.9 N·m) (**Figure 6a-23, Page 6a-34**).
5. Attach the two wires to the master cylinder pressure switch (no particular orientation) (4) (**Figure 6a-23, Page 6a-34**).
6. Adjust the brake pedal as instructed in Section 5. **See Brake Pedal Adjustment, Section 5, Page 5-6.**
7. Fill the reservoir of the master cylinder and bleed the entire hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6a-33.**
8. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are in correct adjustment and are operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

BLEEDING THE HYDRAULIC BRAKE SYSTEM

Read DANGER and WARNING on page 6a-1.

To properly function, the hydraulic system must be free of air. Air in the hydraulic system will result in a “spongy” brake pedal. Air enters the hydraulic system whenever the system is opened as a result of service, or when a leak occurs. Air may also enter the system if the brakes are applied when there is very little hydraulic fluid in the brake fluid reservoir.

The master cylinder controls two separate hydraulic sub-systems. The front two wheels are connected to the smaller, front portion of the brake fluid reservoir, and the rear wheels are connected to the rear, larger portion of the brake fluid reservoir. Depending on where the hydraulic system was opened, bleeding of only the front or rear hydraulic brake sub-system may be required. In some situations, bleeding of both the front and rear brake sub-systems will be required. To bleed both the front and rear hydraulic brake sub-systems, use the following procedure to first bleed the two front brakes and repeat the procedure to bleed the two rear brakes.

1. Check the brake pedal and master cylinder push rod for proper adjustment before proceeding. **See Brake Pedal Adjustment, Section 5, Page 5-6.**
2. Chock the front wheels, release the park brake and lift the vehicle with a chain hoist or floor jack. Place jack stands under the outer front I-beam frame at the weldments of the front cross tube, or under the rear axle tubes for the rear wheels, to support the vehicle. Lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.
3. Remove the cap from the master cylinder reservoir and fill the reservoir with DOT 5 brake fluid.
4. Remove each wheel and gently adjust the clearance between the brake shoes and brake drum by turning each of the two adjusters on the brake cluster as shown (**Figure 6a-16, Page 6a-19**). Use a torque wrench and a Torx #T-27 driver or hydraulic brake adjuster (CCI P/N 102169401). **See following CAUTION.**

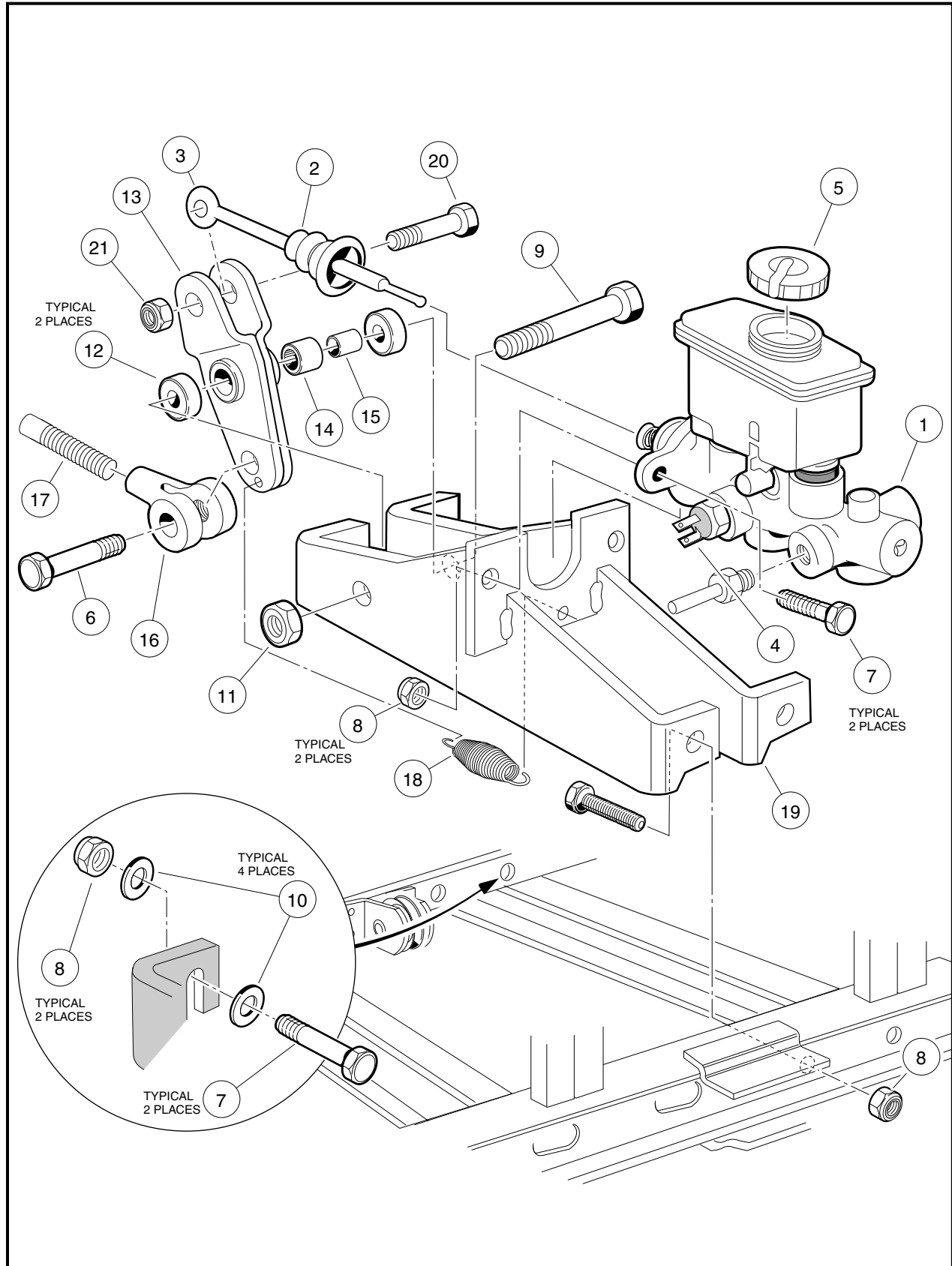


Figure 6a-23 Master Cylinder

Bleeding the Hydraulic Brake System, Continued:** CAUTION**

- **Do not apply more than 65 in-lb (7.3 N-m) of torque to any of the adjuster bolts. Overtightening the adjuster bolts could result in damage to the brake cluster components or the separation of the bolt (4) from the adjuster (3) (Figure 6a-3, Page 6a-4 or Figure 6a-21, Page 6a-25).**
5. Place, but do not tighten, the cap onto the master cylinder reservoir.
 6. To connect vacuum type brake bleeder (CCI P/N S0010702):
 - **Front brakes only:** Connect the two hose fittings from a vacuum type brake bleeder to the brake bleeder valves on the back of each of the front wheel brake cluster assemblies (**Figure 6a-24, Page 6a-36**). Proceed to step 7.
 - **Rear brakes only:** Connect the two hose fittings from a vacuum type brake bleeder to the brake bleeder valves on the back of each of the rear wheel brake cluster assemblies. Proceed to step 7.
 7. Connect an air hose to the vacuum brake bleeder. The air pressure must be regulated at 12 to 15 psi (.827 to 1.034 Bars).
 8. Press the handle on the brake bleeder to start the vacuum.
 9. With the vacuum running, open both of the brake bleeder valves 1/4 turn. **See Figure 6a-3, Page 6a-4 or Figure 6a-21, Page 6a-25.**
 10. Monitor the fluid as it flows through the tubes of the vacuum bleeder tool. Continue to run the vacuum until there are almost no air bubbles in the lines. **See following NOTE.**

NOTE: Do not allow the brake fluid in the master cylinder reservoir (**Figure 6a-25, Page 6a-36**) to drop below the “min” level mark at any time during the brake bleeding procedure. Add brake fluid as necessary while performing step 10.

11. With the vacuum still running, tighten the two brake bleeder valves. **See Figure 6a-3, Page 6a-4 or Figure 6a-21, Page 6a-25.**
12. Allow the handle on the brake bleeder tool to open, turning the vacuum system off.
13. Fill the master cylinder reservoir to the “MAX” level with DOT 5 brake fluid (**Figure 6a-25, Page 6a-36**).
14. Tighten the cap on the master cylinder reservoir.
15. Properly dispose of the brake fluid in the vacuum type brake bleeder tool.
16. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

PURGING THE HYDRAULIC SYSTEM

In some cases it may be necessary to completely drain the front, rear or entire hydraulic brake system of brake fluid. To completely purge the hydraulic system, perform the following procedure.

1. Perform steps 2 through 9 of the brake bleeding procedure on the two front wheels. **See Bleeding the Hydraulic Brake System on page 6a-33.**
2. Allow 1qt. (0.9464 l) of the brake fluid to be pulled into the vacuum type brake bleeder tool.
3. With the vacuum still running, tighten the two brake bleeder valves.
4. Allow the handle on the brake bleeder tool to open, turning the vacuum system off.
5. Repeat steps 1 through 4 for the two rear wheels.

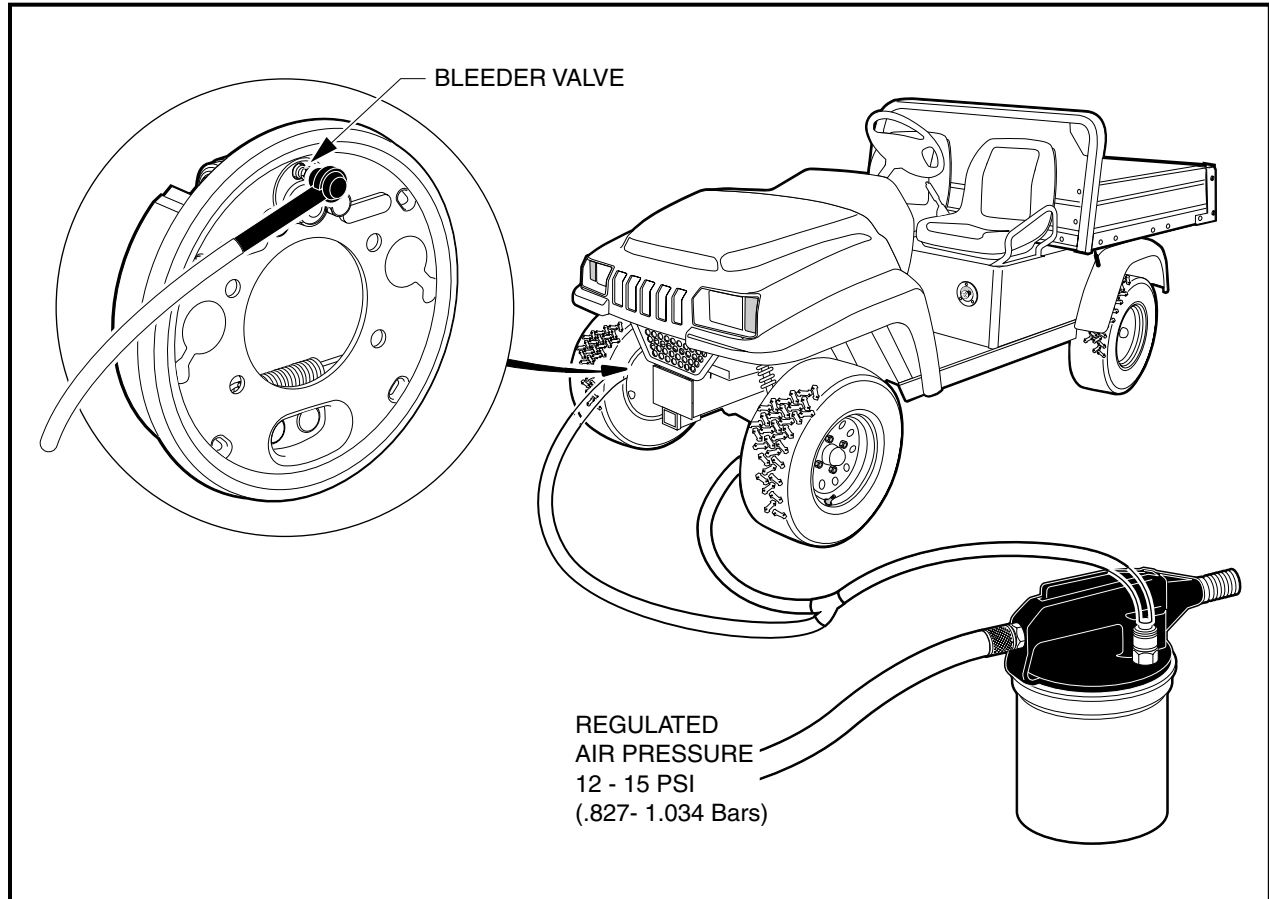


Figure 6a-24 Front and Rear Brake Bleeding

FILLING THE HYDRAULIC SYSTEM

After purging the brake system and making any necessary repairs, bleed the brakes, adding DOT 5 brake fluid until the system is full and virtually no air bubbles are present in the brake bleeder vacuum tubes. **See Bleeding the Hydraulic Brake System on page 6a-33.**

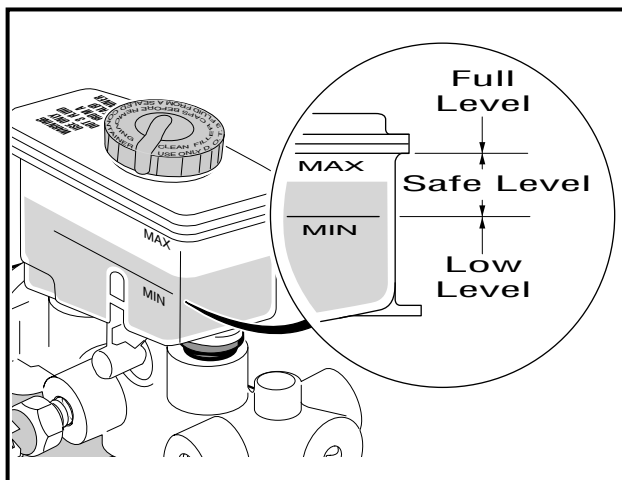


Figure 6a-25 Master Cylinder Reservoir

PARK BRAKE SYSTEM

Read **DANGER** and **WARNING** on page 6a-14.

PARK BRAKE CABLE REMOVAL

Equalizer Cable Removal

1. Chock the wheels and release the park brake.
2. Remove the two screws (3) that secure the park brake boot (2) to the seat support (**Figure 6a-28, Page 6a-40**).
3. Slide the boot (2) off of the park brake handle (1).
4. Remove the boot shield (27) from the park brake handle.
5. Remove the equalizer spring (21) from the equalizer cable (9).
6. Remove the equalizer jam nut (11) and conical nut (23) from the cable end (9).
7. Remove the end of the park brake cable from handle (1) by pushing the equalizer cable in an upward direction and pulling the cable end toward the passenger side of the vehicle.
8. Remove the equalizer cable from the vehicle.

Park Brake Pulley Removal

1. Remove the park brake equalizer cable. **See Park Brake Cable Removal on page 6a-37.**
2. Remove the four #10-24 x 3/4-inch socket-head screws (14), lock nuts (18) and washers (17) from frame (**Figure 6a-28, Page 6a-40**).
3. Remove the pulley assembly (13) from the vehicle (**Figure 6a-28, Page 6a-40**).

Wheel Brake Cable Removal

1. Loosen the equalizer jam nut (11) and the conical nut (23) to provide slack in the wheel brake cables (**Figure 6a-28, Page 6a-40**).
2. Pull a wheel brake cable to the side and remove the cable end from the keyhole opening in the park brake equalizer (**Figure 6a-26, Page 6a-38 and Figure 6a-27, Page 6a-38**).
3. Remove the cable clip (23) from a wheel brake cable (22) at the vehicle frame (25) (**Figure 6a-28, Page 6a-40**).
4. Remove a park brake cable clip (12), hair spring cotter pin (20) and clevis pin (19).
5. Remove the cable from a cable support bracket (16 or 24) (**Figure 6a-28, Page 6a-40**).
6. Slide the cable through the frame hanger (15) and remove the cable from the vehicle.
7. If necessary, remove the opposite wheel brake cable in the same manner.

PARK BRAKE CABLE INSTALLATION

Park Brake Pulley Installation

1. Align the equalizer cable pulley assembly (13) with the mounting holes in the frame (**Figure 6a-28, Page 6a-40**).
2. Install the four 10-24 x 3/4-inch socket-head screws (14), flat washers (17) and lock nuts (18). Tighten to 54 in-lb (6.1 N·m) (**Figure 6a-28, Page 6a-40**).

NOTE: Use new 10-24 lock nuts for this assembly procedure.

3. Install equalizer cable. **See Park Brake Cable Installation on page 6a-37.**

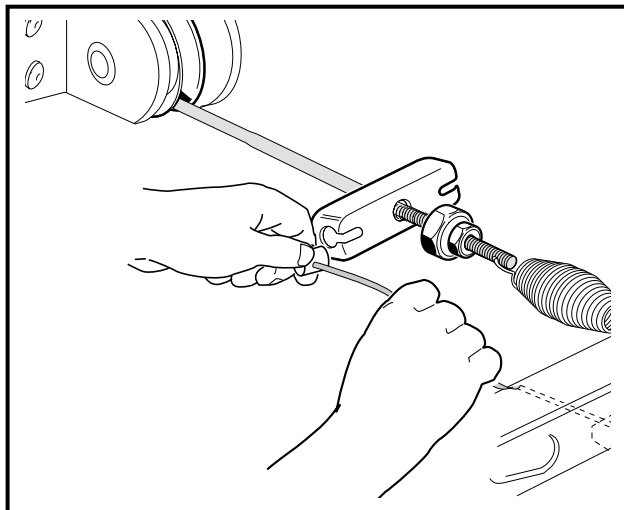


Figure 6a-26 Position Wheel Brake Cable

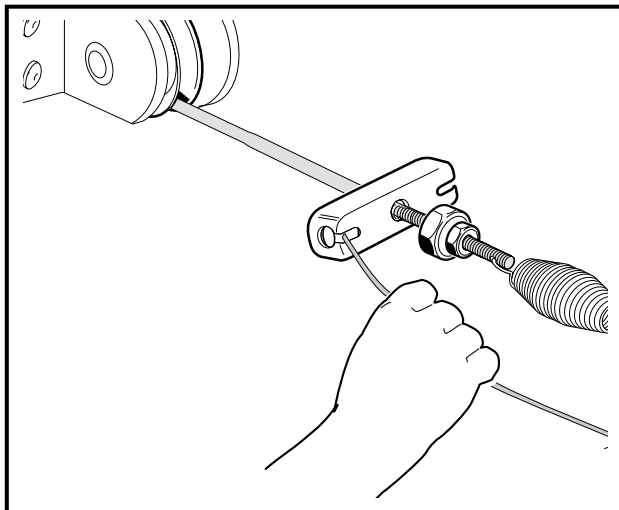


Figure 6a-27 Wheel Brake Cable Attachment

Equalizer Cable Installation

1. Feed the equalizer cable (9) up between the pulley and frame, through the top seat support slot and hook the end of the cable into the handle (1) clevis slot from the passenger side (**Figure 6a-28, Page 6a-40**).
2. Assemble the equalizer bracket (10) onto the threaded end of the equalizer cable (9) (**Figure 6a-28, Page 6a-40**).
3. Attach the conical nut (23) and equalizer jam nut (11) to the threaded end of the equalizer cable (**Figure 6a-28, Page 6a-40**).
4. Attach the equalizer spring (21) from the equalizer cable to the frame (**Figure 6a-28, Page 6a-40**).
5. Slide the boot shield (27) around the park brake handle (**Figure 6a-28, Page 6a-40**).
6. Slide the boot (2) over the handle and down around the boot shield and onto the seat support (**Figure 6a-28, Page 6a-40**).
7. Attach the boot (2) using two 5/16-18 phillips head screws (3).
8. Adjust the park brake. **See Park Brake Adjustment on page 6a-39.**

Wheel Brake Cable Installation

1. Slide the cable (22) through the frame hanger (15) (**Figure 6a-28, Page 6a-40**).
2. Attach the cable clevis end to the wheel brake lever using the clevis pin (19) and hair spring cotter pin (20) (**Figure 6a-28, Page 6a-40**).
3. Attach the cable (22) to the cable support bracket (16 or 24), using a wire clip (12) (**Figure 6a-28, Page 6a-40**).
4. Attach the opposite end of the cable (22) through a frame bracket notch (25) and secure with a wire clip (23) (**Figure 6a-28, Page 6a-40**).
5. Pull the end of the brake cable up and into a keyhole opening in the park brake equalizer bracket (**Figure 6a-26, Page 6a-38 and Figure 6a-27, Page 6a-38**).
6. Adjust the park brake. **See Park Brake Adjustment on page 6a-39.**
7. Install the other wheel brake cable using this same procedure if necessary.

PARK BRAKE HANDLE REMOVAL

1. Remove the park brake equalizer cable. **See Equalizer Cable Removal on page 6a-37.**
2. Remove the two bolts (4), four washers (5) and two lock nuts (6) from the park brake handle (**Figure 6a-28, Page 6a-40**).
3. Remove the park brake handle (1) from the seat support.

PARK BRAKE HANDLE INSTALLATION

1. Attach the handle (1) to the seat support using two 3/8-16 x 1-1/4-inch hex-head bolts (4), 3/8 flat washers (5) and 3/8-16 lock nuts (6) (**Figure 6a-28, Page 6a-40**). Tighten the nuts to 23 ft-lb (31.4 N·m).

NOTE: Use new 3/8-16 lock nuts for this assembly procedure.

2. Install the park brake cable. **See Equalizer Cable Installation on page 6a-38.**
3. Adjust the park brake. **See Park Brake Adjustment on page 6a-39.**
4. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

PARK BRAKE ADJUSTMENT

⚠ CAUTION

- Perform the following procedure only on level surface. To avoid injury or property damage, ensure that the path of the vehicle is clear before pushing vehicle.

1. Ensure that the brake pedal is adjusted correctly. **See Brake Pedal Adjustment, Section 5, Page 5-6.** Chock the wheels, release the park brake and place the Forward/Reverse handle in the NEUTRAL position.
2. Loosen the equalizer cable.
 - 2.1. Loosen the equalizer jam nut (11) and the conical nut (23) to provide slack in the wheel brake cables (**Figure 6a-28, Page 6a-40**).
3. Using a torque wrench and Torx #T-27 driver or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts to increase or decrease the clearance between the brake shoe lining and the brake drum (**Figure 6a-16, Page 6a-19**). **See following CAUTION.**

⚠ CAUTION

- Do not apply more than 65 in-lb (7.3 N·m) of torque to any of the adjuster bolts. Overtightening of the adjuster bolts could result in damage to the brake cluster components or the separation of the bolt (4) from the adjuster (3) (**Figure 6a-3, Page 6a-4 or Figure 6a-21, Page 6a-25**).

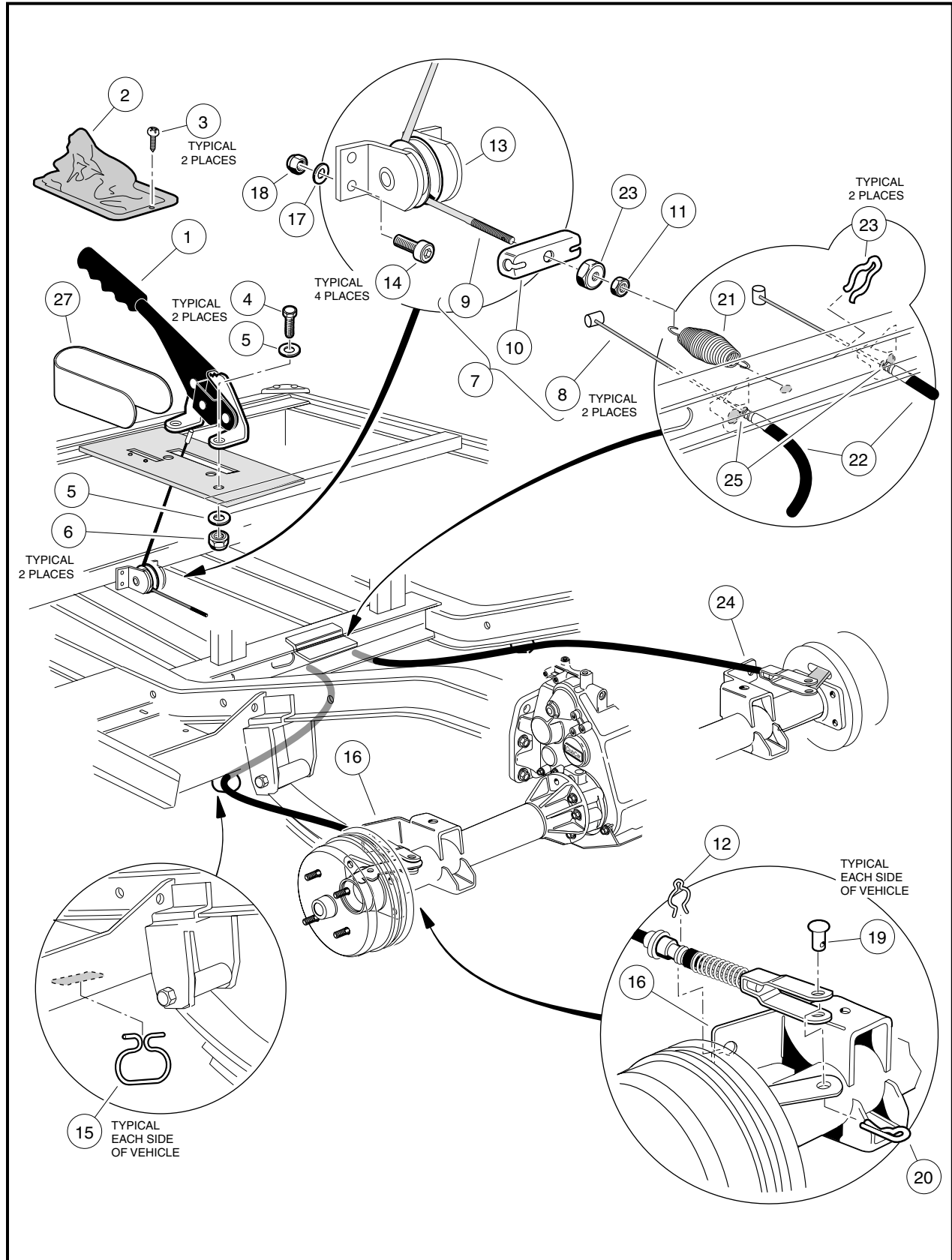


Figure 6a-28 Park Brake System

Park Brake Adjustment, Continued:

4. With the park brake released (down), tighten the conical nut (23) until significant resistance is observed in the equalizer cable in order to fully lock the brakes (**Figure 6a-28, Page 6a-40**).
5. With the vehicle on flat ground and the Forward/Reverse handle in the NEUTRAL position, push the vehicle by hand. If the wheels move when the vehicle is pushed, continue tightening the conical nut until the vehicle can no longer be pushed.
6. Loosen the conical nut two full revolutions.
7. Using the double-wrench method, tighten the equalizer jam nut (11) against the conical nut (23) to 55 in-lb (6.3 N·m) (**Figure 6a-28, Page 6a-40**).
8. The park brake should now be adjusted so that the vehicle will not roll when pushed with the park brake latched in the fourth notch (four clicks from the bottom of its travel).
9. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6a-3.**

SECTION 6B – MC010C-BS00 TRANSAXLE: HYDRAULIC AND PARK BRAKE SYSTEMS

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Some aftermarket brake shoes contain asbestos fiber and asbestos dust is created when these brake mechanisms are handled. Wear approved eye and respiratory protection when disassembling and cleaning brake mechanisms. Inhalation of asbestos could result in severe personal injury or death. Do not use compressed air or aerosol sprays to clean the brake mechanism. Clean brake mechanisms using the negative pressure enclosure/HEPA vacuum system or low pressure/wet cleaning method per OSHA/29 cfr -1910.1001.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

The 272 vehicle is equipped with two types of shoe drum braking systems: a hydraulic, four-wheel braking system for normal stopping, and a hand-activated mechanical rear-wheel park brake system for retaining the vehicle when it is stationary.

The hydraulic brake system consists of a hydraulic brake cluster on each wheel and a master cylinder. Each cluster utilizes a hydraulic cylinder and two brake shoes. The wheel cylinders' dual-piston design ensures an even distribution of force on each pair of brake shoes. Each brake cluster utilizes a leading-trailing design.

TRANSAXLE IDENTIFICATION

The rear-wheel hydraulic brake system maintenance and service will vary slightly, depending on the type of transaxle provided on the vehicle. See **MC010C-BS00 Transaxle (Figure 6b-1, Page 6b-3)** and **MC012C-AS00 Transaxle (Figure 6b-2, Page 6b-3)**. Section 6a deals specifically with the MC012C transaxle. See **Section 6a – MC012C-AS00 Transaxle: Hydraulic and Park Brake Systems**. Section 6b deals specifically with the MC010C transaxle.

The mechanical park brake system for both the MC010C and MC012C transaxles on the 272 vehicle utilizes a hand-activated park brake. The park brake handle is located between the driver and passenger seats. It is provided with a brake cable equalizer and two park brake cables.

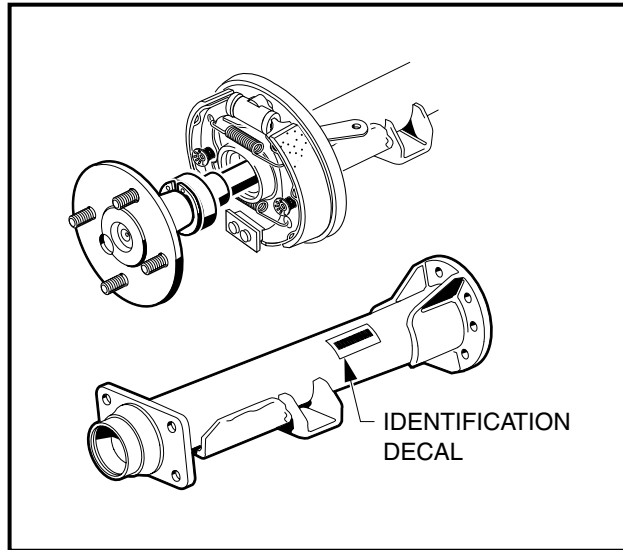


Figure 6b-1 MC010C-BS00 Transaxle

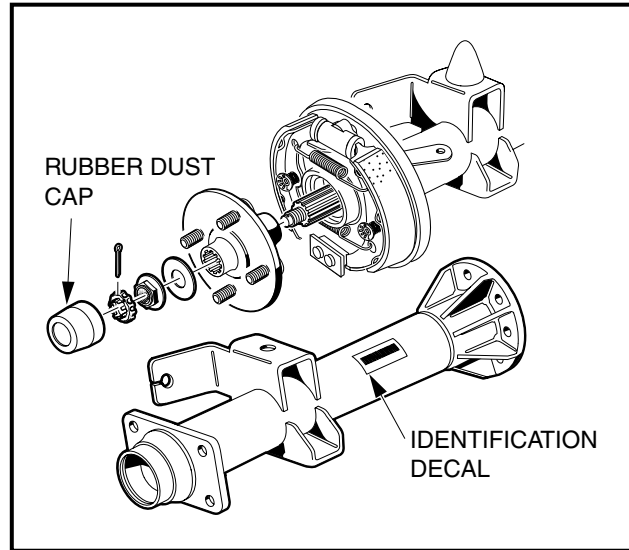


Figure 6b-2 MC012C-AS00 Transaxle

BRAKE SYSTEM INSPECTION

Read **DANGER** and **WARNING** on page 6b-1.

The hydraulic brake system and park brake system should be inspected immediately after any service to either of the brake systems.

Brake Pedal Inspection

- When driving the vehicle and pressing the brake pedal, the vehicle should come to a smooth, straight stop.
- Apply and release the brake pedal several times. If noise or binding occurs, the brake pedal or hydraulic brake system may be in need of service. Pedal movement should be smooth, and when the pedal is released, it should return quickly and quietly.
- Move the brake pedal from side to side to check for worn parts. Excessive side movement indicates worn or loose pedal mounting parts. If worn parts are found, replace the worn parts, then adjust the brake pedal. **See Brake Pedal Adjustment, Section 5, Page 5-6.**
- Apply heavy pressure to the pedal and check for sponginess and excessive pedal travel. The pedal should be firm, and the back of the brake pedal should be a minimum of 2 inches from the floor. If the brake pedal feels “spongy”, perform the brake bleeding procedure. **See Bleeding the Hydraulic Brake System on page 6b-33.**
- Hold the brake pedal depressed with medium foot pressure (25 to 35 lb.) for 15 seconds. The pedal should not continue dropping when pressed with a steady amount of pressure. If the pedal goes to the floor, inspect the hydraulic system for leaks and repair any worn or damaged components. After repair, bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6b-33.**

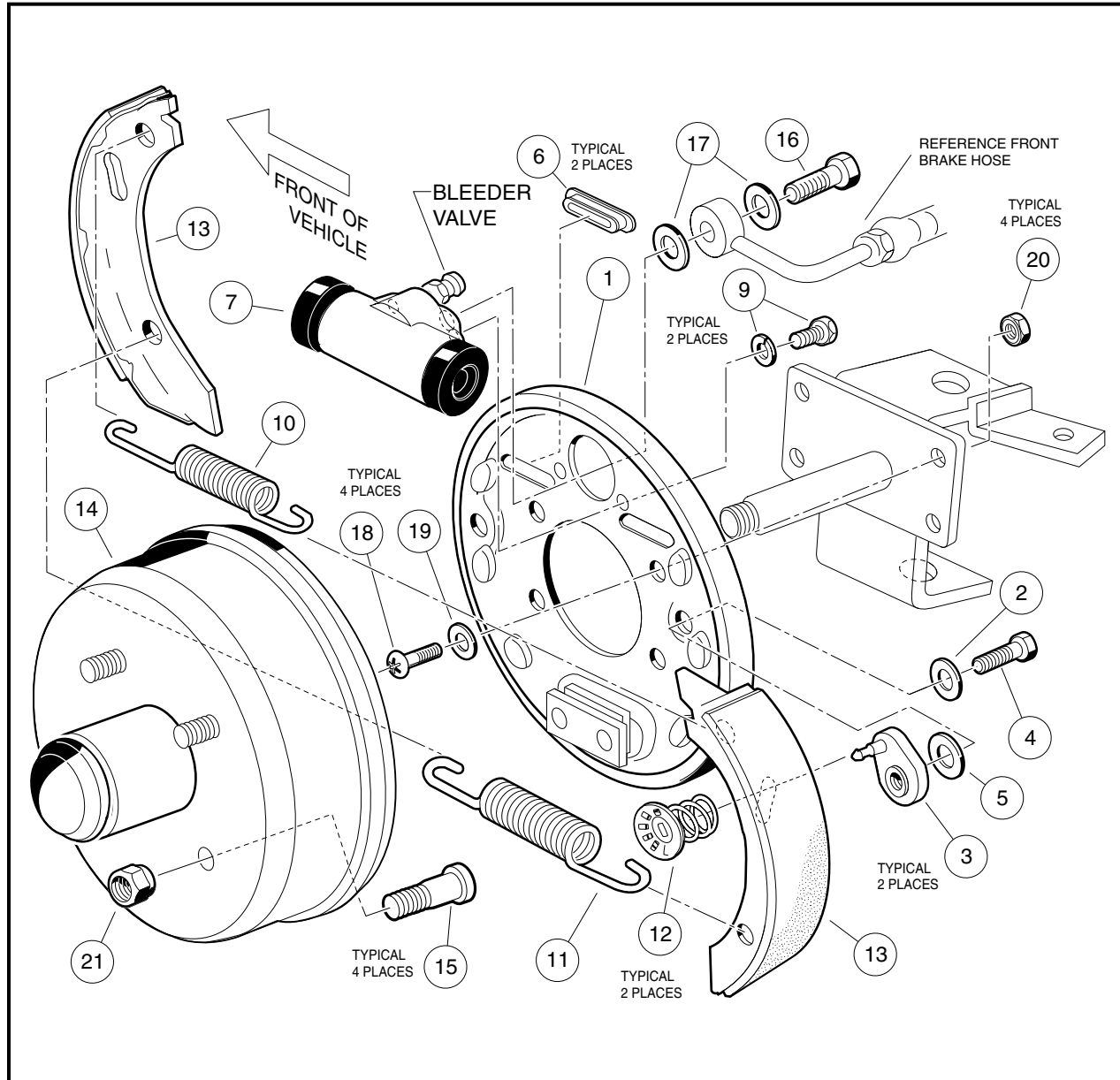


Figure 6b-3 Front Hydraulic Brake Cluster Assembly

Master Cylinder Inspection

- Inspect the exterior of the master cylinder. The presence of brake fluid on the exterior of the master cylinder indicates a brake fluid leak. Replace any leaking components and bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6b-33.**
- Check the brake fluid level. **See Brake Fluid, Section 10, Page 10-6.**
- Remove the reservoir cap and inspect the brake fluid. The brake fluid should be clean with no residue in the bottom of the reservoir or any other evidence of contamination. If brake fluid is contaminated, purge the brake fluid and refill the hydraulic system. **See Filling the Hydraulic System on page 6b-36.**
- Check the vent holes in the reservoir cap. The vent holes should be clean and open. If the vent holes are not clean and open, clean or replace the cap.

- Check the diaphragm inside the reservoir cap. The diaphragm should not have holes or other damage. If the diaphragm is damaged, replace it before placing the vehicle in service.

Brake Line and Hose Inspection

- Inspect the brake lines. The brake lines should not be kinked, dented or damaged in any way. There should be no leakage from the brake lines or fittings. If a leak is discovered, replace the brake line. **See Hydraulic Line and Hose Replacement on page 6b-27.**
- Inspect the brake hoses. Hoses must be flexible and free from leaks, cuts, cracks or bulges. If the hoses do not pass inspection, replace as necessary. **See Hydraulic Line and Hose Replacement on page 6b-27.**
- Inspect the brake hoses at the front wheels. When turning the steering wheel all the way from left to right and back again, the hoses should not come in contact with any components, especially the wheels or tires.
- Check the back side of each brake cluster backing plate. The backing plates should be free from brake fluid and grease. If a brake hose or wheel cylinder shows signs of leaking, determine the cause of the leak and replace the brake hose or wheel cylinder. **See Wheel Cylinder Replacement on page 6b-23. Also see Hydraulic Line and Hose Replacement on page 6b-27**

Park Brake Inspection

- Apply moderate pressure to the park brake handle. Tension should increase as the handle is pulled. When latched, the park brake should lock the wheels and hold the vehicle stationary (on incline of 20% or less). If the park brake does not function as described, adjust the park brake. **See Park Brake Adjustment on page 6b-39.**
- Check the park brake cables, equalizer and linkage. The cables should not be corroded, frayed or damaged and should move freely within the cable sheathing. The cables should not come in contact with either of the rear wheels or tires.

Brake Drum and Shoe Inspection

- Remove and inspect each brake drum. The drum should not be cracked or warped, or have excessive scores or heat checks.
- Inspect the brake shoes. Shoes should not be distorted, cracked or have broken welds.
- Check the condition of the brake shoe linings. The brake shoe lining should not be glazed or soiled with grease or brake fluid. There should be a minimum of 1/32-inch (0.8 mm) of usable lining remaining at the thinnest point.

WARNING

- **Use only approved replacement brake drums designed for your vehicle. For MC010C-BS00 transaxles, use CCI P/N 102044101.**

Brake Cluster Assembly Inspection

- Check each wheel cylinder (7) by pulling back the edge of each dust boot (**Figure 6b-3, Page 6b-4 or Figure 6b-21, Page 6b-25**). There should be no accumulation of brake fluid in the boot. Brake fluid in the boot indicates a leaking wheel cylinder. If there is fluid in the boot, replace the wheel cylinder. **See Wheel Cylinder Replacement on page 6b-23.**
- Inspect the shoe hold-down parts and compression springs. Shoe hold-down pins, compression springs and cups must be properly installed and not damaged.
- Inspect the automatic brake adjuster parts. If the adjusters (3) are frozen (requiring more than 65 in-lb (7.4 N·m) to turn freely), worn or loose, replace the adjuster assemblies in pairs (**Figure 6b-3, Page 6b-4**).

BRAKE SYSTEM TROUBLESHOOTING

With regularly scheduled maintenance and replacement of worn parts, the hydraulic and park brake systems should provide trouble-free operation. In the event that a problem does occur, the following troubleshooting guide will be helpful in identifying operating difficulties. The guide includes the symptom, probable cause(s) and suggested checks. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Low pedal – Pedal may go to the floor	Excessive clearance between the drums and shoe linings	Front - Perform step 19 of Front Wheel Brake Drum Installation on page 6b-18. Rear - Perform step 4 of Rear Wheel Brake Drum Installation on page 6b-20.
	Automatic adjusters are not working	Make several forward and reverse brake stops; if the pedal does not come up, replace the automatic adjusters. See Brake Shoe Adjuster Replacement on page 6b-25.
	Bent or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Leak in the hydraulic system	Check the master cylinder, brake lines and hoses for leaks. Replace all damaged parts.
	Air in the hydraulic system	See Bleeding the Hydraulic Brake System on page 6b-33.
	Weak (bulging) brake hose	Replace the worn hose. See Hydraulic Line and Hose Replacement on page 6b-27.
	Improperly adjusted master cylinder push rod	See Brake Pedal Adjustment, Section 5, Page 5-6.
Springy or spongy brake pedal – Brake pedal has soft, springy or spongy feel when depressed	Bent or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Cracked or thin drums	Replace brake drums. See Brake Drum Removal on page 6b-9.
	Poor quality brake fluid (low boiling point)	Purge hydraulic fluid and fill with approved DOT 5 (silicone) brake fluid. See Purging the Hydraulic System on page 6b-36.
	Weak (bulging) brake hoses that expand under pressure	Check the master cylinder, brake lines and hoses for leaks or bulges. Replace all damaged parts.
	Air in the hydraulic system	See Bleeding the Hydraulic Brake System on page 6b-33.
Hard pedal – Excessive pedal pressure is required to stop the vehicle	Brake fade	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Grease or brake fluid on the brake shoe linings	Replace hub or axle seal and replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Glazed brake shoe linings	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Hard pedal, continued	Damaged or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Scored or barrel-shaped brake shoe drums	Replace the brake drums. See Brake Drum Removal on page 6b-9.
	Clogged master cylinder lines or hoses	Replace brake lines or hoses as required. See Hydraulic Line and Hose Replacement on page 6b-27.
	Frozen master cylinder piston	Replace master cylinder. See Master Cylinder Removal on page 6b-32.
Over-aggressive braking	Incorrect or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Grease or brake fluid on the brake shoe linings	Replace hub, axle seal or wheel brake cylinder and replace brake shoes. See Brake Shoe Removal on page 6b-11.
	Loose or distorted brake backing plate	Tighten or replace the backing plate and/or hardware.
	Scored or warped brake drums	Replace the brake drums. See Brake Drum Removal on page 6b-9.
	Corroded master cylinder bore	Replace master cylinder. See Master Cylinder Removal on page 6b-32.
	Binding brake pedal linkage	Lubricate and adjust. See Section 5 – Accelerator and Brake Pedal Assemblies.
Vehicle pulls to one side	Incorrect or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Grease or brake fluid on the brake shoe linings	Replace hub, axle seal or wheel cylinder and replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Loose or distorted brake cluster backing plate	Tighten or replace the backing plate and/or hardware.
	Scored or warped brake drums	Replace the brake drums. See Brake Drum Removal on page 6b-9.
	Water on the brake shoe linings	Apply the brakes several times to dry the brake shoe linings.
	Sticking wheel cylinder piston	Replace the wheel cylinder. See Wheel Cylinder Replacement on page 6b-23.
	Faulty suspension parts	See Section 7 – Steering and Front Suspension or Section 9 – Rear Suspension.
Pulsating brake pedal	Warped brake drums	Replace the brake drums. See Brake Drum Removal on page 6b-9.
	Bent axle	Replace the axle. See Section 16b – MC010C-BS00 Unitized Transaxle with Differential Lock.
	Worn or damaged front wheel bearings	Replace bearings. See Section 7 – Steering and Front Suspension.
Decreasing brake pedal travel	Weak or broken brake shoe return springs	Replace return springs.
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Decreasing brake pedal travel, continued	Sticking wheel cylinder piston	Replace the wheel cylinder. See Wheel Cylinder Replacement on page 6b-23.
	Overly adjusted brake adjusters	Adjust brake adjusters. See Brake Shoe Adjuster Replacement on page 6b-25.
	Improperly adjusted park brake	Adjust park brake. See Park Brake Adjustment on page 6b-39.
Noise and chatter – Squealing, clicking or scraping sound upon brake application	Bent, damaged or incorrect brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Worn out brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Foreign material embedded in brake shoe linings	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Broken brake shoe return springs or hold down springs	Replace damaged parts.
	Rough, grooved or dry brake shoe ledges or backing plate bosses	Lubricate the bosses of the brake cluster backing plate, and/or replace the brake shoes. See Brake Cluster Inspection and Cleaning on page 6b-12. See Brake Shoe Removal on page 6b-11.
	Brake drums are cracked or scored	Replace the brake drums. See Brake Drum Removal on page 6b-9.
All brakes drag	Binding brake pedal	Lubricate and adjust. See Section 5 – Accelerator and Brake Pedal Assemblies.
	Soft or swollen rubber parts caused by incorrect or contaminated brake fluid	Replace master cylinder. See Master Cylinder Removal on page 6b-32.
Rear brakes drag	Binding park brake cables	Adjust or replace cables and adjust.
	Improper brake adjustment	Adjust shoes and repair the brake shoe adjusters if necessary. See Brake Cluster Inspection and Cleaning on page 6b-12.
One brake drags	Weak or broken brake shoe return springs	Replace the return springs.
	Improper brake shoe adjustment	Adjust shoes and repair the brake shoe adjusters if necessary. See Brake Cluster Inspection and Cleaning on page 6b-12.
	Sticking wheel cylinder pistons	Replace the wheel cylinder. See Wheel Cylinder Replacement on page 6b-23.
	Swollen wheel cylinder cups	Replace the wheel cylinder and purge the hydraulic system. See Wheel Cylinder Replacement on page 6b-23 and Purging the Hydraulic System on page 6b-36.
	Bent or distorted brake shoes	Replace the brake shoes. See Brake Shoe Removal on page 6b-11.
	Loose or worn front wheel bearings	Adjust or replace front wheel bearings. See Section 7 – Steering and Front Suspension.
	Damaged brake line or hydraulic line	Replace brake lines or tubes as required. See Hydraulic Line and Hose Replacement on page 6b-27.

BRAKE DRUM REMOVAL

Read **DANGER** and **WARNING** on page 6b-1.

FRONT WHEEL BRAKE DRUM REMOVAL

▲ WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6b-33.

1. To remove the front brake drums, place chocks at the rear wheels, release the park brake, loosen the front wheel lug nuts and lift the front of the vehicle with a chain hoist or floor jack.
2. Place jack stands under the outer front frame I-beams of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands. **See Figure 5-2, Section 5, Page 5-4.**
3. Remove the lug nuts and remove the front wheel.
4. To remove the front wheel brake drum:
 - 4.1. Remove the dust cover (1) (**Figure 6b-4, Page 6b-9**).
 - 4.2. Remove the cotter pin (2) (**Figure 6b-4, Page 6b-9**).
 - 4.3. Remove the castle nut (3), large flat washer (4), wheel bearing (5) and drum (8) from spindle (**Figure 6b-4, Page 6b-9**).
5. If the brake drum was easily removed, proceed to step 7. **See following NOTE.**

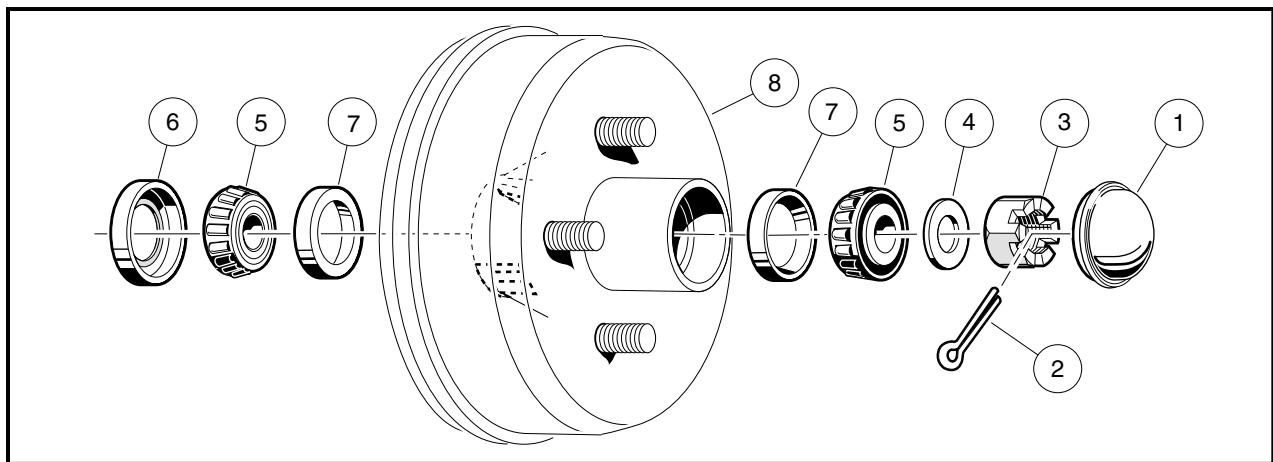


Figure 6b-4 Front Spindle and Brake Drum Assembly

6. To remove tight brake drums:
 - 6.1. On the back of each brake cluster assembly, locate the heads of the two brake shoe adjusters.
 - 6.2. Using a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts in order to increase the clearance between the brake shoe lining and the brake shoe drum (**Figure 6b-5, Page 6b-10**). **See following NOTE.**

Front Wheel Brake Drum Removal, Continued:

NOTE: If the adjusters require more than 65 in-lb (7.3 N·m) of force to rotate, they must be replaced. See **Brake Shoe Adjuster Replacement on page 6b-25.**

- Repeat steps 1 through 6 for the opposite front wheel if necessary.

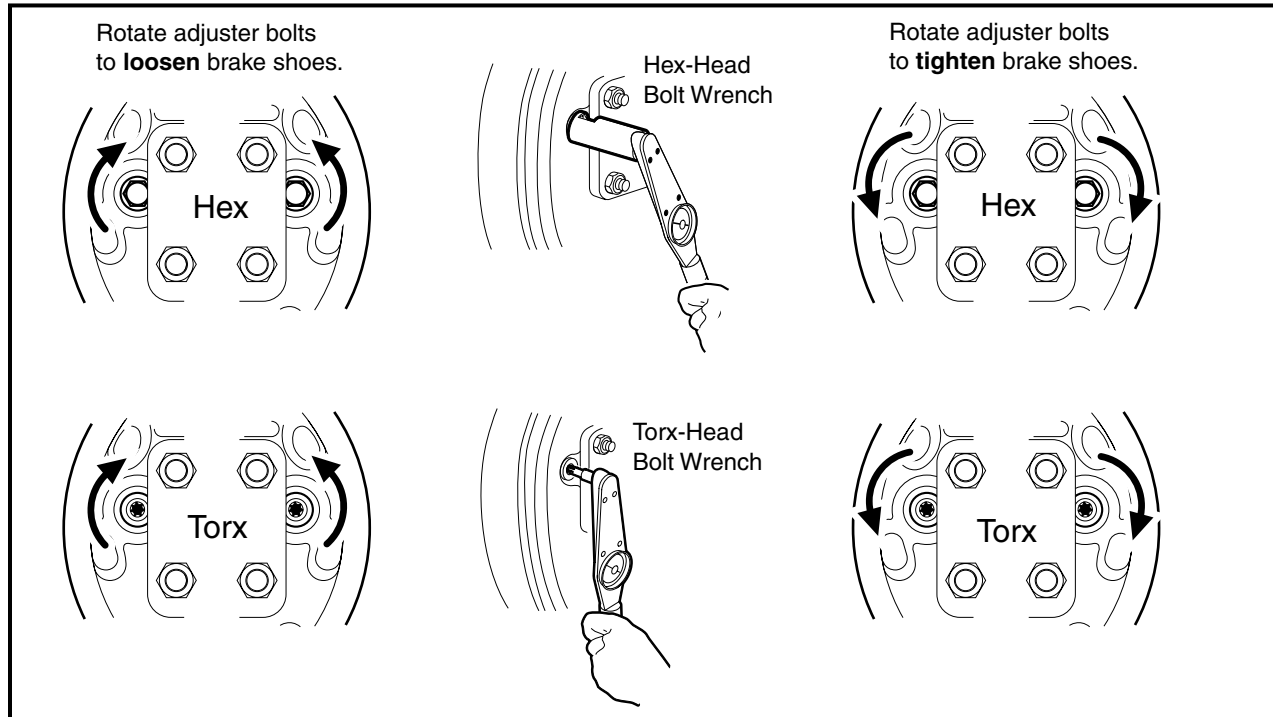


Figure 6b-5 Loosen or Tighten Brake Adjusters

REAR WHEEL BRAKE DRUM REMOVAL**⚠ WARNING**

- Use only approved replacement brake drums designed for your vehicle. For MC010C-BS00 transaxles, use CCI P/N 102044101.

- To remove the rear brake drums, place chocks at the front wheels, release the park brake, loosen the rear wheel lug nuts and lift the rear of the vehicle with a chain hoist or floor jack.
- Place jack stands under the axle tubes to support the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.
- Remove the lug nuts and remove rear wheel.
- Remove the brake drum. If the brake drum was easily removed, proceed to step 6.
- To remove tight brake drums:
 - On the back of each brake cluster assembly, locate the heads of the two brake shoe adjusters.
 - Using a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts in order to increase the clearance between the brake shoelining and the brake drum (**Figure 6b-5, Page 6b-10**). See following **NOTE**.

NOTE: If the adjusters require more than 65 in-lb (7.3 N·m) of force to rotate, they must be replaced. See **Brake Shoe Adjuster Replacement on page 6b-25.**

- 5.3. Rotate the brake drum slightly to remove it from the brake shoe cluster.
6. Repeat steps 3 through 5 for the opposite rear wheel if necessary.

BRAKE SHOE REMOVAL

Read **DANGER** and **WARNING** on page 6b-1.

WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6b-33.

FRONT BRAKE SHOE REMOVAL

1. Brake drum removal is necessary prior to removing front brake shoes. **See Front Wheel Brake Drum Removal on page 6b-9.**
2. To remove front brake shoes:
 - 2.1. Use pliers or a brake tool and rotate the cup washer and compression spring assembly 90°. Remove the cup and spring from each brake shoe (**Figure 6b-6, Page 6b-12**).

NOTE: *The brake shoes are under spring tension and can release suddenly when cup and spring assemblies are removed.*

- 2.2. Grasp both brake shoes and pull them and tensioning springs out of the brake cluster assembly (**Figure 6b-9, Page 6b-12**)
3. Repeat steps 1 and 2 for the opposite front wheel if necessary.

REAR BRAKE SHOE REMOVAL

1. Brake drum removal is necessary prior to removing the rear brake shoes. **See Rear Wheel Brake Drum Removal on page 6b-10.**

NOTE: *It is necessary to remove the rear axle to remove rear brake shoes on an MC010C transaxle (**Figure 6b-1, Page 6b-3**).*

2. To remove rear axle:
 - 2.1. Use a 90° internal snap ring pliers (.090 tip) (CCI P/N 1012560) to remove the internal retaining ring from the axle tube hub (**Figure 6b-7, Page 6b-12**).
 - 2.2. Carefully pull the axle shaft and bearing straight out of the axle tube.
3. Using pliers or a brake tool, rotate the cup washer and compression spring assembly 90° and remove the cup and spring from each rear brake shoe (**Figure 6b-8, Page 6b-12**). **See following NOTE.**

NOTE: *The brake shoes are under spring tension and can release suddenly when cup and spring assemblies are removed.*

4. Grasp both brake shoes and pull them and tensioning springs out of the brake cluster assembly (**Figure 6b-9, Page 6b-12**).
5. Repeat steps 1 through 4 for the opposite rear wheel if necessary.

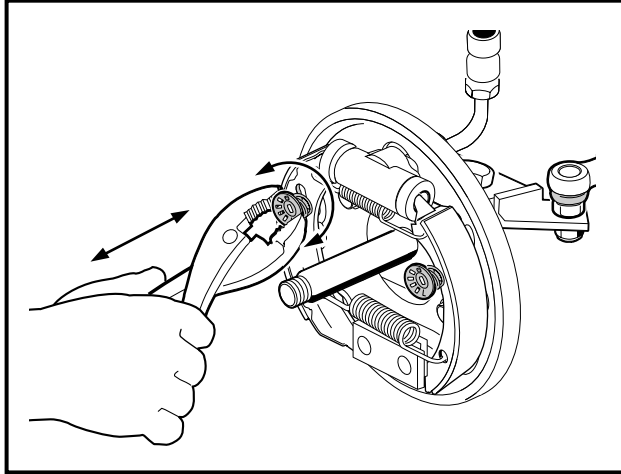


Figure 6b-6 Rotate Front Spring Cups

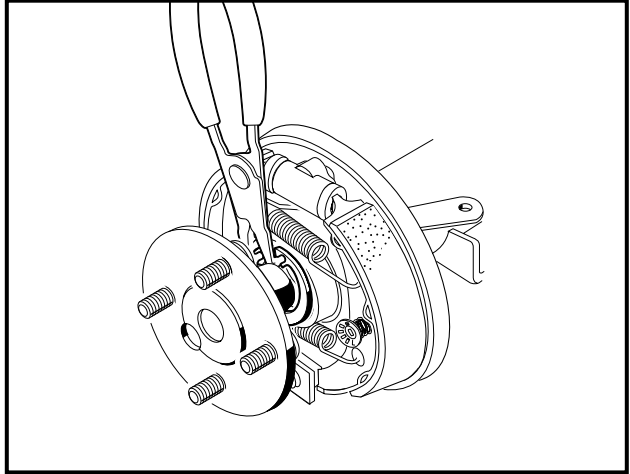


Figure 6b-7 Internal Axle Retaining Ring

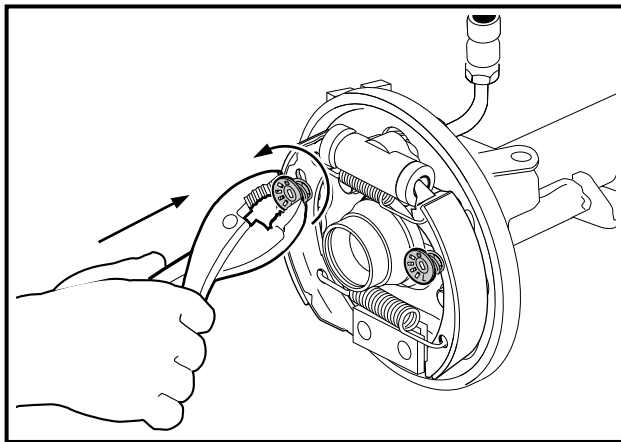


Figure 6b-8 Rotate Rear Spring Cups

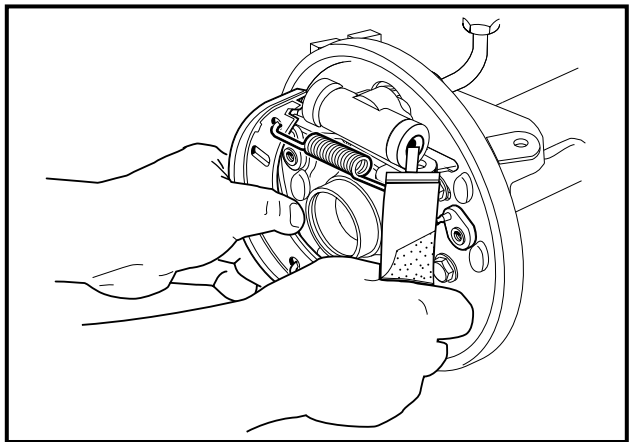


Figure 6b-9 Remove Brake Shoes

BRAKE CLUSTER INSPECTION AND CLEANING

Read **DANGER** and **WARNING** on page 6b-1.

⚠ WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6b-33.

NOTE: Factory installed brake shoes have non-asbestos linings (CCI P/N 102050201). When replacing brake shoes, Club Car, Inc. recommends non-asbestos replacement parts.

1. Remove the brake drum. See **Front Wheel Brake Drum Removal** on page 6b-9, and **Rear Wheel Brake Drum Removal** on page 6b-10.
2. Remove the brake shoes. See **Front Brake Shoe Removal** on page 6b-11, and **Rear Brake Shoe Removal** on page 6b-11.

3. Clean the brake cluster back plate and all of the brake cluster components.
4. Check the brake shoe adjusters in each brake cluster assembly for proper operation.
 - 4.1. With the brake shoes removed, use a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), and gently rotate the adjuster bolts (**Figure 6b-5, Page 6b-10**).
See following NOTE.

NOTE: If the adjusters require more than 65 in-lb (7.3 N·m) of force to rotate, they must be replaced. **See Brake Shoe Adjuster Replacement on page 6b-25.**

5. Check the wheel cylinder for signs of leakage. If there are signs of leakage, replace the wheel cylinder. **See Wheel Cylinder Replacement on page 6b-23.**
6. Check all springs for loss of compression or tension and damage. Replace weak springs and any damaged or badly worn parts.
7. If a brake cluster assembly shows signs of excessive wear or damage, replace the cluster assembly. **See Brake Cluster Assembly Replacement on page 6b-20.**

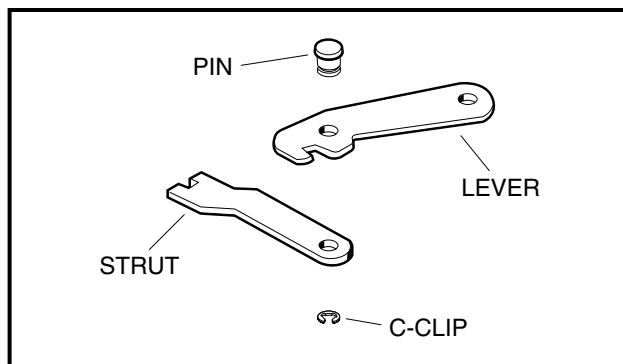


Figure 6b-10 Park Brake Lever and Strut

8. For the rear brake clusters, ensure that the park brake lever and strut assembly (14) can be easily moved by hand (**Figure 6b-21, Page 6b-25**). If the assembly can be easily moved by hand, proceed to step 10. If the assembly cannot be easily removed by hand, cleaning and lubrication will be necessary.
9. Clean and lubricate the rear park brake lever and strut.
 - 9.1. Remove the park brake cable hair spring clip (1), hair spring cotter pin (2), and clevis pin (3) from the cable clevis and strut (**Figure 6b-18, Page 6b-22**).
 - 9.2. Remove the lever and strut (14) from the brake cluster assembly (**Figure 6b-21, Page 6b-25**).
 - 9.3. Disassemble the lever and strut by removing the C-clip and pin (**Figure 6b-10, Page 6b-13**).
 - 9.4. Use a wire brush to remove corrosion and contaminants from the contact areas of the strut and lever.
 - 9.5. Use a small brush to carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning® BR2-Plus or equivalent) to the pin and contact surfaces and reassemble the lever and strut. **See following WARNING.**

⚠ WARNING

- **Make sure the C-clip is properly seated in the groove of the pin. An improperly installed C-clip could result in a non-functioning park brake.**
- **Apply grease carefully when performing the following steps. Do not allow any grease to get on the friction surfaces of the brake shoe pads. Failure to heed this warning could cause diminished brake performance, possibly resulting in property damage or severe personal injury.**

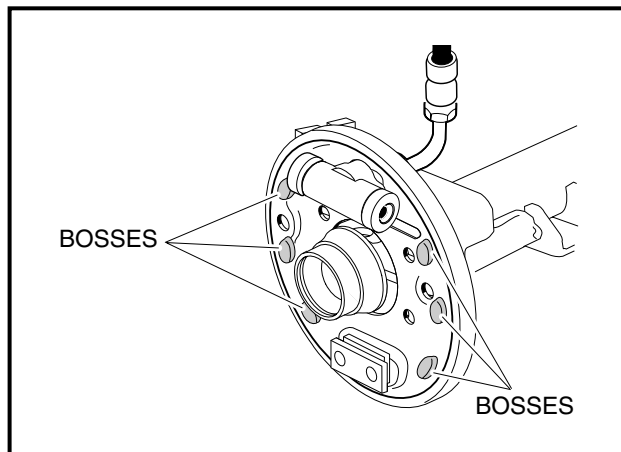
Brake Cluster Inspection and Cleaning, Continued:

Figure 6b-11 Lubricate Raised Bosses

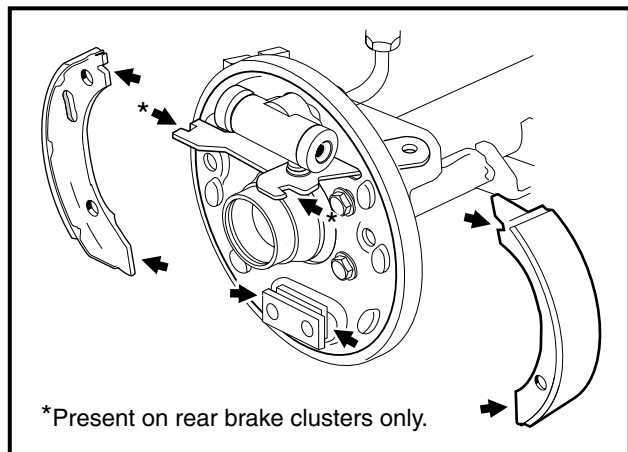


Figure 6b-12 Lubricate Rear Brake Cluster

10. Use a small brush to carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning BR2-Plus or equivalent) on each of the six raised bosses on the brake cluster back plate (**Figure 6b-11, Page 6b-14**). See preceding **WARNING**.
11. Use a small brush to carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning BR2-Plus or equivalent) to each end of both brake shoes and into the slots in the brake shoe mounting block as shown. For rear brake clusters, apply grease to the notches in the mechanical park brake mechanism as shown (**Figure 6b-12, Page 6b-14**). See preceding **WARNING**.
12. Repeat steps 1 through 11 for the remaining brake cluster assemblies if necessary.

BRAKE SHOE INSTALLATION

Read **DANGER** and **WARNING** on page 6b-1.

⚠ WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6b-33.

NOTE: Unlike some other brake systems, the 272 vehicle uses a pair of identical brake shoes in each brake cluster assembly. While a brake shoe may be installed on either the left-hand or right-hand side of the brake cluster assembly, the shoe must be positioned so that the adjuster pin is inserted into the slot of the brake shoe as illustrated (**Figure 6b-13, Page 6b-15**).

FRONT BRAKE SHOE INSTALLATION

1. Install one front brake shoe onto the brake cluster back plate, positioning the bottom tip of the shoe into the brake shoe mounting block, and the top tip of the shoe into the wheel cylinder piston.
2. Install the cup washer and compression spring assembly (12) onto the pin of the adjuster assembly (3) of the brake shoe (**Figure 6b-3, Page 6b-4**). Compress the cup and spring with a pair of pliers or a brake tool and rotate 90°, securing the brake shoe to the brake cluster back plate (**Figure 6b-8, Page 6b-12**).

3. Attach the tensioning springs onto the shoe already installed, with the smaller spring on top and the larger spring on the bottom. Make sure that the park brake strut and lever are engaged into the slots provided in each shoe, located immediately above the top spring attachment holes (**Figure 6b-13, Page 6b-15**).

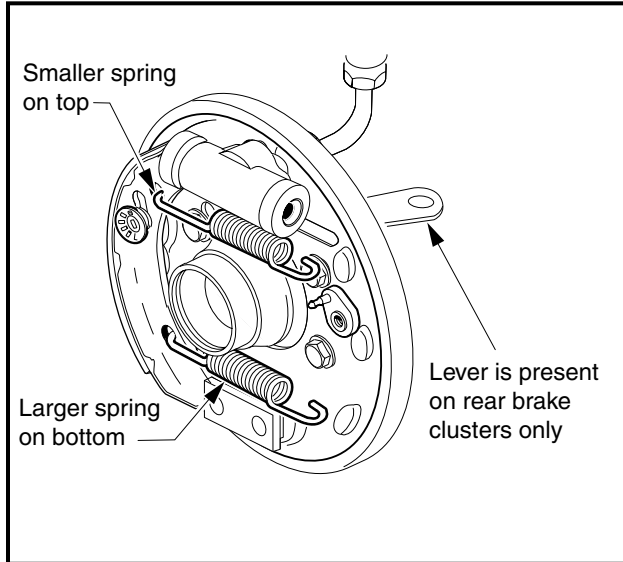


Figure 6b-13 Brake Shoe Tensioning Springs

4. Position the bottom tips of both shoes into the brake shoe mounting block, the top tips of the shoes into the slots in the wheel cylinder pistons, and the park brake lever and strut into the slots in the shoes located just below the top, smaller spring. Attach the free ends of tensioning springs to the loose shoe and push the shoe into place (**Figure 6b-14, Page 6b-15**).
5. Install the remaining cup washer and compression spring assembly (12) onto the pin of the adjuster (3) of the brake shoe (**Figure 6b-6, Page 6b-12**) described in step 2 above.

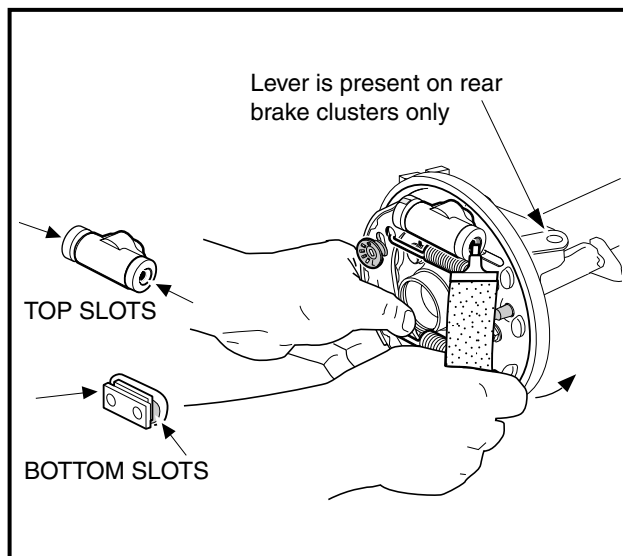


Figure 6b-14 Brake Shoe Installation

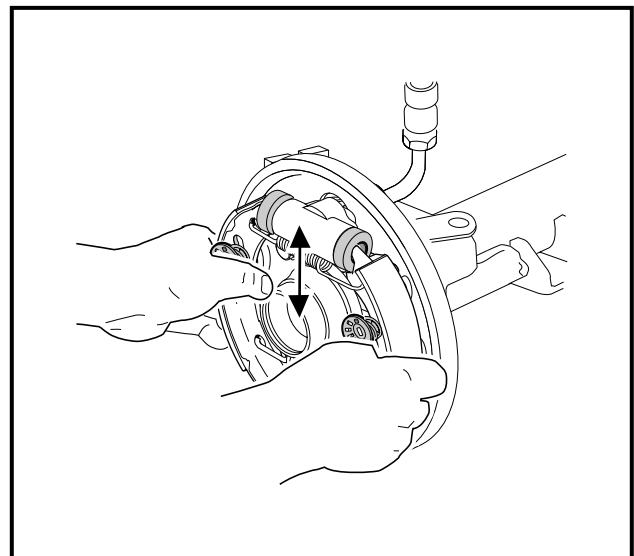


Figure 6b-15 Slide Brake Shoes

Front Brake Shoe Installation, Continued:

6. After the shoes are installed, move them together up and down approximately 1/4 to 3/8-inch (6.3 to 9.5 mm) to make sure that they will slide easily without binding (**Figure 6b-15, Page 6b-15**).
7. Install the front wheel brake drum. **See Front Wheel Brake Drum Installation on page 6b-17.**
8. Repeat steps 1 through 7 for the remaining front wheel if necessary.
9. Bleed the front brakes as instructed. **See Bleeding the Hydraulic Brake System on page 6b-33.**
10. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

REAR BRAKE SHOE INSTALLATION

1. Install rear brake shoes on MC010C transaxle.
 - 1.1. Install one rear brake shoe onto the brake cluster back plate, positioning the bottom tip of the shoe into the brake shoe mounting block, and the top tip of the shoe into the wheel cylinder piston.
 - 1.2. Install the cup washer and compression spring assembly (12) onto the pin of the adjuster assembly (3) of the brake shoe (**Figure 6b-21, Page 6b-25**). Compress the cup and spring (12) with a pair of pliers or a brake tool and rotate 90°, securing the brake shoe to the brake cluster back plate (**Figure 6b-8, Page 6b-12**).
 - 1.3. Attach the tensioning springs onto the shoe already installed (**Figure 6b-13, Page 6b-15**).
 - 1.4. Position the bottom tip of the remaining shoe into the brake shoe mounting block, and the top tip of the shoe into the slot in the wheel cylinder piston. Attach the free ends of tensioning springs to the shoe and push the shoe into place (**Figure 6b-14, Page 6b-15**).
 - 1.5. Install the remaining cup washer and compression spring assembly (12) onto the pin of the adjuster assembly (3) of the brake shoe described in step 1.2 above (**Figure 6b-21, Page 6b-25**).
 - 1.6. After the shoes are installed, move them together up and down to make sure that they will slide easily approximately 1/4 to 3/8-inch (6.3 to 9.5 mm) without binding (**Figure 6b-15, Page 6b-15**).
2. Repeat step 1 for the remaining rear wheel if necessary.
3. Install the rear axle on MC010C transaxle. **See following NOTE.**

NOTE: Clean any residual oil, dirt, or debris from the transaxle splined end of the axle shaft, and the wheel hub oil seal area before installing the axle shaft.

There is a LEFT and RIGHT side axle. The splined portions on the axles that insert into the transaxle case are two different lengths. The longest length spline is the LEFT, or driver side axle.

- 3.1. Insert the splined end of the axle shaft into the axle tube. Be careful not to damage the seal on the inside of the axle tube hub. Advance the shaft through to the bearing on the shaft, and rotate it to align the shaft splines with the splined bore of the differential gear. Continue advancing the shaft until the bearing on the axle is firmly seated within the axle tube hub seat.
- 3.2. Using a 90° internal snap ring pliers (.090 tip) (CCI P/N 1012560), attach the internal retaining ring into the axle tube hub so that it seats against the axle bearing assembly and into the machined slot in the inside wall of the axle tube hub (**Figure 6b-7, Page 6b-12**).
- 3.3. Place a 1/4 to 3/8-inch (6-10 mm) diameter rod against the retaining ring and tap lightly at four or five locations to ensure it is properly seated. **See following WARNING.**

 WARNING

- **Be sure retaining ring is properly seated in its groove. If ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.**

4. Install the rear wheel brake drum. **See Rear Wheel Brake Drum Installation on page 6b-19.**
5. Repeat steps 1 through 4 for the remaining rear axle if necessary.
6. Bleed the rear brakes as instructed. **See Bleeding the Hydraulic Brake System on page 6b-33.**
7. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

BRAKE DRUM INSTALLATION

Read **DANGER** and **WARNING** on page 6b-1.

WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System on page 6b-33.**
- Worn or damaged brake drums cannot be machined. Replace as necessary.
- Use only approved replacement brake drums designed for your vehicle. For MC010C-BS00 transaxles, use CCI P/N 102018401.

FRONT WHEEL BRAKE DRUM INSTALLATION

NOTE: Prior to installing the brake drum, inspect the brake lines, hoses, drums and brake cluster assemblies. **See Brake System Inspection on page 6b-3.**

Clean any residual grease from the friction area of the brake drum prior to installation.

1. Clean the wheel bearings (5) (**Figure 6b-4, Page 6b-9**). **See following NOTE.**

NOTE: Do not use compressed air to dry wheel bearings after cleaning. Spinning the wheel bearings at accelerated speeds, for purposes of drying, can damage bearings and bearing race.

- 1.1. Inspect the wheel bearings (5) for damage or wear.
- 1.2. Inspect the wheel bearings to make sure there is no dirt or debris trapped in the rollers.
2. Replace wheel bearings if they are damaged, pitted, or show signs of uneven wear areas. **See following NOTE.**

NOTE: If the wheel bearings must be replaced, new bearing cups must be provided. New bearing cups are only available as an assembled part of each wheel hub. Refer to the illustrated parts manual for replacement part number of the wheel hub (**Figure 6b-4, Page 6b-9**).

3. Inspect the bearing cups (7) for wear or damage. If they are worn or pitted they must be replaced, along with their respective wheel hub, as an assembly.
4. Pack the wheel bearings (5) and lubricate the bearing cups (7) with Chassis Lube (EP NLGI Grade 2). Make sure the grease is forced between the rollers.
5. Lubricate spindle shaft with grease.
6. Install a new seal (6) and grease packed wheel bearing (5) into rear of hub.
7. Carefully apply grease around the seal (6) inner lip before installation. Do not allow grease to touch the brake shoe linings or the brake shoe surface of the drum hub.

Front Wheel Brake Drum Installation, Continued:

8. Place the brake drum hub (8) onto the spindle and brake cluster (**Figure 6b-4, Page 6b-9**).
9. If the brake drum is difficult to push over the brake shoes, use the following procedure:
 - 9.1. On the back of each brake cluster assembly, locate the bolt heads of the two brake shoe adjusters.
 - 9.2. Using a torque wrench and a Torx #27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts to increase the clearance between the brake shoe lining and the brake drum (**Figure 6b-16, Page 6b-19**). **See following NOTE.**

NOTE: *If the adjusters require more than 65 in-lb (7.3 N·m) of force to rotate, they must be replaced. See **Brake Shoe Adjuster Replacement on page 6b-25.***

10. Fill the brake drum hub cavity with grease.
11. Install the outside bearing (5) onto the spindle (**Figure 6b-4, Page 6b-9**).
12. Install the flat washer (4) up against the bearing race.
13. Install the castle nut (3) onto the spindle finger-tight.
14. Rotate the brake drum slowly while gently tightening the castle nut (3) until the drum hub and bearings are properly seated.
15. Tighten the castle nut (3) to 10 ft-lb (13.6 N·m) in order to fully seat the bearing and cup.
16. Loosen the castle nut 1/2 turn and retighten the nut to 14 in-lb (1.6 N·m).
17. Install a new cotter pin (2), bending the split ends of the pin to secure the castle nut. **See following WARNING, CAUTION, and NOTE.**

⚠ WARNING

- **Make sure to install and bend the cotter pin. Failure to bend the cotter pin could result in the separation of the wheel from the spindle. Loss of vehicle control could result, causing severe personal injury.**

⚠ CAUTION

- **Use a new cotter pin when installing the drum/hub assembly.**

NOTE: *If the cotter pin does not line up with the hole in the spindle when the castle nut is properly tightened, rotate the castle nut back until the next available notch allows the cotter pin to be installed.*

18. Install the dust cover (1) (**Figure 6b-4, Page 6b-9**).
19. With the brake drum properly seated and secured, use a torque wrench with a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), and gently adjust the clearance between the brake shoe lining and brake drum by turning each of the two adjuster bolt heads on the back of the brake cluster plate as shown (**Figure 6b-16, Page 6b-19**). **See following CAUTION.**

⚠ CAUTION

- **Do not apply more than 65 in-lb (7.3 N·m) of torque to any of the adjuster bolts. Over-tightening the adjuster bolts could result in damage to the brake cluster components or the separation of the bolt (4) from the adjuster (3) (**Figure 6b-3, Page 6b-4** or **Figure 6b-21, Page 6b-25**).**

20. Install the wheel and finger-tighten the lug nuts (21) (**Figure 6b-3, Page 6b-4**).
21. Repeat steps 1 through 20 for the opposite front wheel if necessary.

22. Lower the vehicle and finish tightening the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
23. Check the front wheel free play. **See Front Wheel Free Play Inspection, Section 7, Page 7-21.**
24. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted correctly and are operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

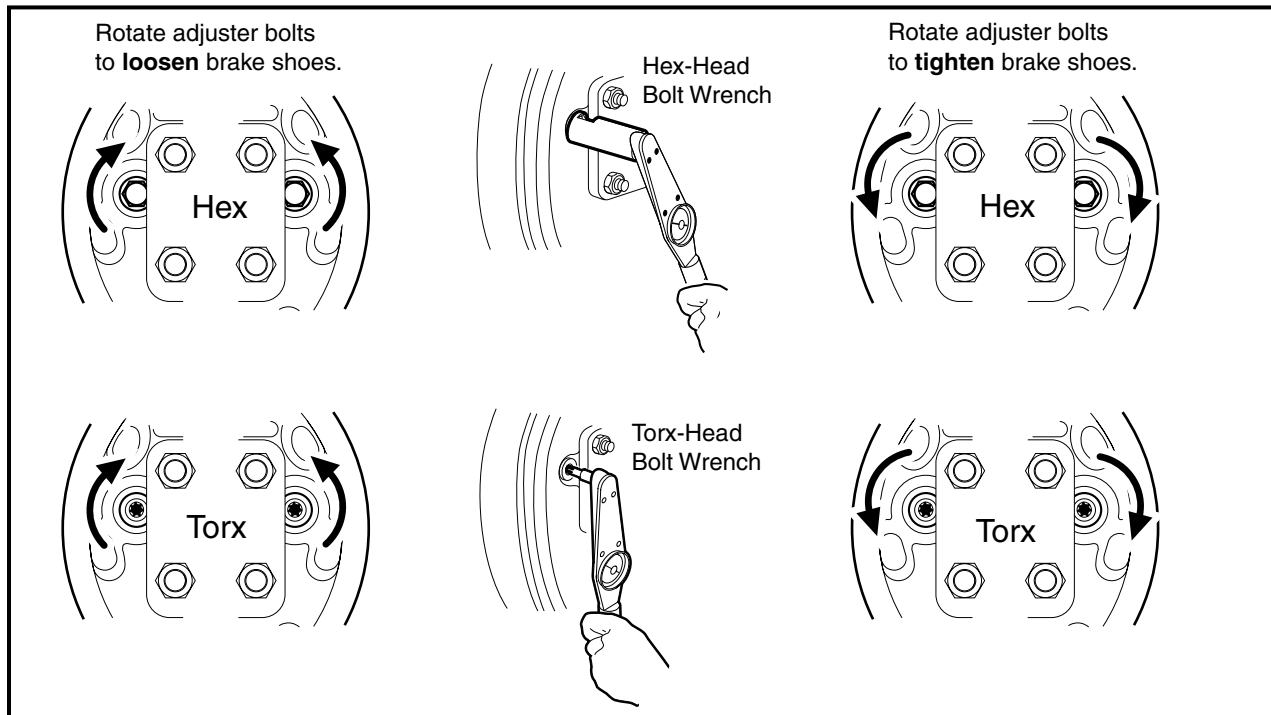


Figure 6b-16 Loosen or Tighten Brake Adjusters

REAR WHEEL BRAKE DRUM INSTALLATION

NOTE: Prior to installing the brake drum, inspect the brake lines, hoses, drums and brake cluster assemblies. **See Brake System Inspection on page 6b-3.**

▲ WARNING

- Use only approved replacement brake drums designed for your vehicle. For MC010C-BS00 transaxles, use CCI P/N 102044101.

1. Place the brake drum (15) onto the axle hub and brake cluster (**Figure 6b-21, Page 6b-25**).

NOTE: If brake drum installation is difficult, the brake shoes may need to be adjusted vertically in the mounting slots.

2. Using a torque wrench with a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolts to increase the clearance between the brake shoe lining and the brake drum (**Figure 6b-16, Page 6b-19**). **See following NOTE.**

NOTE: If the adjusters require more than 65 in-lb (7.3 N·m) of force to rotate, they must be replaced. **See Brake Shoe Adjuster Replacement on page 6b-25.**

Rear Wheel Brake Drum Installation, Continued:

3. Rotate and gently press the brake drum to ensure that the drum is properly seated.
4. With the brake drum properly seated and secured, use a torque wrench with a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), and gently adjust the clearance between the brake shoe lining and brake drum by turning each of the two adjuster bolt heads on the back of the brake cluster plate as shown (**Figure 6b-16, Page 6b-19**). **See following CAUTION.**

 CAUTION

- **Do not apply more than 65 in-lb (7.3 N·m) of torque to any of the adjuster bolts. Over-tightening the adjuster bolts could result in damage to the brake cluster components or the separation of the bolt (4) from the adjuster (3) (Figure 6b-3, Page 6b-4 or Figure 6b-21, Page 6b-25).**
5. Install the wheel and finger-tighten the lug nuts (21) (**Figure 6b-21, Page 6b-25**).
 6. Repeat steps 1 through 5 for the opposite rear wheel as required.
 7. Lower the vehicle and finish tightening the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
 8. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

BRAKE CLUSTER ASSEMBLY REPLACEMENT

Read **DANGER** and **WARNING** on page 6b-1.

 WARNING

- **To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6b-33.**
- **Worn or damaged brake drums must not be machined. Replace as necessary.**
- **Use only approved replacement brake drums designed for your vehicle. For MC010C-BS00 transaxles, use CCI P/N 102044101.**

FRONT BRAKE CLUSTER ASSEMBLY REMOVAL

1. Remove front wheel brake drum. **See Front Wheel Brake Drum Removal on page 6b-9.**
2. Remove the banjo bolt (16) and copper washers (17) from the brake cluster assembly (**Figure 6b-3, Page 6b-4**).
3. To avoid spilling brake fluid, lift the hose above the brake cluster assembly and place a plastic bag over the hose fitting to keep dirt and debris from entering the hydraulic brake system (**Figure 6b-17, Page 6b-21**).
4. Using a Torx #T-40 driver, remove the four Torx-head bolts (18), washers (19) and lock nuts (20) that secure the brake cluster and back plate assembly to the front spindle plate (**Figure 6b-3, Page 6b-4**).

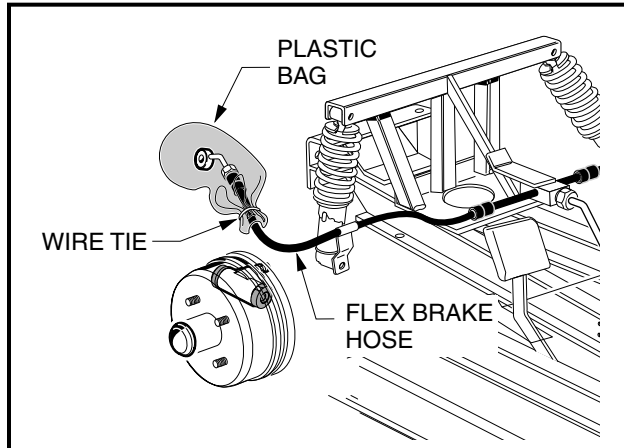


Figure 6b-17 Front Brake Hose With Plastic Bag

FRONT BRAKE CLUSTER ASSEMBLY INSTALLATION

1. Use only new hardware for this step. Install the brake cluster back plate to the front spindle flange using four Torx-head bolts (18), washers (19) and lock nuts (20). Using a torque wrench with a Torx #T-40 driver, tighten all four bolts to 76 in-lb (8.6 N·m) (**Figure 6b-3, Page 6b-4**).

⚠ CAUTION

- **Do not substitute hex-head bolts for Torx-head bolts. Hex-head bolts can interfere with the proper operation of the brake shoe adjusters.**
2. Install a new banjo bolt (16) and new copper washers (17) to the front brake cluster wheel cylinder (7). Position the elbow of the brake hose toward the rear of the vehicle. Tighten the banjo bolt to 13 ft-lb (17.6 N·m) (**Figure 6b-3, Page 6b-4**).
 3. Install front wheel brake drum. **See Front Wheel Brake Drum Installation on page 6b-17.**
 4. Bleed the front wheel brakes. **See Bleeding the Hydraulic Brake System on page 6b-33.**
 5. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

REAR BRAKE CLUSTER ASSEMBLY REMOVAL

1. Remove rear brake drum. **See Rear Wheel Brake Drum Removal on page 6b-10.**
2. Remove rear brake shoes. **See Rear Brake Shoe Removal on page 6b-11.**
3. Remove park brake cable clip (1), hair spring cotter pin (2) and clevis pin (3) (**Figure 6b-18, Page 6b-22**).
4. Remove the clevis from the park brake lever and the cable from the cable support bracket (**Figure 6b-18, Page 6b-22**).
5. Slide the cable so that the coiled spring wire, covering the cable wire, can be fed through the slot in the support bracket, and then removed.
6. Using a 3/8-inch flare nut wrench, remove the brake hose fitting from the rear brake cluster wheel cylinder (**Figure 6b-19, Page 6b-22**).
7. To avoid spilling brake fluid, lift the hose above the brake cluster assembly and place a plastic bag over the hose fitting to keep dirt and debris from entering the hydraulic braking system (**Figure 6b-20, Page 6b-22**).

Rear Brake Cluster Assembly Removal, Continued:

8. Using a Torx #T-40 driver, remove the four Torx-head bolts (16), washers (17), and lock nuts (18) that secure the brake cluster back plate assembly to the axle tube flange (**Figure 6b-21, Page 6b-25**).
9. Repeat steps 1 through 8 for the opposite rear wheel if necessary.

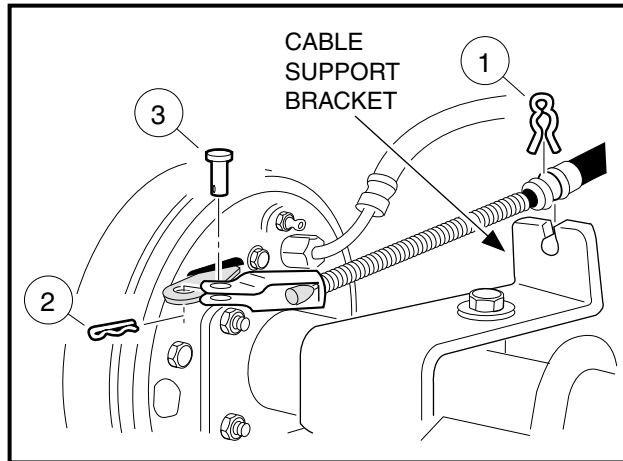


Figure 6b-18 Park Brake Cable

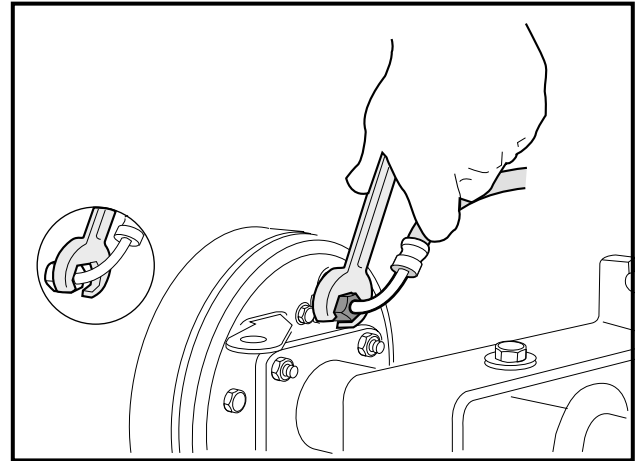


Figure 6b-19 Rear Brake Hose Flare Nut

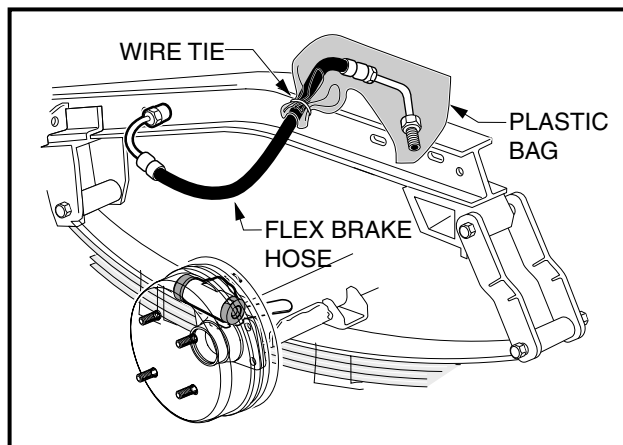


Figure 6b-20 Rear Brake Hose With Plastic Bag

REAR BRAKE CLUSTER ASSEMBLY INSTALLATION

1. Use only new hardware for this step. Install the brake cluster back plate to the axle tube flange with four Torx-head bolts (16), washers (17), and lock nuts (18). Using a torque wrench with a Torx #T-40 driver, tighten all four bolts to 76 in-lb (8.6 N·m) (**Figure 6b-21, Page 6b-25**). **See following NOTE.**

⚠ CAUTION

- Do not substitute hex-head bolts for Torx-head bolts. Hex-head bolts can interfere with the proper operation of the brake shoe adjusters.
2. Connect the brake hose fitting to the brake wheel cylinder using a 3/8-inch flare nut wrench. Tighten the flare nut fitting to 11 ft-lb (14.9 N·m) (**Figure 6b-19, Page 6b-22**).

3. Install the park brake cable into the cable support bracket by sliding the coiled spring wire through the slot in the bracket and feed the clevis end to the park brake lever (**Figure 6b-18, Page 6b-22**).
4. Install the park brake cable clip (1), clevis pin (3) and hair spring cotter pin (2) (**Figure 6b-18, Page 6b-22**).
5. Install rear brake shoes. **See Rear Brake Shoe Installation on page 6b-16.**
6. Install rear wheel brake drum. **See Rear Wheel Brake Drum Installation on page 6b-19.**
7. Repeat steps 1 through 6 for the remaining rear axle if necessary.
8. Bleed the rear wheel brakes. **See Bleeding the Hydraulic Brake System on page 6b-33.**
9. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

WHEEL CYLINDER REPLACEMENT

Read **DANGER** and **WARNING** on page 6b-1.

WARNING

- To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System on page 6b-33.**

FRONT WHEEL CYLINDER REMOVAL

1. Remove front wheel brake drum. **See Front Wheel Brake Drum Removal on page 6b-9.**
2. Remove front brake shoes. **See Front Brake Shoe Removal on page 6b-11.**
3. Remove the banjo bolt (16) and copper washers (17) from the front brake cluster wheel cylinder (7) (**Figure 6b-3, Page 6b-4**).
4. To avoid spilling brake fluid, lift the hose above the brake cluster assembly and place a plastic bag over the hose fitting to keep dirt and debris from entering the hydraulic brake system (**Figure 6b-17, Page 6b-21**).
5. Remove two bolts (9) and lock washers that secure the wheel cylinder to the brake cluster back plate (1), and remove the wheel cylinder (7) (**Figure 6b-3, Page 6b-4**).
6. Repeat steps 1 through 5 for the remaining front wheel if necessary.

FRONT WHEEL CYLINDER INSTALLATION

1. Install wheel cylinder (7) with two bolts (9) and lock washers to the brake cluster back plate (1) (**Figure 6b-3, Page 6b-4**). Tighten each bolt to 120 in-lb (13 N·m). **See following NOTE.**

NOTE: It is recommended that new bolts be used for installation of the wheel cylinder. Use M6 x 10 mm bolts.

Front Wheel Cylinder Installation, Continued:

2. Install a new banjo bolt (16) and new copper washers (17) to the front brake cluster wheel cylinder (7). Position the elbow of the brake hose toward the rear of the vehicle. Tighten the banjo bolt to 13 ft-lb (17.6 N·m) (**Figure 6b-3, Page 6b-4**).
3. Install front brake shoes. **See Front Brake Shoe Installation on page 6b-14.**
4. Install front wheel brake drum. **See Front Wheel Brake Drum Installation on page 6b-17.**
5. Repeat steps 1 through 4 for the remaining front wheel if necessary.
6. Bleed the front wheel brakes. **See Bleeding the Hydraulic Brake System on page 6b-33.**
7. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

REAR WHEEL CYLINDER REMOVAL

1. Remove rear wheel brake drum. **See Rear Wheel Brake Drum Removal on page 6b-10.**
2. Remove rear brake shoes. **See Rear Brake Shoe Removal on page 6b-11.**
3. Using a 3/8-inch flare nut wrench, remove the brake hose fitting from the rear brake cluster wheel cylinder (**Figure 6b-19, Page 6b-22**).
4. To avoid spilling brake fluid, lift the hose above the brake cluster assembly and place a plastic bag over the hose fitting to keep dirt and debris from entering the hydraulic brake system (**Figure 6b-20, Page 6b-22**).
5. Remove two bolts (9) and lock washers that secure the wheel cylinder to the brake cluster back plate (1), and remove the wheel cylinder (7) (**Figure 6b-21, Page 6b-25**).
6. Repeat steps 1 through 5 for the remaining rear wheel if necessary.

REAR WHEEL CYLINDER INSTALLATION

1. Install wheel cylinder (7) with two bolts (9) and lock washers to the brake cluster assembly back plate (1) (**Figure 6b-21, Page 6b-25**). Tighten each bolt to 120 in-lb (13 N·m). **See following NOTE.**

NOTE: *It is recommended that new bolts be used for installation of the wheel cylinder. Use M6 x 10 mm bolts.*

2. Using a 3/8-inch flare nut wrench, attach the brake hose fitting to the brake cluster wheel cylinder (**Figure 6b-19, Page 6b-22**).
3. Install rear brake shoes. **See Rear Brake Shoe Installation on page 6b-16.**
4. Install rear wheel brake drum. **See Rear Wheel Brake Drum Installation on page 6b-19.**
5. Repeat steps 1 through 4 for the remaining rear wheel if necessary.
6. Bleed the rear wheel brakes. **See Bleeding the Hydraulic Brake System on page 6b-33.**
7. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

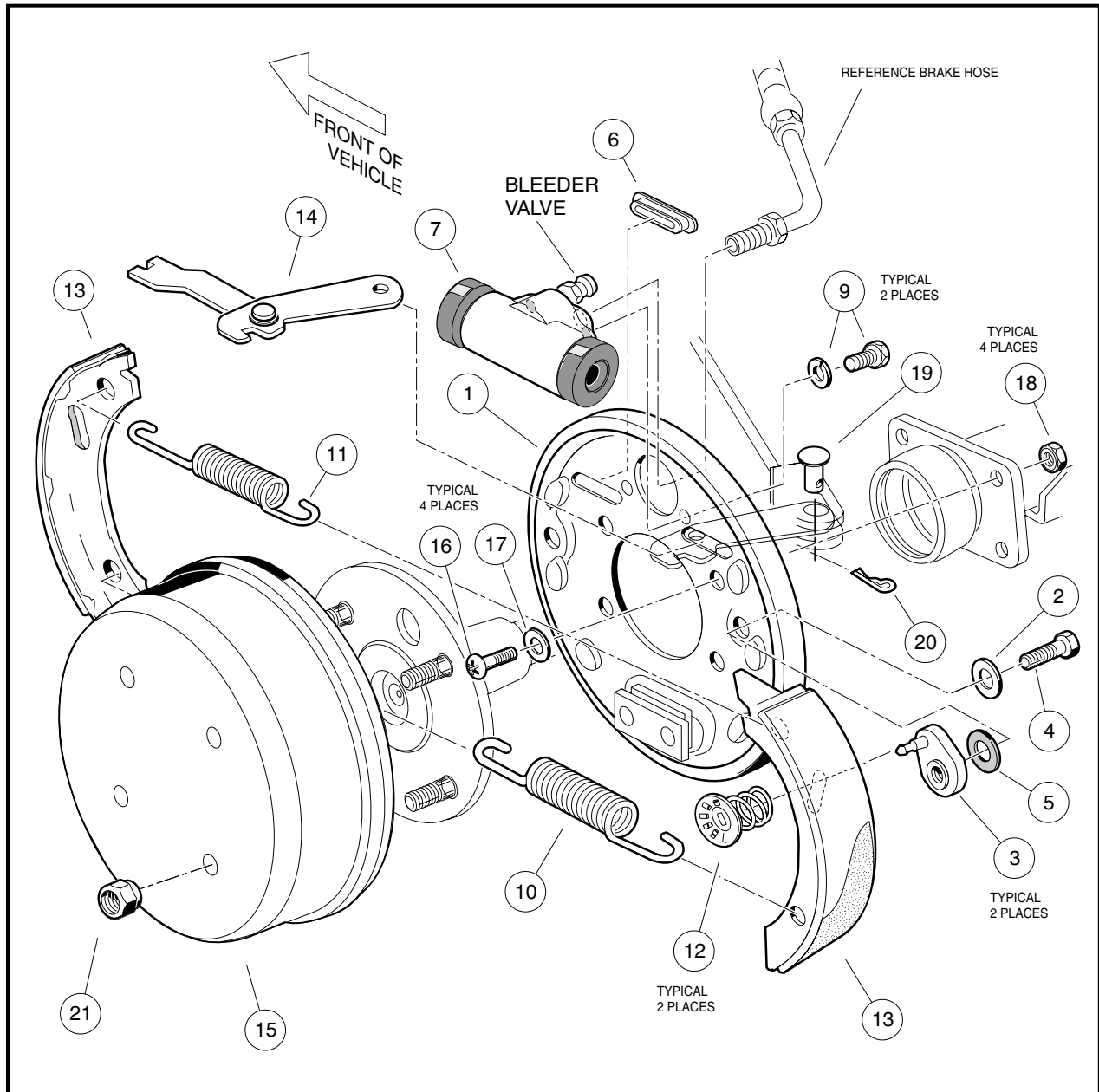


Figure 6b-21 Rear Hydraulic Brake Cluster Assembly

BRAKE SHOE ADJUSTER REPLACEMENT

Read **DANGER** and **WARNING** on page 6b-1.

▲ WARNING

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6b-33.

FRONT BRAKE SHOE ADJUSTER REMOVAL

1. Remove front wheel brake drum. **See Front Wheel Brake Drum Removal on page 6b-9.**
2. Remove front brake shoes. **See Front Brake Shoe Removal on page 6b-11.**
3. Remove front brake cluster assembly. **See Front Brake Cluster Assembly Removal on page 6b-20.**
4. With the back plate removed, grip adjuster arm (3) with a pair of locking pliers. Use a Torx #T-27 driver or 7/16-inch socket to remove the bolt (4) and Bellville washer (5) from the brake cluster back plate (1) **(Figure 6b-3, Page 6b-4)**. Remove remaining adjuster assembly and discard all adjuster components (3, 4, and 5) for both assemblies.
5. Clean the back plate surfaces that contact the adjusters.
6. Repeat steps 1 through 5 for the remaining front wheel if necessary.

FRONT BRAKE SHOE ADJUSTER INSTALLATION

NOTE: The adjusters must be replaced as pairs using new hardware.

1. Install bolt (4) through the flat washer (2) and through the back plate (1) **(Figure 6b-3, Page 6b-4)**.
2. Apply a light coat of grease to the Belleville washer (5) and install the washer onto the bolt (4) and against the inside surface of the back plate (1) **(Figure 6b-3, Page 6b-4)**.
3. Carefully apply Loctite® 222 to the threaded portion of the bolt (4) and attach the adjuster arm (3). Position adjuster so that the brake mounting post is to the top of the back plate. **(Figure 6b-3, Page 6b-4)**.
4. Grip the adjuster arm (3) with a pair of locking pliers. Use a Torx #T-27 driver or 7/16-inch socket to tighten the bolt (4) to 115 in-lb (13 N·m) **(Figure 6b-3, Page 6b-4)**.
5. Repeat steps 1 through 4 for the remaining adjuster.
6. Install front brake cluster assembly. **See Front Brake Cluster Assembly Installation on page 6b-21.**
7. Install front brake shoes. **See Front Brake Shoe Installation on page 6b-14.**
8. Install front wheel brake drum. **See Front Wheel Brake Drum Installation on page 6b-17.**
9. Repeat steps 1 through 8 for the remaining front wheel if necessary.
10. Bleed the front brakes. **See Bleeding the Hydraulic Brake System on page 6b-33.**
11. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

REAR BRAKE SHOE ADJUSTER REMOVAL

1. Remove rear wheel brake drum. **See Rear Wheel Brake Drum Removal on page 6b-10.**
2. Remove rear brake shoes. **See Rear Brake Shoe Removal on page 6b-11.**
3. Remove rear brake cluster assembly. **See Rear Brake Cluster Assembly Removal on page 6b-21.**
4. With the back plate removed, grip adjuster arm (3) with a pair of locking pliers. Use a Torx #T-27 driver or 7/16-inch socket to remove the bolt (4), flat washer (2), and Bellville washer (5) from the brake cluster back plate (1), **(Figure 6b-21, Page 6b-25)**. Remove remaining adjuster assembly and discard all adjuster components (3, 4, 2, and 5) for both assemblies.
5. Clean the back plate surfaces that contact the adjusters.
6. Repeat steps 1 through 5 for the remaining rear wheel if necessary.

REAR BRAKE SHOE ADJUSTER INSTALLATION

NOTE: The adjusters must be replaced as pairs using new hardware.

1. Install bolt (4) through flat washer (2) and through the brake cluster back plate (1) (**Figure 6b-21, Page 6b-25**).
2. Apply a light coat of grease to the Bellville washer (5) and install the washer onto the bolt (4) and against the inside surface of the back plate (1) (**Figure 6b-21, Page 6b-25**).
3. Carefully apply Loctite 222 to the threaded portion of bolt (4) and attach the adjuster arm (3). Position adjuster so that the brake mounting post is to the top of the back plate (**Figure 6b-21, Page 6b-25**).
4. Grip the adjuster arm (3) with a pair of locking pliers. Use a Torx #T-27 driver or 7/16-inch socket to tighten the bolt (4) to 115 in-lb (13 N·m) (**Figure 6b-21, Page 6b-25**).
5. Repeat steps 1 through 4 for the remaining adjuster.
6. Install rear brake cluster assembly. **See Rear Brake Cluster Assembly Installation on page 6b-22.**
7. Install rear brake shoes. **See Rear Brake Shoe Installation on page 6b-16.**
8. Install rear brake drum. **See Rear Wheel Brake Drum Installation on page 6b-19.**
9. Repeat steps 1 through 8 for the opposite rear wheel if necessary.
10. Bleed the rear brakes. **See Bleeding the Hydraulic Brake System on page 6b-33.**
11. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

HYDRAULIC LINE AND HOSE REPLACEMENT

Read **DANGER** and **WARNING** on page 6b-1.

WARNING

- To perform any of the following procedures, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. **See Bleeding the Hydraulic Brake System on page 6b-33.**
- Prior to servicing hydraulic brakes, thoroughly clean the vehicle, paying particular attention to areas immediately surrounding hydraulic connections, to prevent dirt or debris from entering system.

FRONT BRAKE LINE REMOVAL

1. Place chocks at the rear wheels, release the park brake and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam of the vehicle, and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands. **See Figure 5-2, Section 5, Page 5-4.**
2. Drill the rivet (8) securing the brake line (4) to the vehicle frame (**Figure 6b-22, Page 6b-28**).
3. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following step.
4. Using a 7/16-inch flare nut wrench, remove the flare nut of the front brake line (4) from the master cylinder (**Figure 6b-22, Page 6b-28**).
5. Using a 3/8-inch flare nut wrench, remove the opposite end of the brake line (4) from the T-manifold block (1) (**Figure 6b-22, Page 6b-28**).

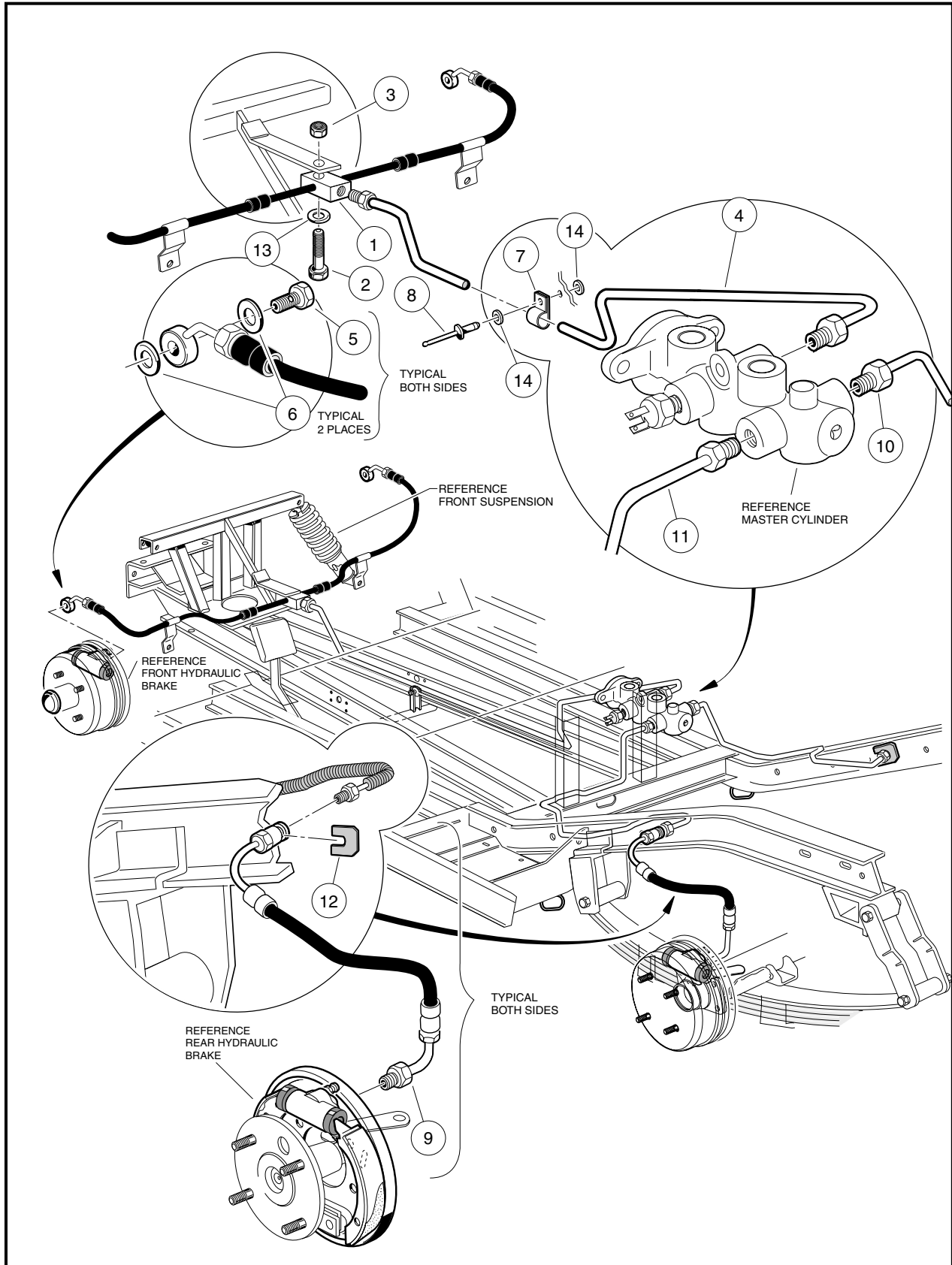


Figure 6b-22 Four-Wheel Hydraulic Brake System

FRONT BRAKE LINE INSTALLATION

1. Connect the 7/16-inch flare nut of the brake line (4) to the master cylinder and tighten finger-tight (**Figure 6b-22, Page 6b-28**).
2. Connect the 3/8-inch flare nut of the brake line (4) to the T-manifold block (1) and tighten finger-tight (**Figure 6b-22, Page 6b-28**).
3. Secure the brake line to the vehicle frame with the P-clamp (7), new 3/16 x 3/4-inch aluminum pop rivet (8) and two 3/16-inch rivet washers (14) (**Figure 6b-22, Page 6b-28**).
4. Using a 7/16-inch flare nut wrench, tighten the flare nut from the brake line (4) to the master cylinder to 11 ft-lb (14.9 N·m) (**Figure 6b-22, Page 6b-28**).
5. Using a 3/8-inch flare nut wrench, tighten the flare nut from the brake line (4) to the T-manifold block (1) to 11 ft-lb (14.9 N·m) (**Figure 6b-22, Page 6b-28**).
6. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6b-33.**
7. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are in correct adjustment and are operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

FRONT BRAKE HOSE ASSEMBLY REMOVAL

NOTE: If either of the two front brake hoses or the T-manifold block (1) are found to be damaged, the entire assembly must be replaced (**Figure 6b-22, Page 6b-28**).

1. Place chocks at the rear wheels, release the park brake and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands. **See Figure 5-2, Section 5, Page 5-4.**
2. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following step.
3. Remove the banjo bolt (16) and two copper washers (17) from each of the front brake wheel cylinder assemblies (**Figure 6b-3, Page 6b-4**). Discard the copper washers (17).
4. Remove the bolt (2), lock nut (3), front hose bracket, and weldment steering stop (34) from where the bottom of the shock connects to each of the front A-arms. **See Figure 7-29, Section 7, Page 7-18.**
5. Using a 3/8-inch flare nut wrench, remove the brake line (4) from the T-manifold block (1) (**Figure 6b-22, Page 6b-28**).
6. Remove the bolt (2), washer (13) and lock nut (3) that secure the T-manifold block (1) to the shock tower and remove the front brake hose assembly (**Figure 6b-22, Page 6b-28**).

FRONT BRAKE HOSE ASSEMBLY INSTALLATION

1. Install the 1/4-20 x 1-1/4-inch hex-head bolt (2) through washer (13) and through the T-manifold block (1) and frame bracket. Install and tighten the nylon lock nut (3) to 76 in-lb (8.6 N·m) (**Figure 6b-22, Page 6b-28**).
2. Connect the brake hose assemblies to each of the front brake wheel cylinders, using new copper washers (17) and banjo bolts (16). Position the elbow of each hose toward the rear of the vehicle. Tighten bolts to 13 ft-lb (17.6 N·m) (**Figure 6b-3, Page 6b-4**).
3. Assemble each front hose bracket, weldment steering stop (34), and lower shock absorber mount using bolt (2) and lock nut (3). Position each hose bracket in-line with each shock absorber and tighten to 20 ft-lb (27 N·m). **See Figure 7-29, Section 7, Page 7-18.**

Front Brake Hose Assembly Installation, Continued:

4. Using a 3/8-inch flare nut wrench, connect the flare fitting on the front brake line (4) to the T-manifold block (1). Tighten to 11 ft-lb (14.9 N·m) (**Figure 6b-22, Page 6b-28**).
5. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6b-33.**
6. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

REAR BRAKE LINE REMOVAL

1. Place chocks at the front wheels, release the park brake and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the rear axle tubes to support the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.
2. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following step.
3. Using a 3/8-inch flare nut wrench, remove brake line (10 or 11) from the master cylinder (**Figure 6b-22, Page 6b-28**).
4. Using a 3/8-inch flare nut wrench, remove the same brake line (10 or 11) from the rear brake hose at the I-beam of the vehicle frame and remove from the vehicle (**Figure 6b-22, Page 6b-28**).
5. Repeat steps 3 through 4 for the opposite rear brake line if necessary.

REAR BRAKE LINE INSTALLATION

1. Using a 3/8-inch flare nut wrench, install brake line (10 or 11) to rear brake hose at the I-beam of the vehicle frame (**Figure 6b-22, Page 6b-28**). Tighten to 11 ft-lb (14.9 N·m).
2. Using a 3/8-inch flare nut wrench, install the opposite end of the brake line to the master cylinder. Tighten the flare nut fitting to 11 ft-lb (14.9 N·m) (**Figure 6b-22, Page 6b-28**).
3. Repeat steps 1 through 2 for the opposite rear brake line if necessary.
4. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6b-33.**
5. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

REAR BRAKE HOSE REMOVAL

1. Place chocks at the rear wheels, release the park brake and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the rear axle tubes to support the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.
2. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following step.
3. Using a 3/8-inch flare nut wrench, remove the brake hose from the rear brake wheel cylinder assembly (**Figure 6b-19, Page 6b-22**).
4. Using a 3/8-inch flare nut wrench, remove the rear brake line (10 or 11) from the rear brake hose at the I-beam of the vehicle frame (**Figure 6b-22, Page 6b-28**).

5. Remove the horseshoe clip (12) that secures the rear brake hose (9) to the I-beam frame (**Figure 6b-22, Page 6b-28**) and remove the brake hose (9) through the D-shaped hole in the vehicle I-beam.
6. Repeat steps 3 through 5 for the opposite rear brake hose if necessary.

REAR BRAKE HOSE INSTALLATION

1. Install brake hose (9) through the D-shaped hole in I-beam, and install the horseshoe clip (12) that secures the brake hose to the I-beam frame (**Figure 6b-22, Page 6b-28**).
2. Using a 3/8-inch flare nut wrench, attach the flare nut fitting on the rear brake hose to the rear brake wheel cylinder (**Figure 6b-19, Page 6b-22**). Tighten to 11 ft-lb (14.9 N·m).
3. Using a 3/8-inch flare nut wrench, install the rear brake line (10 or 11) to the rear brake hose (9) at the I-beam of the vehicle frame (**Figure 6b-22, Page 6b-28**). Tighten to 11 ft-lb (14.9 N·m).
4. Repeat steps 1 through 3 for the opposite rear brake hose if necessary.
5. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6b-33.**
6. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

MASTER CYLINDER AND BELL CRANK REPLACEMENT

Read **DANGER** and **WARNING** on page 6b-1.

BELL CRANK REMOVAL

1. Chock the wheels and release the park brake. Raise the passenger seat for access to the master cylinder and bell crank.
2. Remove the brake rod clevis bolt (6) and clevis (16) from the bell crank assembly (13) (**Figure 6b-23, Page 6b-34**).
3. Remove the spring (18) from the bell crank (13) and master cylinder mounting bracket (19) (**Figure 6b-23, Page 6b-34**).
4. Remove the push rod clevis bolt (20) and lock nut (21) from the bell crank (13) (**Figure 6b-23, Page 6b-34**).
5. Remove the bell crank bolt (9) and nylon lock nut (11) from the master cylinder mounting bracket (19) and remove bell crank (13) and two centering spacers (12) (**Figure 6b-23, Page 6b-34**).
6. Inspect the needle bearing (14) and the inner race (15) for damage or wear and replace if necessary (**Figure 6b-23, Page 6b-34**).

NOTE: The needle bearing (14) is press fitted to the bell crank. If replacement is necessary, the bearing must be pressed out and replaced (**Figure 6b-23, Page 6b-34**).

BELL CRANK INSTALLATION

1. Install the bell crank bolt (9) through the two centering spacers (12) and bell crank inner bearing race (15). Tighten nut (11) to 25 ft-lb (40 N·m) (**Figure 6b-23, Page 6b-34**).

Bell Crank Installation, Continued:

2. Install bolt (20) through push rod (3) and bell crank (13) and attach nylon lock nut (21). Tighten to 14 ft-lb (19 N·m) **(Figure 6b-23, Page 6b-34)**.
3. Install break rod clevis bolt (6) through clevis (16) and bell crank (13) and tighten to 19 ft-lb (25.8 N·m) **(Figure 6b-23, Page 6b-34)**.
4. Install spring (18) as shown **(Figure 6b-23, Page 6b-34)**.
5. Adjust the brake pedal as instructed in Section 5. **See Brake Pedal Adjustment, Section 5, Page 5-6.**
6. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

MASTER CYLINDER REMOVAL** WARNING**

- **To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6b-33.**

1. Chock the wheels and release the park brake.
2. Place a pan below the vehicle to collect the brake fluid when the hydraulic system is opened in the following steps.
3. Remove the two wires from the master cylinder pressure switch (4) **(Figure 6b-23, Page 6b-34)**.
4. Using a 7/16-inch flare nut wrench, remove the brake line (4) from the master cylinder **(Figure 6b-22, Page 6b-28)**.
5. Using a 3/8-inch flare nut wrench, remove the brake lines (10 and 11) from the master cylinder **(Figure 6b-22, Page 6b-28)**.
6. Cover the flare nut fittings of the three brake lines with plastic bags and wire ties to keep any dirt or debris from entering the hydraulic system **(Figure 6b-20, Page 6b-22)**.
7. Remove the two bolts (7) and nylon lock nuts (8) that secure the master cylinder (1) to the master cylinder mounting bracket (19) **(Figure 6b-23, Page 6b-34)**.
8. Remove master cylinder (1) from mounting bracket (19), push rod (3) and rubber boot (2).

MASTER CYLINDER INSTALLATION

1. Install master cylinder (1) into mounting bracket (19) and insert push rod (3), then seat boot (2) **(Figure 6b-23, Page 6b-34)**.
2. Install the two bolts (7) and nylon lock nuts (8) that secure the master cylinder (1) to the master cylinder mounting bracket (19). Tighten to 14 ft-lb (19 N·m) **(Figure 6b-23, Page 6b-34)**.
3. Using a 7/16-inch flare nut wrench, attach brake line (4) to master cylinder **(Figure 6b-22, Page 6b-28)**. Tighten flare nut fitting to 11 ft-lb (14.9 N·m).
4. Using a 3/8-inch flare nut wrench, attach brake lines (10 and 11) to master cylinder **(Figure 6b-22, Page 6b-28)**. Tighten flare nut fittings to 11 ft-lb (14.9 N·m).
5. Attach the two wires to the master cylinder pressure switch (no particular orientation) (4) **(Figure 6b-23, Page 6b-34)**.

6. Adjust the brake pedal as instructed in Section 5. **See Brake Pedal Adjustment, Section 5, Page 5-6.**
7. Fill the reservoir of the master cylinder and bleed the entire hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6b-33.**
8. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are in correct adjustment and are operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

BLEEDING THE HYDRAULIC BRAKE SYSTEM

Read **DANGER** and **WARNING** on page 6b-1.

To properly function, the hydraulic system must be free of air. Air in the hydraulic system will result in a “spongy” brake pedal. Air enters the hydraulic system whenever the system is opened as a result of service or a leak occurs. Air may also enter the system if the brakes are applied when there is very little hydraulic fluid in the brake fluid reservoir.

The master cylinder controls two separate hydraulic sub-systems. The front two wheels are connected to the smaller, front portion of the brake fluid reservoir, and the rear wheels are connected to the rear, larger portion of the brake fluid reservoir. Depending on where the hydraulic system was opened, bleeding of only the front or rear hydraulic brake sub-system may be required. In some situations, bleeding of both the front and rear brake sub-systems will be required. To bleed both the front and rear hydraulic brake sub-systems, use the following procedure to first bleed the two front brakes and repeat the procedure to bleed the two rear brakes.

1. Check the brake pedal and master cylinder push rod for proper adjustment before proceeding. **See Brake Pedal Adjustment, Section 5, Page 5-6.**
2. Chock the front wheels, release the park brake and lift the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam, or rear axle tubes, of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.
3. Remove the cap from the master cylinder reservoir and fill the reservoir with DOT 5 brake fluid.
4. Remove each wheel and gently adjust the clearance between the brake shoes and brake drum by turning each of the two adjusters on the brake cluster as shown (**Figure 6b-16, Page 6b-19**). Use a torque wrench and a Torx #T-27 driver or hydraulic brake adjuster (CCI P/N 1021694). **See following CAUTION.**

CAUTION

- **Do not apply more than 65 in-lb (7.3 N-m) of torque to any of the adjuster bolts. Overtightening the adjuster bolts could result in damage to the brake cluster components or the separation of the bolt (4) from the adjuster (3) (Figure 6b-3, Page 6b-4 or Figure 6b-21, Page 6b-25).**
5. Place, but do not tighten, the cap onto the master cylinder reservoir.
 6. To connect vacuum type brake bleeder (CCI P/N S0010702):
 - **Front brakes only:** Connect the two hose fittings from a vacuum type brake bleeder to the brake bleeder valves on the back of each of the front wheel brake cluster assemblies (**Figure 6b-24, Page 6b-35**). Proceed to step 7.
 - **Rear brakes only:** Connect the two hose fittings from a vacuum type brake bleeder to the brake bleeder valves on the back of each of the rear wheel brake cluster assemblies. Proceed to step 7.
 7. Connect an air hose to the vacuum brake bleeder. The air pressure must be regulated at 12 to 15 psi (.827 to 1.034 Bars).

Bleeding the Hydraulic Brake System, Continued:

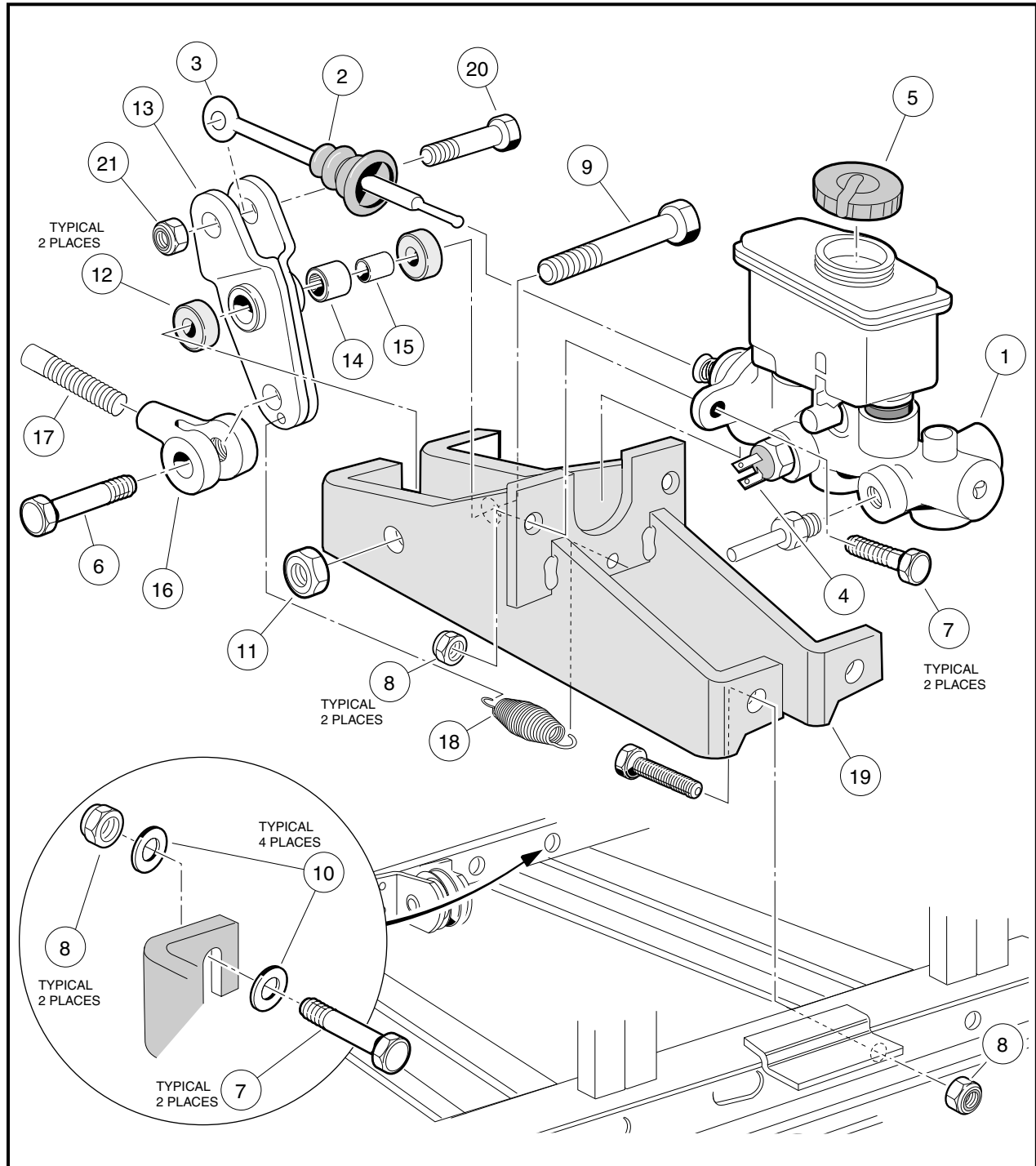


Figure 6b-23 Master Cylinder

8. Press the handle on the brake bleeder to start the vacuum.
9. With the vacuum running, open both of the brake bleeder valves 1/4 turn. **See Figure 6b-3, Page 6b-4 or Figure 6b-21, Page 6b-25.**

10. Monitor the fluid as it flows through the tubes of the vacuum bleeder tool. Continue to run the vacuum until there are almost no air bubbles in the lines. **See following NOTE.**

NOTE: Do not allow the brake fluid in the master cylinder reservoir to drop below the “min” level mark at any time during the brake bleeding procedure. Add brake fluid as necessary while performing step 10 (Figure 6b-25, Page 6b-36).

11. With the vacuum still running, tighten the two brake bleeder valves. **See Figure 6b-3, Page 6b-4 or Figure 6b-21, Page 6b-25.**
12. Allow the handle on the brake bleeder tool to open, turning the vacuum system off.
13. Fill the master cylinder reservoir to the “MAX” level with DOT 5 brake fluid (Figure 6b-25, Page 6b-36).
14. Tighten the cap on the master cylinder reservoir.
15. Properly dispose of the brake fluid in the vacuum type brake bleeder tool.
16. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

PURGING THE HYDRAULIC SYSTEM

In some cases it may be necessary to completely drain the front, rear or entire hydraulic brake system of brake fluid. To completely purge the hydraulic system, perform the following procedure.

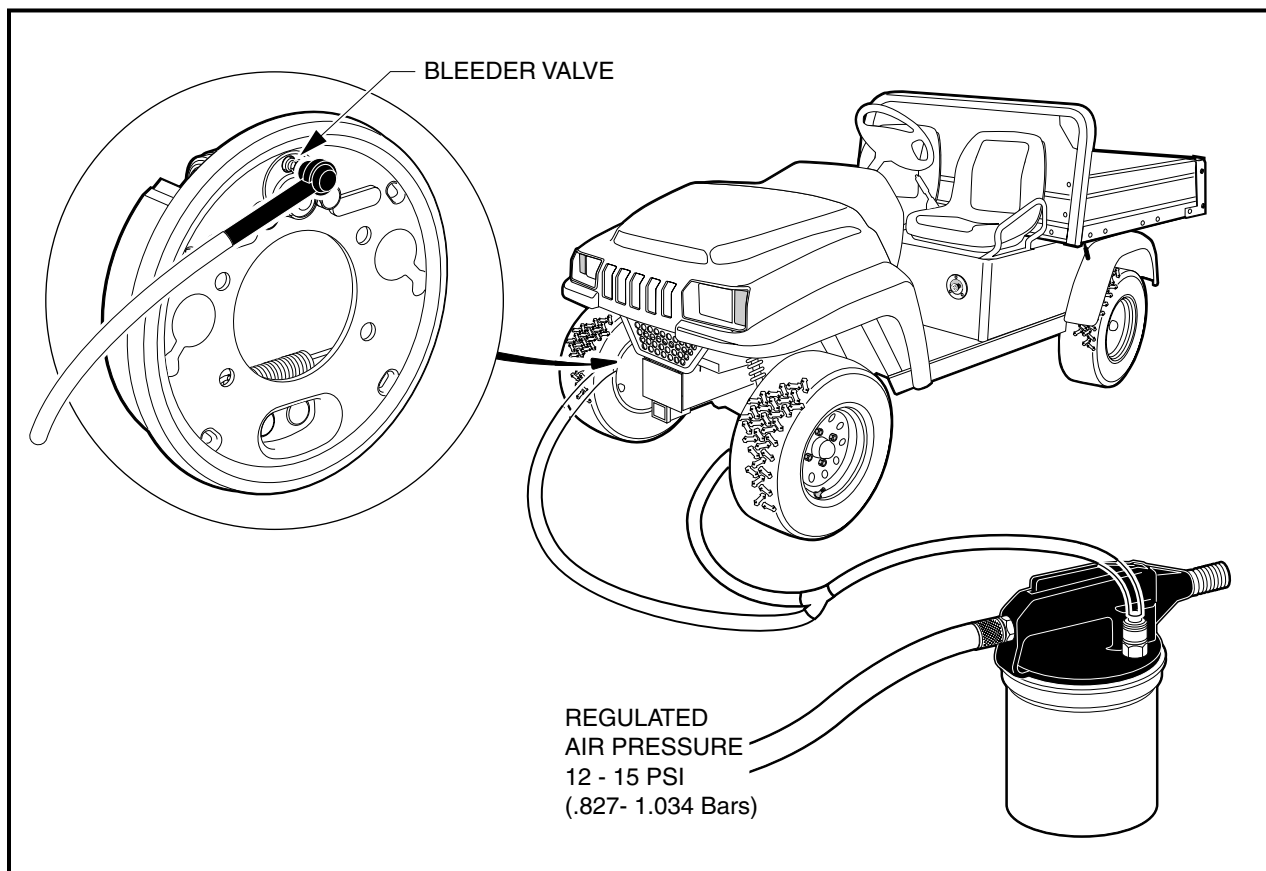


Figure 6b-24 Front and Rear Brake Bleeding

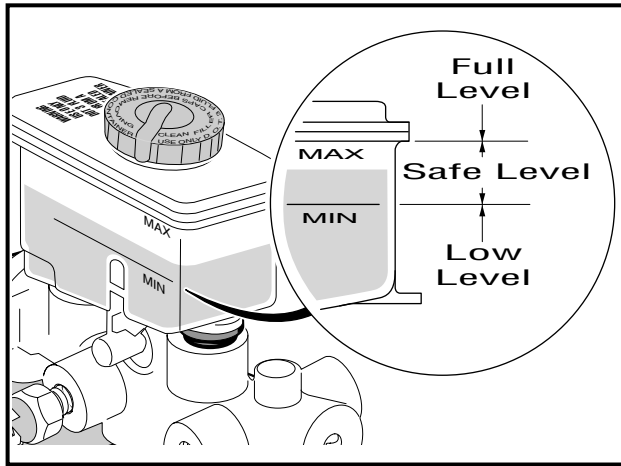
Purging the Hydraulic System, Continued:

Figure 6b-25 Master Cylinder Reservoir

1. Perform steps 2 through 9 of the brake bleeding procedure on the two front wheels. **See Bleeding the Hydraulic Brake System on page 6b-33.**
2. Allow 1qt. (0.9464 l) of the brake fluid to be pulled into the vacuum type brake bleeder tool.
3. With the vacuum still running, tighten the two brake bleeder valves.
4. Allow the handle on the brake bleeder tool to open, turning the vacuum system off.
5. Repeat steps 1 through 4 for the two rear wheels.

FILLING THE HYDRAULIC SYSTEM

After purging the brake system and making any necessary repairs, bleed the brakes, adding DOT 5 brake fluid until the system is full and virtually no air bubbles are present in the brake bleeder vacuum tubes. **See Bleeding the Hydraulic Brake System on page 6b-33.**

PARK BRAKE SYSTEM

Read **DANGER** and **WARNING** on page 6b-1.

PARK BRAKE CABLE REMOVAL**Equalizer Cable Removal**

1. Chock the wheels and release the park brake.
2. Remove the two screws (3) that secure the park brake boot (2) to the seat support (**Figure 6b-28, Page 6b-40**).
3. Slide the boot (2) off of the park brake handle (1).
4. Remove the boot shield (31) from the park brake handle (1).
5. Remove the equalizer spring (24) from the equalizer cable (9).
6. Remove the equalizer jam nut (11) and conical nut (23).

7. Remove the end of the park brake cable from handle (1) by pushing the equalizer cable in an upward direction and pulling the cable end toward the passenger side of the vehicle.
8. Remove the equalizer cable from the vehicle.

Park Brake Pulley Removal

1. Remove the park brake equalizer cable. **See Park Brake Cable Removal on page 6b-36.**
2. Remove the four #10-24 x 3/4-inch socket-head screws (14), lock nuts (28) and washers (27) from frame (**Figure 6b-28, Page 6b-40**).
3. Remove the pulley assembly (13) from frame (**Figure 6b-28, Page 6b-40**).

Wheel Brake Cable Removal

1. Loosen the equalizer jam nut (11) and the conical nut (23) to provide slack in the wheel brake cables (**Figure 6b-28, Page 6b-40**).
2. Pull the wheel brake cable to the side and remove the cable end from the keyhole opening in the park brake equalizer (**Figure 6b-26, Page 6b-38 and Figure 6b-27, Page 6b-38**).
3. Remove the cable clip (12) from the wheel brake cable (25) at the vehicle frame (**Figure 6b-28, Page 6b-40**).
4. Remove the park brake cable clip (29), hair spring cotter pin (30) and clevis pin (22).
5. Remove the cable from the cable support bracket (17 or 18) (**Figure 6b-28, Page 6b-40**).
6. Slide the cable through the hanger (15) and remove the cable from the vehicle.
7. If necessary, remove the other wheel brake cable in the same manner.

PARK BRAKE CABLE INSTALLATION

Park Brake Pulley Installation

1. Align the equalizer cable pulley assembly (13) with the mounting holes in the frame (**Figure 6b-28, Page 6b-40**).
2. Install the four 10-24 x 3/4-inch socket head screws (14), flat washers (27) and lock nuts (28). Tighten to 54 in-lb (6.1 N·m) (**Figure 6b-28, Page 6b-40**).

NOTE: Use new 10-24 lock nuts for this assembly procedure.

3. Install equalizer cable. **See Equalizer Cable Installation on page 6b-37.**

Equalizer Cable Installation

1. Feed the equalizer cable (9) up between the pulley and frame, through the top seat support slot and hook the end of the cable into the handle (1) clevis slot from the passenger side (**Figure 6b-28, Page 6b-40**).
2. Assemble the equalizer bracket (10) onto the threaded end of the equalizer cable (9) (**Figure 6b-28, Page 6b-40**).
3. Attach the conical nut (23) and equalizer jam nut (11) to the threaded end of the equalizer cable (**Figure 6b-28, Page 6b-40**).
4. Attach the equalizer spring (24) from the equalizer cable to the frame (**Figure 6b-28, Page 6b-40**).

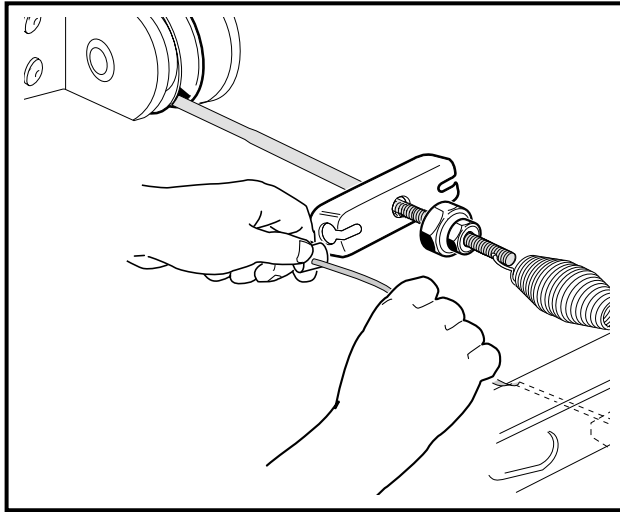
Equalizer Cable Installation Continued:

Figure 6b-26 Position Wheel Brake Cable

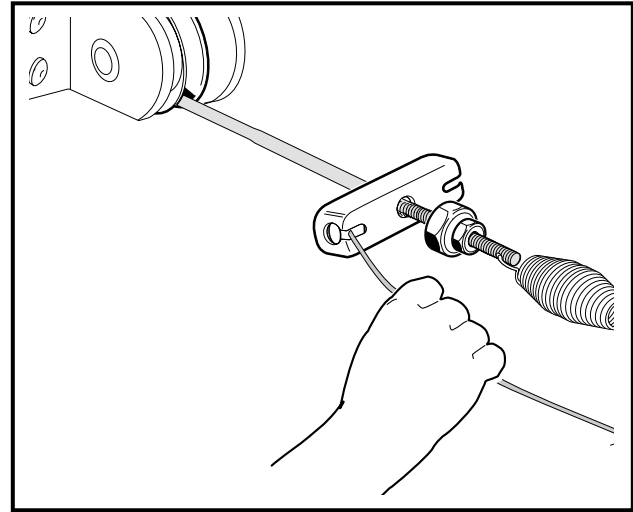


Figure 6b-27 Wheel Brake Cable Attachment

5. Slide the boot shield (31) around the park brake handle (**Figure 6b-28, Page 6b-40**).
6. Slide the boot (2) over the handle (1) and down around the boot shield (31) and onto the seat support (**Figure 6b-28, Page 6b-40**).
7. Attach the boot (2) using two 5/16 -18 phillips head screws (3).
8. Adjust the park brake. **See Park Brake Adjustment on page 6b-39.**

Wheel Brake Cable Installation

1. Slide a cable (25) through the frame hanger (15) (**Figure 6b-28, Page 6b-40**).
2. Attach the cable clevis end to the wheel brake lever using the clevis pin (22) and hair spring cotter pin (30) (**Figure 6b-28, Page 6b-40**).
3. Attach a cable (25) to the cable support bracket (17 or 18), using a wire clip (29) (**Figure 6b-28, Page 6b-40**).
4. Attach the opposite end of the cable (25) through a frame bracket notch (32) and secure with a wire clip (12) (**Figure 6b-28, Page 6b-40**).
5. Pull the end of the brake cable up and into the keyhole opening in the park brake equalizer bracket (**Figure 6b-26, Page 6b-38 and Figure 6b-27, Page 6b-38**).
6. Adjust the park brake. **See Park Brake Adjustment on page 6b-39.**
7. Install the other wheel brake cable using this same procedure if necessary.

PARK BRAKE HANDLE REMOVAL

1. Remove the park brake equalizer cable. **See Equalizer Cable Removal on page 6b-36.**
2. Remove the two bolts (4), four washers (5) and two lock nuts (6) from the park brake handle (**Figure 6b-28, Page 6b-40**).
3. Remove the park brake handle (1) from the seat support.

PARK BRAKE HANDLE INSTALLATION

1. Attach the handle (1) to the seat support using two 3/8-16 x 1-1/4-inch hex-head bolts (4), 3/8 flat washers (5) and 3/8-16 lock nuts (6) (**Figure 6b-28, Page 6b-40**). Tighten the nuts (6) to 23 ft-lb (31.4 N·m).

NOTE: Use new 3/8-16 lock nuts for this assembly procedure.

2. Install the park brake cable. **See Equalizer Cable Installation on page 6b-37.**
3. Adjust the park brake. **See Park Brake Adjustment on page 6b-39.**
4. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

PARK BRAKE ADJUSTMENT

⚠ CAUTION

- **Perform the following procedure only on level surface. To avoid injury or property damage, ensure that the path of the vehicle is clear before pushing vehicle.**

1. Ensure that the brake pedal is adjusted correctly. **See Brake Pedal Adjustment, Section 5, Page 5-6.** Chock the wheels, release the park brake and place the Forward/Reverse handle in the NEUTRAL position.
2. Loosen the equalizer cable.
 - 2.1. Loosen the equalizer jam nut (11) and the conical nut (23) to provide slack in the wheel brake cables (**Figure 6b-28, Page 6b-40**).
3. Using a torque wrench and Torx #27 driver, or hydraulic brake adjuster (CCI P/N 1021694), gently rotate the adjuster bolts to increase or decrease the clearance between the brake shoes and the brake drum (**Figure 6b-16, Page 6b-19**). **See following CAUTION.**

⚠ CAUTION

- **Do not apply more than 65 in-lb (7.3 N·m) of torque to any of the adjuster bolts. Overtightening of the adjuster bolts could result in damage to the brake cluster components or the separation of the bolt (4) from the adjuster (3) (Figure 6b-3, Page 6b-4 or Figure 6b-21, Page 6b-25).**
4. With the park brake released (down), tighten the conical nut (23) until significant resistance is observed in the equalizer cable in order to fully lock the brakes (**Figure 6b-28, Page 6b-40**).
 5. With the vehicle on flat ground and the Forward/Reverse handle in the NEUTRAL position, push the vehicle by hand. If the wheels move when the vehicle is pushed, continue tightening the conical nut until the vehicle can no longer be pushed.
 6. Loosen the conical nut two full revolutions.
 7. Using the double-wrench method, tighten the equalizer jam nut (11) against the conical nut (23) to 55 in-lb (6.3 N·m) (**Figure 6b-28, Page 6b-40**).
 8. The park brake should now be adjusted so that the vehicle will not roll when pushed with the park brake latched in the fourth notch (four clicks from the bottom of its travel).
 9. Perform all of the brake system inspections to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before placing the vehicle into service. **See Brake System Inspection on page 6b-3.**

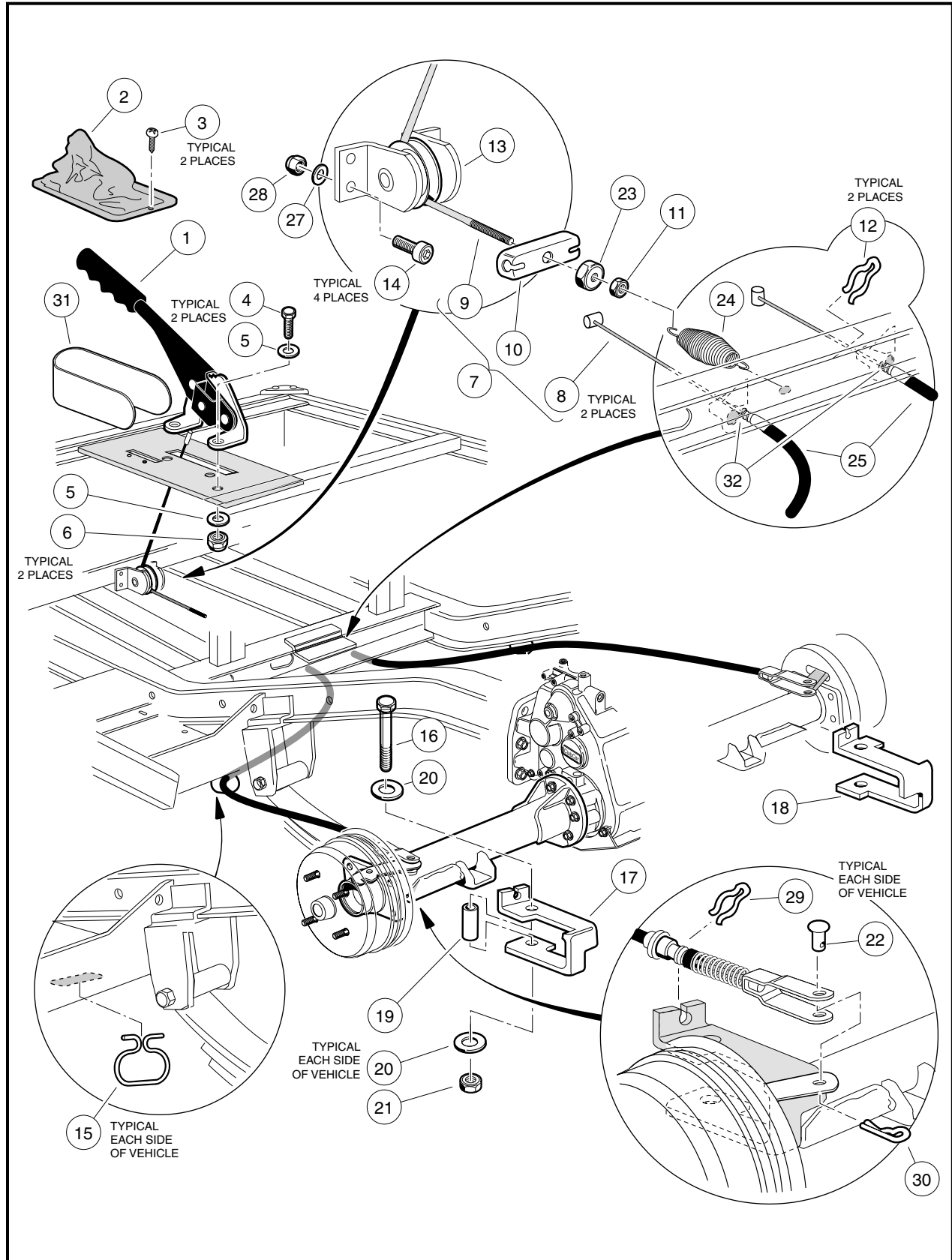


Figure 6b-28 Park Brake System

SECTION 7 – STEERING AND FRONT SUSPENSION

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (–) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner’s manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

Steering is controlled through a rack and pinion steering assembly that is connected by a steering column to a steering wheel. No manual adjustment to the rack and pinion gear assembly is required. A spring loaded self-adjusting mechanism is incorporated into the assembly.

STEERING WHEEL

Read **DANGER** and **WARNING** on page 7-1.

STEERING WHEEL REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 7-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 7-1.**
4. Disconnect the spark plug. **See WARNING "To avoid unintentionally starting..." on page 7-1.**
5. Remove the two mounting screws (24) and plate (19) (**Figure 7-1, Page 7-3**).
6. Match mark the steering wheel (25) and steering column shaft (11) so that reattachment of the steering wheel will be in the exact same position.
7. Loosen the steering wheel nut (18) and back it off approximately 1/4 inch (6 mm). Do not remove the nut.
8. Use the steering wheel puller (CCI P/N 102061201) to remove steering wheel.
 - 8.1. Place the puller anvil (4) through the top opening of the steering wheel (**Figure 7-2, Page 7-4**).
 - 8.2. Insert the anvil feet through the two slots in the base plate (marked "B") (5) as shown (**Figure 7-2, Page 7-4**).

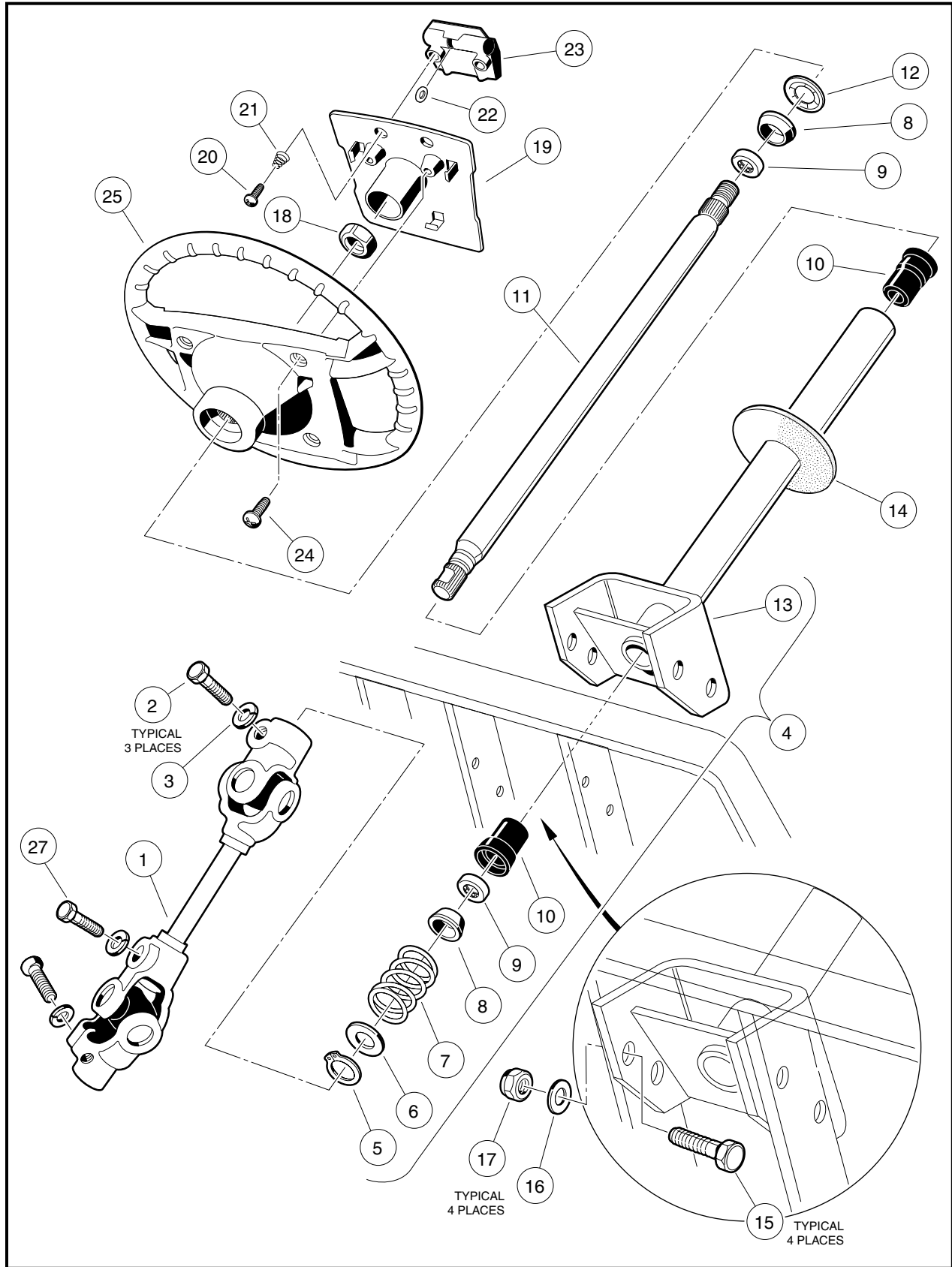


Figure 7-1 Steering Column

Steering Wheel Removal, Continued:

- 8.3. Rotate the anvil screw (6) clockwise until the base plate contacts the bottom of the steering wheel where it attaches to the steering column (**Figure 7-3, Page 7-4**).
- 8.4. Using a 1/2-inch drive air impact wrench, tighten the anvil screw (6) until the steering wheel releases from the steering shaft.
- 8.5. Remove the steering wheel puller.
- 8.6. Remove the steering wheel nut (18) and the steering wheel from the steering column (14) (**Figure 7-1, Page 7-3**).

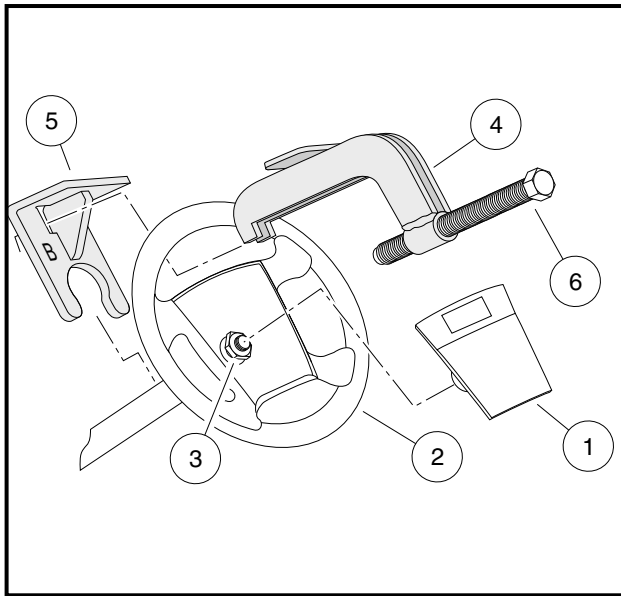


Figure 7-2 Steering Wheel Puller

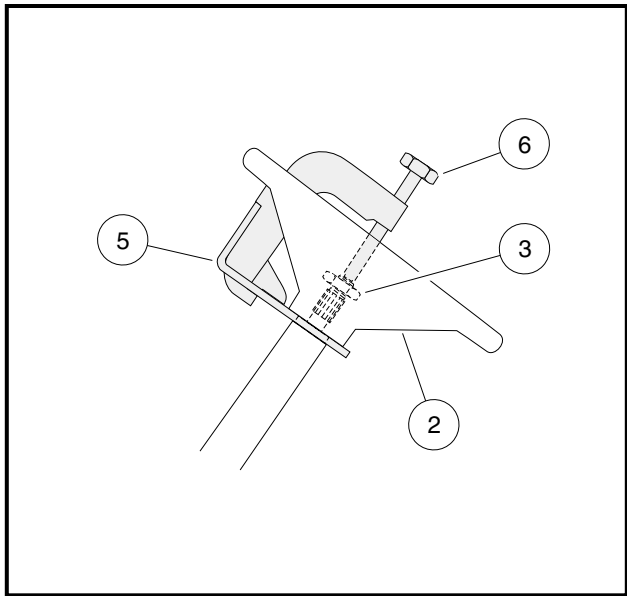


Figure 7-3 Steering Wheel Puller

STEERING WHEEL INSTALLATION

NOTE: To minimize corrosion and to make future removal of the steering wheel easier, apply a small amount of oil or anti-seize compound to steering shaft splines and taper before installing the steering wheel.

1. Install the steering wheel (25) on the splines of the steering shaft (11). Be sure to align the match marks placed on the wheel and steering column shaft in step 6 above (**Figure 7-1, Page 7-3**).
2. Install the steering wheel nut (18) and tighten to 13 ft-lb (17.6 N·m).
3. Install the steering wheel plate (19) and plate mounting screws (24) (**Figure 7-1, Page 7-3**). Tighten screws to 16 in-lb (1.8 N·m).
4. Connect the spark plug.
5. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 7-2.**

STEERING COLUMN

Read **DANGER** and **WARNING** on page 7-1.

STEERING COLUMN REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 7-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the spark plug. **See WARNING "To avoid unintentionally starting..." on page 7-1.**
4. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 7-1.**
5. Remove the steering wheel. **See Steering Wheel Removal on page 7-2.**
6. Remove dashboard. **See Dashboard Removal, Section 4, Page 4-3.**
7. Remove the front body. **See Front Body Removal, Section 4, Page 4-4.**
8. Remove the upper bolt (2) and lock washer (3) from the steering universal joint (1) (**Figure 7-4, Page 7-5**).
9. Remove the nuts (17), bolts (15), and washers (16) from the steering column mount (13) (**Figure 7-1, Page 7-3**).
10. Disconnect the steering universal joint (1) from the steering column shaft and remove the steering column from the vehicle (**Figure 7-4, Page 7-5**).

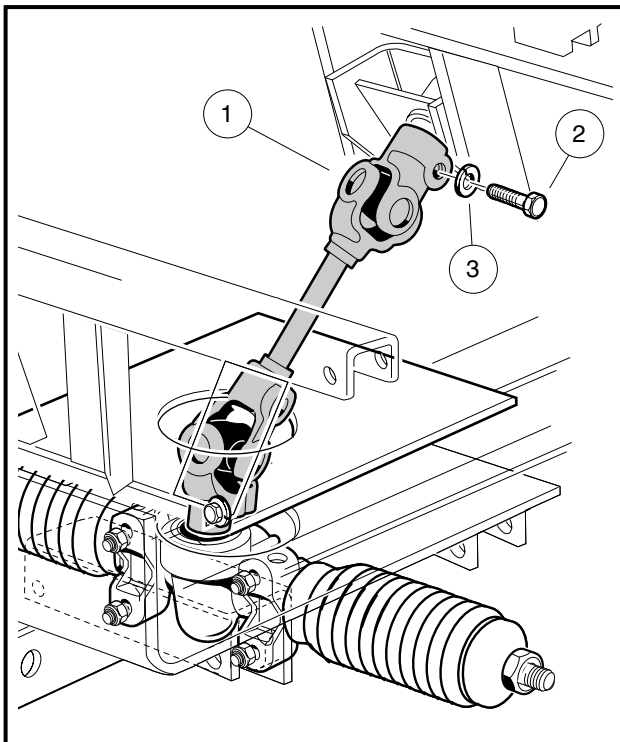


Figure 7-4 Steering Joint Assembly

STEERING COLUMN DISASSEMBLY

1. While supporting steering column (13) on a workbench, remove snap ring (5) from shaft (**Figure 7-1, Page 7-3**).

NOTE: Do not allow the steering shaft to slide out of the steering tube when removing the snap ring.

2. Remove the washer (6), spring (7), and wedge (8) (**Figure 7-1, Page 7-3**).
3. Turn the steering column over and slide the shaft out of the tube to expose the retaining ring (12). Use pliers to twist the retaining ring (12) until it breaks off, then remove the wedge (8).
4. Remove the shaft (11) from the bottom of the tube (13).
5. Use steering shaft (11) to push bearing seat (10) out from the opposite end of the steering tube (13).
6. Insert a flat blade screwdriver between the bottom of the outer race of the bearing (9) and the bottom lip of the bearing seat (10) and remove the bearing (9).

NOTE: Use new retaining rings and bearings for reassembly.

STEERING COLUMN ASSEMBLY

1. Insert bearing seat (10) into both ends of steering tube (13). Place a block of wood on bearing seat and tap lightly on block until bearing seat (10) is fully seated in steering tube (13) (**Figure 7-5, Page 7-6 and Figure 7-6, Page 7-6**).

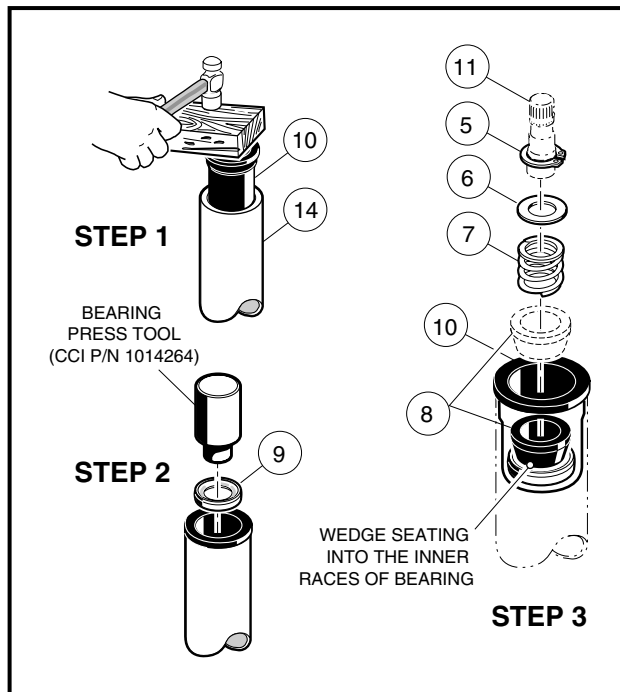


Figure 7-5 Steering Shaft–Bottom End

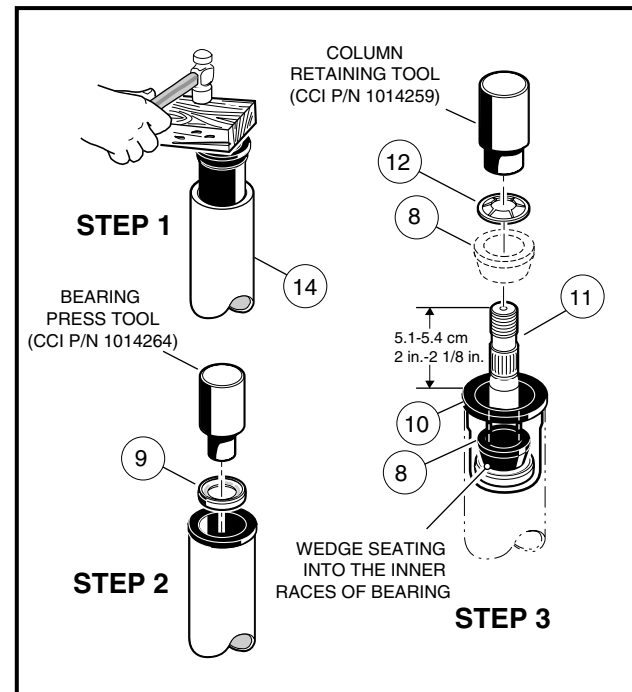


Figure 7-6 Steering Shaft–Top End

2. Press the bearing (9) all the way into the bearing seat (10) using a steering column bearing press tool (CCI P/N 1014264) or a metal tube approximately six inches (15.2 cm) long with a maximum outer diameter of 1-3/16-inches (3.3 cm) and a minimum inside diameter of 7/8-inch (2.2 cm). Be sure the bearing is installed in the bearing seat as shown (**Figure 7-5, Page 7-6**) so the wedge (8) will ride against the inner race of the bearing.

3. Install the wedge (8), spring (7), washer (6) and snap ring (5) onto the bottom end of the steering shaft (11) (**Figure 7-5, Page 7-6**).
4. Insert the shaft (11) from the bottom of the steering tube (13) (**Figure 7-1, Page 7-3**).
5. Turn the assembly over and place the shaft (11) on a bench. Install the wedge (8) and retaining ring (12) onto the top of the shaft. Be sure the prongs on the retaining ring face up and away from the wedge. Use a steering column retaining ring tool (CCI P/N 1014259) to seat the retaining ring to the proper depth. Support end of tube while pressing. If you do not have the recommended tool, use the same tube as was used in step 2 to press the retaining ring onto the top of the shaft. The retaining ring should be pressed onto the shaft until 2 to 2-1/8 inches (5.1-5.4 cm) of the shaft extends from the top of the bearing seat in the steering tube (**Figure 7-6, Page 7-6**).

STEERING COLUMN INSTALLATION

1. Install boot (14) (if previously removed) (**Figure 7-1, Page 7-3**).
2. For ease of assembly and to prevent corrosion, apply a light coat of anti-seize or lubricating compound to both splined ends of the steering shaft.
3. Position the steering column assembly in the vehicle while inserting the steering column shaft into the upper steering universal joint (1). The flat portion of the steering shaft spline (11) must be aligned with the bolt hole in the steering universal joint (1) before sliding the spline into place (**Figure 7-1, Page 7-3**).
4. Install the bolt (2) and lock washer (3) on the upper universal steering joint and finger-tighten (**Figure 7-4, Page 7-5**).
5. While holding the steering column in place, attach it to the frame using bolts (15), washers (16) and lock nuts (17) (**Figure 7-1, Page 7-3**). Tighten the four bolts, in a crisscross pattern, to 23 ft-lb (31.2 N·m).
6. Tighten the bolt (2) on the upper steering universal joint to 15 ft-lb (20 N·m) (**Figure 7-1, Page 7-3**).
7. Check the other bolts (27) on the lower steering universal joint assembly (1) to ensure that they are properly tightened to 15 ft-lb (20 N·m) (**Figure 7-1, Page 7-3**).
8. Install the front body. **See Front Body Installation, Section 4, Page 4-6.**
9. Install dashboard. **See Dashboard Installation, Section 4, Page 4-4.**
10. Install dash panel. **See Dash Panel Installation, Section 4, Page 4-4.**
11. Install the steering wheel. **See Steering Wheel Installation, Section 7, Page 7-4.**
12. Connect the spark plug.
13. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
14. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 7-2.**

RACK AND PINION

Read DANGER and WARNING on page 7-1.

RACK AND PINION REMOVAL

1. Place chocks at the rear wheels, loosen the front wheel lug nuts and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands. **See Figure 5-2, Section 5, Page 5-4.**
2. Remove the lug nuts from the front wheels.

Rack and Pinion Removal, Continued:

3. Remove the cotter pins (18) and ball joint retaining nuts (24) (**Figure 7-20, Page 7-13**).
4. Remove the ball joints (23) from the spindle assemblies (**Figure 7-20, Page 7-13**).

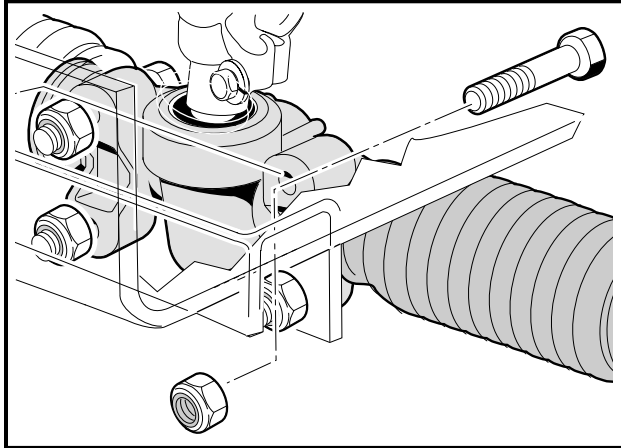


Figure 7-7 Rack and Pinion Bolts

5. Remove the four bolts (20), washers (21) and nuts (22) from the steering rack and pinion assembly mounting bracket (**Figure 7-20, Page 7-13**). Also see **Figure 7-7, Page 7-8**.
6. Remove the bolt (27) and lock washer (**Figure 7-1, Page 7-3**) from the universal joint, then remove the rack and pinion assembly and universal joint from the vehicle (**Figure 7-8, Page 7-9**).

RACK AND PINION DISASSEMBLY

1. Using the double-wrench method, remove the two ball joints and inspect them for excessive wear (**Figure 7-9, Page 7-9**).
2. With one wrench on the flat surface of the drag link, and another wrench on the ball joint jam nut, remove the drag link (28) (**Figure 7-10, Page 7-9**). Repeat this step for the other drag link.
3. Remove both bellows clamps (metal clamps or plastic wire ties) (**Figure 7-11, Page 7-10**).

NOTE: If the dust seal bellows are secured with a metal clamp, use a pair of pliers to remove the clamp. Do not attempt to reuse the clamp when the rack and pinion is reassembled. Use a plastic wire tie to secure the dust seal bellows.

4. Remove the two hex nuts (12) and slide off both of the dust seal bellows (10) (**Figure 7-20, Page 7-13**).
5. Remove the rack screw nut (8), rack guide screw (7), rack guide pressure spring (6) and the rack guide (5) (**Figure 7-20, Page 7-13**).
6. Remove the universal joint assembly from the pinion (3) by fully removing the bolt and then sliding off the universal joint (**Figure 7-20, Page 7-13**).
7. Remove the dust seal (**Figure 7-14, Page 7-10**).
8. Using snap ring pliers, remove the snap ring (**Figure 7-15, Page 7-10**).
9. Install the universal joint onto the pinion and place a fork or a large open end wrench under the universal joint (**Figure 7-16, Page 7-11**). Gently pry the pinion from the housing (**Figure 7-17, Page 7-11**).
10. Remove the U-joint from the pinion (3) (**Figure 7-20, Page 7-13**).
11. If the ball bearing (15) (**Figure 7-20, Page 7-13**) has been damaged, remove the c-type stop ring (16) (**Figure 7-15, Page 7-10**) and press the bearing off (**Figure 7-13, Page 7-10**).

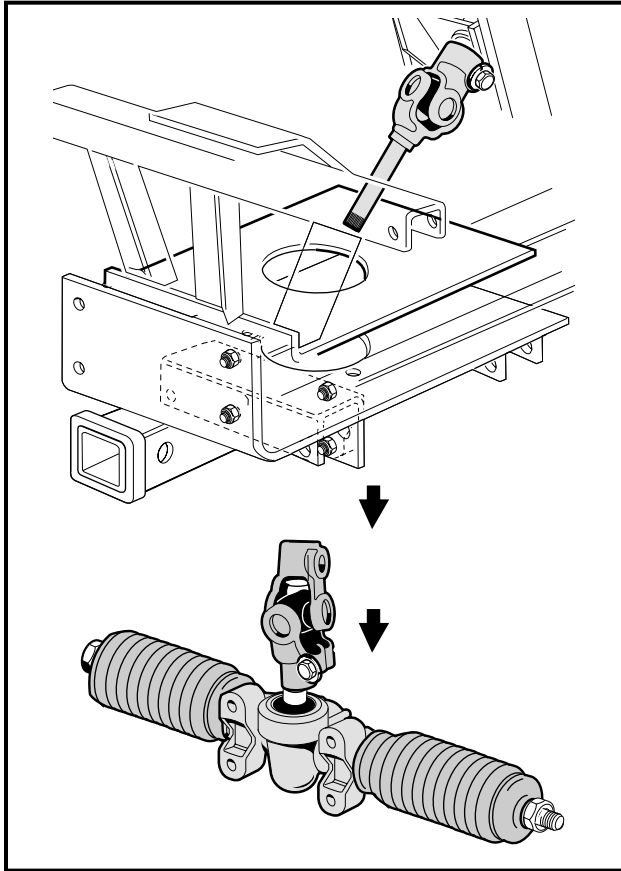


Figure 7-8 Remove Rack and Pinion

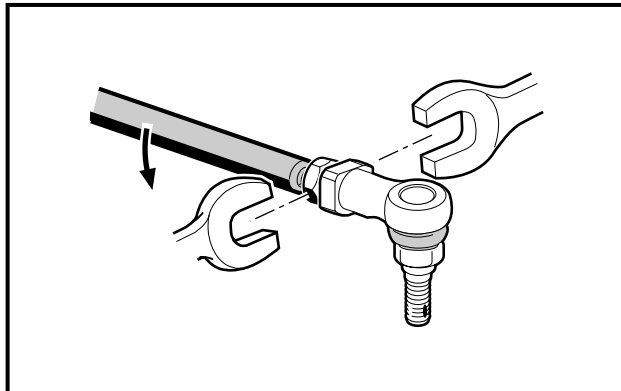


Figure 7-9 Ball Joint

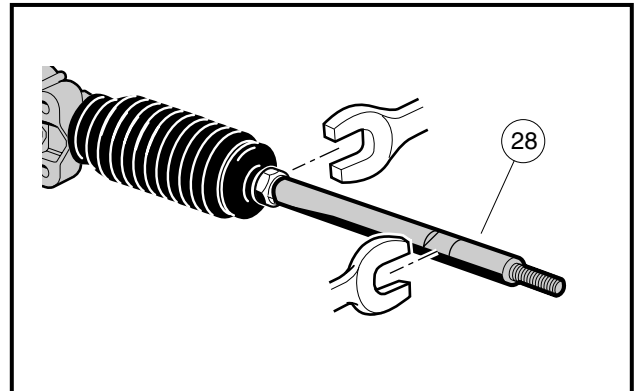


Figure 7-10 Drag Link

12. Inspect the bushing (17) and needle bearing (14) for excessive wear. If wear is excessive, replace the steering box assembly (CCI P/N 102010101) (**Figure 7-20, Page 7-13**).
13. Inspect the ball joints (9) for wear (**Figure 7-20, Page 7-13**). If one or both of the ball joints (9) are excessively worn, remove and replace the ball joint from the rack.
 - 13.1. Secure the rack in a vise (**Figure 7-18, Page 7-11**). Use wood blocks between the rack and the jaws of the vise to protect the rack from damage.
 - 13.2. Tap the flange out of the notch in the rack (**Figure 7-19, Page 7-11**).

Rack and Pinion Disassembly, Continued:

- 13.3. Using a wrench, remove the ball joint (9) from the rack (2) (**Figure 7-20, Page 7-13**).
14. Remove the rack (2) from housing (1) (**Figure 7-20, Page 7-13**).

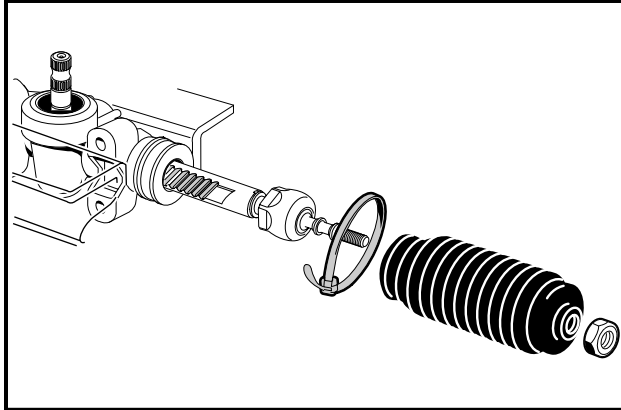


Figure 7-11 Dust Bellows Clamp

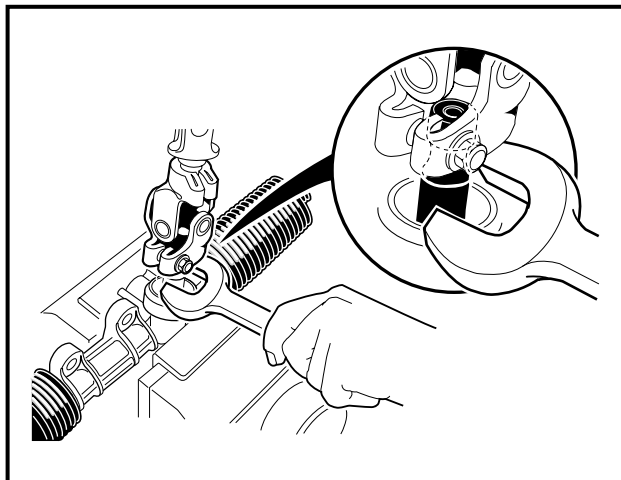


Figure 7-12 Remove Pinion from Housing

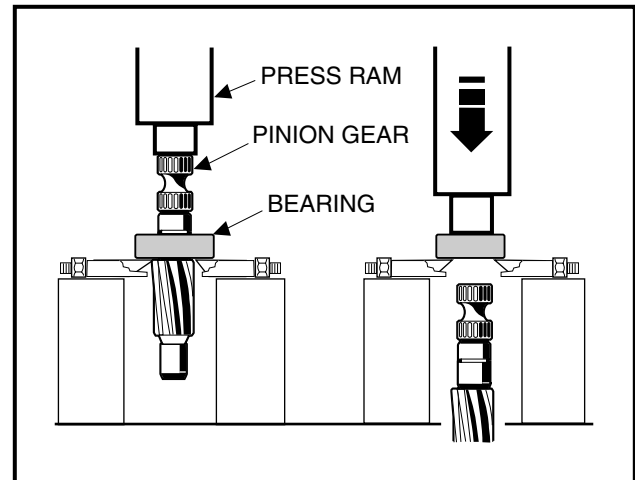


Figure 7-13 Remove Bearing from Pinion

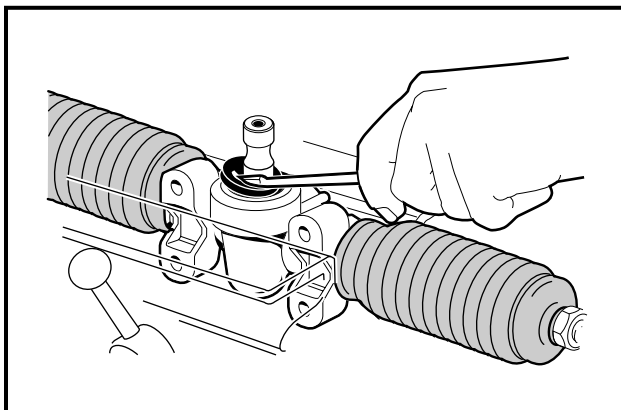


Figure 7-14 Remove Dust Seal

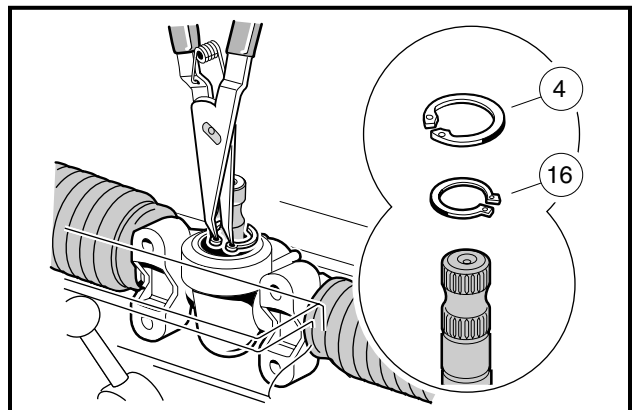


Figure 7-15 Pinion Snap Rings

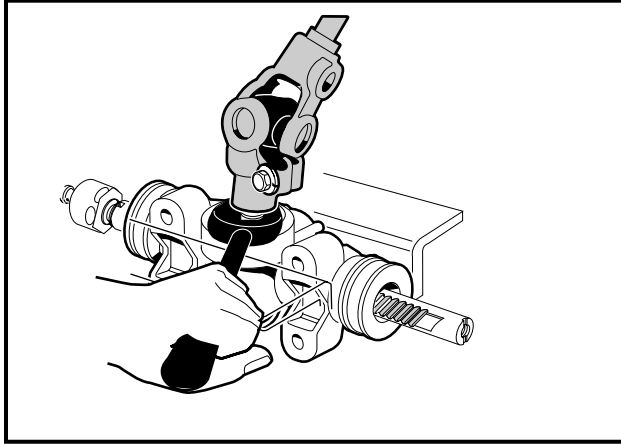


Figure 7-16 Remove Pinion

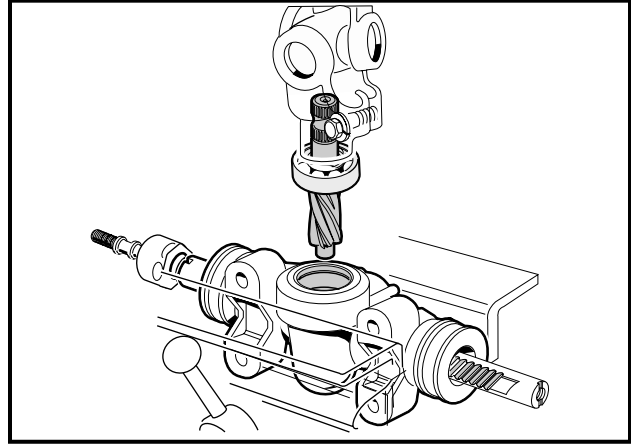


Figure 7-17 Remove Pinion Gear Assembly

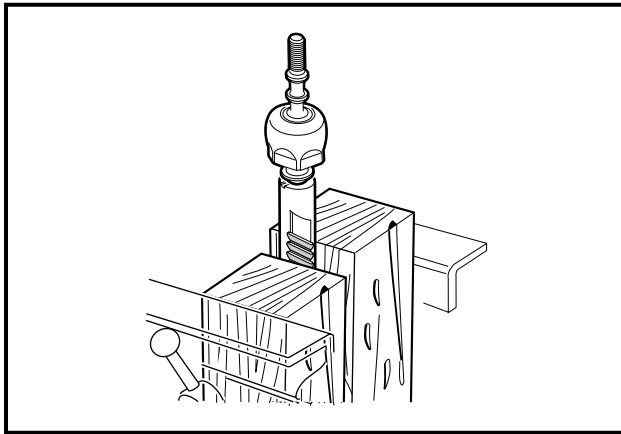


Figure 7-18 Remove Rack

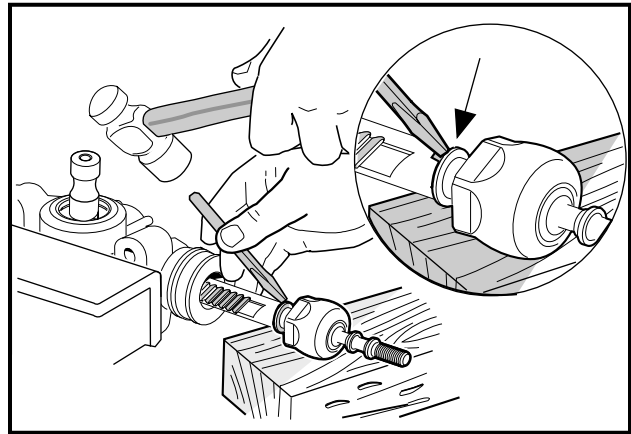


Figure 7-19 Remove Ball Joint

RACK AND PINION ASSEMBLY

1. Apply a liberal amount of EP grease to the teeth of the rack (2), then slide the rack through the bushing (17) and housing (1) (**Figure 7-20, Page 7-13**).

⚠ CAUTION

- In step 2, do not press against the outer race of the bearing.
2. If the pinion bearing (15) was removed, grease a new bearing before installation. Press new bearing onto pinion shaft, exerting all pressure on the inner race. Then install the c-type stop ring (16) (**Figure 7-20, Page 7-13**).
 3. Install pinion (3) and bearing (15) assembly into the housing (1) (**Figure 7-20, Page 7-13**). Make sure the rack gear teeth will mesh with the gear teeth on the pinion. The rack may need to be rotated slightly while lightly tapping on the pinion-bearing assembly with a rubber mallet. **See following CAUTION.**

⚠ CAUTION

- Do not force the pinion-bearing assembly into the housing. The gear teeth or the small bearing could be damaged.

Rack and Pinion Assembly, Continued:

4. Install the snap ring (4) **(Figure 7-20, Page 7-13)**.
5. Using a socket to apply pressure evenly, press in a new dust seal **(Figure 7-21, Page 7-14)**.
6. Apply a small amount of grease to the rack guide (5) where it comes into contact with the rack (2) **(Figure 7-20, Page 7-13)**.
7. Place a few drops of Loctite 222 to the threads of the screw (7) **(Figure 7-20, Page 7-13)**.
8. Install the ball joints onto the rack by securing the rack in a vise using wood blocks between the rack and the jaws of the vise to protect the rack from damage. Tighten the ball joints to 60 ft-lb (81 N·m).
9. Install the rack guide (5), pressure spring (6) and screw (7) **(Figure 7-20, Page 7-13)**. The screw should be threaded-in until it bottoms out and then backed out 1/4 turn **(Figure 7-22, Page 7-14)**.
10. Insert a 3/8-inch, 1/4-drive, deep-well socket into the steering column end of the universal joint (2) and tighten the bolts (1) to 15 ft-lb (20.3 N·m) **(Figure 7-23, Page 7-14)**.
11. Use a torque wrench connected to the 3/8-inch, deep-well socket to measure the resistance of the rack and pinion. Rotational resistance should measure 7 to 15 in-lb (.8 to 1.7 N·m).
12. If measured resistance is not 7 to 15 in-lb (.8 to 1.7 N·m), adjust the screw (7) until correct setting is achieved. Tighten the nut (8) to 28 ft-lb (38 N·m) **(Figure 7-22, Page 7-14)**.

NOTE: When tightening the nut (8) make sure the screw (7) does not change adjustment **(Figure 7-22, Page 7-14)**.

13. Install the ball joints (9) to each end of the rack (2). Tighten to 20 ft-lb (27 N·m) **(Figure 7-20, Page 7-13)**.
14. Tap a flange into the notch on the rack **(Figure 7-24, Page 7-14)**.
15. Install the two dust seal bellows (10) **(Figure 7-20, Page 7-13)**.
16. Install new bellows clamps (wire ties) (11) **(Figure 7-20, Page 7-13)**.
17. For ease of assembly and to prevent corrosion, apply a light coat of anti-seize and lubricating compound to the ball joint threads.
18. Install the two nuts (12) and drag links (19). Tighten drag link (19) against nut (12) to 20 ft-lb (27 N·m) **(Figure 7-10, Page 7-9 and Figure 7-20, Page 7-13)**.
19. Apply a light coat of anti-seize and lubricating compound to the drag link threads.
20. Install the two nuts (12) and ball joints (23) to the drag links (19). Tighten to 20 ft-lb (27 N·m) **(Figure 7-20, Page 7-13)**.
21. Apply a light coat of anti-seize compound to the universal joint and install it on the pinion shaft. Tighten the bolt to 15 ft-lb (20 N·m).

RACK AND PINION INSTALLATION

1. For ease of assembly and to prevent corrosion, apply a light coat of anti-seize and lubricating compound to the splined portion of the steering column universal joint.
2. Align the flat portion of the shaft spline with the bolt hole in the upper universal joint and then slide the shaft into the universal joint. Install the bolt (27) and lock washer and tighten to 15 ft-lb (20.3 N·m) **(Figure 7-1, Page 7-3)**.
3. Position the steering rack and pinion assembly on the vehicle frame, sliding the steering universal joint up and through to hole in the mounting plate. Install the bolts (20), washers (21) and nuts (22). Using a crisscross pattern, tighten the four nuts to 20 ft-lb (27.12 N·m) **(Figure 7-20, Page 7-13)**.
4. Install the remaining bolt and lock washer on the steering universal joint and tighten it to 15 ft-lb (20 N·m).
5. Check all universal joint bolts for proper torque of 15 ft-lb (20 N·m).
6. Adjust the toe-in. **See Toe-in Adjustment on page 7-15.**

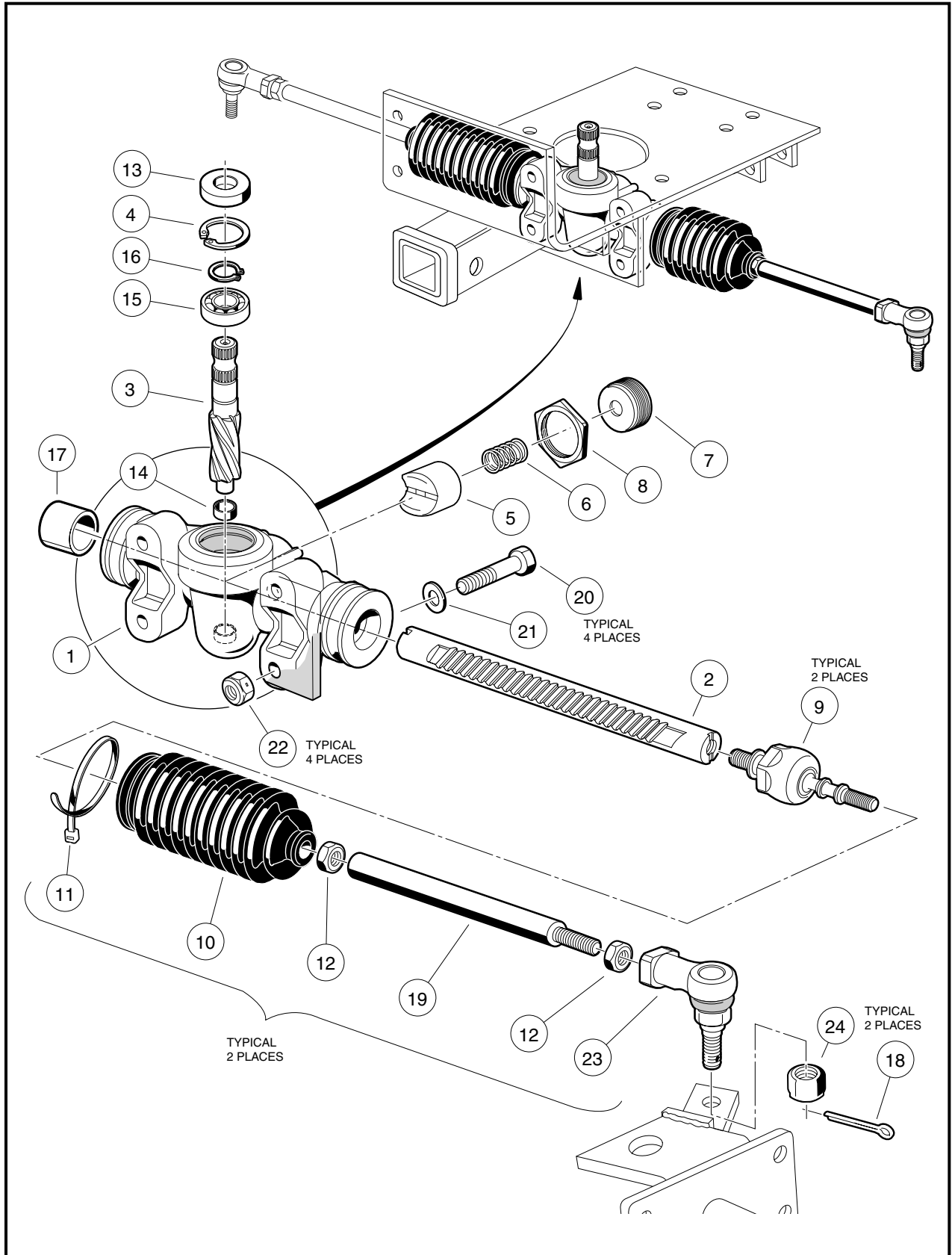


Figure 7-20 Steering Gear

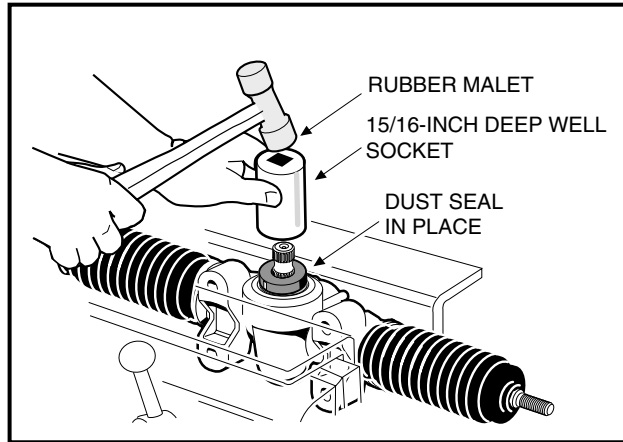


Figure 7-21 Press In Dust Seal

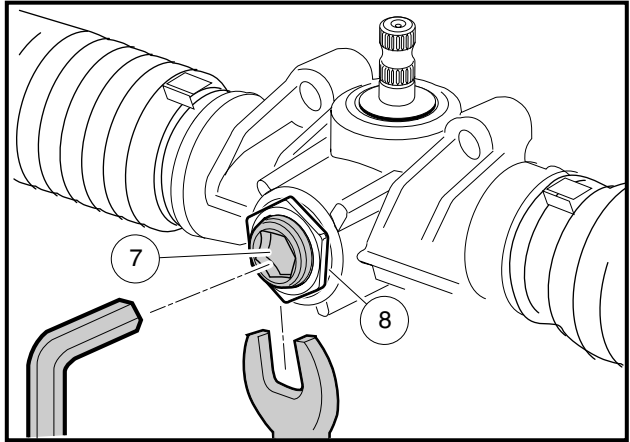


Figure 7-22 Rack and Pinion Adjustment

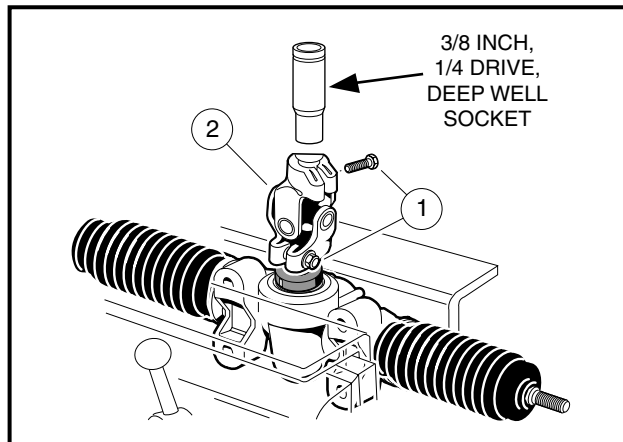


Figure 7-23 Rack and Pinion Resistance

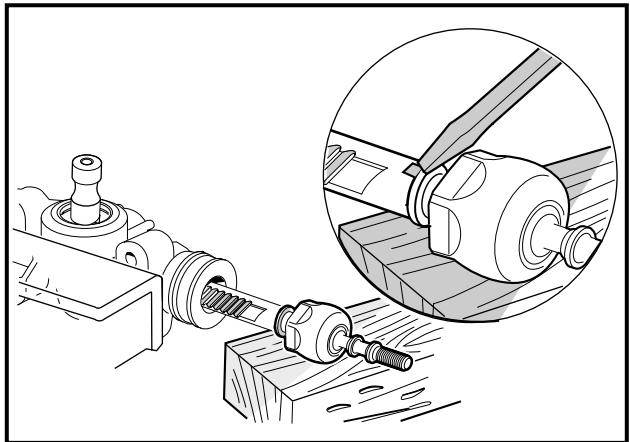


Figure 7-24 Install Ball Joint

FRONT SUSPENSION

Read **DANGER** and **WARNING** on page 7-1.

LUBRICATION

Two grease fittings are provided (one for each kingpin). Lubricate these fittings semi-annually with the proper lubricant. See **Periodic Lubrication Schedule, Section 10, Page 10-5**.

CAUTION

- To ensure proper lubrication of the front suspension, raise front of vehicle to lubricate. See **WARNING** on page 7-1.

WHEEL ALIGNMENT

Wheel alignment is limited to adjusting the toe-in of the front wheels. See **Toe-in Adjustment on page 7-15**. See following **NOTE**.

NOTE: Prior to making any front suspension adjustments, inspect components for wear or damage and repair or replace as necessary.

Toe-in Adjustment

1. On a level surface, roll the vehicle forward, then stop. Make sure the front wheels are pointed straight ahead. Do not turn the steering wheel again during this procedure.
2. On each front tire, mark (as closely as possible) the center of the tread face that is oriented toward the rear of the vehicle. The marks should be at the same height as the center of each hub.
3. Measure the distance between the marks on the rear-facing surfaces of the tires, and then roll the vehicle forward one and one-half wheel revolutions until the marks appear on the forward-facing surfaces of the tires at the same height as the center of the hub.

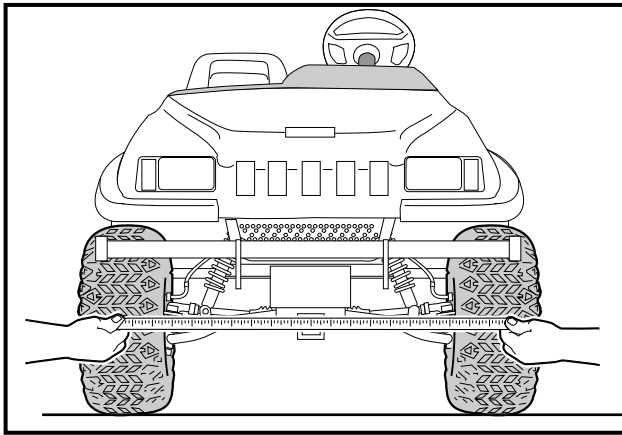


Figure 7-25 Measure Toe-in

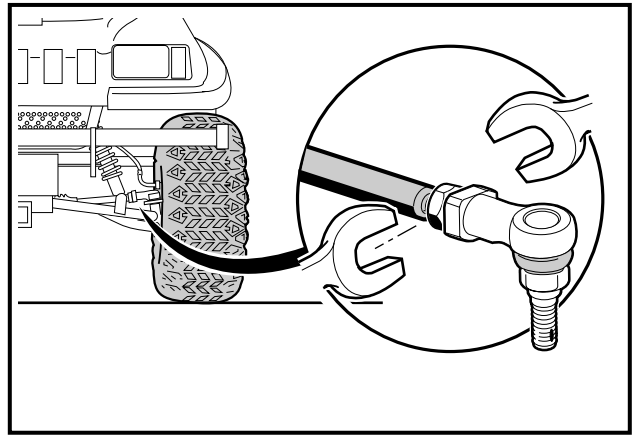


Figure 7-26 Adjust Toe-in

4. Measure the distance between the marks on the forward-facing surfaces of the tires (**Figure 7-25, Page 7-15**).

NOTE: The front measurement must be less than the rear measurement.

5. Subtract the measurement on the front of the tires from the measurement on the rear of the tires. The difference is the toe-in. Proper toe-in is 11/16 inch \pm 3/8 of an inch (18 mm \pm 10 mm).

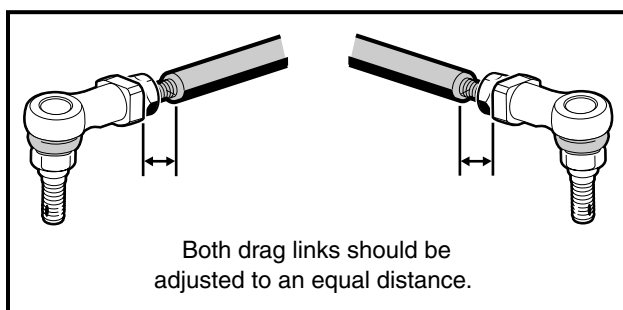


Figure 7-27 Adjust Toe-in

6. If adjustment is necessary:
 - 6.1. Remove the two cotter pins (18) (**Figure 7-20, Page 7-13**).

Toe-in Adjustment, Continued:

- 6.2. Remove the lock nuts (24) (**Figure 7-20, Page 7-13**).
- 6.3. Rotate both of the ball joints an equal amount. To increase the toe-in, rotate both of the ball joints counterclockwise. To decrease the toe-in, rotate both of the ball joints clockwise. Maintain an equal distance from the ball joint to the end of the threads on each drag link (**Figure 7-27, Page 7-15**).
- 6.4. Tighten the lock nuts (24) to 18 ft-lb (24.4 N·m) (**Figure 7-20, Page 7-13**).
7. Check the toe-in. If toe-in is not adjusted properly, repeat step 6.
8. Tighten nuts (12) to 20 ft-lb (27 N·m) and recheck toe-in. If an adjustment is necessary, continue repeating step 6 until the toe-in adjustment is correct.
9. Install new cotter pins (18).
10. After toe-in adjustment is made and with wheels in the straight ahead position, the steering wheel should be at the center of its travel. If the steering wheel is not at the center of travel, remove the steering wheel and install it in the correct orientation. **See Steering Wheel Installation on page 7-4.**

FRONT SUSPENSION COMPONENTS

Read **DANGER** and **WARNING** on page 7-1.

KINGPIN AND STEERING SPINDLE REMOVAL

1. Remove the front brake drum. **See Front Wheel Brake Drum Removal, Section 6a, Page 6a-9.**
2. Remove cotter pin (18) and nut (24), then remove the ball joint from the spindle assembly (**Figure 7-20, Page 7-13**).
3. Remove the four Torx-head bolts (18), washers (19) and lock nuts (20) securing the brake cluster to the spindle assembly. **See Figure 6a-3, Section 6a, Page 6a-4.**
4. Rest the brake cluster on the A-arm as shown (**Figure 7-28, Page 7-17**). Ensure that there is no strain on the brake hose. **See following WARNING.**

WARNING

- **Strain on the brake hose or the brake hose fittings can result in damage to the hose or fittings, causing a leak in the hydraulic system, diminished brake performance, or brake failure.**
5. Remove the nut (22) and washer (36) from kingpin (21) and remove the kingpin (**Figure 7-29, Page 7-18**).
 6. Remove the thrust washer (32).
 7. Remove the wave washer (33) and inspect it. If the washer is broken or has a wave bottom to wave crest height dimension of less than .040 inch (0.10 cm), it must be replaced.
 8. Slide the spindle assembly (20) off of the A-arm (13).
 9. Repeat steps 1 through 8 for the opposite front wheel if necessary.

KINGPIN AND STEERING SPINDLE INSTALLATION

1. Inspect all parts and replace them as necessary.
2. Inspect the kingpin (21) and spindle (19). If either are worn or damaged, they must be replaced (**Figure 7-29, Page 7-18**).

3. Inspect the kingpin bushings (16 and 18) (**Figure 7-29, Page 7-18**). If the bushings are worn or damaged, remove them and press in new ones. **See following NOTE.**

NOTE: If the bushings are replaced, ream new bushings to .750-.752 of an inch (19.05-19.10 mm) in diameter. The reamer should be long enough to ream both bushings from one direction.

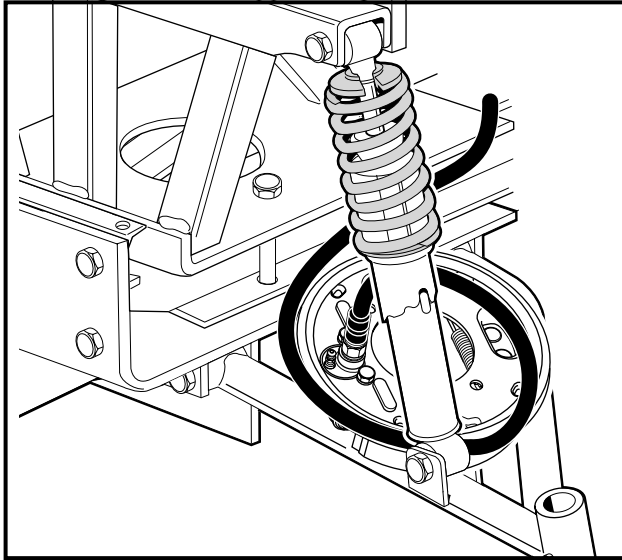


Figure 7-28 Rest Brake Cluster on A-arm

4. Install the spindle assembly (20) onto the A-arm (13) (**Figure 7-29, Page 7-18**).
5. Install the thrust washer (32), wave washer (33) and kingpin (21).
6. Install the washer (36) and a new lock nut (22). Tighten to 18 ft-lb (24.4 N·m).
7. Insert the ball joint (23) into the spindle assembly (**Figure 7-20, Page 7-13**).
8. Install the lock nut (24) and tighten to 40 ft-lb (54.2 N·m).
9. Install a new cotter pin (18) and bend it to secure it to the ball joint.
10. Using a grease gun, apply grease to the grease fitting (17) in the A-arm (13) (**Figure 7-29, Page 7-18**). **See Lubrication on page 7-14.**
11. Install the brake cluster. **See Front Brake Cluster Assembly Installation, Section 6a, Page 6a-21.**
12. Install the wheel and tighten the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
13. Repeat steps 1 through 12 for the opposite front wheel if necessary.
14. Check toe-in adjustment and make adjustments if necessary. **See Toe-in Adjustment on page 7-15.**

A-ARM REMOVAL

1. Remove the front brake cluster. **See Front Brake Cluster Assembly Removal, Section 6a, Page 6a-20.**
2. Remove cotter pin (18) and nut (24), then remove the ball joint from the spindle assembly (**Figure 7-20, Page 7-13**).
3. Remove the nut (22) and washer (36) from the kingpin (21) and remove the kingpin (**Figure 7-29, Page 7-18**).
4. Remove the thrust washer (32) (**Figure 7-29, Page 7-18**).

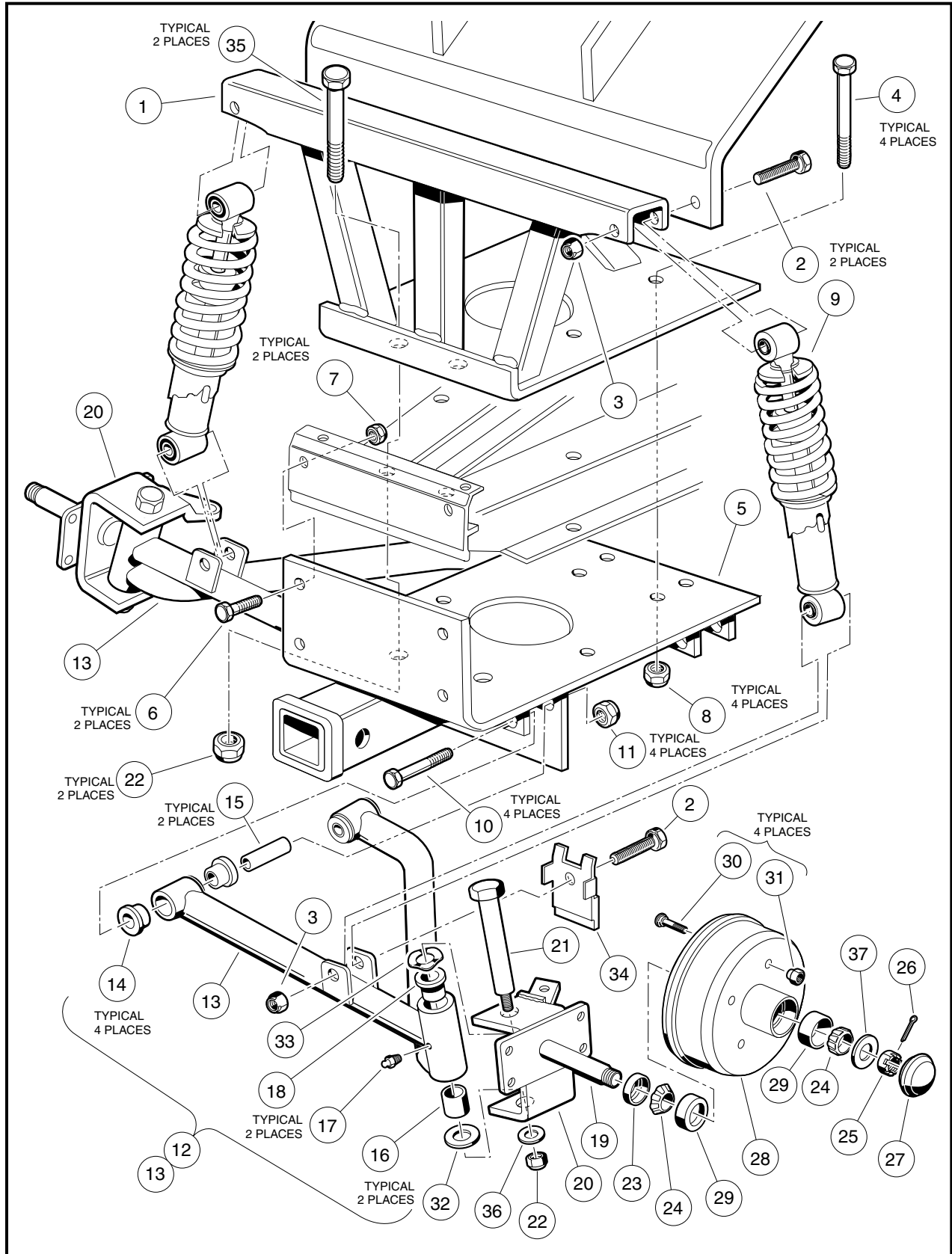


Figure 7-29 Front Suspension

A-Arm Removal, Continued:

5. Remove the wave washer (33) and inspect it. If the washer is broken or has a wave bottom to wave crest height dimension of less than .040 inch (0.10 cm), it must be replaced (**Figure 7-29, Page 7-18**).
6. Slide the spindle assembly (20) off of the A-arm (13) (**Figure 7-29, Page 7-18**).
7. Remove the lower shock absorber mounting bolt (2), nut (3), and steering stop bracket (34) from the A-arm (13) (**Figure 7-29, Page 7-18**).
8. Remove the two bolts (10) and two nuts (11) securing the A-arm (13) to the front suspension mounting plate (**Figure 7-29, Page 7-18**).
9. Remove the A-arm (13) from the suspension mounting plate.
10. Repeat steps 1 through 9 for the opposite front wheel if necessary.

A-ARM INSTALLATION

1. Prior to installation, inspect the bushings (14) and sleeves (15) in the A-arm (13) and replace them if necessary (**Figure 7-29, Page 7-18**).
2. Inspect the bushings (16 and 18) (**Figure 7-29, Page 7-18**). If the bushings are worn or damaged, remove them and press in new ones. **See following NOTE.**

NOTE: If the bushings are replaced, ream new bushings to .750-.752 (3/4-inch) (19.05-19.10 mm) in diameter. The reamer should be long enough to ream both bushings from one direction.

3. Install the A-arm (13) to the front suspension mounting plate using bolt (10) and nut (11). Tighten to 20 ft-lb (27 N·m) (**Figure 7-29, Page 7-18**).
4. Install the spindle assembly (20) onto the A-arm (13).
5. Install the lower shock absorber mount to the A-arm with bolt (2), nut (3) with brake hose bracket and steering stop bracket (34). Position each hose bracket in-line with each shock absorber and tighten the bolt to 22 ft-lb (29.7 N·m).
6. Install the thrust washer (32), wave washer (33) and kingpin (21).
7. Install the washer (36) and a new lock nut (22). Tighten to 18 ft-lb (24.4 N·m).
8. Insert the ball joint (23) into the spindle assembly (**Figure 7-20, Page 7-13**).
9. Install the lock nut (24) to secure the ball joint to the spindle and tighten to 18 ft-lb (24.4 N·m).
10. Install a new cotter pin (18) and bend it to secure it to the ball joint.
11. Using a grease gun, apply grease to the grease fitting (17) in the A-arm (13) (**Figure 7-29, Page 7-18**). **See Lubrication on page 7-14.**
12. Install the brake cluster. **See Front Brake Cluster Assembly Installation, Section 6a, Page 6a-21.**
13. Install the wheel and tighten the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
14. Repeat steps 1 through 13 for the opposite front wheel if necessary.
15. Check toe-in adjustment and make adjustments if necessary. **See Toe-in Adjustment on page 7-15.**
16. Inspect the brake hoses at the front wheels. When turning the steering wheel all the way from left to right and back again, the hoses should not come in contact with any component, especially the wheels or tires.

SHOCK ABSORBER REMOVAL

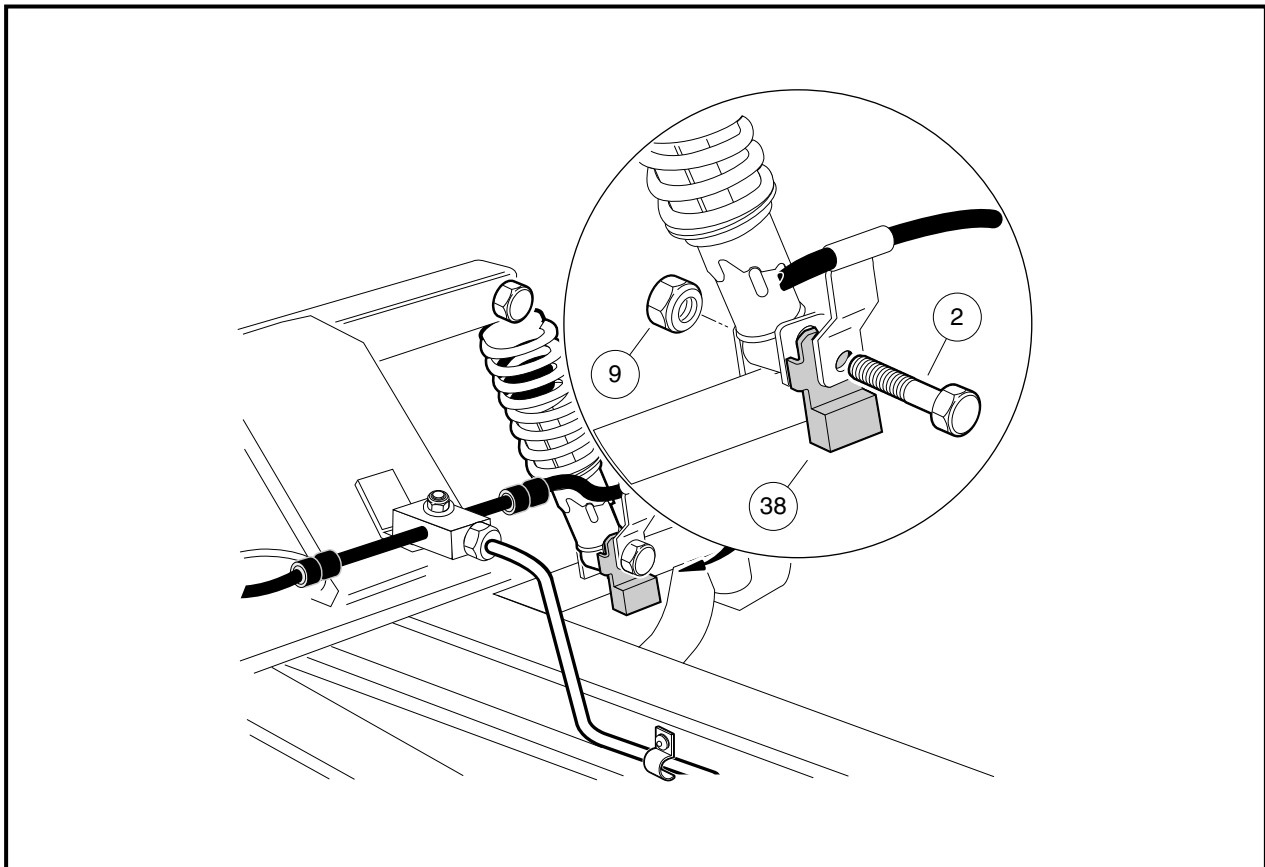
1. Place chocks at the rear wheels, set the park brake, and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands.

Shock Absorber Removal, Continued:

2. Inspect the shock absorbers for damage or fluid leakage on the shock absorber body. Leaking or damaged shock absorbers should be replaced.
3. Remove the bolt (2) and nut (9) attaching the shock absorber to the A-arm (**Figure 7-30, Page 7-20**).
4. Remove the steering stop weldment (38) and brake hose support bracket from the A-arm (**Figure 7-30, Page 7-20**).
5. Remove the nut (3) and bolt (2) attaching the shock absorber to the shock and gear support (**Figure 7-29, Page 7-18**).
6. Remove the shock absorber.

SHOCK ABSORBER INSTALLATION

1. Install the shock absorber by reversing the removal procedure. Position each brake hose bracket in-line with each shock absorber.
2. Tighten the bolts and nuts to 20 ft-lb (27 N·m).
3. Inspect the brake hoses at the front wheels. When turning the steering wheel all the way from left to right and back again, the hoses should not come in contact with any component, especially the wheels or tires.
4. Connect the spark plug.
5. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 7-2.**

**Figure 7-30 Shock Absorber Removal**

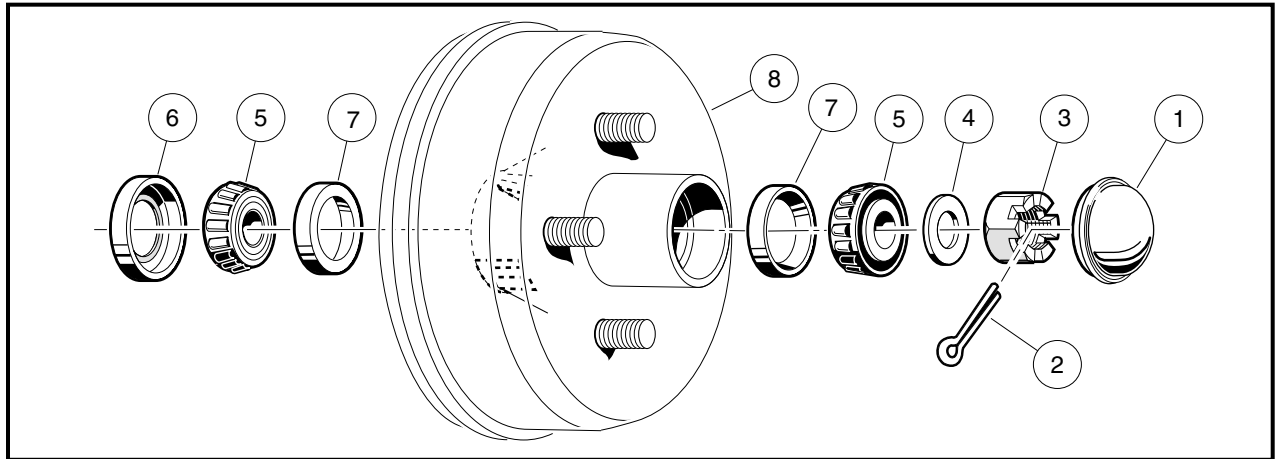


Figure 7-31 Front Wheel Bearings and Hub

FRONT WHEEL BEARINGS AND HUBS

Read **DANGER** and **WARNING** on page 7-1.

FRONT WHEEL FREE PLAY INSPECTION

1. Place chocks at the rear wheels, loosen the front wheel lug nuts and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam of the vehicle and lower the floor jack or chain hoist so that the vehicle is resting on the jack stands. **See Figure 5-2, Section 5, Page 5-4.**
2. Use your hands and attempt to rock the wheel and hub assembly back and forth on the spindle. If there is any observable movement of the wheel and hub on the spindle, remove dust cap (1) and cotter pin (2) and then tighten the spindle nut (3) until both bearings (5) fully seat in the bearing cups (7) (**Figure 7-31, Page 7-21**).
3. Loosen spindle nut one cotter pin position. If the hub does not turn freely, loosen spindle nut one more cotter pin position.
4. Install a new cotter pin (2). If movement continues, replace the wheel bearings (5) as required.
5. Finger-tighten the wheel lug nuts, and lower the vehicle. Tighten the lug nuts in a crisscross pattern to 55 ft-lb (74.6 N-m).

FRONT WHEEL BEARINGS AND HUB REMOVAL

See **Front Wheel Brake Drum Removal, Section 6a, Page 6a-9** or **Front Wheel Brake Drum Removal, Section 6b, Page 6b-9.**

FRONT WHEEL BEARINGS AND HUB INSTALLATION

See **Front Wheel Brake Drum Installation, Section 6a, Page 6a-17** or **Front Wheel Brake Drum Installation, Section 6b, Page 6b-17.**

SECTION 8 – WHEELS AND TIRES

▲ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

▲ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (–) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner’s manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

Maximum tire life and good vehicle handling qualities are directly related to proper wheel and tire care.

- Keep tires properly inflated as follows:

All Terrain Tread	Front: 7-11 psi (.48-.76 Bars)
	Rear: 14-18 psi (.97-1.24 Bars)
Turf Tread	Front: 12-16 psi (.83-1.10 Bars)
	Rear: 16-20 psi (1.10-1.38 Bars)

- Keep lug nuts properly tightened.
- Keep the front end properly aligned and adjusted.

WHEELS

Read **DANGER** and **WARNING** on page 8-1.

WHEEL REMOVAL

1. Slightly loosen the lug nuts on the wheel to be removed.
2. Raise the end of the vehicle from which the wheel is to be removed. Make sure the wheels are off the ground. **See WARNING "Lift only one end..." on page 8-2.**
3. Remove the lug nuts and remove the wheel.

WHEEL INSTALLATION

1. Install wheel(s) and tighten the lug nuts, using a crisscross pattern, finger tight.
2. Lower the vehicle and finish tightening the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N-m).
3. Inspect the brake hoses at the front wheels. When turning the steering wheel all the way from left to right and back again, the hoses should not come in contact with any component, especially the wheels or tires.
4. Check the park brake cables. The cables should not come in contact with either of the rear wheels or tires.

TIRES

Read **DANGER** and **WARNING** on page 8-1.

TIRE REPAIR

1. Determine the location and cause of the air leak.
 - 1.1. Remove the wheel as instructed. **See Wheel Removal on page 8-2.** Inflate the tire to the recommended tire pressure. **See General Information on page 8-2.**
 - 1.2. Immerse the tire in water and then mark the point where bubbles are formed by escaping air.
 - 1.3. Determine the cause of the air leak and repair as required. **See following NOTE.**

NOTE: *An air leak could be due to a punctured tire, faulty valve core, improperly seated valve stem, or improperly seated tire bead.*

Small holes in the tire can be plugged using a standard automotive tubeless tire repair kit available at auto supply stores.

TIRE REMOVAL

NOTE: *Tire must be removed or installed from the valve stem side of the rim.*

1. Remove the tire and wheel assembly from the vehicle. **See Wheel Removal on page 8-2.**
2. Remove the valve cap and valve core and allow air to escape from the tire.
3. Use a tire machine to remove the tire from the rim.

TIRE INSTALLATION

1. Use a tire machine to install the new tire on the rim.
2. Install the valve core.
3. Adjust air pressure in the tire to the recommended pressure and immerse the wheel and tire assembly in water to make sure there are no leaks. **See General Information on page 8-2.**
4. Install the valve cap.
5. Install the wheel. **See Wheel Installation on page 8-3.**

SECTION 9 – REAR SUSPENSION

▲ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

▲ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

The rear suspension and powertrain of the 272 vehicle move independently from the vehicle frame. The suspension includes two multi-leaf springs controlled by two hydraulic shock absorbers mounted between the spring mounting plate and the frame. The engine is mounted on an engine mounting plate that moves with the suspension. At the front of the mounting plate, a snubber limits the mounting plate motion.

The design of the rear suspension components vary slightly between the MC010C-BS00 and MC012C-AS00 transaxles. Some of the component parts are not interchangeable between the two transaxle designs. However, disassembly and assembly procedures of the components are the same on both transaxles.

SHOCK ABSORBERS

Read **DANGER** and **WARNING** on page 9-1.

SHOCK ABSORBER REMOVAL AND INSPECTION

NOTE: The following procedure is the same for both MC012C-AS00 and MC010C-BS00 transaxles. See **Transaxle Identification, Section 6a, Page 6a-2.**

1. Check shock absorbers (1) for damage or fluid leakage around the lower housing of the shock absorber body. Replace damaged or leaking shock absorbers (**Figure 9-1, Page 9-3 or Figure 9-2, Page 9-4**).
2. To remove a shock absorber (1), remove the nut (2), cup washer (3) and rubber bushing (4) from the upper shock absorber stem.
3. Remove lower mounting hardware (6, 7 and 8) on shock absorber lower mount.
4. Compress the shock absorber to remove it.

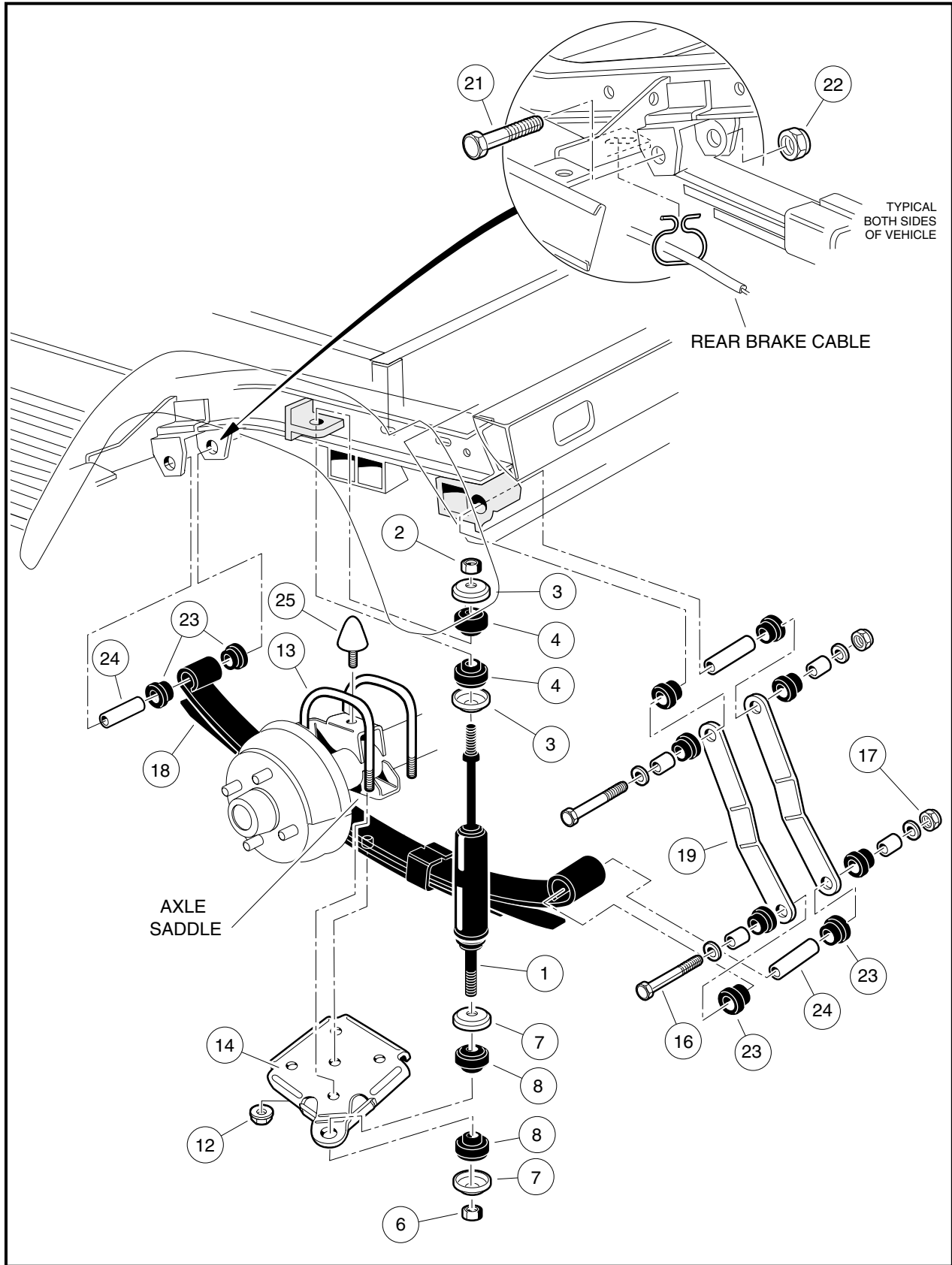


Figure 9-1 Rear Suspension for MC012C-AS00 Transaxle

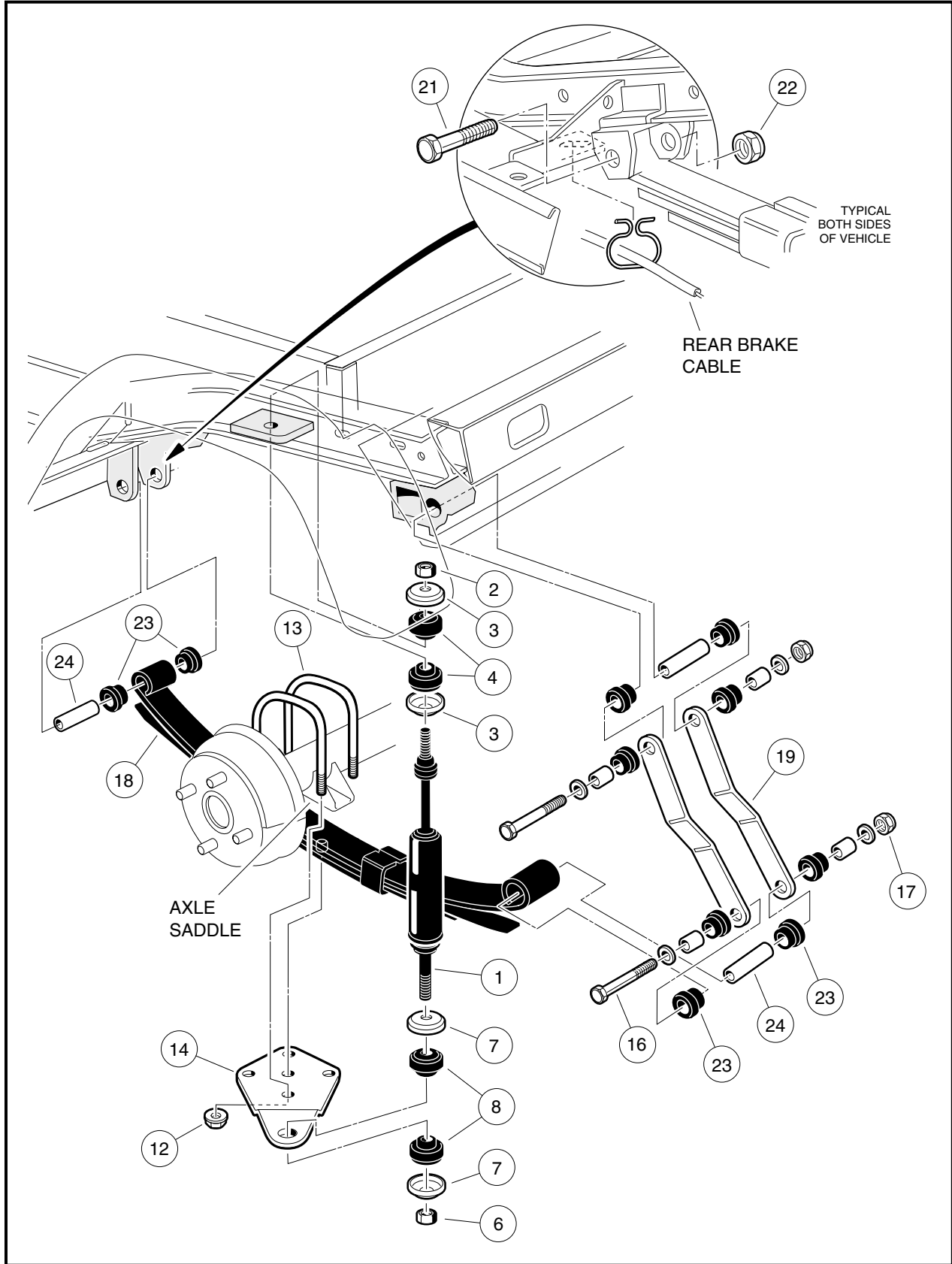


Figure 9-2 Rear Suspension for MC010C-BS00 Transaxle

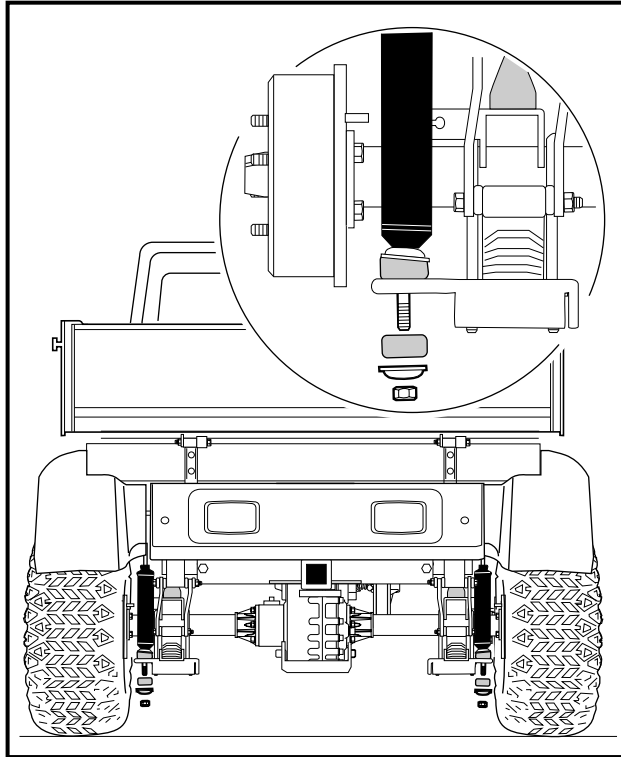


Figure 9-3 Remove Shock Absorbers, MC012C

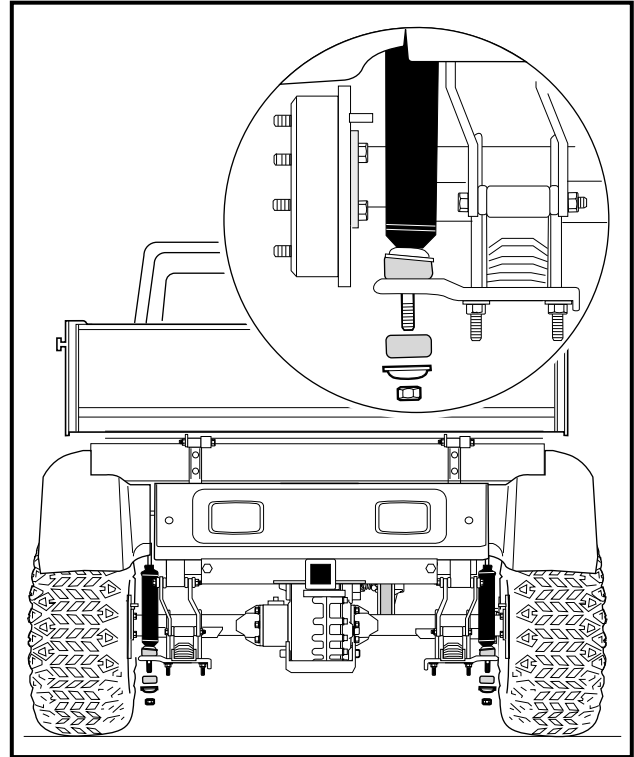


Figure 9-4 Remove Shock Absorbers, MC010C

SHOCK ABSORBER INSTALLATION

NOTE: The following procedure is the same for both MC012C-AS00 and MC010C-BS00 transaxles. See *Transaxle Identification, Section 6a, Page 6a-2*.

When installing shock absorbers, make sure front shocks have identical part numbers and rear shocks have identical part numbers.

1. To install, reverse the removal procedure.
2. On the upper shock absorber mount, tighten nut (2) until rubber bushings (4) expands to the same diameter as the cup washers (3) (**Figure 9-1, Page 9-3 or Figure 9-2, Page 9-4**).
3. On the lower shock absorber mount, install mounting hardware. Tighten the nut (6) until the rubber bushings (8) expands to the same diameter as the cup washers (7).

MULTI-LEAF SPRINGS

Read **DANGER** and **WARNING** on page 9-1.

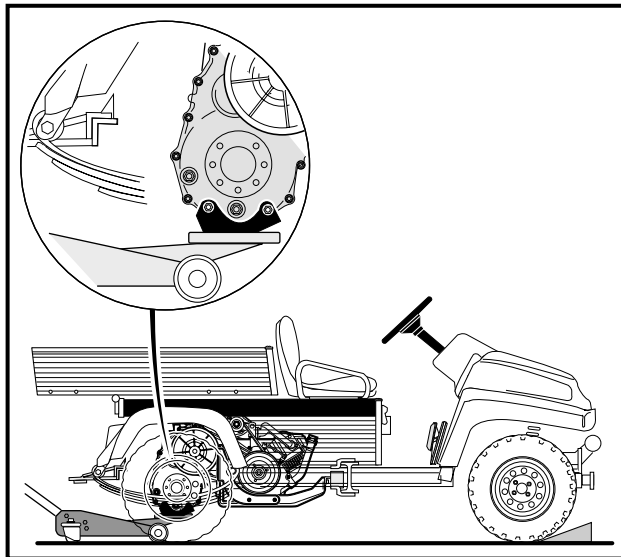
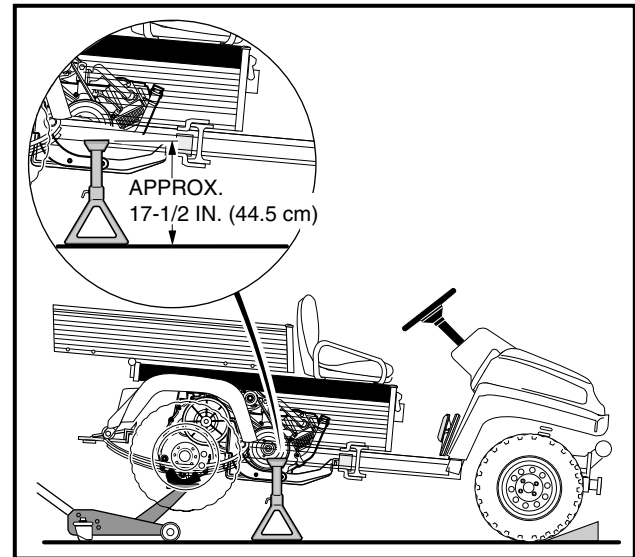
MULTI-LEAF SPRING REMOVAL

NOTE: The following procedure is the same for both MC012C-AS00 and MC010C-BS00 transaxles. See *Transaxle Identification, Section 6a, Page 6a-2*.

1. Remove shock absorbers. See **Shock Absorber Removal and Inspection** on page 9-2.

Multi-Leaf Spring Removal, Continued:

2. Loosen the lug nuts on wheel(s) to be removed.
3. Place chocks in front of the front wheels and lift rear of vehicle with a chain hoist or floor jack. If using floor jack, place jack under transaxle as shown (**Figure 9-5, Page 9-6**).
4. Position jack stands under the two side stringers as shown (**Figure 9-6, Page 9-6**). Lower the floor jack to let the jack stands support the vehicle. **See WARNING on page 9-1.**

**Figure 9-5 Correct Positioning of Floor Jack****Figure 9-6 Correct Positioning of Jack Stands**

5. Remove tire and wheel assembly on the side from which the spring is to be removed. Thread one lug nut onto a stud on the rear hub or bolt flange. This will keep the brake drum on the hub.
6. The jack stands should be supporting the vehicle and the floor jack should be supporting the rear suspension. Lower the floor jack until the leaf springs are unloaded but the floor jack is still supporting the axle.
7. Remove the lock nuts (12) attaching the U-bolts (13) to the shock mount bracket (14) (**Figure 9-1, Page 9-3 or Figure 9-2, Page 9-4**).
8. Remove bolt (16) and lock nut (17) attaching the leaf spring (18) to the rear shackles (19).
9. Allow rear of leaf spring (18) to rest on the ground and remove the bolt (21) and lock nut (22) attaching the front of the spring to the vehicle frame. Remove spring from vehicle.
10. Inspect the rubber bushings (23) and steel sleeves (24) in the spring eyes and replace them if they are worn or damaged.

MULTI-LEAF SPRING INSTALLATION

NOTE: The following procedure is the same for both MC012C-AS00 and MC010C-BS00 transaxles. **See Transaxle Identification, Section 6a, Page 6a-2.**

When installing leaf springs, make sure that both springs have identical part numbers.

1. Install rubber bushings (23) and steel sleeves (24) into both leaf spring eyes if bushings were removed (**Figure 9-1, Page 9-3 or Figure 9-2, Page 9-4**).

2. Place front of leaf spring (18) into front spring mounts and insert the grade eight bolt (21) through mount and leaf spring eye. Install lock nut (22) and tighten to 15 ft-lb (20.3 N·m).

▲ CAUTION

- Use only grade-eight bolts for the front leaf spring mounts.
3. Align the other end of leaf spring with the holes in the spring shackles (19). Insert bolt (16) through leaf spring eye and shackles. Install lock nut (17) and tighten to 15 ft-lb (20.3 N·m). Lower transaxle onto leaf spring (18) (**Figure 9-1, Page 9-3 or Figure 9-2, Page 9-4**).

▲ CAUTION

- When placing transaxle on spring, be sure to position locating bolt on the spring in the center locating hole in the axle saddle (**Figure 9-1, Page 9-3 or Figure 9-2, Page 9-4**).
4. Install shock mount bracket (14) onto locating bolt at bottom center of leaf-spring. **See preceding NOTE.**
 5. Install U-bolts (13) and lock nuts (12). Tighten lock nuts in a crisscross pattern to 35 ft-lb (47.5 N·m).
 6. Install shock absorber. **See Shock Absorber Installation on page 9-5.**

SNUBBER

Read **DANGER** and **WARNING** on page 9-1.

SNUBBER REMOVAL

NOTE: The following procedure is the same for both FE350 and FE400 engines.

1. Support the powertrain with a floor jack under the engine mounting plate so that the snubber is raised slightly and does not rest on the vehicle frame.
2. Working from above, remove the two bolts (2) and two lock nuts (1) securing the snubber bracket to the engine mounting plate (**Figure 9-7, Page 9-8**).
3. Slide snubber and bracket assembly toward battery to remove it from vehicle. **See following CAUTION.**

▲ CAUTION

- With snubber removed, the powertrain must be supported. Loss of support could result in damage to the vehicle or personal injury.

SNUBBER INSTALLATION

1. Install in the reverse order of removal.
2. Tighten snubber bracket mounting nuts (1) to 13 ft-lb (17.6 N·m) (**Figure 9-7, Page 9-8**).

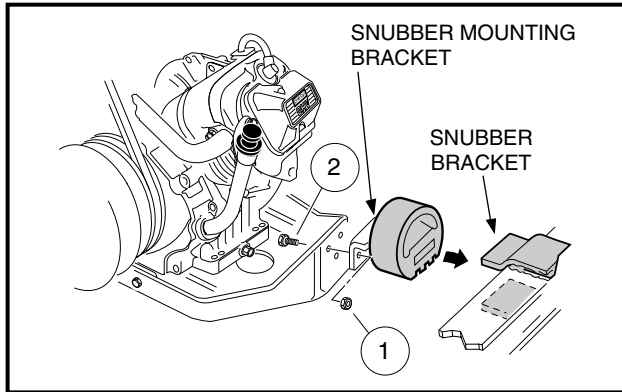


Figure 9-7 Snubber Brackets

SECTION 10 – PERIODIC MAINTENANCE

▲ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

▲ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first (Figure 10-1, Page 10-2).**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

To ensure trouble-free vehicle performance, it is very important to follow an established preventive maintenance program. Regular and consistent vehicle maintenance can prevent vehicle downtime and expensive repairs that result from neglect. Use the Pre-Operation and Daily Safety Checklist in the owners manual, and the following Periodic Service Schedule and Periodic Lubrication Schedule to keep the vehicle in proper working condition.

Any vehicle not functioning correctly should be removed from use until it is repaired. This will prevent further damage to the vehicle and avoid the possibility of injury due to unsafe conditions.

Contact your local Club Car, Inc., dealer for repairs, semiannual and annual periodic service.

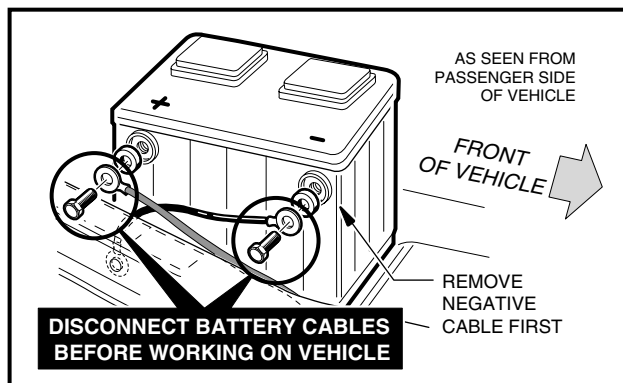


Figure 10-1 Battery Cable Removal

PRE-OPERATION AND DAILY SAFETY CHECKLIST

Use the following checklist as a guide to inspect the vehicle. This checklist should be used daily to ensure that the vehicle is in proper working condition and in conjunction with the Periodic Service Schedule on page 10-4. Any problems should be corrected by your Club Car distributor/dealer or a trained technician.

- **General:** All the parts should be in place and properly installed. Be sure that all nuts, bolts, and screws are tight. Check hose clamps for tight fit and the starter belt for tightness.
- **Safety and information decals:** Check to ensure that all safety and information decals are in place. **See the vehicle owner's manual.**
- **Tires:** Visually inspect for wear, damage and proper inflation on a daily basis. **See Section 2 – Vehicle Specifications.**
- **Battery:** Check electrolyte to ensure it is at the proper level. **See Figure 11a-24, Section 11a, Page 11a-23.** Check battery posts. Wires should be tight and free of corrosion and battery should be fully charged.
- **Engine:** Check for proper engine oil level. **See Engine Oil Level Check on page 10-6.**
- **Fuel:** Check fuel level. **See Fueling Instructions on page 10-7.** Check fuel tank, lines, cap, pump, fuel filters, and carburetor for leakage.
- **Exhaust System:** Check for leaks.
- **Hydraulic Brakes:** Check fluid level. **See Master Cylinder on page 10-6.**

PERFORMANCE INSPECTION

Use the following checklist as a guide to inspect the vehicle and check daily for proper operation. Any problems should be corrected by a Club Car distributor/dealer or a trained technician.

- **Forward/Reverse shifter:** Check for proper operation. **See Controls and Indicators in the vehicle owner's manual.**
- **Brakes:** Be sure the brakes function properly. When brake pedal is fully depressed under moderate pressure, it should not go more than halfway to the floor, and vehicle should come to a smooth, straight stop. If the brake pedal goes more than halfway to the floor, or if the vehicle swerves or fails to stop, have the brake system checked and adjusted as required. When brake pedal is fully depressed under heavy pressure, pedal should feel firm and foot pad should be a minimum of 2 inches (5.1 cm) from floor. Brake adjustment must be maintained so the brake pedal cannot be depressed to the floor under any circumstance.
- **Park Brake:** Apply moderate pressure to park brake handle. Tension should increase as the handle is pulled. When latched, the park brake should lock the wheels and hold the vehicle stationary (on an incline of 20% or less).
- **Reverse Buzzer:** The reverse buzzer will sound as a warning when the Forward/Reverse handle is in REVERSE.
- **Steering:** The vehicle should be easy to steer and should not have any play in the steering wheel.
- **Accelerator:** After starting the engine with the key switch and placing the Forward/Reverse handle in FORWARD, the vehicle should accelerate smoothly to full speed as the accelerator pedal is depressed. When the pedal is released it should return to the original position and the engine should idle. Pioneer vehicles operate at reduced speed in REVERSE.
- **Governor:** Check maximum vehicle speed. It should operate at 17-19 mph (27-31 km/h) on a level surface.
- **Differential Lock Cable:** With the wheels at rest, pull the differential lock handle toward the rear of the vehicle (locked position). The differential lock arm at the other end of the cable should move approximately one-half inch (12.7 mm) downward. When the differential lock handle is placed back into the unlocked position, the differential lock arm should move approximately one-half inch (12.7 mm) upward.
- **General:** Listen for any unusual noises such as squeaks or rattles. Check the vehicle's ride and performance. Have a Pioneer dealer or a trained technician investigate anything unusual.

PERIODIC SERVICE SCHEDULE

WARNING

- Service, repairs, and adjustments must be made per instructions in this maintenance and service manual.

NOTE: If the vehicle is constantly subjected to heavy use or severe operating conditions, the preventive maintenance procedures should be performed more often than recommended in the periodic service and lubrication schedules.

Both the Periodic Service Schedule and the Periodic Lubrication Schedule must be followed to keep the vehicle in optimum operating condition.

PERIODIC SERVICE SCHEDULE		
REGULAR INTERVAL	SERVICE	
Monthly service by owner or trained technician	Engine	Check engine oil level; change if necessary. See Periodic Lubrication Schedule on page 10-5.
		Check engine cooling air intake; visually inspect unshrouded area around engine exhaust for grass and debris and clean if necessary.
	Tires	Check air pressure and adjust if necessary. See Section 2 – Vehicle Specifications.
	General vehicle	Wash engine compartment and underside of vehicle. Do not wash engine when hot.
Semiannual service by trained technician only (every 50 hours of operation)	Battery	Clean terminals and wash dirt from casing; check electrolyte level. See Battery, Section 12a, Page 12a-33..
	Front wheel alignment and toe-in	Check and adjust if necessary. See Wheel Alignment, Section 7, Page 7-14.
	Electrical wiring and connections	Check for tightness and damage.
	Brake system	Inspect master cylinder, wheel cylinders, brake lines, and hoses for damage or leakage.
Check park brake cables for damage; replace if necessary.		
Check brake shoes and drums; replace if necessary. See Brake System Inspection, Section 6a, Page 6a-3.		
Annual service by trained technician only (every 100 hours of operation)	Engine	Check for leaks around gaskets, fill plugs, etc.
		Inspect, clean and gap spark plug; replace if necessary.
	Engine air intake system	Check air filter element; clean or replace if necessary.
		Check clamps for tightness; check hose for cracks.
General vehicle	Check for loose hardware and tighten if necessary.	
Two year service by trained technician only (every 200 hours of operation)	Fuel filters	Replace. Dispose of used filters properly.

WARNING

- If any problems are found, do not operate the vehicle until repairs are made. Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.

PERIODIC LUBRICATION SCHEDULE

PERIODIC LUBRICATION SCHEDULE			
REGULAR INTERVAL	SERVICE	LUBRICATION POINT	RECOMMENDED LUBRICANT
Semiannually by owner or trained technician (every 50 hours of operation)	Brake pedal shaft bearings	1	Dry Moly Lube (CCI P/N 1012151)
	Accelerator push rod pivots, mounts, and shifter cable pivots	2	Dry Moly Lube (CCI P/N 1012151)
	Front suspension (2 fittings)	3	Chassis Lube (EP NLGI Grade 2)
	Check/add brake fluid	4	Use ONLY DOT-5 (silicone) Brake Fluid
Annually by trained technician only (every 100 hours of operation)	Check/fill unitized transaxle to plug level	5	MC010C-BS00: 31 oz. (.92 liters) 80-90 WT. API class GL-3 or 80-90 WT. AGMA class 5 EP gear lubricant. MC012C-AS00: 29 oz. (.85 liters) 80-90 WT. API class GL-3 or 80-90 WT. AGMA class 5 EP gear lubricant.
	Inspect front wheel bearings (Repack as necessary)	6	Chassis Lube (EP NLGI Grade 2)
First change 100 hours – additional change every 200 hours of operation or annually, whichever comes first	Change engine oil and oil filter: FE350 and FE400	7	32 oz. (.95 liter) without filter; 38 oz. (1.12 liters) with filter

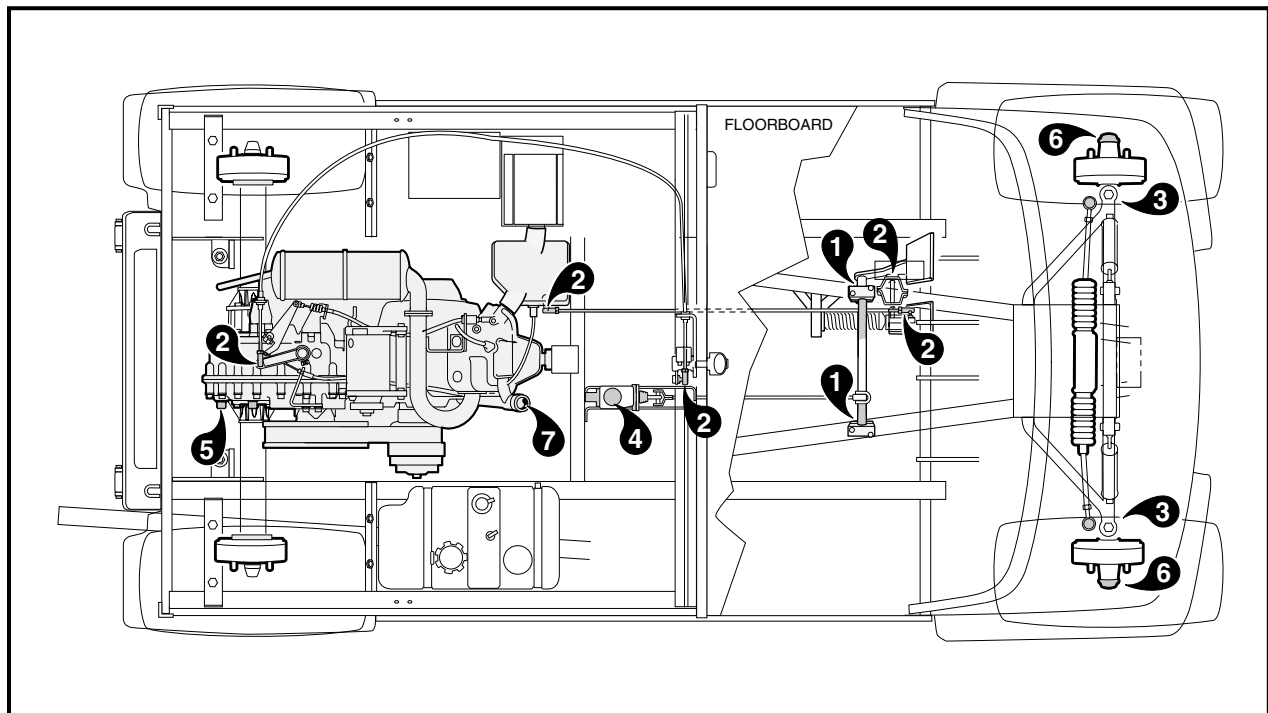


Figure 10-2 Lubrication Points

MASTER CYLINDER

The master cylinder is located under the passenger seat toward the center of the vehicle (**Figure 10-3, Page 10-6**). Raise or remove the seat to check the brake fluid level.

When checking the brake fluid, also inspect the following:

- The presence of brake fluid on the exterior surface of the master cylinder indicates a leak.
- The vent holes in the reservoir cover should be clean and open.
- The reservoir diaphragm should not have holes or other damage.

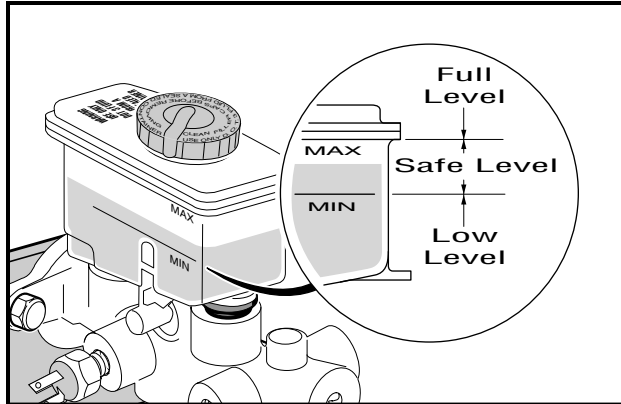


Figure 10-3 Master Cylinder

BRAKE FLUID

Brake fluid level should be within 1/4-inch (6 mm) from top of reservoir (**Figure 10-3, Page 10-6**). Also, brake fluid should be clean with no residue in bottom of reservoir or other evidence of contamination.

⚠ CAUTION

- Use only DOT 5 brake fluid. Use of any other type brake fluid is not recommended.

ENGINE OIL

Read **DANGER** and **WARNING** on page 10-3.

Even though the oil warning light on the dash should illuminate if oil is getting low, the engine oil level should be checked monthly. The vehicle should be on a level surface when checking oil. Do not overfill with oil.

ENGINE OIL LEVEL CHECK

1. Remove the oil level dipstick from the oil filler tube and wipe oil from the stick (**Figure 10-4, Page 10-7**). See following **CAUTION**.

⚠ CAUTION

- Do not remove dipstick while engine is running.
2. Check oil by fully inserting the dipstick into the oil filter tube and immediately remove it again.
 3. If the oil level is at or below the low level mark on the dipstick gauge, add oil until the level is between low and full level (safe level).

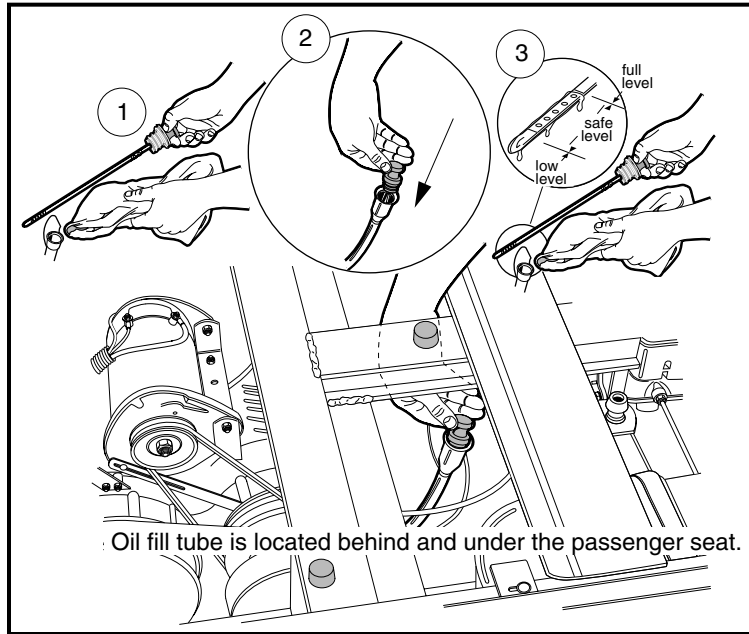


Figure 10-4 Check Engine Oil Level

OIL VISCOSITY

Choose the viscosity according to the temperature as shown (Figure 10-5, Page 10-7). See following NOTE.

NOTE: Using multi-grade oils (5W-20, 10W-30, and 10W-40) will increase oil consumption. Check oil level more frequently when using multi-grade oils.

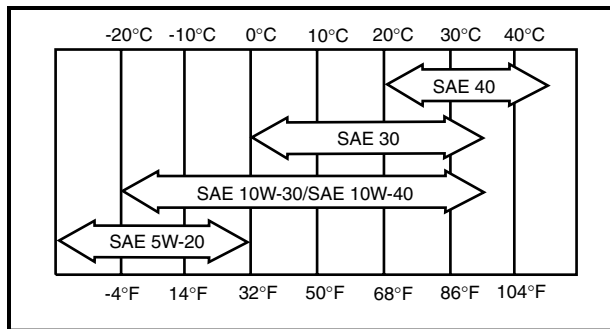


Figure 10-5 Oil Viscosity Chart

FUELING INSTRUCTIONS

Read DANGER and WARNING on page 10-3.

⚠ DANGER

- Turn key switch to OFF before fueling.
- Never pour gasoline into the fuel tank when the engine is hot or while it is running.

DANGER CONTINUED ON NEXT PAGE...

⚠ DANGER

- To avoid electric arc caused by static electricity, the fuel storage/pumping device must be grounded. If the pump is not grounded, the vehicle must be grounded to the pump before and during the fueling operation.
- If the vehicle has an all-weather enclosure installed, the gas tank must be properly vented as shown (Figure 10-6, Page 10-8).
- To avoid the possibility of fire, clean up any spilled gasoline before operating the vehicle.

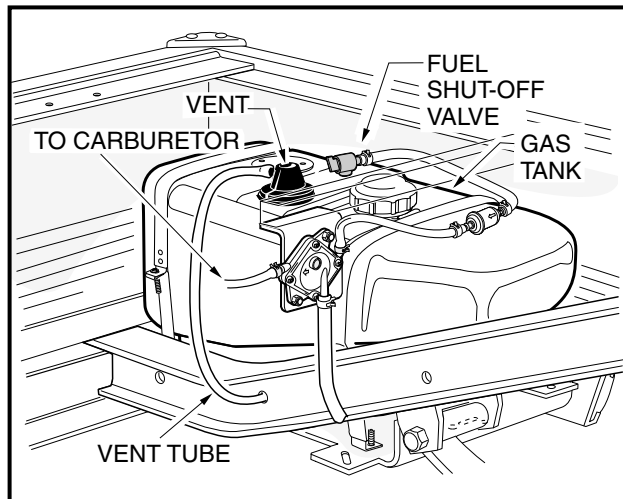


Figure 10-6 Gasoline Tank

1. Remove the passenger seat.
2. Remove fuel cap and fill the fuel tank with fresh, unleaded gasoline only (Figure 10-6, Page 10-8). See following **CAUTION** and **NOTE**.

⚠ CAUTION

- To allow for expansion, do not fill higher than one inch from the top of the fuel tank. Avoid spilling fuel.

NOTE: Whenever possible, avoid using oxygenated fuels and fuels that are blended with alcohol. Vehicles to be stored for extended periods should be prepared for storage as instructed in Section 3 of this manual.

3. Replace fuel cap on tank. Make sure cap is tightened securely.
4. Replace passenger seat. See following **WARNING**.

⚠ WARNING

- Make sure seat hinges and latch are securely engaged before operating vehicle.

BATTERY

For periodic battery maintenance, see **Battery, Section 12b, Page 12b-32**.

SECTION 11A – TROUBLESHOOTING AND ELECTRICAL SYSTEM: FE400, KEY-START ENGINE

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

This section contains the information required to correctly troubleshoot the FE400 key-start vehicles. A troubleshooting guide is provided for general troubleshooting. For issues pertaining solely to the electrical system, proceed to Circuit Testing on page 11a-15.

In addition to troubleshooting, this section contains general information on the electrical system and the electrical circuits of the system.

TROUBLESHOOTING GUIDE

The following troubleshooting guide will be helpful in identifying operating difficulties should they occur. The guide includes the symptom, probable cause(s) and suggested checks. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine does not start easily.	Spark plug is partially fouled or in poor condition	Section 13 – FE350 and FE400 Engines
	Spark plug wire is damaged or loose	Section 13 – FE350 and FE400 Engines
	Loose wire connection at ignition coil or RPM limiter	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 14, 15, and 16
	Intermittent ignition coil failure	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 14, 15, and 16
	Low cylinder compression	Section 13 – FE350 and FE400 Engines
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Section 14 – Fuel System
	Carburetor improperly adjusted	Section 14 – Fuel System
	Starter/generator belt is slipping	Section 12a – Electrical Components: FE400, Key-Start Engine Belt Tension Adjustment on page 12a-12
Engine starts but does not run smoothly.	Spark plug is fouled or in poor condition	Section 13 – FE350 and FE400 Engines
	Spark plug wire is damaged or loose	Section 13 – FE350 and FE400 Engines
	Intermittent ignition coil failure	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 14, 15, and 16
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Section 14 – Fuel System
	Fuel pump malfunction; fuel pressure to carburetor too low	Section 14 – Fuel System
Engine turns but fails to start.	Fuel tank is empty	Section 14 – Fuel System
	Fuel line or filters clogged	Section 14 – Fuel System
	Fouled spark plug	Section 13 – FE350 and FE400 Engines
	Spark plug wire damaged or loose	Section 13 – FE350 and FE400 Engines
	Loose wire connection at ignition coil or RPM limiter	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 14, 15, and 16
	Engine flooded with fuel as result of excess choking	Turf or Carryall Owner's Manual, Controls and Indicators. See Choke.
	Fuel pump malfunction or failure	Section 14 – Fuel System
	Ignition coil or RPM limiter failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 14, 15, and 16
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine turns but fails to start, continued.	Kill circuit grounded	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 14, 15, and 16
Engine overheats.	Fan screen is partially blocked or plugged	Section 13 – FE350 and FE400 Engines
	Governor is improperly adjusted	Section 14 – Fuel System
	Carburetor is too lean; check main jet size	Section 14 – Fuel System
Engine pre-ignites.	Excessive carbon deposits on piston head or in combustion chamber	Section 13 – FE350 and FE400 Engines
	Spark plug heat range is incorrect	Section 13 – FE350 and FE400 Engines
	Unsuitable or contaminated fuel	Section 14 – Fuel System
Loss of engine power.	Exhaust valve is restricted with carbon deposit	Section 13 – FE350 and FE400 Engines
	Muffler or exhaust pipe restricted with carbon or other substance	Section 15 – Exhaust System
	Ignition coil failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 14, 15, and 16
	Air filter is dirty or clogged	Section 14 – Fuel System
	Governor is improperly adjusted	Section 14 – Fuel System
	Throttle linkage out of adjustment	Section 14 – Fuel System
	Low cylinder compression	Section 13 – FE350 and FE400 Engines
	Spark plug failed	Section 13 – FE350 and FE400 Engines
	Restricted fuel flow	Section 14 – Fuel System
	Torque converter is not backshifting properly	Section 17 – Torque Converter
Spark plug fouls repeatedly.	Incorrect plug	Section 13 – FE350 and FE400 Engines
	Spark plug wire is damaged	Section 13 – FE350 and FE400 Engines
	Unsuitable fuel, or incorrect (rich) fuel mixture	Section 14 – Fuel System
	Ignition coil failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 14, 15, and 16
	Rings are heavily worn, low cylinder pressure	Section 13 – FE350 and FE400 Engines
	Dirt entering combustion chamber	Section 13 – FE350 and FE400 Engines
Carburetor floods.	Inlet valve or seat is leaking, dirty, worn, or damaged	Section 14 – Fuel System
	Float is damaged and filled with gasoline	Section 14 – Fuel System
	Carburetor vent is clogged	Section 14 – Fuel System
	Float needle valve not functioning properly	Section 14 – Fuel System
Starter fails to operate.	Lockout cam is in the wrong position	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Lockout Cam Circuit on page 11a-13
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	REFER TO
Starter fails to operate, continued.	Fuse is blown	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 2
	Battery is dead	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 1
	Starter control circuit is not operating	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Starter Circuit on page 11a-16
	Starter/generator failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 8
	Starter solenoid failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 6
	Key switch failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 4
	Lockout limit switch failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 7
	Loose or broken wire in starter/generator circuit	Starter/Generator, Section 12a, Page 12a-2
	Cylinder and/or crankcase flooded with fuel	Section 14 – Fuel System
Starter/Generator does not charge battery.	Diode failed (open condition)	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 10
	Loose or broken wire in the starter/generator circuit	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 11
	Generator field coil is shorted	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 11
	Brushes are worn or commutator is dirty	Starter/Generator, Section 12a, Page 12a-2
	Starter/generator belt is loose or slipping	Starter/Generator, Section 12a, Page 12a-2
	Voltage regulator failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 12
	Battery failed	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 1
Transmission does not engage or disengage smoothly.	Transmission shifter linkage is binding or is out of adjustment	Forward/Reverse Shifter Cable Adjustment, Section 16a, Page 16a-51
	Idle RPM Setting is set too high	Section 14 – Fuel System
	Insufficient (low) level of lubricant or wrong type of lubricant in transmission	Unitized Transaxle Service, Section 16a, Page 16a-5
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	REFER TO
Transmission does not engage or disengage smoothly, continued.	Internal gears are damaged or worn	Differential Gear Case Disassembly, Section 16a, Page 16a-22
	Synchronizer rings are worn, damaged or jammed	Synchronizer Gear Disassembly, Section 16a, Page 16a-25
Excessive vehicle vibration.	Engine mounting nuts or bolts are loose	Section 13 – FE350 and FE400 Engines
	Snubber on frame is worn or damaged	Section 13 – FE350 and FE400 Engines
	Misaligned muffler mounting clamp	Section 15 – Exhaust System
	Damaged drive belt or starter belt	Section 17 – Torque Converter
	Damaged drive clutch	Section 17 – Torque Converter
	Damaged driven clutch	Section 17 – Torque Converter
	Damaged starter/generator pulley	Starter/Generator Removal, Section 12a, Page 12a-3
Torque converter does not shift smoothly.	Drive belt is worn, cracked, glazed, or frayed	Drive Belt, Section 17, Page 17-4
	Drive clutch malfunction	Drive Clutch Cleaning and Inspection, Section 17, Page 17-6
	Driven clutch malfunction	Drive Clutch Cleaning and Inspection, Section 17, Page 17-6
	Governor is sticking	Differential Gear Case Disassembly, Section 16a, Page 16a-22
Engine won't stop running.	Kill circuit wire is disconnected from the ignition coil	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedure 13
	Key switch failure	Section 11a – Troubleshooting and Electrical System: FE400, Key-Start Engine, Test Procedures 4 and 17
	Carburetor is too lean; check main and pilot jet sizes	Section 14 – Fuel System
	Carburetor throttle stop screw out of adjustment	Section 14 – Fuel System

ELECTRICAL SYSTEM

The electrical system on the FE400 key-start vehicles is 12 volts DC with negative ground to frame. It consists of ten circuits that are easily identified:

- Starter Circuit
- Generator Circuit
- Engine Ignition Circuit
- Engine Kill Circuit
- Reverse Buzzer Circuit
- Low Oil Warning Circuit
- Lockout Cam Circuit
- Fuel Gauge and Sending Unit Circuit
- Hour Meter Circuit
- Lighting Circuit

A key-start vehicle uses the ignition key to activate the electrical system and start the engine. This key-start vehicle has a feature which allows the engine to run at idle or advanced RPM using the accelerator pedal when the Forward/Reverse handle is in NEUTRAL. **See Section 13 – FE350 and FE400 Engines.**

Recognizing and understanding the function of each of the electrical circuits will help to quickly isolate the source of an electrical problem. Use the troubleshooting flow charts in the Circuit Testing section to find the proper test procedure to correct the electrical problem. **See Circuit Testing on page 11a-15.**

For a complete wiring diagram, see pages 11a-8 and 11a-9.

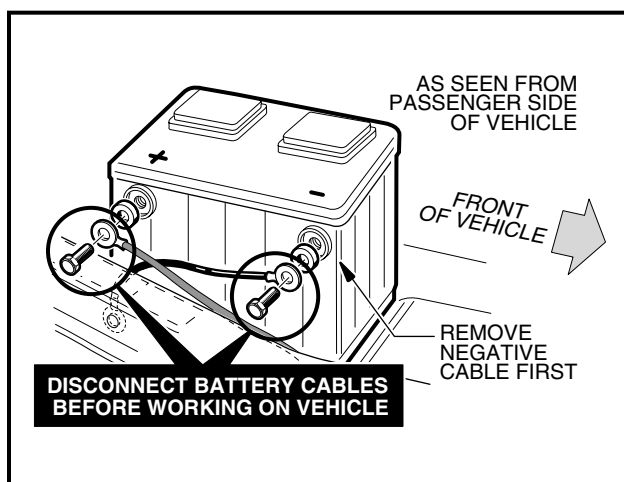


Figure 11a-1 Battery Disconnect

WIRING DIAGRAM

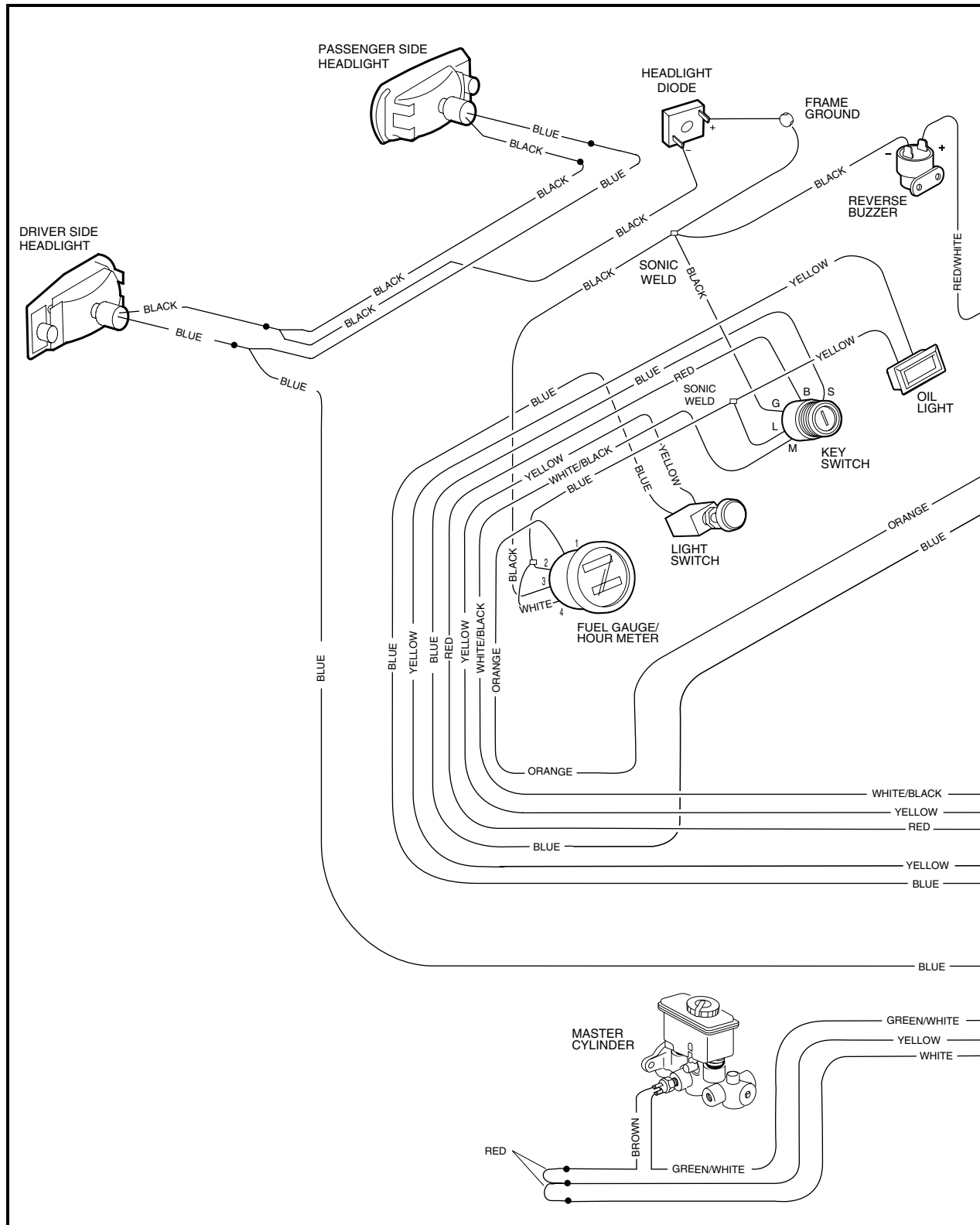


Figure 11a-2 Wiring Diagram for FE400 Key-Start Vehicles (Front)

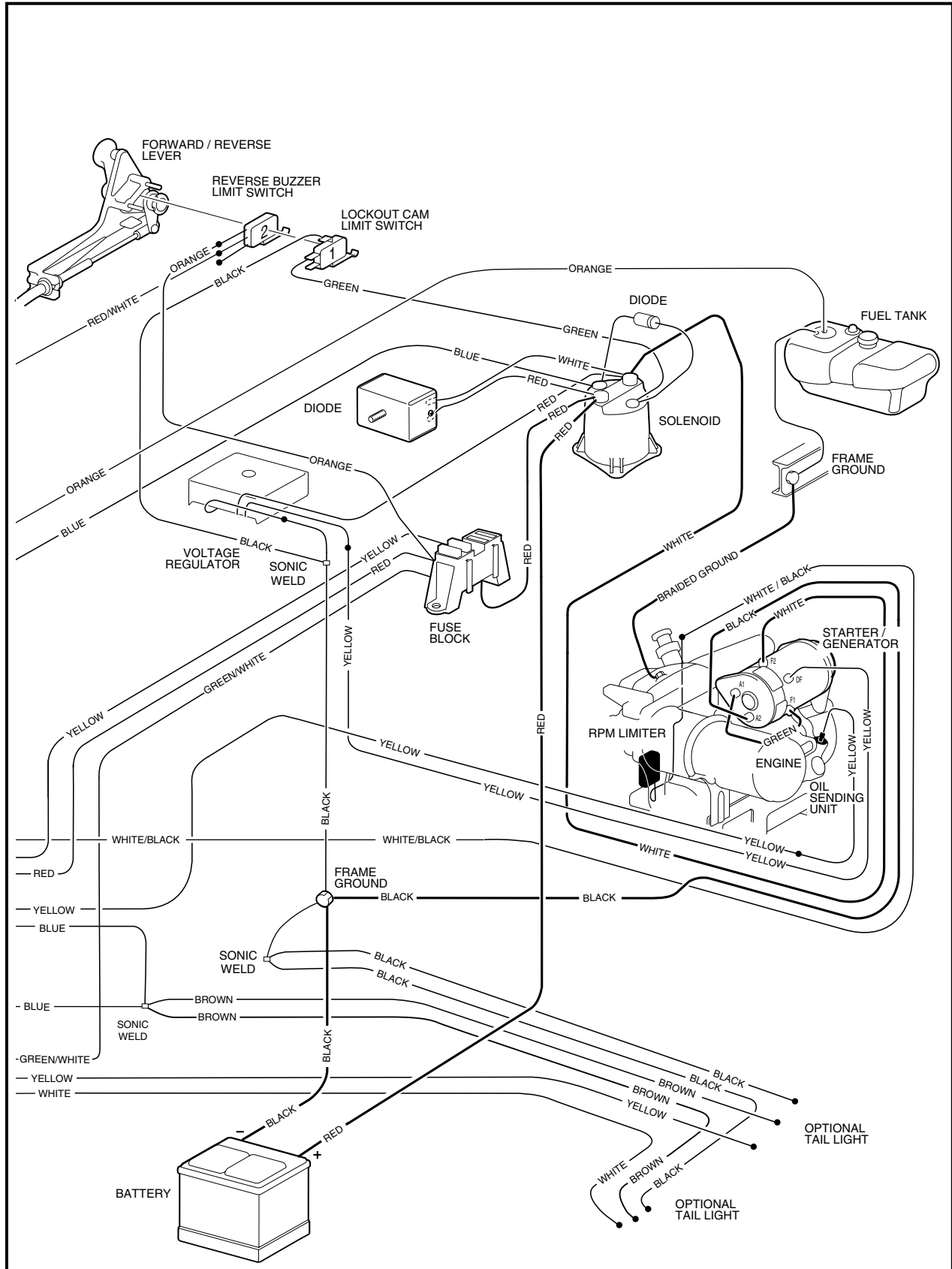


Figure 11a-3 Wiring Diagram for FE400 Key-Start Vehicles (Rear)

ELECTRICAL CIRCUITS

STARTER CIRCUIT

The starter circuit consists of a 12-volt battery, fuse, key switch, lockout cam limit switch, solenoid, starter/generator, and connecting wires (**Figure 11a-4, Page 11a-10**). The battery is the source of power for the system. The fuse provides protection to the solenoid activating circuit. **See following NOTE.**

NOTE: The starter circuit is completely independent of the ignition circuit. The battery does not supply power for ignition. The battery supplies power to the starter/generator which in turn starts the engine components rotating. Once the engine is running, the ignition circuit supplies power to the spark plug. **See Engine Ignition Circuit on page 11a-11.**

The starter circuit is activated when the key switch is turned to the START position. Electrical current is then supplied to the solenoid coil, completing the circuit between the positive post of the battery and the F2 post of the starter/generator. The starter/generator then turns and cranks the engine through belt-driven pulleys.

NOTE: Engine rotation (clockwise) is as viewed from the clutch side of the engine.

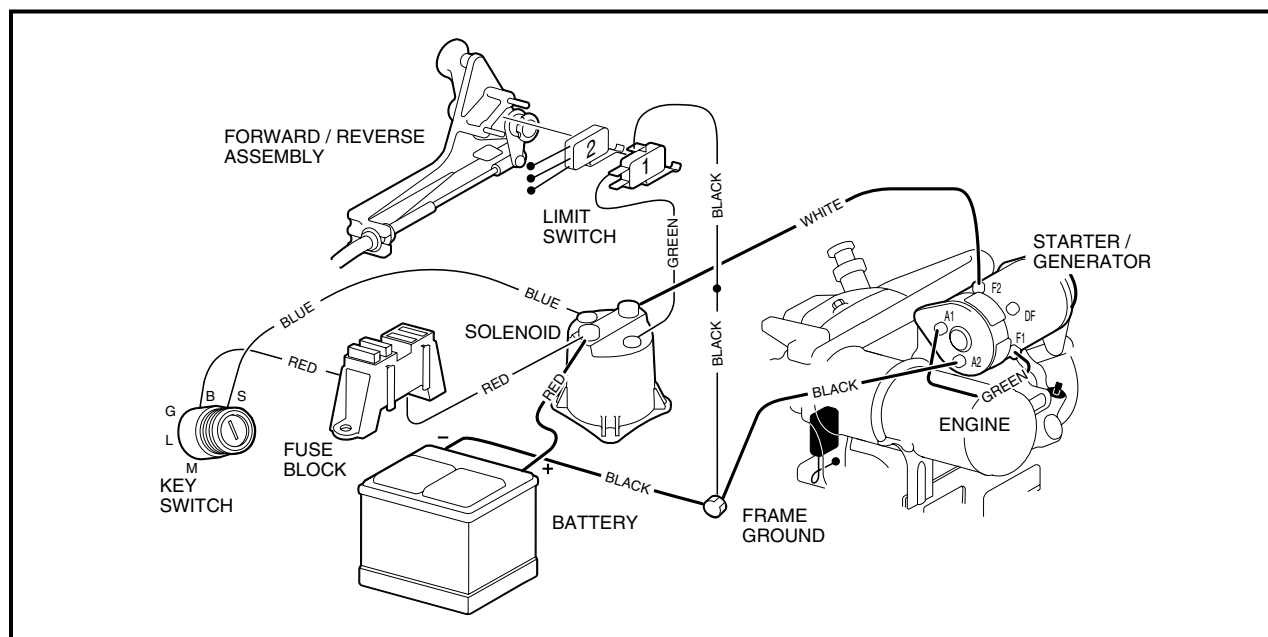


Figure 11a-4 Key-Start Starter Circuit

GENERATOR CIRCUIT

The generator circuit consists of the starter/generator, voltage regulator, diode, solenoid, battery, and connecting wires (**Figure 11a-5, Page 11a-11**).

When battery power is first supplied to the starter/generator, the starter/generator turns the engine at low RPM (approx. 700). Once the engine starts running, it then drives the starter/generator. At any engine RPM over 1215 (3000 starter/generator RPM), the starter/generator functions as a generator, supplying charging current, through the diode, to the battery. To prevent battery overcharging, the voltage regulator senses battery voltage, and by opening and closing an electronic switch, controls the amount of charge going to the battery.

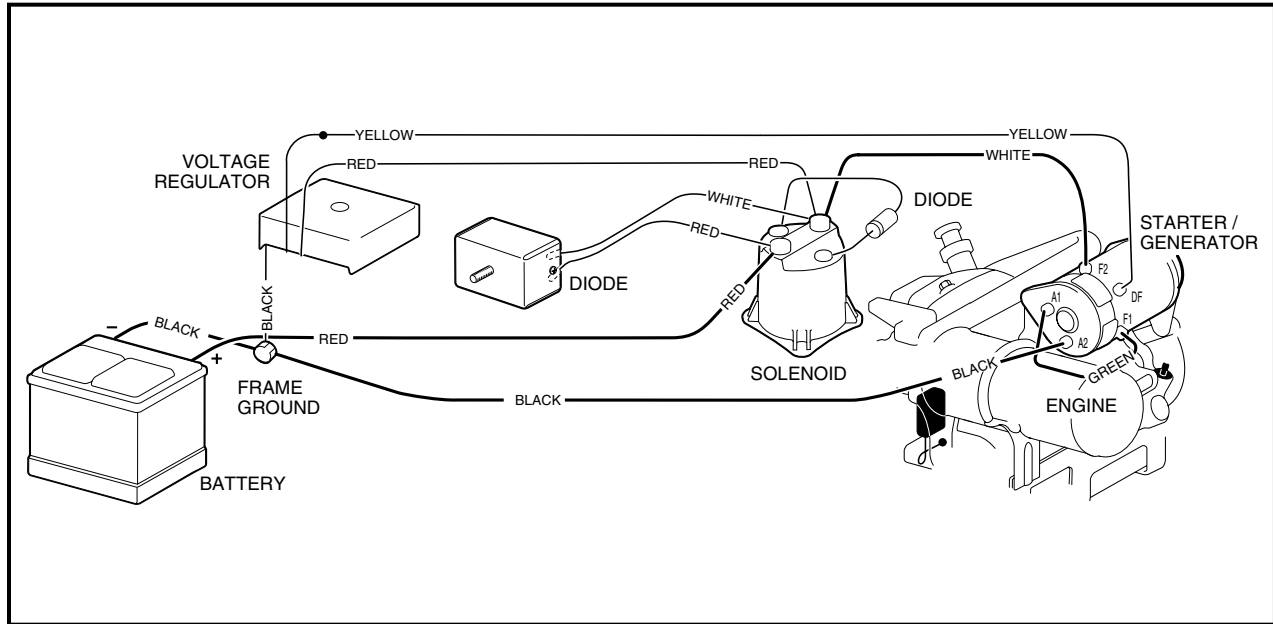


Figure 11a-5 Key-Start Generator Circuit

ENGINE IGNITION CIRCUIT

The engine ignition circuit is independent of all other circuits except the kill circuit. It consists of the ignition coil with internal igniter, spark plug, RPM limiter, and connecting wires (**Figure 11a-6, Page 11a-11**).

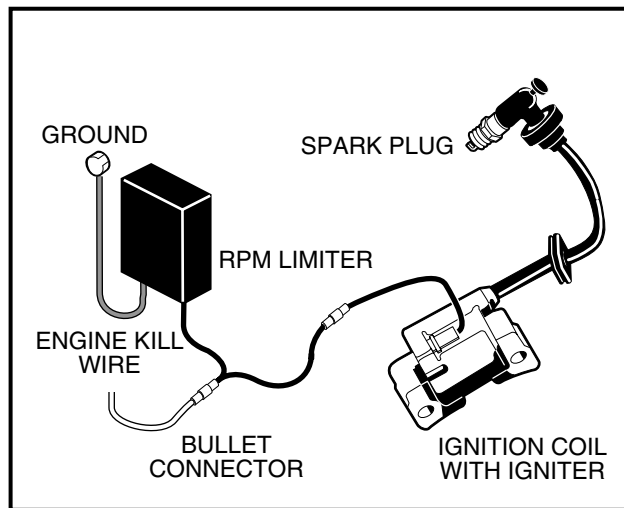


Figure 11a-6 Ignition Circuit

ENGINE KILL CIRCUIT

The ignition coil supplies electrical power for the spark plug; therefore, the proper way to stop the engine is to run this electrical power to ground, bypassing the spark plug (**Figure 11a-7, Page 11a-12**).

The engine kill circuit consists of the key switch and connecting wires. The engine can be stopped by turning the key switch to the OFF position. **See Lockout Cam Circuit on page 11a-13.**

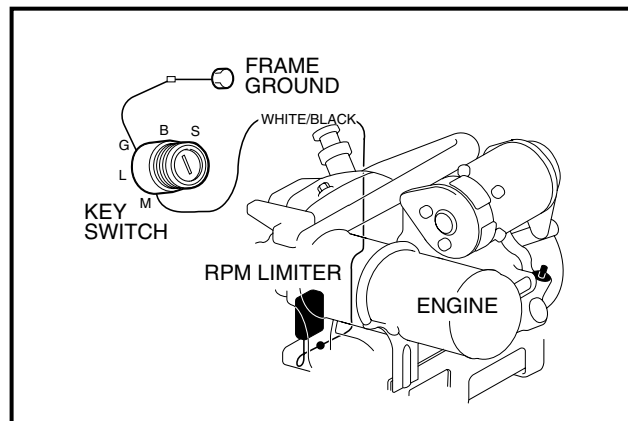


Figure 11a-7 Engine Kill Circuit

REVERSE BUZZER CIRCUIT

The reverse buzzer is a safety warning device that sounds when the Forward/Reverse handle is in REVERSE. It functions to remind the operator not to leave the vehicle in reverse and to warn anyone in the area that the vehicle is in reverse.

The reverse buzzer circuit consists of a reverse buzzer, reverse buzzer limit switch, fuse, fuse block, and connecting wires (**Figure 11a-8, Page 11a-12**).

The battery supplies power through the fuse block and is controlled by the reverse buzzer limit switch that is activated by a cam located on the back of the Forward/Reverse shifter. When the Forward/Reverse handle is placed in REVERSE, a cam depresses the reverse limit switch, closing the circuit. The reverse buzzer sounds.

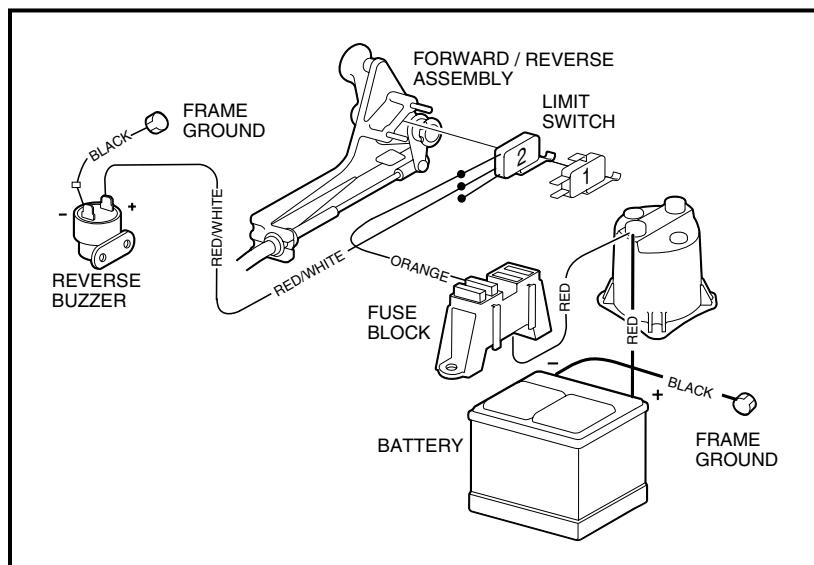


Figure 11a-8 Reverse Buzzer Circuit

LOW OIL WARNING CIRCUIT

The low oil warning circuit consists of an oil level sensor in the engine, a dash-mounted low oil warning light, key switch, and connecting wires (**Figure 11a-9, Page 11a-13**).

The light receives power through the key switch when the key switch is turned to the ON position. When the oil level in the crankcase is low, the oil level sensor closes the circuit to ground and illuminates the low oil warning light.

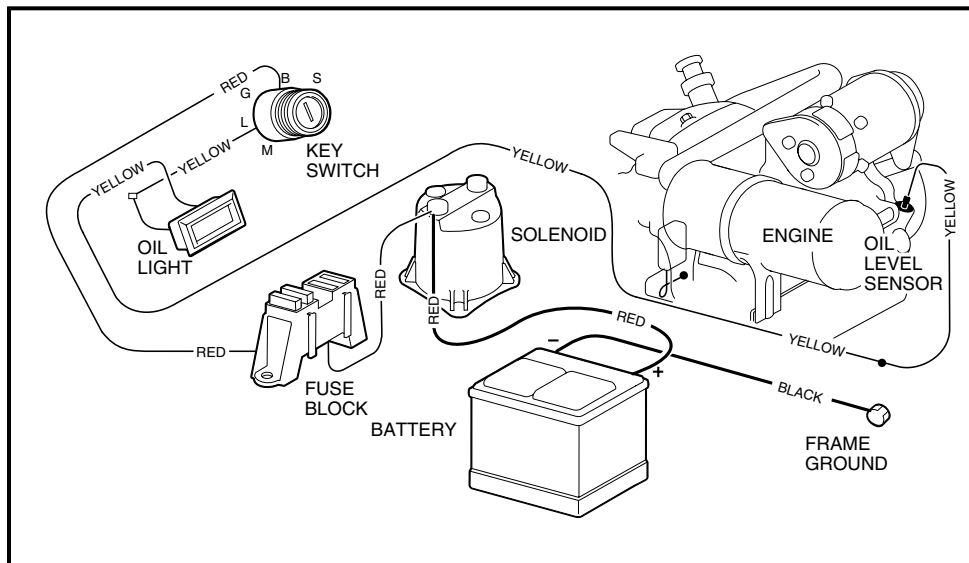


Figure 11a-9 Low Oil Warning Circuit

LOCKOUT CAM CIRCUIT

This key-start vehicle is equipped with a lockout cam that allows the engine to be started and reved only when the Forward/Reverse handle is in the NEUTRAL position. The lockout cam (yellow) is located on the back of the Forward/Reverse handle, inside the engine compartment.

NOTE: Be sure the cam is in the correct position. The cam should activate the limit switch only when the Forward/Reverse handle is in the NEUTRAL position (Figure 11a-10, Page 11a-13).

The lockout cam circuit consists of the connecting wires and a limit switch that is located on the Forward/Reverse shifter assembly and is activated by the lockout cam (Figure 11a-11, Page 11a-14).

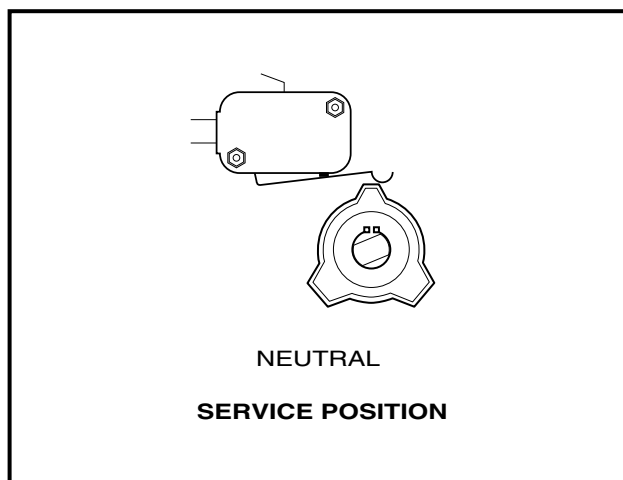


Figure 11a-10 Correct Position for Lockout Cam

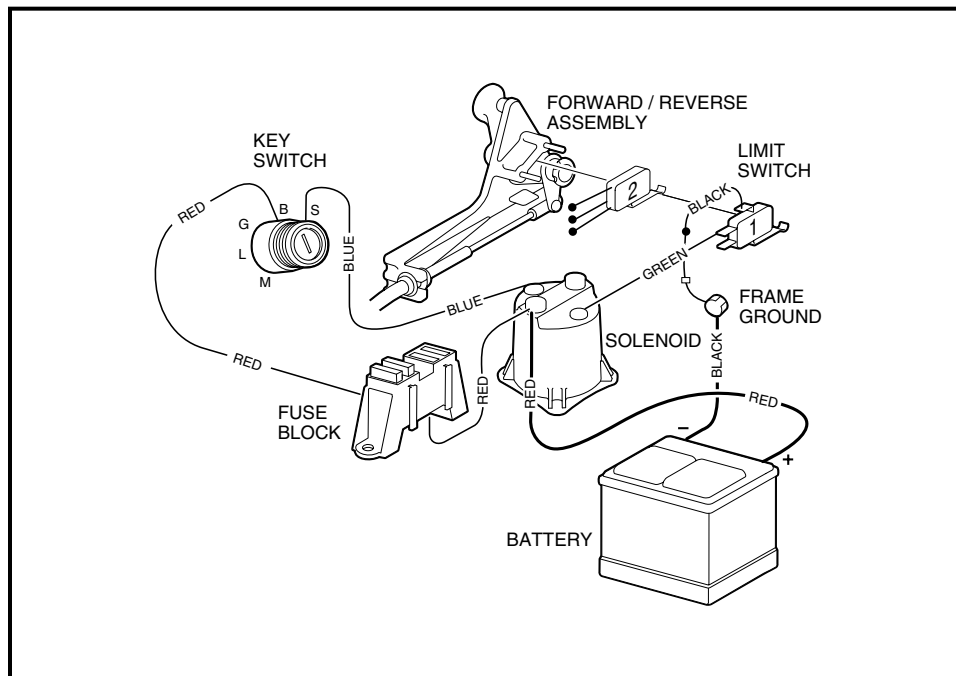


Figure 11a-11 Lockout Cam Circuit

FUEL GAUGE AND SENDING UNIT CIRCUIT

The fuel gauge and sending unit circuit consists of the fuel gauge/hour meter, fuel level sending unit, key switch and connecting wires. The fuel gauge sending unit picks up power from the key switch when the key switch is turned to the ON position. The power goes through the gauge to the sending unit at the fuel tank. The sending unit tells the gauge how much fuel is in the tank (**Figure 11a-12, Page 11a-14**).

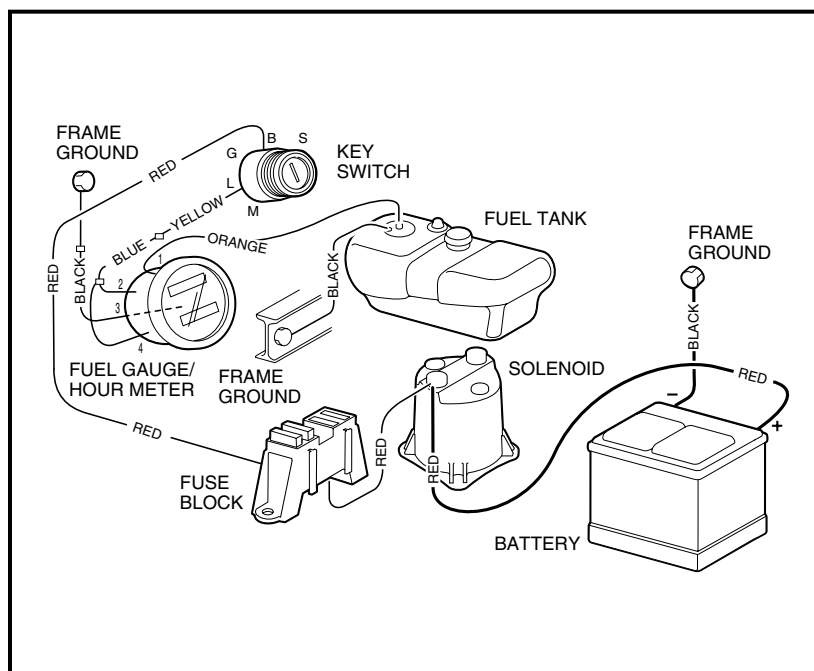


Figure 11a-12 Fuel Gauge and Sending Unit Circuit

HOUR METER CIRCUIT

The hour meter circuit consists of the fuel gauge/hour meter, key switch, solenoid, and connecting wires (Figure 11a-13, Page 11a-15).

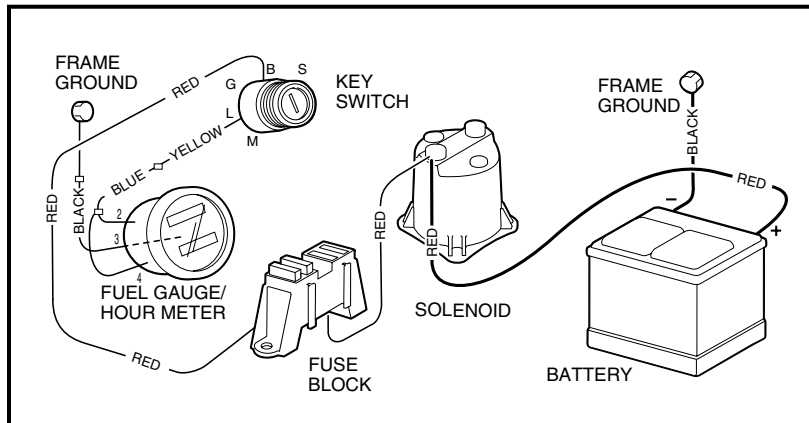


Figure 11a-13 Key-Start Hour Meter Circuit

LIGHTING CIRCUIT

The headlights receive power through the fuse block when the light switch is pulled to the ON position (Figure 11a-14, Page 11a-15).

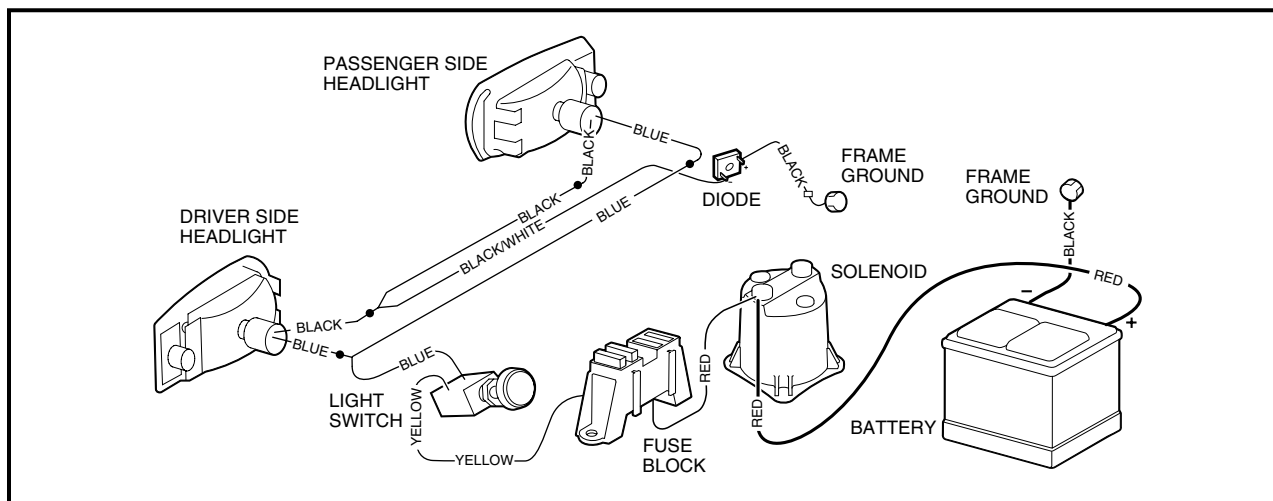


Figure 11a-14 Key-Start Lighting Circuit

CIRCUIT TESTING

Read **DANGER** and **WARNING** on page 11a-1.

Before testing the electrical circuits to determine the source of an electrical problem, test the vehicle battery to determine whether or not it is the source of the problem. A hydrometer, multimeter, and 160 ampere load tester will be required. See **Test Procedure 1 – Battery** on page 11a-22.

TESTING THE STARTER CIRCUIT AND GENERATOR CIRCUIT

Read **DANGER** and **WARNING** on page 11a-1.

Use these charts (**Figure 11a-15, Page 11a-16 and Figure 11a-16, Page 11a-16**) to begin troubleshooting problems with the starter and generator circuits.

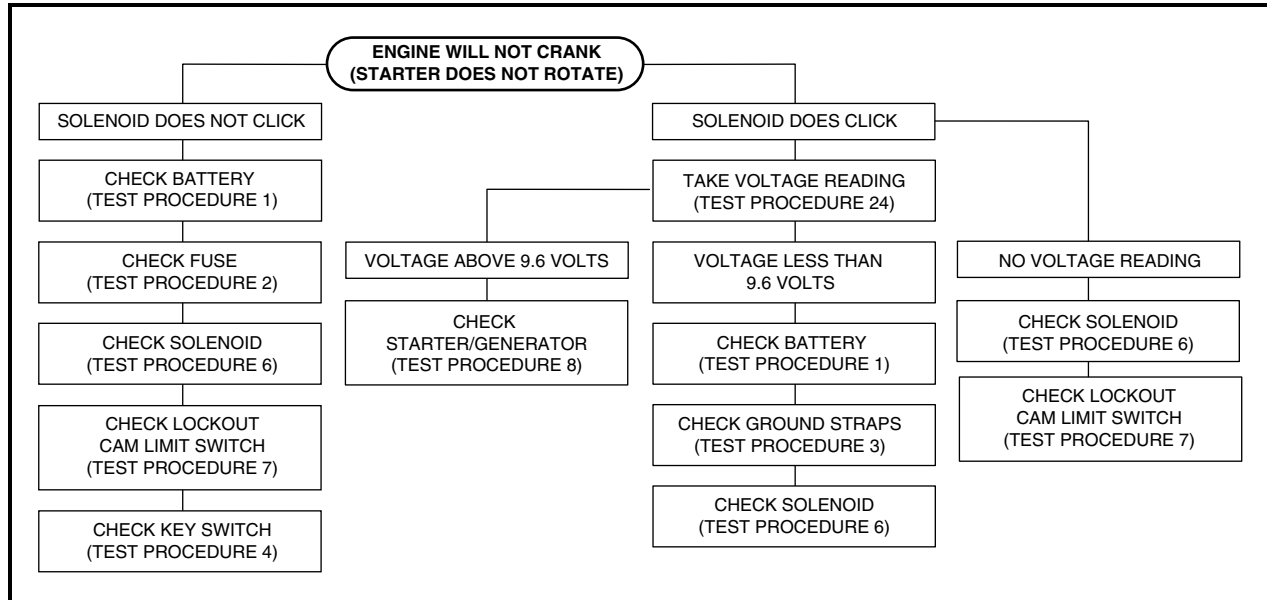


Figure 11a-15 Testing the Starter Circuit

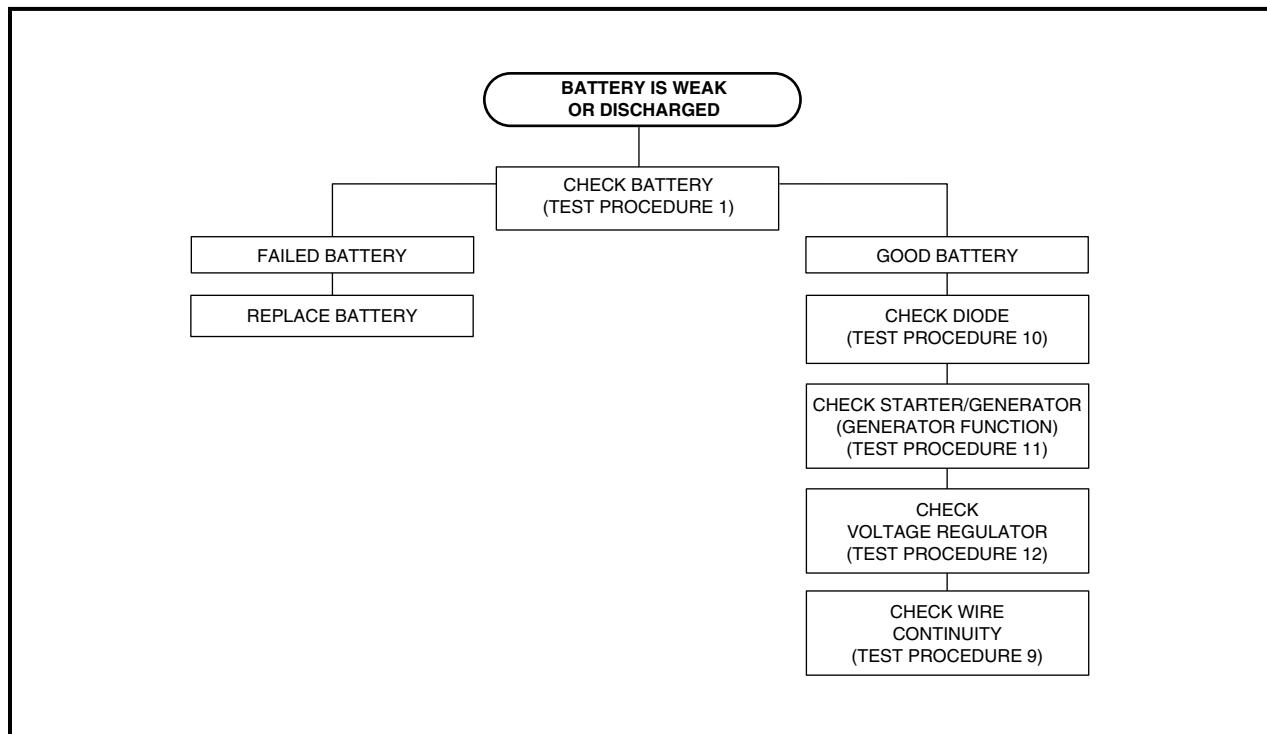


Figure 11a-16 Testing the Generator Circuit

TESTING THE ENGINE IGNITION CIRCUIT

Read **DANGER** and **WARNING** on page 11a-1.

Use this chart (Figure 11a-17, Page 11a-17) to begin troubleshooting engine ignition circuit problems.

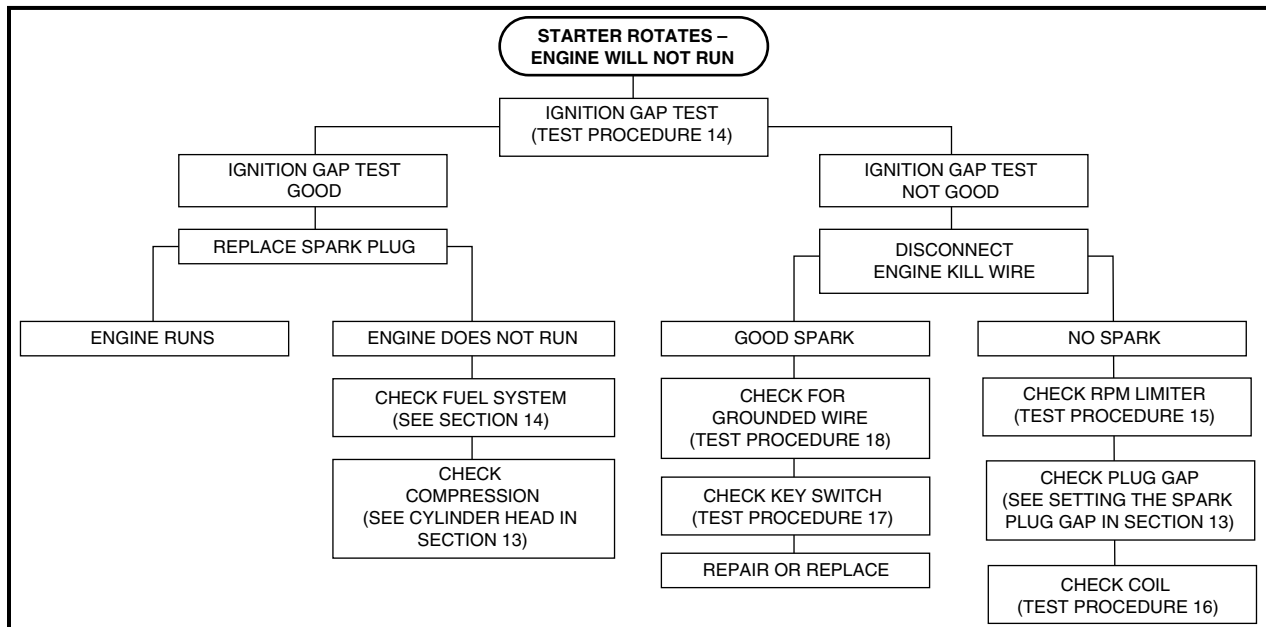


Figure 11a-17 Testing the Engine Ignition Circuit

TESTING THE ENGINE KILL CIRCUIT

Read **DANGER** and **WARNING** on page 11a-1.

Use this chart (Figure 11a-18, Page 11a-17) to begin troubleshooting problems with the engine kill circuit.

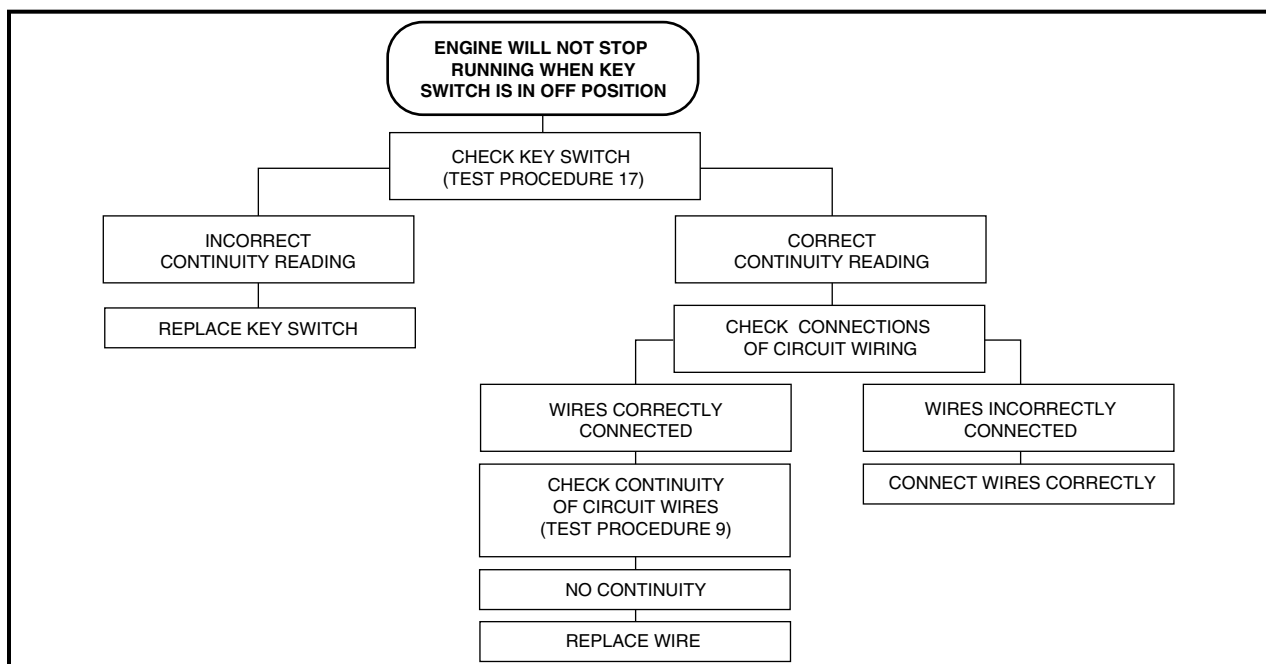


Figure 11a-18 Testing the Engine Kill Circuit

TESTING THE REVERSE BUZZER CIRCUIT

Read **DANGER** and **WARNING** on page 11a-1.

Use this chart (Figure 11a-19, Page 11a-18) to begin troubleshooting the reverse buzzer circuit.

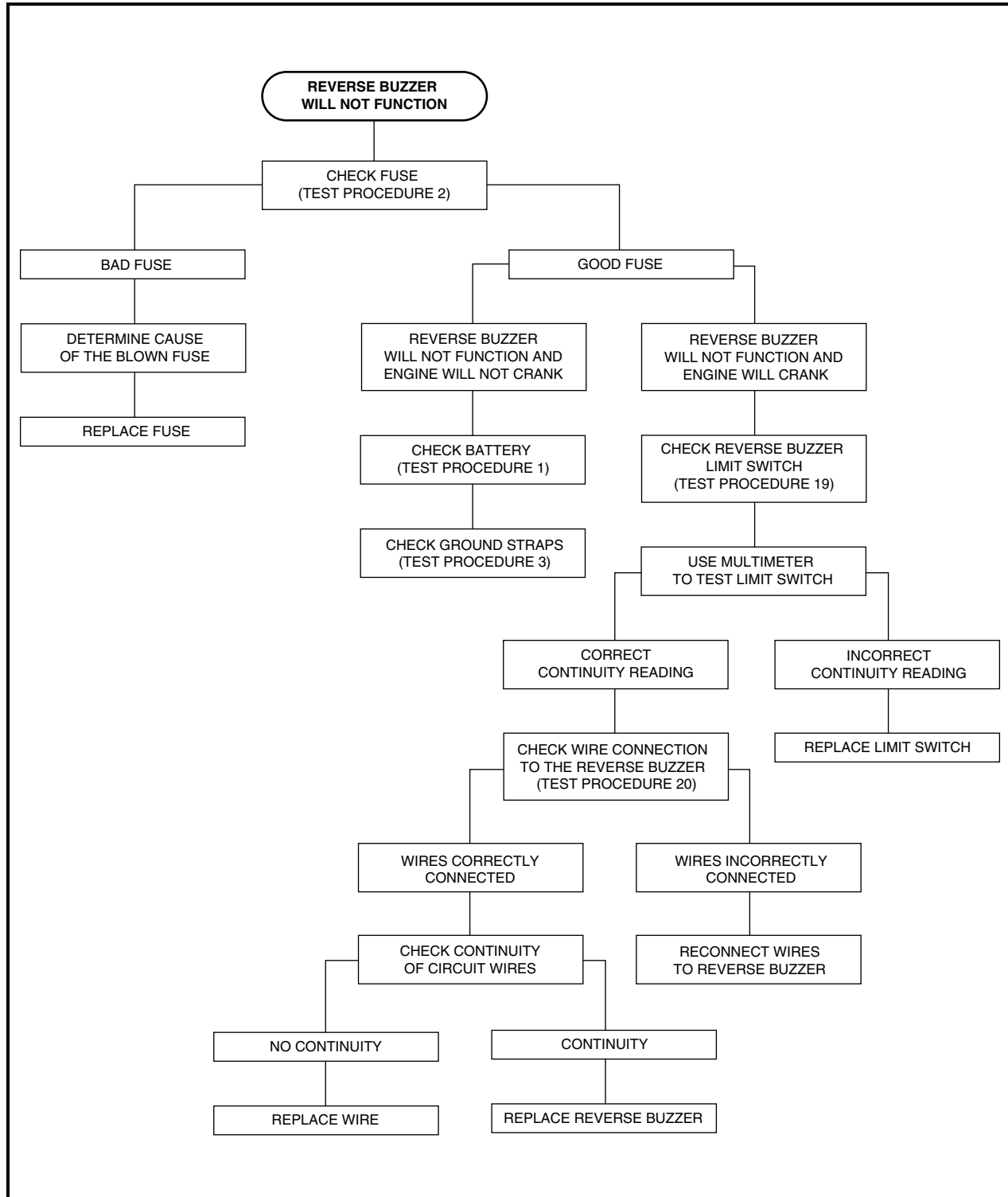


Figure 11a-19 Testing the Reverse Buzzer Circuit

TESTING THE LOW OIL WARNING CIRCUIT

Read **DANGER** and **WARNING** on page 11a-1.

Use this chart (**Figure 11a-20, Page 11a-19**) to begin troubleshooting the low oil warning circuit.

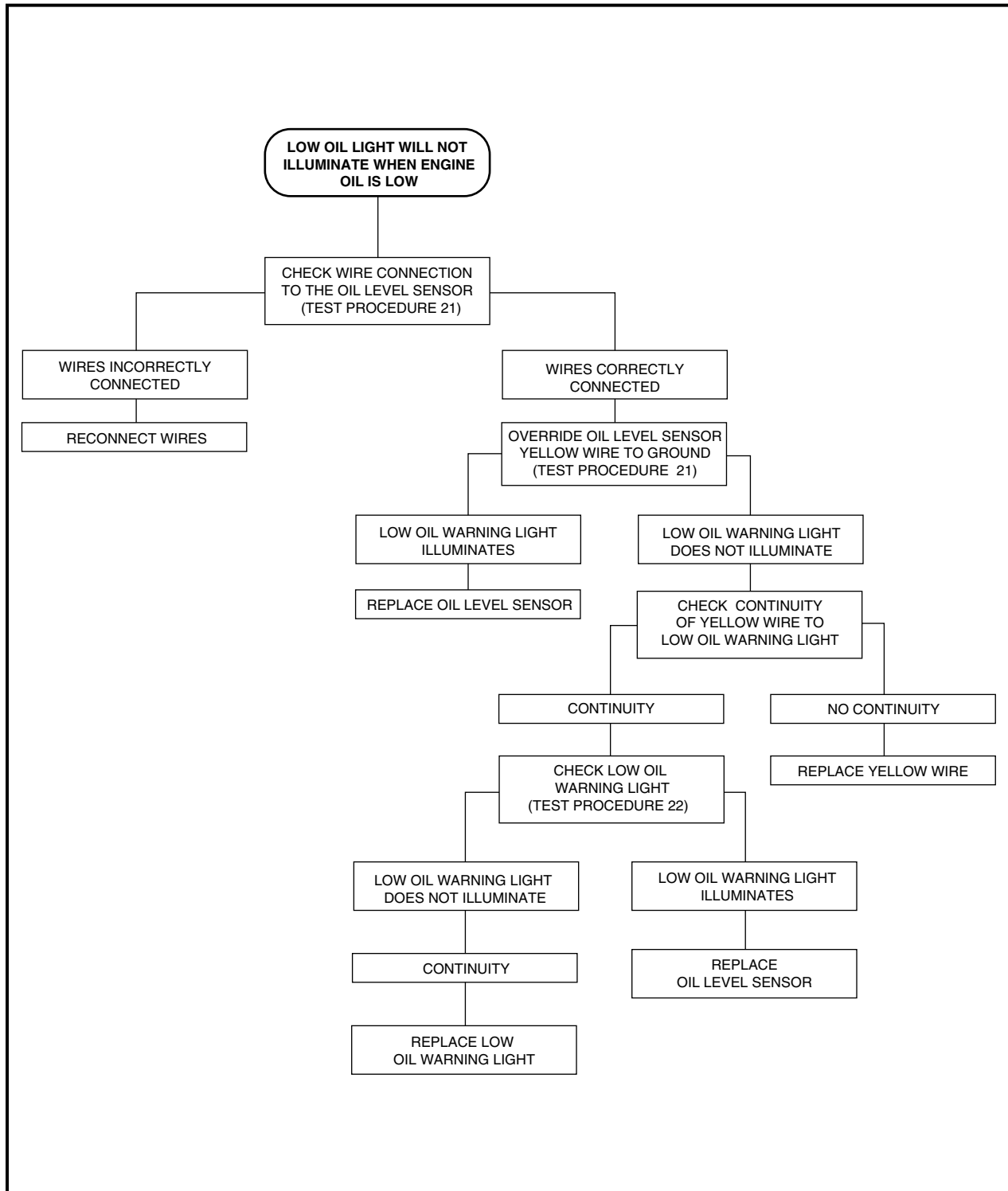


Figure 11a-20 Testing the Low Oil Warning Circuit

TESTING THE LOCKOUT CAM CIRCUIT

Read **DANGER** and **WARNING** on page 11a-1.

A failure in the lockout cam circuit will prevent the starter from rotating. See **Testing the Starter Circuit and Generator Circuit** on page 11a-16.

TESTING THE FUEL GAUGE AND SENDING UNIT CIRCUIT

Read **DANGER** and **WARNING** on page 11a-1.

Use this chart (**Figure 11a-21, Page 11a-20**) to begin troubleshooting the fuel gauge and sending unit circuit.

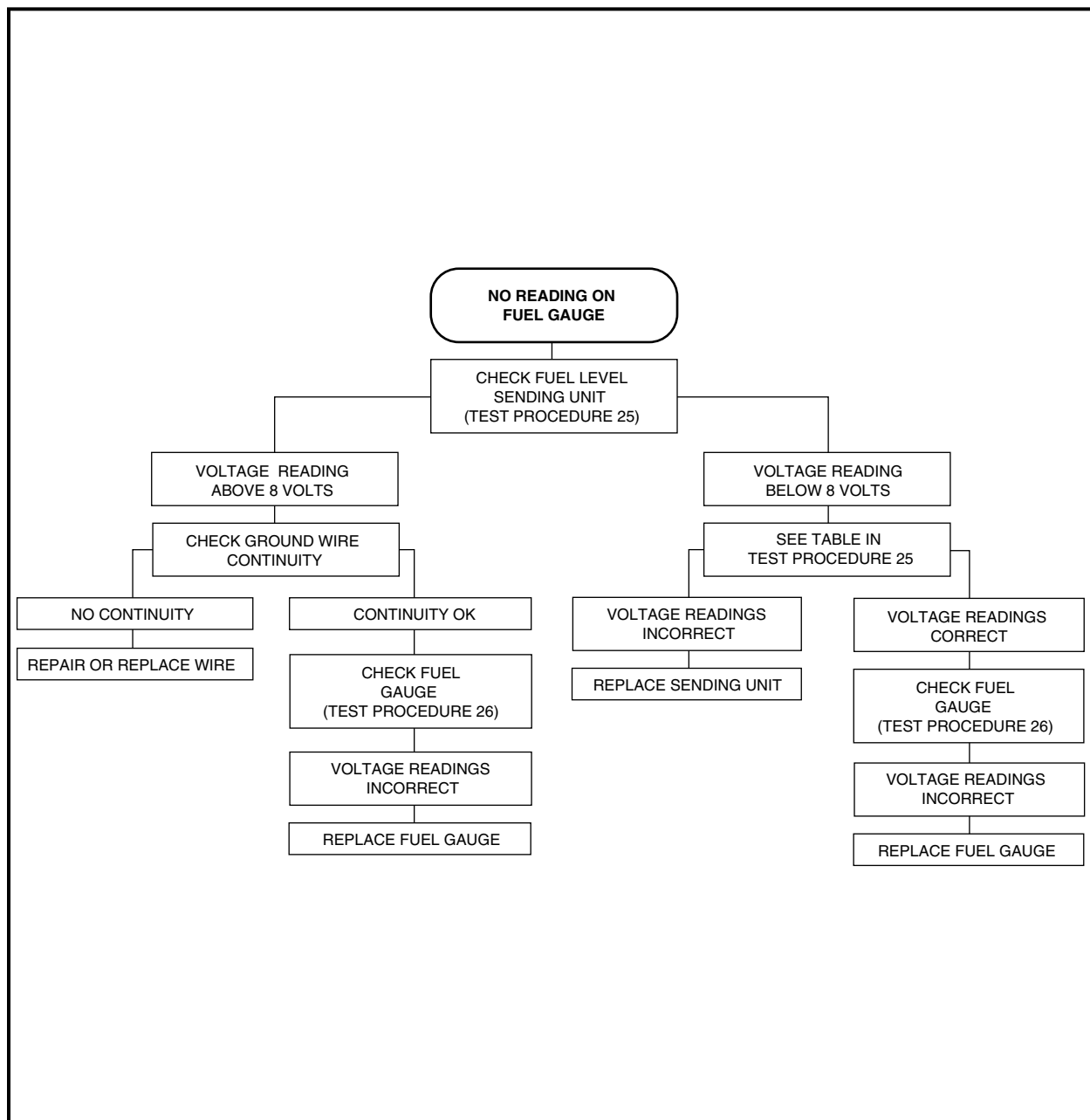


Figure 11a-21 Testing the Fuel Gauge and Sending Unit Circuit

TESTING THE LIGHTING CIRCUIT

Read **DANGER** and **WARNING** on page 11a-1.

Use this chart (**Figure 11a-22, Page 11a-21**) to begin troubleshooting the lighting circuit.

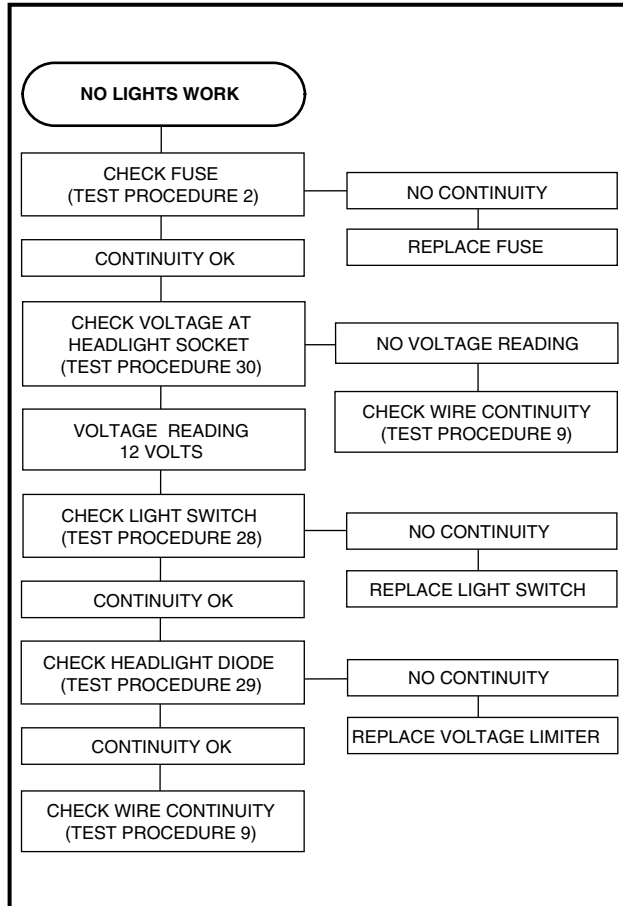


Figure 11a-22 Testing the Lighting Circuit

TEST PROCEDURES

INDEX OF TEST PROCEDURES

1. Battery
2. Fuse
3. Ground Cables
4. Key Switch (Starter Circuit)
5. Key Switch (Accessory Terminal)
6. Solenoid
7. Lockout Cam Limit Switch
8. Starter/Generator (Starter Function)

Index of Test Procedures, Continued:

9. Wire Continuity
10. Diode (Generator Circuit)
11. Starter/Generator (Generator Function)
12. Voltage Regulator
13. Disconnected Kill Wire
14. Ignition Spark
15. RPM Limiter
16. Ignition Coil
17. Key Switch (Engine Kill Circuit)
18. Engine Kill Wire
19. Reverse Buzzer Limit Switch
20. Reverse Buzzer
21. Oil Level Sensor
22. Oil Warning Light
23. Lockout Cam
24. Battery Test (Under Load)
25. Fuel Level Sending Unit
26. Fuel Gauge
27. Hour Meter
28. Light Switch
29. Headlight Diode
30. Voltage at Headlight Socket

TEST PROCEDURE 1 – BATTERY

Read **DANGER** and **WARNING** on page 11a-1.

 DANGER

- Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.
- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.**
- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

NOTE: The battery must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in Section 12a of this manual. **See Battery, Section 12a, Page 12a-33.**

1. Place the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten, and replace connections as necessary.

Hydrometer Test

A hydrometer (CCI P/N 1011478) measures the specific gravity. The higher the specific gravity, the higher the state of charge of the battery. A fully charged battery should read between 1.250 and 1.280 at 80 °F (27 °C). Never add acid to the battery to obtain a higher specific gravity (**Figure 11a-23, Page 11a-23**).

⚠ CAUTION

- Do not allow battery acid from battery caps or hydrometer to drip onto the body. Battery acid will cause permanent damage. Wash off immediately.

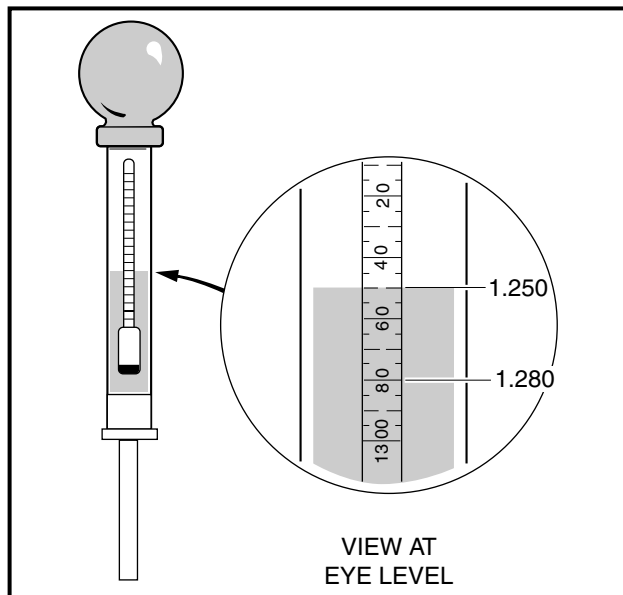


Figure 11a-23 Hydrometer Test

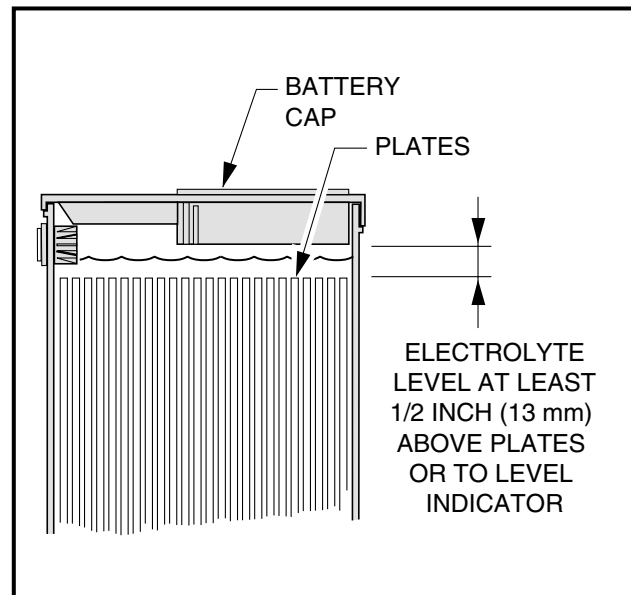


Figure 11a-24 Battery Electrolyte Level

Performing the Hydrometer Test

1. Be sure that the battery has sufficient water to cover the plates by approximately 1/2-inch (13 mm) and is fully charged prior to beginning the test. If water must be added, recharge the battery before performing the hydrometer test (**Figure 11a-24, Page 11a-23**).
2. Remove the vent cap.
3. Using a battery thermometer (CCI P/N 1011767), record the electrolyte temperature of a center cell.
4. Squeeze the rubber bulb of the hydrometer and insert into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
5. When the float rises off the bottom, adjust the electrolyte level so that the float rides free of the bottom but does not strike the bottom of the rubber bulb. Remove the hydrometer from the cell and release the pressure from the bulb.
6. Hold the hydrometer vertically, ensuring that the float is not contacting the sides of the glass tube. Hold the hydrometer at eye level and read the scale at the level of electrolyte (**Figure 11a-23, Page 11a-23**).
7. Record the reading.
8. Return the electrolyte to the cell from which it was taken. Replace vent cap.
9. Repeat steps 2 through 8 on all cells.

Hydrometer Calibration

Most hydrometers are calibrated to read correctly at 80 °F (27 °C). The readings obtained as described above must be corrected for temperature. For each 10 °F (5.6 °C) above 80 °F (27 °C), add 0.004 to the reading. For each 10 °F (5.6 °C) below 80 °F (27 °C), subtract 0.004 from the reading.

Interpreting the Results of the Hydrometer Test

The approximate state of charge can be determined by referring to the following table:

SPECIFIC GRAVITY (TEMPERATURE CORRECTED)	APPROXIMATE STATE OF CHARGE
1.250-1.280	100%
1.220-1.240	75%
1.190-1.210	50%
1.160-1.180	25%

If the difference between the cells is 0.020 or more, the low cell should be suspected. It may require a catch-up charge or it may be a weak cell. When the variations between cells reach 0.050 or more, the battery should be replaced.

Voltage Test

- Place the red (+) probe of a multimeter set at Volts DC, 20 volt range, on the positive (+) cable and place the black (-) probe on the negative (-) post of the battery and take a voltage reading. If it shows less than 12.4 volts, or if the lowest specific gravity reading from the hydrometer test is less than 1.225, recharge the battery. If battery voltage is greater than 12.4 volts and specific gravity is greater than 1.225, the problem is not with the battery. If the battery does not reach 12.4 volts, or if the specific gravity of a cell is still less than 1.225 after charging, replace the battery. **See following NOTE.**

NOTE: A fully charged battery that is in good condition should have a specific gravity of at least 1.225 in all cells, and the difference in the specific gravity of any two cells should be less than 50 points. Open circuit voltage should be at least 12.4 volts.

Load Test

- Using a 160 ampere load tester, connect the load tester to the battery posts.
- Turn the switch on the load tester to the ON position.
- Read the battery voltage after the load tester has been turned ON for 15 seconds. Compare the battery's voltage reading with the table below. Make sure you have the correct ambient temperature.

IF TEMPERATURE IS	MINIMUM CRANKING VOLTAGE
70 °F (20 °C and above)	9.6 V
60 °F (16 °C)	9.5 V
50 °F (10 °C)	9.4 V
40 °F (4 °C)	9.3 V
30 °F (-1 °C)	9.1 V

IF TEMPERATURE IS	MINIMUM CRANKING VOLTAGE
20 °F (-7 °C)	8.9 V
10 °F (-12 °C)	8.7 V
0 °F (-18 °C)	8.5 V

4. If the battery is found to be good, or if the electrical problem continues after the battery has been replaced with a good one, test the electrical circuits.

TEST PROCEDURE 2 – FUSE

Read DANGER and WARNING on page 11a-1.

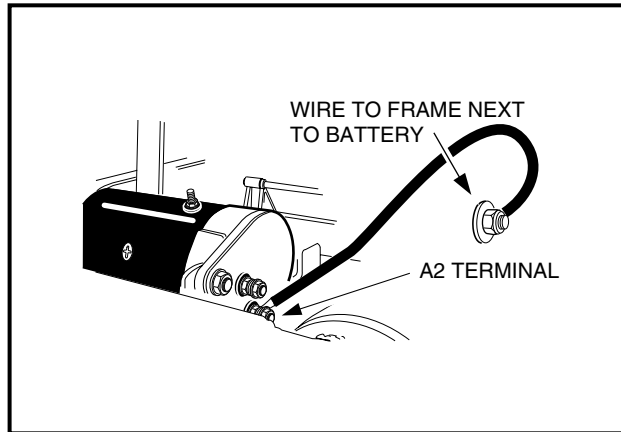
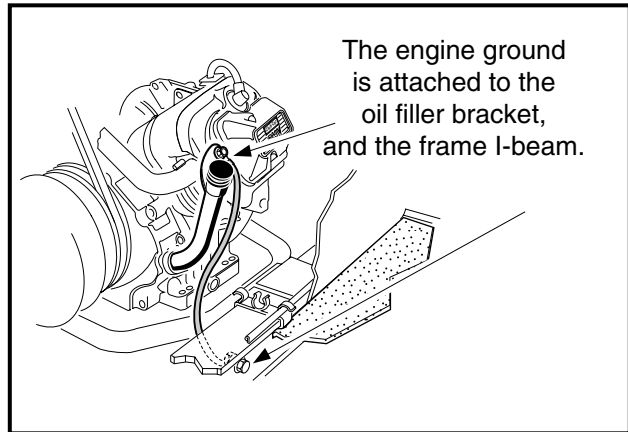
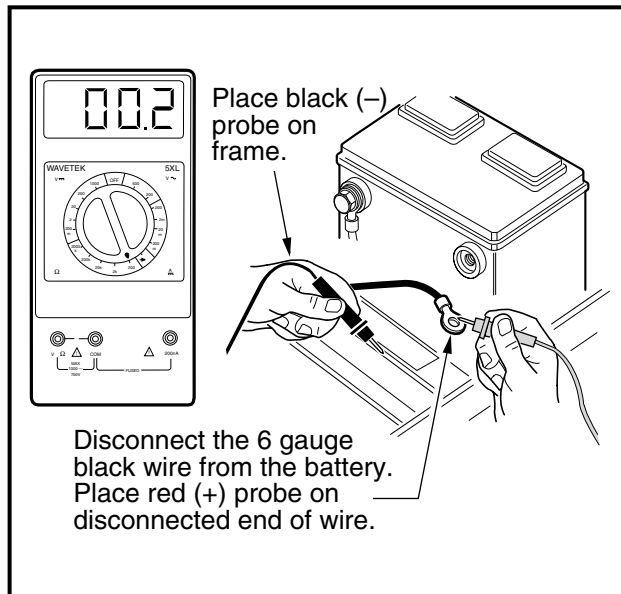
The fuse (red 10 amp) is located in the electrical component box.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels, and disconnect the battery cables, negative (–) cable first.
2. Remove the cover on the electrical component box.
3. Check that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Remove fuse to be tested from the fuse block. **See Fuse Removal, Section 12a, Page 12a-18.** The red 10 amp fuse protects the solenoid for the starter (cranking) circuit. The 20 amp fuse at the yellow wire connection protects the headlights.
5. Connect the probes of a multimeter set to 200 Ω (ohms) to the fuse terminals. The reading should be continuity. If there is no continuity, determine and repair the cause of the fuse failure. Replace the fuse with a properly rated new one.

TEST PROCEDURE 3 – GROUND CABLES

Read DANGER and WARNING on page 11a-1.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Check the starter/generator ground strap.
 - 2.1. Set the multimeter to 200 Ω (ohms). Place the red (+) probe on the (A2) terminal of the starter/generator and place the black (–) probe on the vehicle frame (**Figure 11a-25, Page 11a-26**). The reading should be continuity. If the reading is incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.
3. Check the engine ground strap.
 - 3.1. Place the red (+) probe of the multimeter on the ground strap terminal end located on the oil filler bracket on the engine (**Figure 11a-26, Page 11a-26**). Place the black (–) probe on the vehicle frame. The reading should be continuity. If the reading is incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.

Test Procedure 3 – Ground Cables, Continued:**Figure 11a-25 Test Starter/Generator Ground Strap****Figure 11a-26 Test Engine Ground Strap****Figure 11a-27 Battery Ground Cable Test**

4. Check voltage regulator ground connection (at battery frame ground). Make sure it is clean and tight.
5. Check the battery ground cable.
 - 5.1. A 6-gauge black wire connects the negative battery post to the frame. The frame connection should be clean and tight. Visual inspection of the connection on the frame is very difficult. The best check for tightness is to pull on the black wire. If the wire moves at the connection end, disassemble the frame connection and clean the bolt, ring terminal, and nut. Reinstall the frame connection.
 - 5.2. Set the multimeter to 200 Ω (ohms). Place the red (+) probe on the unconnected end of the 6-gauge black wire, and place the black (-) probe on the vehicle frame (**Figure 11a-27, Page 11a-26**). The reading should be continuity. If the reading is incorrect, check that terminal connections are clean and tight. If the connections are good and the reading is incorrect, repair or replace the wire.

TEST PROCEDURE 4 – KEY SWITCH (STARTER CIRCUIT)

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse shifter handle in NEUTRAL. Chock the wheels and disconnect the battery, negative (–) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12a, Page 12a-16.**
3. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.
4. Insert the key and turn the key to ON. Place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch. The reading should be continuity. If the reading is incorrect, replace the key switch (**Figure 11a-28, Page 11a-27**). **See Key Switch Removal, Section 12a, Page 12a-16.**
5. With the key still in the ON position, place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (S) terminal of the key switch. The reading should show no continuity. If the reading is incorrect, replace the key switch. **See Key Switch Removal, Section 12a, Page 12a-16.** If the reading is correct, leave the probes connected and proceed to the next step.
6. Insert the key and hold the key in the START position. The reading should be continuity. If the reading is incorrect, replace the key switch (**Figure 11a-29, Page 11a-27**). With the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch, the reading should be continuity. If either reading is incorrect, replace the key switch. **See Key Switch Removal, Section 12a, Page 12a-16.**

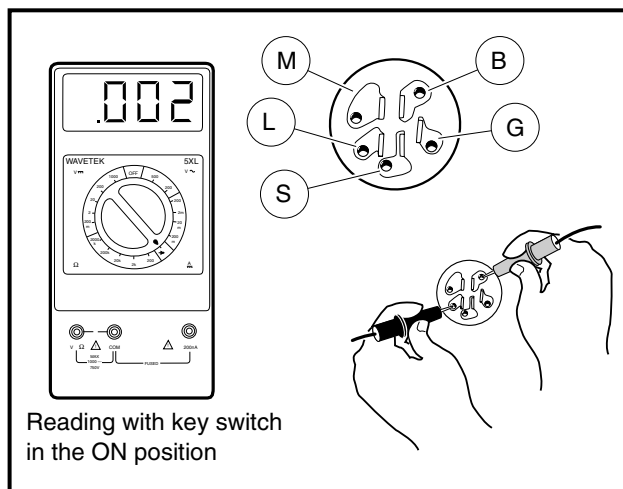


Figure 11a-28 Key Switch Test – Accessory Terminal

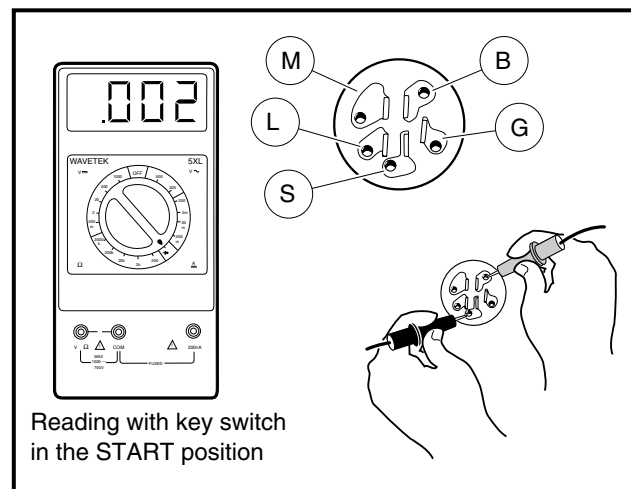


Figure 11a-29 Key Switch Test – Starter Circuit

TEST PROCEDURE 5 – KEY SWITCH (ACCESSORY TERMINAL)

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and disconnect the battery cables, negative (–) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12a, Page 12a-16.**
3. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.

Test Procedure 5 – Key Switch (Accessory Terminal), Continued:

4. Insert the key and turn the switch to the ON position. With the multimeter set to 200 Ω (ohms), place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch (**Figure 11a-28, Page 11a-27**). The reading should be continuity. If the reading is incorrect, replace the key switch. See **Key Switch Removal, Section 12a, Page 12a-16**.

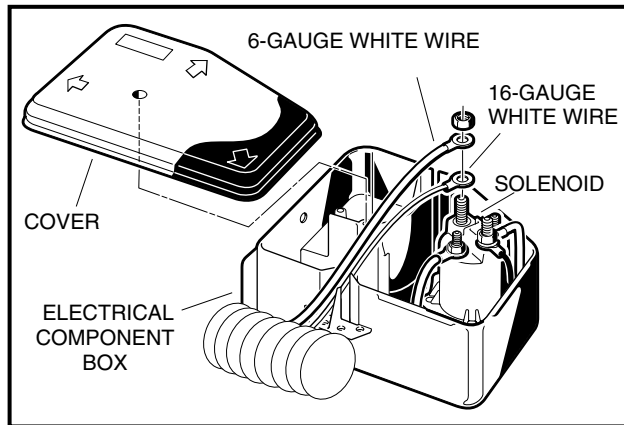


Figure 11a-30 Remove Solenoid Wires

TEST PROCEDURE 6 – SOLENOID**Read DANGER and WARNING on page 11a-1.**

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect battery cables, negative (–) cable first.
2. Remove the electrical component box cover.
3. Check that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Set a multimeter to 200 Ω (ohms). Place the red (+) probe on one of the small posts of the solenoid and place the black (–) probe on the other small post. The reading should be 14 to 16 Ω (ohms). If the reading is not within limits, replace the solenoid.
5. Remove the 6 and 12-gauge white wires, and the 18-gauge red wire, from the large post of the solenoid. Do not allow the wires to touch the frame or other components of the vehicle (**Figure 11a-30, Page 11a-28**).
6. Set the multimeter to 200 Ω (ohms). Connect the red (+) probe to one of the large posts of the solenoid and connect the black (–) probe to the other large post (**Figure 11a-31, Page 11a-29**).
7. With the key switch in the OFF position, connect the battery, positive (+) cable first.
8. Place the Forward/Reverse handle in NEUTRAL. With the key in the OFF position, the reading on the multimeter should be no continuity. Turn the key switch to the START position and listen for the solenoid click. While holding the key in the START position, there should be continuity. After the key is released, it should rotate to the ON position and should be no continuity. If either reading is incorrect, replace the solenoid.
9. With the Forward/Reverse handle still in NEUTRAL, set the multimeter to 20 volts DC and place the red (+) probe on the large post that does *not* have wires connected to it. Place the black (–) probe on the vehicle frame. Turn key switch to the START position and listen for the solenoid click. While holding the key in the START position, the meter should read full battery voltage. If the reading is incorrect, replace the solenoid (**Figure 11a-32, Page 11a-29**).

10. Disconnect the 6-gauge black wire from the negative post of the battery before reconnecting the wires to the solenoid.
11. Reconnect the solenoid. **See Fuse Installation, Section 12a, Page 12a-20. See also following WARNING.**

⚠ WARNING

- **Incorrect wiring could result in severe injury or death.**
- **Diode and solenoid connections must have correct polarity.**
- **Keep all persons clear of engine belts when making final connections.**

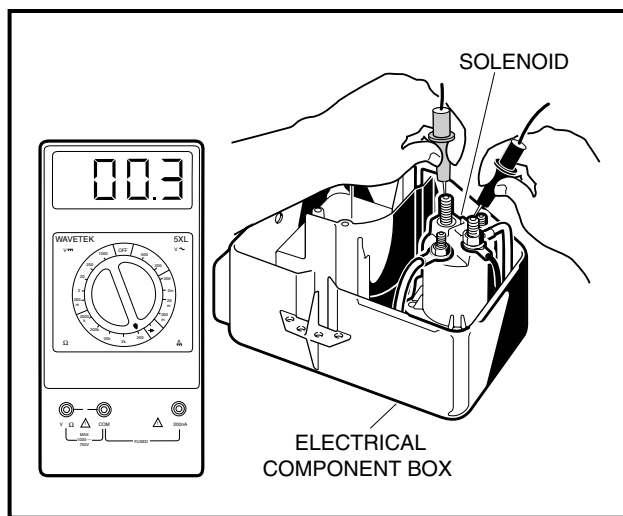


Figure 11a-31 Test Solenoid Continuity

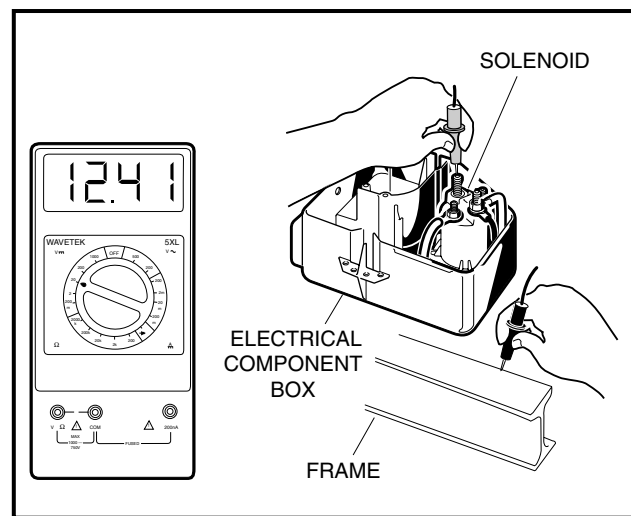


Figure 11a-32 Test Solenoid Ground

TEST PROCEDURE 7 – LOCKOUT CAM LIMIT SWITCH

Read **DANGER** and **WARNING** on page 11a-1.

This switch is located on the Forward/Reverse switch assembly. A black wire and a green wire are connected to this limit switch.

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Check for proper wiring and tight connections.
3. Set the multimeter to 200 Ω (ohms). Place the red (+) probe of the multimeter on the common (COM) terminal of the limit switch. Place the black (–) probe on the normally open (NO) terminal of the switch. Without the lever depressed, the reading should be no continuity. Depress the lever, and the reading should be continuity. If either reading is incorrect, replace the limit switch (**Figure 11a-33, Page 11a-30**).
4. Check to be sure the lobes on the cam are depressing the lockout cam limit switch when the Forward/Reverse shifter is in the NEUTRAL position only. The limit switch should make an audible click as it is depressed. If it does not, check for wear on the cam lobe. If the cam lobe will not activate the limit switch, replace the cam.

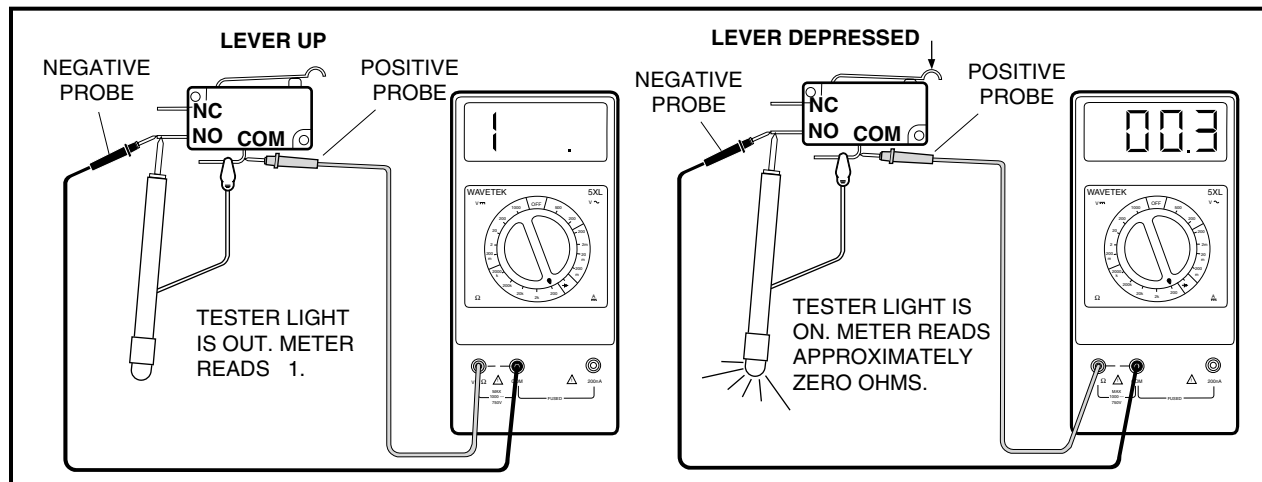


Figure 11a-33 Test Lockout Cam Limit Switch

TEST PROCEDURE 8 – STARTER/GENERATOR (STARTER FUNCTION)

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Engine rotation (clockwise) is as viewed from the clutch side of the engine.

1. Turn the key switch OFF, place the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Check that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Disconnect the wires from all the terminals on the starter/generator. Then place the black (–) probe of a multimeter, set to Ω (ohms), on the starter/generator housing (scratch through the finish to ensure a good ground). While holding the black probe against the housing, place the red (+) probe (one at a time) on the A1, A2, F1, F2 and DF terminals respectively (**Figure 11a-34, Page 11a-31**). The readings should be no continuity. If the readings are incorrect, the starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 12a, Page 12a-3.**
 - An incorrect reading from the A1 or A2 terminal indicates three possible problems: 1) a grounded A1 or A2 terminal, 2) a grounded wire in the brush area, or 3) a grounded armature/commutator.
 - If the F1 or F2 reading is incorrect, it indicates a possible grounded F1 or F2 terminal or a grounded field coil.
 - If the DF reading is incorrect, it indicates a possible grounded DF terminal or a grounded field coil.
4. Disconnect the ground wire from the A2 terminal and the green wire from the A1 terminal on the starter/generator.
5. Using a multimeter set to 200 Ω (ohms), place the red (+) probe on the A1 terminal and the black (–) probe on the A2 terminal. The reading should be continuity. If the reading is incorrect, a possible open or poor contact in a brush assembly and/or open armature windings may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 12a, Page 12a-3.**
6. With the wires still disconnected, using a multimeter set on 200 Ω (ohms), place the red (+) probe on the F1 terminal and the black (–) probe on the F2 terminal. The reading should be between approximately 0.1 and 0.3 Ω (ohms). If the reading is incorrect, a possible open field coil or bad connections at terminals may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 12a, Page 12a-3.**

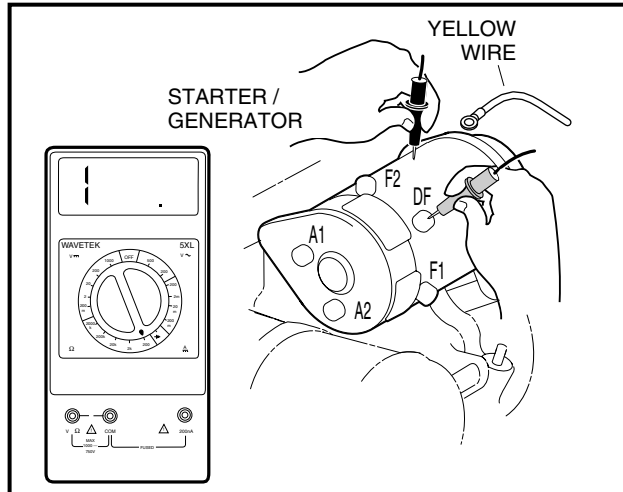


Figure 11a-34 Check Starter Terminal Continuity

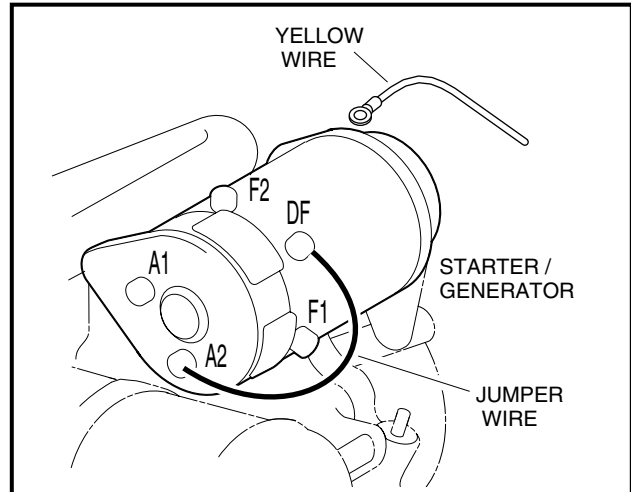


Figure 11a-35 Jumper Wire Ground – DF to A2

7. With the wires still disconnected, using a multimeter set to 200 Ω (ohms), place the red (+) probe on the DF terminal and the black (-) probe on the F1 terminal. The reading should be between 4.5 and 5.5 Ω (ohms). If the reading is incorrect, a possible grounded DF terminal and/or grounded field coil may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 12a, Page 12a-3.**

TEST PROCEDURE 9 – WIRE CONTINUITY

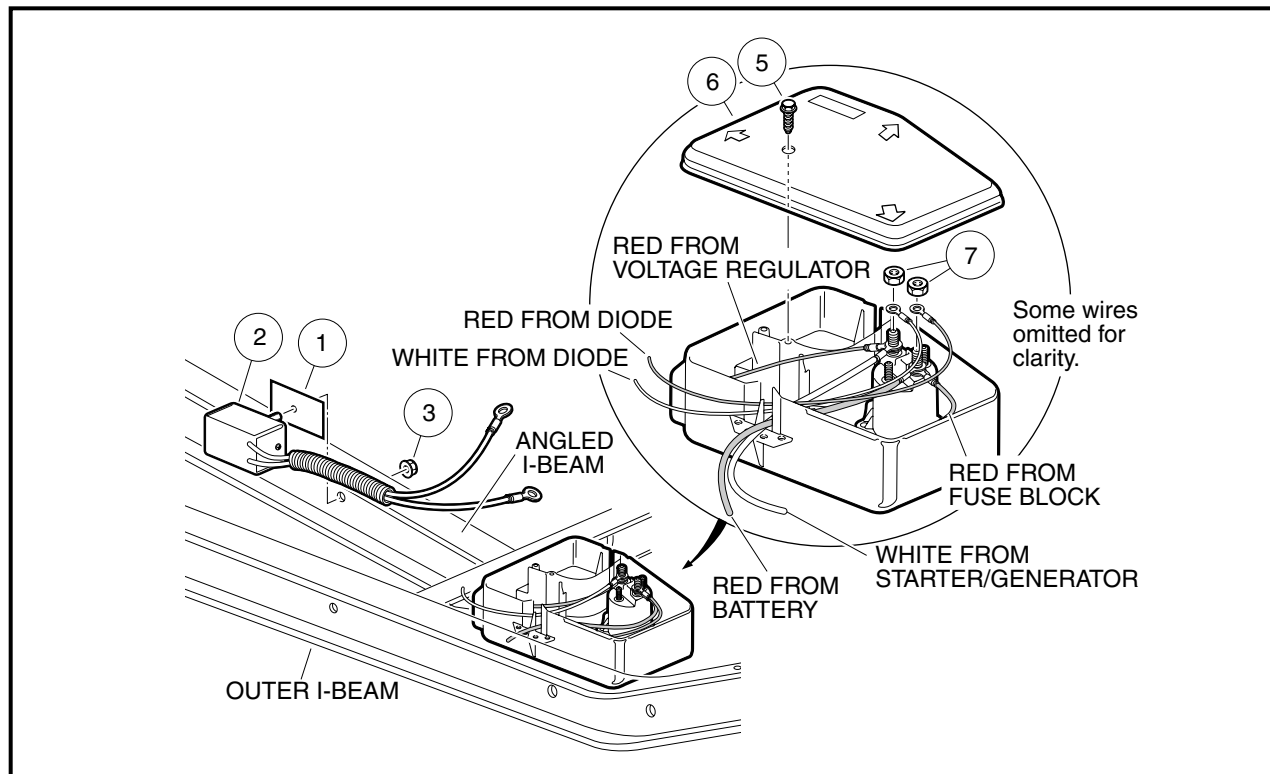
Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. To test a wire for continuity, disconnect either end from the electrical component it is attached to.
3. Set the multimeter to 200 Ω (ohms) and place the red (+) probe on the terminal at one end of the wire. Place the black (-) probe on the other terminal end of the wire. The reading should be continuity. If the reading is incorrect, repair or replace the wire.

TEST PROCEDURE 10 – DIODE (GENERATOR CIRCUIT)

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and disconnect the battery cables, negative (-) cable first.
2. Disconnect the red and white wires of the diode assembly from the solenoid posts, located within the electrical component box.
 - 2.1. Remove the intake hose to the carburetor at the carburetor intake port and move the hose to allow easy access to the electrical component box cover.
 - 2.2. Remove the cover retaining screw (5) and electrical component box cover (6) (**Figure 11a-36, Page 11a-32**).
 - 2.3. Remove the lock nuts (7) from the two large solenoid posts and disconnect the diode wires from the solenoid.

Test Procedure 10 – Diode (Generator Circuit), Continued:**Figure 11a-36 Electrical Control Box and Diode Orientation**

3. With the multimeter set to the diode test function (\rightarrow), connect the black (–) probe of the multimeter to the white lead of the diode and the red (+) probe of the multimeter to the red lead of the diode (**Figure 11a-37, Page 11a-33**). The reading should indicate an overload (no continuity). A diode is designed to conduct current in one direction only. If a diode conducts current (shows continuity) with the meter probes as described, the diode has failed and must be replaced. **See Large Style Diode Removal, Section 12a, Page 12a-14.**
4. Reverse the multimeter probes and note the reading. With the black (–) probe of the multimeter to the red lead of the diode and the red (+) probe of the multimeter to the white lead, the meter should read approximately 450 mV, however, a range of 400-500 mV is acceptable (**Figure 11a-38, Page 11a-33**).
5. Connect either the black (–) or red (+) lead of the multimeter to the diode body (case). Connect the other multimeter lead to both the red and white lead terminals of the diode. The multimeter should indicate an overload, (no continuity). If continuity reading does occur, it indicates that one or both of the diode leads are grounded to the diode body (case) and the diode must be replaced. **See Large Style Diode Removal, Section 12a, Page 12a-14.**
6. If the diode tests good, reconnect the diode leads. **See Large Style Diode Installation, Section 12a, Page 12a-16. See also following WARNING.**

⚠ WARNING

- Incorrect wiring could result in severe injury or death.
- Diode and solenoid connections must have correct polarity.
- Keep all persons clear of engine belts when making final connections.

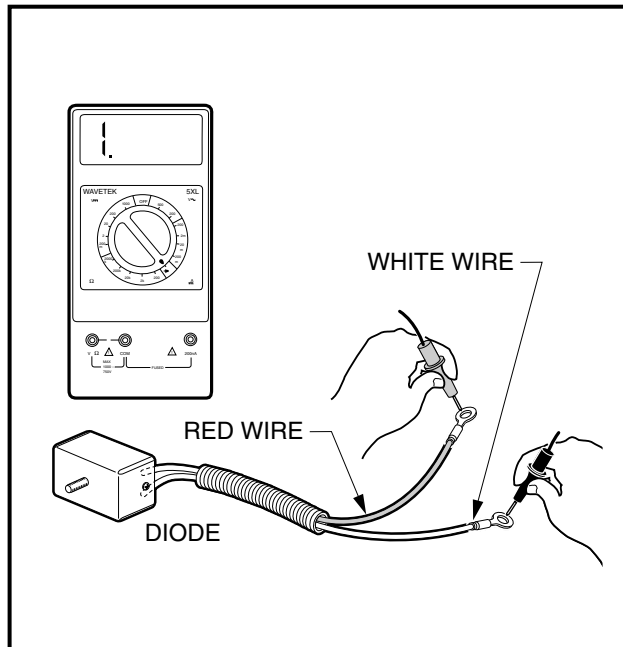


Figure 11a-37 Diode Test

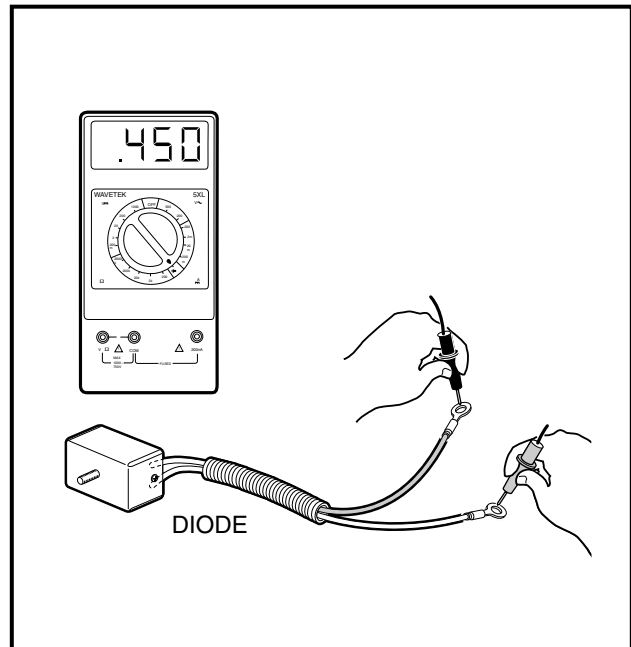


Figure 11a-38 Diode Test – Probes Reversed

TEST PROCEDURE 11 – STARTER/GENERATOR (GENERATOR FUNCTION)

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Perform Test Procedure 10 before proceeding with this test procedure.

Keep the battery connected while performing this test procedure.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Disconnect the yellow wire from the DF terminal on the starter/generator. Cover the connector on the yellow wire to make sure the yellow wire will not short to ground. Then, using a jumper wire, ground the DF terminal to the A2 terminal (**Figure 11a-35, Page 11a-31**).
4. Using a multimeter set to 20 volts DC, place the red (+) probe on the positive (+) cable of the battery, and place the black (–) probe on the negative (–) post. Start the engine and run it at full governed speed. The reading should show the voltage rising on the meter. If the voltage rises, see Test Procedure 12 – Voltage Regulator on page 11a-33. If the voltage does not rise, and the diode was found to be functioning properly in Test Procedure 10, a tear-down inspection of the starter/generator will be necessary. **See Starter/Generator Removal, Section 12a, Page 12a-3.**
5. Reconnect the yellow wire to the DF terminal on the starter/generator.

TEST PROCEDURE 12 – VOLTAGE REGULATOR

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Perform Test Procedures 10 and 11 before proceeding with this test procedure.

Keep the battery connected while performing this test procedure.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.

Test Procedure 12 – Voltage Regulator, Continued:

3. Check the engine RPM setting to ensure that it is adjusted correctly. **See Engine RPM Adjustment, Section 14, Page 14-14.**
4. With the battery in good condition and fully charged, run the engine for several minutes to bring the voltage regulator to operating temperature.
5. Turn the key switch to the OFF position, killing the engine. Using a multimeter set to 20 volts DC, place the red (+) probe on the large post of the solenoid with the red wire from the voltage regulator attached. Place the black (-) probe on the negative (-) battery post (**Figure 11a-39, Page 11a-34**). With the Forward/Reverse handle in the NEUTRAL position and the wheels chocked, turn the key switch to the START position to start the engine. Depress the accelerator to run the engine at full governed speed. If the reading is between 14.7 and 15.3 volts, the regulator is good. If the reading is lower than 14.7 volts but rising steadily, check battery condition. **See Hydrometer Test on page 11a-23.** If the reading is lower than 14.7 volts and not rising, and the starter/generator is good; or if the reading is over 15.3 volts and continues to rise, replace voltage regulator. **See Voltage Regulator Removal, Section 12a, Page 12a-13.**

TEST PROCEDURE 13 – DISCONNECTED KILL WIRE

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the engine-kill white/black wire at the bullet connector located next to the RPM limiter (**Figure 11a-41, Page 11a-35**).
3. With the wheels chocked, connect the 6-gauge red wire to the positive (+) post on the battery, then connect the 6-gauge black wire to the negative (-) post.

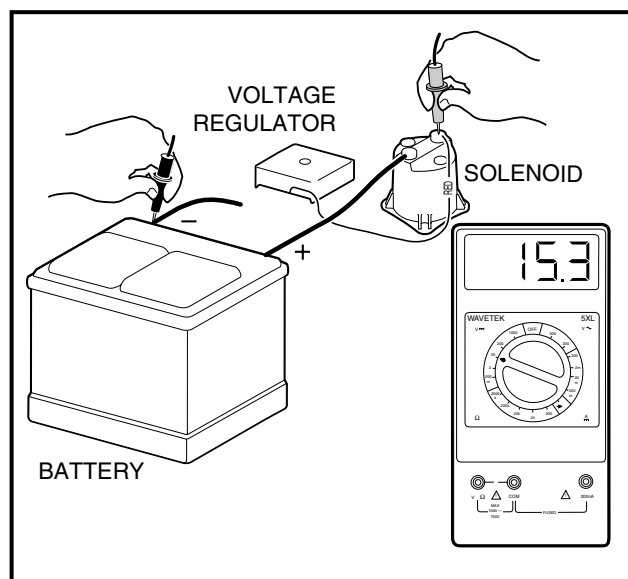


Figure 11a-39 Test Voltage Regulator

4. Turn the key switch all the way to the START position and release after the engine is running. The engine should idle.
5. If the engine begins to run, test the engine kill circuit for a shorted wire or other failed components in the engine kill circuit. **See Testing the Engine Kill Circuit on page 11a-17. See following WARNING.**

⚠ WARNING

- When the white/black engine kill wire is disconnected, the engine will not stop running after the key switch is turned to the OFF position. It will be necessary to pull and hold the choke handle until the engine stops running.

6. If the engine does not run, proceed to Test Procedure 14 – Ignition Spark on page 11a-35.

TEST PROCEDURE 14 – IGNITION SPARK

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove the plug wire from the spark plug. Using an ignition spark gap test tool (Thexton 404[®] or equivalent), check for correct spark (**Figure 11a-40, Page 11a-35**).

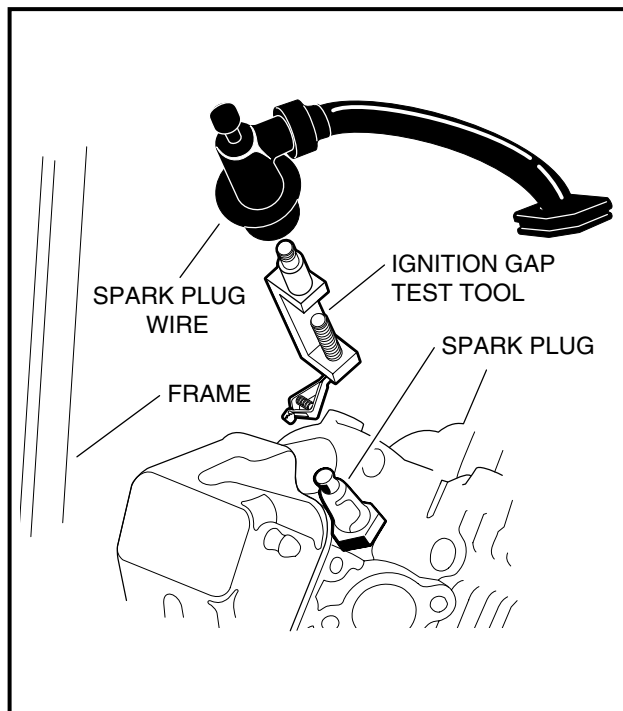


Figure 11a-40 Ignition Spark Test

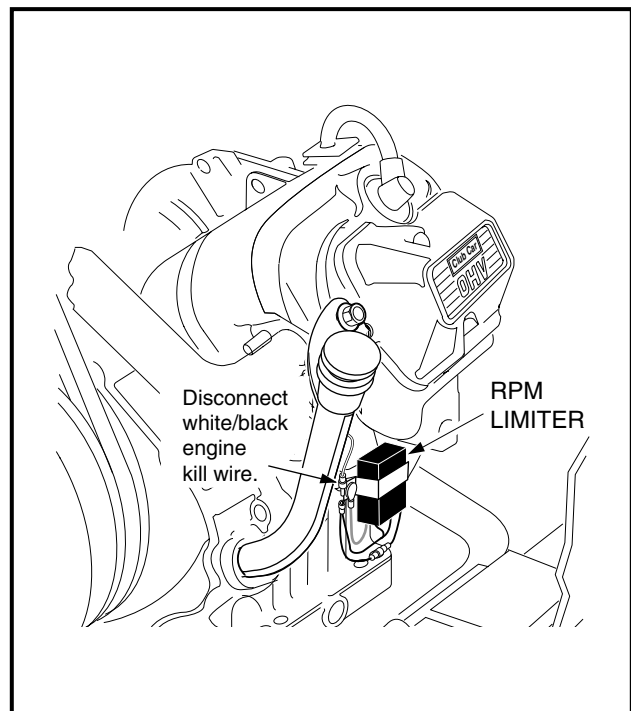


Figure 11a-41 Disconnect White/Black Engine Kill Wire

- 2.1. Adjust the tester probes to approximately to 18,000 volts (18 Kv) setting (SE – Small Engine Setting on the Thexton 404 tool). Connect the tester to the spark plug wire, and connect the alligator clip to a solid engine ground.
- 2.2. Start the engine. There should be a strong blue spark between the probes of the spark gap tester. If there is no spark, or if the spark is a faint yellow or red color, test components of the ignition circuit.
3. If the spark gap tester tool indicates a strong blue spark, it is possible the spark plug has failed internally. Check the spark plug gap. The gap should be set at 0.027 to 0.031 of an inch (.69 to .79 mm). If the gap is correct, replace the spark plug with a new part and test the engine for proper operation.

TEST PROCEDURE 15 – RPM LIMITER

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Disconnect both of the bullet terminals (**Figure 11a-42, Page 11a-36**).
3. Using a multimeter set to 200 Ω (ohms), place the red (+) probe on the brown ground wire and place the black (–) probe on one of the black wire female bullet connectors. The reading should be no continuity. If the reading is not correct, replace the RPM limiter.
4. This test will find most bad RPM limiters. Some of them may bench test okay but fail under a load due to heat while operating. Another method of testing is to replace the RPM limiter and then run the engine. If the engine runs properly, keep the new RPM limiter in the circuit.

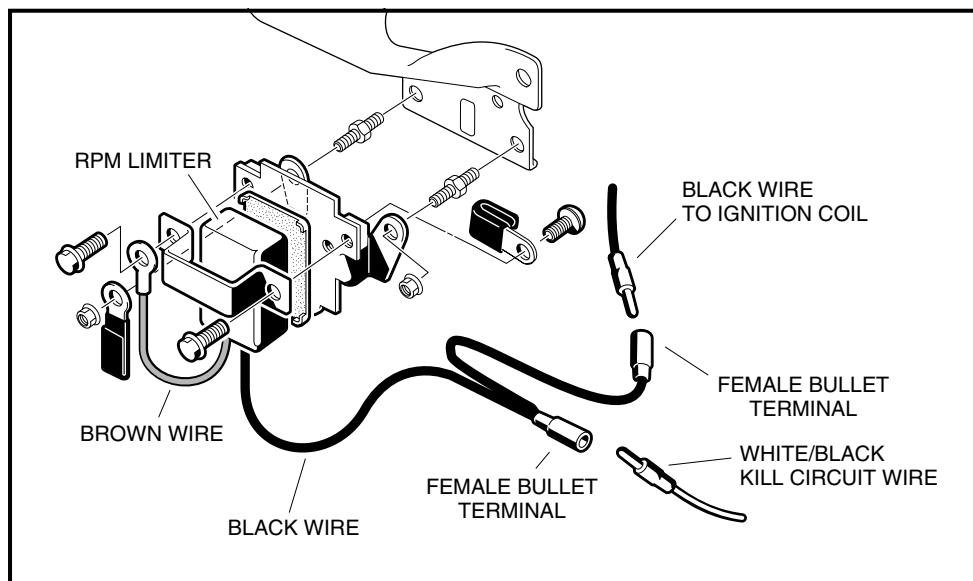


Figure 11a-42 RPM Limiter

TEST PROCEDURE 16 – IGNITION COIL

Read **DANGER** and **WARNING** on page 11a-1.

The following test procedures will properly detect a coil that has failed in most cases; however, in rare cases, some ignition coils can fail to operate at normal (warmer) operating temperatures. If the ignition coil has tested okay in the vehicle and on the bench, but fails to operate reliably, replace the coil with a known good-coil and operate the engine for several minutes to ensure that the coil functions at normal operating temperature. If the new coil functions properly, keep the new coil in the circuit.

Ignition Coil – In Vehicle Test

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and disconnect the battery, negative (–) cable first.
2. Using a multimeter set to 200 Ω (ohms), measure the primary coil resistance.
 - 2.1. Disconnect both of the bullet terminals at the RPM limiter (**Figure 11a-42, Page 11a-36**). Place the red (+) probe of the meter on the male bullet terminal of the wire connecting to the ignition coil under the fan housing, and place the black (–) probe on a clean unpainted surface of the engine or frame (**Figure 11a-43, Page 11a-37**).
 - 2.2. If the resistance is not between 0.6 - 1.7 Ω (ohms), bench test the ignition coil. **See Ignition Coil – Bench Test on page 11a-39.**

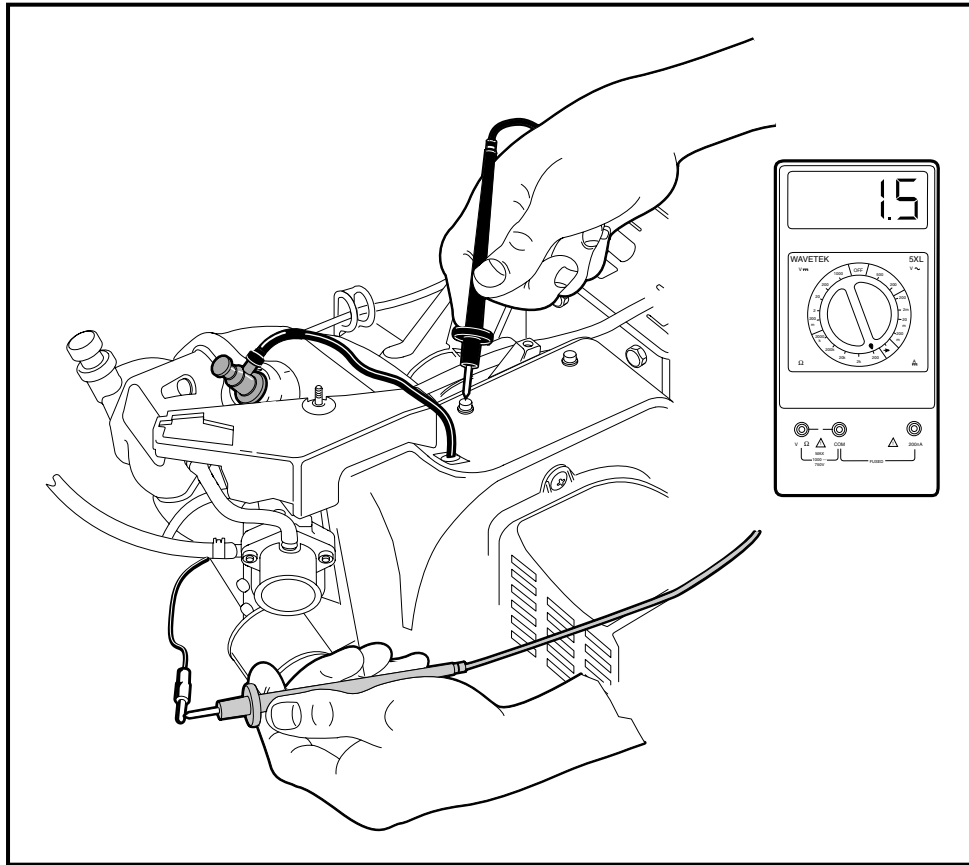


Figure 11a-43 Primary Coil Resistance – In Vehicle Test

3. Using a multimeter set to 20k Ω (ohms), measure the resistance of the secondary coil and spark plug cap together.
 - 3.1. Place the red (+) probe of the meter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe on a clean unpainted surface of the engine or frame (**Figure 11a-44, Page 11a-38**).
 - 3.2. If the resistance is between 12.0k - 14.0k Ω (ohms), the secondary coil and spark plug cap are within acceptable limits; proceed to step 6 on page 11a-39. If the resistance is not between 12.0k - 14.0k Ω (ohms), the spark plug cap and secondary coil must be tested independently from each other.
4. Test the spark plug cap separately from the secondary coil.
 - 4.1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire (3) (**Figure 11a-45, Page 11a-38**).
 - 4.2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire (**Figure 11a-46, Page 11a-38**).
 - 4.3. Using a multimeter set to 20k Ω (ohms), place the red (+) probe of the multimeter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe into the end of the cap with the internal screw (**Figure 11a-47, Page 11a-39**). If the resistance is not between 4.5k - 6.0k Ω (ohms), the cap has failed and must be replaced. Proceed to the next step with the spark plug cap still removed.

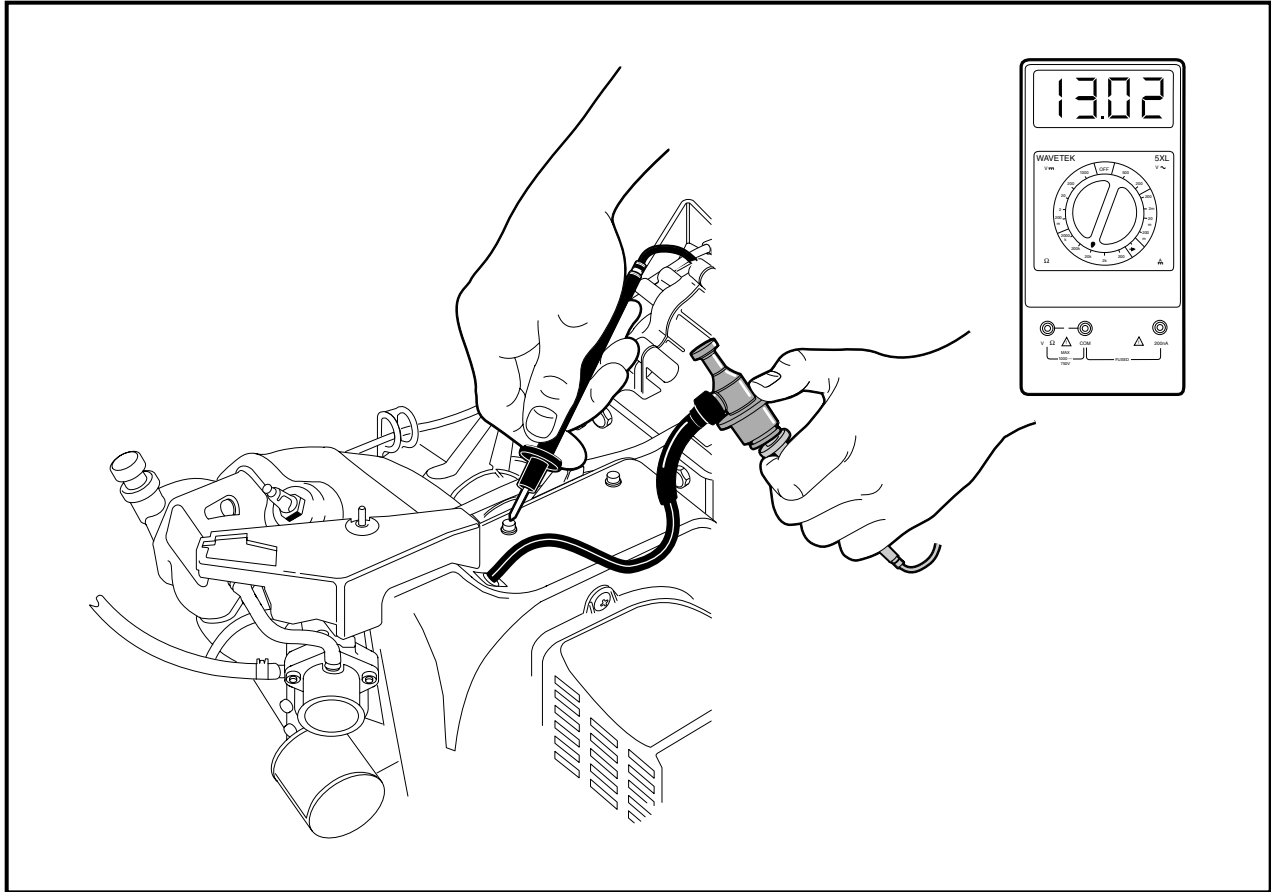


Figure 11a-44 Secondary Coil Test – In Vehicle Test

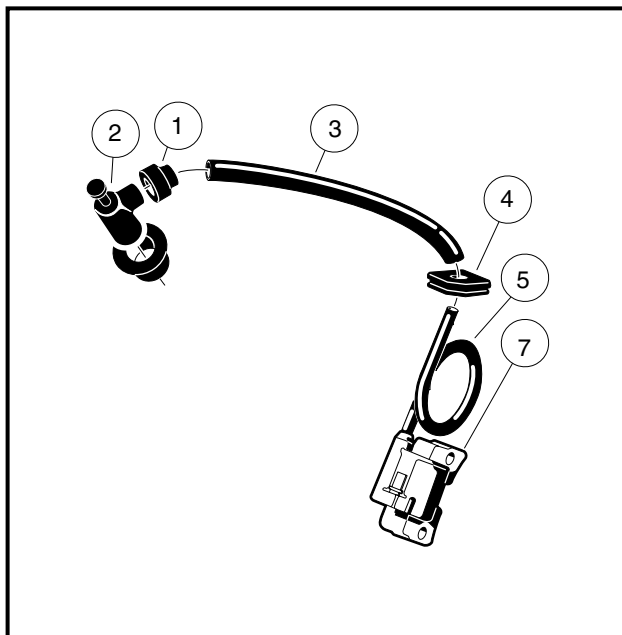


Figure 11a-45 Ignition Coil and Cap

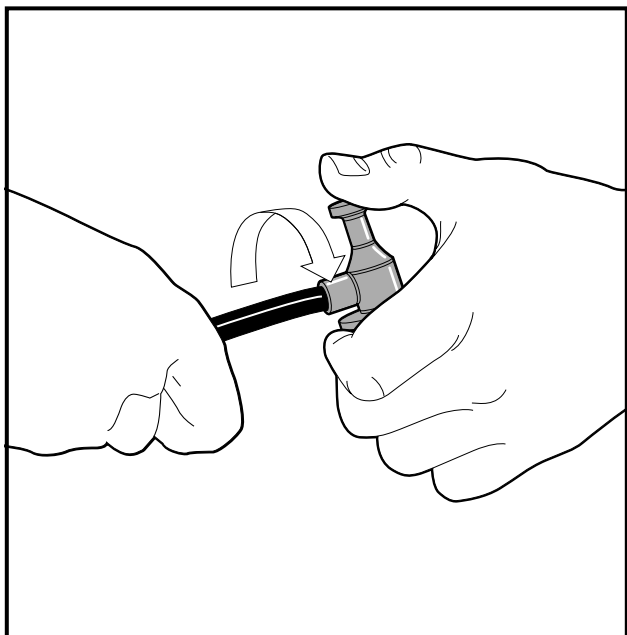


Figure 11a-46 Spark Plug Cap Removal

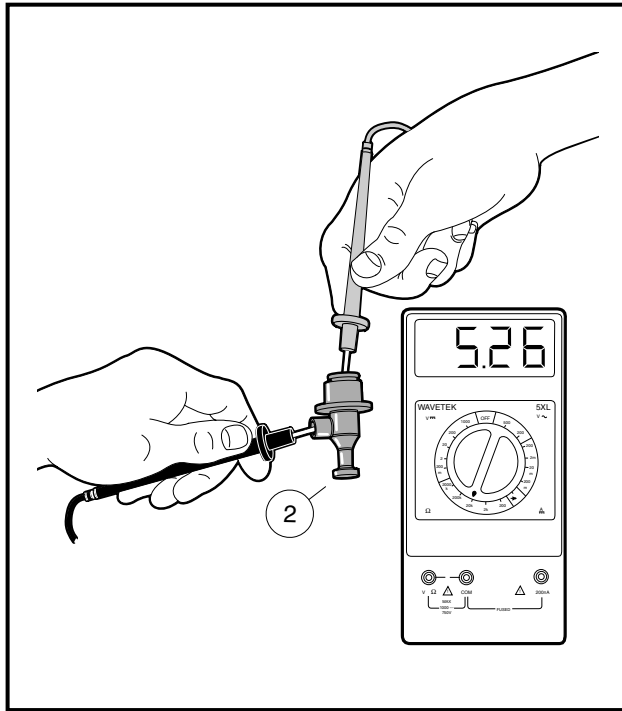


Figure 11a-47 Spark Plug Cap Test

5. Test the secondary coil separately from the spark plug cap.
 - 5.1. Using a multimeter set to 20k Ω (ohms), place the red (+) probe of the meter into the end of the spark plug wire and place the black (-) probe on a clean unpainted surface of the engine or frame (**Figure 11a-48, Page 11a-40**). If the resistance is between 6.0k - 11.0k Ω (ohms), the secondary coil is within acceptable limits. If the resistance is not between 6.0k - 11.0k Ω (ohms), bench test the ignition coil. **See Ignition Coil – Bench Test on page 11a-39.**
6. If the preceding procedures indicate that the ignition coil resistance readings are within acceptable ranges, but the coil fails to function properly, proceed to the following bench test procedures.

Ignition Coil – Bench Test

1. Remove the coil from the engine. **See Ignition Coil Removal, Section 12a, Page 12a-28.**
2. Using a multimeter set to 200 Ω (ohms), measure the primary coil resistance.
 - 2.1. Place the black (-) probe of the meter on the terminal on the ignition coil (1), and place the red (+) probe on the core (2) (**Figure 11a-49, Page 11a-40**).
 - 2.2. If the resistance is not between 0.6 - 1.7 Ω (ohms), replace the ignition coil.
3. Using a multimeter set to 20k Ω (ohms), measure the resistance of the secondary coil and spark plug cap together.
 - 3.1. Place the red (+) probe of the meter into the end of the spark plug cap that normally connects to the spark plug (3) and place the black (-) probe on the core (2) (**Figure 11a-50, Page 11a-40**).
 - 3.2. If the resistance is between 12.0k - 14.0k Ω (ohms), the secondary coil and spark plug cap are within acceptable limits; proceed to step 6 on page 11a-41. If the resistance is not between 12.0k - 14.0k Ω (ohms), the spark plug cap and secondary coil must be tested independently from each other.

Ignition Coil – Bench Test, Continued:

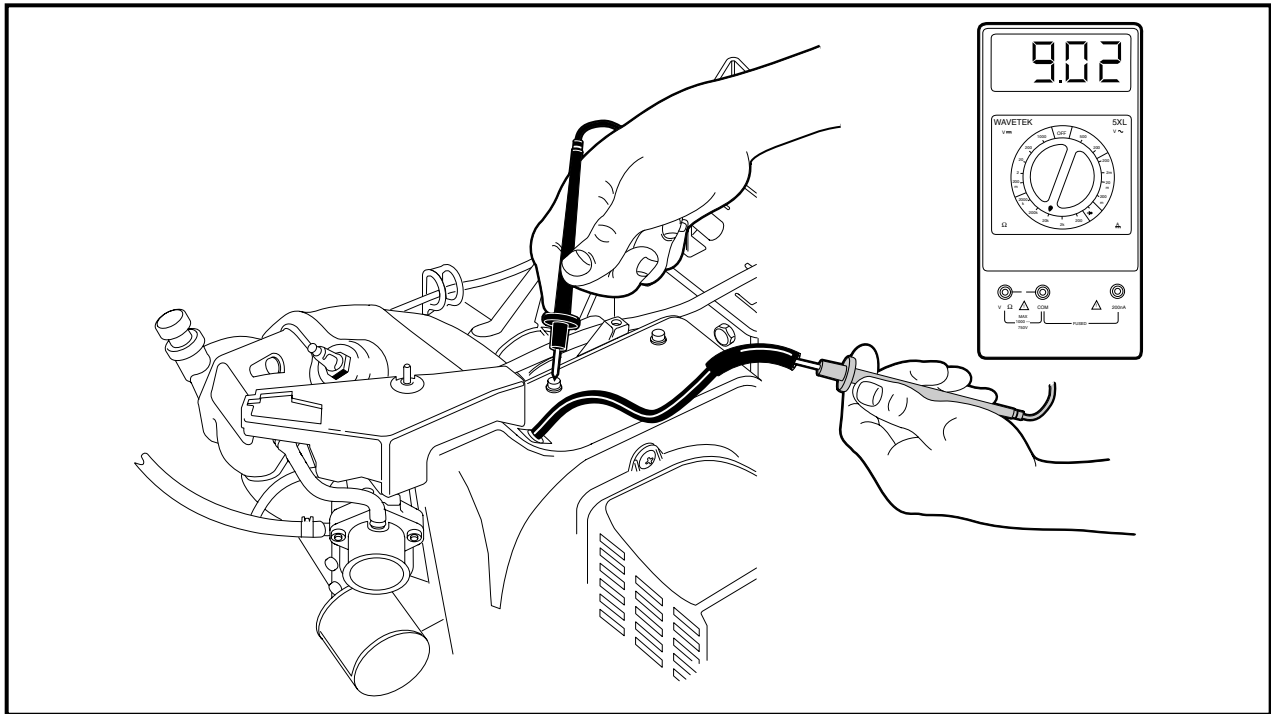


Figure 11a-48 Secondary Coil Test Without Cap

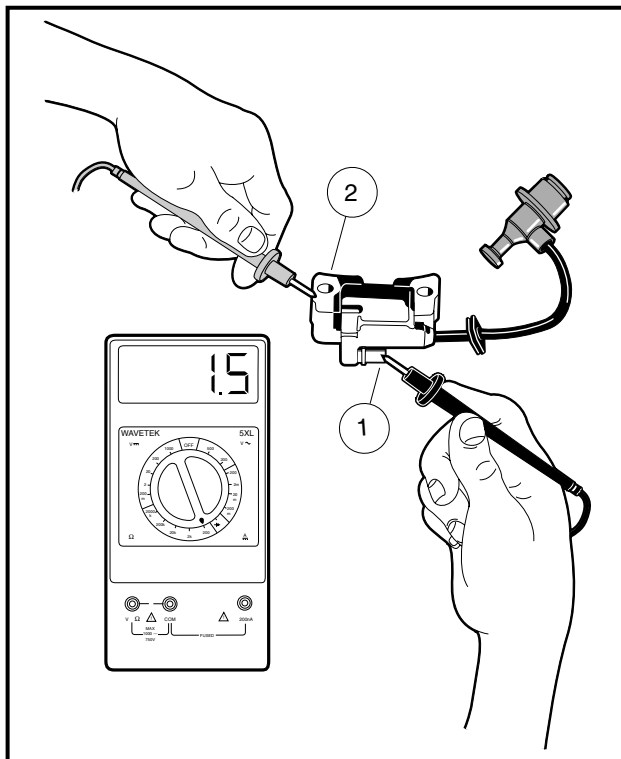


Figure 11a-49 Primary Coil Resistance – Bench Test

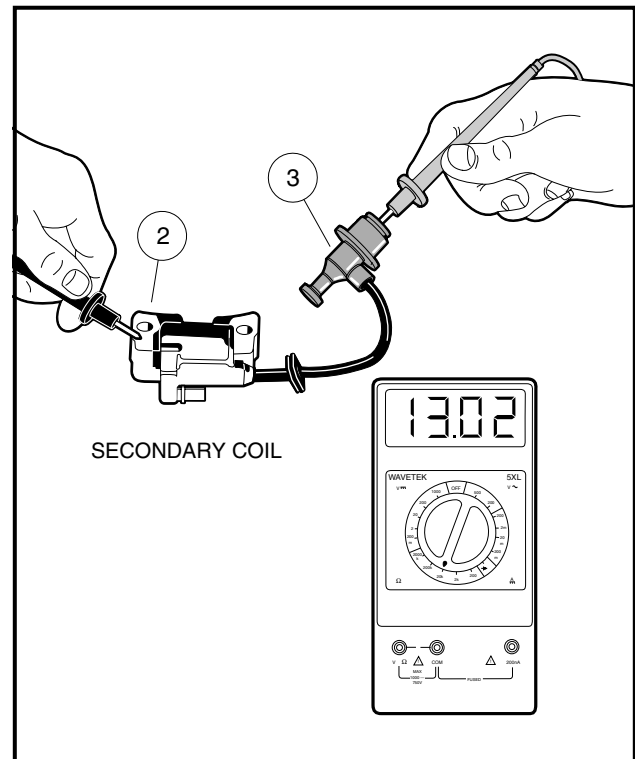


Figure 11a-50 Secondary Coil and Cap Resistance – Bench Test

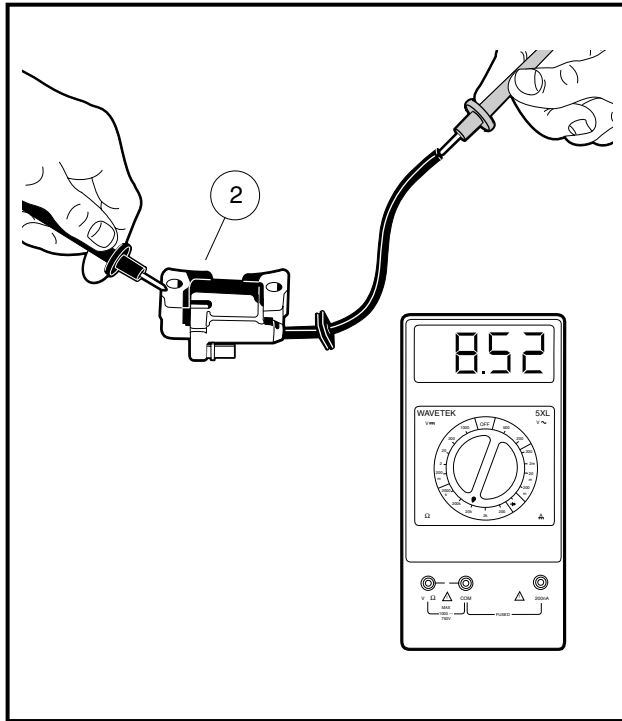


Figure 11a-51 Secondary Coil Resistance – Bench Test

4. If not previously tested, test the spark plug cap separately from the secondary coil.
 - 4.1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire (3) (**Figure 11a-45, Page 11a-38**).
 - 4.2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire (**Figure 11a-46, Page 11a-38**).
 - 4.3. Using a multimeter set to 20k Ω (ohms), place the red (+) probe of the multimeter into the end of the spark plug cap that normally connects to the spark plug and place the black (-) probe into the end of the cap with the internal screw (**Figure 11a-47, Page 11a-39**). If the resistance is not between 4.5k - 6.0k Ω (ohms), the cap has failed and must be replaced. Proceed to the next step with the spark plug cap still removed.
5. Test the secondary coil separately from the spark plug cap.
 - 5.1. Using a multimeter set to 20k Ω (ohms), place the red (+) probe of the meter into the end of the spark plug wire and place the black (-) probe on the core (2) (**Figure 11a-51, Page 11a-41**). If the resistance is between 6.0k - 11.0k Ω (ohms), the secondary coil is within acceptable limits. If the resistance is not between 6.0k - 11.0k Ω (ohms), the ignition coil has failed and must be replaced.
6. If the preceding procedures indicate that the ignition coil resistance readings are within acceptable ranges, but the coil fails to function properly, replace the ignition coil and cap.

TEST PROCEDURE 17 – KEY SWITCH (ENGINE KILL CIRCUIT)

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels and disconnect the battery cables, negative (-) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12a, Page 12a-16.**
3. Remove the connector from the key switch.

Test Procedure 17 – Key Switch (Engine Kill Circuit), Continued:

- Place the red (+) probe on the (M) terminal and the black (–) probe on the (G) terminal. With the key switch OFF, the reading should be continuity. With the key switch turned ON, the reading should be no continuity. If either reading is incorrect, replace the key switch (**Figure 11a-52, Page 11a-42**).
- Reconnect the key switch to the wire harness. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.

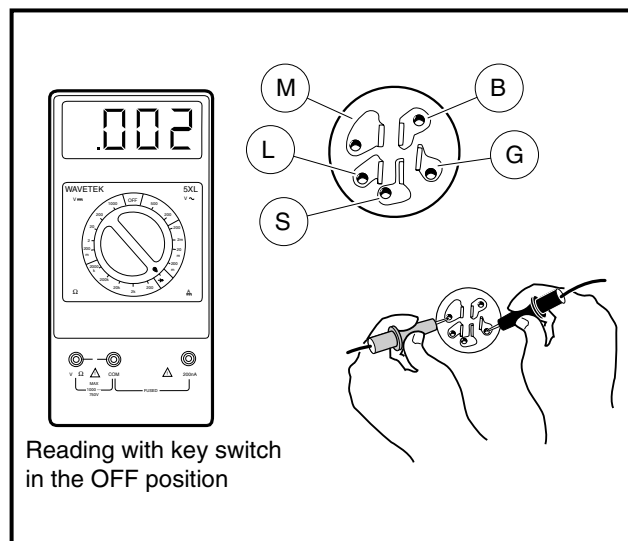


Figure 11a-52 Test Key Switch – Engine Kill Circuit

TEST PROCEDURE 18 – ENGINE KILL WIRE

Read **DANGER** and **WARNING** on page 11a-1.

- Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
- Disconnect white/black wire bullet connector located at the engine RPM limiter (**Figure 11a-41, Page 11a-35**).
- Connect red (+) probe of multimeter to the male bullet terminal on the white/black wire and connect the black (–) probe to the vehicle frame.
- With the Forward/Reverse handle in the NEUTRAL position, turn the key switch to the ON position and note the multimeter reading. Turn the key and hold it in the START position while noting the multimeter reading. There should be no continuity when the key switch is in the ON or START position. If there is continuity, check for worn insulation on the white/black wire that is allowing the wire to ground to the frame.

TEST PROCEDURE 19 – REVERSE BUZZER LIMIT SWITCH

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Keep the battery connected while performing this test procedure.

The reverse buzzer limit switch is located on the Forward/Reverse shifter; red/white and orange wires are connected to it.

- Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Move the Forward/Reverse handle to REVERSE and listen for an audible click from the limit switch. If there is no click, check the switch for proper alignment and switch arm movement.
3. If the switch is being activated but the buzzer does not function, place the red (+) probe of the multimeter on one terminal and the black (-) probe on the other terminal of the limit switch (**Figure 11a-8, Page 11a-12**). Without the lever depressed, the reading should be no continuity. Depress the lever and the reading should be continuity. If either reading is incorrect, replace limit switch.

TEST PROCEDURE 20 – REVERSE BUZZER

Read **DANGER** and **WARNING** on page 11a-1.

The reverse buzzer is mounted to the center dash assembly under the front body.

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. To test the reverse buzzer, remove center dash panel. **See Key Switch Removal, Section 12a, Page 12a-16.**
3. Check for proper wiring and tight connections. Using a multimeter, individually check for continuity through each wire that connects to the reverse buzzer (**Figure 11a-8, Page 11a-12**). If the buzzer will not function when properly wired, replace the buzzer.

TEST PROCEDURE 21 – OIL LEVEL SENSOR

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the Forward/Reverse handle in the NEUTRAL position, turn the key switch to the OFF position, disconnect the spark plug wire, and chock the wheels.
2. Ensure that the low oil warning light and all connecting wires are functioning correctly. **See Test Procedure 22 – Oil Warning Light on page 11a-43.**
3. Drain the engine oil into an approved container and properly dispose of used oil.
4. Turn the key switch ON, closing the circuit. The oil light should illuminate. If the low oil warning light does not illuminate, the oil level sensor may need to be replaced. Refer to Test Procedure 22 before replacing sensor. **See Oil Level Sensor Installation, Section 13, Page 13-24.**
5. Fill the engine with new oil and install a new oil filter before returning the vehicle to service. **See Engine Oil, Section 10, Page 10-6.**

TEST PROCEDURE 22 – OIL WARNING LIGHT

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.

Test Procedure 22 – Oil Warning Light, Continued:

2. Remove the center dash assembly. **See Key Switch Removal, Section 12a, Page 12a-16.**
3. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary (**Figure 11a-9, Page 11a-13**).
4. Disconnect the yellow wire (to the oil level sensor) from the terminal on the oil light. Using an alligator clip jumper wire, connect the oil light terminal to the vehicle frame. Connect the red (+) battery cable to the positive (+) battery post, then attach the black (-) cable to the negative (-) battery post.
5. Turn the key switch to the ON position. The oil light should illuminate. If it does not, check continuity of the yellow wire that connects the key switch to the oil light through a sonic weld connection within the wire harness. If there is no continuity in the wire, replace the wire. Then test the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11a-27.** If the yellow wire and the key switch test okay, then replace the oil light.

TEST PROCEDURE 23 – LOCKOUT CAM

Read **DANGER** and **WARNING** on page 11a-1.

1. Check to be sure the lobes on the cam are depressing the lockout cam limit switch when the Forward/Reverse shifter is in the NEUTRAL position only. The limit switch should make an audible click as it is depressed. If it does not, check for wear on the cam lobe. If the cam lobe will not activate the limit switch, replace the cam.

TEST PROCEDURE 24 – BATTERY TEST (UNDER LOAD)

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set a multimeter to 20 volts and place the red (+) probe on the F2 (white wire) terminal on the starter/generator. Place the black (-) probe on the negative battery post.
3. Turn the key switch to the START position and hold it in the START position while noting the voltage reading on the multimeter (with the key in the START position the battery is under load).
 - 3.1. If the voltage reading is over 9.6 volts at 70 °F (21 °C) (electrolyte temperature) check the starter/generator. **See following NOTE.**

NOTE: The voltage reading is taken at 70 °F (21 °C). At lower electrolyte temperatures the voltage reading will be lower.

- 3.2. If the reading is below 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the battery. **See Test Procedure 1 – Battery on page 11a-22.**
- 3.3. If the reading is zero, there may be NO continuity across the large posts of the solenoid. **See Test Procedure 6 – Solenoid on page 11a-28.**
4. If all of the test results are good and the voltage reading is zero, there may be a broken or damaged 6-gauge white wire from the solenoid to the starter/generator. **See Test Procedure 8 – Starter/Generator (Starter Function) on page 11a-30.**

TEST PROCEDURE 25 – FUEL LEVEL SENDING UNIT

Read **DANGER** and **WARNING** on page 11a-1.

 WARNING

- To avoid the possibility of fire or explosion, make sure the fuel tank cap is securely in place while performing this test procedure.

1. Turn the key switch to the OFF position, put the Forward/Reverse handle in the NEUTRAL position, disconnect the battery cables, negative (-) cable first, and chock the wheels.
2. Disconnect the orange wire from the center post of the fuel level sending unit.
3. With a multimeter set to $2k\ \Omega$ (ohms), place the red (+) probe of the multimeter on the center post of the sending unit. Place the black (-) probe on the ground connection of the sending unit (**Figure 11a-53, Page 11a-45**).
4. The following resistance readings (in ohms) should be obtained depending on the position of the float inside the fuel tank. The resistance reading will vary according to the exact position of the float. The chart below may be used as a guideline to determine if the fuel level sending unit is operating correctly. Make sure the float is at the surface of the fuel in the tank.

FLOAT POSITION	RESISTANCE READING	FUEL GAUGE READINGS
Lower position (tank empty)	$240 \pm 20\ \Omega$ (ohms)	Empty
Center position (tank half full)	$120 \pm 20\ \Omega$ (ohms)	Half full
Upper position (tank full)	$60 \pm 20\ \Omega$ (ohms)	Full

5. If the readings are within the specifications listed above, the fuel level sending unit is working properly. If the readings are incorrect, the fuel level sending unit has failed and the fuel tank must be replaced. **See Fuel Tank Removal, Section 14, Page 14-28.**
6. If the readings are correct and the fuel gauge does not function correctly, check the continuity of the orange wire from the fuel level sending unit to the fuel gauge/hour meter. Leave the battery disconnected while checking continuity. Also check the continuity of the yellow wire from the fuel gauge/hour meter to the key switch, and the black ground wires at the fuel level sending unit and at the fuel gauge/hour meter. **See Fuel Gauge/Hour Meter Removal, Section 12a, Page 12a-25.**
7. If the readings are correct according to the position of the float, but give an incorrect reading on the fuel gauge/hour meter, test the fuel gauge/hour meter. **See Test Procedure 26 – Fuel Gauge on page 11a-46.**

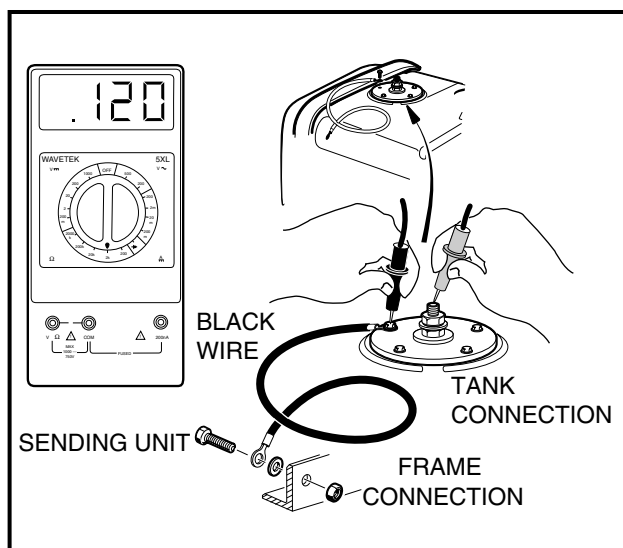


Figure 11a-53 Test Fuel Level Sending Unit

TEST PROCEDURE 26 – FUEL GAUGE

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in NEUTRAL, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Remove the center dash assembly to gain access to the back of the fuel gauge/hour meter. **See Key Switch Removal, Section 12a, Page 12a-16.**
3. Place a sheet of insulating material between the front frame and the electrical connections on the rear of the center dash assembly to prevent contact between the two.
4. Disconnect the orange wire from the fuel gauge/hour meter.
5. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the positive post of the battery. Place the black (–) probe on the negative post of the battery. Record the voltage reading.
6. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the (2) terminal of the fuel gauge/hour meter with the blue wire. Place the black (–) probe on the (3) terminal of the fuel gauge/hour meter with the black wire (**Figure 11a-54, Page 11a-46**).
7. Connect the battery cables, positive (+) cable first, and tighten to 20 ft-lb (27.1 N·m).
8. Turn the key switch ON. The voltage reading should be the same as the battery voltage reading recorded earlier. If not, check the continuity of the blue and black wires (**Figure 11a-54, Page 11a-46**).
9. The orange wire should remain disconnected for this step. With the black probe still on the (3) terminal of the fuel gauge/hour meter, place the red (+) probe of the multimeter on the (1) terminal of the fuel gauge/hour meter (**Figure 11a-55, Page 11a-46**). The voltage reading should be the same as the full battery voltage reading obtained in step 5. If the reading is incorrect, replace fuel gauge/hour meter.

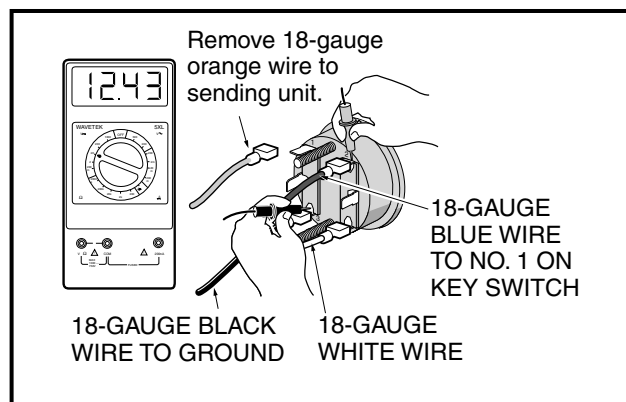


Figure 11a-54 Test Fuel Gauge Continuity

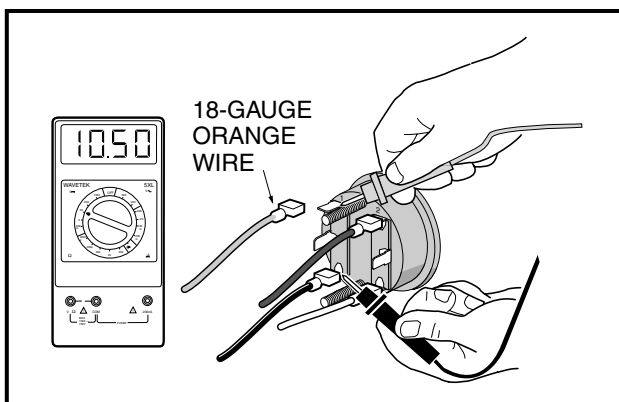


Figure 11a-55 Test Fuel Gauge Voltage

TEST PROCEDURE 27 – HOUR METER

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Turn the key switch to ON and record the current hour meter reading.
3. Turn the key past the ON position to the START position and hold until the engine is running smoothly. Release the key and it will return to the ON position and the engine should idle.

4. Allow the engine to idle for at least six minutes (the meter records in six-minute increments). **See following DANGER.**

⚠ DANGER

- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

5. If the reading does not change after six minutes, then replace the fuel gauge/hour meter.

TEST PROCEDURE 28 – LIGHT SWITCH

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in NEUTRAL, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12a, Page 12a-16.**
3. Using a multimeter set on 20 volts DC, place alligator clips on the multimeter probes. Connect the red (+) probe to the light switch terminal with the blue wire connected to it (**Figure 11a-56, Page 11a-47**).

⚠ CAUTION

- **Before connecting battery cables, make sure none of the electrical components touch the front body trim or other parts of the vehicle frame. Place a dry towel between the body trim and the center dash to prevent an electrical short.**

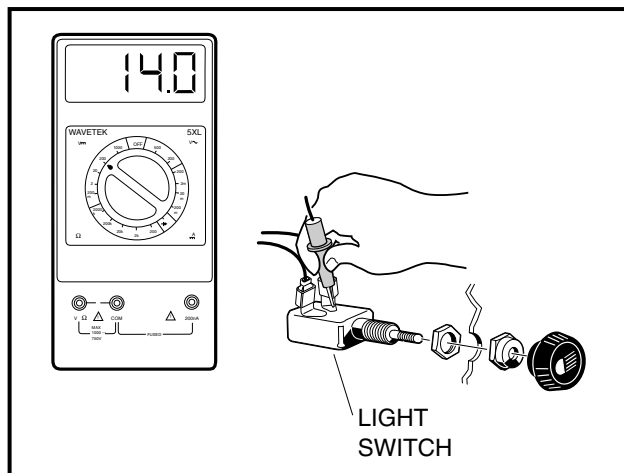


Figure 11a-56 Light Switch Test

4. Connect the battery cables, positive (+) cable first.
5. Connect the black (–) probe of the multimeter to the negative (–) post of the battery.
6. With the light switch in the OFF position, the reading should be zero volts. With the light in the ON position, the reading should be between 11 and 12.5 volts. If there is no voltage reading, check continuity of the 10-gauge red wire from the fuse block to the solenoid. Check continuity of the 14-gauge yellow wire from the light switch to the fuse block. Check the fuse. **See Test Procedure 2 – Fuse on page 11a-25.** If the headlight diode is functioning correctly, the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal, Section 12a, Page 12a-33.**

TEST PROCEDURE 29 – HEADLIGHT DIODE

Read **DANGER** and **WARNING** on page 11a-1.

1. Place the Forward/Reverse handle in NEUTRAL, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12a, Page 12a-16.**
3. Using a multimeter set on 20 volts DC, connect the red (+) probe to the light switch terminal with the yellow wire (**Figure 11a-57, Page 11a-48**).
4. Loosen the black wire connector (on the end of the long black wire) at the headlight diode assembly just enough to maintain the connection and yet expose part of the metal terminal in the connector. Place black (-) probe on the connector (**Figure 11a-57, Page 11a-48**). **See following CAUTION.**

⚠ CAUTION

- **Before connecting battery cables, make sure no electrical components touch the front body trim or other parts of the vehicle frame. Place a dry towel between the body trim and the center dash to prevent an electrical short circuit.**

5. Connect the battery, positive (+) cable first.
6. Pull the light switch to the ON position. The reading should be 11-12 volts. If there is no voltage reading, check continuity of the 16-gauge black wire from the headlight to the headlight diode. Check continuity of the 16-gauge black wire from headlight diode to the vehicle frame. If the wires show continuity and the readings are still incorrect, replace the headlight diode. **See Headlight Diode Removal, Section 12a, Page 12a-32.**
7. With the Forward/Reverse handle in the NEUTRAL position and the wheels chocked, start the engine and depress the accelerator pedal to the floor.
8. Push the light switch to the OFF position. The reading should be 14.7-15.3 volts.
9. Pull the light switch to the ON position. The reading should be 11-13 volts. If the reading does not drop from 14.5-15.5 volts to 11-13 volts, replace the headlight diode.

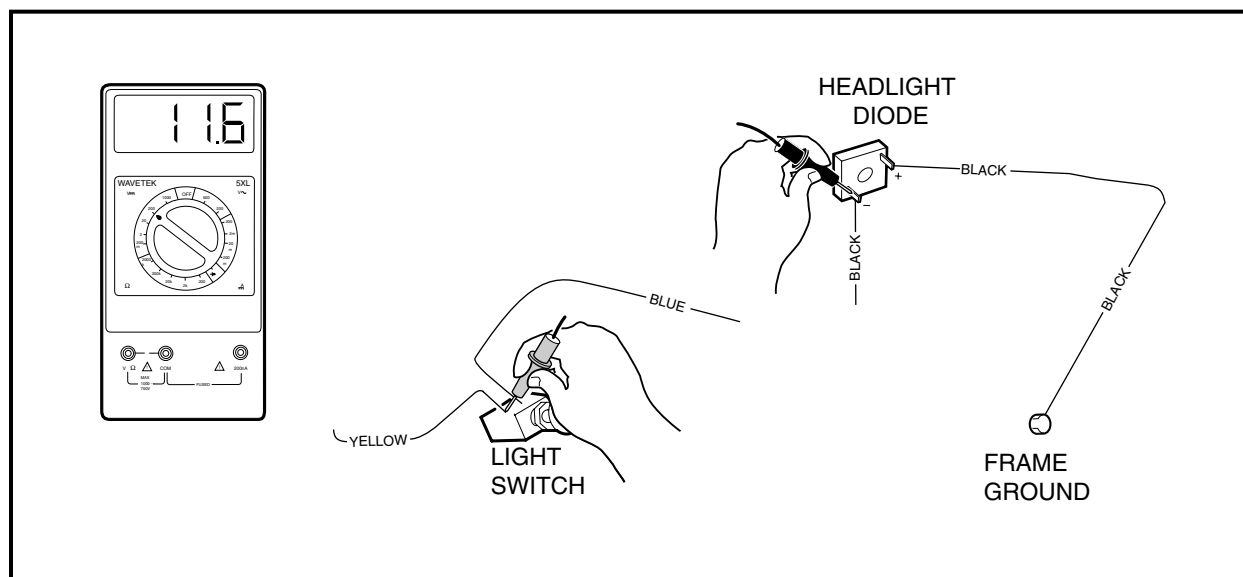


Figure 11a-57 Headlight Diode Circuit Test

TEST PROCEDURE 30 – VOLTAGE AT HEADLIGHT SOCKET

Read **DANGER** and **WARNING** on page 11a-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Inspect wires at the light bulb socket. Make sure wires are securely fastened to the contacts inside socket.
3. Remove the wire harness from the headlight (**Figure 11a-58, Page 11a-49**).
4. Using a multimeter set to 20 volts DC, place the black (–) probe of multimeter into the black wire terminal of the wire harness. Place the red (+) probe into the blue wire terminal.
5. Pull the light switch to the ON position. If the multimeter reads approximately 12 volts, replace the headlight bulb.
6. If there is no voltage reading at the wire harness, check continuity of the 16-gauge blue wire from the headlight to the light switch. Using a multimeter set to 20 volts DC, attach using an alligator clip, the black (–) probe of multimeter onto the negative battery terminal and place the red (+) probe into the blue wire terminal of the wire harness. If the multimeter reading is approximately 12 volts, the blue wire has continuity.
7. Check continuity of the 16-gauge black wire from the headlight to the ground terminal. Using a multimeter set to 20 volts DC, place the black (–) probe of multimeter into the black wire terminal of the wire harness and attach using an alligator clip, the red (+) probe onto the positive battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.

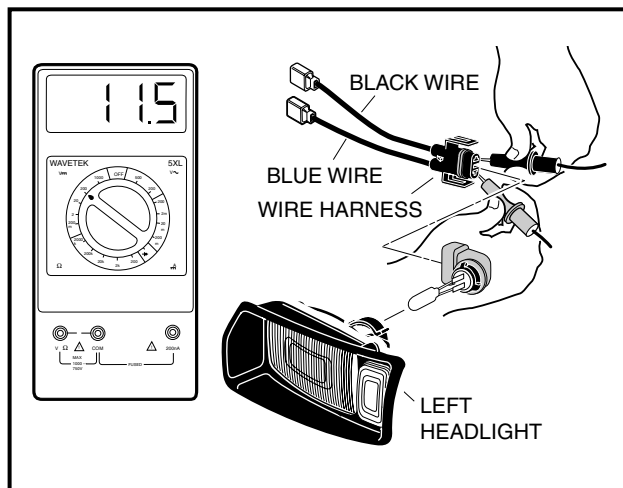


Figure 11a-58 Check Voltage to Headlight Socket

SECTION 11B – TROUBLESHOOTING AND ELECTRICAL SYSTEM: FE350, PEDAL-START ENGINE

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

This section contains the information required to correctly troubleshoot the FE350 pedal-start vehicles. A troubleshooting guide is provided for general troubleshooting. For issues pertaining solely to the electrical system, proceed to Circuit Testing on page 11b-16.

In addition to troubleshooting, this section contains general information on the electrical system and the electrical circuits of the system. Refer to the correct diagrams when troubleshooting specific vehicles.

TROUBLESHOOTING GUIDE

The following troubleshooting guide will be helpful in identifying operating difficulties should they occur. The guide includes the symptom, probable cause(s) and suggested checks. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Engine does not start easily.	Spark plug is partially fouled or in poor condition	Section 13 – FE350 and FE400 Engines
	Spark plug wire is damaged or loose	Section 13 – FE350 and FE400 Engines
	Loose wire connection at ignition coil or RPM limiter	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 13, 14, and 15
	Intermittent ignition coil failure	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 13, 14, and 15
	Low cylinder compression	Section 13 – FE350 and FE400 Engines
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Section 14 – Fuel System
	Carburetor improperly adjusted	Section 14 – Fuel System
	Starter/generator belt is slipping	Section 12b – Electrical Components: FE350, Pedal-Start Engine, Belt Tension Adjustment on page 12b-12
Engine starts but does not run smoothly.	Spark plug is fouled or in poor condition	Section 13 – FE350 and FE400 Engines
	Spark plug wire is damaged or loose	Section 13 – FE350 and FE400 Engines
	Intermittent ignition coil failure	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 13, 14, and 15
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Section 14 – Fuel System
	Fuel pump malfunction; fuel pressure to carburetor too low	Section 14 – Fuel System
Engine turns but fails to start.	Fuel tank is empty	Section 14 – Fuel System
	Fuel line or filters clogged	Section 14 – Fuel System
	Fouled spark plug	Section 13 – FE350 and FE400 Engines
	Spark plug wire damaged or loose	Section 13 – FE350 and FE400 Engines
	Loose wire connection at ignition coil or RPM limiter	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 13, 14, and 15
	Ignition coil or RPM limiter failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 13, 14, and 15
	Engine flooded with fuel as result of excess choking	Owner's manual, Controls and Indicators. See Choke.
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Engine turns but fails to start, continued.	Kill circuit grounded	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 13, 14, and 15
	Fuel pump malfunction or failure	Section 14 – Fuel System
Engine overheats.	Fan screen is partially blocked or plugged	Section 13 – FE350 and FE400 Engines
	Governor is improperly adjusted	Section 14 – Fuel System
	Carburetor is too lean; check main jet size	Section 14 – Fuel System
Engine pre-ignites.	Excessive carbon deposits on piston head or in combustion chamber	Section 13 – FE350 and FE400 Engines
	Spark plug heat range is incorrect	Section 13 – FE350 and FE400 Engines
	Unsuitable or contaminated fuel	Section 14 – Fuel System
Loss of engine power.	Exhaust valve is restricted with carbon deposit	Section 13 – FE350 and FE400 Engines
	Muffler or exhaust pipe restricted with carbon or other substance	Section 15 – Exhaust System
	Ignition coil failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 13, 14, and 15
	Air filter is dirty or clogged	Section 14 – Fuel System
	Governor is improperly adjusted	Section 14 – Fuel System
	Throttle linkage out of adjustment	Section 14 – Fuel System
	Low cylinder compression	Section 13 – FE350 and FE400 Engines
	Spark plug failed	Section 13 – FE350 and FE400 Engines
	Restricted fuel flow	Section 14 – Fuel System
	Torque converter is not backshifting properly	Section 17 – Torque Converter
Spark plug fouls repeatedly.	Incorrect plug	Section 13 – FE350 and FE400 Engines
	Spark plug wire is damaged	Section 13 – FE350 and FE400 Engines
	Unsuitable fuel, or incorrect (rich) fuel mixture	Section 14 – Fuel System
	Ignition coil failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 13, 14, and 15
	Rings are heavily worn, low cylinder pressure	Section 13 – FE350 and FE400 Engines
Carburetor floods.	Inlet valve or seat is leaking, dirty, worn, or damaged	Section 14 – Fuel System
	Float is damaged and filled with gasoline	Section 14 – Fuel System
	Float needle valve not functioning properly	Section 14 – Fuel System
	Carburetor vent is clogged	Section 14 – Fuel System
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Starter fails to operate.	Lockout cam is in the wrong position	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Neutral Lockout Circuit on page 11b-13
	Fuse is blown	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 2
	Battery is dead	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 1
	Starter control circuit is not operating	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Starter Circuit on page 11b-10
	Starter/generator failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 8
	Starter solenoid failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 6
	Key switch failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 4
	Lockout cam limit switch failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 7
	Loose or broken wire in starter/generator circuit	Section 12b – Electrical Components: FE350, Pedal-Start Engine Starter/Generator on page 12b-2
	Cylinder and/or crankcase flooded with fuel	Section 14 – Fuel System
Starter/Generator does not charge battery.	Loose or broken wire in the starter/generator circuit	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 10
	Generator field coil is shorted	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 10
	Brushes are worn or commutator is dirty	Section 12b – Electrical Components: FE350, Pedal-Start Engine, Starter/Generator on page 12b-2
Starter/Generator does not charge battery, continued.	Starter/generator belt is loose or slipping	Section 12b – Electrical Components: FE350, Pedal-Start Engine, Belt Tension Adjustment on page 12b-12
	Voltage regulator failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 11
	Battery failed	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 1
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Transmission does not engage or disengage smoothly.	Transmission shifter linkage is binding or is out of adjustment	Section 16b – MC010C-BS00 Unitized Transaxle with Differential Lock
	Idle RPM setting is set too high	Section 14 – Fuel System
	Insufficient (low) level of lubricant or wrong type of lubricant in transmission	Section 16b – MC010C-BS00 Unitized Transaxle with Differential Lock
	Internal gears are damaged or worn	Section 16b – MC010C-BS00 Unitized Transaxle with Differential Lock
	Synchronizer rings are worn, damaged or jammed	Section 16b – MC010C-BS00 Unitized Transaxle with Differential Lock
Excessive vehicle vibration.	Engine mounting nuts or bolts are loose	Section 13 – FE350 and FE400 Engines
	Snubber on frame is worn or damaged	Section 13 – FE350 and FE400 Engines
	Misaligned muffler mounting clamp	Section 15 – Exhaust System
	Damaged drive belt or starter belt	Section 17 – Torque Converter
	Damaged drive clutch	Section 17 – Torque Converter
	Damaged driven clutch	Section 17 – Torque Converter
	Damaged starter/generator pulley	Section 12b – Electrical Components: FE350, Pedal-Start Engine, Starter/Generator on page 12b-2
	RPM setting is incorrect	Section 14 – Fuel System Engine RPM Adjustment on page 14-14
Torque converter does not shift smoothly.	Drive belt is worn, cracked, glazed, or frayed	Drive Belt, Section 17, Page 17-4
	Drive clutch malfunction	Drive Clutch Cleaning and Inspection, Section 17, Page 17-6
	Driven clutch malfunction	Drive Clutch Cleaning and Inspection, Section 17, Page 17-6
	Governor is sticking	Differential Gear Case Disassembly, Section 16b, Page 16b-22
Engine won't stop running.	Kill circuit wire is disconnected from the ignition coil	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedure 12
	Key switch failure	Section 11b – Troubleshooting and Electrical System: FE350, Pedal-Start Engine, Test Procedures 4 and 17
	Carburetor is too lean; check main and pilot jet sizes	Section 14 – Fuel System
	Carburetor throttle stop screw out of adjustment	Section 14 – Fuel System

ELECTRICAL SYSTEM

The electrical system on the FE350 pedal-start vehicle is 12 volts DC with negative ground to frame. It consists of ten circuits that are easily identified:

- Starter Circuit
- Generator Circuit
- Engine Ignition Circuit
- Engine Kill Circuit
- Reverse Buzzer Circuit
- Low Oil Warning Circuit
- Lockout Cam Circuit
- Fuel Gauge and Sending Unit Circuit
- Hour Meter Circuit
- Lighting Circuit

A pedal-start vehicle uses the ignition key to activate both the electrical system and starting circuit. Advancing the accelerator pedal starts the engine and provides forward or backward travel, depending on the position of the Forward/Reverse handle. **See Section 13 – FE350 and FE400 Engines.**

Recognizing and understanding the function of each of these circuits will help to quickly isolate the source of an electrical problem. Use the troubleshooting flow charts in the Circuit Testing section to find the proper test procedure to correct the electrical problem. **See Circuit Testing on page 11b-16.**

For a complete wiring diagram, see pages 11b-8 and 11b-9.

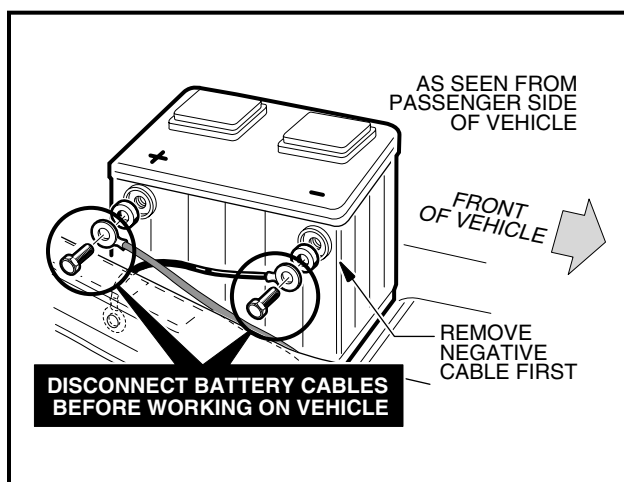


Figure 11b-1 Battery Disconnect

WIRING DIAGRAM

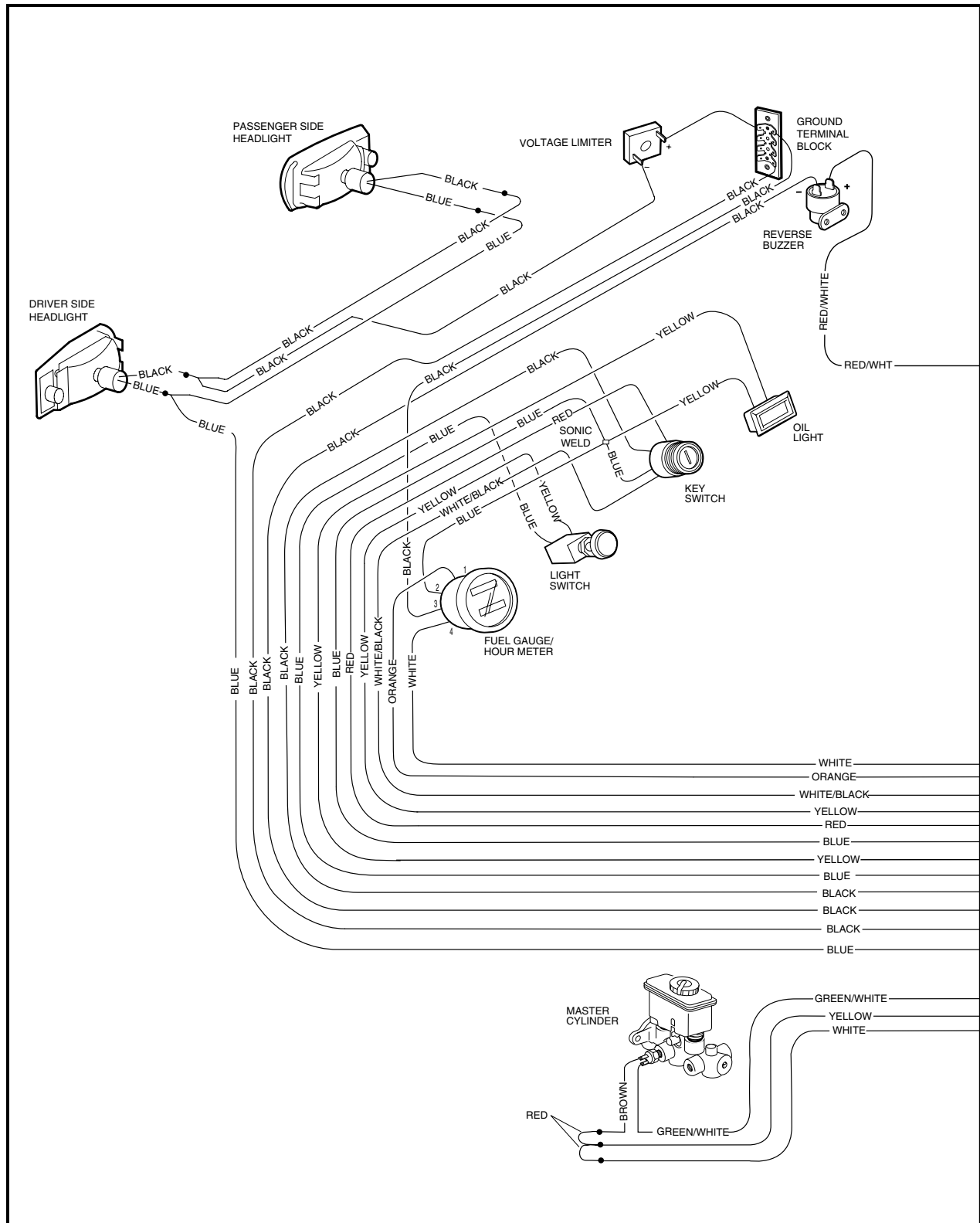


Figure 11b-2 Wiring Diagram for FE350 Pedal-Start Vehicle (Front)

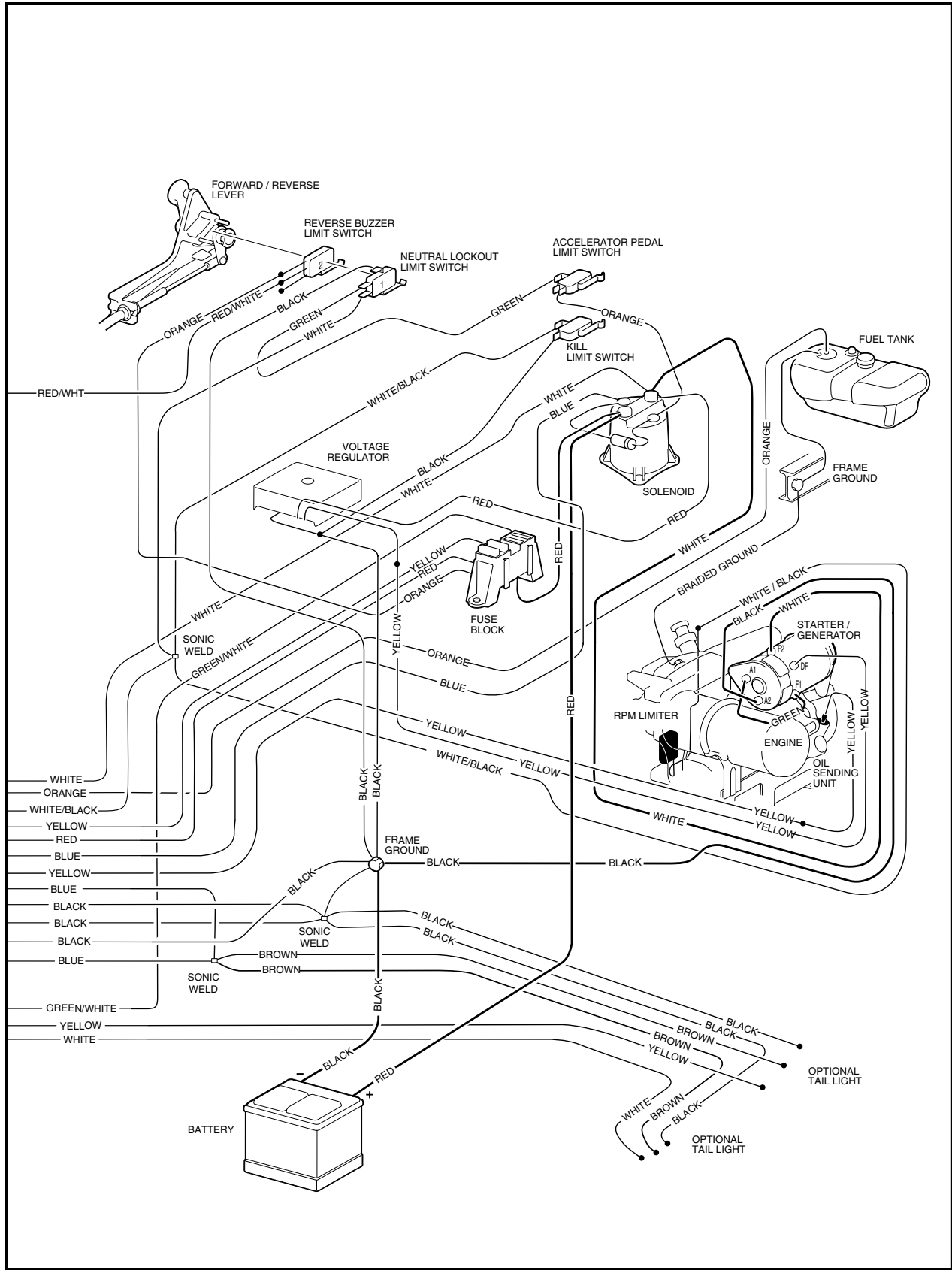


Figure 11b-3 Wiring Diagram for FE350 Pedal-Start Vehicle (Rear)

STARTER CIRCUIT

The starter circuit consists of a 12-volt battery, fuse, key switch, accelerator pedal limit switch, neutral lockout limit switch, solenoid, starter/generator, and connecting wires (**Figure 11b-4, Page 11b-10**). The battery is the source of power for the system. The fuse provides protection to the solenoid activating circuit. **See following NOTE.**

NOTE: The starter circuit is completely independent of the ignition circuit. The battery does not supply power for ignition. The battery supplies power to the starter/generator which in turn starts the engine components rotating. Once the engine is running, the ignition circuit supplies power to the spark plug. **See Engine Ignition Circuit on Page 11b-11.**

The starter circuit is activated when the key switch is turned to the ON position, the accelerator pedal is depressed, and the Forward/Reverse handle is placed in either the FORWARD or REVERSE position. These processes actuate the neutral lockout limit switch. **See Neutral Lockout Circuit on page 11b-13.** Electrical current is then supplied to the solenoid, completing the circuit between the positive post of the battery and the F2 post of the starter/generator. The starter/generator then turns and cranks the engine through belt-driven pulleys.

NOTE: Engine rotation (clockwise) is as viewed from the clutch side of the engine.

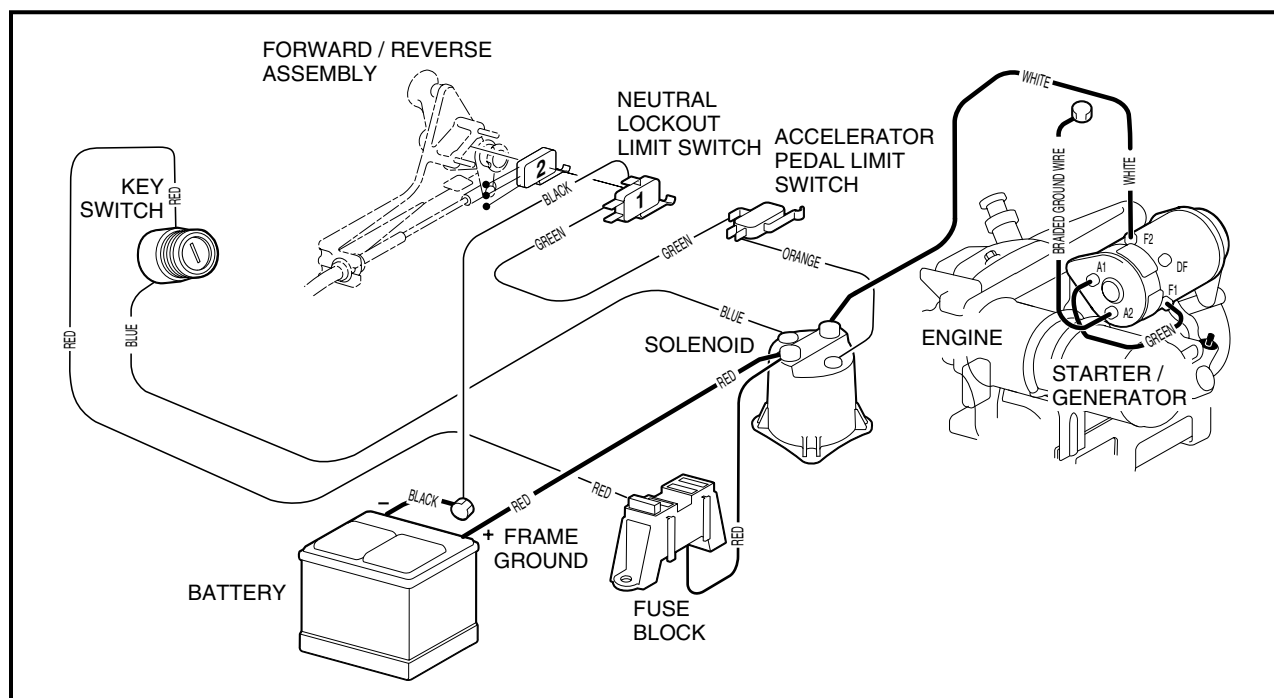


Figure 11b-4 Pedal-Start Starter Circuit

GENERATOR CIRCUIT

The generator circuit consists of the starter/generator, voltage regulator, solenoid, battery, and connecting wires (**Figure 11b-5, Page 11b-11**).

When battery power is first supplied to the starter/generator, the starter/generator turns the engine at low RPM (approx. 700). Once the engine starts running, it then drives the starter/generator. At any engine RPM over 1215 (3000 starter/generator RPM), the starter/generator functions as a generator, supplying charging current to the battery. To prevent battery overcharging, the voltage regulator senses battery voltage, and by opening and closing an electronic switch, controls the amount of charge going to the battery.

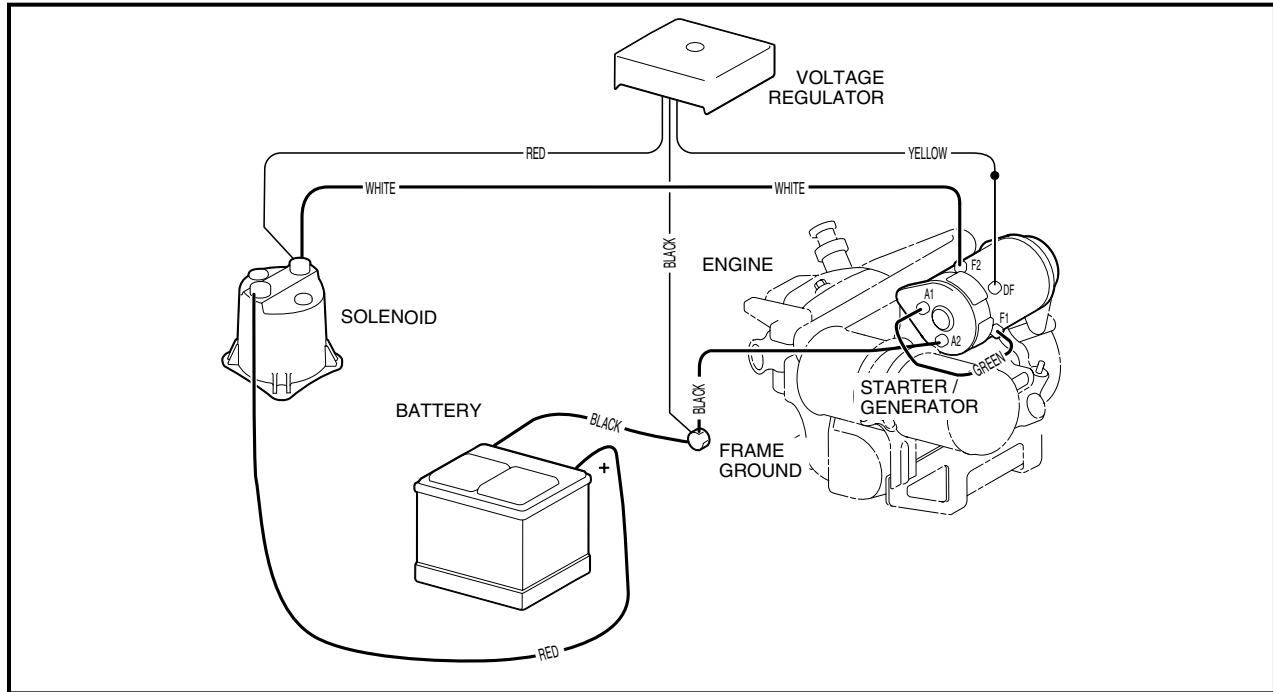


Figure 11b-5 Pedal-Start Generator Circuit

ENGINE IGNITION CIRCUIT

The engine ignition circuit is independent of all other circuits except the kill circuit. It consists of the ignition coil with internal igniter, spark plug, RPM limiter, and connecting wires (**Figure 11b-6, Page 11b-11**).

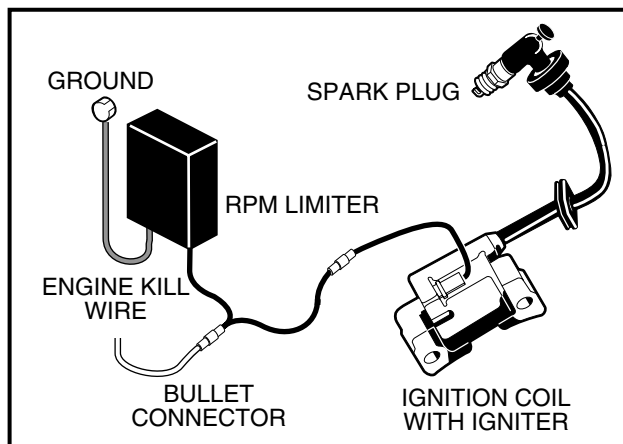


Figure 11b-6 Ignition Circuit

ENGINE KILL CIRCUIT

The ignition coil supplies electrical power for the spark plug; therefore, the proper way to stop the engine is to run this electrical power to ground, bypassing the spark plug (**Figure 11b-7, Page 11b-12**).

The engine kill circuit consists of the key switch, a kill limit switch that is activated by the accelerator pedal, a neutral lockout limit switch that is activated by a cam located on the back of the Forward/Reverse shifter, and connecting wires. The engine can be stopped by releasing the accelerator pedal, turning the key switch to the OFF position, or by shifting the Forward/Reverse handle to NEUTRAL. **See Neutral Lockout Circuit on page 11b-13.**

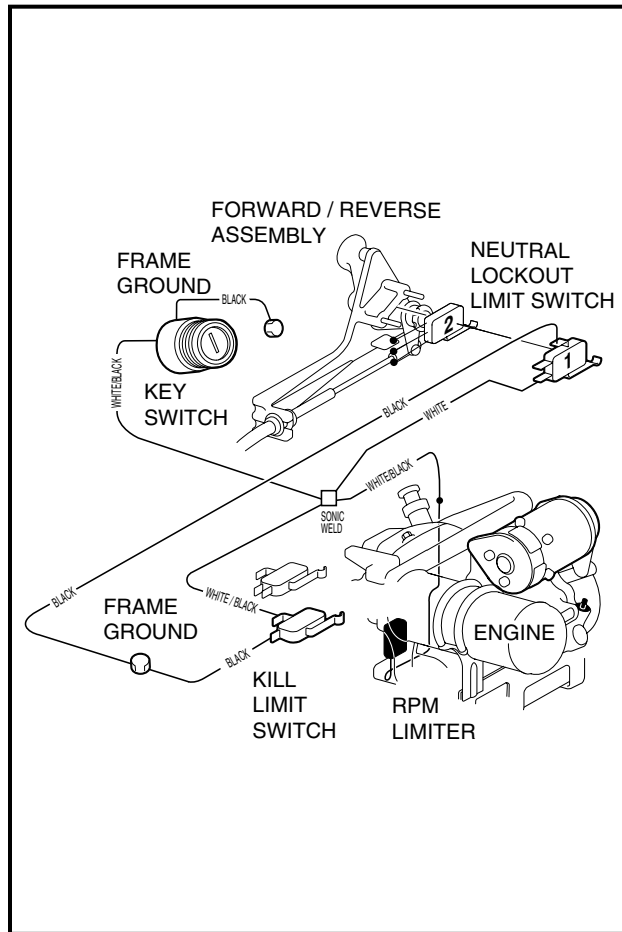


Figure 11b-7 Engine Kill Circuit

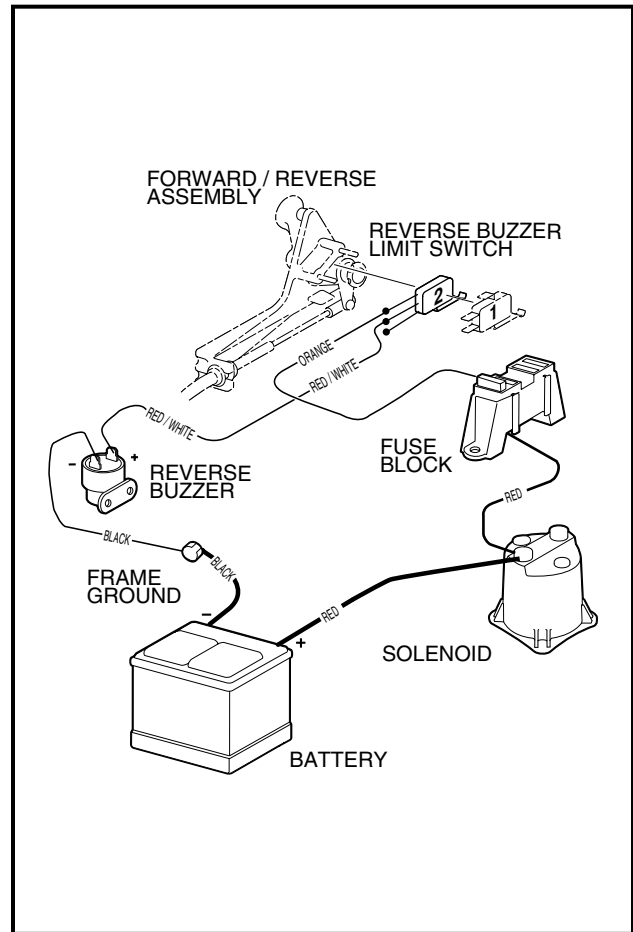


Figure 11b-8 Reverse Buzzer Circuit

REVERSE BUZZER CIRCUIT

The reverse buzzer is a safety warning device that sounds when the Forward/Reverse handle is in REVERSE. It functions to remind the operator not to leave the vehicle in reverse and to warn anyone in the area that the vehicle is in reverse.

The reverse buzzer circuit consists of a reverse buzzer, reverse buzzer limit switch, fuse, fuse block, and connecting wires (**Figure 11b-8, Page 11b-12**).

The battery supplies power through the fuse block and is controlled by the reverse buzzer limit switch that is activated by a cam located on the back of the Forward/Reverse shifter. When the Forward/Reverse handle is placed in REVERSE, a cam depresses the reverse limit switch, closing the circuit. The reverse buzzer sounds.

LOW OIL WARNING CIRCUIT

The low oil warning circuit consists of an oil level sensor in the engine, a dash-mounted low oil warning light, key switch, and connecting wires (**Figure 11b-9, Page 11b-13**).

The light receives power through the key switch when the key switch is turned to the ON position. When the oil level in the crankcase is low, the oil level sensor closes the circuit to the ground and illuminates the low oil warning light.

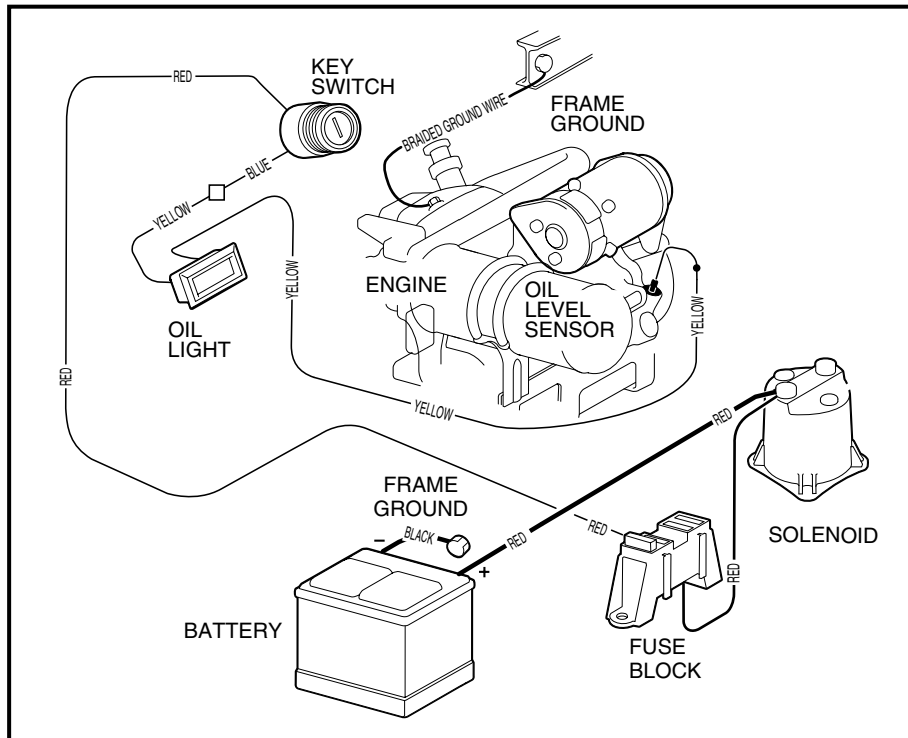


Figure 11b-9 Low Oil Warning Circuit

NEUTRAL LOCKOUT CIRCUIT

The neutral lockout circuit prevents the operator from starting the vehicle in NEUTRAL. Also, if the vehicle is started in FORWARD or REVERSE and then shifted to NEUTRAL, the engine will stop running.

The neutral lockout circuit consists of the connecting wires, a limit switch that is located on the Forward/Reverse shifter assembly, which is activated by a neutral lockout cam, and a limit switch that is located in the electrical component box, which is activated by the accelerator pedal (**Figure 11b-12, Page 11b-14**).

For the convenience of the trained technician, there is a neutral lockout cam (yellow knob) located on the back of the Forward/Reverse shifter, inside the engine compartment. If the neutral lockout cam is pulled out approximately 3/8 inch (10 mm) and then rotated one-half turn until it snaps into place, the cam will be in the SERVICE position (**Figure 11b-10, Page 11b-14**).

When the cam is in the SERVICE position, it will allow the technician to run the engine in NEUTRAL for certain maintenance procedures. With the cam in this position, the vehicle will not operate if the Forward/Reverse handle is placed in either the FORWARD or REVERSE position.

To put the neutral lockout cam back into the OPERATE position, pull the cam out approximately 3/8 inch (10 mm) and rotate it one-half turn until it snaps into place (**Figure 11b-11, Page 11b-14**). See following **WARNING** and **NOTE**.

▲ WARNING

- With the cam in the SERVICE position and the engine running, the vehicle may move suddenly if the Forward/Reverse handle is shifted or accidentally bumped. To prevent this, chock the front and rear wheels and firmly set the park brake before servicing or leaving the vehicle.

Neutral Lockout Circuit, Continued:

NOTE: Be sure to return the cam to the OPERATE position after servicing the vehicle, or the vehicle will not run.

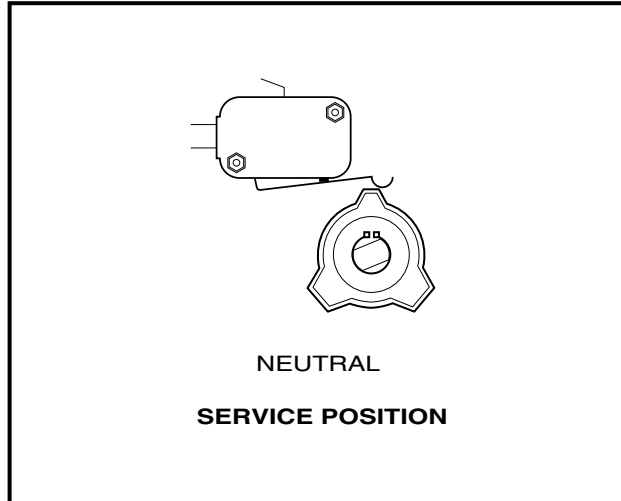


Figure 11b-10 Service Position For Neutral Lockout Cam

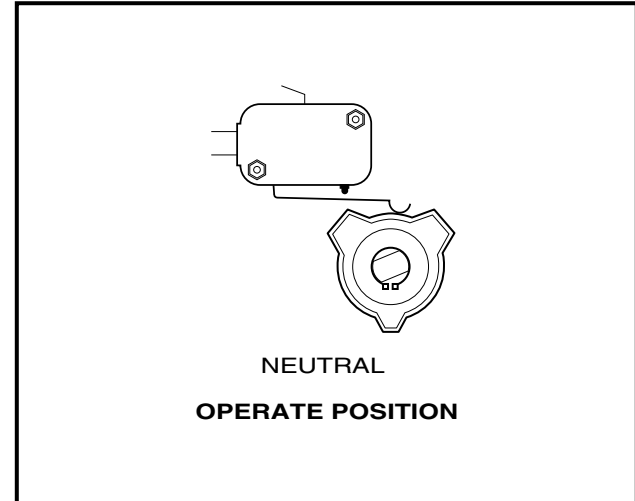


Figure 11b-11 Operate Position For Neutral Lockout Cam

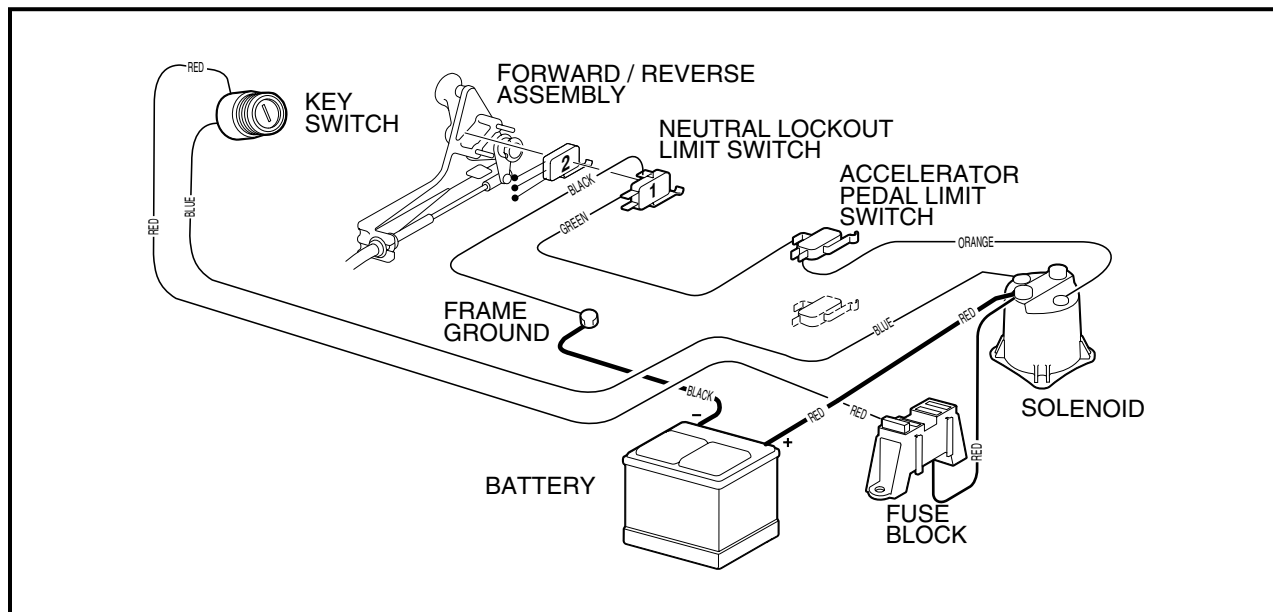


Figure 11b-12 Neutral Lockout Circuit

FUEL GAUGE AND SENDING UNIT CIRCUIT

The fuel gauge and sending unit circuit consists of the fuel gauge/hour meter, fuel level sending unit, key switch and connecting wires. The fuel gauge sending unit picks up power from the key switch when the key switch is turned to the ON position. The power goes through the gauge to the sending unit at the fuel tank. The sending unit tells the gauge how much fuel is in the tank (**Figure 11b-13, Page 11b-15**).

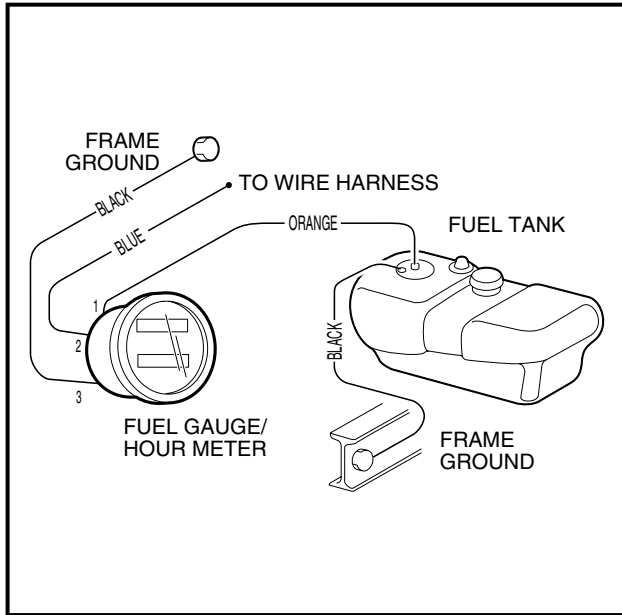


Figure 11b-13 Fuel Gauge and Sending Unit Circuit

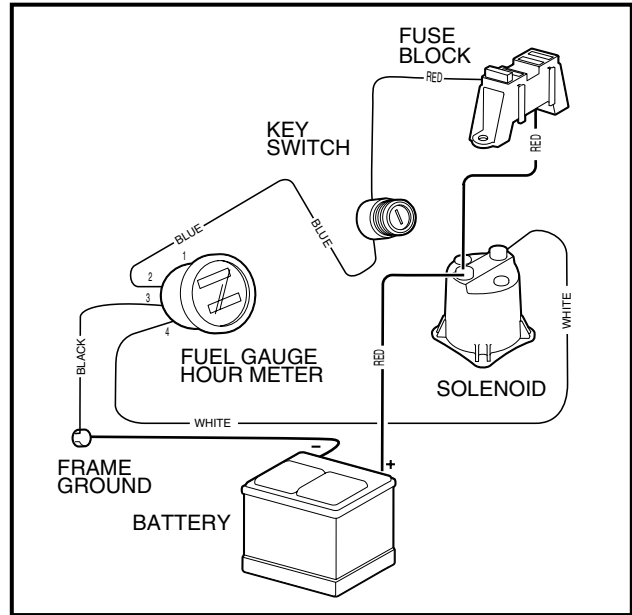


Figure 11b-14 Pedal-Start Hour Meter Circuit

HOUR METER CIRCUIT

The hour meter circuit consists of the fuel gauge/hour meter, key switch, solenoid and connecting wires (Figure 11b-14, Page 11b-15).

LIGHTING CIRCUIT

The headlights receive power through the fuse block when the light switch is pulled to the ON position (Figure 11b-15, Page 11b-15).

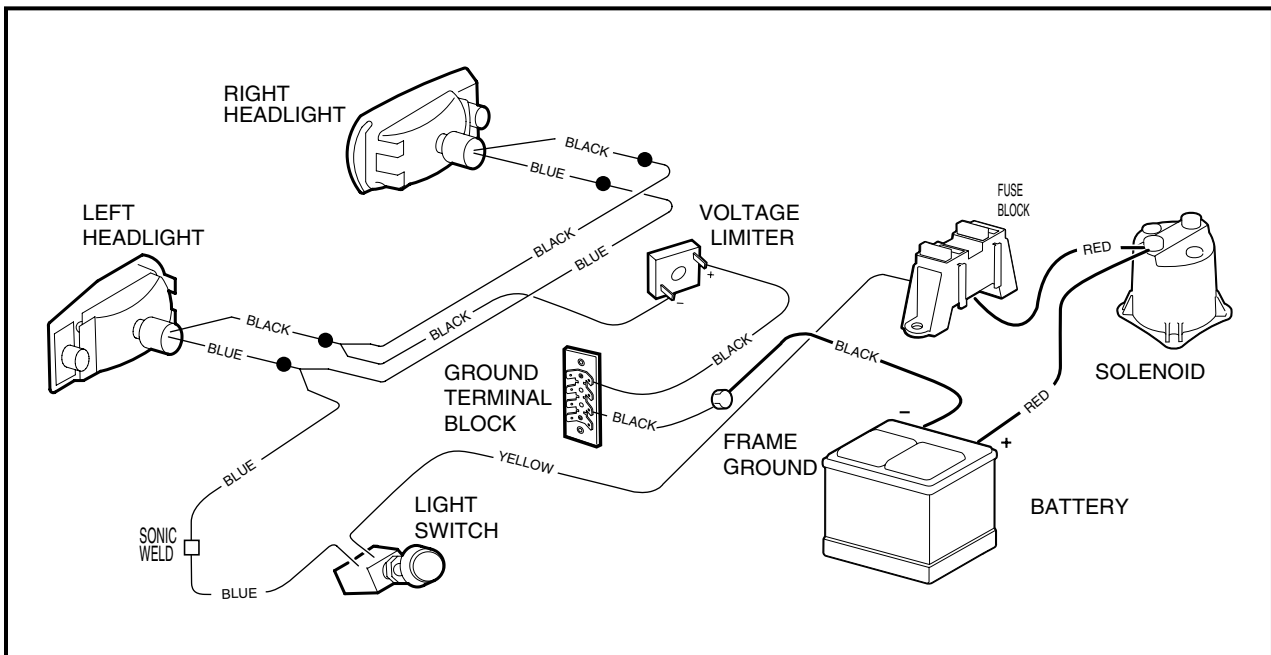


Figure 11b-15 Pedal-Start Lighting Circuit

CIRCUIT TESTING

Read **DANGER** and **WARNING** on page 11b-1.

Before testing the electrical circuits to determine the source of an electrical problem, test the vehicle battery to determine whether or not it is the source of the problem. A hydrometer, multimeter, and 160 ampere load tester will be required. See **Test Procedure 1 – Battery on page 11b-24**.

TESTING THE STARTER CIRCUIT AND GENERATOR CIRCUIT

Read **DANGER** and **WARNING** on page 11b-1.

Use the following chart to begin troubleshooting problems with the starter and generator circuits.

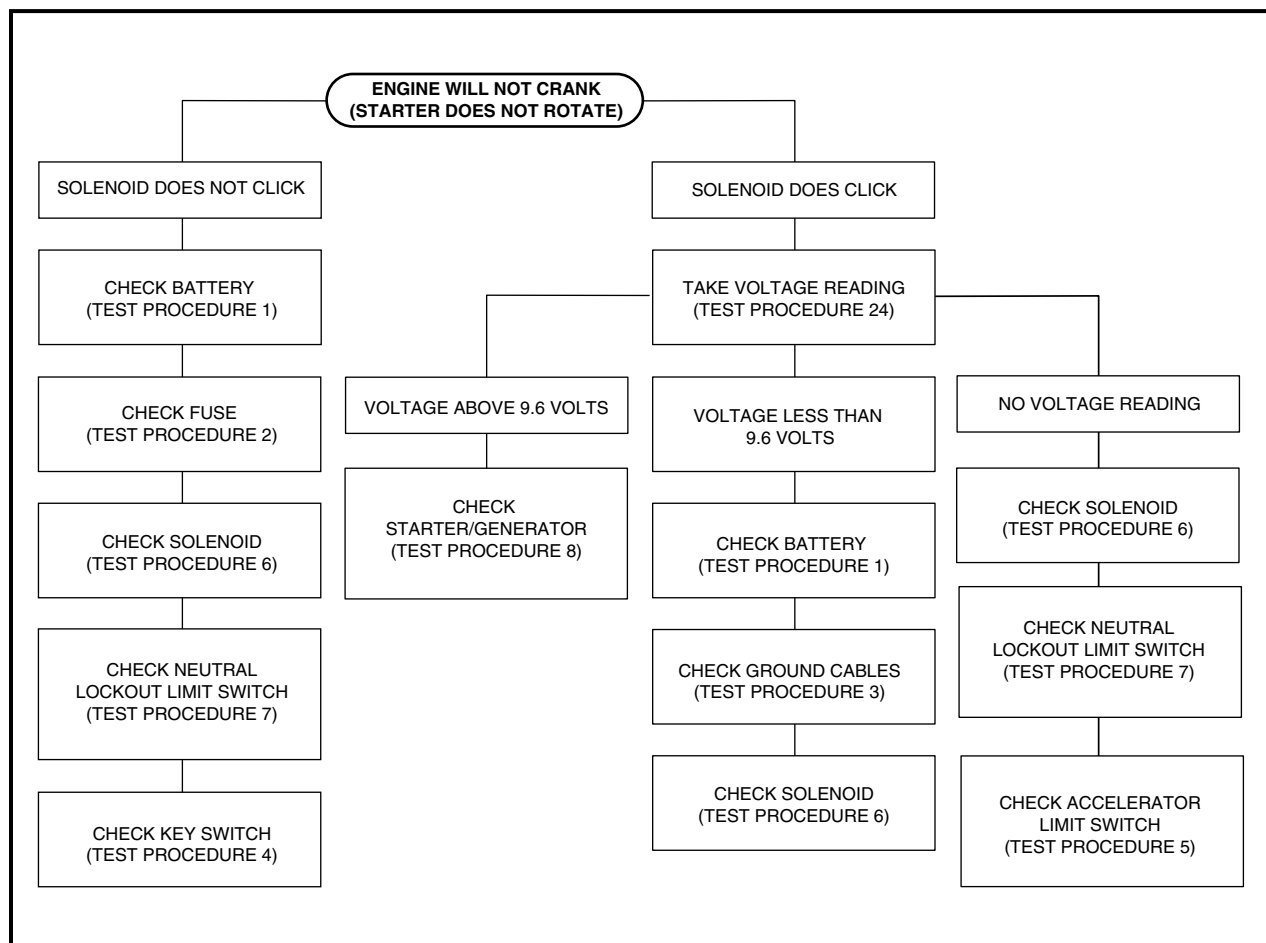


Figure 11b-16 Testing the Starter and Generator Circuits

TESTING THE ENGINE IGNITION CIRCUIT

Read **DANGER** and **WARNING** on page 11b-1.

Use the following chart (**Figure 11b-17, Page 11b-17**) to begin troubleshooting problems with the engine ignition circuit.

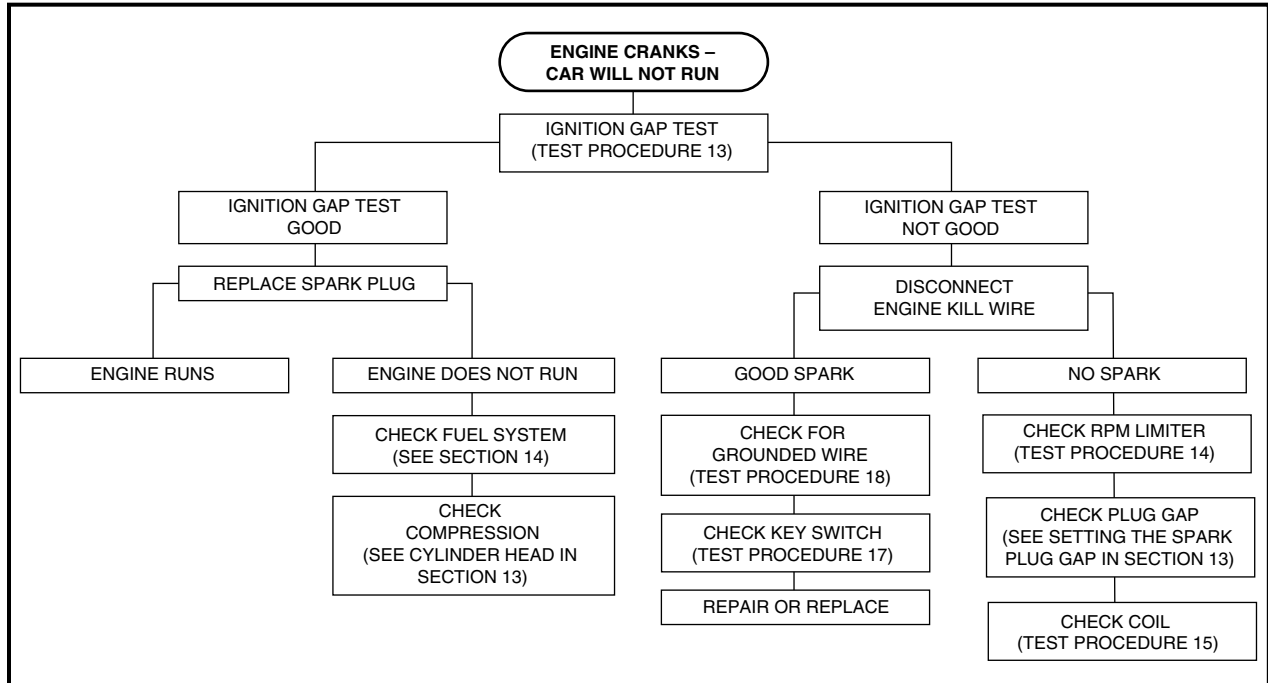


Figure 11b-17 Testing the Engine Ignition Circuit

TESTING THE ENGINE KILL CIRCUIT

Read **DANGER** and **WARNING** on page 11b-1.

Use the following charts (Figure 11b-18, Page 11b-17 through Figure 11b-20, Page 11b-18) to begin troubleshooting problems with the engine kill circuit.

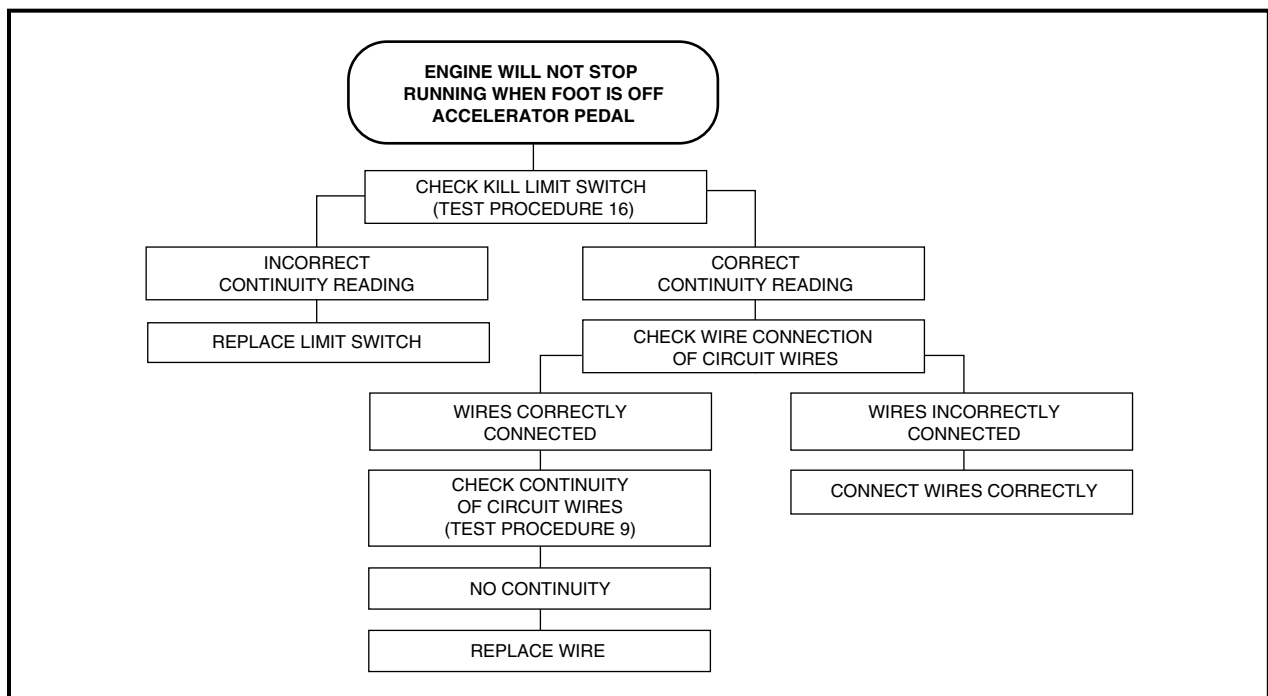


Figure 11b-18 Testing the Engine Kill Circuit – Chart 1

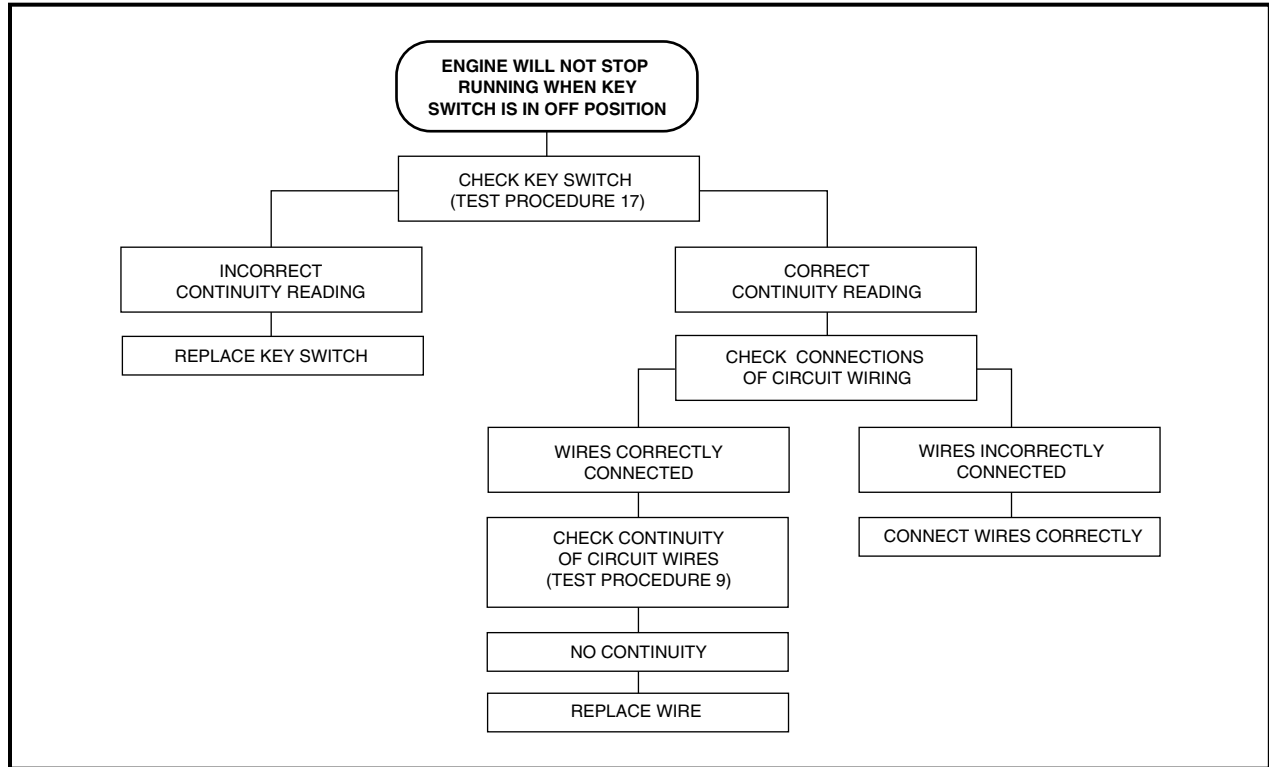


Figure 11b-19 Testing the Engine Kill Circuit – Chart 2

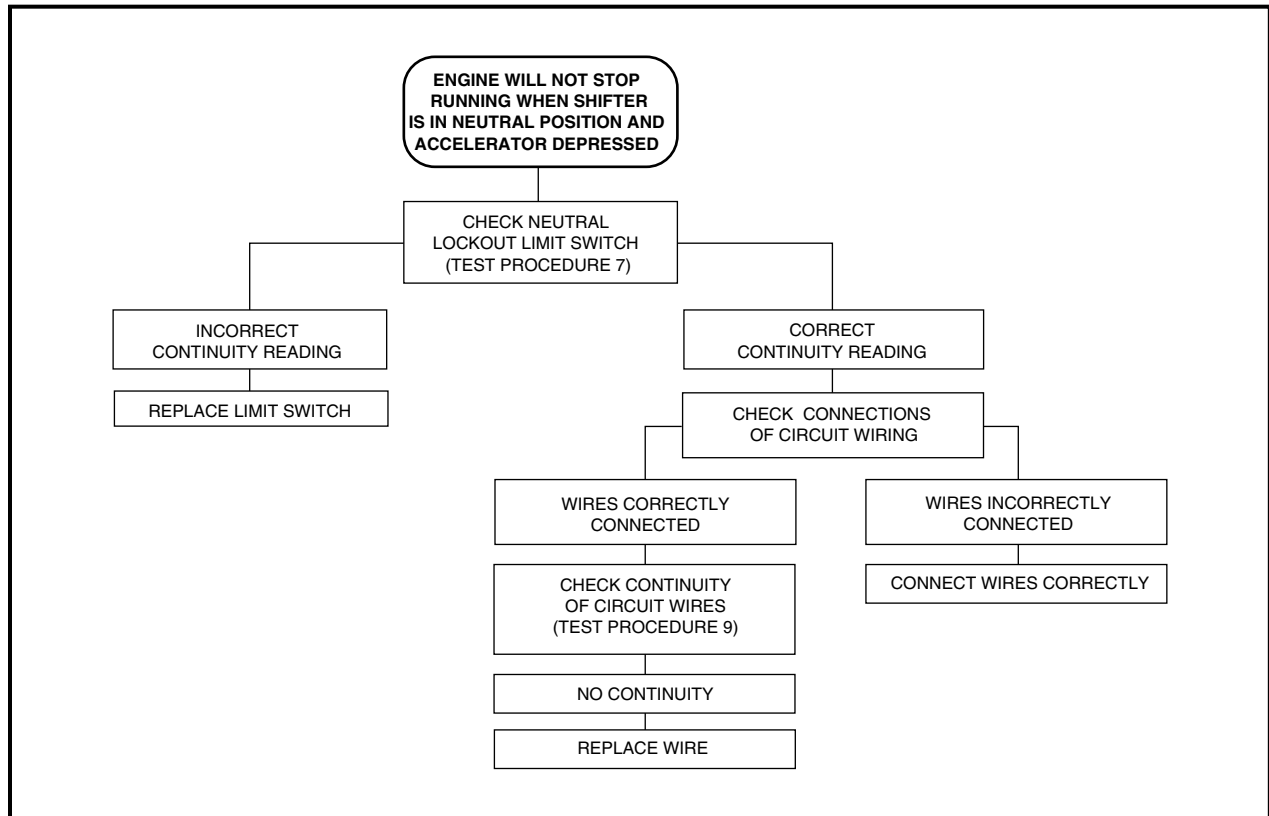


Figure 11b-20 Testing the Engine Kill Circuit – Chart 3

TESTING THE REVERSE BUZZER CIRCUIT

Read **DANGER** and **WARNING** on page 11b-1.

Use the following chart (**Figure 11b-21, Page 11b-19**) to begin troubleshooting the reverse buzzer circuit.

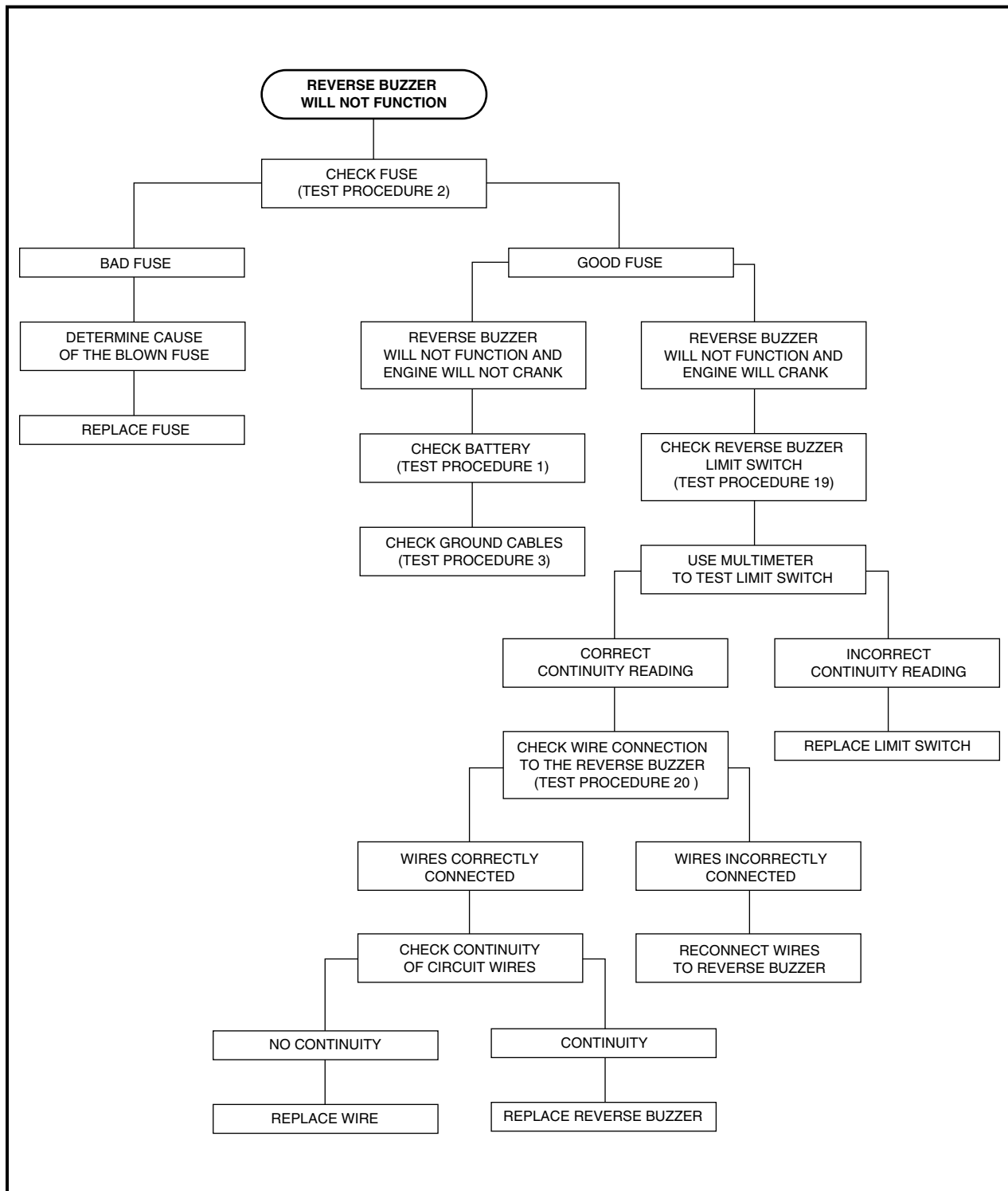


Figure 11b-21 Testing the Reverse Buzzer Circuit

TESTING THE LOW OIL WARNING CIRCUIT

Read **DANGER** and **WARNING** on page 11b-1.

Use the following chart (Figure 11b-22, Page 11b-20) to begin troubleshooting the low oil warning circuit.

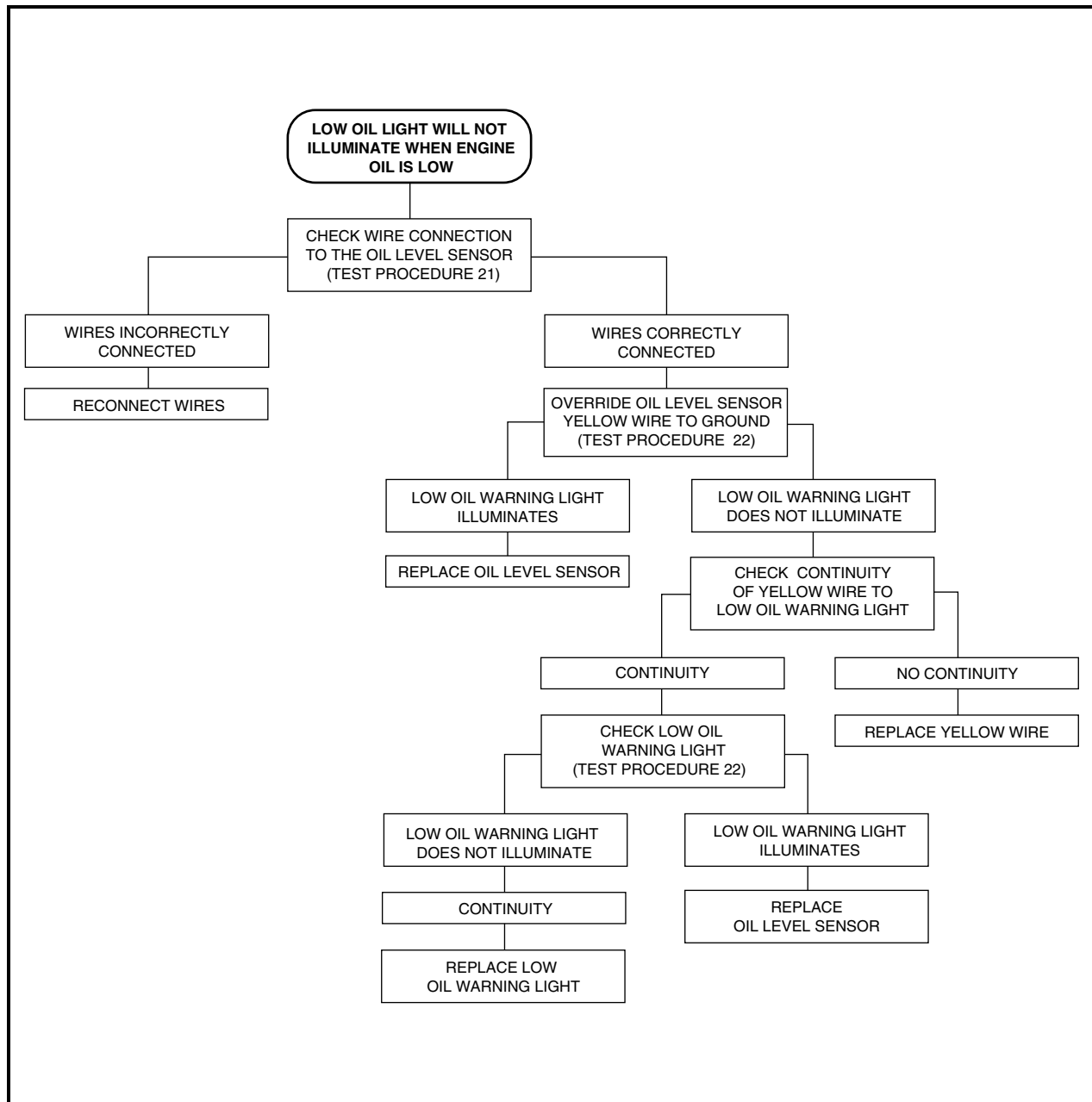


Figure 11b-22 Testing the Low Oil Warning Circuit

TESTING THE NEUTRAL LOCKOUT CIRCUIT

Read **DANGER** and **WARNING** on page 11b-1.

Use the following chart (Figure 11b-23, Page 11b-21) to begin troubleshooting the neutral lockout circuit.

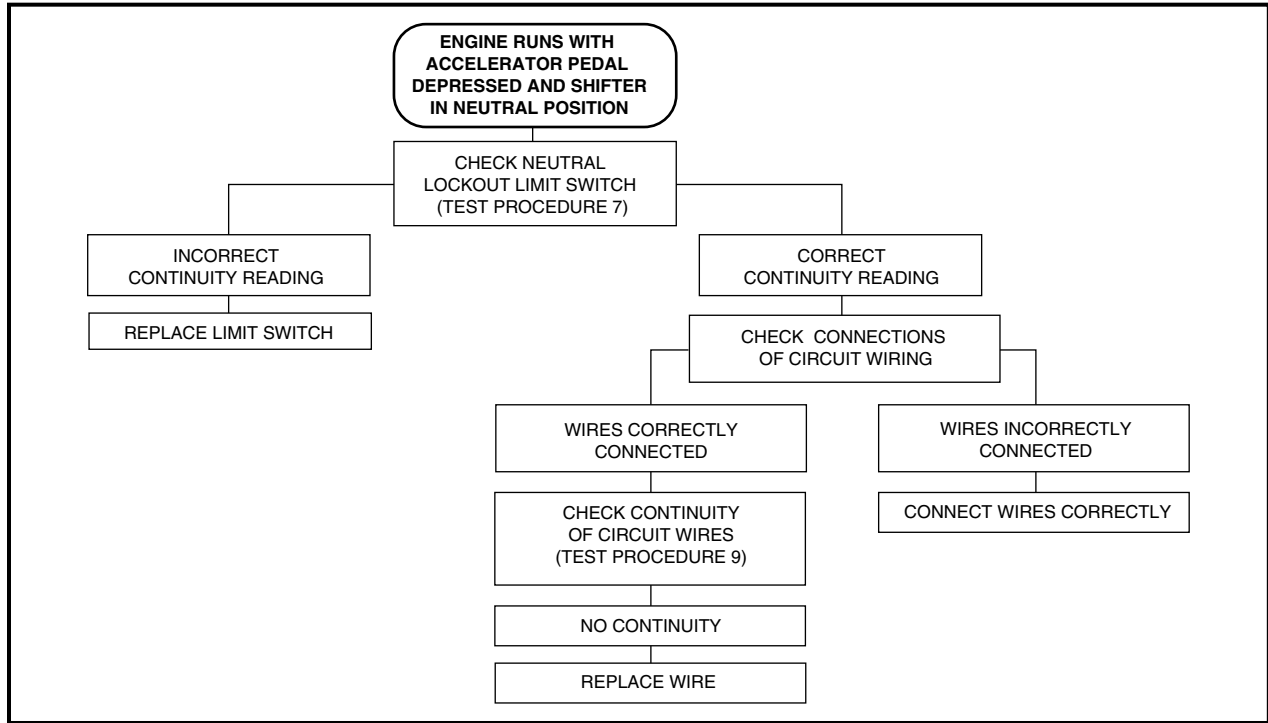


Figure 11b-23 Testing the Neutral Lockout Circuit

TESTING THE FUEL GAUGE AND SENDING UNIT CIRCUIT

Read **DANGER** and **WARNING** on page 11b-1.

Use the chart (Figure 11b-24, Page 11b-21) to begin troubleshooting the fuel gauge and sending unit circuit.

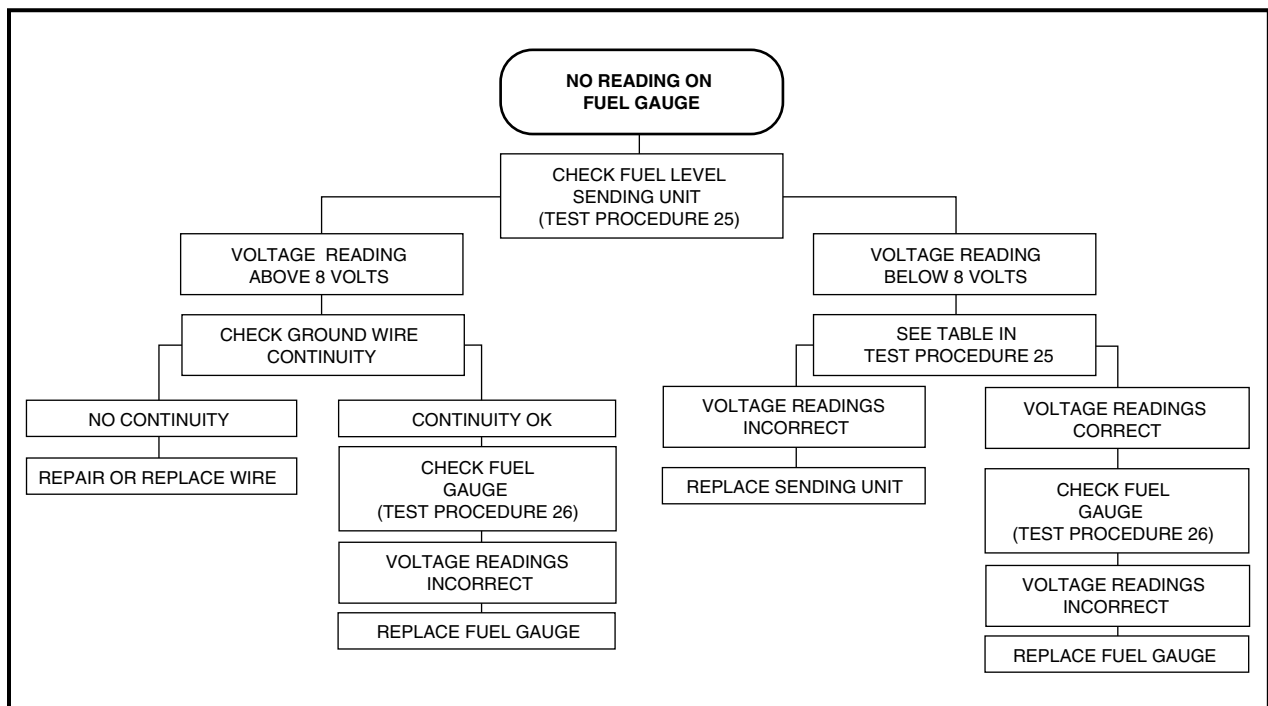


Figure 11b-24 Testing the Fuel Gauge and Sending Unit Circuit

TESTING THE LIGHTING CIRCUIT

Read DANGER and WARNING on page 11b-1.

Use the two charts below (Figure 11b-25, Page 11b-22 and Figure 11b-26, Page 11b-22) to begin troubleshooting the lighting circuit.

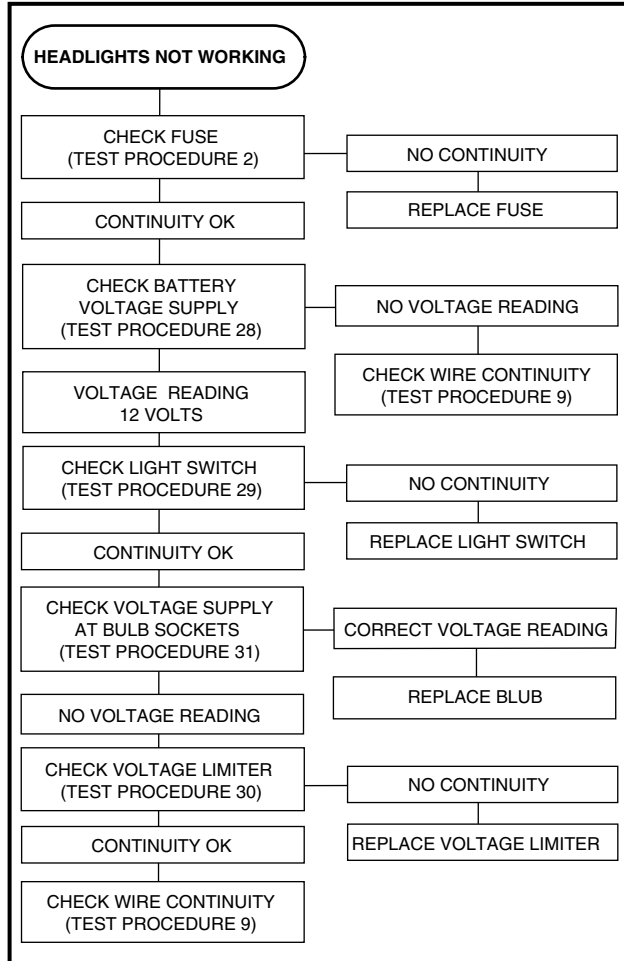


Figure 11b-25 Testing the Lighting Circuit – Chart 1

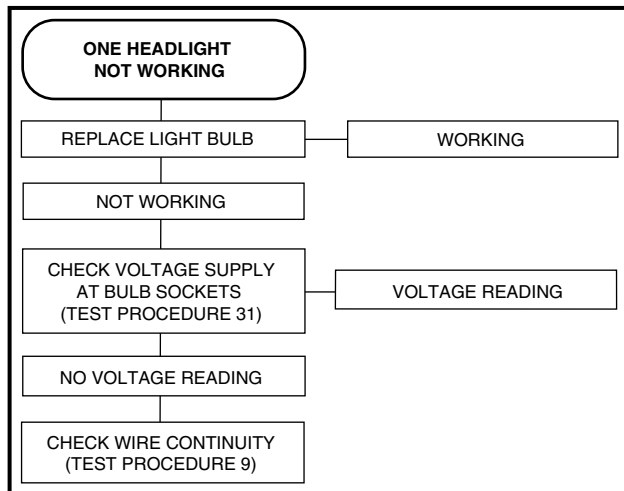


Figure 11b-26 Testing the Lighting Circuit – Chart 2

TEST PROCEDURES

INDEX OF TEST PROCEDURE

1. Battery
2. Fuse
3. Ground Cables
4. Key Switch (Starter Circuit)
5. Accelerator Pedal Limit Switch
6. Solenoid
7. Neutral Lockout Limit Switch
8. Starter/Generator (Starter Function)
9. Wire Continuity
10. Starter/Generator (Generator Function)
11. Voltage Regulator
12. Disconnected Kill Wire
13. Ignition Spark
14. RPM Limiter
15. Ignition Coil
16. Kill Limit Switch
17. Key Switch (Engine Kill Circuit)
18. Engine Kill Wire
19. Reverse Buzzer Limit Switch
20. Reverse Buzzer
21. Oil Level Sensor
22. Oil Warning Light
23. Neutral Lockout Cam
24. Battery Test (Under Load)
25. Fuel Level Sending Unit
26. Fuel Gauge
27. Hour Meter
28. Battery Voltage Supply
29. Light Switch
30. Voltage Limiter
31. Voltage at Headlight Socket

TEST PROCEDURE 1 – BATTERY

Read **DANGER** and **WARNING** on page 11b-1.

DANGER

- Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.
- **Battery—Explosive gases.** Keep sparks and flames away from vehicle and service area. Ventilate when charging or using in an enclosed space. Always wear eye protection when working on or near battery. For added protection, cover top of the battery when servicing the vehicle.
- **Battery—Poison/danger. Contains acid—Causes severe burns—Avoid contact with skin, eyes, or clothing.**
 - **External:** Flush with water. Call physician immediately.
 - **Internal:** Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call physician immediately.
 - **Eyes:** Flush with water for 15 minutes. Call physician immediately.

NOTE: The battery must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in Section 12a of this manual. **See Battery, Section 12b, Page 12b-32.**

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten, and replace connections as necessary.

TEST PROCEDURE 2 – FUSE

Read **DANGER** and **WARNING** on page 11b-1.

The fuse (red 10 amp) is located in the electrical component box.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and disconnect the battery cables, negative (–) cable first.
2. Remove the cover on the electrical component box.
3. Check that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Remove fuse to be tested from the fuse block. **See Fuse Removal, Section 12b, Page 12b-17.** The red 10 amp fuse protects the solenoid for the starter (cranking) circuit. The 20 amp fuse at the yellow wire connection protects the headlights.
5. Connect the probes of a multimeter set to 200 Ω (ohms) to the fuse terminals. There should be continuity. If there is no continuity, determine and repair the cause of the fuse failure. Replace the fuse with a properly rated new one.

Hydrometer Test

A hydrometer (CCI P/N 1011478) measures the specific gravity. The higher the specific gravity, the higher the state of charge of the battery. A fully charged battery should read between 1.250 and 1.280 at 80 °F (27 °C). Never add acid to the battery to obtain a higher specific gravity (**Figure 11b-27, Page 11b-25**).

CAUTION

- **Do not allow battery acid from battery caps or hydrometer to drip onto the body. battery acid will cause permanent damage. wash off immediately.**

Performing the Hydrometer Test

1. Be sure that the battery has sufficient water to cover the plates by approximately 1/2-inch (13 mm) and is fully charged prior to beginning the test. If water must be added, recharge the battery before performing the hydrometer test (**Figure 11b-28, Page 11b-25**).
2. Remove the vent cap.
3. Using a battery thermometer (CCI P/N 1011767), record the electrolyte temperature of a center cell.
4. Squeeze the rubber bulb of the hydrometer and insert into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
5. When the float rises off the bottom, adjust the electrolyte level so that the float rides free of the bottom but does not strike the bottom of the rubber bulb. Remove the hydrometer from the cell and release the pressure from the bulb.
6. Hold the hydrometer vertically, ensuring that the float is not contacting the sides of the glass tube. Hold the hydrometer at eye level and read the scale at the level of electrolyte (**Figure 11b-27, Page 11b-25**).
7. Record the reading.
8. Return the electrolyte to the cell from which it was taken. Replace vent cap.
9. Repeat steps 2 through 8 on all cells.

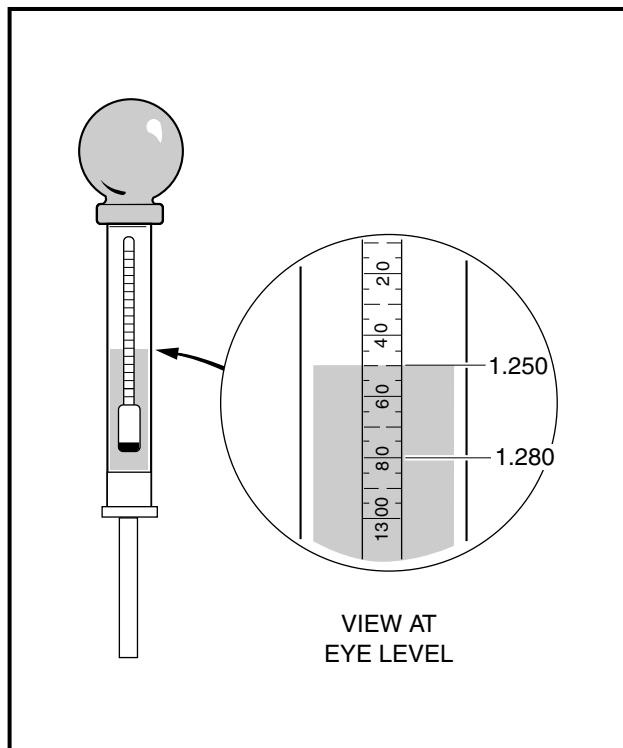


Figure 11b-27 Hydrometer Test

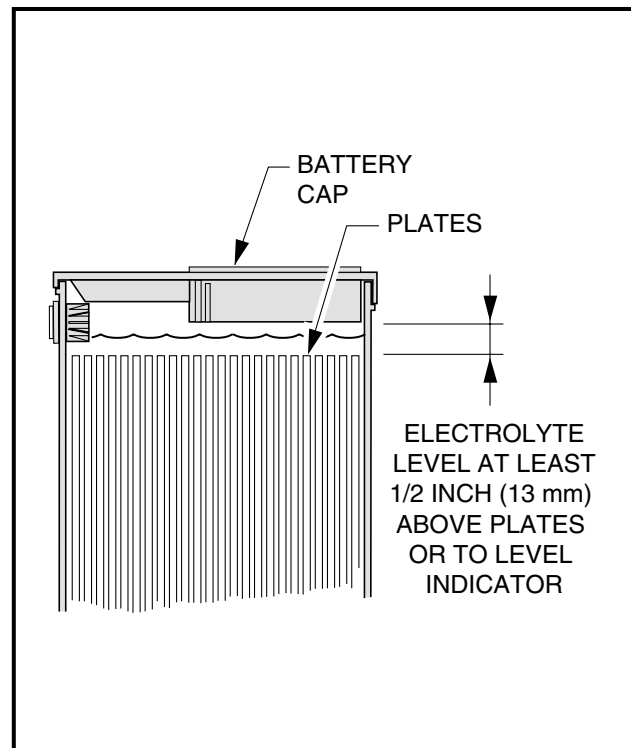


Figure 11b-28 Battery Electrolyte Level

Hydrometer Calibration

Most hydrometers are calibrated to read correctly at 80 °F (27 °C). The readings obtained as described above must be corrected for temperature. For each 10 °F (5.6 °C) above 80 °F (27 °C), add 0.004 to the reading. For each 10 °F (5.6 °C) below 80 °F (27 °C), subtract 0.004 from the reading.

Interpreting the Results of the Hydrometer Test

The approximate state of charge can be determined from the following table:

SPECIFIC GRAVITY (TEMPERATURE CORRECTED)	APPROXIMATE STATE OF CHARGE
1.250-1.280	100%
1.220-1.240	75%
1.190-1.210	50%
1.160-1.180	25%

If the difference between the cells is 0.020 or more, the low cell should be suspected. It may require a catch-up charge or it may be a weak cell. When the variations between cells reach 0.050 or more, the battery should be replaced.

Voltage Test

1. Place the red (+) probe of a multimeter set at Volts DC, 20 volt range, on the positive (+) post and place the black (-) probe on the negative (-) terminal of the battery and take a voltage reading. If it shows less than 12.4 volts, or if the lowest specific gravity reading from the hydrometer test is less than 1.225, recharge the battery. If battery voltage is greater than 12.4 volts and specific gravity is greater than 1.225, the problem is not with the battery. If the battery does not reach 12.4 volts, or if the specific gravity of a cell is still less than 1.225 after charging, replace the battery. **See following NOTE.**

NOTE: A fully charged battery that is in good condition should have a specific gravity of at least 1.225 in all cells, and the difference in the specific gravity of any two cells should be less than 50 points. Open circuit voltage should be at least 12.4 volts.

Load Test

1. Using a 160 ampere load tester, connect the load tester to the battery posts.
2. Turn the switch on the load tester to the ON position.
3. Read the battery voltage after the load tester has been turned ON for 15 seconds. Compare the battery's voltage reading with the table below. Make sure you have the correct ambient temperature.
4. If the battery is found to be good, or if the electrical problem continues after the battery has been replaced with a good one, test the electrical circuits.

IF TEMPERATURE IS	MINIMUM CRANKING VOLTAGE
70 °F (20 °C and above)	9.6 V
60 °F (16 °C)	9.5 V
50 °F (10 °C)	9.4 V
40 °F (4 °C)	9.3 V
30 °F (-1 °C)	9.1 V
20 °F (-7 °C)	8.9 V
10 °F (-12 °C)	8.7 V
0 °F (-18 °C)	8.5 V

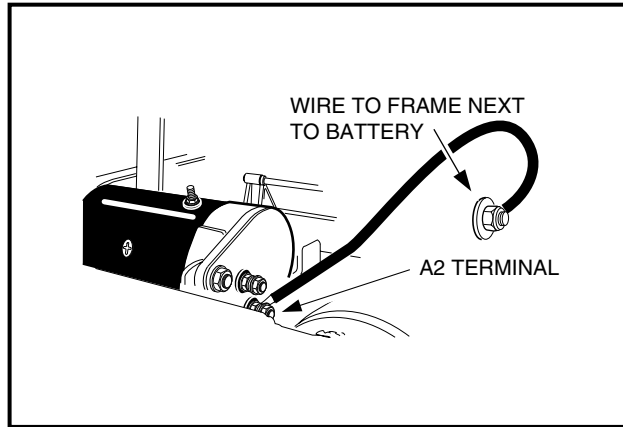


Figure 11b-29 Test Starter/Generator Ground Cable

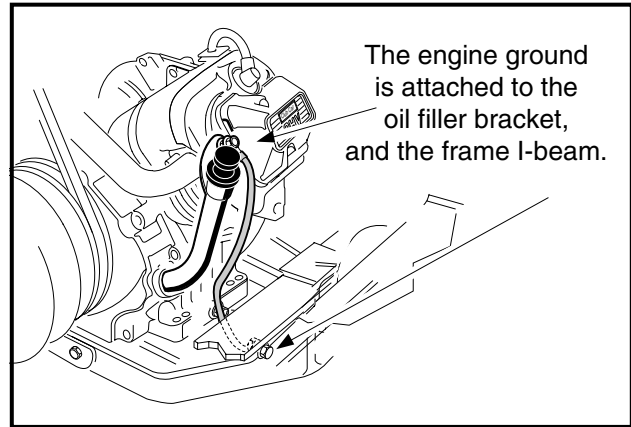


Figure 11b-30 Test Engine Ground Cable

TEST PROCEDURE 3 – GROUND CABLES

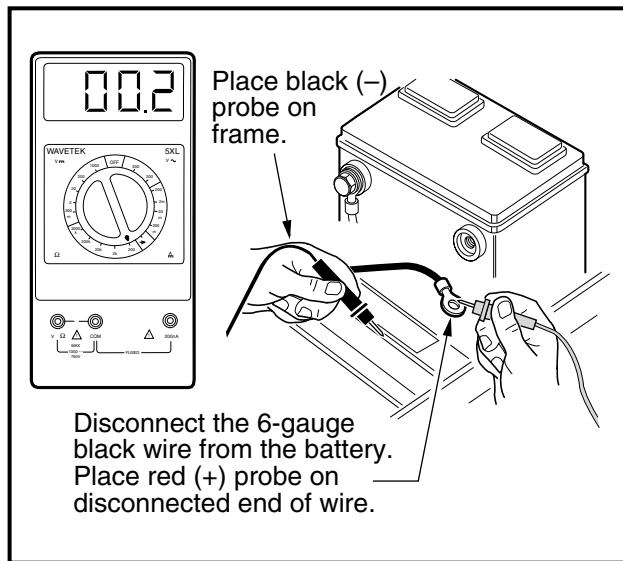
Read **DANGER** and **WARNING** on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Check the starter/generator ground cable.
 - 2.1. Set the multimeter to 200 Ω (ohms). Place the red (+) probe on the (A2) terminal of the starter/generator and place the black (–) probe on the vehicle frame (**Figure 11b-29, Page 11b-27**). The reading should be continuity. If the reading is incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.
3. Check the engine ground cable.
 - 3.1. Place the red (+) probe of the multimeter on the ground cable terminal end located on the oil filler bracket on the engine (**Figure 11b-30, Page 11b-27**). Place the black (–) probe on the vehicle frame. The reading should be continuity. If the reading is incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.
4. Check voltage regulator ground connection (at battery frame ground). Make sure it is clean and tight.
5. Check the battery ground cable.
 - 5.1. A 6-gauge black wire connects the negative battery post to the frame. The frame connection should be clean and tight. Visual inspection of the connection on the frame is very difficult. The best check for tightness is to pull on the black wire. If the wire moves at the connection end, disassemble the frame connection and clean the bolt, ring terminal, and nut. Reinstall the frame connection.
 - 5.2. Set the multimeter to 200 Ω (ohms). Place the red (+) probe on the unconnected end of the 6 gauge black wire, and place the black (–) probe on the vehicle frame (**Figure 11b-31, Page 11b-28**). The reading should be continuity. If the reading is incorrect, check that terminal connections are clean and tight. If the connections are good and the reading is incorrect, repair or replace the wire.

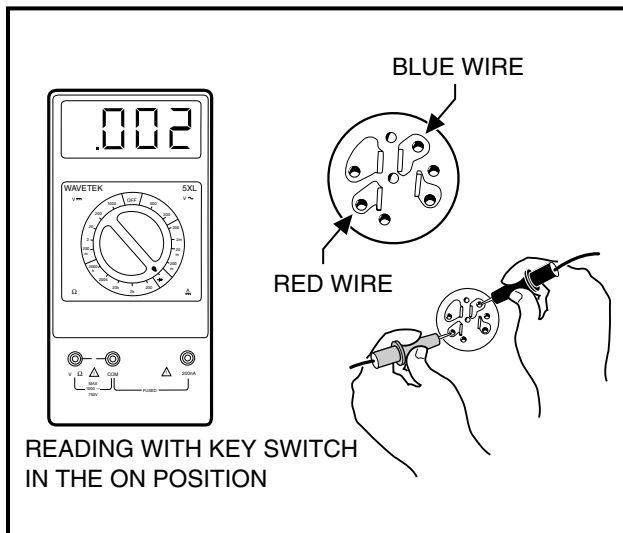
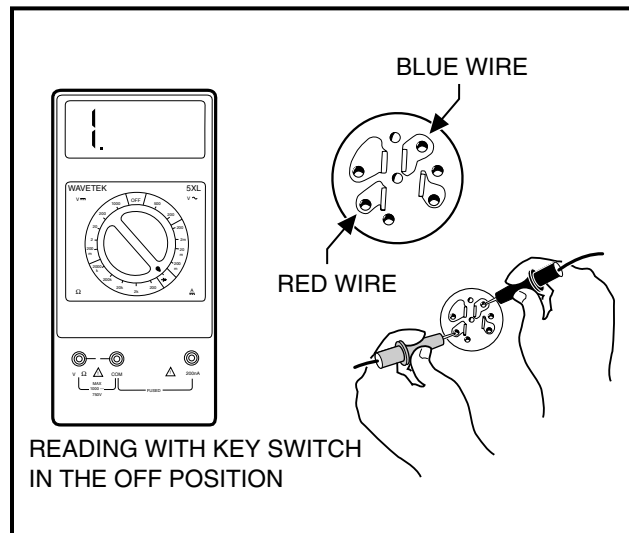
TEST PROCEDURE 4 – KEY SWITCH (STARTER CIRCUIT)

Read **DANGER** and **WARNING** on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse shifter handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12b, Page 12b-14.**
3. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.
4. Insert the key and turn the key to the ON position.

Test Procedure 4 – Key Switch (Starter Circuit), Continued:**Figure 11b-31 Test Battery Ground Strap**

5. Place the red (+) probe of the multimeter on the red wire terminal and the black (-) probe on the blue wire terminal of the key switch (**Figure 11b-32, Page 11b-28**). The reading should be continuity. If the reading is incorrect, replace the key switch. **See Key Switch Removal, Section 12b, Page 12b-14.**
6. Turn the key to the OFF position.

**Figure 11b-32 Test Key Switch Starter Circuit—Key Switch ON****Figure 11b-33 Test Key Switch Starter Circuit—Key Switch OFF**

7. Place the red (+) probe of the multimeter on the red wire terminal and the black (-) probe on the blue wire terminal of the key switch (**Figure 11b-33, Page 11b-28**). The reading should be no continuity. If the reading is incorrect, replace the key switch. **See Key Switch Removal, Section 12b, Page 12b-14.**

TEST PROCEDURE 5 – ACCELERATOR PEDAL LIMIT SWITCH

Read **DANGER** and **WARNING** on page 11b-1.

The accelerator pedal limit switch is the top switch located in the electrical component box. There is an 18-gauge green wire and an 18-gauge orange wire connected to this limit switch.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Check for proper wiring and tight connections (**Figure 11b-4, Page 11b-10**).
3. Set the multimeter to 200 Ω (ohms). Place the red (+) probe on the common (COM) terminal (green wire) of the limit switch and place the black (–) probe on the normally closed (NC) terminal (orange wire) of the limit switch.
4. Make sure the battery is disconnected. With the key switch in the OFF position, the Forward/Reverse handle in NEUTRAL, and the accelerator pedal in the UP position, the reading should be no continuity. With the accelerator pedal depressed, the reading should be continuity. If readings are incorrect, replace the switch.

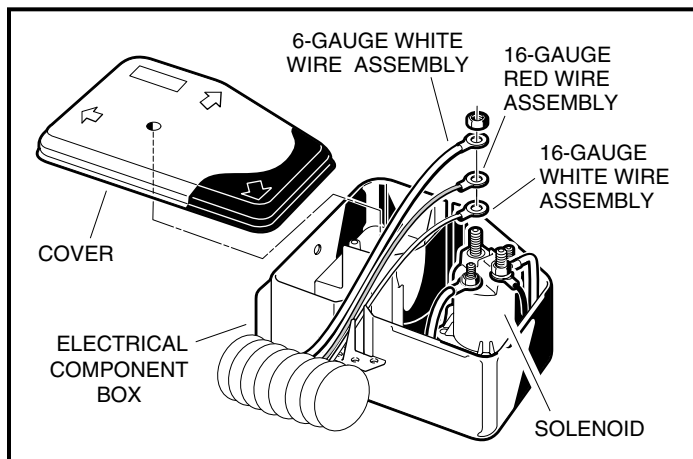


Figure 11b-34 Remove Solenoid Wires

TEST PROCEDURE 6 – SOLENOID

Read **DANGER** and **WARNING** on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Remove the electrical component box cover.
3. Check that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Set a multimeter to 200 Ω (ohms). Place the red (+) probe on one of the small posts of the solenoid and place the black (–) probe on the other small post. The reading should be 14 to 16 Ω (ohms). If the reading is not within limits, replace the solenoid.
5. Remove the 6-gauge white wire, 16-gauge red wire, and 16-gauge white wire from the large post of the solenoid. Do not allow the wires to touch the frame or other components of the vehicle (**Figure 11b-34, Page 11b-29**).
6. Set the multimeter to 200 Ω (ohms). Connect the red (+) probe to one of the large posts of the solenoid and connect the black (–) probe to the other large post (**Figure 11b-35, Page 11b-30**).
7. Connect the battery, positive (+) cable first.

8. Place the Forward/Reverse handle in NEUTRAL and place the neutral lockout cam in the SERVICE position. Turn the key switch to the ON position. With the accelerator in the up position, the reading on the multimeter should be no continuity. Depress the accelerator pedal and listen for the solenoid click. There should be continuity. If either reading is incorrect, replace the solenoid.
9. With the Forward/Reverse handle still in NEUTRAL and the neutral lockout cam in the SERVICE position, set the multimeter to 20 volts DC and place the red (+) probe on the large post that does *not* have wires connected to it. Place the black (-) probe on the vehicle frame. Turn key switch to the ON position, depress accelerator pedal, and listen for solenoid click. The meter should read full battery voltage. If the reading is incorrect, replace the solenoid (**Figure 11b-36, Page 11b-30**).
10. Disconnect the 6-gauge black wire from the negative post of the battery before reconnecting the wires to the solenoid.
11. Connect the solenoid. **See Fuse Installation, Section 12b, Page 12b-17. See following WARNING.**

⚠ WARNING

- **Incorrect wiring could result in severe injury or death.**
- **Diode and solenoid connections must have correct polarity.**
- **Keep all persons clear of engine belts when making final connections.**

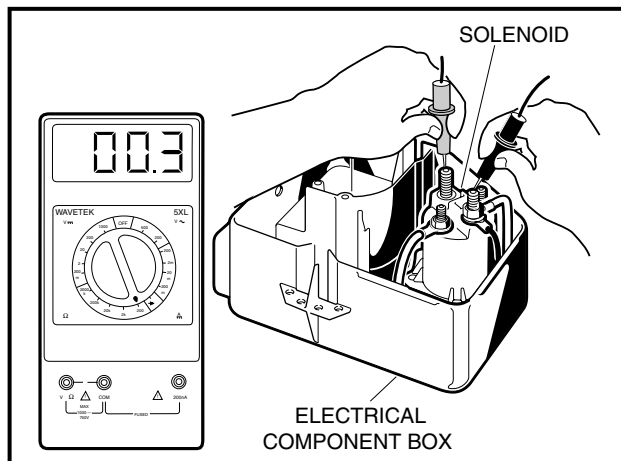


Figure 11b-35 Test Solenoid Continuity

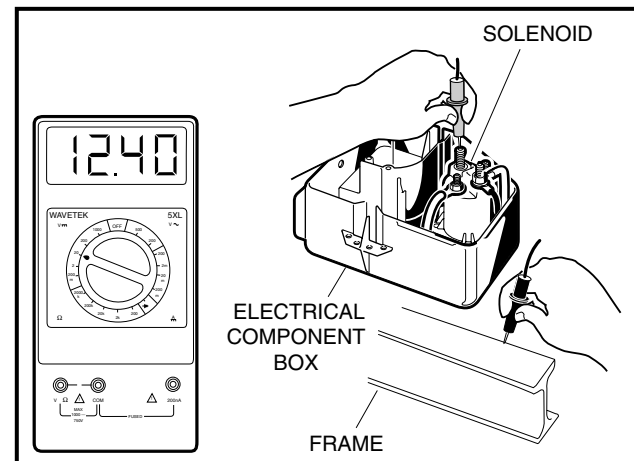


Figure 11b-36 Test Solenoid Ground

TEST PROCEDURE 7 – NEUTRAL LOCKOUT LIMIT SWITCH

Read **DANGER** and **WARNING** on page 11b-1.

This switch is located on the Forward/Reverse switch assembly. A black wire, a green wire, and a white wire are connected to this limit switch (**Figure 11b-4, Page 11b-10**).

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. Check for proper wiring and tight connections.
3. Set the multimeter to 200 Ω (ohms). Place the red (+) probe of the multimeter on the common (COM) terminal of the limit switch. Place the black (-) probe on the normally open (NO) terminal of the limit switch. Without the lever depressed, the reading should be no continuity. Depress the lever, and the reading should be continuity. If either reading is incorrect, replace the limit switch (**Figure 11b-37, Page 11b-31**).

4. Check to be sure the lobes on the cam are depressing the neutral lockout limit switch as the Forward/Reverse shifter is being shifted. The limit switch should make an audible click as it is depressed. If it does not, check for wear on the cam lobes. Be sure the cam snaps fully back into place. If the cam lobes still do not activate the limit switch, replace the cam.

TEST PROCEDURE 8 – STARTER/GENERATOR (STARTER FUNCTION)

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Engine rotation (clockwise) is as viewed from the clutch side of the engine.

1. Turn the key switch OFF, place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. Check that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.

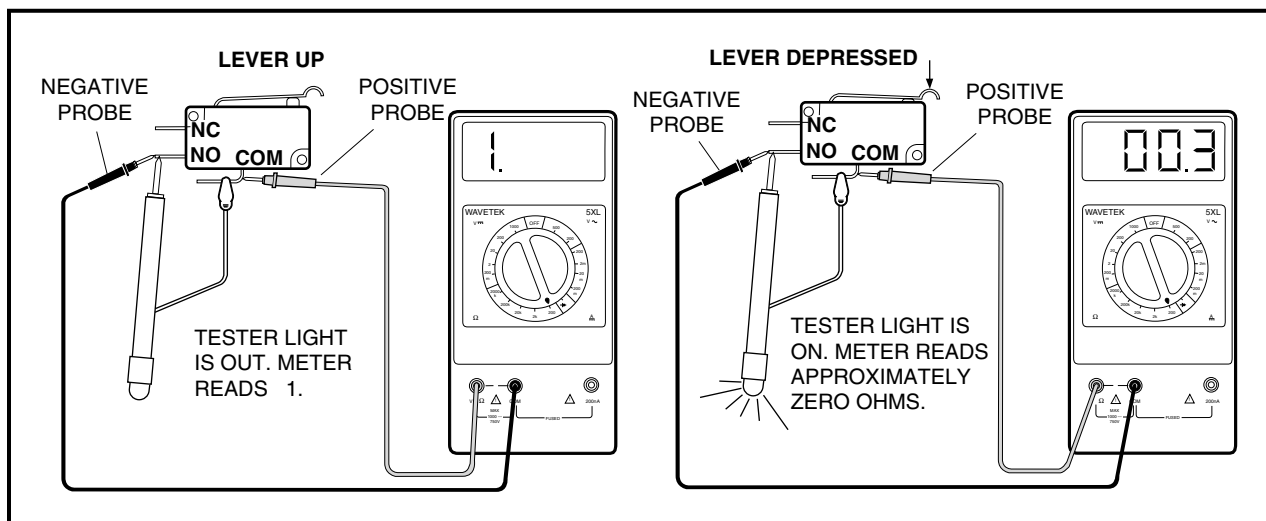


Figure 11b-37 Test Neutral Lockout Switch

3. Disconnect the wires from all the terminals on the starter/generator. Then place the black (-) probe of a multimeter, set to 200 Ω (ohms), on the starter/generator housing (scratch through the finish to ensure a good ground). While holding the black probe against the housing, place the red (+) probe (one at a time) on the A1, A2, F1, F2 and DF terminals respectively (**Figure 11b-38, Page 11b-32**). The readings should be no continuity. If the readings are incorrect, the starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 12b, Page 12b-2.**
 - An incorrect reading from the A1 or A2 terminal indicates three possible problems: 1) a grounded A1 or A2 terminal, 2) a grounded wire in the brush area, or 3) a grounded armature/commutator.
 - If the F1 or F2 reading is incorrect, it indicates a possible grounded F1 or F2 terminal or a grounded field coil.
 - If the DF reading is incorrect, it indicates a possible grounded DF terminal or a grounded field coil.
4. Disconnect the ground wire from the A2 terminal and the green wire from the A1 terminal on the starter/generator.

Test Procedure 8 – Starter/Generator (Starter Function), Continued:

5. Using a multimeter set to 200 Ω (ohms), place the red (+) probe on the A1 terminal and the black (–) probe on the A2 terminal. The reading should be continuity. If the reading is incorrect, a possible open or poor contact in a brush assembly and/or open armature windings may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 12b, Page 12b-2.**
6. With the wires still disconnected, using a multimeter set on 200 Ω (ohms), place the red (+) probe on the F1 terminal and the black (–) probe on the F2 terminal. The reading should be between approximately 0.1 and 0.3 Ω (ohms). If the reading is incorrect, a possible open field coil or bad connections at terminals may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 12b, Page 12b-2.**
7. With the wires still disconnected, using a multimeter set to 200 Ω (ohms), place the red (+) probe on the DF terminal and the black (–) probe on the F1 terminal. The reading should be between 4.5 and 5.5 Ω (ohms). If the reading is incorrect, a possible grounded DF terminal and/or grounded field coil may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 12b, Page 12b-2.**

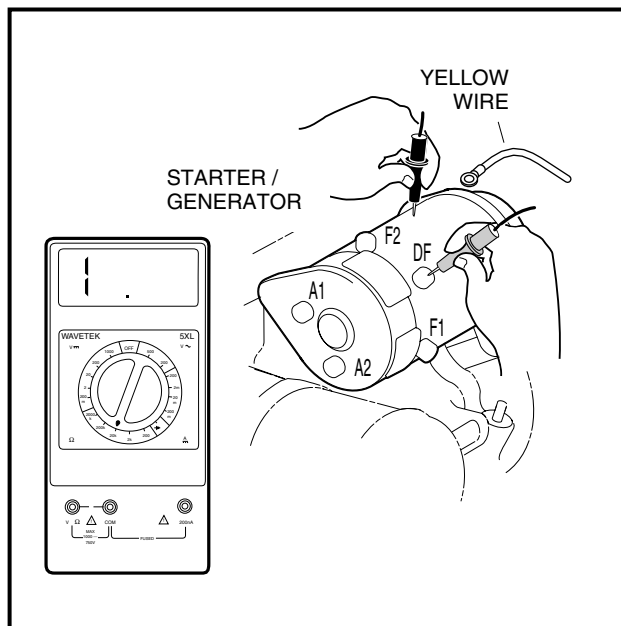


Figure 11b-38 Check Starter Terminal Continuity

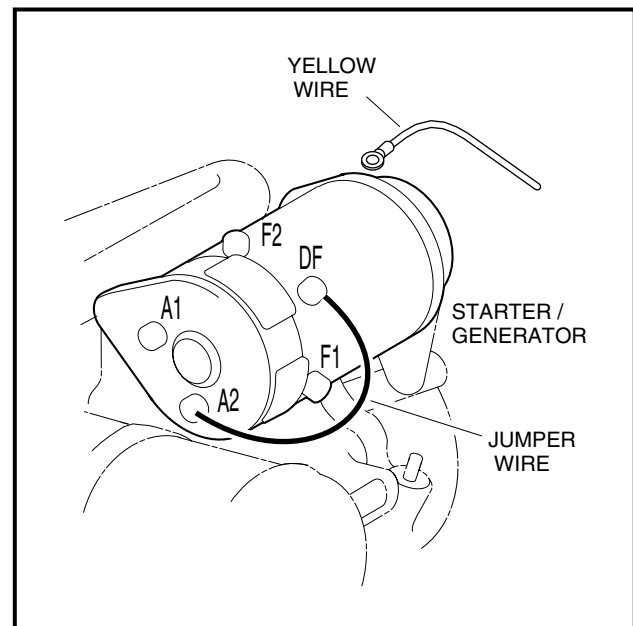


Figure 11b-39 Jumper Wire Ground – DF to A2

TEST PROCEDURE 9 – WIRE CONTINUITY

Read DANGER and WARNING on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. To test a wire for continuity, disconnect either end from the electrical component it is attached to.
3. Set the multimeter to 200 Ω (ohms) and place the red (+) probe on the terminal at one end of the wire. Place the black (–) probe on the other terminal end of the wire. The reading should be continuity. If the reading is incorrect, repair or replace the wire.

TEST PROCEDURE 10 – STARTER/GENERATOR (GENERATOR FUNCTION)

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Disconnect the yellow wire from the DF terminal on the starter/generator. Cover the connector on the yellow wire to make sure the yellow wire will not short to ground. Then, using a jumper wire, ground the DF terminal to the A2 terminal (**Figure 11b-39, Page 11b-32**).
4. Using a multimeter set to 20 volts DC, place the red (+) probe on the positive (+) post of the battery, and place the black (–) probe on the negative (–) post. Turn the key switch to the ON position, and depress the accelerator pedal to start the engine. Run the engine at full governed speed. The reading should show the voltage rising on the meter. If the voltage rises, see Test Procedure 11 – Voltage Regulator on page 11b-33. If the voltage does not rise, a tear-down inspection of the starter/generator will be necessary. **See Starter/Generator Removal, Section 12b, Page 12b-2.**
5. Connect the yellow wire to the DF terminal on the starter/generator.

TEST PROCEDURE 11 – VOLTAGE REGULATOR

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Perform Test Procedure 10 before proceeding with this test procedure.

Keep the battery connected while performing Test Procedure 11.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Check that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Check the engine RPM setting to ensure that it is adjusted correctly. **See Engine RPM Adjustment, Section 14, Page 14-14.**
4. With the battery in good condition and fully charged, run the engine for several minutes to bring the voltage regulator to operating temperature.
5. Turn the key switch to the OFF position, killing the engine. Using a multimeter set to 20 volts DC, place the red (+) probe on the large post of the solenoid with the red wire from the voltage regulator attached. Place the black (–) probe on the negative (–) battery post (**Figure 11b-40, Page 11b-34**). Turn the key switch to the ON position. Depress the accelerator to start the engine and run it at full governed speed. If the reading is between 14.7 and 15.3 volts, the regulator is good. If the reading is lower than 14.7 volts but rising steadily, check battery condition. **See Hydrometer Test on page 11b-24.** If the reading is lower than 14.7 volts and not rising, and the starter/generator is good; or if the reading is over 15.3 volts and continues to rise, replace voltage regulator. **See Voltage Regulator Removal, Section 12b, Page 12b-13.**

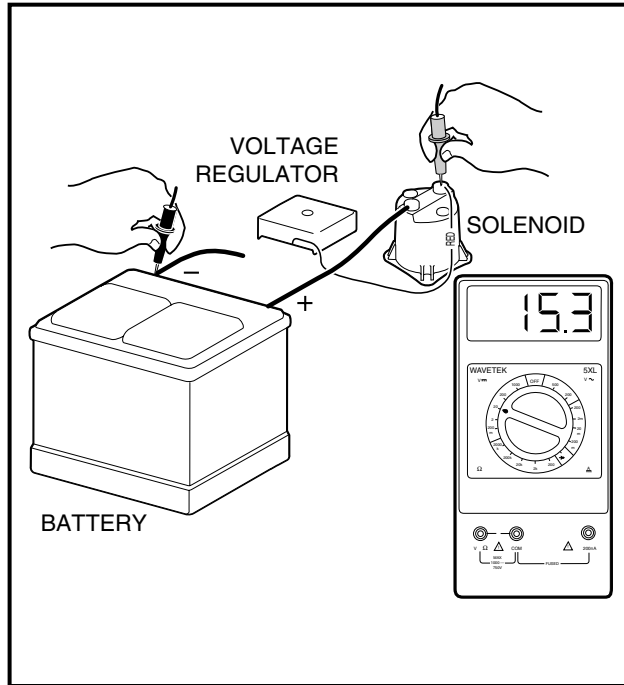


Figure 11b-40 Test Voltage Regulator

TEST PROCEDURE 12 – DISCONNECTED KILL WIRE

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Disconnect the engine-kill white/black wire at the bullet connector located next to the RPM limiter (**Figure 11b-42, Page 11b-35**).
3. With the neutral lockout cam placed in the SERVICE position and the wheels chocked, connect the 6-gauge red wire to the positive (+) post on the battery, then connect the 6-gauge black wire to the negative (-) post.
4. Turn the key switch to the ON position and depress the accelerator pedal to start the engine.
5. If the engine begins to run, test the engine kill circuit for a shorted wire or other failed components in the engine kill circuit. **See Testing the Engine Kill Circuit on page 11b-17. See following WARNING.**

⚠ WARNING

- When the white/black engine kill wire is disconnected, the engine will not stop running after the accelerator pedal is released. It will be necessary to pull and hold the choke handle until the engine stops running.

6. If the engine does not run, proceed to Test Procedure 13 – Ignition Spark on page 11b-35.

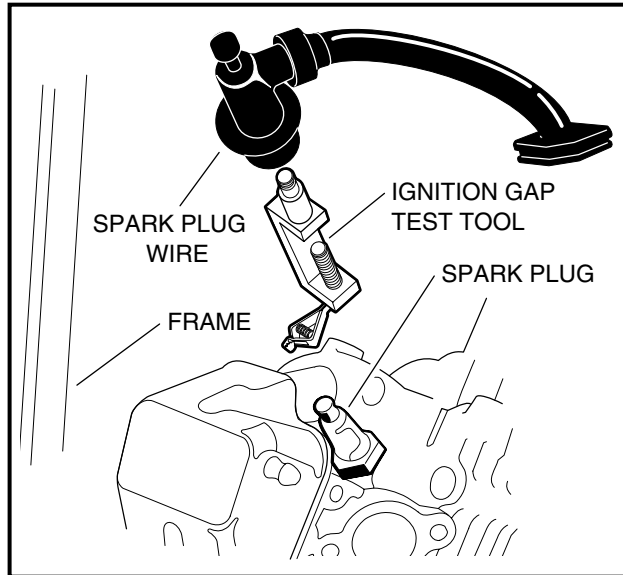


Figure 11b-41 Ignition Spark Test

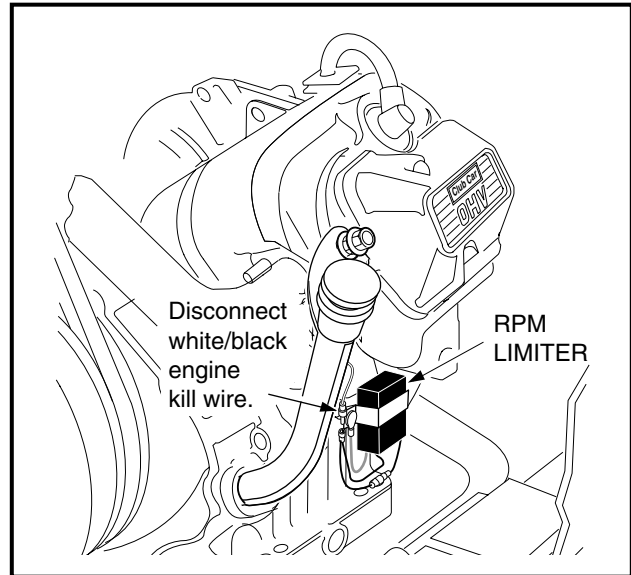


Figure 11b-42 Disconnect White/Black Engine Kill Wire

TEST PROCEDURE 13 – IGNITION SPARK

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Remove the plug wire from the spark plug. Using an ignition spark gap test tool (Thexton 404[®] or equivalent), check for correct spark (**Figure 11b-41, Page 11b-35**).
 - 2.1. Adjust the tester probes to approximately to 18,000 volts (18 Kv) setting (SE – Small Engine Setting on the Thexton 404 tool). Connect the tester to the spark plug wire, and connect the alligator clip to a solid engine ground.
 - 2.2. Start the engine. There should be a strong blue spark between the probes of the spark gap tester. If there is no spark, or if the spark is a faint yellow or red color, test components of the ignition circuit.
3. If the spark gap tester tool indicates a strong blue spark, it is possible the spark plug has failed internally. Check the spark plug gap. The gap should be set at 0.027 to 0.031 inch (.69 to .79 mm). If the gap is correct, replace the spark plug with a new part and test the engine for proper operation.

TEST PROCEDURE 14 – RPM LIMITER

Read **DANGER** and **WARNING** on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Disconnect both of the bullet terminals (**Figure 11b-43, Page 11b-36**).
3. Using a multimeter set to 200 Ω (ohms), place the red (+) probe on the brown ground wire and place the black (–) probe on one of the black wire female bullet connectors. The reading should be no continuity. If the reading is not correct, replace the RPM limiter.

Test Procedure 14 – RPM Limiter, Continued:

- This test will find most bad RPM limiters. Some of them may bench test okay but fail under a load due to heat while operating. Another method of testing is to replace the RPM limiter and then run the engine. If the engine runs properly, keep the new RPM limiter in the circuit.

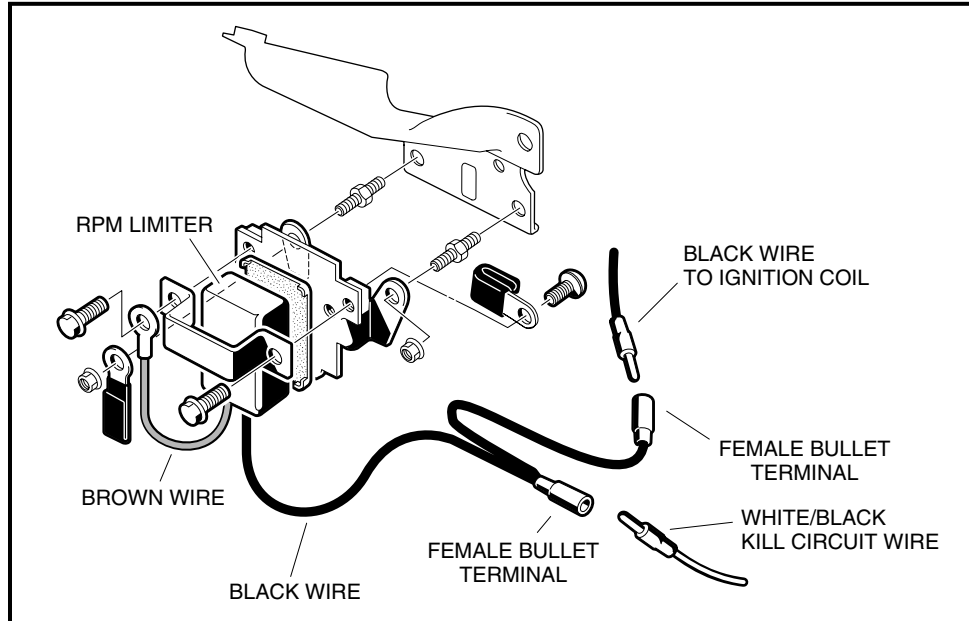


Figure 11b-43 RPM Limiter

TEST PROCEDURE 15 – IGNITION COIL**Read DANGER and WARNING on page 11b-1.**

The following test procedures will properly detect a coil that has failed in most cases; however, in rare cases, some ignition coils can fail to operate at normal (warmer) operating temperatures. If the ignition coil has tested okay in the vehicle and on the bench, but fails to operate reliably, replace the coil with a known good coil and operate the engine for several minutes to ensure that the coil functions at normal operating temperature. If the new coil functions properly, keep the new coil in the circuit.

Ignition Coil – In Vehicle Test

- Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and disconnect the battery cables, negative (–) cable first.
- Using a multimeter set to 200 Ω (ohms), measure the primary coil resistance.
 - Disconnect both of the bullet terminals at the RPM limiter (**Figure 11b-44, Page 11b-37**). Place the red (+) probe of the meter on the male bullet terminal of the wire connecting to the ignition coil under the fan housing, and place the black (–) probe on a clean unpainted surface of the engine or frame (**Figure 11b-44, Page 11b-37**).
 - If the resistance is not between 0.6 - 1.7 Ω (ohms), bench test the ignition coil. **See Ignition Coil – Bench Test on page 11b-39.**
- Using a multimeter set to 20k Ω (ohms), measure the resistance of the secondary coil and spark plug cap together.
 - Place the red (+) probe of the meter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe on a clean unpainted surface of the engine or frame (**Figure 11b-45, Page 11b-37**).

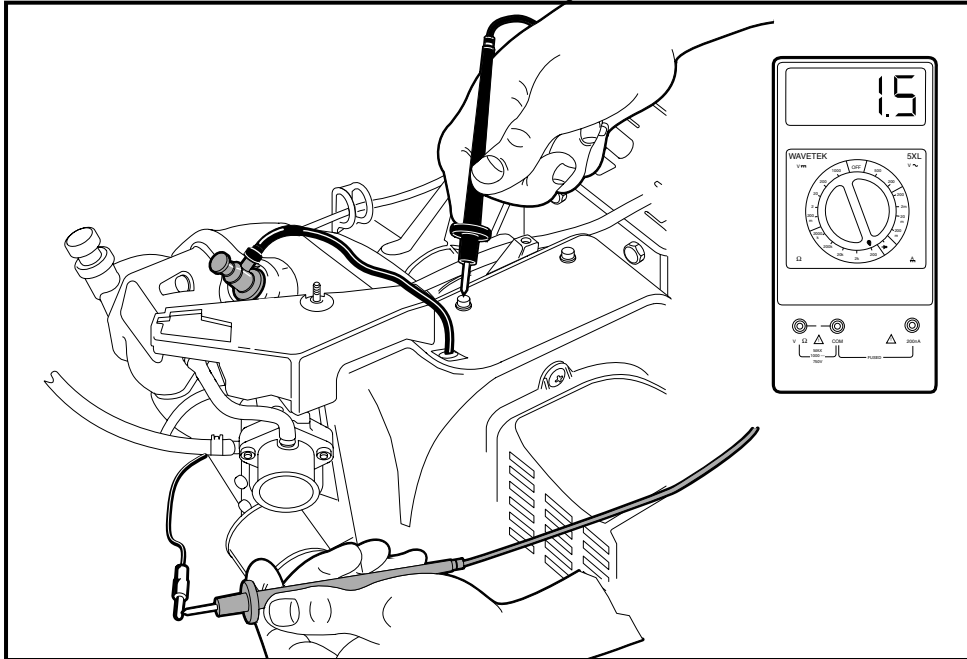


Figure 11b-44 Primary Coil Resistance – In Vehicle Test

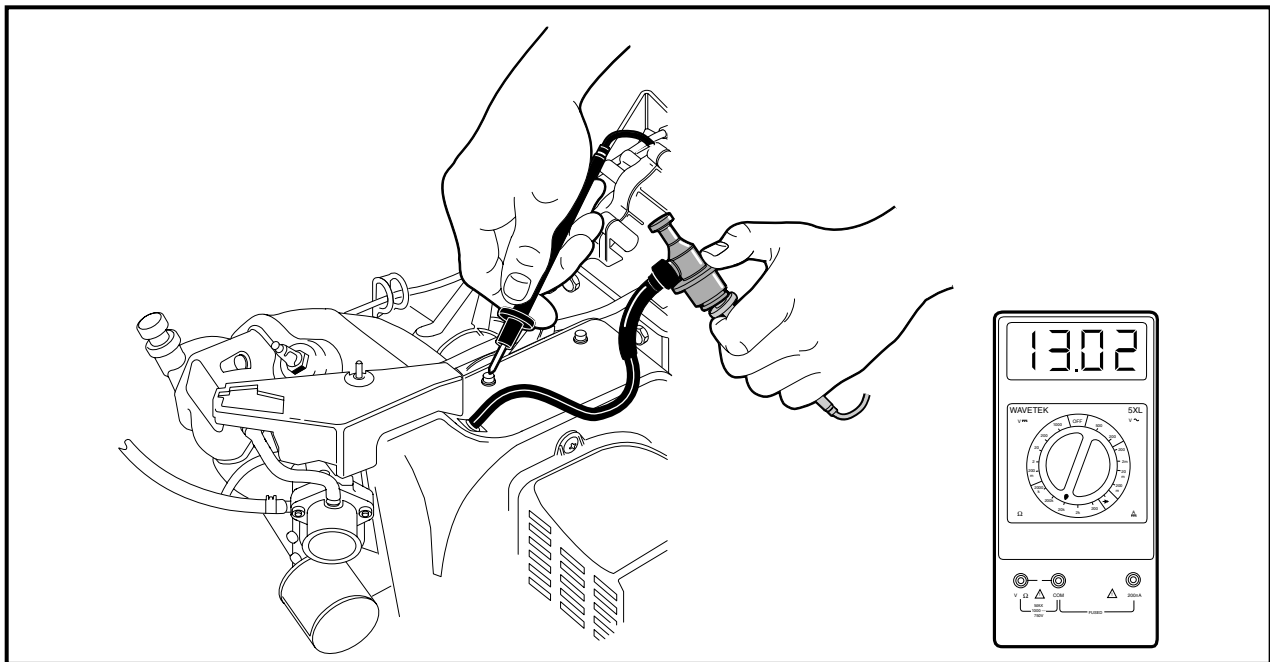


Figure 11b-45 Secondary Coil Test – In Vehicle Test

- 3.2. If the resistance is between 12.0k - 14.0k Ω (ohms), the secondary coil and spark plug cap are within acceptable limits; proceed to step 6 on page 11b-38. If the resistance is not between 12.0k - 14.0k Ω (ohms), the spark plug cap and secondary coil must be tested independently from each other.
4. Test the spark plug cap separately from the secondary coil.
 - 4.1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire (3) (**Figure 11b-46, Page 11b-38**).

Test Procedure 15 – Ignition Coil, Continued:

- 4.2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire (**Figure 11b-47, Page 11b-38**).

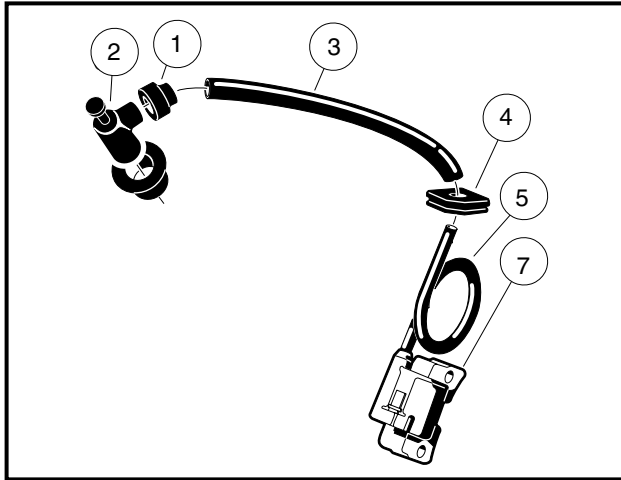


Figure 11b-46 Ignition Coil and Cap

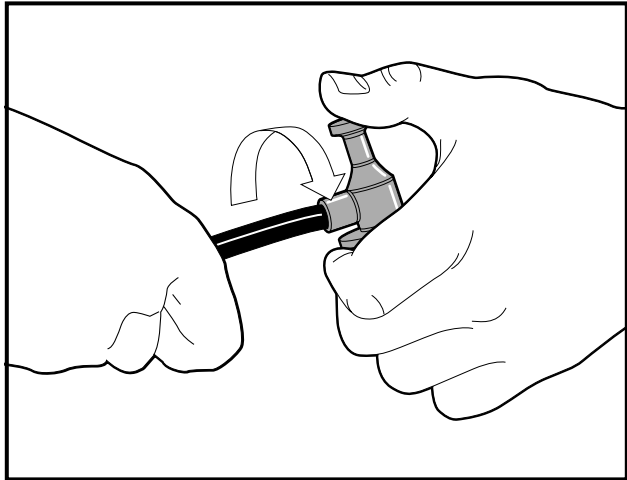


Figure 11b-47 Spark Plug Cap Removal

- 4.3. Using a multimeter set to 20k Ω (ohms), place the red (+) probe of the multimeter into the end of the spark plug cap that normally connects to the spark plug and place the black (-) probe into the end of the cap with the internal screw (**Figure 11b-48, Page 11b-38**). If the resistance is not between 4.5k - 6.0k Ω (ohms), the cap has failed and must be replaced. Proceed to the next step with the spark plug cap still removed.

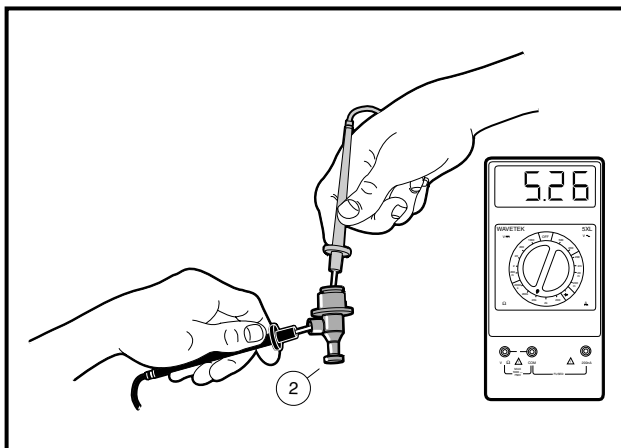


Figure 11b-48 Spark Plug Cap Test

5. Test the secondary coil separately from the spark plug cap.
- 5.1. Using a multimeter set to 20k Ω (ohms), place the red (+) probe of the meter into the end of the spark plug wire and place the black (-) probe on a clean unpainted surface of the engine or frame (**Figure 11b-49, Page 11b-39**). If the resistance is between 6.0k - 11.0k Ω (ohms), the secondary coil is within acceptable limits. If the resistance is not between 6.0k - 11.0k Ω (ohms), bench test the ignition coil. **See Ignition Coil – Bench Test on page 11b-39.**
6. If the preceding procedures indicate that the ignition coil resistance readings are within acceptable ranges, but the coil fails to function properly, proceed to the following bench test procedures.

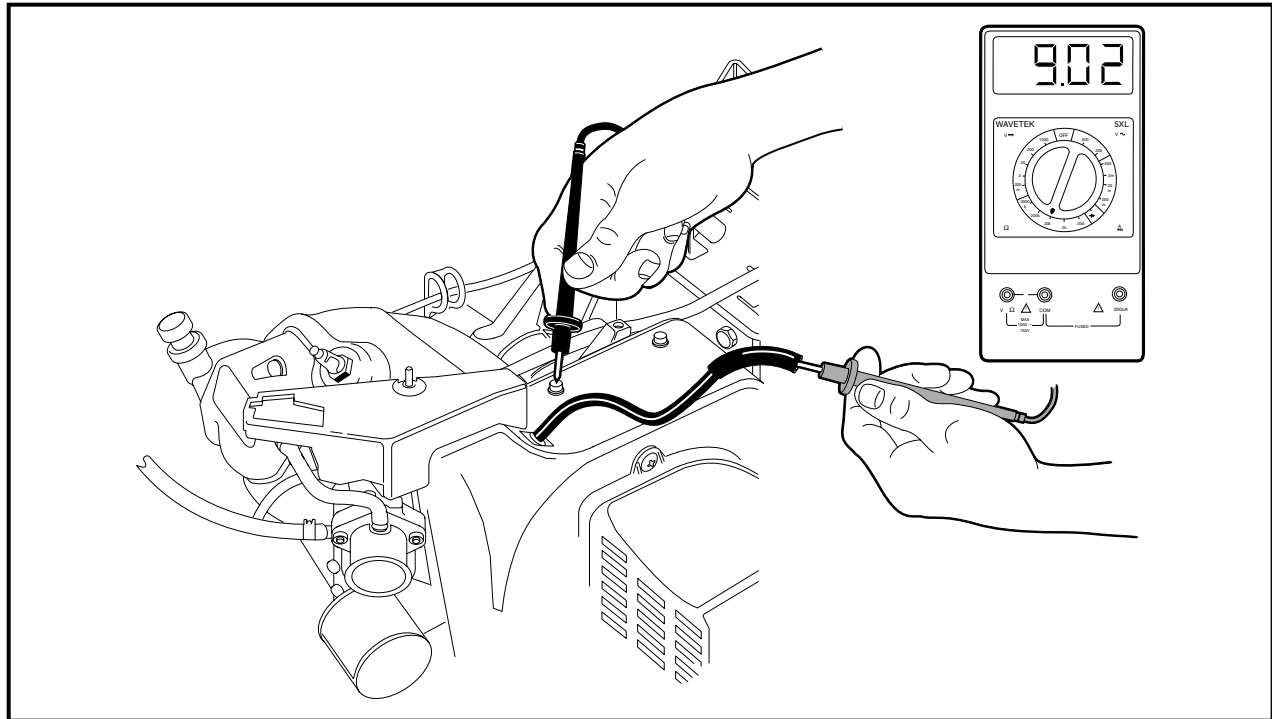


Figure 11b-49 Secondary Coil Test Without Cap

Ignition Coil – Bench Test

1. Remove the coil from the engine. **See Ignition Coil Removal, Section 12b, Page 12b-27.**
2. Using a multimeter set to 200 Ω (ohms), measure the primary coil resistance.
 - 2.1. Place the black (–) probe of the meter on the terminal on the ignition coil (1), and place the red (+) probe on the core (2) (**Figure 11b-50, Page 11b-40**).
 - 2.2. If the resistance is not between 0.6 - 1.7 Ω (ohms), replace the ignition coil.
3. Using a multimeter set to 20k Ω (ohms), measure the resistance of the secondary coil and spark plug cap together.
 - 3.1. Place the red (+) probe of the meter into the end of the spark plug cap that normally connects to the spark plug (3) and place the black (–) probe on the core (2) (**Figure 11b-51, Page 11b-40**).
 - 3.2. If the resistance is between 12.0k - 14.0k Ω (ohms), the secondary coil and spark plug cap are within acceptable limits; proceed to step 6 on page 11b-41. If the resistance is not between 12.0k - 14.0k Ω (ohms), the spark plug cap and secondary coil must be tested independently from each other.
4. If not previously tested, test the spark plug cap separately from the secondary coil.
 - 4.1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire (3) (**Figure 11b-46, Page 11b-38**).
 - 4.2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire (**Figure 11b-47, Page 11b-38**).
 - 4.3. Using a multimeter set to 20k Ω (ohms), place the red (+) probe of the multimeter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe into the end of the cap with the internal screw (**Figure 11b-48, Page 11b-38**). If the resistance is not between 4.5k - 6.0k Ω (ohms), the cap has failed and must be replaced. Proceed to the next step with the spark plug cap still removed.

Test Procedure 15 – Ignition Coil, Continued:

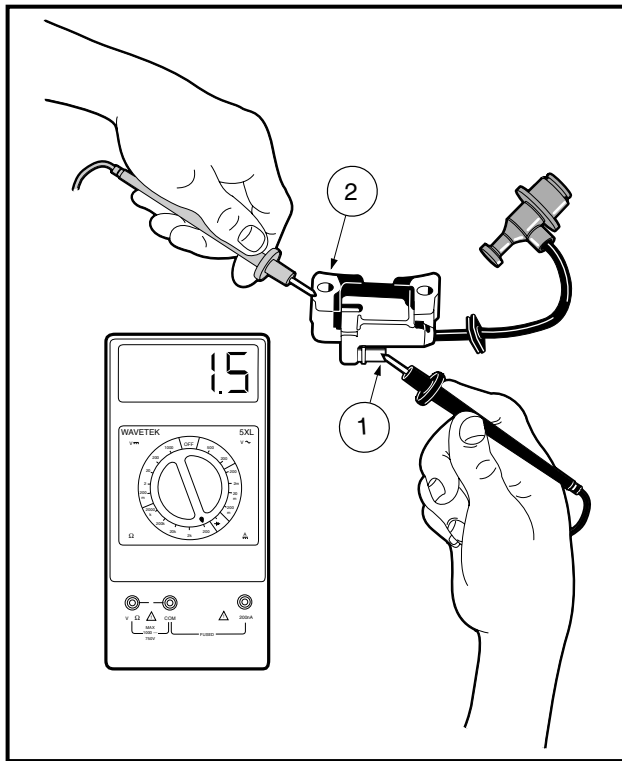


Figure 11b-50 Primary Coil Resistance – Bench Test

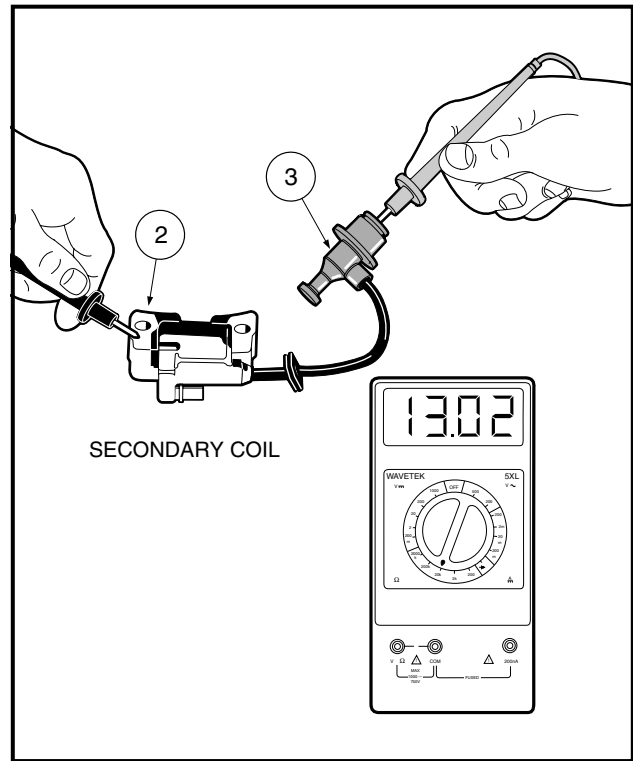


Figure 11b-51 Secondary Coil and Cap Resistance – Bench Test

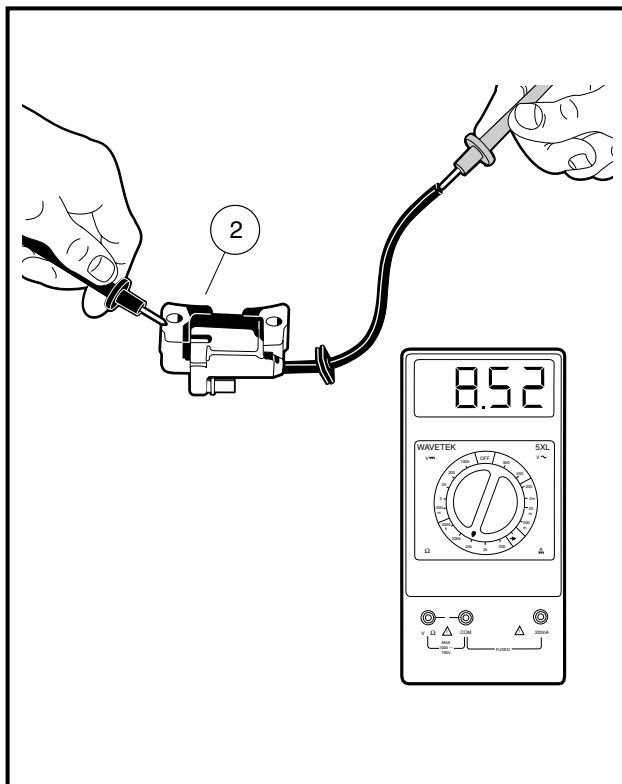


Figure 11b-52 Secondary Coil Resistance – Bench Test

5. Test the secondary coil separately from the spark plug cap.
 - 5.1. Using a multimeter set to 20k Ω (ohms), place the red (+) probe of the meter into the end of the spark plug wire and place the black (-) probe on the core (2) (**Figure 11b-52, Page 11b-40**). If the resistance is between 6.0k - 11.0k Ω (ohms), the secondary coil is within acceptable limits. If the resistance is not between 6.0k - 11.0k Ω (ohms), the ignition coil has failed and must be replaced.
6. If the preceding procedures indicate that the ignition coil resistance readings are within acceptable ranges, but the coil fails to function properly, replace the ignition coil and cap.

TEST PROCEDURE 16 – KILL LIMIT SWITCH

Read **DANGER** and **WARNING** on page 11b-1.

The kill limit switch is located inside the electrical component box. The accelerator kill switch is the lower of the two limit switches and has a white/black wire and black wire connected to it.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. Check for proper wiring and tight connections.
3. Disconnect the wires from the limit switch and test the limit switch for continuity. Place the red (+) probe of the multimeter on the common (COM) terminal (white/black wire) of the limit switch. Place the black (-) probe on the normally open (NO) terminal (black wire) of the limit switch. Without the lever depressed, the reading should be no continuity. Depress the lever, and the reading should be continuity. If either reading is incorrect, replace the limit switch (**Figure 11b-53, Page 11b-41**).

TEST PROCEDURE 17 – KEY SWITCH (ENGINE KILL CIRCUIT)

Read **DANGER** and **WARNING** on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12b, Page 12b-14.**
3. Remove the connector from the key switch.

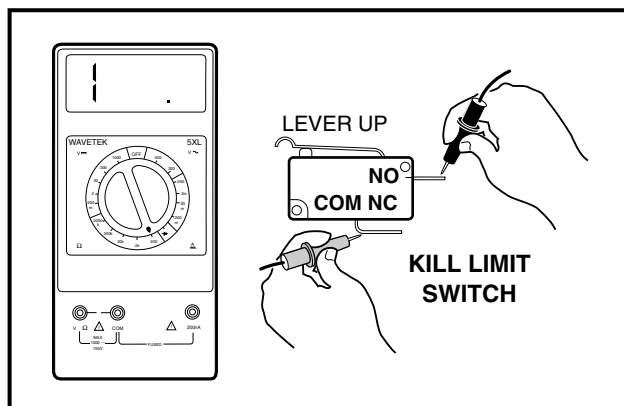


Figure 11b-53 Test Kill Limit Switch

Test Procedure 17 – Key Switch (Engine Kill Circuit), Continued:

- Using a multimeter, set to 200 Ω (ohms). Place the red (+) probe on the black wire terminal of the key switch and the black (-) probe on the white/black wire terminal. With the key switch OFF, the reading should be continuity (**Figure 11b-55, Page 11b-42**). With the key switch turned ON, the reading should be no continuity (**Figure 11b-54, Page 11b-42**). If either reading is incorrect, replace the key switch.
- Reconnect the connector to the key switch. Make sure the connector is tight.

TEST PROCEDURE 18 – ENGINE KILL WIRE

Read **DANGER** and **WARNING** on page 11b-1.

- Place the neutral lockout cam in the OPERATE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
- Disconnect white/black wire bullet connector located at the engine RPM limiter (**Figure 11b-42, Page 11b-35**).
- Connect red (+) probe of multimeter to the male bullet terminal on the white/black wire and connect the black (-) probe to the vehicle frame.

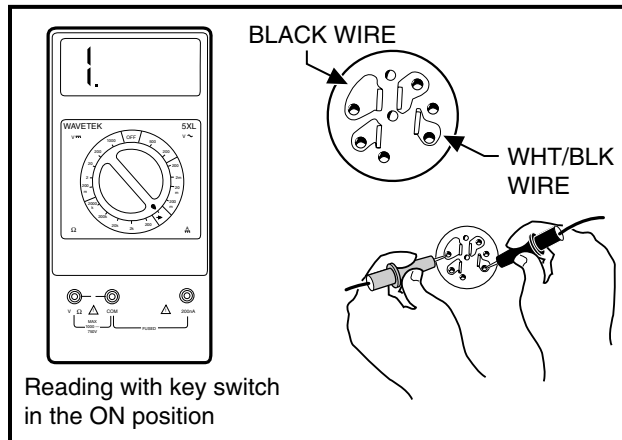


Figure 11b-54 Test Key Switch—Engine Kill Circuit—Key Switch ON

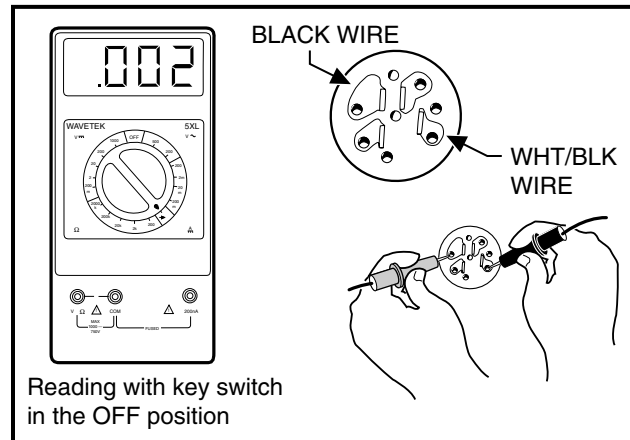


Figure 11b-55 Test Key Switch—Engine Kill Circuit—Key Switch OFF

- Turn the key switch ON, place the Forward/Reverse handle in FORWARD, and depress the accelerator pedal. There should be no continuity. If there is continuity, check for worn insulation on the white/black wire that is allowing the wire to ground to the frame.

TEST PROCEDURE 19 – REVERSE BUZZER LIMIT SWITCH

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Keep the battery connected while performing this test procedure.

The reverse buzzer limit switch is located on the Forward/Reverse shifter; red/white and orange wires are connected to it.

- Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
- Move the Forward/Reverse handle to REVERSE and listen for an audible click from the limit switch. If there is no click, check the switch for proper alignment and switch arm movement.

3. If the switch is being activated but the buzzer does not function, place the red (+) probe of the multimeter on one terminal and the black (-) probe on the other terminal of the limit switch (**Figure 11b-8, Page 11b-12**). Without the lever depressed, the reading should be no continuity. Depress the lever and the reading should be continuity. If either reading is incorrect, replace limit switch.

TEST PROCEDURE 20 – REVERSE BUZZER

Read **DANGER** and **WARNING** on page 11b-1.

The front reverse buzzer is mounted to the frame under the front body.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. Remove center dash panel. **See Key Switch Removal, Section 12b, Page 12b-14.**
3. Check for proper wiring and tight connections. Using a multimeter, individually check for continuity through each wire that connects to the reverse buzzer (**Figure 11b-8, Page 11b-12**). If the buzzer will not function when properly wired, replace the buzzer.

TEST PROCEDURE 21 – OIL LEVEL SENSOR

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, turn the key switch to the OFF position, disconnect the spark plug wire, and chock the wheels.
2. Ensure that the low oil warning light and all connecting wires are functioning correctly. **See Test Procedure 22 – Oil Warning Light on page 11b-43.**
3. Drain the engine oil into an approved container and properly dispose of used oil.
4. Turn the key switch ON, closing the circuit. The oil light should illuminate. If the low oil warning light does not illuminate, the oil level sensor may need to be replaced. Refer to Test Procedure 22 before replacing sensor. **See Oil Level Sensor Installation, Section 13, Page 13-24.**
5. Fill the engine with new oil and install a new oil filter before returning the vehicle to service. **See Engine Oil, Section 10, Page 10-6.**

TEST PROCEDURE 22 – OIL WARNING LIGHT

Read **DANGER** and **WARNING** on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, chock the wheels and disconnect the battery cables, negative (-) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12b, Page 12b-14.**
3. Check that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary (**Figure 11b-9, Page 11b-13**).
4. Disconnect the yellow wire (to the oil level sensor) from the terminal on the oil light. Using an alligator clip jumper wire, connect the oil light terminal to the vehicle frame. Connect the red (+) battery cable to the positive (+) battery post, then attach the black (-) cable to the negative (-) battery post.

Test Procedure 22 – Oil Warning Light, Continued:

5. Turn the key switch to the ON position. The oil light should illuminate. If it does not, check continuity of the yellow wire that connects the key switch to the oil light (through a sonic weld within the wire harness). If there is no continuity in the wire, replace the wire. Then test the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11b-27.** If the yellow wire and the key switch test okay, then replace the oil light.

TEST PROCEDURE 23 – NEUTRAL LOCKOUT CAM**Read DANGER and WARNING on page 11b-1.**

1. Check to be sure the lobes on the cam are depressing the neutral lockout limit switch lever as the Forward/Reverse handle is being shifted. The limit switch should make an audible click as it is depressed. If it does not, check for wear on the cam lobes. Be sure the cam has snapped fully back into place. If the cam lobes still do not actuate the limit switch, replace the cam.

TEST PROCEDURE 24 – BATTERY TEST (UNDER LOAD)**Read DANGER and WARNING on page 11b-1.**

NOTE: Keep the battery connected while performing this test procedure.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Set a multimeter to 20 volts and place the red (+) probe on the F2 (white wire) terminal on the starter/generator. Place the black (–) probe on the negative battery post.
3. Turn the key switch to the ON position, leave the Forward/Reverse shifter in the NEUTRAL position and depress the accelerator pedal (with the accelerator pedal depressed the battery is under load).
 - 3.1. If the voltage reading is over 9.6 volts at 70 °F (21 °C) electrolyte temperature, check the starter/generator. **See following NOTE.**

NOTE: The voltage reading is taken at 70 °F (21 °C). At lower electrolyte temperatures the voltage reading will be lower.

- 3.2. If the reading is below 9.6 volts at 70 °F (21 °C) electrolyte temperature, check the battery. **See Test Procedure 1 – Battery on page 11b-24.**
 - 3.3. If the reading is zero, there may be NO continuity across the large posts of the solenoid. **See Test Procedure 6 – Solenoid on page 11b-29.**
4. If all of the test results are good and the voltage reading is zero, there may be a broken or damaged 6 gauge white wire from the solenoid to the starter/generator. **See Test Procedure 8 – Starter/Generator (Starter Function) on page 11b-31.**

TEST PROCEDURE 25 – FUEL LEVEL SENDING UNIT**Read DANGER and WARNING on page 11b-1.**** WARNING**

- To avoid the possibility of fire or explosion, make sure the fuel tank cap is securely in place while performing this test procedure.
1. Turn the key switch to the OFF position, put the Forward/Reverse handle in the NEUTRAL position, disconnect the battery cables, negative (–) cable first, and chock the wheels.

2. Disconnect the orange wire from the center post of the fuel level sending unit.
3. With a multimeter set to 2 k Ω (ohms), place the red (+) probe of the multimeter on the center post of the sending unit. Place the black (-) probe on the ground connection of the sending unit (**Figure 11b-56, Page 11b-45**).
4. The following resistance readings (in ohms) should be obtained depending on the position of the float inside the fuel tank. The resistance reading will vary according to the exact position of the float. The chart below may be used as a guideline to determine if the fuel level sending unit is operating correctly. Make sure the float is at the surface of the fuel in the tank.

FLOAT POSITION	RESISTANCE READING	FUEL GAUGE READINGS
Lower position (tank empty)	240 \pm 20 Ω (ohms)	Empty
Center position (tank half full)	120 \pm 20 Ω (ohms)	Half full
Upper position (tank full)	60 \pm 20 Ω (ohms)	Full

5. If the readings are within the specifications listed above, the fuel level sending unit is working properly. If the readings are incorrect, the fuel level sending unit has failed and the fuel tank must be replaced. **See Fuel Tank Removal, Section 14, Page 14-28.**
6. If the readings are correct and the fuel gauge does not function correctly, check the continuity of the orange wire from the fuel level sending unit to the fuel gauge/hour meter. Leave the battery disconnected while checking continuity. Also check the continuity of the blue wire from the fuel gauge/hour meter to the key switch, and the black ground wires at the fuel level sending unit and at the fuel gauge/hour meter. **See Fuel Gauge/Hour Meter Removal, Section 12b, Page 12b-24.**
7. If the readings are correct according to the position of the float, but give an incorrect reading on the fuel gauge/hour meter, test the fuel gauge/hour meter. **See Test Procedure 26 – Fuel Gauge on page 11b-46.**

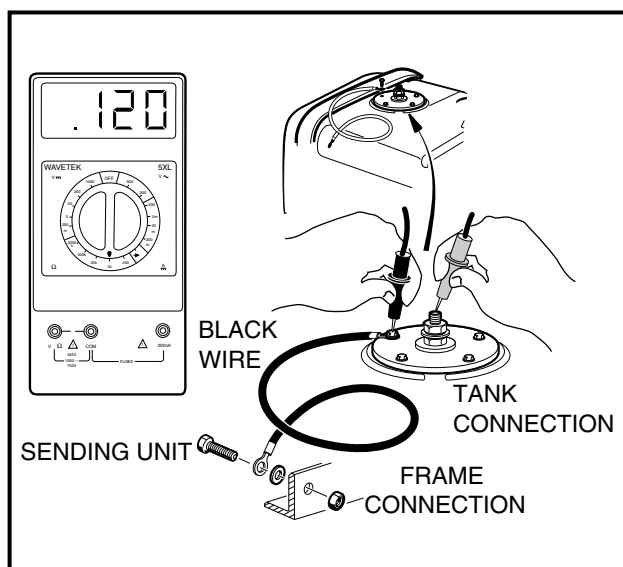


Figure 11b-56 Test Fuel Level Sending Unit

TEST PROCEDURE 26 – FUEL GAUGE

Read **DANGER** and **WARNING** on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in NEUTRAL, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Remove the center dash assembly to gain access to the back of the fuel gauge/hour meter. **See Key Switch Removal, Section 12b, Page 12b-14.**
3. Disconnect the orange wire from the fuel gauge/hour meter.
4. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the positive post of the battery. Place the black (–) probe on the negative post of the battery. Record the voltage reading.
5. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the (2) terminal of the fuel gauge/hour meter with the blue wire. Place the black (–) probe on the (3) terminal of the fuel gauge/hour meter with the black wire (**Figure 11b-57, Page 11b-46**).
6. Connect the battery cables, positive (+) cable first, and tighten to 20 ft-lb (27.1 N·m).
7. Turn the key switch ON. The voltage reading should be the same as the battery voltage reading recorded earlier. If not, check the continuity of the blue and black wires (**Figure 11b-57, Page 11b-46**).
8. The orange wire should remain disconnected for this step. With the black probe still on the (3) terminal of the fuel gauge/hour meter, place the red (+) probe of the multimeter on the (1) terminal of the fuel gauge/hour meter (**Figure 11b-58, Page 11b-46**). The voltage reading should be the same as the full battery voltage reading obtained in step 4. If the reading is incorrect, replace fuel gauge/hour meter.

TEST PROCEDURE 27 – HOUR METER

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Turn the key switch to ON and record the current hour meter reading.

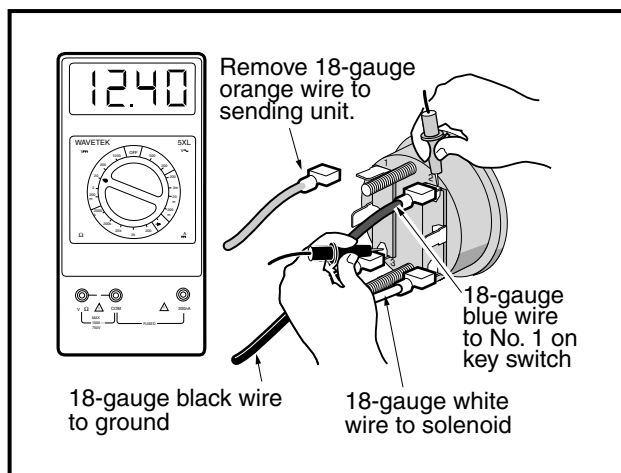


Figure 11b-57 Test Fuel Gauge Continuity

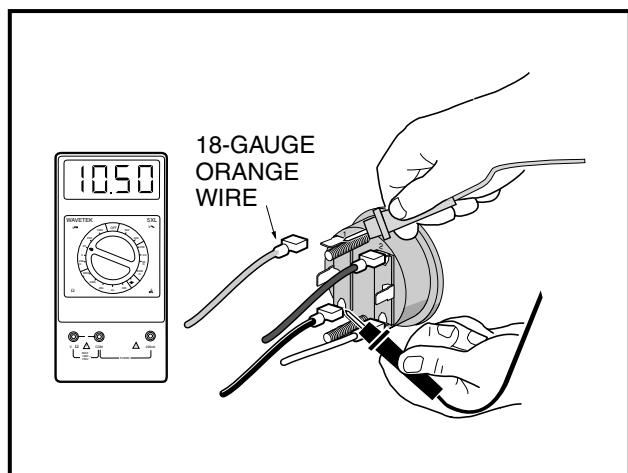


Figure 11b-58 Test Fuel Gauge Voltage

3. Depress and hold the accelerator pedal to run the engine for at least six minutes (the meter records in six-minute increments). **See following DANGER.**

▲ DANGER

- Do not operate gasoline vehicle in an enclosed area without proper ventilation. Engine produces carbon monoxide, which is an odorless, deadly poison.

4. If the reading does not change after six minutes, then replace the fuel gauge/hour meter.

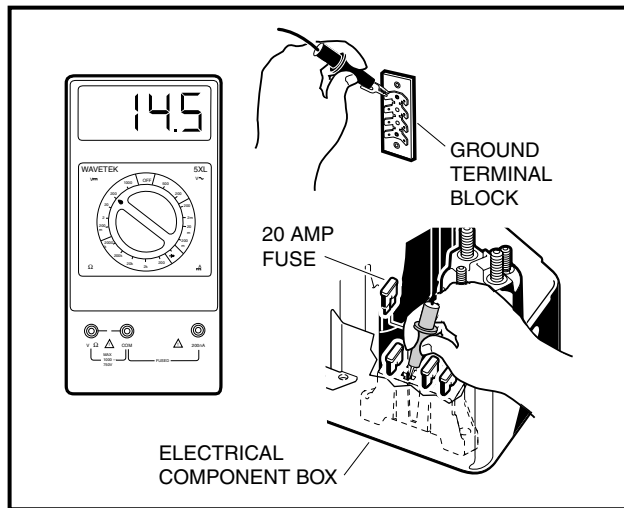


Figure 11b-59 Test Battery Voltage Supply

TEST PROCEDURE 28 – BATTERY VOLTAGE SUPPLY

Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Place an alligator clip on the black (–) probe of the multimeter and connect the black probe to the terminal block located on the frame under the front body (**Figure 11b-59, Page 11b-47**).
3. Remove the fuse located at the yellow wire position in the fuse block.
4. Place the red (+) probe of the multimeter on the terminal connector inside the fuse block across from the yellow wire connector.

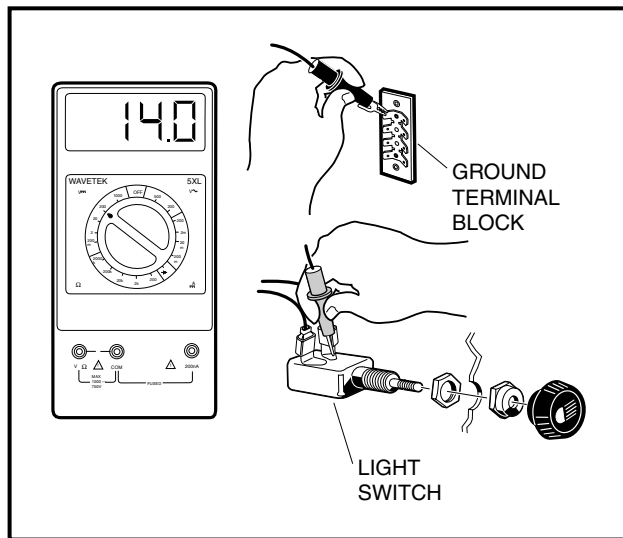
NOTE: Make sure the red probe is placed on the same side (positive side) as the 10-gauge red wire.

5. Set the multimeter to 20 volts DC. The reading should be at least 12.4 volts.
6. If there is no voltage reading, check continuity of the 10-gauge red wire from the fuse block to the solenoid. Check continuity of the 10-gauge black wire from the terminal block to the frame ground.

TEST PROCEDURE 29 – LIGHT SWITCH

Read **DANGER** and **WARNING** on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in NEUTRAL, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12b, Page 12b-14.**
3. Using a multimeter set on 20 volts DC, place alligator clips on the multimeter probes. Connect the black (–) probe to the terminal block under the front body (**Figure 11b-60, Page 11b-48**).

Test Procedure 29 – Light Switch, Continued:**Figure 11b-60 Test Light Switch**

4. Connect the red (+) probe to the light switch terminal with the blue wire connected to it. **See following CAUTION.**

⚠ CAUTION

- **Before connecting battery cables, make sure none of the electrical components touch any part of the vehicle frame. Place a dry towel between the body trim and center dash to prevent an electrical short.**

5. Connect the battery, positive (+) cable first.
6. With the light switch in the OFF position, the reading should be zero volts. With the light in the ON position, the reading should be between 11 and 12.5 volts. If there is no voltage reading, check continuity of the 10-gauge red wire from the fuse block to the solenoid. Check continuity of the 14-gauge yellow wire from the light switch to the fuse block. Check the fuse. **See Test Procedure 2 – Fuse on page 11b-24.** If the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal, Section 12b, Page 12b-32.**

TEST PROCEDURE 30 – VOLTAGE LIMITER

Read DANGER and WARNING on page 11b-1.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in NEUTRAL, chock the wheels and disconnect the battery cables, negative (–) cable first.
2. Remove the center dash assembly. **See Key Switch Removal, Section 12b, Page 12b-14.**
3. Using a multimeter set on 20 volts DC, connect the red (+) probe to the light switch terminal with the yellow wire (**Figure 11b-61, Page 11b-49**).
4. Loosen the black wire connector (on the end of the long black wire) at the voltage limiter assembly just enough to maintain the connection and yet expose part of the metal terminal in the connector. Place black (–) probe on the connector (**Figure 11b-61, Page 11b-49**). **See following CAUTION.**

⚠ CAUTION

- Before connecting battery cables, make sure no electrical components touch any part of the vehicle frame.

5. Connect the battery, positive (+) cable first.

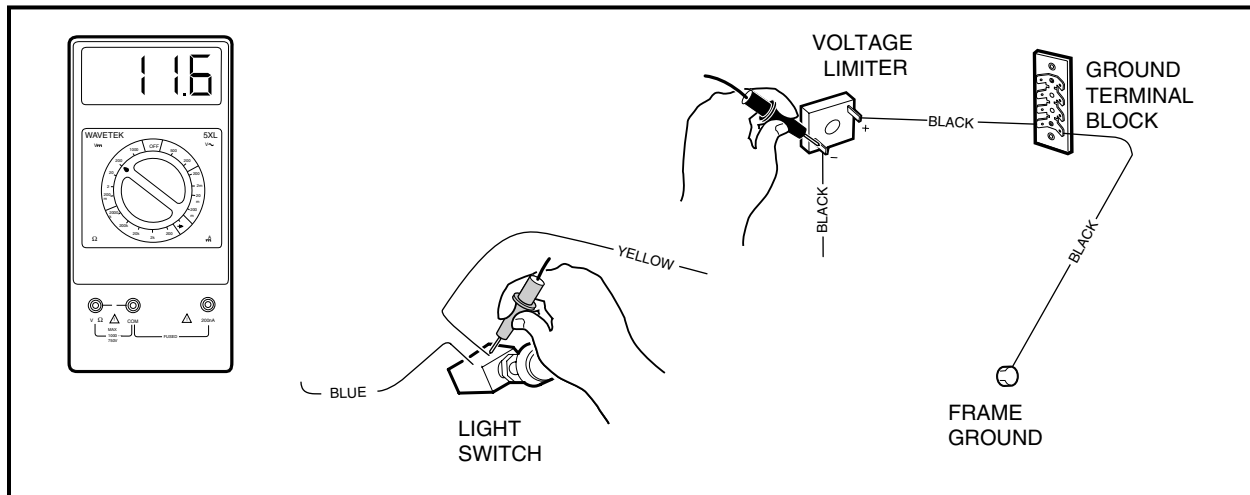


Figure 11b-61 Testing the Voltage Limiter

6. Pull the light switch to the ON position. The reading should be 11-13 volts. If there is no voltage reading, check continuity of the 16-gauge black wire from the headlight to the voltage limiter. Check continuity of the 16-gauge black wire from voltage limiter to the ground terminal block. If the wires show continuity and the readings are still incorrect, replace the voltage limiter. **See Voltage Limiter Removal, Section 12b, Page 12b-31.**
7. With the neutral lockout cam in the SERVICE position, start the engine and depress the accelerator pedal to the floor.
8. Push the light switch to the OFF position. The reading should be 14.5-15.5 volts.
9. Pull the light switch to the ON position. The reading should be 11-13 volts. If the reading does not drop from 14.5-15.5 volts to 11-13 volts, replace the voltage limiter.

TEST PROCEDURE 31 – VOLTAGE AT HEADLIGHT SOCKET

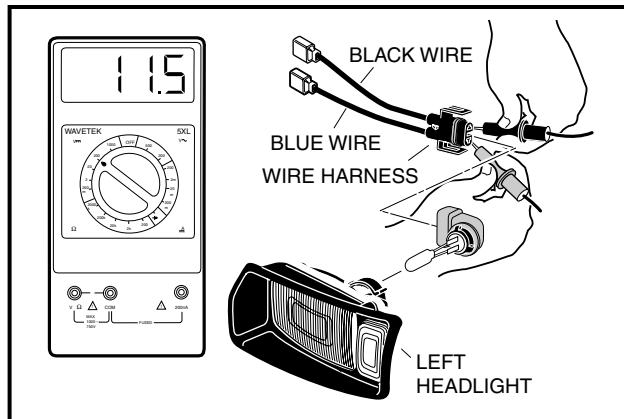
Read **DANGER** and **WARNING** on page 11b-1.

NOTE: Keep the battery connected while performing this test procedure.

1. Place the neutral lockout cam in the SERVICE position, put the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Inspect wires at the light bulb socket. Make sure wires are securely fastened to the contacts inside socket.
3. Remove the wire harness from the headlight (**Figure 11b-62, Page 11b-50**).
4. Using a multimeter set to 20 volts DC, place the black (–) probe of multimeter into the black wire terminal of the wire harness. Place the red (+) probe into the blue wire terminal.
5. Pull the light switch to the ON position. If the multimeter reads approximately 12 volts, replace the headlight bulb.

Test Procedure 31 – Voltage at Headlight Socket, Continued:

6. If there is no voltage reading at the wire harness, check continuity of the 16-gauge blue wire from the headlight to the light switch. Using a multimeter set to 20 volts DC, attach using an alligator clip, the black (-) probe of multimeter onto the negative battery terminal and place the red (+) probe into the blue wire terminal of the wire harness. If the multimeter reading is approximately 12 volts, the blue wire has continuity.
7. Check continuity of the 16-gauge black wire from the headlight to the ground terminal. Using a multimeter set to 20 volts DC, place the black (-) probe of multimeter into the black wire terminal of the wire harness and attach using an alligator clip, the red (+) probe onto the positive battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.

**Figure 11b-62 Check Voltage to Headlight Socket**

SECTION 12A – ELECTRICAL COMPONENTS: FE400, KEY-START ENGINE

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first (Figure 12a-1, Page 12a-2).**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

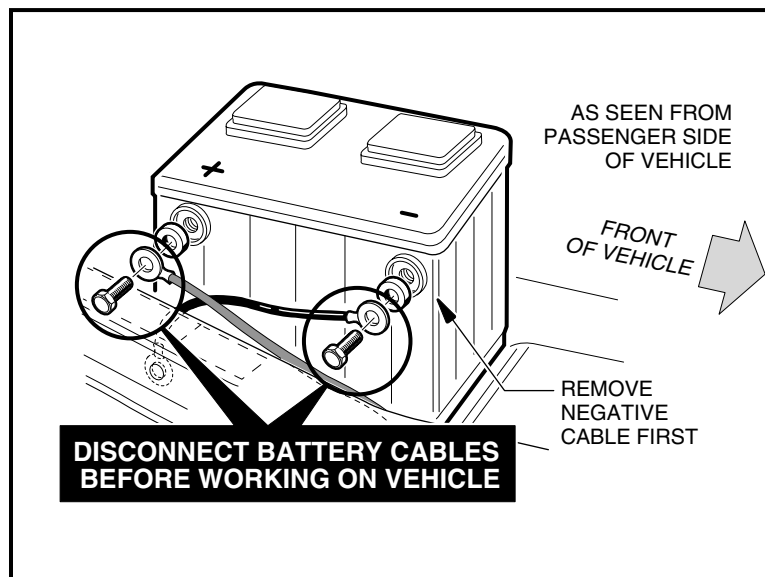


Figure 12a-1 Battery Disconnect

STARTER/GENERATOR

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Starter/Generator

See Test Procedure 8, Section 11a, Page 11a-30. Also see Test Procedure 11 – Starter/Generator (Generator Function) on page 11a-33.

Starter/Generator Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Disconnect the wires from the starter/generator (1). Mark wires before disconnecting. Loosen the pivot nuts (7) and bolts (5) (**Figure 12a-2, Page 12a-3**).
5. Remove the mounting/adjustment nut (12), washer (9) and bolt (11). Lower the starter/generator and slip the belt (4) off the pulley (10).
6. Support the starter/generator so that when the pivot bolts are removed the starter/generator will not fall to the ground. Remove the two pivot nuts (7) and bolts (5) from the mounting bracket.
7. Remove the starter/generator.

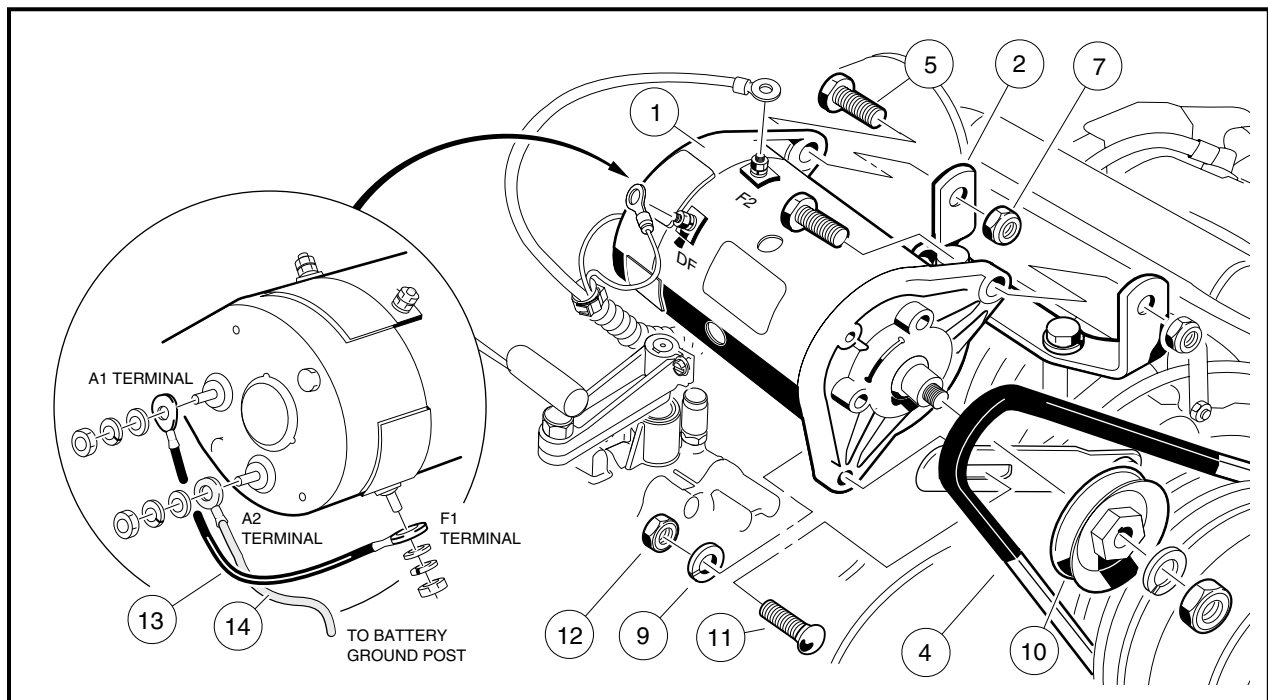


Figure 12a-2 Starter/Generator Removal

Disassembly of the Starter/Generator to Service the Brushes

1. Remove the two bolts (20) and pull commutator end cover (23) free of starter/generator housing (24) (**Figure 12a-3, Page 12a-4**). **See following NOTE.**

NOTE: If the brushes are not removed, contact between the brushes and commutator as the commutator end cover is being removed or installed could damage the brushes. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover (**Figure 12a-7, Page 12a-6**).

Disassembly of the Starter/Generator to Service the Brushes, Continued:

2. Remove brush covers (29 and 30), screws (25) and lockwashers (26), brush springs (28), and brushes (27) (**Figure 12a-4, Page 12a-4**). See following NOTE.

NOTE: To clean and inspect the armature/commutator and the bearings, see **Disassembly of the Starter/Generator to Service the Armature/Commutator on page 12a-6**.

Brush Inspection and Replacement

1. Visually inspect brushes. Replace brushes that are cracked or severely chipped.
2. Check the wear line on the side of the brush. If the end of the brush is within 1/16 of an inch (1.6 mm) of the wear line, replace all four brushes (**Figure 12a-5, Page 12a-4**).

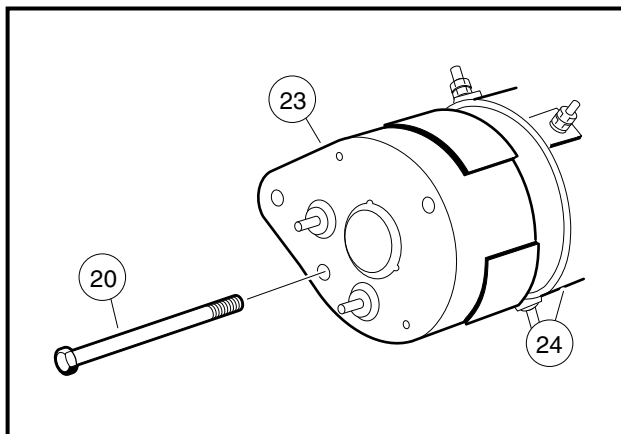


Figure 12a-3 Commutator End Cover

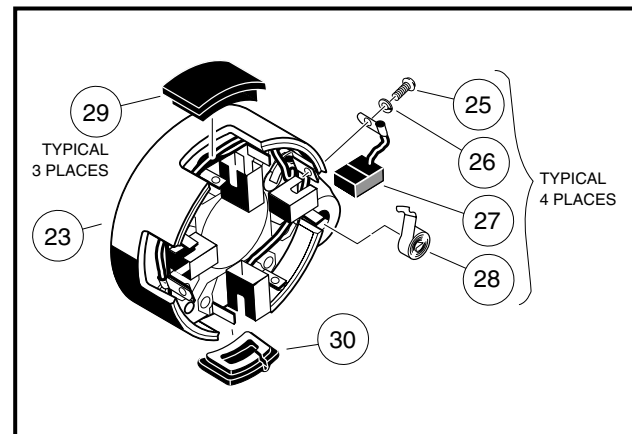


Figure 12a-4 Brush Covers and Brushes

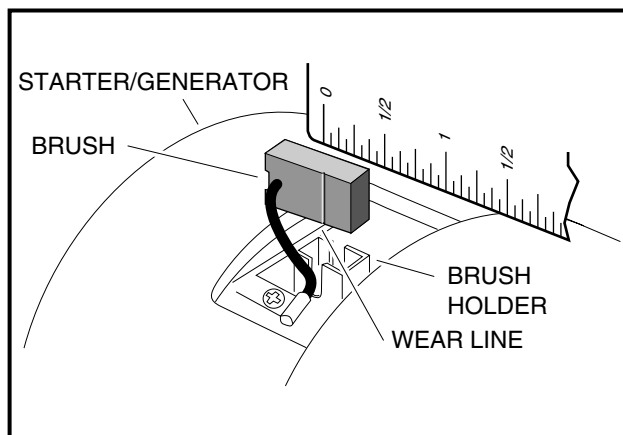


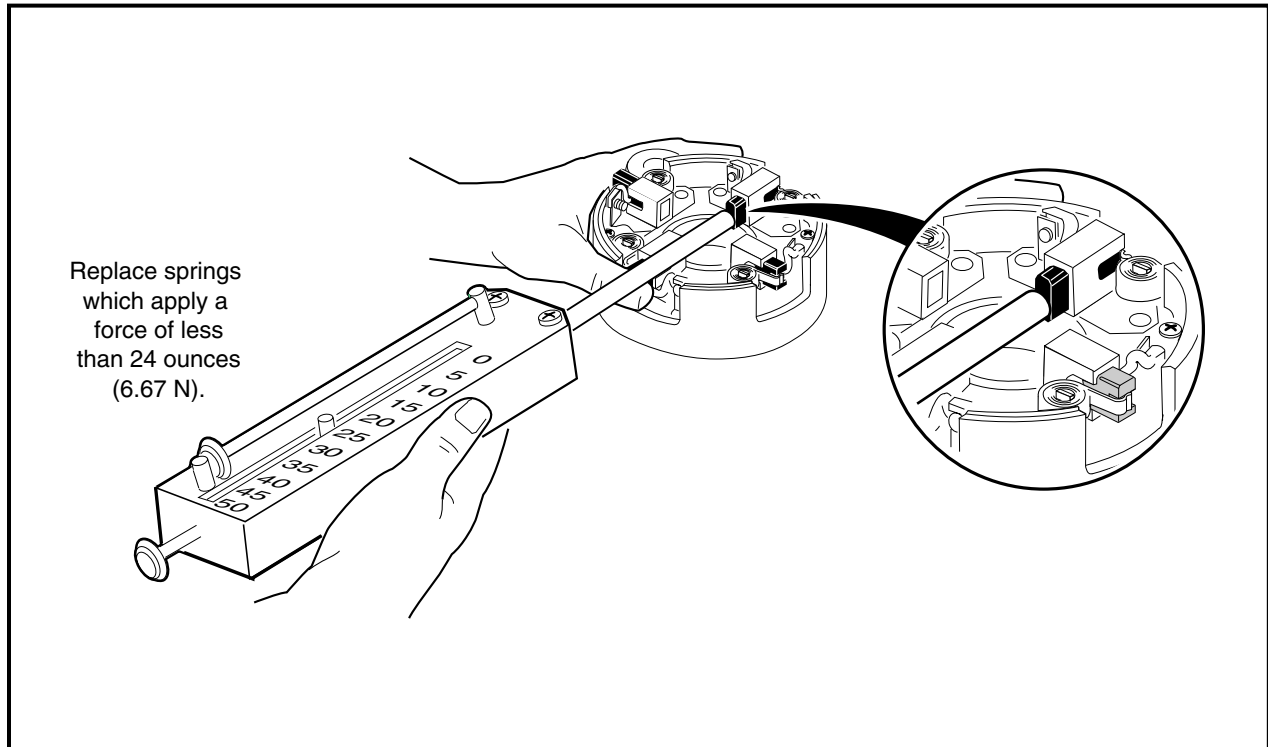
Figure 12a-5 Inspect Brushes

Brush Spring Inspection and Replacement

1. Visually inspect springs. Replace all four springs if any spring is discolored from heat (straw or bluish in color).
2. Install the four brushes (27) into their holders and insert the four brush springs (28) (**Figure 12a-4, Page 12a-4**). Using a spring scale, test brush spring tension. If any spring has a tension less than 24 ounces (6.67 N), replace all four springs (**Figure 12a-6, Page 12a-5**). See following CAUTION.

⚠ CAUTION

- When checking brush spring tension, do not push springs beyond the point they would normally be if there were new brushes installed. Exerting excessive force or pushing brush springs beyond their normal maximum extension point will damage springs.

**Figure 12a-6 Brush Spring Tension Test****Starter/Generator Assembly**

1. Connect the brush wires to the holders using four lock washers (26) and four screws (25), making sure the crossover leads are connected also. Tighten the screws to 31 in-lb (3.5 N·m) (**Figure 12a-4, Page 12a-4**).
2. To prevent contact between the brushes and commutator as the commutator is installed, and possible damage to the brushes, lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover (**Figure 12a-7, Page 12a-6**).
3. Install the commutator end cover (23) onto the armature shaft. Align the locating pin with the pin hole in the cover. Install two M6 x 180 mm bolts (20) and tighten to 100 in-lb (11.3 N·m) (**Figure 12a-3, Page 12a-4**).
4. Push the brushes down into the holders. Position springs into the notches in the brushes. Install the brush cover (30) that has the drain hole in it next to the A2 terminal. Install the remaining three brush covers (29) in the openings in the commutator end cover (23) (**Figure 12a-4, Page 12a-4**).

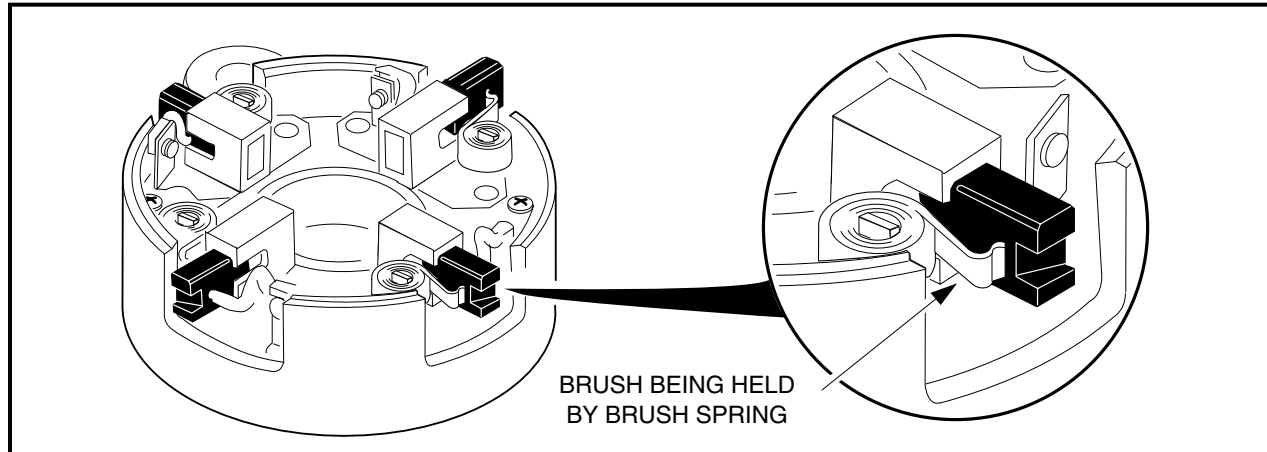


Figure 12a-7 Pull Brushes Away From Center of the Commutator End Cover

Disassembly of the Starter/Generator to Service the Armature/Commutator

1. If the brushes are not removed, contact between the brushes and commutator as the commutator end cover is being removed or installed could damage the brushes.
 - 1.1. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover (**Figure 12a-7, Page 12a-6**).
2. Remove the two bolts (20), and pull commutator end cover (23) free of the starter/generator housing (24) (**Figure 12a-3, Page 12a-4**).
3. To separate armature (33) from output end cover (36), remove nut (41), lock washer (40), pulley (39), shaft key (34), spacer (37), and bearing retainer screws (43) (**Figure 12a-8, Page 12a-6**).

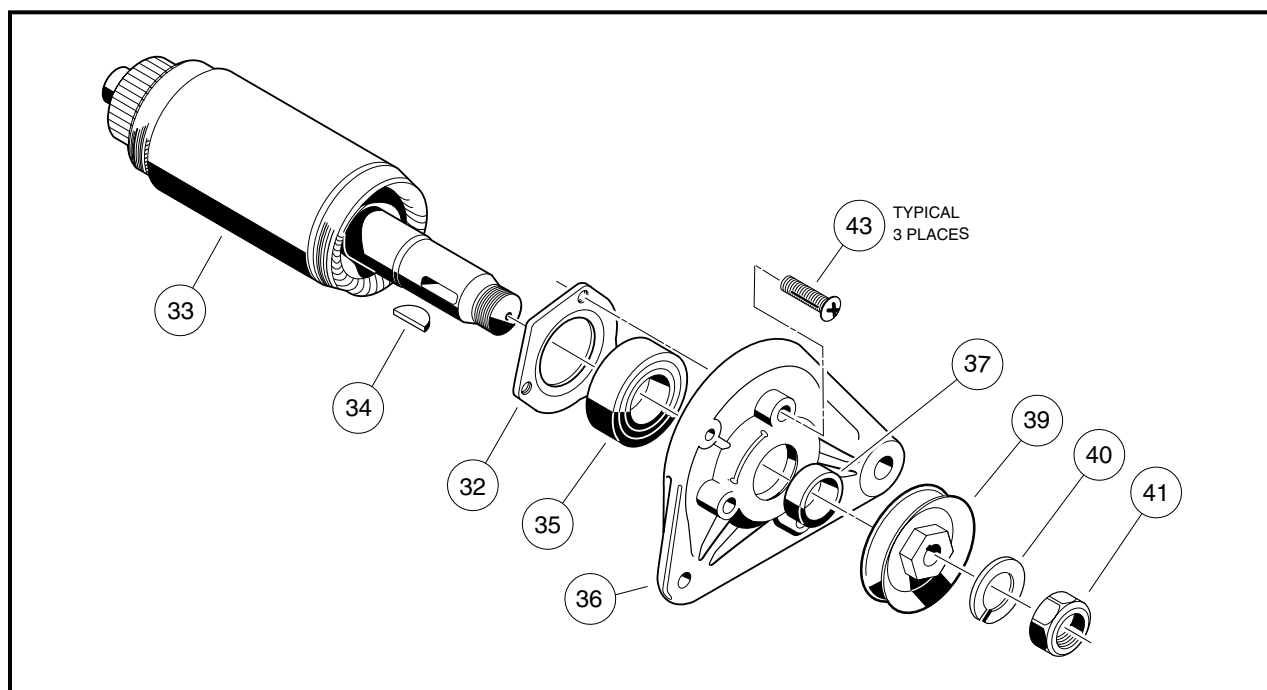


Figure 12a-8 Armature and Output End Cover Assembly

Bearing Cleaning and Inspection

1. Using a clean cloth, wipe the carbon dust from the two bearings. Inspect bearings by spinning them by hand and checking for both axial (A) and radial (B) play (**Figure 12a-9, Page 12a-7**).
2. Replace the bearing if it is noisy, does not spin smoothly, or has excessive play. Check the bearings and replace if rusted, worn, cracked, or if there is an abnormal color change in the metal of the bearing. Bearings should be replaced if there is extensive wear or pitting on the balls or on the rolling surfaces. Do not remove the bearings unless they are to be replaced.

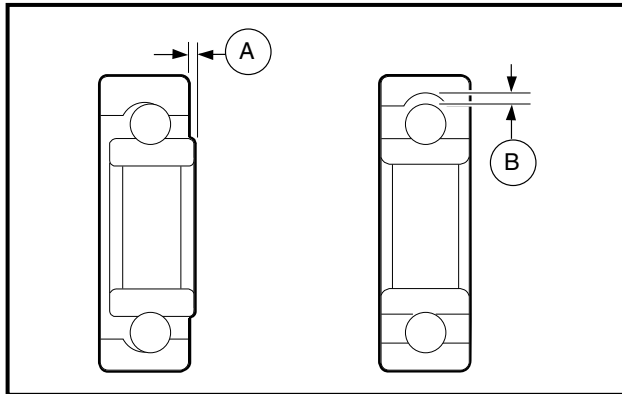


Figure 12a-9 Bearing Play Inspection

Bearing Removal

1. Place the wedge attachment tool (CCI P/N 1012812) between the bearing and the armature. Make sure the wedge attachment tool is supporting the inner race of the bearing. If a press is not available, secure a bearing puller (CCI P/N 1012811) to the wedge attachment tool and pull the bearing off of the end of the armature shaft. Support the armature so that it will not drop when the bearing is removed (**Figure 12a-10, Page 12a-7**).
2. Discard the bearings.
3. Slide the bearing retainer (32) off of the output end of the shaft (**Figure 12a-8, Page 12a-6**).

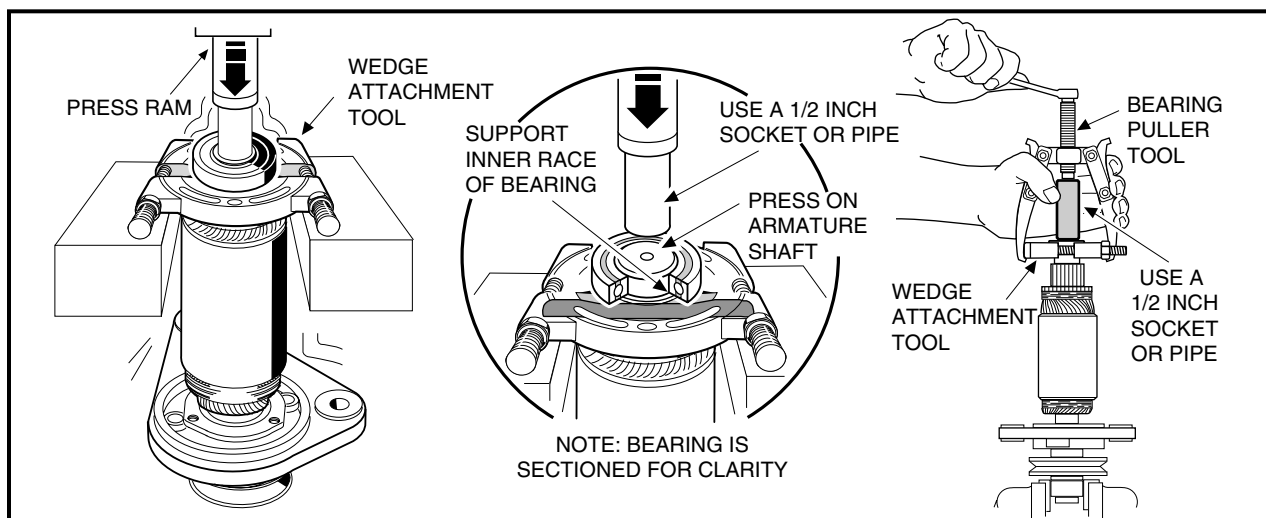


Figure 12a-10 Bearing Removal

Field Coil Removal

1. Remove the retaining nut from each field coil terminal and slide the insulator out of the slots in the housing. Remove the four pole piece screws from the housing. Remove the four pole pieces from inside the housing. Remove the field coils from the inside of the housing (**Figure 12a-11, Page 12a-8**). See following **NOTE**.

NOTE: Do not remove the insulators or the field coils unless an electrical test indicates that it is necessary (**Figure 12a-11, Page 12a-8**). See **Test Procedure 8, Section 11a, Page 11a-30**.

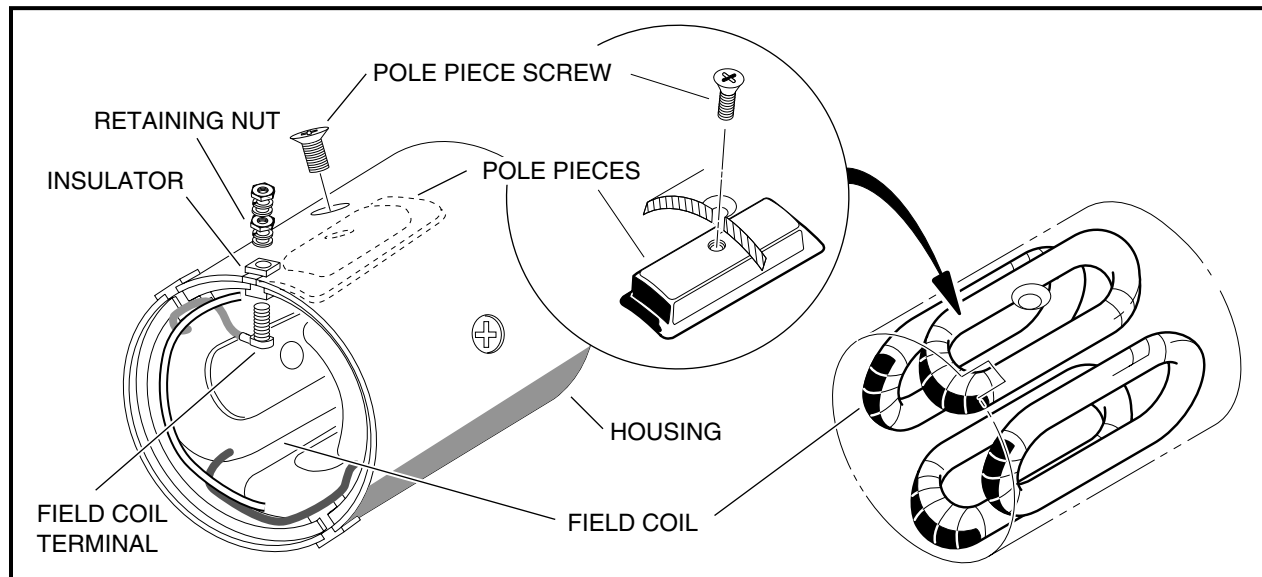


Figure 12a-11 Field Coil Assembly

Visual Inspection of Armature

Obvious defects can be seen by examining the armature. If an armature has frayed or charred insulation, broken wires or thrown solder, it is obvious without testing that it should be replaced. Faults seen during the visual inspection can aid in diagnosing the original cause of the failure. Items to look for are listed below.

- Burned, charred, or cracked insulation
- Improperly cured varnish
- Thrown solder
- Flared armature windings
- Worn, burned, or glazed commutator
- Loose or raised commutator bars
- Bruised or damaged armature core laminations
- Worn armature bearing or shaft
- Dirty or oily commutator

Commutator Cleaning and Inspection

1. Clean the carbon dust, dirt and oil from the commutator. Visually inspect the commutator for worn, burned or glazed areas. Check for loose or raised commutator bars. Slight roughness of the commutator can be polished away with 400 grit (or finer) sandpaper. See following **CAUTION**.

⚠ CAUTION

- Never use emery cloth on the commutator. Particles of emery are conductive and may short-circuit the commutator bars. Never use oil or lubricants on the commutator or brushes.

2. Using a micrometer, measure the outside diameter at four points; two points 90° to each other to the outside of the commutator (A1 and A2), and two points 90° to each other to the inside of the commutator (B1 and B2). If the commutator diameter is less than 1.535 inches (39 mm) at any of the four locations, replace the armature assembly and bearings (**Figure 12a-12, Page 12a-9**).

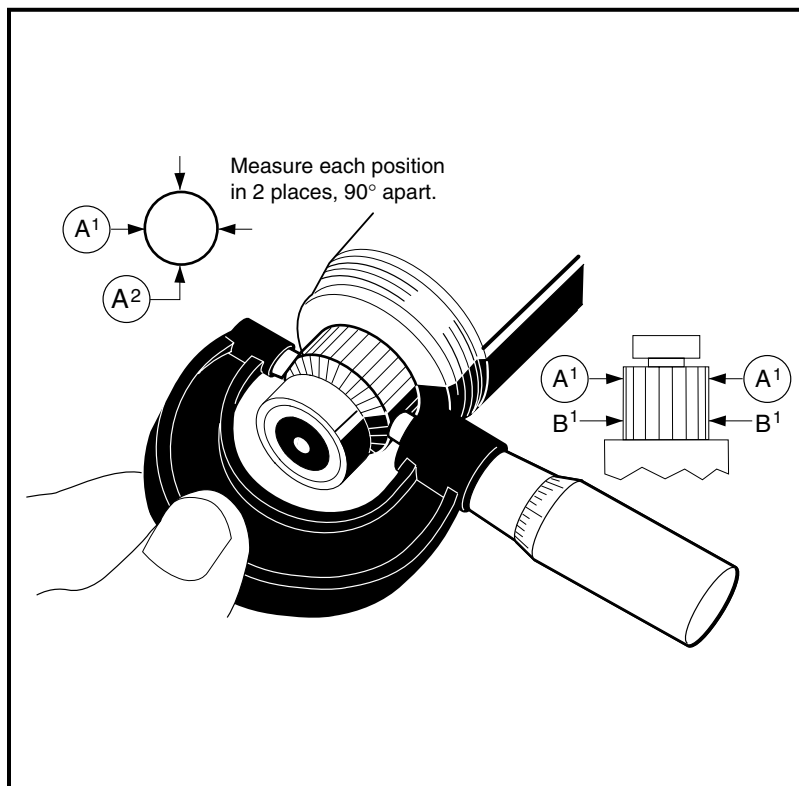


Figure 12a-12 Inspect Commutator

Armature Ground Test**⚠ CAUTION**

- Do not submerge armature in solvent.

NOTE: Before testing, wipe the armature with a clean cloth and remove carbon dust and metal particles from between commutator bars.

1. Using a multimeter set on 200 Ω (ohms), place the positive probe on the commutator bars and the negative probe on the armature core. The reading should be no continuity. If the reading is incorrect, replace the armature and the two bearings (**Figure 12a-13, Page 12a-10**).

Visual Inspection of Field Coils

If the insulation on the field coils appears blackened or charred, the serviceability of the coils is questionable. Burned or scorched coil insulation indicates the starter/generator has overheated due to overloads or grounded or shorted coil windings. Be sure the insulators are tight in the housing.

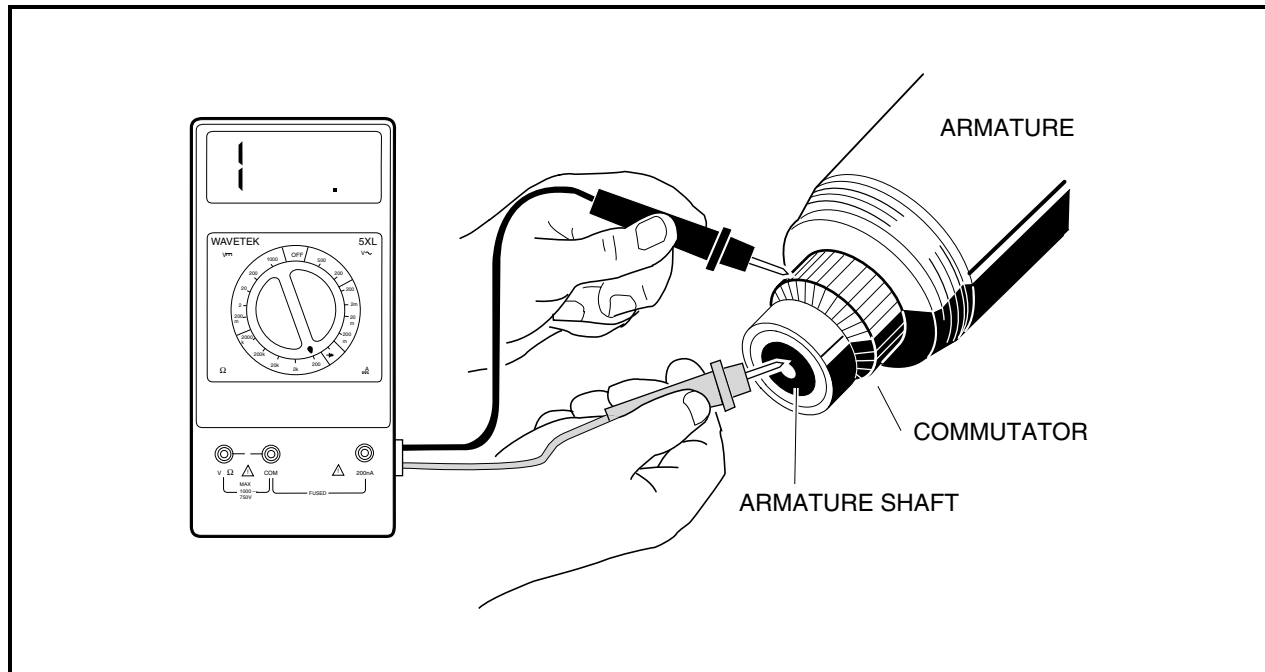


Figure 12a-13 Armature Ground Test

Starter/Generator Rework

Any rework must be performed by a qualified technician. Starter/Generator service specifications are listed in the following table.

ITEM	SERVICE LIMIT
Commutator diameter (minimum)	1.535 in. (39 mm)
Concentric with armature shaft within	0.002 in. (0.051 mm)
Limit depth of cut when machining commutator	0.007 in. (0.2 mm)
If undercut of segment insulator is less than 0.016 inch (0.406 mm), then it should be undercut to	0.031 in. (0.8 mm)
Dielectric strength	500 VAC for one minute
Armature insulation resistance	0.2M Ω (ohms) at 500 VDC
Starter field coil resistance	0.006-0.01 Ω (ohms)
Generator field coil resistance	4.5-5.5 Ω (ohms)

Starter/Generator Assembly

1. Place the field coil into the housing. The two insulators that look alike fit into the slots next to the F1 and F2 markings on the outside of the housing. The insulator that looks different slides into the slot next to the DF marking.
2. After the insulators are seated in the slots, install the threaded terminals through the wire connectors and then through the insulators. Install a flat washer, lock washer and nut onto each threaded terminal on the outside of the housing. Tighten nuts to 47.5 in-lb (5.4 N·m) (**Figure 12a-11, Page 12a-8**).

▲ CAUTION

- Route the field terminal wires so that they will not contact the armature.

3. Install the four pole pieces into the housing. Use the four screws to secure pole pieces to the inside of the housing to retain the field wires. Tighten screws to 9 ft-lb (12.2 N·m) (**Figure 12a-11, Page 12a-8**).
4. Slide the bearing retainer onto the output end of the armature shaft (33) so that it will hold the outside of the bearing (35) only (**Figure 12a-8, Page 12a-6**).
5. Press a new ball bearing (35) onto the output end of the armature (**Figure 12a-8, Page 12a-6**). Press a new ball bearing onto the commutator end of the armature shaft. **See following CAUTION.**

▲ CAUTION

- To prevent damage to the retainer, use care while pressing new bearing onto the output end of the shaft.
 - Press against the inner race of the new bearing until it is fully seated.
6. Install the output end cover (36) onto the armature. Secure the bearing retainer (32) to the cover and tighten the screws (43) to 39 in-lb (4.4 N·m) (**Figure 12a-8, Page 12a-6**).
 7. Slide the housing with field coils over the armature. Use the locating pin to align housing to the cover.

NOTE: The terminal insulators should be on the commutator end of the housing.

8. To prevent contact between the brushes and commutator as the commutator cover is installed, and possible damage to the brushes, lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover (**Figure 12a-7, Page 12a-6**).
9. Install the commutator end cover (23) onto the armature shaft. Align the locating pin with the pin hole in the cover. Install the two M6 x 180 mm bolts (20) and tighten to 100 in-lb (11.3 N·m) (**Figure 12a-3, Page 12a-4**).
10. Push the brushes down into the holders. Place springs into the notches in the brushes. Install the brush cover (30) that has the drain hole in it next to the A2 terminal. Install the remaining three brush covers (29) in the openings in the commutator end cover (23) (**Figure 12a-4, Page 12a-4**).
11. Slide the spacer (37) onto the end of the shaft. Insert the shaft key (34) into the shaft. Install the belt pulley (39) onto the shaft, and install the lock washer (40) and M14 nut (41). Tighten the nut to 28 ft-lb (38 N·m) (**Figure 12a-8, Page 12a-6**).

Starter/Generator Installation

1. Install the green wire from the F1 terminal to the A1 terminal on the starter/generator (**Figure 12a-2, Page 12a-3**). Install a flat washer, lock washer, and nut onto each terminal and tighten to 48 in-lb (5.4 N·m).

Starter/Generator Installation, Continued:

2. Install two 3/8 hex-head pivot bolts (5) into the mounting bracket with the heads of the bolts facing towards the driver side of the vehicle. Position the starter/generator in the mounting bracket so that the bolts will go through the starter/generator before going through the bracket. Install a lock nut (7) onto each bolt. Tighten to finger-tight (**Figure 12a-14, Page 12a-12**).
3. Install the adjustment bolt (11) through the adjusting bracket (4) and then through the starter/generator. Install a lock washer (9) and 5/16-inch nut (12) onto the end of the adjustment bolt (11). Tighten to finger-tight (**Figure 12a-14, Page 12a-12**).
4. Install the belt (3), then tighten the mounting bolts. **See Belt Tension Adjustment on page 12a-12.**
5. Connect the yellow wire from the voltage regulator to the DF terminal on the starter/generator. Install a flat washer, lock washer, and nut onto the terminal. Tighten the nut to 31 in-lb (3.5 N·m).
6. Install the white wire from the solenoid to the F2 terminal on the starter/generator. Install the black wire from the frame to the A2 terminal on the starter/generator. Install a flat washer, lock washer and nut onto each terminal, and tighten the nut to 48 in-lb (5.4 N·m).
7. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
8. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

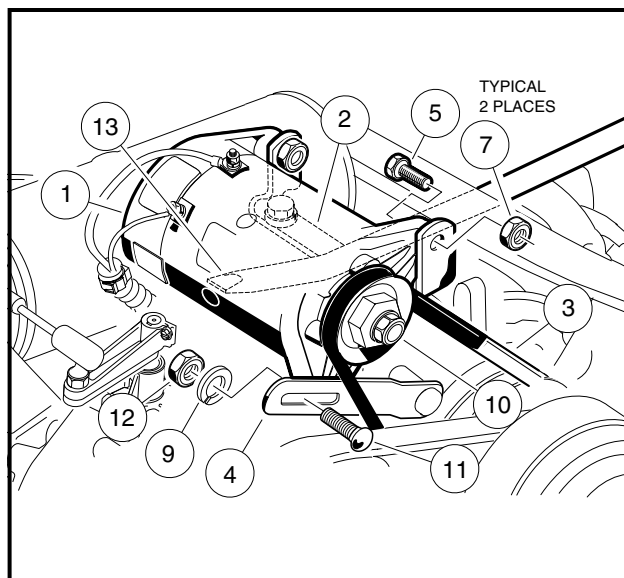


Figure 12a-14 Starter/Generator Installation

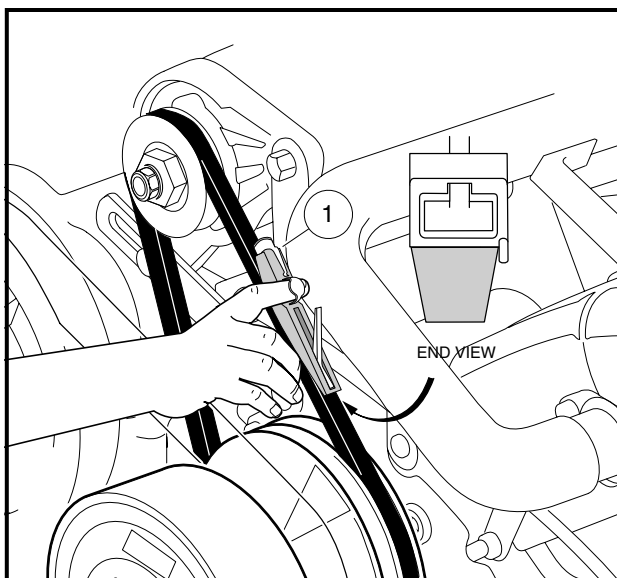


Figure 12a-15 Belt Tension Gauge

Belt Tension Adjustment

Belt tension should be checked periodically. If the belt slips when starter/generator motor operates, adjust belt to correct tension.

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first (**Figure 12a-1, Page 12a-2**). **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Make sure the two pivot bolts (5) on the mounting bracket are finger tight. The carriage bolt (11) and hex nut (12) are to be finger-tight also (**Figure 12a-14, Page 12a-12**).

5. Push the starter/generator down so it is at the lowest point of its adjustment travel. With the starter/generator belt fully in place around the drive clutch pulley, install the starter/generator belt (3) around the pulley (10) on the end of the starter/generator.
6. Position a pry bar (13) between the top of the starter/generator mounting bracket (2) and the underside of the starter/generator by passing the pry bar under the exhaust header.
7. While holding the pry bar, measure the belt tension using a Krikit[®] gauge (1) (available at NAPA[®] Auto Parts stores), or equivalent. Proper tension for a new starter/generator belt should be 75 ft-lb (101.7 N·m), or for an existing belt, 45 ft-lb (61 N·m) (**Figure 12a-15, Page 12a-12**).
8. While maintaining the tension, tighten the adjustment nut (12) to 12 ft-lb (16.3 N·m). Tighten the two pivot bolts (5) and hex nuts (7) to 23 ft-lb (31.2 N·m) (**Figure 12a-14, Page 12a-12**). **See following CAUTION.**

▲ CAUTION

- **Remove pry bar before starting engine.**
9. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
 10. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

VOLTAGE REGULATOR

Read DANGER and WARNING on page 12a-1.

Testing the Voltage Regulator

See Test Procedure 12, Section 11a, Page 11a-33.

Voltage Regulator Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Remove the electrical component box cover.
5. Disconnect the voltage regulator red wire (1) at the large post on the solenoid, the yellow wire (4) at the bullet connector, and the black wire (7) from the wire harness and at the battery frame ground (**Figure 12a-16, Page 12a-14**).
6. Remove the voltage regulator mounting screw (8) and remove the voltage regulator (9).

Voltage Regulator Installation

1. Position the voltage regulator (9) in the electrical component box and install the mounting screw (8) (**Figure 12a-16, Page 12a-14**). Tighten screw to 23 in-lb (2.6 N·m).
2. Connect the voltage regulator red wire (1) at the large post on the solenoid with the other red wires, the yellow wire (4) at the bullet connector, and the black wire (7) to the wire harness and the battery frame ground (**Figure 12a-16, Page 12a-14**).
3. Install snap-on electrical component box cover. Be sure to firmly press down all corners. Install screw and tighten to 18 in-lb (2 N·m).

Voltage Regulator Installation, Continued:

4. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. With the Forward/Reverse handle in NEUTRAL, start the engine and check regulator for proper functioning as described in the voltage regulator test procedure. **See Test Procedure 12, Section 11a, Page 11a-33.**
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

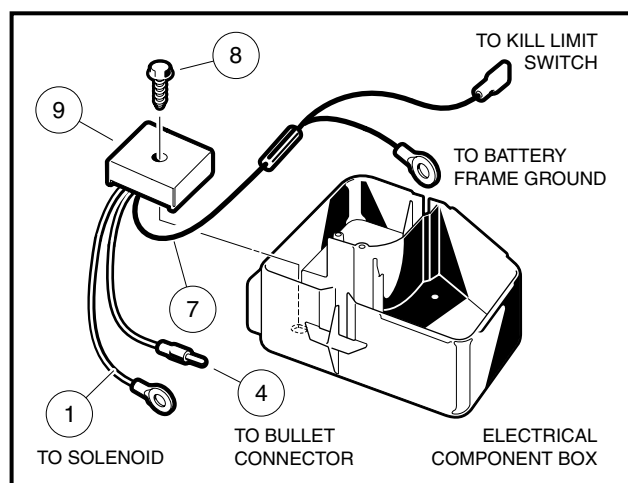


Figure 12a-16 Voltage Regulator

DIODE

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Diode

See **Test Procedure 10, Section 11a, Page 11a-31.**

Key-start vehicles could have one of two styles of diode designs. One is referred to as a small diode (**Figure 12a-17, Page 12a-15**), and the other is referred to as a large diode (**Figure 12a-18, Page 12a-15**). Each has a separate removal and installation procedure. All vehicles equipped with the small style diode (**Figure 12a-17, Page 12a-15**) should be replaced with the current large style diode (**Figure 12a-18, Page 12a-15**). See **Service Bulletin 01-24, or refer to Diode Kit Installation (CCI P/N 102272501).**

Large Style Diode Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Remove the intake hose to the carburetor at the carburetor intake port and move the hose to allow easy access to the electrical component box cover.
5. Remove the cover retaining screw (5) and electrical component box cover (6) (**Figure 12a-19, Page 12a-15**).
6. Remove the nuts (7) from the two large solenoid posts and disconnect the diode wires from the solenoid.

- 6.1. Observe color orientation of the wires with the terminal locations on the solenoid. The 12-gauge red wire from the diode should be attached to the same terminal as the red wire from the fuse block, and the red wire from the battery. The 12-gauge white wire should be attached to the other large solenoid post, along with the red wire from the voltage regulator and the white wire from the starter/generator.
7. Remove the hardware nut (3) from the diode body post and remove the diode (2) and thermal transfer pad (1) from the vehicle frame (Figure 12a-18, Page 12a-15).

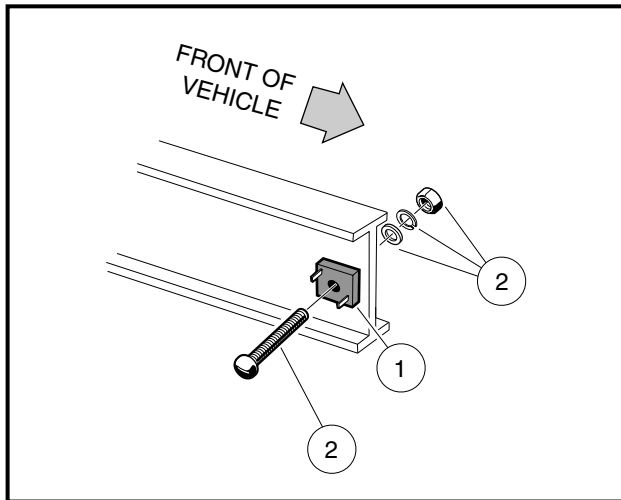


Figure 12a-17 Small Style Diode

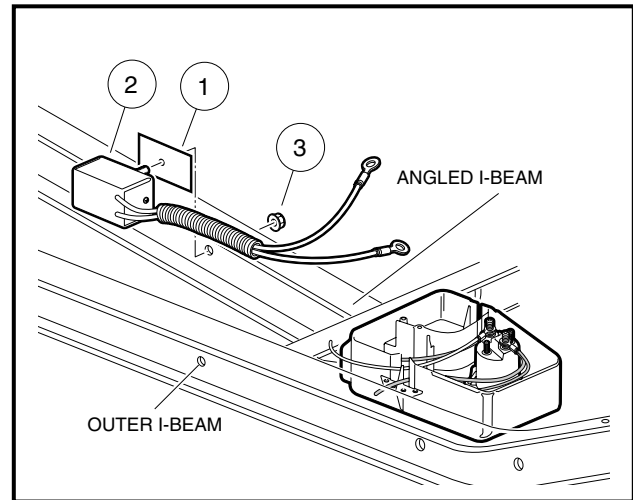


Figure 12a-18 Large Style Diode

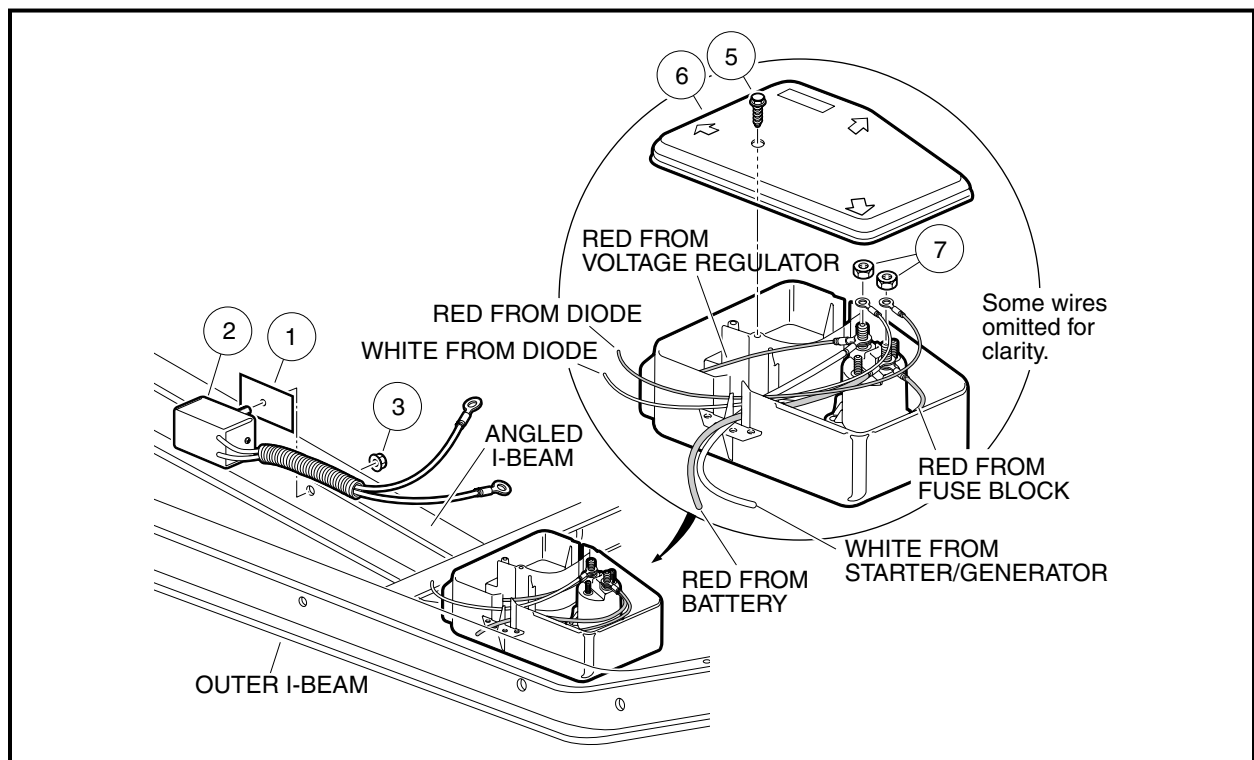


Figure 12a-19 Electrical Component Box and Large Diode Orientation

Large Style Diode Installation

1. Thoroughly clean and dry the area of the I-beam where the new diode is to be attached.
2. Peel the protective film from both sides of the new thermal pad (1) (**Figure 12a-19, Page 12a-15**). See following **CAUTION**.

CAUTION

- **Be sure to remove and discard the protective film from both sides of the thermal pad before installing it. If not removed, the film will reduce the thermal heat transfer and therefore reduce the power handling capability of the diode, causing it to overheat and damage the electrical system.**
3. Mount the diode (2) to the frame using the thermal transfer pad (1) and mounting nut (3). Tighten to 25 in-lb (2.8 N·m) (**Figure 12a-19, Page 12a-15**).
 4. Route and connect the red and white diode wires to the solenoid posts in the electrical component box. See following **WARNING**.

WARNING

- **Incorrect wiring could result in severe injury or death.**
 - **Diode and solenoid connections must have correct polarity.**
 - **Keep all persons clear of engine belts when making final connections.**
- 4.1. Connect the 12-gauge red wire from the diode to the solenoid post with the fuse block and battery red wires (**Figure 12a-19, Page 12a-15**). Tighten lock nut to 90 in-lb (10.2 N·m).
 - 4.2. Connect the 12-gauge white wire to the other large solenoid post, along with the red wire from the voltage regulator and white wire from the starter/generator. Tighten nut to 90 in-lb (10.2 N·m).
 5. Replace the electrical component box cover (6) and retaining screw (5). Tighten the retaining screw to 18 in-lb (2.0 N·m).
 6. Connect the intake hose to the carburetor and secure the hose with the hose clamp.
 7. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
 8. Lower the cargo bed. See **WARNING "For vehicles with cargo beds..." on page 12a-2**.

KEY SWITCH

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Key Switch

See **Test Procedure 4, Section 11a, Page 11a-27**. Also see **Test Procedure 17 – Key Switch (Engine Kill Circuit)** on page 11a-41.

Key Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. See **WARNING "For vehicles with cargo beds..." on page 12a-2**.
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. See **WARNING "To avoid unintentionally starting..." on page 12a-1**.
4. Remove the dash panel.

- 4.1. Loosen seven Tuflok screws, but do not remove screws completely, as shown in Detail A (**Figure 12a-21, Page 12a-19**).
- 4.2. Remove Tuflok screws from dash panel as shown in Detail B.
- 4.3. Pull forward on top of dash panel to access back side of key switch. There is sufficient slack in wiring to allow for this as shown in Detail C.
5. Disconnect the wire connector from the key switch.
6. Remove the key switch.
 - 6.1. Remove the key switch nut (1) (**Figure 12a-20, Page 12a-17**).
 - 6.2. Remove key switch (2) from back side of dash panel.

Key Switch Installation

1. Reverse removal procedures to install key switch in the dash. Tighten the key switch nut firmly. Reconnect the wire connector to the key switch.
2. Install the dash panel.
3. Connect the battery cables, positive (+) cable first and tighten the terminals to 20 ft-lb (27.1 N-m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

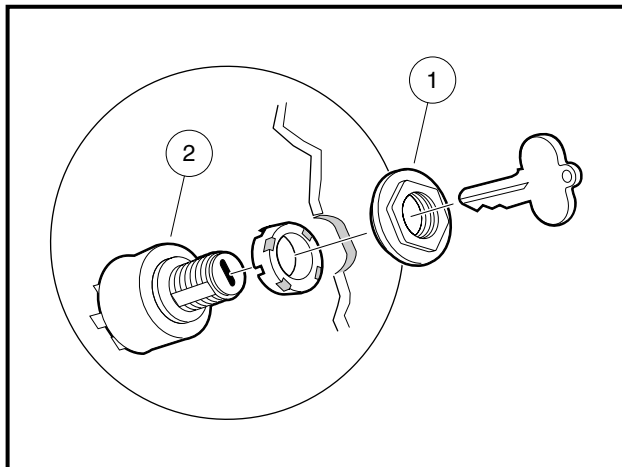


Figure 12a-20 Key Switch Removal

SOLENOID

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Solenoid

See Test Procedure 6, Section 11a, Page 11a-28.

Solenoid Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.

Solenoid Removal, Continued:

3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Remove electrical component box cover.
5. Disconnect all the wires from the solenoid.
6. Remove the two screws securing the solenoid in place.
7. Remove the solenoid.

Solenoid Installation

1. Install the solenoid in the electrical component box. Use two screws to secure the solenoid to the box and tighten to 14 in-lb (1.6 N·m). **See following WARNING.**

 WARNING

- **Incorrect wiring could result in severe injury or death.**
 - **Diode and solenoid connections must have correct polarity.**
 - **Keep all persons clear of engine belts when making final connections.**
2. Connect all wires as indicated.
 - 2.1. Connect the 6-gauge white wire from the starter/generator, 18-gauge red wire from the voltage regulator, and the 12-gauge white wire from the diode to the large post on the solenoid. **See Wiring Diagram, Section 11a, Page 11a-8.**
 - 2.2. Connect the 6-gauge red wire from the battery, the 10-gauge red wire from the fuse block, the 18-gauge red wire from the voltage regulator, and the 12-gauge red wire from the diode to the other large post on the solenoid.
 - 2.3. Connect the 18-gauge blue wire from the key switch to the small post on the solenoid.
 - 2.4. Connect the 18-gauge green wire from the Forward/Reverse limit switch to the other small post on the solenoid.
 3. Tighten the hex nuts on the large solenoid posts to 60 in-lb (6.8 N·m). Tighten the nuts on the small solenoid posts to 22 in-lb (2.5 N·m).
 4. Install the snap-on electrical box cover by firmly pressing down on all corners and install the screw, tightening to 18 in-lb (2 N·m).
 5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
 6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

FUSE

Read DANGER and WARNING on page 12a-1.

Testing the Fuse

See Test Procedure 2, Section 11a, Page 11a-25.

Fuse Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**

4. Remove electrical component box cover.
5. Remove the fuse from the fuse block.

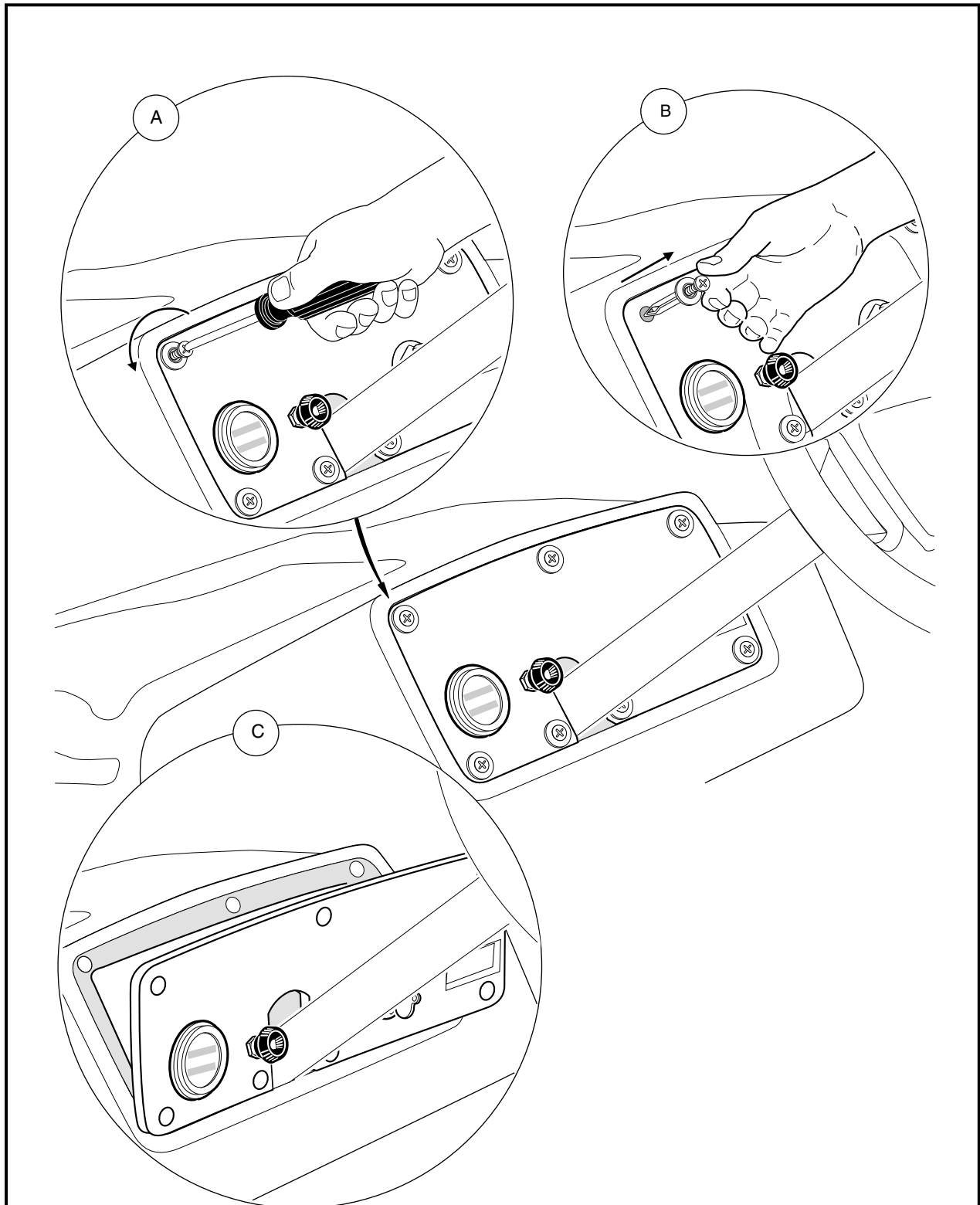


Figure 12a-21 Center Dash Panel Removal

Fuse Installation

1. Install the fuse. **See following WARNING.**

WARNING

- **If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.**
2. Install the snap-on electrical box cover by firmly pressing down on all corners and install the screw, tightening to 18 in-lb (2 N·m).
 3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
 4. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

LOCKOUT CAM LIMIT SWITCH

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Lockout Cam Limit Switch

See Test Procedure 7, Section 11a, Page 11a-29.

Lockout Cam Limit Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Disconnect the wires from the lockout cam limit switch (5) located on the back of the Forward/Reverse shifter assembly (**Figure 12a-22, Page 12a-21**).
5. Remove two nuts (2) and washers (6) from the lockout cam limit switch (5) and slide the lockout cam limit switch off of the screws.

Lockout Cam Limit Switch Installation

1. Install the lockout cam limit switch (5) with two washers (6) and two nuts (2) (**Figure 12a-22, Page 12a-21**). Tighten to 5 in-lb (0.6 N·m). Place the Forward/Reverse handle in REVERSE to make sure that both switches actuate. **See following CAUTION.**

CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, limit switches could be damaged.**
2. Connect wires to the lockout cam limit switch.
 - 2.1. Connect the black wire to the common (COM) terminal and the green wire to the normally open (NO) terminal of the lockout cam limit switch. **See Wiring Diagram, Section 11a, Page 11a-8.**

3. Connect battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Check limit switch operation.
 - 4.1. With the Forward/Reverse handle in NEUTRAL, the lockout cam should be activating the lockout cam limit switch. Make sure everyone is clear of the vehicle.
 - 4.2. Turn the key switch to the START position. The engine should crank only when the Forward/Reverse handle is in the NEUTRAL position.
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
6. Test drive the vehicle and attempt cranking the engine in both forward and reverse for proper operation.

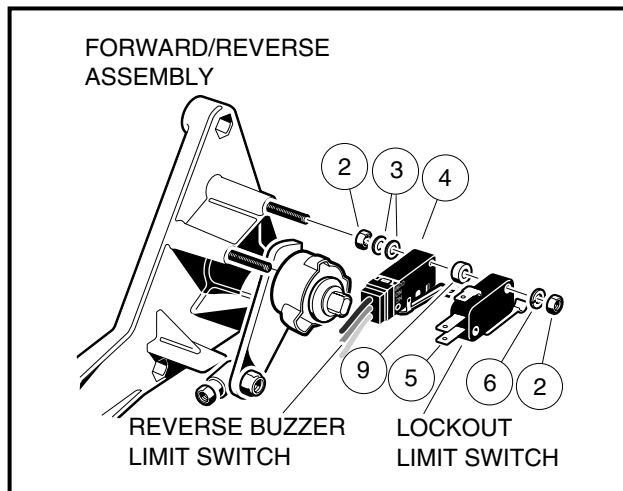


Figure 12a-22 Lockout Cam and Reverse Buzzer Limit Switches

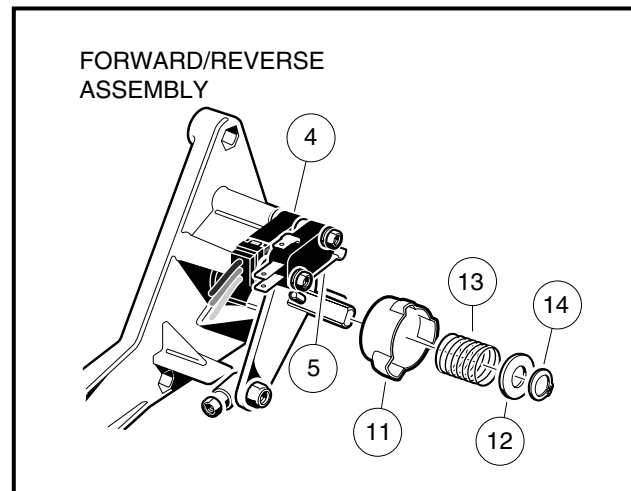


Figure 12a-23 Lockout Cam

LOCKOUT CAM

Read **DANGER** and **WARNING** on page 12a-1.

If the cam lobes have worn to the point where they will no longer actuate the lockout cam limit switch, the cam must be replaced.

Testing the Lockout Cam

See Test Procedure 23, Section 11a, Page 11a-44.

Lockout Cam Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Remove the external snap ring (14) (**Figure 12a-23, Page 12a-21**).
5. Remove the plastic washer (12) and the spring (13).
6. Remove the cam (11).

Lockout Cam Installation

1. Install the cam (11) (**Figure 12a-23, Page 12a-21**).
2. Install the spring (13) and the plastic washer (12).
3. Install the external snap ring (14) onto the shaft. Be sure the snap ring is installed in the groove on the shaft. Also be sure that the cam is installed so that the lockout limit switch is activated only when the Forward/Reverse handle is in NEUTRAL.
4. Connect battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

REVERSE WARNING BUZZER

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Reverse Warning Buzzer

See Test Procedure 20, Section 11a, Page 11a-43.

Reverse Warning Buzzer Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Remove the dash panel. **See Key Switch Removal on page 12a-16.**
5. Disconnect the wires from the reverse warning buzzer (2) (**Figure 12a-24, Page 12a-23**).
6. Remove the two 4-40 x 3/4-inch machine screws (3), nuts (4), flat washers (6), and lock washers (5) securing the buzzer to the vertical frame support.
7. Remove the reverse warning buzzer body (2).

Reverse Warning Buzzer Installation

1. Install the two 4-40 x 3/4-inch machine screws (3) through the buzzer (2) bracket tab and through the frame.
2. Attach the flat washers (6), lock washers (5), and secure with nuts (4). Tighten to 14 in-lb (1.6 N·m) (**Figure 12a-24, Page 12a-23**).

NOTE: The reverse warning buzzer is secured at one hole only.

3. Connect the black wire from the wire harness to the negative (–) terminal on the buzzer.
4. Connect the red/white wire from the wire harness to the positive (+) terminal on the buzzer.
5. Install the dash panel in reverse order of removal. **See Key Switch Installation on page 12a-17.**
6. Connect battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

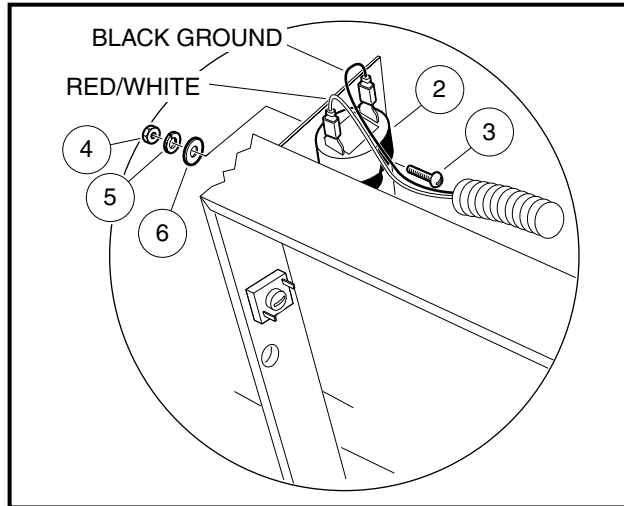


Figure 12a-24 Front Reverse Warning Buzzer

REVERSE BUZZER LIMIT SWITCH

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Reverse Buzzer Limit Switch

See Test Procedure 19, Section 11a, Page 11a-42.

Reverse Buzzer Limit Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Disconnect the wires from the reverse buzzer limit switch (4) located on the back of the Forward/Reverse assembly (**Figure 12a-22, Page 12a-21**).
5. Remove the nuts (2) and washers (6) from the lockout cam limit switch (5) and slide the lockout cam limit switch off of the screws. Do not disconnect the wires.
6. Remove the spacers (9) from the reverse buzzer limit switch (4) and slide the reverse buzzer limit switch off the screws.

Reverse Buzzer Limit Switch Installation

1. Install the reverse buzzer limit switch (4), and then install two spacers (9) against the limit switch.
2. Install the lockout cam limit switch (5) with two washers (6) and two nuts (2). Tighten to 5 in-lb (0.6 N·m). **See following CAUTION.**

⚠ CAUTION

- Do not overtighten the retaining nuts. If the nuts are overtightened, limit switches could be damaged.

Reverse Buzzer Limit Switch Installation, Continued:

3. Place the Forward/Reverse handle in REVERSE to make sure that only the reverse buzzer limit switch is actuated.
4. Connect the orange wire to the black (COM) wire terminal and the red/white wire to the blue wire, normally open (NO) terminal of the reverse buzzer limit switch (4) (**Figure 12a-22, Page 12a-21**).
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N-m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Turn the key switch to the ON position. With the Forward/Reverse handle in REVERSE, the buzzer should sound.
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

OIL WARNING LIGHT

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Oil Warning Light

See **Test Procedure 22, Section 11a, Page 11a-43.**

Oil Warning Light Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Remove the dash panel. **See Key Switch Removal on page 12a-16.**
5. Disconnect the wires from the oil warning light (1) (**Figure 12a-25, Page 12a-25**). Do not allow wires to touch.
6. Depress the retaining tabs and remove the light from the center dash.
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

Oil Warning Light Installation

1. Push a new unit into hole in dash until plastic tabs engage dash (**Figure 12a-25, Page 12a-25**).
2. Connect the two yellow wires from the wire harness to the oil warning light.
3. Install the dash panel. **See Key Switch Removal on page 12a-16.**
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N-m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

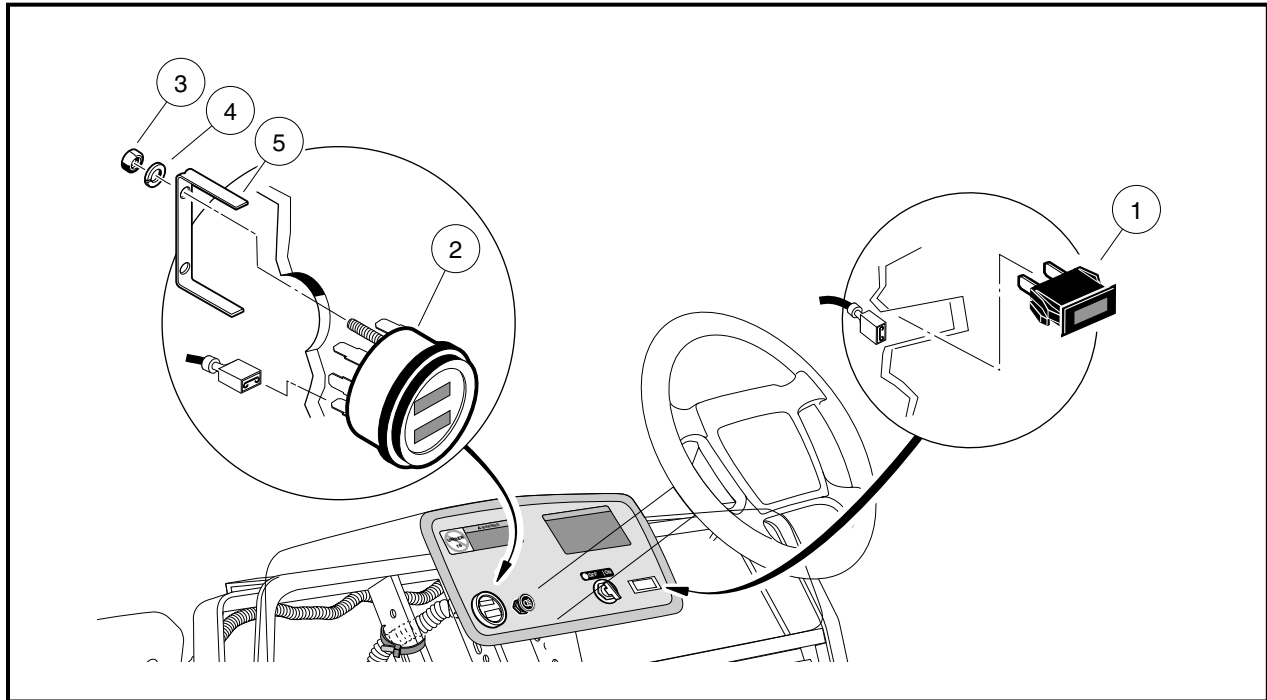


Figure 12a-25 Fuel Gauge/Hour Meter and Oil Warning Light Installation

FUEL GAUGE/HOUR METER

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Fuel Gauge/Hour Meter

See Test Procedure 26, Section 11a, Page 11a-46. Also see Test Procedure 27 – Hour Meter on page 11a-46

With the key switch in the OFF position, the fuel gauge/hour meter fields are blank. When the key switch is turned to ON, both fields activate. The fuel gauge initially registers full for a brief moment before indicating the actual fuel level.

The hour meter displays the number of hours of use in increments of .1 hour, but does not record additional time unless the key switch is in the ON position. When the hour meter is recording, the hourglass icon at the left of the field blinks slowly.

Fuel Gauge/Hour Meter Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Remove the dash panel. **See Key Switch Removal on page 12a-16.**
5. Disconnect the wires from the fuel gauge/hour meter (2) (**Figure 12a-25, Page 12a-25**). Do not allow wires to touch.
6. Remove the two hex nuts (3) and lock washers (4) from the threaded studs on the back of the fuel gauge/hour meter. Remove the mounting bracket (5) from the back side of the fuel gauge/hour meter and remove the fuel gauge/hour meter from the dash.

Fuel Gauge/Hour Meter Installation

1. Install a new gauge/meter into hole in dash until flange seats against dash (**Figure 12a-25, Page 12a-25**).
2. Slide the mounting bracket onto the two threaded studs on the gauge/meter and secure with two lock washers and two hex nuts. Tighten to 2.5 in-lb (0.28 N·m). Place one drop of Loctite™ on each hex nut. Do not allow Loctite to come into contact with the gauge/meter casing.
3. Connect the orange wire from the fuel level sending unit to the no. 1 terminal, the blue wire to the no. 2 terminal, the white wire to the No. 4 terminal, and the black wire to the No. 3 terminal on the gauge/meter. **See Wiring Diagram, Section 11a, Page 11a-8.**
4. Coat the terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Install the dash panel. **See Key Switch Installation on page 12a-17.**
6. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

FUEL LEVEL SENDING UNIT

Read DANGER and WARNING on page 12a-1.

The fuel level sending unit is an integral part of the fuel tank and should never be removed. Thoroughly test the fuel level sending unit before replacing the fuel tank.

Testing the Fuel Level Sending Unit

See Test Procedure 25, Section 11a, Page 11a-44.

RPM LIMITER

Read DANGER and WARNING on page 12a-1.

Testing the RPM Limiter

See Test Procedure 15, Section 11a, Page 11a-36.

RPM Limiter Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 2.2. Remove both seats from the vehicle.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Disconnect the white/black wire from the black wire at the bullet connector located near the RPM limiter (**Figure 12a-26, Page 12a-27**).
5. Disconnect the other black wire at the other bullet connector near the RPM limiter.
6. Remove the flange head bolts from the RPM limiter band and remove the RPM limiter and damper (**Figure 12a-26, Page 12a-27**).

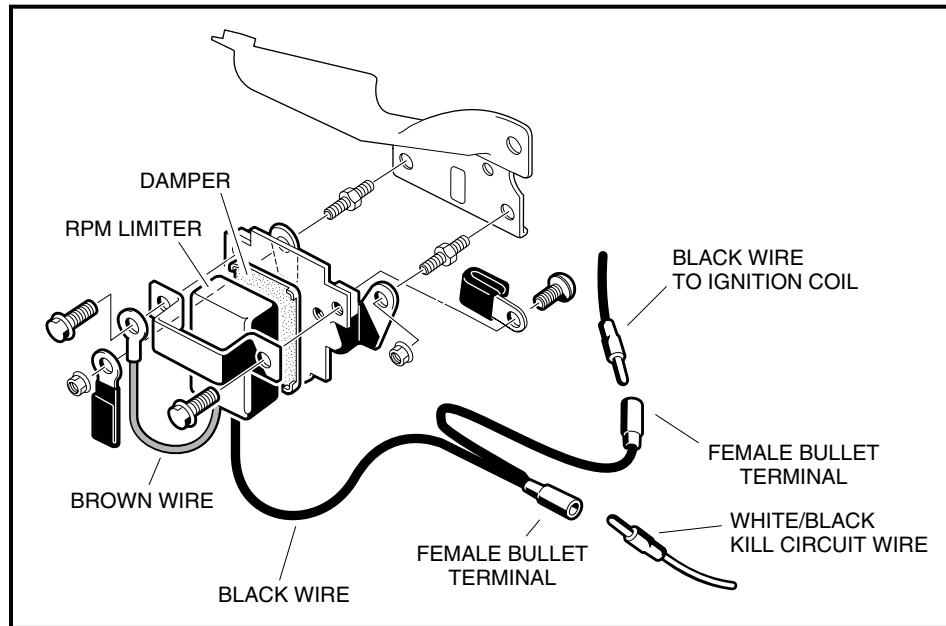


Figure 12a-26 RPM Limiter Assembly

RPM Limiter Installation

1. Place the RPM limiter on the damper squarely so that RPM limiter fits tightly against the damper.
2. Place the RPM limiter with damper on the front of the RPM limiter mounting bracket (**Figure 12a-26, Page 12a-27**).
3. Place the band over the RPM limiter and align the holes. Place the brown wire ring connector onto the flange head bolt and secure the left side of the band. Use another flange head bolt to secure the other side of the band. Make sure the band holds the RPM limiter securely in place. Tighten fasteners to 7 ft-lb (9.5 N·m).
4. Connect the black wire at the bullet connector to the white/black kill circuit wire, and the remaining black wire at the other bullet connector to the black wire from the ignition coil.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Install both seats.
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-1.**

IGNITION COIL

Read DANGER and WARNING on page 12a-1.

The ignition coil is located under the flywheel shroud of the engine. To replace it requires the removal and installation of the engine and transaxle. It is recommended that the ignition coil be thoroughly tested prior to replacement.

Testing the Ignition Coil

See Test Procedure 14, Section 11a, Page 11a-35. Also see Test Procedure 15 – RPM Limiter on page 11a-36 and Test Procedure 16 – Ignition Coil on page 11a-36.

Ignition Coil Removal

Removing the ignition coil requires the removal of the engine and unitized transaxle. **See Unitized Transaxle Removal, Section 16a, Page 16a-9.**

CAUTION

- Before removal and disassembly, clean the engine.

1. Remove the starter/generator. **See Starter/Generator Removal on page 12a-3.**

NOTE: The crankshaft has left-hand threads at the clutch mounting hole.

2. Remove the muffler. **See Muffler Removal, Section 15, Page 15-2.**
3. Remove the engine mounting hardware (items 1, 2, and 5). **See Figure 13-41, Section 13, Page 13-23.**
4. Remove the two nuts (6) and washers (3) from the stud bolts in the engine body. **See Figure 13-41, Section 13, Page 13-23.**
5. Slide the engine away from the transaxle housing and lift the engine from the mounting plate.
6. Place the engine on a solid, flat surface, preferably on a sturdy work bench.
7. Remove the pan head bolts (5) securing the fan shroud (8) to the fan housing (9) (**Figure 12a-27, Page 12a-28**).
8. Loosen, but do not remove, three bolts (6) attaching the fan housing as shown.
9. Remove the remaining four bolts (10) attaching the fan housing as shown (**Figure 12a-27, Page 12a-28**), then while opening the housing, detach the spark plug wire grommet (4) from the housing (**Figure 12a-29, Page 12a-29**).
10. Disconnect the 18-gauge black wire (12) from the spade terminal on the ignition coil (11) and remove the coil by removing two bolts (10) (**Figure 12a-28, Page 12a-28**).

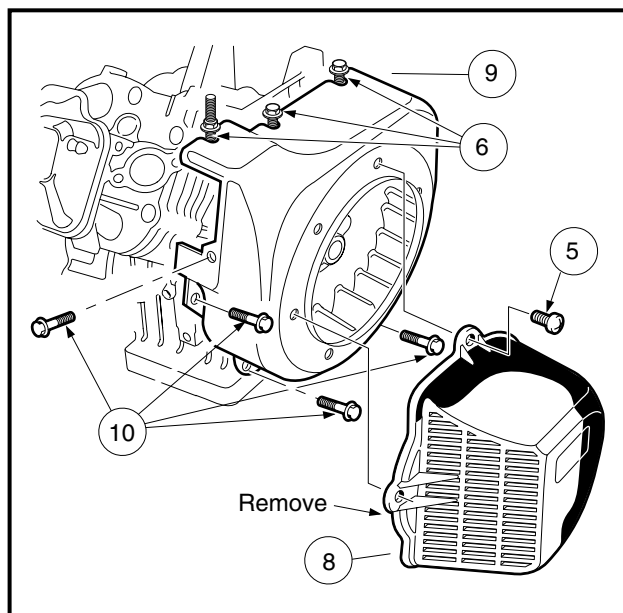


Figure 12a-27 Remove Fan Housing

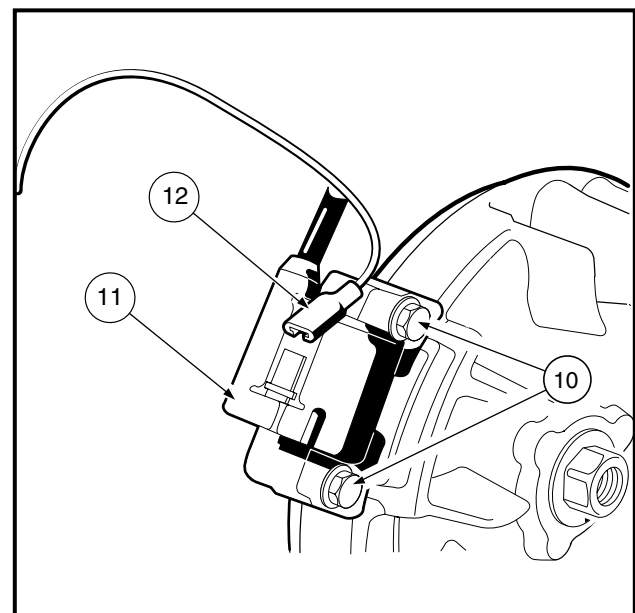


Figure 12a-28 Remove Ignition Coil

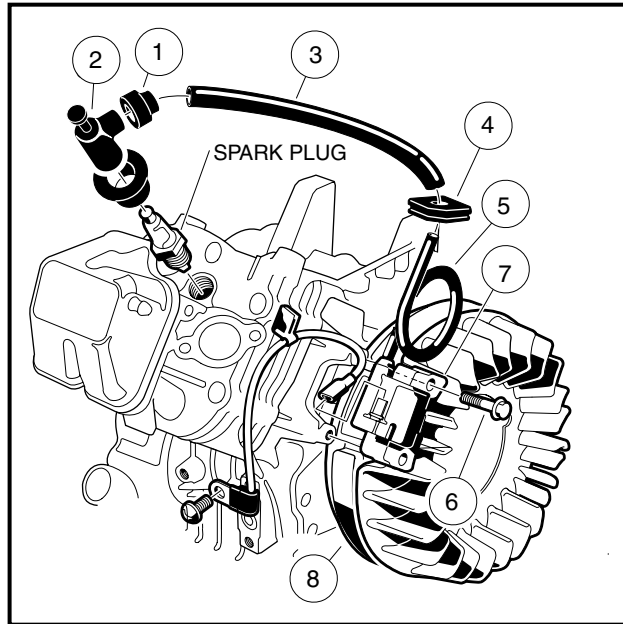


Figure 12a-29 Clean Grommet

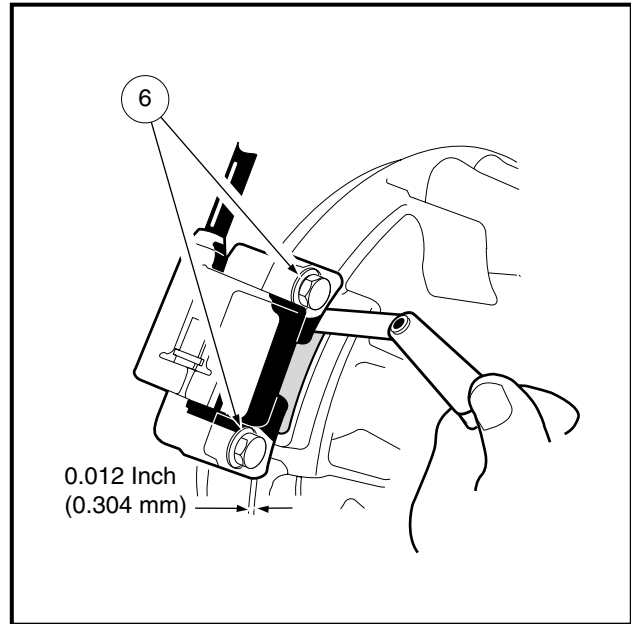


Figure 12a-30 Mount Ignition Coil Using Feeler Gauge

Ignition Coil Installation

NOTE: If a new ignition coil is being installed, the spark plug cap, gasket, protector tube and grommet must be removed from the old coil and installed on the new coil. **See steps 1 through 8 for procedures to remove and install these existing parts.**

If the existing ignition coil will be remounted, proceed to step 9.

1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire.
2. Remove the cap (2) from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire (**Figure 12a-29, Page 12a-29**).
3. Remove the gasket (1) and protector tube (3) from the old coil.

NOTE: Moisten the spark plug wire with water to make gasket removal and installation easier.

4. Remove the grommet (4) from the old spark plug wire. Clean the grommet and place it on the new spark plug wire (5).
5. Install the protector tube onto the new wire.
6. Slide the gasket onto the end of the new spark plug wire.
7. Install the cap (2) on the new coil spark plug wire by rotating it clockwise three or four revolutions while applying light pressure on the cap.
8. Install the gasket (1) on the cap (2) (**Figure 12a-29, Page 12a-29**).
9. Position the ignition coil (7) onto the cast mounting bosses on the engine crankcase and tighten the two mounting bolts (6) finger tight.
10. Rotate the flywheel (8) until the magnet is positioned directly under the ignition coil. Use a 0.012 inch (0.304 mm) bronze feeler gauge to set the air gap between the ignition coil and the flywheel magnet. Tighten the two mounting bolts (6) to 30 in-lb (3.4 N·m) (**Figure 12a-30, Page 12a-29**).
11. Connect the 18-gauge black wire to the spade terminal on the coil (**Figure 12a-28, Page 12a-28**).
12. Position the fan housing close to the engine crankcase and slide the plug wire grommet into the notch on the housing.

Ignition Coil Installation, Continued:

13. When installing fan housing, make sure the top front corner of the housing is above the upper cylinder shroud. The front edge of the fan housing should be behind the lower cylinder shroud. Align the slots in the housing with the flanged bolts (6) loosened earlier (**Figure 12a-27, Page 12a-28**).
14. Install the four remaining flanged bolts (10) that secure the fan housing to the engine crankcase. Tighten all seven mounting bolts (6) and (10) to 90 in-lb (10.2 N·m) (**Figure 12a-27, Page 12a-28**).
15. Install the fan shroud with four pan-head bolts (5). Tighten to 50 in-lb (5.7 N·m) (**Figure 12a-27, Page 12a-28**).
16. Place the engine onto the engine mounting plate and slide the two washers (3) onto the two engine body bolts, then slide the bolts through the mounting plate and transaxle housing. Loosely attach the two nuts (6) finger tight. **See Figure 13-41, Section 13, Page 13-23.**
17. Attach the engine to the bottom of the engine mounting plate using the bolts (1), washers (2), and nuts (5). Tighten hardware to 21 ft-lb (28.4 N·m). **See Figure 13-41, Section 13, Page 13-23.**
18. Tighten the two engine body bolt nuts (6) to 17 ft-lb (23.1 N·m).
19. Install the engine and transaxle assembly. **See Unitized Transaxle Installation, Section 16a, Page 16a-42.**

 CAUTION

- **Make sure wire harness is routed and secured away from the muffler.**

20. Install the muffler. **See Muffler Installation, Section 15, Page 15-3.**
21. Install the starter/generator and belt. **See Starter/Generator Installation on page 12a-11.**
22. Connect the spark plug wire to the spark plug.
23. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
24. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

OIL LEVEL SENSOR

Read DANGER and WARNING on page 12a-1.

Testing the Oil Level Sensor

See Test Procedure 21, Section 11a, Page 11a-43.

Oil Level Sensor Removal

See Oil Level Sensor Installation, Section 13, Page 13-24.

Oil Level Sensor Installation

See Oil Level Sensor Installation, Section 13, Page 13-24.

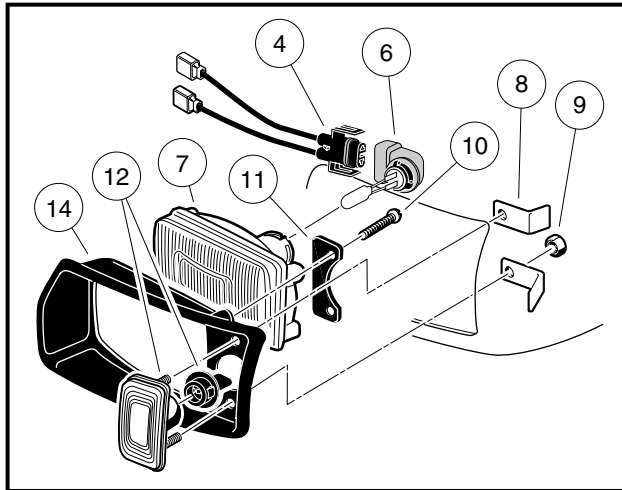


Figure 12a-31 Headlight Assembly

HEADLIGHTS

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Headlight Bulb and Socket

See Test Procedure 30, Section 11a, Page 11a-49.

Headlight Bulb Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. From the front of vehicle, reach under cowl and turn the wire harness/halogen bulb assembly (4 and 6) clockwise one-quarter turn (**Figure 12a-31, Page 12a-31**).
5. Remove the wire harness/halogen bulb assembly (4 and 6) from the headlight lens (7).
6. Lift the retaining tabs on the connector (4) and remove halogen bulb assembly (6).

Headlight Bulb Installation

NOTE: When handling halogen bulbs, do not touch glass portion of bulb. Oil from finger tips can cause premature failure of bulb.

1. Connect wire harness (4) to the halogen bulb assembly (6). The retaining tab should lock onto the halogen bulb assembly (**Figure 12a-31, Page 12a-31**).
2. From the front of vehicle, reach under cowl and insert wire harness/halogen bulb assembly (4 and 6) into the headlight lens (7).
3. Turn the wire harness/halogen bulb assembly (4 and 6) counterclockwise one-quarter turn.

Headlight Bulb Installation, Continued:

4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

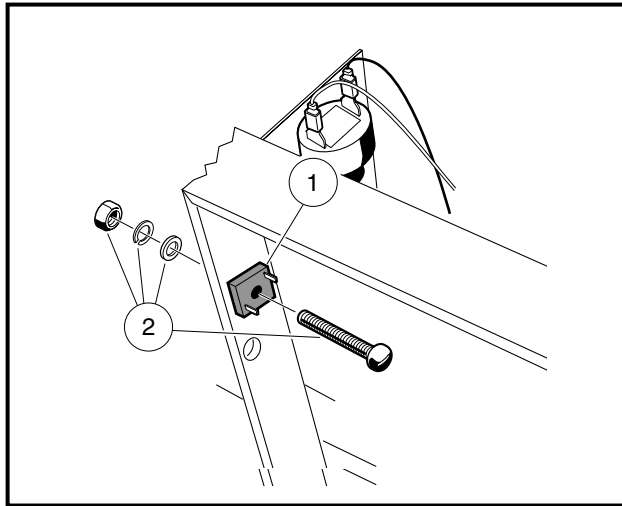


Figure 12a-32 Headlight Diode

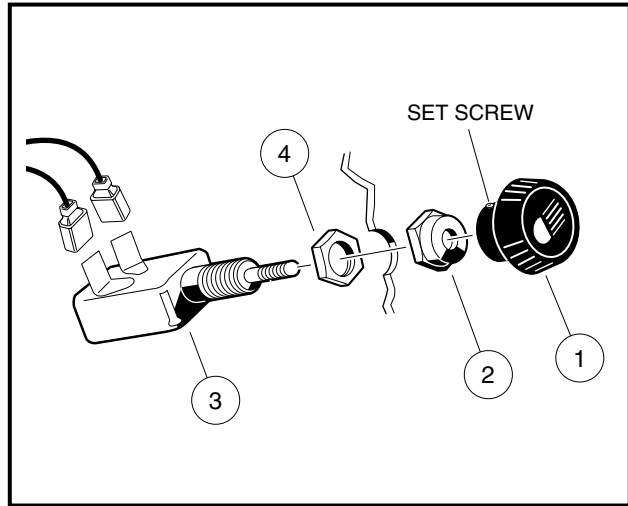


Figure 12a-33 Light Switch

HEADLIGHT DIODE

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Headlight Diode

See **Test Procedure 29, Section 11a, Page 11a-48.**

Headlight Diode Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Remove the center dash panel. **See Key Switch Removal on page 12a-16.**
5. Disconnect wires from the headlight diode (1) (**Figure 12a-32, Page 12a-32**).
6. Remove the mounting hardware (2) from the headlight diode and remove it from the vehicle.

Headlight Diode Installation

1. Mount the headlight diode to the frame using the mounting hardware. Tighten to 25 in-lb (2.8 N·m) (**Figure 12a-32, Page 12a-32**).
2. Connect the black 16-gauge wire from the harness to the negative (-) wire from the frame ground terminal on the headlight diode.
3. Install the dash panel. **See Key Switch Installation on page 12a-17.**
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

LIGHT SWITCH

Read **DANGER** and **WARNING** on page 12a-1.

Testing the Light Switch

See Test Procedure 28, Section 11a, Page 11a-47.

Light Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
4. Loosen the set screw locking the light switch knob (1) to the shaft (**Figure 12a-33, Page 12a-32**).
5. Remove the dash panel. **See Key Switch Removal on page 12a-16.**
6. Disconnect the wires from the light switch.
7. Remove the outer nut (2) from the light switch (3) (**Figure 12a-33, Page 12a-32**).
8. Remove the light switch from the dash panel.

Light Switch installation

1. Connect the wires to the light switch. **See Wiring Diagram, Section 11a, Page 11a-8.**
2. Thread the check nut (4) onto the switch until an equal number of threads show on both sides. Insert the switch through the dash panel and install the nut (2) on the outside of the dash. Tighten the nut to 14 in-lb (1.6 N·m) (**Figure 12a-33, Page 12a-32**).
3. Push the light switch shaft in. Screw the knob onto the end of the shaft until the knob touches the outer nut. Then turn the knob in the opposite direction until the headlight beams on the knob are horizontal to the ground. Tighten the set screw to lock the knob to the shaft.
4. Install the dash panel. **See Key Switch Installation on page 12a-17.**
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**

BATTERY

Read **DANGER** and **WARNING** on page 12a-1.

DANGER

- Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.
- Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.

DANGER CONTINUED ON NEXT PAGE...

⚠ DANGER

- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

General Information

See preceding DANGER statement.

Club Car gasoline vehicles are equipped with 12-volt, low-maintenance batteries. When changing a 12-volt battery in any Club Car gasoline-powered vehicle, the same size battery with adequate amperage ratings should be used as a replacement.

Club Car recommends a group 70, side-post battery (CCI P/N 1012328), with a 650 cranking amp rating at 32 °F (0 °C) (500 CCA at 0 °F (-17.8 °C)) and a reserve capacity of at least 105 minutes. The group 70 classification indicates battery size: 8-1/4 inches W x 6-1/2 inches D x 7-1/4 inches H (21.0 cm W x 16.5cm D x 18.4 cm H). It is important to use the proper size to ensure that the battery clamp will fit correctly.

Testing the Battery

See Test Procedure 1, Section 11a, Page 11a-22. Also see Test Procedure 24 – Battery Test (Under Load) on page 11a-44.

Preventive Maintenance

To keep the battery in good operating condition, follow these steps on a regular basis.

1. Any corrosion build-up on or around the battery should be removed immediately. Post connections should be clean and tight. Any frayed or worn wires should be replaced. After all cables have been connected and properly tightened to 20 ft-lb (27.1 N-m), coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to prevent future corrosion.
2. The battery should be kept clean and dry to prevent self-discharge. Any dirt, grime or acid spillage should be removed. Wash the battery with a bristle brush using water and bicarbonate of soda or baking soda (1 cup (237 mL) per 1 gallon (3.8 L) water). Rinse with water. Do not allow solution to enter battery through the vent cap holes. **See Self-Discharge on page 12a-34.**
3. Maintain proper water level. **See Water Level on page 12a-34.**
4. Check battery periodically to see that it is in a full state of charge. **See Charging the Battery on page 12a-36.**
5. Keep battery hold-down clamp tight. **See Vibration Damage on page 12a-35.**

Self-Discharge

Dirt and battery acid can provide a path for a small current draw that slowly discharges the battery. To prevent self-discharge, the battery should always be kept clean.

Hot weather also has an effect on a battery's self-discharge rate. The higher the temperature, the quicker a battery will discharge. In hotter climates, therefore, the battery should be checked more often. When storing the battery, keep in a cool place. **See Battery Storage on page 12a-37.**

Water Level

The water level should be checked semi-annually to be sure water is at its proper level. Never allow the water level to fall below the tops of the plates because this will cause the exposed part of the plate to become permanently inactive. Check the water level more frequently in hot weather or when the battery becomes old. **See Figure 11a-24, Section 11a, Page 11a-23.**

Vibration Damage

The battery hold-down clamp should always be tight enough to keep the battery from bouncing. Battery life may be severely shortened if the clamp is too loose. Excessive vibration shortens the life of the battery. It may also cause acid to leak out of the vent caps and corrosion to build up on surrounding metal parts. The acid that is lost reduces the capacity of the battery and cannot be replaced.

Mineral Content

For the longest battery life, distilled water should be used in the battery. However, if tap water is going to be used, contact your local water department to be sure mineral contents are below the levels listed in the following table. **See following NOTE.**

NOTE: Contact your local water department for mineral content analysis.

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)
Suspended matter	Trace
Total solids	100.0
Calcium and Magnesium Oxides	40.0
Iron	5.0
Ammonia	8.0
Organic matter	50.0
Nitrates	10.0
Nitrites	5.0
Chloride	5.0

Battery Removal

Read DANGER and WARNING on page 12a-1 and DANGER on page 12a-33.

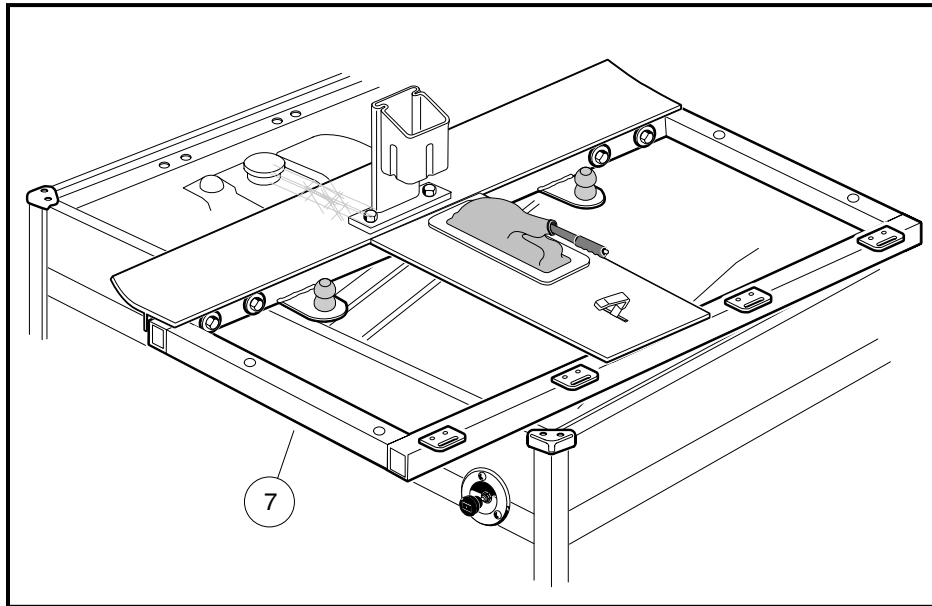
1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Completely remove both seats from the vehicle.
4. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
5. Remove the four bolts (8), eight washers (9) and four lock nuts (10) from the armrests. **See Figure 4-3, Section 4, Page 4-10.**
6. Remove the two armrests (11 and 12) from the vehicle.
7. Carefully lift and rotate the seat support 90° counterclockwise and allow it to rest on the vehicle body as illustrated (**Figure 12a-34, Page 12a-36**). **See following NOTE.**

NOTE: It is not necessary to remove the park brake cable or differential lock cable to service or remove the battery.

8. Remove the battery hold-down clamp from the battery.
9. Lift the battery from the vehicle. **See following WARNING.**

Battery Removal, Continued:**⚠ WARNING**

- Keep the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent hole. Do not exceed this 45° angle when lifting, carrying or installing battery. The battery acid could cause severe personal injury when accidentally coming in contact with the skin or eyes, and could damage clothing.

**Figure 12a-34 Battery Removal****Charging the Battery**

Read **DANGER** and **WARNING** on page 12a-1 and **DANGER** on page 12a-33.

1. Charge the battery using an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the positive charger cable (+) to the positive (+) battery post.
3. Attach the negative charger cable (–) to the negative (–) battery post.
4. The battery may be charged with a slow charge (3-10 amps) or a fast charge (20-30 amps). Charge until the specific gravity reaches 1.250. **See following WARNING.**

⚠ WARNING

- If the battery case feels hot (approximately 125 °F (52 °C) or more), emits gases, or fluid boils from vents, stop charging immediately. Failure to stop charging battery when any of these conditions are present could result in an explosion, personal injury and/or damage to the battery.
- Do not disconnect the DC leads and battery when the charger is on. The resulting arcing between the DC leads and battery post could cause an explosion.
- If the charger must be stopped, disconnect the AC supply cord from the wall outlet before disconnecting the DC leads from the battery. Allow the battery to cool to room temperature and resume charging battery at a lower amp rate.

Battery Installation

Read DANGER and WARNING on page 12a-1 and DANGER on page 12a-33.

1. Place the battery into the vehicle. Make sure the battery posts are facing the engine.
2. Secure the battery to the vehicle with the clamp. Install bolt, washer and lock nut and tighten to 12 ft-lb (16.3 N·m).
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m) (**Figure 12a-1, Page 12a-2**). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Return the seat support to its original position by rotating it 90° clockwise. Install the armrests using four bolts, eight washers and four lock nuts. Tighten bolts (8) to 13 ft-lb (17.6 N·m). **See Figure 4-2, Section 4, Page 4-7.**
5. Install both seats.
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12a-2.**
7. Check the park brake and differential lock lever for proper adjustment and operation.

Battery Storage

Read DANGER and WARNING on page 12a-1 and DANGER on page 12a-33.

1. Keep the battery clean and free of corrosion. **See Preventive Maintenance on page 12a-34.**
2. The battery cables should be disconnected from the vehicle so it can be connected to the charger. The battery can be left in the vehicle. Disconnect the negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12a-1.**
3. Fully charge the battery prior to storage.
4. Store in a cool, dry area. The colder the area in which the battery is stored, the less the battery will self-discharge. A battery stored at 0 °F (-17.8 °C) will discharge very little over a four-month period. A battery stored at 80 °F (27 °C) will have to be recharged every few weeks.
5. Check the state of charge periodically. A battery that is discharged and left in a cold environment can freeze and crack. If the specific gravity drops below 1.220, the battery should be recharged. **See following WARNING.**

WARNING

- **If the battery is frozen or the container is bulged, discard battery. A frozen battery can explode.**

Battery Storage, Continued:

6. The frequency of recharging required depends on the temperature of the storage area, but it is recommended that the battery be monitored for state of charge every month. Also, if the storage area is unheated in a cold climate and recharging is required, it is recommended that the area be heated to at least 60 °F (16 °C) prior to charging. The battery will not charge effectively in cold temperatures for the same reasons that it does not discharge as rapidly in cold temperatures.

Charging a Dead Battery

Read DANGER and WARNING on page 12a-1 and DANGER on page 12a-33.

The vehicle is equipped with a starter/generator. The generator is not designed to charge a dead battery. If the vehicle battery has become discharged, it must be charged using a properly rated automotive type charger. See following WARNING.

 WARNING

- Do not jump-start a dead battery using another battery and jumper cables.

GROUND CABLES

Testing the Ground Cables

See Test Procedure 3, Section 11a, Page 11a-25.

SECTION 12B – ELECTRICAL COMPONENTS: FE350, PEDAL-START ENGINE

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first (Figure 12b-1, Page 12b-2).**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

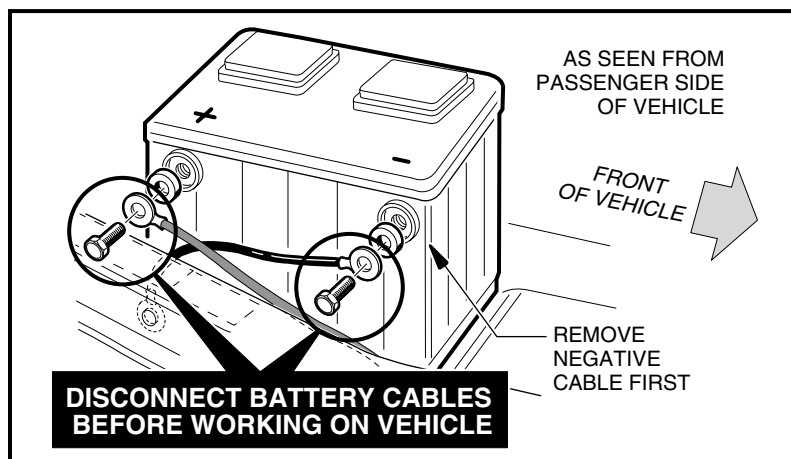


Figure 12b-1 Battery Disconnect

STARTER/GENERATOR

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Starter/Generator

See Test Procedure 8, Section 11b, Page 11b-31. Also see Test Procedure 10 – Starter/Generator (Generator Function) on page 11b-33.

Starter/Generator Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. See **WARNING "For vehicles with cargo beds..."** on page 12b-2.

- 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. See **WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Disconnect the wires from the starter/generator (1). Mark wires before disconnecting. Loosen the pivot nuts (7) and bolts (5) (**Figure 12b-2, Page 12b-3**).
6. Remove the mounting/adjustment nut (12), lock washer (9) and bolt (11). Lower the starter/generator and slip the belt (4) off the pulley (10).
7. Support the starter/generator so that when the pivot bolts are removed the starter/generator will not fall to the ground. Remove the two pivot nuts (7) and bolts (5) from the mounting bracket.
8. Remove the starter/generator.

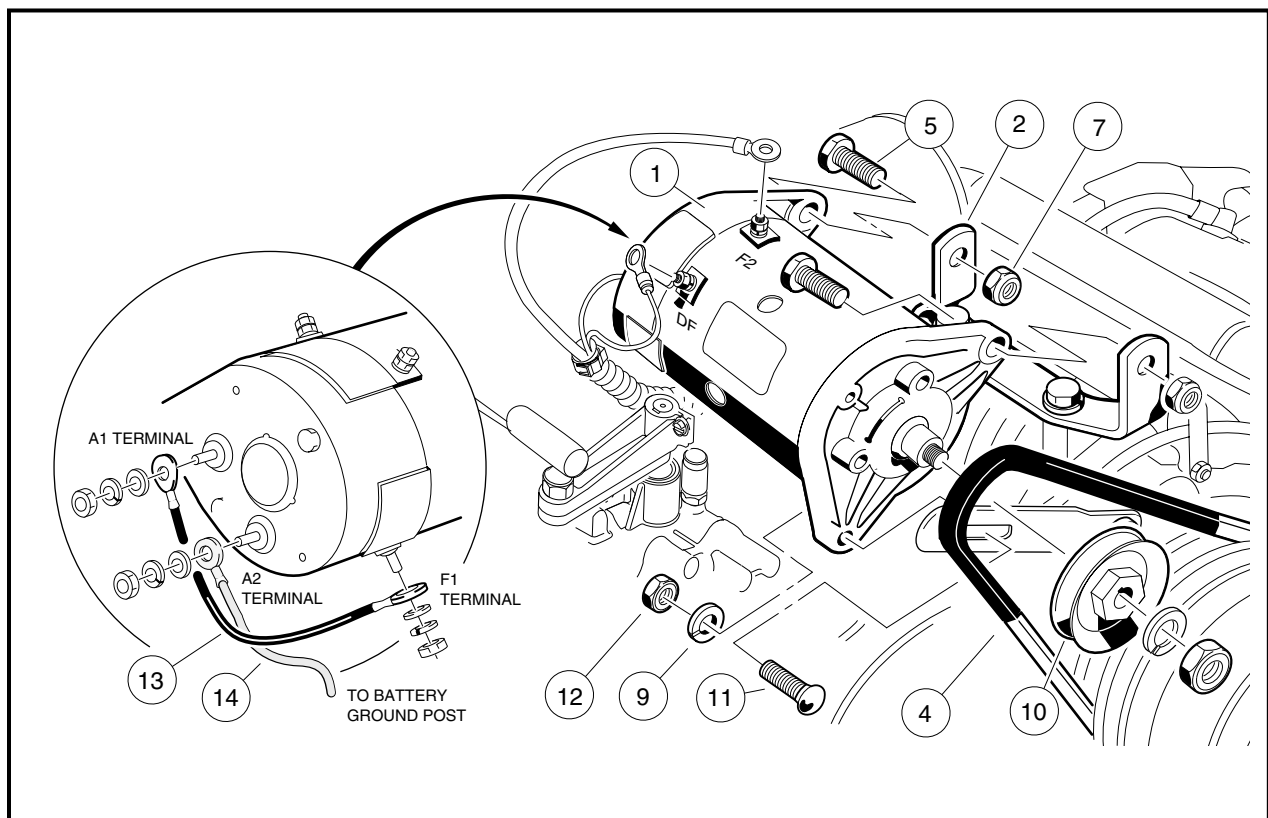


Figure 12b-2 Starter/Generator Removal

Disassembly of the Starter/Generator to Service the Brushes

1. Remove the two bolts (20) and pull commutator end cover (23) free of starter/generator housing (24) (**Figure 12b-3, Page 12b-4**). See following **NOTE**.

NOTE: If the brushes are not removed, contact between the brushes and commutator as the commutator end cover is being removed or installed could damage the brushes. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover (**Figure 12b-7, Page 12b-6**).

Disassembly of the Starter/Generator to Service the Brushes, Continued:

2. Remove brush covers (29 and 30), screws (25) and lock washers (26), brush springs (28), and brushes (27) (**Figure 12b-4, Page 12b-4**). See following **NOTE**.

NOTE: To clean and inspect the armature/commutator and the bearings, see **Disassembly of the Starter/Generator to Service the Armature/Commutator on page 12b-6**.

Brush Inspection, and Replacement

1. Visually inspect brushes. Replace brushes that are cracked or severely chipped.
2. Check the wear line on the side of the brush. If the end of the brush is within 1/16-inch (1.6 mm) of the wear line, replace all four brushes (**Figure 12b-5, Page 12b-4**).

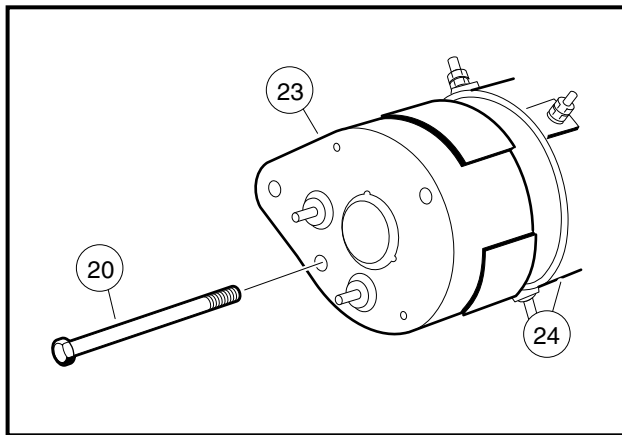


Figure 12b-3 Commutator End Cover

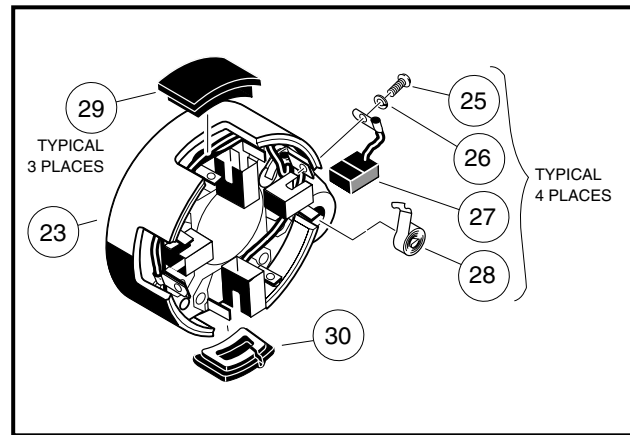


Figure 12b-4 Brush Covers and Brushes

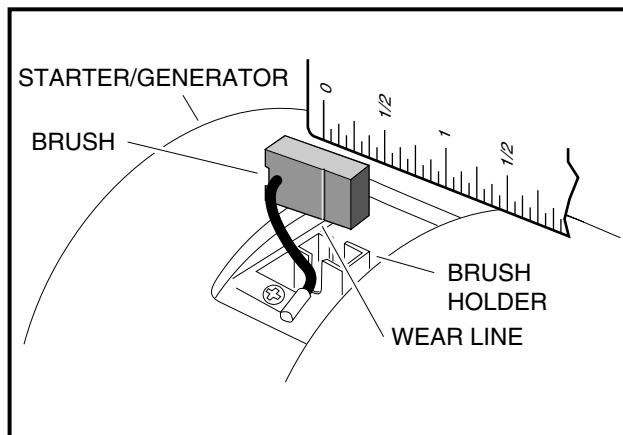


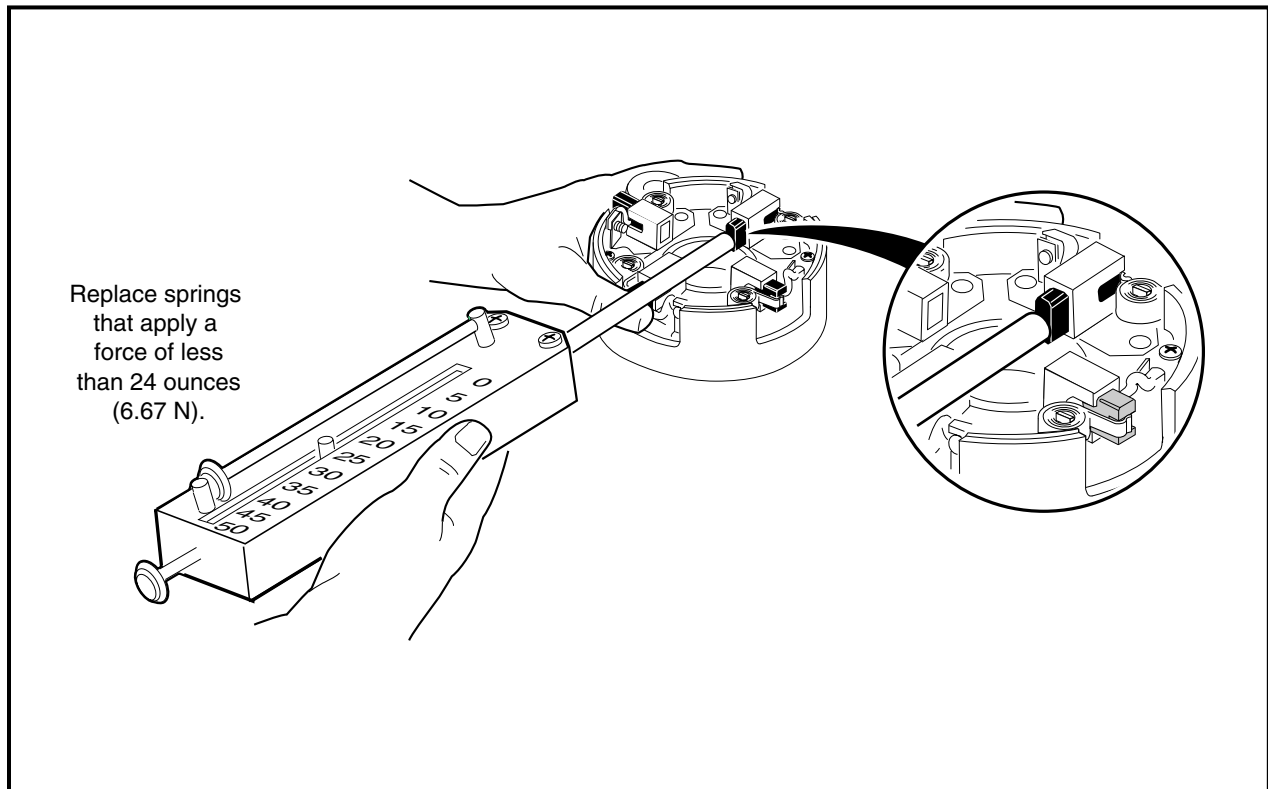
Figure 12b-5 Inspect Brushes

Brush Spring Inspection, and Replacement

1. Visually inspect springs. Replace all four springs if any spring is discolored from heat (straw or bluish in color).
2. Install the four brushes (27) into their holders and insert the four brush springs (28) (**Figure 12b-4, Page 12b-4**). Using a spring scale, test brush spring tension. If any spring has a tension less than 24 ounces (6.67 N), replace all four springs (**Figure 12b-6, Page 12b-5**). See following **CAUTION**.

⚠ CAUTION

- When checking brush spring tension, do not push springs beyond the point they would normally be if there were new brushes installed. Exerting excessive force or pushing brush springs beyond their normal maximum extension point will damage springs.

**Figure 12b-6 Check Spring Tension****Starter/Generator Assembly**

1. Connect the brush wires to the holders using four lock washers (26) and four screws (25), making sure the crossover leads are connected also. Tighten screws to 31 in-lb (3.4 N·m) (**Figure 12b-4, Page 12b-4**).
2. To prevent contact between the brushes and commutator as the commutator is installed, and possible damage to the brushes, lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover (**Figure 12b-7, Page 12b-6**).
3. Install commutator end cover (23) onto armature shaft. Align the locating pin with pin hole in cover. Install two M6 x 180 mm bolts (20) and tighten to 100 in-lb (11.2 N·m) (**Figure 12b-3, Page 12b-4**).
4. Push the brushes down into the holders. Position springs into the notches in the brushes. Install the brush cover (30) that has the drain hole in it next to the A2 terminal. Install the remaining three brush covers (29) in the openings in the commutator end cover (23) (**Figure 12b-4, Page 12b-4**).

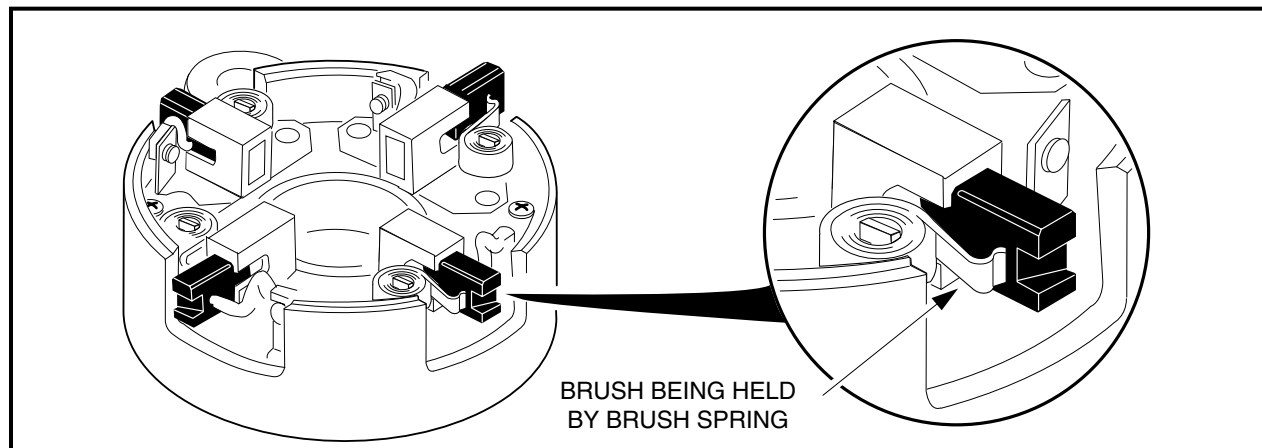


Figure 12b-7 Pull Brushes Away from Center of the Commutator End Cover

Disassembly of the Starter/Generator to Service the Armature/Commutator

1. If the brushes are not removed, contact between the brushes and commutator as the commutator end cover is being removed or installed could damage the brushes.
 - 1.1. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover (**Figure 12b-7, Page 12b-6**).
2. Remove the two bolts (20) and pull commutator end cover (23) free of the starter/generator housing (24) (**Figure 12b-3, Page 12b-4**).
3. To separate armature (33) from output end cover (36), remove nut (41), lock washer (40), pulley (39), shaft key (34), spacer (37), and bearing retainer screws (43) (**Figure 12b-8, Page 12b-6**).

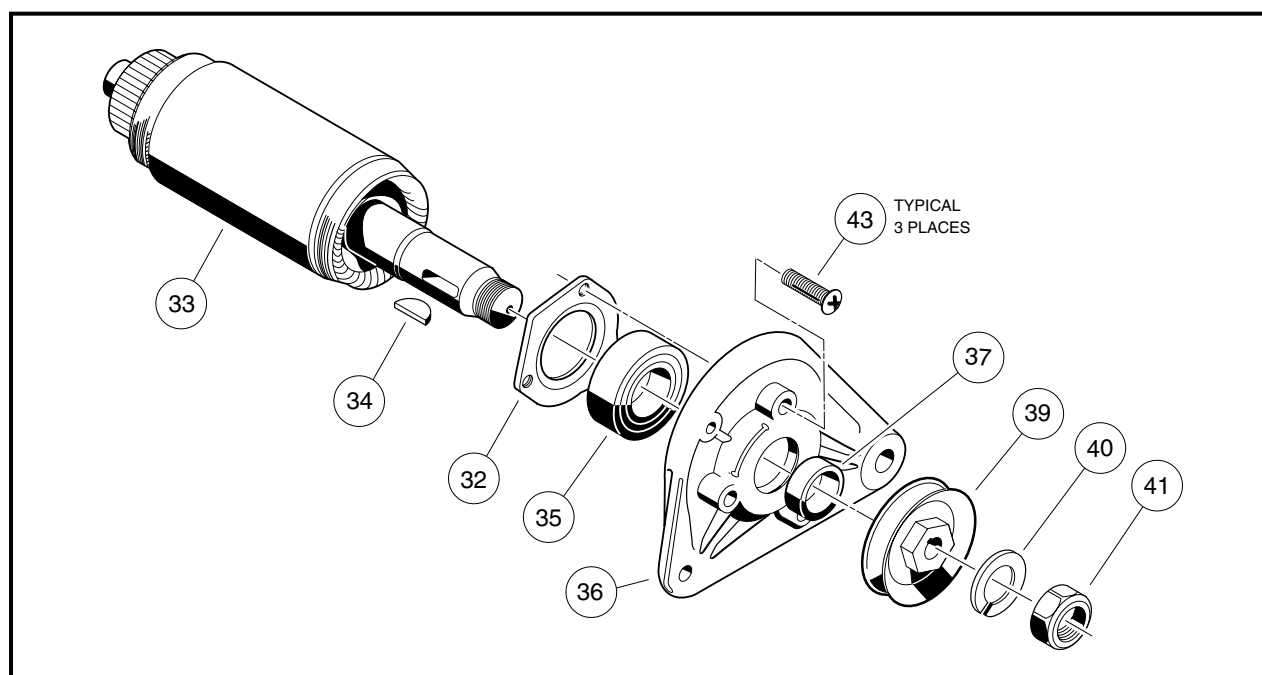


Figure 12b-8 Armature and Output End Cover Assembly

Bearing Cleaning And Inspection

1. Using a clean cloth, wipe the carbon dust off the two bearings. Inspect bearings by spinning them by hand and checking for both axial (A) and radial (B) play (**Figure 12b-9, Page 12b-7**).
2. Replace the bearing if it is noisy, does not spin smoothly, or has excessive play. Check the bearings and replace if rusted, worn, cracked, or if there is an abnormal color change in the metal of the bearing. Bearings should be replaced if there is extensive wear or pitting on the balls or on the rolling surfaces. Do not remove the bearings unless they are to be replaced.

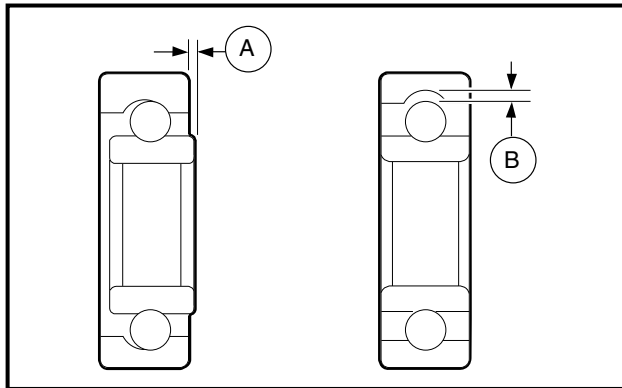


Figure 12b-9 Bearing Play Inspection

Bearing Removal

1. Place the wedge attachment tool (CCI P/N 1012812) between the bearing and the armature. Make sure the wedge attachment tool is supporting the inner race of the bearing. If a press is not available, secure a bearing puller (CCI P/N 1012811) to the wedge attachment tool and pull bearing off of the end of the armature shaft. Support the armature so that it will not drop when bearing is removed (**Figure 12b-10, Page 12b-7**).
2. Discard the bearings.
3. Slide the bearing retainer (32) off of the output end of the shaft (**Figure 12b-8, Page 12b-6**).

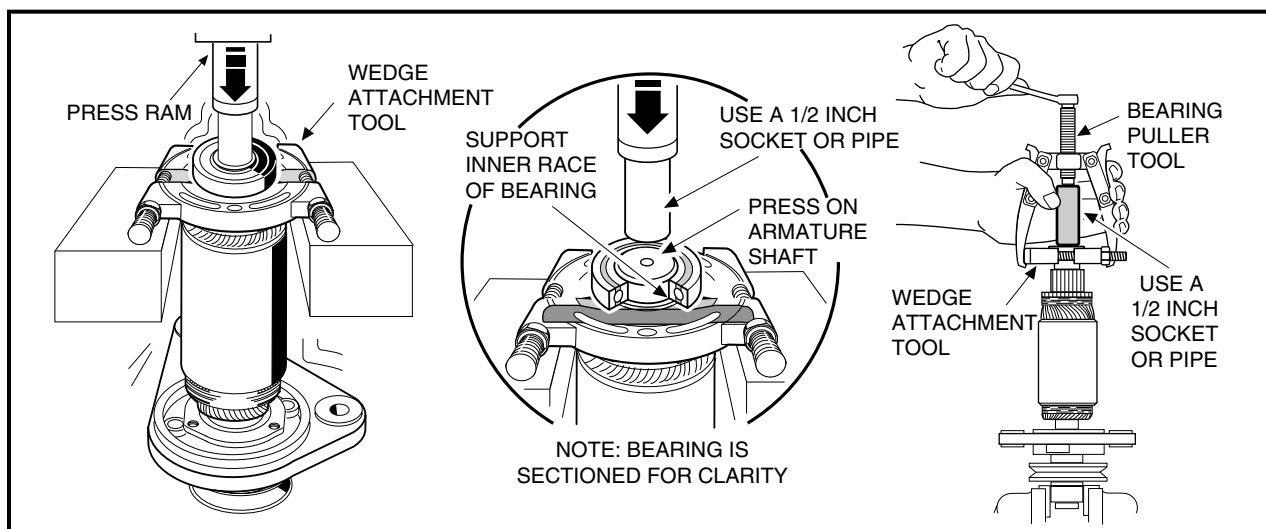


Figure 12b-10 Bearing Removal

Field Coil Removal

1. Remove the retaining nut from each field coil terminal and slide the insulator out of the slots in the housing. Remove the four pole piece screws from the housing. Remove the four pole pieces from inside the housing. Remove the field coils from the inside of the housing (**Figure 12b-11, Page 12b-8**). See following **NOTE**.

NOTE: Do not remove the insulators or the field coils unless an electrical test indicates that it is necessary (**Figure 12b-11, Page 12b-8**). See **Test Procedure 8, Section 11b, Page 11b-31**.

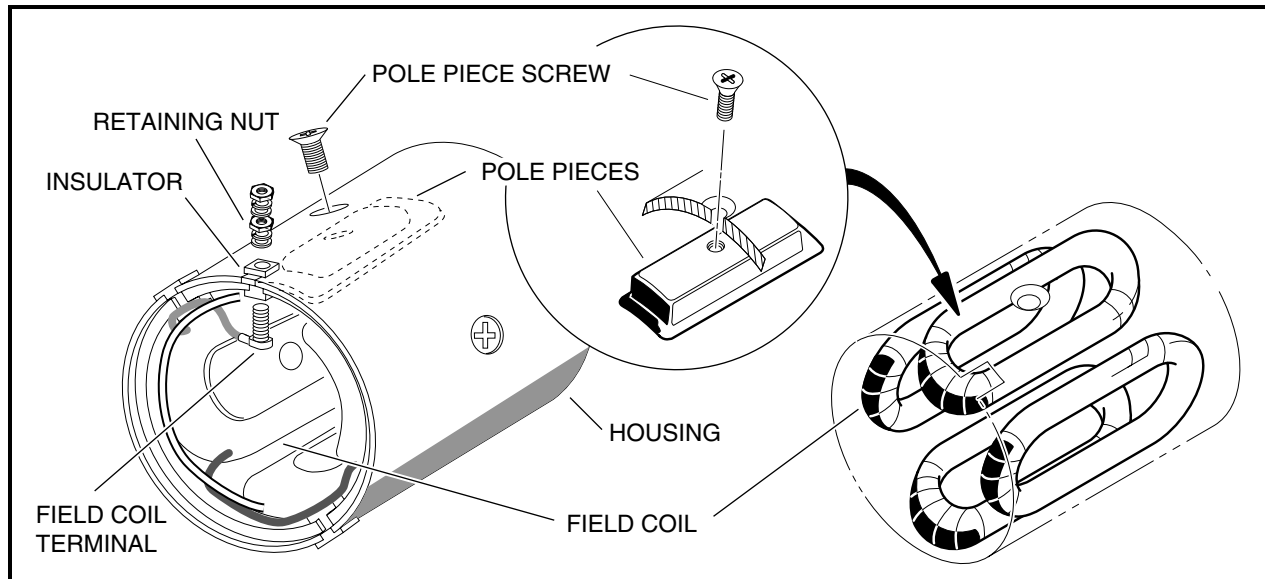


Figure 12b-11 Field Coil Assembly

Visual Inspection of Armature

Obvious defects can be seen by examining the armature. If an armature has frayed or charred insulation, broken wires or thrown solder, it is obvious without testing that it should be replaced. Faults seen during the visual inspection can aid in diagnosing the original cause of the failure. Items to look for are listed below.

- Burned, charred, or cracked insulation
- Improperly cured varnish
- Thrown solder
- Flared armature windings
- Worn, burned, or glazed commutator
- Loose or raised commutator bars
- Bruised or damaged armature core laminations
- Worn armature bearing or shaft
- Dirty or oily commutator

Commutator Cleaning, Inspection, and Replacement

1. Clean the carbon dust, dirt and oil from the commutator. Visually inspect the commutator for worn, burned or glazed areas. Check for loose or raised commutator bars. Slight roughness of the commutator can be polished away with 400 grit (or finer) sandpaper. See following **CAUTION**.

⚠ CAUTION

- Never use emery cloth on the commutator. particles of emery are conductive and may short-circuit the commutator bars. Never use oil or lubricants on the commutator or brushes.

2. Using a micrometer, measure the outside diameter at four points: two points 90° to each other to the outside of the commutator (A¹ and A²), and two points 90° to each other to the inside of the commutator (B¹ and B²). If the commutator diameter is less than 1.535 inches (39 mm) at any of the four locations, replace the armature assembly and bearings (**Figure 12b-12, Page 12b-9**).

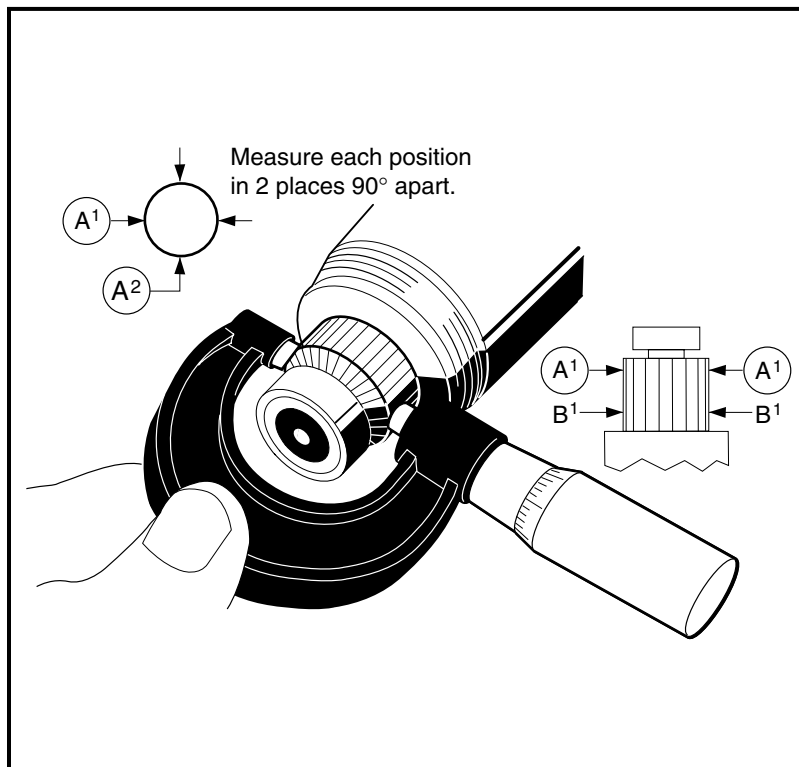


Figure 12b-12 Inspect Commutator

Armature Ground Test**⚠ CAUTION**

- Do not submerge armature in solvent.

NOTE: Before testing, wipe the armature with a clean cloth and remove carbon dust and metal particles from between commutator bars.

1. Using a multimeter set on 200 Ω (ohms), place the positive (+) probe on the commutator bars and the negative (-) probe on the armature core. The reading should be no continuity. If the reading is incorrect, replace the armature and the two bearings (**Figure 12b-13, Page 12b-10**).

Visual Inspection of Field Coils

If the insulation on the field coils appears blackened or charred, the serviceability of the coils is questionable. Burned or scorched coil insulation indicates the starter/generator has overheated due to overloads or grounded or shorted coil windings. Be sure the insulators are tight in the housing.

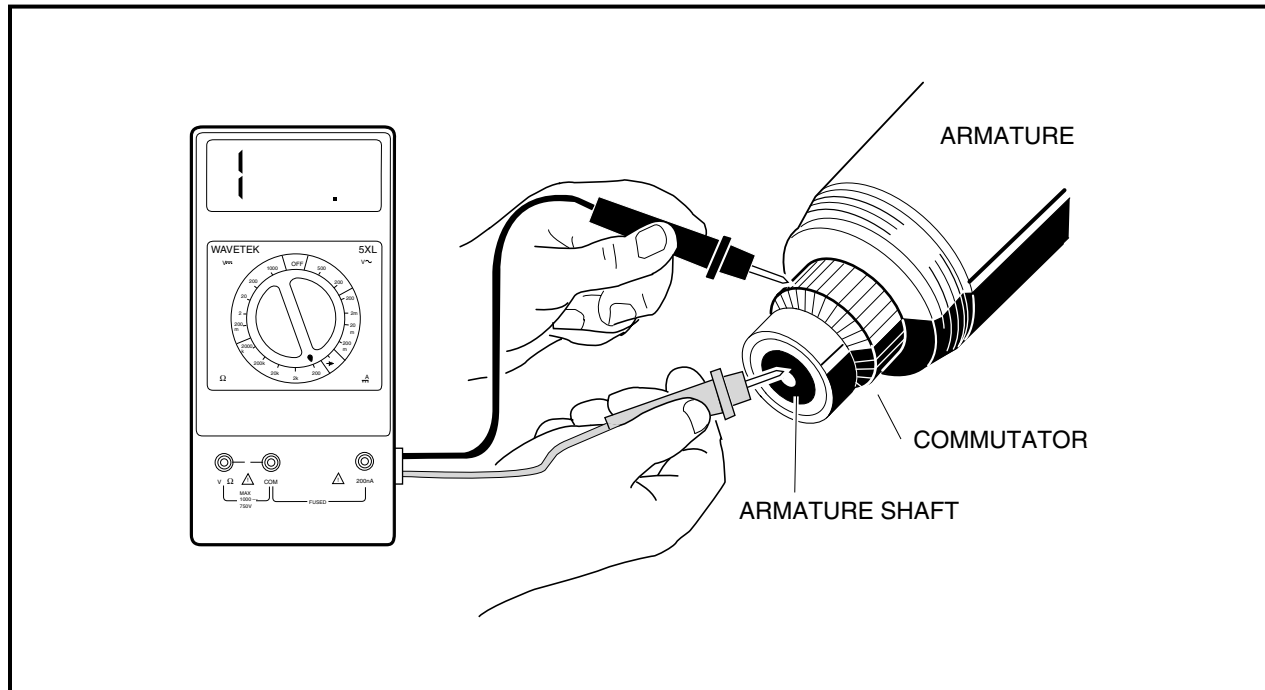


Figure 12b-13 Armature Ground Test

Starter/Generator Rework

Any rework must be performed by a qualified technician. Starter/Generator service specifications are listed in the following table.

ITEM	SERVICE LIMIT
Commutator diameter (minimum)	1.535 in. (39 mm)
Concentric with armature shaft within	0.002 in. (0.051 mm)
Limit depth of cut when machining commutator	0.007 in. (0.2 mm)
If undercut of segment insulator is less than 0.016 inch (0.406 mm), then it should be undercut to	0.031 in. (0.8 mm)
Dielectric strength	500 VAC for one minute
Armature insulation resistance	0.2M Ω (ohms) at 500 VDC
Starter field coil resistance	0.006-0.01 Ω (ohms)
Generator field coil resistance	4.5-5.5 Ω (ohms)

Starter/Generator Assembly

1. Place the field coil into the housing. The two insulators that look alike fit into the slots next to the F1 and F2 markings on the outside of the housing. The insulator that looks different slides into the slot next to the DF marking.
2. After the insulators are seated in the slots, install the threaded terminals through the wire connectors and then through the insulators. Install a flat washer, lock washer and nut onto each threaded terminal on the outside of the housing. Tighten nuts to 47.5 in-lb (5.4 N·m) (**Figure 12b-11, Page 12b-8**).

▲ CAUTION

- **Route the field terminal wires so that they will not contact the armature.**
3. Install the four pole pieces into the housing. Use the four screws to secure pole pieces to the inside of the housing to retain the field wires. Tighten screws to 9 ft-lb (12.2 N·m) (**Figure 12b-11, Page 12b-8**).
 4. Slide the bearing retainer onto the output end of the armature shaft (33) so that it will hold the outside of the bearing (35) only (**Figure 12b-8, Page 12b-6**).
 5. Press a new ball bearing (35) onto the output end of the armature. Press a new ball bearing onto the commutator end of the armature shaft. **See following CAUTION.**

▲ CAUTION

- **To prevent damage to the retainer, use care while pressing new bearing onto the output end of the shaft.**
 - **Press against the inner race of the new bearing until it is fully seated.**
6. Install the output end cover (36) onto the armature. Secure the bearing retainer (32) to the cover and tighten the screws (43) to 39 in-lb (4.4 N·m) (**Figure 12b-8, Page 12b-6**).
 7. Slide the housing with field coils over the armature. Use the locating pin to align housing to the cover.

NOTE: *The terminal insulators should be on the commutator end of the housing.*

8. To prevent contact between the brushes and commutator as the commutator cover is installed, and possible damage to the brushes, lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover (**Figure 12b-7, Page 12b-6**).
9. Install the commutator end cover (23) onto the armature shaft. Align the locating pin with the pin hole in the cover. Install the two M6 x 180mm bolts (20) and tighten to 100 in-lb (11.3 N·m) (**Figure 12b-3, Page 12b-4**).
10. Push the brushes down into the holders. Place springs into the notches in the brushes. Install the brush cover (30) that has the drain hole in it next to the A2 terminal. Install the remaining three brush covers (29) in the openings in the commutator end cover (23) (**Figure 12b-4, Page 12b-4**).
11. Slide the spacer (37) onto the end of the shaft. Insert the shaft key (34) into the shaft. Install the belt pulley (39) onto the shaft, and install the lock washer (40) and M14 nut (41). Tighten the nut to 28 ft-lb (38 N·m) (**Figure 12b-8, Page 12b-6**).

Starter/Generator Installation

1. Install the green wire from the F1 terminal to the A1 terminal on the starter/generator (**Figure 12b-2, Page 12b-3**). Install a flat washer, lock washer, and nut onto each terminal and tighten to 48 in-lb (5.4 N·m).

Starter/Generator Installation, Continued:

2. Install two 3/8-inch hex-head pivot bolts (5) into the mounting bracket with the heads of the bolts facing towards the driver side of the vehicle. Position the starter/generator in the mounting bracket so that the bolts will go through the starter/generator before going through the bracket. Install a lock nut (7) onto each bolt. Tighten to finger tight (**Figure 12b-14, Page 12b-12**).
3. Install the adjustment bolt (11) through the adjusting bracket (4) and then through the starter/generator. Install a lock washer (9) and 5/16-inch nut (12) onto the end of the adjustment bolt (11). Tighten to finger tight (**Figure 12b-14, Page 12b-12**).
4. Install the belt (3), then tighten the mounting bolts. **See Belt Tension Adjustment on page 12b-12.**
5. Connect the yellow wire from the voltage regulator to the DF terminal on the starter/generator. Install a flat washer, lock washer, and nut onto the terminal. Tighten the nut to 31 in-lb (3.5 N·m).
6. Install the white wire from the solenoid to the F2 terminal on the starter/generator. Install the black wire from the frame to the A2 terminal on the starter/generator. Install a flat washer, lock washer and nut onto each terminal, and tighten to 48 in-lb (5.4 N·m).
7. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
8. Place the neutral lockout cam in the OPERATE position.
9. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

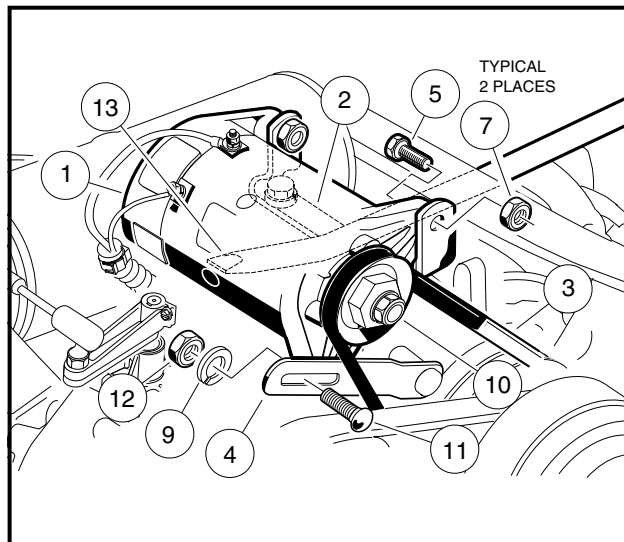


Figure 12b-14 Starter/Generator Installation

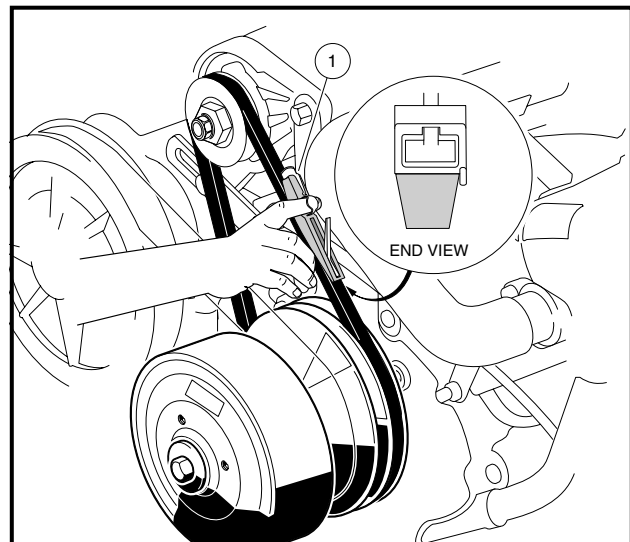


Figure 12b-15 Belt Tension Gauge

Belt Tension Adjustment

Belt tension should be checked periodically. If the belt slips when starter/generator motor operates, adjust belt to correct tension.

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is engage.
3. Place the neutral lockout cam in the SERVICE position.

4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Make sure the two pivoting screws (5) on the mounting bracket are finger tight. The carriage bolt (11) and hex nut (12) are to be finger tight also (**Figure 12b-14, Page 12b-12**).
6. Push the starter/generator down so it is at the lowest point of its adjustment travel. With the starter/generator belt fully in place around the drive clutch pulley, install the starter/generator belt (3) around the pulley (10) on the end of the starter/generator.
7. Position a pry bar (13) between the top of the starter/generator mounting bracket (2) and the underside of the starter/generator by passing the pry bar under the exhaust header.
8. While holding the pry bar, measure the belt tension using a Krikit[®] gauge (1) (available at NAPA[®] Auto Parts stores), or equivalent. Proper tension for a new starter/generator belt should be 75 ft-lb (101.7 N·m), or for an existing belt, 45 ft-lb (61 N·m) **Figure 12b-15, Page 12b-12**.
9. While maintaining the tension, tighten the adjustment nut (12) to 12 ft-lb (16.3 N·m). Tighten the two pivot bolts (5) and hex nuts (7) to 23 ft-lb (31.2 N·m) (**Figure 12b-14, Page 12b-12**). **See following CAUTION.**

⚠ CAUTION

- **Remove pry bar before starting engine.**
10. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
 11. Place the neutral lockout cam in the OPERATE position.
 12. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

VOLTAGE REGULATOR

Read DANGER and WARNING on page 12b-1.

Testing the Voltage Regulator

See Test Procedure 11, Section 11b, Page 11b-33.

Voltage Regulator Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove the electrical component box cover.
6. Disconnect the voltage regulator red wire (1) at the large post on the solenoid, the yellow wire (4) at the bullet connector, and the black wire (7) from the normally open (NO) terminal of the kill limit switch and at the battery frame ground (**Figure 12b-16, Page 12b-14**).
7. Remove the voltage regulator mounting screw (8) and remove the voltage regulator (9).

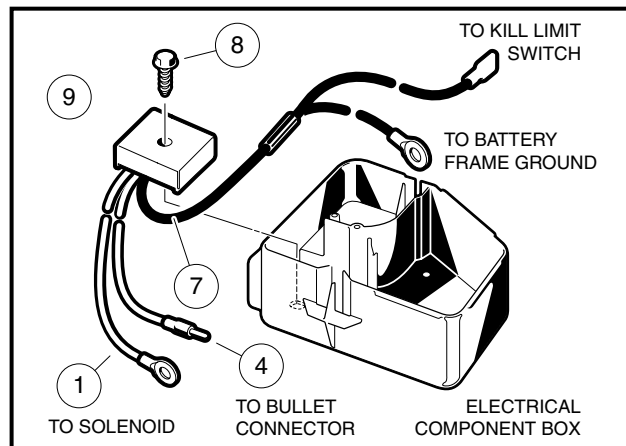


Figure 12b-16 Voltage Regulator

Voltage Regulator Installation

1. Position the voltage regulator (9) in the electrical component box and install the mounting screw (8) (Figure 12b-16, Page 12b-14). Tighten screw to 23 in-lb (2.6 N·m).
2. Connect the voltage regulator red wire (1) at the large post on the solenoid, the yellow wire (4) at the bullet connector, and the black wire (7) at the battery frame ground and the normally open (NO) terminal of the kill limit switch (Figure 12b-16, Page 12b-14).
3. Install snap-on electrical component box cover. Be sure to firmly press down all corners. Install screw and tighten to 18 in-lb (2 N·m).
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Place the neutral lockout cam in the OPERATE position.
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
7. Start the engine and check regulator for proper functioning as described under voltage regulator testing. **See Test Procedure 11, Section 11b, Page 11b-33.**

KEY SWITCH

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Key Switch

See Test Procedure 17, Section 11b, Page 11b-41. Also see Test Procedure 4 – Key Switch (Starter Circuit) on page 11b-27.

Key Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "for vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first (Figure 12b-1, Page 12b-2). **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove the dash panel.
 - 5.1. Loosen seven Tuflok screws, but do not remove screws completely, as shown in detail A (Figure 12b-18, Page 12b-16).
 - 5.2. Remove Tuflok screws from dash panel as shown in detail B.

- 5.3. Pull forward on top of dash panel to access back side of key switch. There is sufficient slack in wiring to allow for this as shown in detail C.
6. Disconnect the wire connector from the key switch.
7. Remove the key switch.
 - 7.1. Remove the key switch nut (1) (**Figure 12b-17, Page 12b-15**).
 - 7.2. Remove key switch (2) from back side of dash panel.

Key Switch Installation

1. Reverse removal procedures to install key switch in the dash. Tighten the key switch nut firmly. Reconnect the wire connector to the key switch.
2. Install the dash panel.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N-m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Place the neutral lockout cam in the OPERATE position.
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

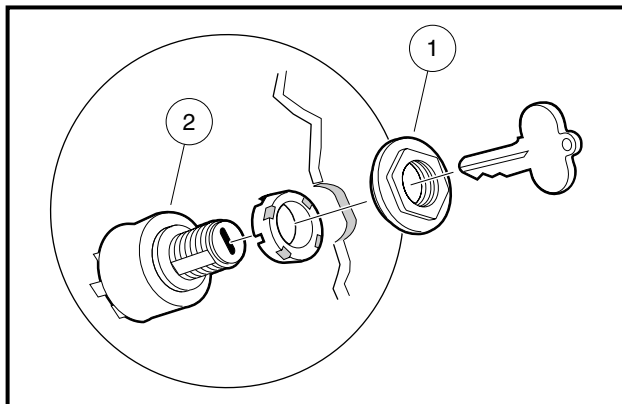


Figure 12b-17 Key Switch Removal

SOLENOID

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Solenoid

See Test Procedure 6, Section 11b, Page 11b-29.

Solenoid Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove electrical component box cover (**Figure 12b-19, Page 12b-19**).
6. Disconnect all the wires from the solenoid.
7. Remove the two screws securing the solenoid in place.
8. Remove the solenoid.

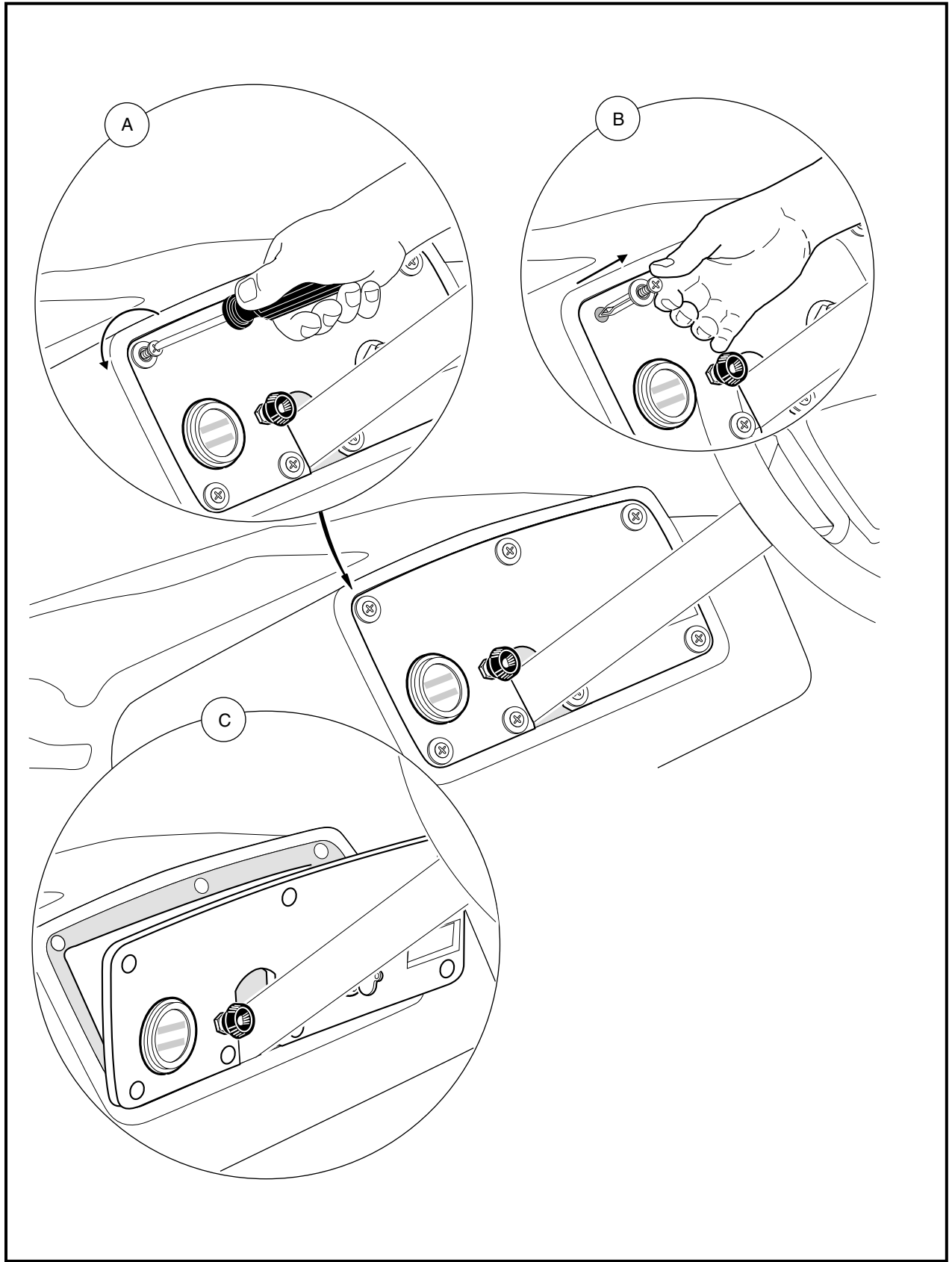


Figure 12b-18 Center Dash Panel Removal

Solenoid Installation

1. Install the solenoid in the electrical component box. Use two screws to secure the solenoid to the box and tighten to 13.5 in-lb (1.5 N·m).
2. Connect all wires as indicated.
 - 2.1. Connect the 6-gauge white wire from the starter/generator, the 18-gauge white wire from the fuel gauge/hour meter, and the 16-gauge red wire from the voltage regulator to the large post on the solenoid.
 - 2.2. Connect the 6-gauge red wire from the battery terminal and the 10-gauge red wire from the fuse block to the other large post on the solenoid.
 - 2.3. Connect the 18-gauge blue wire from the key switch to the small post on the solenoid.
 - 2.4. Connect the 18-gauge orange wire from the accelerator pedal limit switch to the other small post on the solenoid.
3. Tighten the hex nuts on the large solenoid posts to 60 in-lb (6.8 N·m). Tighten the nuts on the small solenoid posts to 22 in-lb (2.5 N·m).
4. Install the snap-on electrical box cover by firmly pressing down on all corners and install the screw, tightening to 18 in-lb (2 N·m).
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Place the neutral lockout cam in the OPERATE position.
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

FUSE

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Fuse

See Test Procedure 2, Section 11b, Page 11b-24.

Fuse Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first (**Figure 12b-1, Page 12b-2**). **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove electrical component box cover.
6. Remove the fuse from the fuse block.

Fuse Installation

1. Install the fuse. **See following WARNING.**

WARNING

- If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.

Fuse Installation, Continued:

2. Install the snap-on electrical box cover by firmly pressing down on all corners and install the screw, tightening to 18 in-lb (2 N·m).
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Place the neutral lockout cam in the OPERATE position.
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

KILL LIMIT SWITCH

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Kill Limit Switch

See Test Procedure 16, Section 11b, Page 11b-41.

Kill Limit Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove electrical component box cover (**Figure 12b-19, Page 12b-19**).
6. Remove the two nuts (9) and washers (10) securing the accelerator pedal limit switch (11). Do not disconnect the wires (**Figure 12b-19, Page 12b-19**).
7. Disconnect the two white/black wires and the black wire from the kill limit switch (12).
8. Remove the kill limit switch (12).

Kill Limit Switch Installation

1. Install the kill limit switch (12) onto the two screws (16) (**Figure 12b-19, Page 12b-19**).
2. Connect the two white/black wires to the common (COM) terminal and the black wire to the normally open (NO) terminal of the kill limit switch (12). Install the accelerator pedal limit switch (11).
3. Secure the switches in place using two washers (10) and two nuts (9). Tighten to 5 in-lb (0.6 N·m). **See following CAUTION.**

CAUTION

- **Do not overtighten the retaining nuts. If the nuts are over-torqued, limit switches could be damaged.**
4. Depress and release the accelerator pedal to make sure that both switches are being actuated when the pedal is released.
 5. Install snap-on electrical component box cover. Be sure to firmly press down all corners. Install screw and tighten to 18 in-lb (2 N·m).

6. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
7. Place the neutral lockout cam in the OPERATE position.
8. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

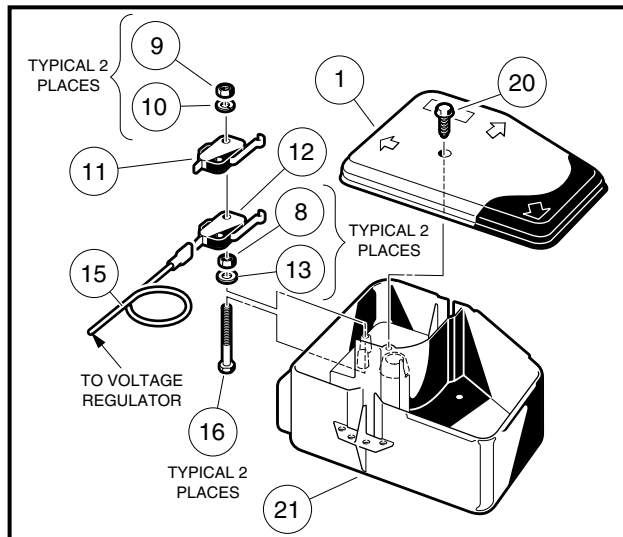


Figure 12b-19 Kill Limit Switch

NEUTRAL LOCKOUT LIMIT SWITCH

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Neutral Lockout Limit Switch

See Test Procedure 7, Section 11b, Page 11b-30.

Neutral Lockout Limit Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Disconnect the wires from the neutral lockout limit switch (5) located on the back of the Forward/Reverse shifter assembly (**Figure 12b-20, Page 12b-20**).
6. Remove two nuts (2) and washers (6) from the neutral lockout limit switch (5) and slide the neutral lockout limit switch off of the screws.

Neutral Lockout Limit Switch Installation

1. Install the neutral lockout limit switch (5) and install two washers (6) and two nuts (2) (**Figure 12b-20, Page 12b-20**). Tighten to 5 in-lb (0.6 N·m). Place the Forward/Reverse handle in REVERSE to make sure that both switches actuate. **See following WARNING.**

Neutral Lockout Limit Switch Installation Continued:** WARNING**

- Do not overtighten the retaining nuts. If the nuts are overtightened, limit switches could be damaged.
2. Connect the black wire to common (COM) terminal, the green wire to the normally open (NO) terminal and the white wire to the normally closed (NC) terminal of the neutral lockout limit switch (**Figure 12b-21, Page 12b-20**).
 3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
 4. With the Forward/Reverse handle in the NEUTRAL position, the neutral lockout cam should be in the OPERATE position. Make sure everyone is clear of the vehicle.
 5. Turn the key switch to the ON position. The engine should not crank when depressing the accelerator. If the engine does crank, turn the key switch OFF and readjust the shift linkage.
 6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 7. Test drive the vehicle in both forward and reverse for proper operation.

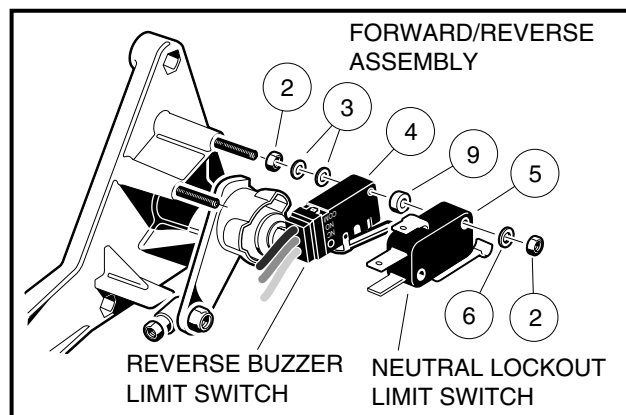


Figure 12b-20 Neutral Lockout and Reverse Buzzer Limit Switches

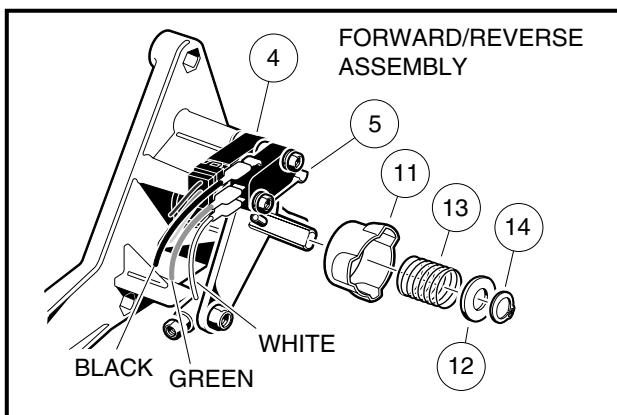


Figure 12b-21 Neutral Lockout Cam

NEUTRAL LOCKOUT CAM

Read **DANGER** and **WARNING** on page 12b-1.

If the cam lobes have worn to the point where they will no longer actuate the neutral lockout limit switch, the cam must be replaced.

Testing the Neutral Lockout Cam

See **Test Procedure 23, Section 11b, Page 11b-44.**

Neutral Lockout Cam Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.

3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove the external snap ring (14) (**Figure 12b-21, Page 12b-20**).
6. Remove the plastic washer (12) and the spring (13).
7. Remove the cam (11).

Neutral Lockout Cam Installation

1. Install the cam (11) (**Figure 12b-21, Page 12b-20**).
2. Install the spring (13) and the plastic washer (12).
3. Install the external snap ring (14) onto the shaft. Be sure the snap ring is installed in the groove on the shaft.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Place the neutral lockout cam in the OPERATE position.
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

REVERSE WARNING BUZZER

Read DANGER and WARNING on page 12b-1.

Testing the Reverse Warning Buzzer

See Test Procedure 20, Section 11b, Page 11b-43.

Reverse Warning Buzzer Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove the dash panel. **See Key Switch Removal on page 12b-14.**
6. Disconnect the wires from the reverse warning buzzer (2) (**Figure 12b-22, Page 12b-22**).
7. Remove the two 4-40 x 3/4-inch machine screws (3), nuts (4), flat washers (6), and lock washers (5) securing the buzzer to the vertical frame support.
8. Remove the reverse warning buzzer body (2).

Reverse Warning Buzzer Installation

1. Install the two 4-40 x 3/4-inch machine screws (3) through the buzzer (2) bracket tab and through the frame.
2. Attach the flat washers (6), lock washers (5), and secure with nuts (4). Tighten to 14 in-lb (1.6 N·m) (**Figure 12b-22, Page 12b-22**).

NOTE: The reverse warning buzzer is mounted at one hole only.

3. Connect the black wire from the frame ground to the negative (–) terminal on the buzzer.
4. Connect the red/white wire from the wire harness to the positive (+) terminal on the buzzer.
5. Install the dash panel. **See Key Switch Installation on page 12b-15.**

Reverse Warning Buzzer Installation, Continued:

6. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N-m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
7. Place the neutral lockout cam in the OPERATE position.
8. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

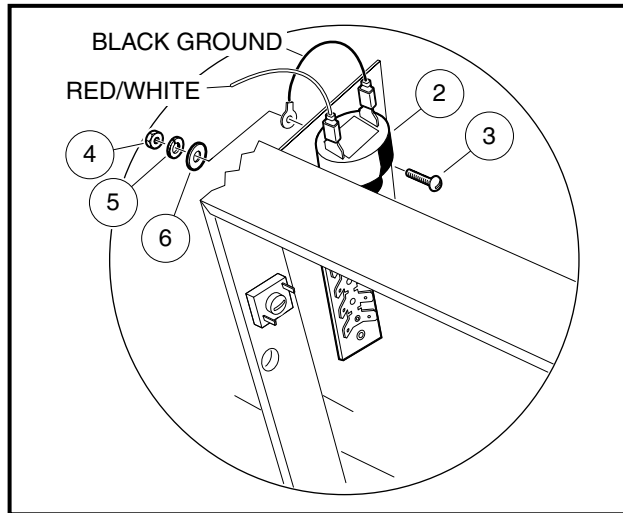


Figure 12b-22 Front Reverse Warning Buzzer

REVERSE BUZZER LIMIT SWITCH

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Reverse Buzzer Limit Switch

See Test Procedure 19, Section 11b, Page 11b-42.

Reverse Buzzer Limit Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Disconnect the wires from the reverse buzzer limit switch (4) located on the back of the Forward/Reverse assembly (**Figure 12b-20, Page 12b-20**).
6. Remove the nuts (2) and washers (6) from the neutral lockout limit switch (5) and slide the neutral lockout limit switch off of the screws. Do not disconnect the wires.
7. Remove the spacers (9) from the reverse buzzer limit switch (4) and slide the reverse buzzer limit switch off the screws.

Reverse Buzzer Limit Switch Installation

1. Install the reverse buzzer limit switch (4), and then install two spacers (9) against the limit switch.
2. Install the neutral lockout limit switch (5) and install two washers (6) and two nuts (2). Tighten to 5 in-lb (0.6 N·m). **See following CAUTION.**

⚠ CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, limit switches could be damaged.**
3. Place the neutral lockout cam in the OPERATE position.
 4. Place the Forward/Reverse handle in REVERSE to make sure that both switches actuate.
 5. Connect the orange wire to the common (COM) black wire terminal and the red/white wire to the normally open (NO) blue wire terminal of the reverse buzzer limit switch (4) (**Figure 12b-20, Page 12b-20**).
 6. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
 7. Turn the key switch to the ON position. Shift the Forward/Reverse handle to the REVERSE position. The buzzer should sound.
 8. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

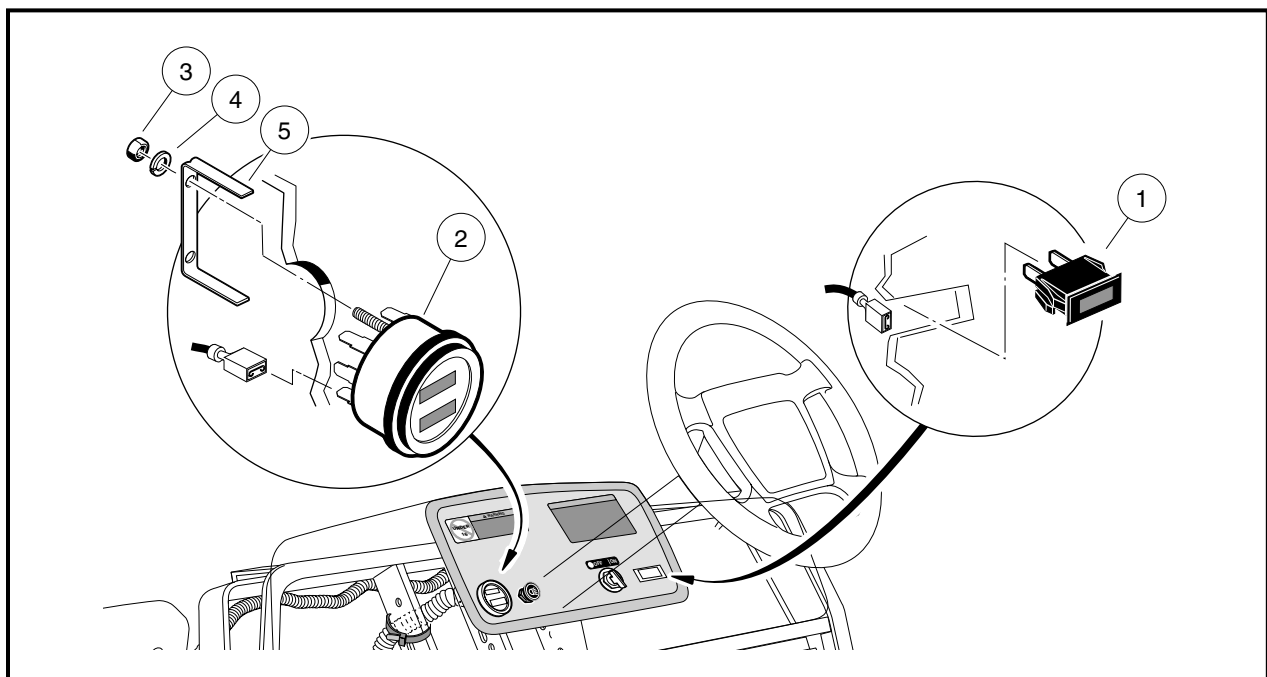


Figure 12b-23 Fuel Gauge/Hour Meter and Oil Warning Light Installation

OIL WARNING LIGHT

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Oil Warning Light

See Test Procedure 22, Section 11b, Page 11b-43.

Oil Warning Light Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove the dash panel. **See Key Switch Removal on page 12b-14.**
6. Disconnect the wires from the oil warning light (1) (**Figure 12b-23, Page 12b-23**). Do not allow wires to touch.
7. Depress the retaining tabs and remove the light from the center dash.

Oil Warning Light Installation

1. Push a new unit into hole in dash until plastic tabs engage dash (**Figure 12b-23, Page 12b-23**).
2. Connect yellow wire from the key switch and yellow wire from the oil level sensor to the oil light.
3. Install the dash panel. **See Key Switch Installation on page 12b-15.**
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Place the neutral lockout cam in the OPERATE position.
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

FUEL GAUGE/HOUR METER

Read DANGER and WARNING on page 12b-1.

Testing the Fuel Gauge/Hour Meter

See Test Procedure 26, Section 11b, Page 11b-46. Also see Test Procedure 27 – Hour Meter on page 11b-46.

With the key switch in the OFF position, the fuel gauge/hour meter fields are black. When the key switch is turned to ON, both fields activate. The fuel gauge initially registers *full* for a brief moment before indicating the actual fuel level.

The hour meter displays the number of hours of use in increments of .1 (one tenth) hour, but does not record additional time unless the engine is running. When the hour meter is recording, the hourglass icon at the left of the field blinks slowly.

Fuel Gauge/Hour Meter Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove the dash panel. **See Key Switch Removal on page 12b-14.**
6. Disconnect the wires from the fuel gauge/hour meter (2) (**Figure 12b-23, Page 12b-23**). Do not allow wires to touch.

7. Remove the two hex nuts (3) and lock washers (4) from the threaded studs on the back of the gauge/meter. Remove the mounting bracket (5) from the back side of the gauge/meter and remove the gauge/meter from the dash.

Fuel Gauge/Hour Meter Installation

1. Install a new gauge/meter into hole in dash until flange seats against dash (**Figure 12b-23, Page 12b-23**).
2. Slide the mounting bracket onto the two threaded studs on the fuel gauge/hour meter and secure with two lock washers and two hex nuts. Tighten to 2.5 in-lb (0.28 N·m). Place one drop of Loctite™ on each hex-nut. Do not allow Loctite to come into contact with the fuel gauge/hour meter casing.
3. Connect the orange wire from the fuel level sending unit to the no. 1 terminal, the blue wire to the no. 2 terminal, the black wire from the ground terminal block to the no. 3 terminal, and the white wire from the solenoid to the no. 4 terminal on the fuel gauge/hour meter. **See Wiring Diagram, Section 11b, Page 11b-8.**
4. Install the dash panel. **See Key Switch Installation on page 12b-15.**
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Place the neutral lockout cam in the OPERATE position.
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

FUEL LEVEL SENDING UNIT

Read DANGER and WARNING on page 12b-1.

The fuel level sending unit is an integral part of the fuel tank and should never be removed. Thoroughly test the fuel level sending unit before replacement of fuel tank.

Testing the Fuel Level Sending Unit

See Test Procedure 25, Section 11b, Page 11b-44.

RPM LIMITER

Read DANGER and WARNING on page 12b-1.

Testing the RPM Limiter

See Test Procedure 14, Section 11b, Page 11b-35.

RPM Limiter Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 2.2. Remove both seats from the vehicle.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Disconnect the white/black wire from the black wire at the bullet connector located near the RPM limiter (**Figure 12b-24, Page 12b-26**).
6. Disconnect the other black wire at the other bullet connector near the RPM limiter.
7. Remove the flange head bolts from the RPM limiter band and remove the RPM limiter and damper (**Figure 12b-24, Page 12b-26**).

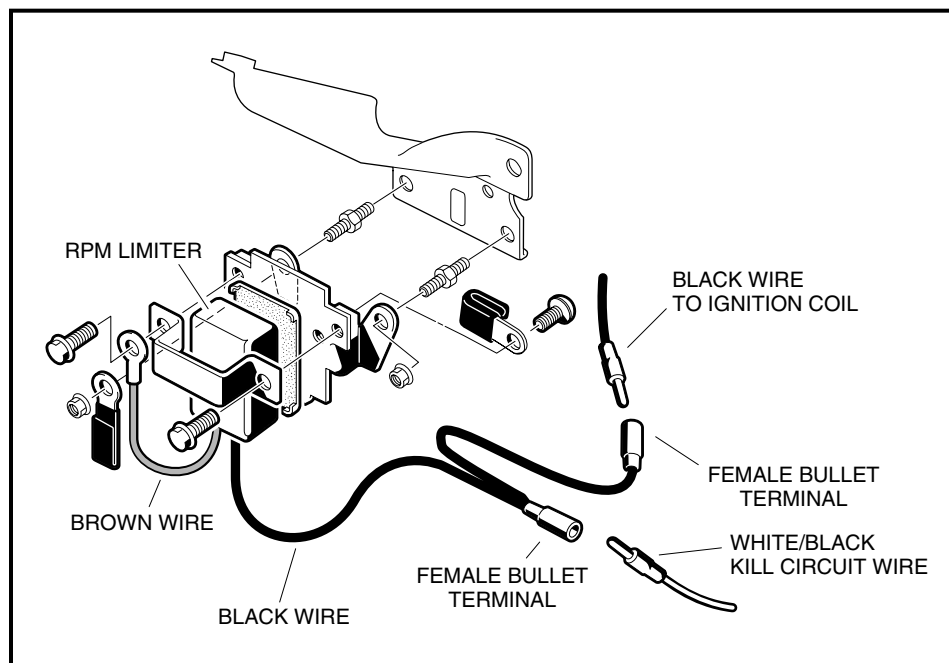


Figure 12b-24 RPM Limiter Assembly

RPM Limiter Installation

1. Place the RPM limiter damper on the front of the RPM limiter mounting bracket (**Figure 12b-24, Page 12b-26**).
2. Place the RPM limiter (2) on the damper squarely so that RPM limiter fits tightly against damper.
3. Place the band (5) over the RPM limiter and align the holes. Place the brown wire ring connector onto the flange head bolt (1) and secure the left side of the band. Use another flange head bolt to secure the other side of the band. Make sure the band holds the RPM limiter securely in place. Tighten fasteners to 7 ft-lb (9.4 N·m).
4. Connect black wire at the bullet connector to the white/black kill circuit wire, and the remaining black wire at the other bullet connector to the black wire from the ignition coil.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Place the neutral lockout cam in the OPERATE position.
7. Install both seats.
8. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

IGNITION COIL

Read DANGER and WARNING on page 12b-1.

The ignition coil is located under the flywheel shroud of the engine. To replace it requires the removal and installation of the engine and transaxle. It is recommended that the ignition coil be thoroughly tested prior to replacement.

Testing the Ignition Coil

See Test Procedure 13, Section 11b, Page 11b-35. Also see Test Procedure 14 – RPM Limiter on page 11b-35 and Test Procedure 15 – Ignition Coil on page 11b-36.

Ignition Coil Removal

Removing the ignition coil requires the removal of the engine and unitized transaxle. **See Unitized Transaxle Removal, Section 16b, Page 16b-9.**

▲ CAUTION

- Before removal and disassembly, clean the engine.

1. Remove the starter/generator. **See Starter/Generator Removal on page 12b-2.**

NOTE: The crankshaft has left-hand threads at the clutch mounting hole.

2. Remove the muffler. **See Muffler Removal, Section 15, Page 15-2.**
3. Remove the engine mounting hardware (items 1, 2, and 5). **See Figure 13-41, Section 13, Page 13-23.**
4. Remove the two nuts (6) and washers (3) from the stud bolts in the engine body. **See Figure 13-41, Section 13, Page 13-23.**
5. Slide the engine away from the transaxle housing and lift the engine from the mounting plate.
6. Place the engine on a solid, flat surface, preferably on a sturdy work bench.
7. Remove the pan head bolts (5) securing the fan shroud (8) to the fan housing (9) (**Figure 12b-25, Page 12b-27**).
8. Loosen, but do not remove, three bolts (6) attaching the fan housing as shown.
9. Remove the remaining four bolts (10) attaching the fan housing as shown (**Figure 12b-25, Page 12b-27**), then while opening the housing, detach the spark plug wire grommet (4) from the housing (**Figure 12b-27, Page 12b-28**).
10. Disconnect the 18-gauge black wire (12) from the spade terminal (13) on the ignition coil (11) and remove the coil by removing two bolts (10) (**Figure 12b-26, Page 12b-27**).

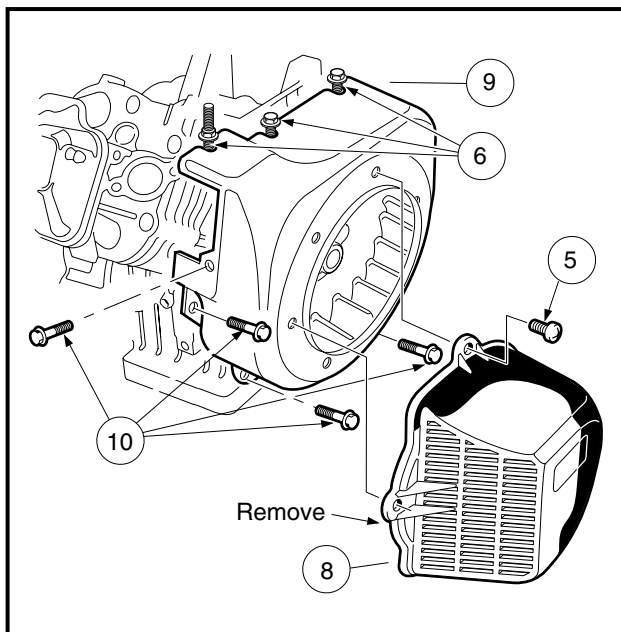


Figure 12b-25 Remove Fan Housing

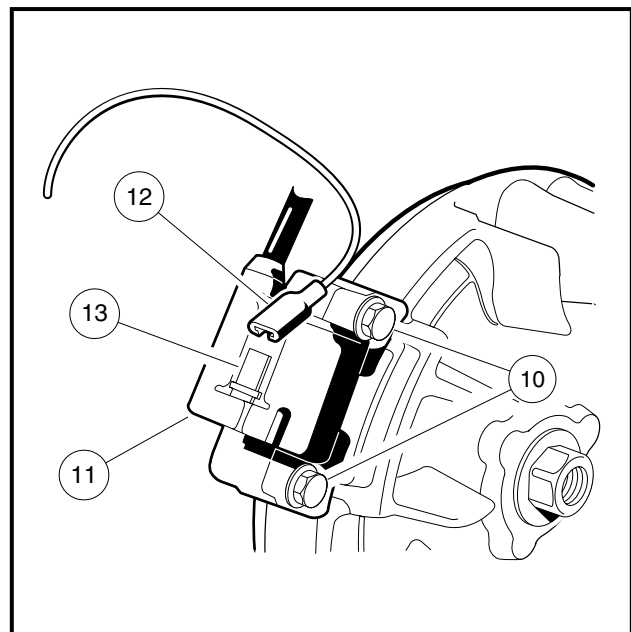


Figure 12b-26 Black Wire And Ignition Coil

Ignition Coil Installation

NOTE: If a new ignition coil is being installed, the spark plug cap, gasket, protector tube and grommet must be removed from the old coil and installed on the new coil. **See steps 1 through 8 for procedures to remove and install these existing parts.**

If the existing ignition coil will be remounted, proceed to step 9.

1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire.
2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire (**Figure 12b-27, Page 12b-28**).
3. Remove the gasket and protector tube (3) from the old coil.

NOTE: Moisten the spark plug wire with water to make the gasket removal and installation easier.

4. Remove the grommet (4) from the old spark plug wire. Clean the grommet and place it on the new spark plug wire (5).
5. Install the protector tube onto the new wire.
6. Slide the gasket onto the end of the new spark plug wire.
7. Install the cap on the new coil spark plug wire by rotating it clockwise three or four revolutions while applying light pressure on the cap.
8. Install the gasket (1) on the cap (2).
9. Position the ignition coil (7) onto the cast mounting bosses on the engine crankcase and tighten the two mounting bolts (6) to finger tight at this time.
10. Rotate the flywheel (8) until the magnet is positioned directly under the ignition coil (**Figure 12b-28, Page 12b-28**). Use a 0.012 inch (0.304 mm) bronze feeler gauge to set the air gap between the ignition coil and the flywheel magnet. Tighten the two mounting bolts (6) to 30 in-lb (3.4 N-m) (**Figure 12b-28, Page 12b-28**).

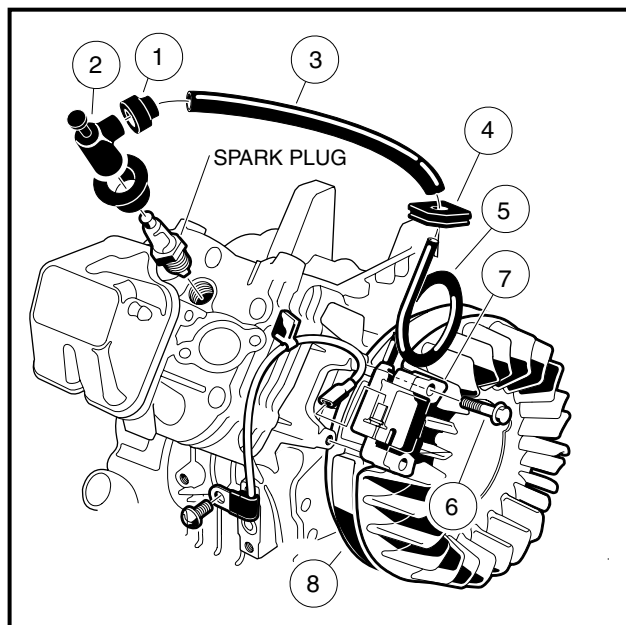


Figure 12b-27 Clean Grommet

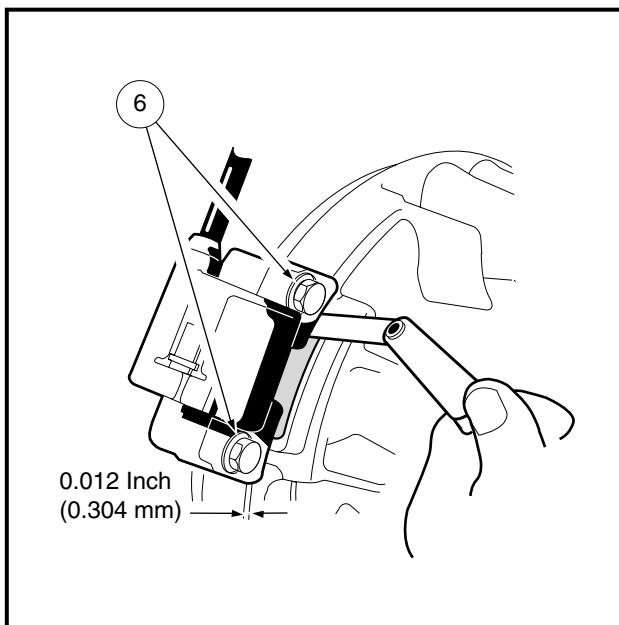


Figure 12b-28 Mount Ignition Coil Using Feeler Gauge

11. Connect the 18-gauge black wire (12) to the spade terminal (13) on the coil (11) (**Figure 12b-26, Page 12b-27**).
12. Position the fan housing close to the engine crankcase and slide the plug wire grommet into the notch on the housing.
13. When installing fan housing, make sure the top front corner of the housing is above the upper cylinder shroud. The front edge of the fan housing should be behind the lower cylinder shroud. Align the slots in the housing with the flanged bolts (6) loosened earlier (**Figure 12b-25, Page 12b-27**).
14. Install the four remaining flange bolts (10) that secure the fan housing to the engine crankcase. Tighten all seven mounting bolts to 90 in-lb (10.2 N·m).
15. Install the fan shroud with four pan head bolts (5). Tighten to 50 in-lb (5.7 N·m) (**Figure 12b-25, Page 12b-27**).
16. Place the engine onto the engine mounting plate and slide the two washers (3) onto the two engine body bolts, then slide the bolts through the mounting plate and transaxle housing. Loosely attach the two nuts (6) finger tight. **See Figure 13-41, Section 13, Page 13-23.**
17. Attach the engine to the bottom of the engine mounting plate using the bolts (1), washers (2), and nuts (5). Tighten hardware to 21 ft-lb (28.4 N·m). **See Figure 13-41, Section 13, Page 13-23.**
18. Tighten the two engine body bolt nuts (6) to 17 ft-lb (23.1 N·m).
19. Install the engine and transaxle assembly. **See Unitized Transaxle Installation, Section 16b, Page 16b-41.**

▲ CAUTION

- **Make sure wire harness is routed and secured away from the muffler.**

20. Install the muffler. **See Muffler Installation, Section 15, Page 15-3.**
21. Install the starter/generator and belt. **See Starter/Generator Installation on page 12b-11.**
22. Connect the spark plug wire to the spark plug.
23. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
24. Place the neutral lockout cam in the OPERATE position.
25. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

OIL LEVEL SENSOR

Read DANGER and WARNING on page 12b-1.

Testing the Oil Level Sensor

See Test Procedure 21, Section 11b, Page 11b-43.

Oil Level Sensor Removal

See Oil Level Sensor Installation, Section 13, Page 13-24.

Oil Level Sensor Installation

See Oil Level Sensor Installation, Section 13, Page 13-24.

HEADLIGHTS

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Headlight Bulb and Socket

See Test Procedure 31, Section 11b, Page 11b-49.

Headlight Bulb Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. From the front of vehicle, reach under cowl and turn the wire harness/halogen bulb assembly (4 and 6) clockwise one-quarter turn (**Figure 12b-29, Page 12b-30**).
6. Remove the wire harness/halogen bulb assembly (4 and 6) from the headlight lens (7).
7. Lift the retaining tabs on the connector (4) and remove halogen bulb assembly (6).

Headlight Bulb Installation

NOTE: When handling halogen bulbs, do not touch glass portion of bulb. Oil from finger tips can cause premature failure of bulb.

1. Connect wire harness (4) to the halogen bulb assembly (6). The retaining tab should lock onto the halogen bulb assembly (**Figure 12b-29, Page 12b-30**).
2. From the front of vehicle, reach under cowl and insert wire harness/halogen bulb assembly (4 and 6) into the headlight lens (7).
3. Turn the wire harness/halogen bulb assembly (4 and 6) counterclockwise one-quarter turn.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Place the neutral lockout cam in the OPERATE position.
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

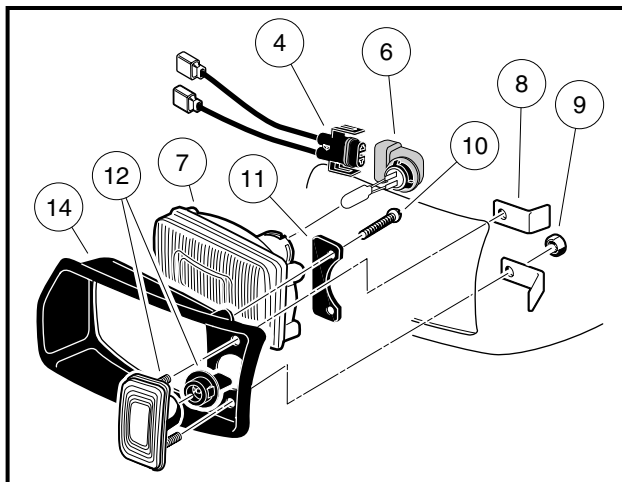


Figure 12b-29 Headlight Assembly

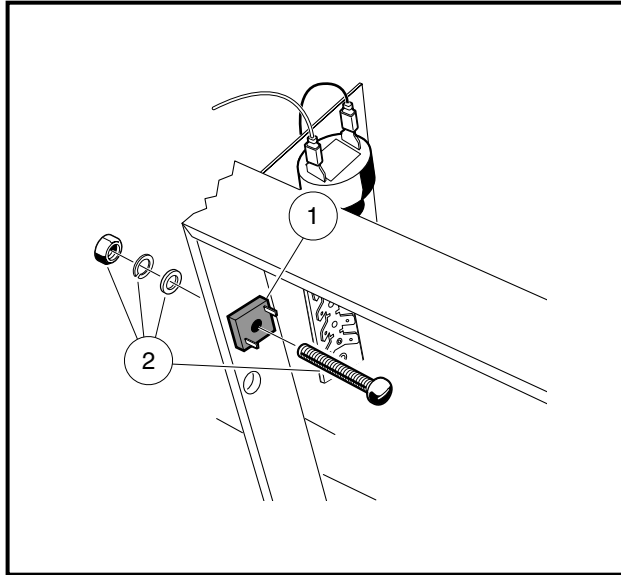


Figure 12b-30 Voltage Limiter

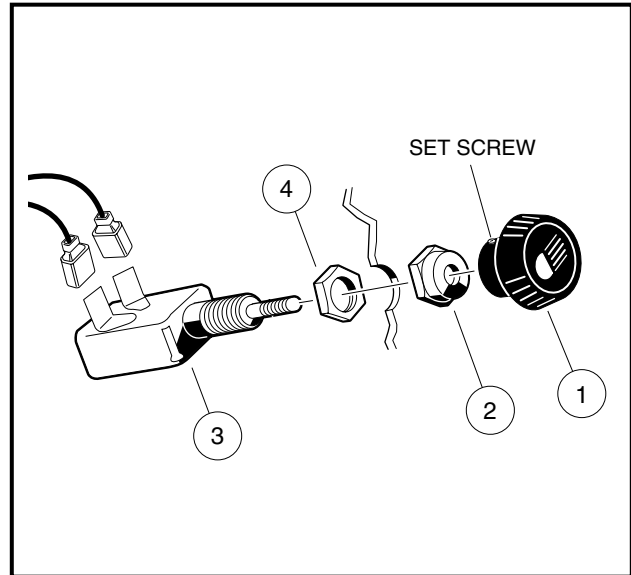


Figure 12b-31 Light Switch

VOLTAGE LIMITER

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Voltage Limiter

See Test Procedure 30, Section 11b, Page 11b-48.

Voltage Limiter Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Remove the center dash panel. **See Key Switch Removal on page 12b-14.**
6. Disconnect wires from the voltage limiter (1). Do not allow wires to touch (**Figure 12b-30, Page 12b-31**).
7. Remove the mounting hardware (2) from the voltage limiter and remove it from the vehicle.

Voltage Limiter Installation

1. Mount the voltage limiter to the frame using the mounting hardware. Tighten to 25 in-lb (2.8 N-m) (**Figure 12b-30, Page 12b-31**).
2. Connect the black 18-gauge wire from the harness to the negative (-) terminal on the voltage limiter. Connect the black wire from the ground terminal block to the positive (+) terminal on the voltage limiter.
3. Install the dash panel. **See Key Switch Installation on page 12b-15.**
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N-m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Place the neutral lockout cam in the OPERATE position.
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

LIGHT SWITCH

Read **DANGER** and **WARNING** on page 12b-1.

Testing the Light Switch

See Test Procedure 29, Section 11b, Page 11b-47.

Light Switch Removal

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
5. Loosen the set screw locking the light switch knob (1) to the shaft (**Figure 12b-31, Page 12b-31**).
6. Remove the dash panel. **See Key Switch Removal on page 12b-14.**
7. Disconnect the wires from the light switch. Do not allow wires to touch.
8. Remove the outer nut (2) from the light switch (3) (**Figure 12b-31, Page 12b-31**).
9. Remove the light switch from the dash panel.

Light Switch installation

1. Connect the wires to the light switch. **See Wiring Diagram, Section 11b, Page 11b-8.**
2. Thread the check nut (4) onto the switch until an equal number of threads shows on either side. Insert the switch through the dash panel and install the nut (2) on the outside of the dash. Tighten the nut to 14 in-lb (1.6 N·m) (**Figure 12b-31, Page 12b-31**).
3. Push the light switch shaft in. Screw the knob onto the end of the shaft until the knob touches the outer nut. Then turn the knob in the opposite direction until the headlight beams on the knob are horizontal to the ground. Tighten the set screw to lock the knob to the shaft.
4. Install the dash panel. **See Key Switch Installation on page 12b-15.**
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Place the neutral lockout cam in the OPERATE position.
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**

BATTERY

Read **DANGER** and **WARNING** on page 12b-1.

DANGER

- Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.
- Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.

DANGER CONTINUED ON NEXT PAGE...

DANGER

- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

General Information

See preceding DANGER statement.

Club Car gasoline vehicles are equipped with 12-volt, low-maintenance batteries. When changing a 12-volt battery in any Club Car gasoline-powered vehicle, the same size battery with adequate amperage ratings should be used as a replacement.

Club Car recommends a group 70, side-post battery (CCI P/N 1012328), with a 650 cranking amp rating at 32 °F (0 °C) (500 CCA at 0 °F (-17.8 °C)) and a reserve capacity of at least 105 minutes. The group 70 classification indicates battery size: 8-1/4 inches W x 6-1/2 inches D x 7-1/4 inches H (21.0 cm W x 16.5 cm D x 18.4 cm H). It is important to use the proper size to ensure that the battery clamp will fit correctly.

Testing the Battery

See Test Procedure 1, Section 11b, Page 11b-24. Also see Test Procedure 24 – Battery Test (Under Load) on page 11b-44.

Preventive Maintenance

To keep the battery in good operating condition, follow these steps on a regular basis.

1. Any corrosion build-up on or around the battery should be removed immediately. Post connections should be clean and tight. Any frayed or worn wires should be replaced. After all cables have been connected and properly tightened to 20 ft-lb (27.1 N·m), coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to prevent future corrosion.
2. The battery should be kept clean and dry to prevent self-discharge. Any dirt, grime or acid spillage should be removed. Wash the battery with a bristle brush using water and bicarbonate of soda (1 cup (237 ml) baking soda per 1 gallon (3.8 l) of water). Rinse with water. Do not allow solution to enter battery through the vent cap holes. **See Self-Discharge on page 12b-33.**
3. Maintain proper water level. **See Water Level on page 12b-33.**
4. Check battery periodically to see that it is in a full state of charge. **See Charging the Battery on page 12b-35.**
5. Keep battery hold-down clamp tight. **See Vibration Damage on page 12b-34.**

Self-Discharge

Dirt and battery acid can provide a path for a small current draw that slowly discharges the battery. To prevent self-discharge, the battery should always be kept clean.

Hot weather also has an effect on a battery's self-discharge rate. The higher the temperature, the quicker a battery will discharge. In hotter climates, therefore, the battery should be checked more often. When storing the battery, keep in a cool place. **See Battery Storage on page 12b-36.**

Water Level

The water level should be checked semi-annually to be sure water is at its proper level. Never allow the water level to fall below the tops of the plates because this will cause the exposed part of the plate to become per-

manently inactive. Check the water level more frequently in hot weather or when the battery becomes old. **See Figure 11b-28, Section 11b, Page 11b-25.**

Vibration Damage

The battery hold-down clamp should always be tight enough to keep the battery from bouncing. Battery life may be severely shortened if the clamp is too loose. Excessive vibration shortens the life of the battery. It may also cause acid to leak out of the vent caps and corrosion to build up on surrounding metal parts. The acid that is lost reduces the capacity of the battery and cannot be replaced.

Mineral Content

For the longest battery life, distilled water should be used in the battery. However, if tap water is going to be used, contact your local water department to be sure mineral contents are below the levels listed in the following table. **See following NOTE.**

NOTE: Contact your local water department for mineral content analysis.

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)
Suspended matter	Trace
Total solids	100.0
Calcium and magnesium oxides	40.0
Iron	5.0
Ammonia	8.0
Organic matter	50.0
Nitrates	10.0
Nitrites	5.0
Chloride	5.0

Battery Removal

Read DANGER and WARNING on page 12b-1 and DANGER on page 12b-32.

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 2.2. Completely remove both seats.
3. Place the neutral lockout cam in the SERVICE position.
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**

DANGER

- **Use caution when working under bed. Be sure prop rod is secure. otherwise the bed will fall, resulting in severe personal injury or death.**
5. Remove the four bolts (8), eight washers (9), and four lock nuts (10) from the armrests (11 and 12). **See Figure 4-3, Section 4, Page 4-10.**
 6. Remove the two armrests (11 and 12) from the vehicle.

7. Carefully lift and rotate the seat support (7) 90° counterclockwise and allow it to rest on the vehicle body as illustrated (**Figure 12b-32, Page 12b-35**).

NOTE: It is not necessary to remove the park brake cable or differential lock cable to service or remove the battery.

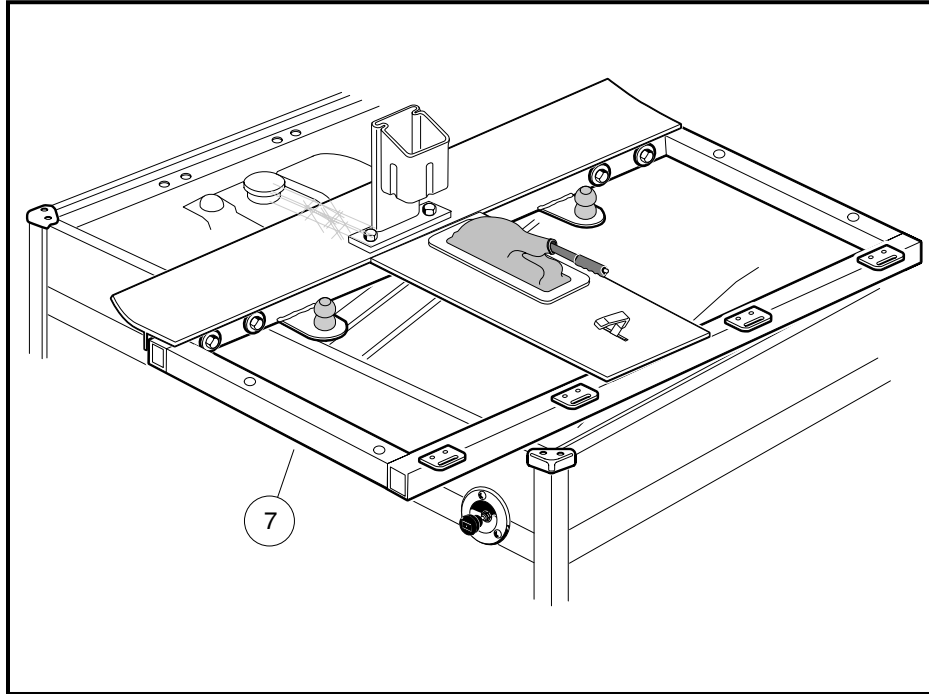


Figure 12b-32 Battery Removal

8. Remove the battery hold-down clamp from the battery.
9. Lift the battery from the vehicle. **See following WARNING.**

⚠ WARNING

- Keep the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent hole. Do not exceed this 45° angle when lifting, carrying or installing battery. The battery acid could cause severe personal injury when accidentally coming in contact with the skin or eyes, and could damage clothing.

CHARGING THE BATTERY

Read **DANGER** and **WARNING** on page 12b-1 and **DANGER** on page 12b-32.

1. Charge the battery using an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the positive charger cable (+) to the positive (+) battery post.
3. Attach the negative charger cable (-) to the negative (-) battery post.
4. The battery may be charged with a slow charge (3-10 amps) or a fast charge (20-30 amps). Charge until the specific gravity reaches 1.250. **See following WARNING.**

⚠ WARNING

- If the battery case feels hot (approximately 125 °F (52 °C) or more), emits gases, or fluid boils from vents, stop charging immediately. Failure to stop charging battery when any of these conditions are present could result in an explosion, personal injury and/or damage to the battery.
- Do not disconnect the DC leads and battery when the charger is on. The resulting arcing between the DC leads and battery post could cause an explosion.
- If the charger must be stopped, disconnect the AC supply cord from the wall outlet before disconnecting the DC leads from the battery. Allow the battery to cool to room temperature and resume charging battery at a lower amp rate.

Battery Installation

Read DANGER and WARNING on page 12b-1 and DANGER on page 12b-32.

1. Place the battery into the vehicle. Make sure the battery posts are facing the engine.
2. Secure the battery to the vehicle with the clamp. Install bolt, washer and lock nut and tighten to 12 ft-lb (16.3 N·m).
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27.1 N·m) (**Figure 12b-1, Page 12b-2**). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Return the seat support to its original position by rotating it 90° counterclockwise. Install the armrests using four bolts, eight washers and four lock nuts. Tighten bolts (8) to 13 ft-lb (17.6 N·m). **See Figure 4-3, Page 4-10.**
5. Install both seats.
6. Place the neutral lockout cam in the OPERATE position.
7. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 12b-2.**
8. Check the park brake and differential lock lever for proper adjustment and operation.

Battery Storage

Read DANGER and WARNING on page 12b-1 and DANGER on page 12b-32.

1. Keep the battery clean and free of corrosion. **See Preventive Maintenance on page 12b-33.**
2. The battery cables should be disconnected from the vehicle so it can be connected to the charger. The battery can be left in the vehicle. Disconnect the negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 12b-1.**
3. Fully charge the battery prior to storage.
4. Store in a cool, dry area. The colder the area in which the battery is stored, the less the battery will self-discharge. A battery stored at 0 °F (-17.8 °C) will discharge very little over a four-month period. A battery stored at 80 °F (27 °C) will have to be recharged every few weeks.
5. Check the state of charge periodically. A battery that is discharged and left in a cold environment can freeze and crack. If the specific gravity drops below 1.220, the battery should be recharged. **See following WARNING.**

⚠ WARNING

- If the battery is frozen or the container is bulged, discard battery. A frozen battery can explode.

6. The frequency of recharging required depends on the temperature of the storage area, but it is recommended that the battery be monitored for state of charge every month. Also, if the storage area is unheated in a cold climate and recharging is required, it is recommended that the area be heated to at least 60 °F (16 °C) prior to charging. The battery will not charge effectively in cold temperatures for the same reasons that it does not discharge as rapidly in cold temperatures.

Charging a Dead Battery

Read DANGER and WARNING on page 12b-1 and DANGER on page 12b-32.

The vehicle is equipped with a starter/generator. The generator is not designed to charge a dead battery. If the vehicle battery has become discharged, it must be charged using a properly rated automotive type charger. **See following WARNING.**

WARNING

- Do not jump-start a dead battery using another battery and jumper cables.

GROUND CABLES

Testing the Ground Cables

See Test Procedure 3, Section 11b, Page 11b-27.

SECTION 13 – FE350 AND FE400 ENGINES

▲ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

▲ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

Read DANGER and WARNING on page 13-1.

All Club Car gasoline vehicles are powered by 4-cycle, overhead valve, single cylinder, air-cooled engines. The 272 model vehicles are equipped with one of two engine models: FE350 or FE400. These 4-cycle engines have an oil reservoir (crankcase) similar to automobile, truck, heavy equipment machinery and other similar equipment engines designed for reliable heavy-duty service. These engines have two major component assemblies: the cylinder assembly and the crankcase assembly.

Servicing procedures for these two engines are identical. Unless otherwise noted, all maintenance and repair of component parts, both internal and external, are identical. When any specification or procedure differs from one engine model to another, those specifics will be noted as pertaining to FE350 or FE400. Tools used to service these engines are also identical, with one exception: That exception is the piston ring compressor sleeve. However, both piston ring compressor sleeves are provided in the piston ring compressor kit (CCI P/N 1016414).

The FE350 engine may be supplied with either the MC010C-BS00 or MC012C-AS00 transaxle. The FE400 engine is only supplied with the MC012C-AS00 transaxle. **See Transaxle Identification, Section 6a, Page 6a-2.**

NOTE: Engine rotation on both engine models is clockwise as viewed from the clutch side of the engine.

SPECIAL ENGINE SERVICE TOOLS AVAILABLE FROM CLUB CAR

DESCRIPTION	CCI P/N
Gear yoke	1016418
Compression gauge and adapter	101641002
Valve spring compressor	101641101
Valve guide reamer	101641201
Valve guide reamer and arbor	101641202
Piston ring compressor kit	1016414
Piston ring pliers	1016415
Bearing driver set	1016416
Flywheel puller kit	1016627
Valve clearance adjuster screw holder	1016413
Bearing and seal remover assembly	1016417
Valve seat cutter t wrench	1016551
Valve seat cutter 30° and 45° x 35 mm diameter	1016554
Valve seat cutter guide	1016552

BEFORE SERVICING

To eliminate unnecessary work, carefully read the applicable information and instructions before beginning engine service. Diagrams, DANGER, WARNING, CAUTION and NOTE statements and detailed descriptions have been included wherever necessary. Nevertheless, even a detailed account has limitations. Therefore, anyone attempting engine service should have knowledge and experience in small engine service and repair.

MECHANICAL SYSTEMS**Adjustments**

All adjustments shall be made in accordance with Section 10 – Periodic Maintenance.

Edges** WARNING**

- **Watch for sharp edges, especially during major engine disassembly and assembly. Protect your hands with gloves or a piece of thick cloth when lifting the engine or turning it over.**

Force

Common sense should dictate how much force is necessary for assembly and disassembly. If a part seems especially difficult to remove or install, stop and determine what may be causing the problem. Whenever tapping is necessary, tap lightly using a wooden or plastic-faced mallet. Use an impact driver for the removal of screws (particularly those held by a locking agent) in order to avoid damaging the heads.

Mechanical Systems, Continued:

Dirt

Clean the engine thoroughly before servicing it. **See following CAUTION.**

▲ CAUTION

- **Before removal and disassembly, clean the engine. Any dirt entering the engine, carburetor, or other parts will work as an abrasive and shorten the life of the engine. For the same reason, before installing a new part, clean off any dust or metal filings.**

Tightening Sequence

Where there is a tightening sequence indicated in this maintenance and service manual, the bolts, nuts, or screws must be tightened in the order and by the method indicated. When installing a part that is secured with several bolts, nuts, or screws, hand tighten all, then tighten to specified torque in the proper sequence. This is to avoid distortion of the part and/or causing gas or oil leakage. Conversely, when loosening the bolts, nuts or screws, loosen all about a quarter of a turn first and then remove them.

Torque

The torque values given in this maintenance and service manual should always be adhered to. Applying too little or too much torque may lead to serious damage.

Lubricant

Some oils and greases should only be used in certain applications and may be harmful if used in an application for which they are not intended.

Lubrication

Engine wear is generally at its maximum while the engine is warming up and before all the rubbing surfaces have adequate lubrication. During assembly, oil or grease (whichever is more suitable) should be applied to any rubbing surface.

Press

A part installed using a press or driver, such as a seal, should first be coated with oil on its outer or inner circumference (contact surface) so that it will go into place smoothly.

Oil Seal, Grease Seal

During assembly use new oil or grease seals to replace any that were removed, as removal generally damages seals. To avoid damaging the seal lips, a seal guide is required for installation. Before a shaft passes through a seal, apply a small amount of lubricant (preferably high temperature grease) to the lip to reduce rubber-to-metal friction.

Gasket, O-Ring

When in doubt as to the condition of a gasket or O-ring, replace it with a new one. To avoid leaks, the mating surface around the gasket or O-rings should be free of foreign matter and perfectly smooth.

Liquid Gasket and Non-permanent Locking Agent

Follow manufacturer's directions for cleaning and preparing surfaces where these compounds will be used. Apply sparingly. Excessive amounts may block engine oil passages and cause serious damage.

Certain compounds can lead to premature gasket failure. Use the non-permanent locking agent Loctite[®], Lock'n Seal (Blue) or approved equivalent.

Ball Bearing Installation

When installing a ball bearing, the bearing race which has a press fit should be pushed by a suitable driver. This prevents severe stress on the balls and races, and prevents damage. Press on the inner race if the ball bearing is being pressed onto a shaft, or on the outer race if the ball bearing is being pressed into a housing. Press the ball bearing until it is seated against the housing or on the shaft.

Circlip, Retaining Ring

Replace circlips and retaining rings that were removed with new circlips and retaining rings, as removal weakens and deforms them. During installation, take care to compress or expand them only enough for installation.

High Flash-point Solvent

To reduce fire danger a high flash-point solvent is recommended. A commercial solvent commonly available in North America is Stoddard solvent (generic name). Always follow manufacturer and container directions regarding the use of any solvent.

Molybdenum Disulfide (MoS₂) Grease

NOTE: This manual makes reference to molybdenum disulfide grease in the assembly of certain engine and chassis parts. Always refer to manufacturer's recommendations printed on the container before using such special lubricants.

Engine Rotation

When turning the crankshaft by hand, always turn it clockwise as viewed from the clutch side of the engine. This will ensure proper adjustments.

LUBRICATION SYSTEM

FE350 and FE400 engines are equipped with hydraulic lifters and a pressurized lubrication system which consists of these components (**Figure 13-1, Page 13-6 and Figure 13-3, Page 13-6**):

- Inlet filter screen (2)
- Trochoid pump (3)
- Cartridge filter (5)
- Pressure relief valve (8)

The pump draws oil from the sump and forces it under pressure into the crankcase passages as shown (**Figures 13-2 and 13-3, page 6**). Oil can build up excess pressure in a lubrication system. To prevent build-up of excess oil pressure which could possibly force oil past the seals and damage the engine, the pump is fitted with a pressure relief valve (8) (**Figure 13-1, Page 13-6**) that is made of a ball and a spring. When the pressure increases beyond the pressure of the spring, the ball is forced off its seat against the spring pressure and excess oil is routed back into the sump (crankcase), thus relieving the pressure. When the pressure drops below the preset limit, the spring holds the ball against its seat to keep the oil from draining back into the sump (crankcase).

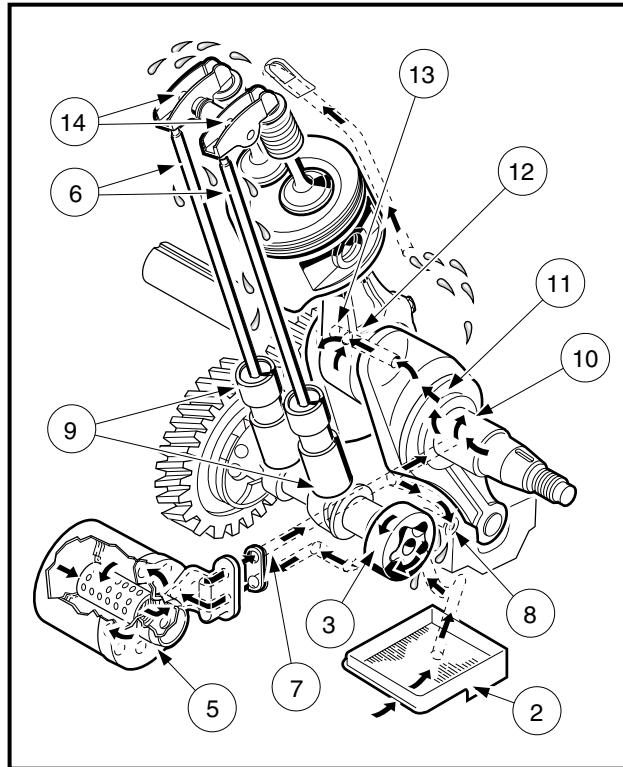


Figure 13-1 Lubrication System

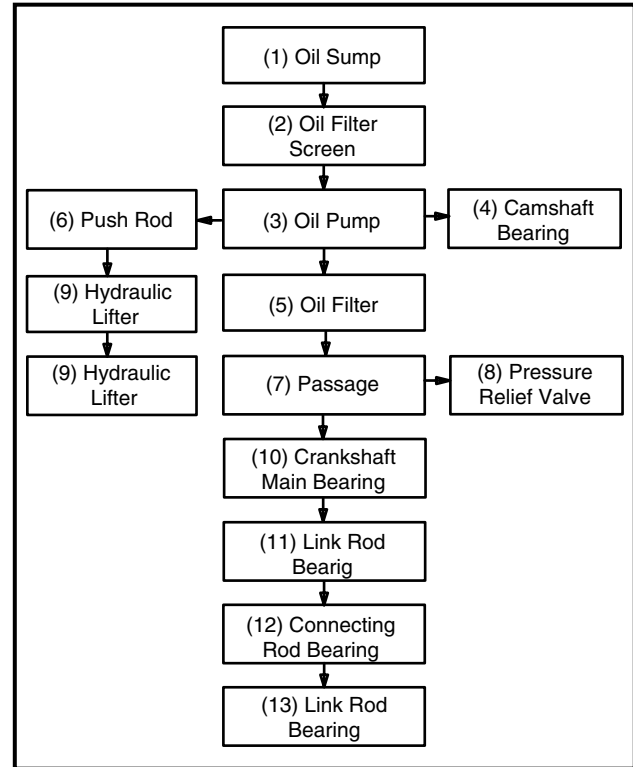


Figure 13-2 Lubrication System Flow Chart

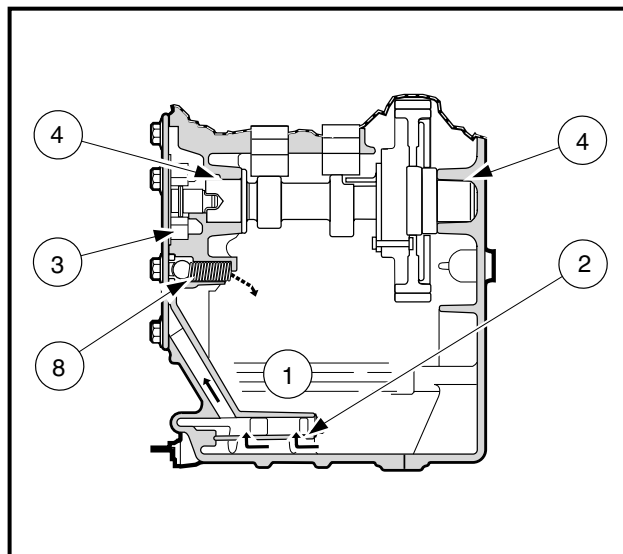


Figure 13-3 Cutaway View of Crankcase

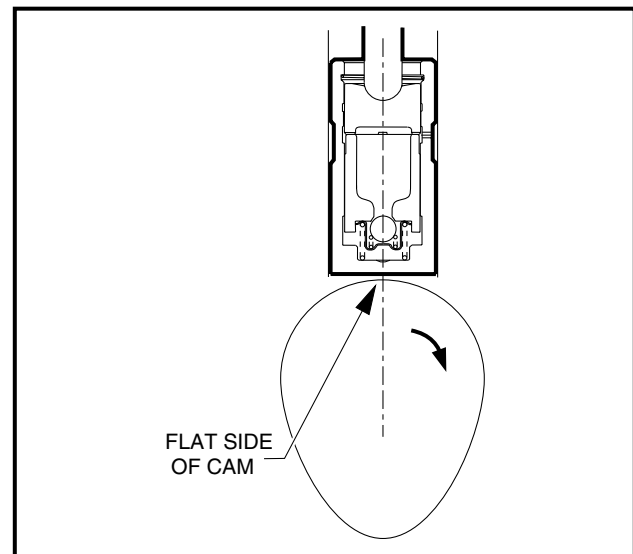


Figure 13-4 Cam Position for Lifter Installation

HYDRAULIC LIFTERS

FE350 and FE400 engines are equipped with non-adjustable rocker arms (14) and hydraulic lifters (9) (Figure 13-1, Page 13-6). The purpose of hydraulic lifters is to automatically eliminate all valve clearance in the valve train. This zero-clearance condition ensures that the valve begins to open at precisely the same time during each valve event. However, to ensure good seating, there is a small amount of clearance present after the valve closes. This clearance is eliminated by the lifter before the valve is opened again. The installation of

the hydraulic lifters at the time of engine assembly does not, in most cases, require any special techniques beyond the normal practice for solid lifter valve trains. There are, however, two areas of concern to be aware of to assure satisfactory installation and initial engine start. New hydraulic lifters are filled with hydraulic fluid at the time of installation and they are at their fully extended position. As each rocker arm is tightened into place, the lifter should be resting on the flat side of the cam lobe (**Figure 13-4, Page 13-6**). If the camshaft is not in the correct position, it may be possible to open the valve beyond its normal operating range. This may cause over-compensation of the valve spring or contact between the valves and the piston.

SPARK PLUG

Spark plugs are selected to suit specific engine design and vehicle operating conditions. The spark plug (CCI P/N 101881101) is designed for both the FE350 and FE400 engines, providing maximum life and efficient combustion of fuel. The spark gap is 0.027 - 0.031 inches (0.69 - 0.79 mm).

Spark Plug Removal

Read **DANGER** and **WARNING** on page 13-1.

⚠ CAUTION

- Before removal and disassembly, clean the engine.

Remove all dirt from plug base in the cylinder head before removing plug. Use a 13/16 deep well socket wrench or 13/16 plug wrench to loosen the plug.

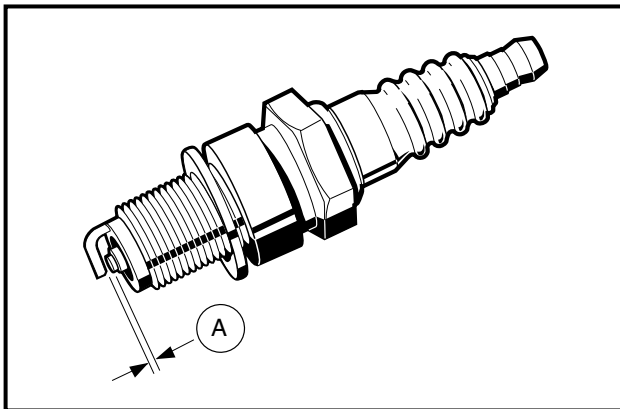


Figure 13-5 Spark Plug

Spark Plug Cleaning, Inspection and Repair

Examine the plug (**Figure 13-5, Page 13-7**). The deposits on the plug base and electrode are an indication of the correct heat range and efficiency as well as a guide to the general condition of the engine, fuel and air mixture and ignition system. If all of the above conditions are proper, the spark plug should be a light brown color. There should be no bridging between the electrode and base. The electrode should not be eroded. Black color, excessive carbon, and/or a wet plug indicate a too rich condition. White, burned or melted electrodes indicate a too lean condition or pre-ignition. Oily deposits on the plug electrode are an indication of worn rings, valve guides, cylinder wall, etc. Also examine the spark plug wire. Remove rubber boot and inspect internal spring for damage. Inspect spark plug wire for damage and be sure spring coil is securely attached to spark plug. **See following WARNING.**

WARNING

- **Remove spark plug wire to avoid accidental start up of the engine when servicing vehicle. To avoid ignition of fuel and serious personal injury or death, never try to start the engine with plug removed from engine.**

Testing the Spark Plug

Check the sparking ability of a cleaned and regapped plug on a sparking comparator if possible. Spark should be blue and strong and able to jump a 5/16-inch (8 mm) gap.

Setting the Spark Gap

1. Before setting the spark gap on a used plug, pass a contact point file between the electrodes to produce flat, parallel surfaces to facilitate accurate gauging.
2. Use a wire type gauge. Bend the outside or ground electrode so only a slight drag on the gauge is felt when passing it between the electrode. Never make an adjustment by bending the center electrode. Set gap (A) to 0.027 - 0.031 inches (0.69 - 0.79 mm) (**Figure 13-5, Page 13-7**).

Spark Plug Installation

NOTE: Before installing the plug, check the condition of the threads in the cylinder head. Soften deposits in cylinder head threads with penetrating oil and clean the threads with a tap if necessary.

1. Install the spark plug and thread it in until finger tight, then tighten the spark plug to 20 ft-lb (27 N·m).

ENGINE MOUNTING PLATE

See Engine Removal on page 13-22.

CYLINDER HEAD

Read DANGER and WARNING on page 13-1.

GENERAL INFORMATION

Prior to attempting time-consuming repairs to the cylinder assembly, a cylinder compression test should be performed using a standard compression tester. Low compression would normally indicate a problem in the cylinder assembly such as defective rings, gaskets, etc.

- **Key-Start Engines:** Both FE350 and FE400 model engines are equipped with an automatic compression release valve (ACR). This valve releases compression pressure at normal cranking RPM, resulting in lower compression. At a normal cranking speed of 550 - 600 RPM, the compression should be typically 71 psi. This value could vary slightly depending on wear of components affecting compression. **See Automatic Compression Release Valve (ACR) Inspection on page 13-26.**
- **Pedal-Start Engines:** These FE350 model engines are not equipped with automatic compression release valves (ACR). At a normal cranking speed of 550 - 600 RPM, the compression should be typically 156 psi. This value could vary slightly depending on wear of components affecting compression.

CYLINDER SHROUD REMOVAL

⚠ CAUTION

- Before removal and disassembly, clean the engine.

1. Access the engine compartment. See **WARNING "For vehicles with cargo beds..."** on page 13-2.
 - 1.1. Tilt the bed and ensure that the prop rod is properly engaged.
2. Disconnect the battery cables, negative (-) cable first. See **WARNING "To avoid unintentionally starting..."** on page 13-1.
3. Remove spark plug wire from spark plug.
4. Loosen air intake hose clamp (7) from the intake pipe (5) and remove hose (6) (**Figure 13-6, Page 13-9**).
5. Disconnect the fuel line (9) and vent tube (10) from the carburetor (4) (**Figure 13-7, Page 13-9**)

⚠ WARNING

- Plug fuel line to prevent gas from draining from line.

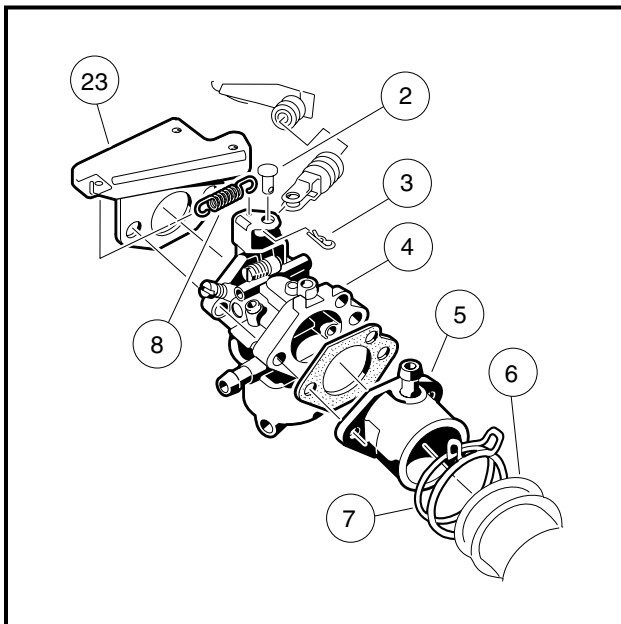


Figure 13-6 Carburetor Removal

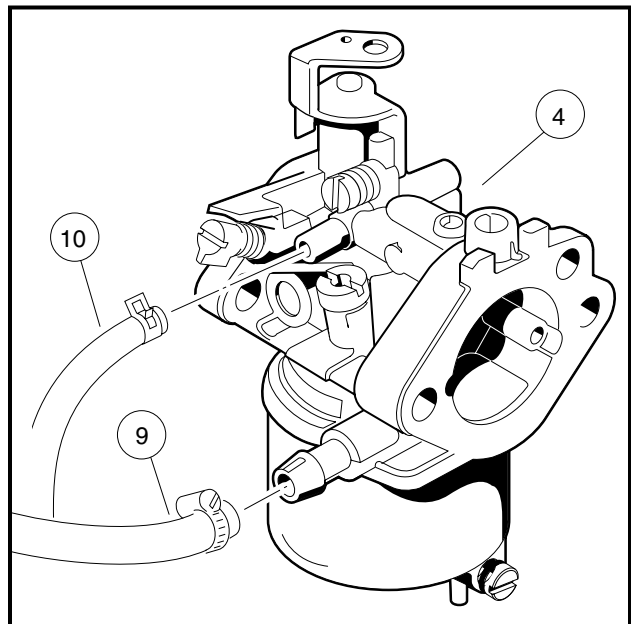


Figure 13-7 Carburetor, Fuel and Vent Line

6. Remove cotter pin (3) and clevis pin (2) from throttle lever (**Figure 13-6, Page 13-9**).
7. Remove nuts at carburetor intake pipe (5) and remove intake pipe. See following **CAUTION**.

⚠ CAUTION

- Disconnect the governor linkage from the carburetor before attempting to remove the carburetor. Failure to do so could damage the linkage.

8. Remove carburetor (4) along with throttle spring (8) and throttle spring bracket (23) (**Figure 13-6, Page 13-9**).
9. Remove muffler. See **Muffler Removal, Section 15, Page 15-2**.

Cylinder Shroud Removal, Continued:

10. If the engine is to be totally disassembled, drain oil and remove the oil filter. If only the cylinder head is to be disassembled, proceed without draining the oil or removing the oil filter.
11. Disconnect oil filler tube (20) from cylinder shroud by first removing the lock nut (18), ground wire (17) and flange nut (10) and then pulling oil filler tube out of the crankcase cover (**Figure 13-8, Page 13-10**).

NOTE: Make sure vehicle is level before removing filler tube. This will prevent oil from spilling when filler tube is removed.

12. Remove the nine bolts (14) and two-ended bolt (11) (**Figure 13-8, Page 13-10 and Figure 13-9, Page 13-10**).
13. Take off the head shroud (13), the upper shroud (23) and the bracket (22).

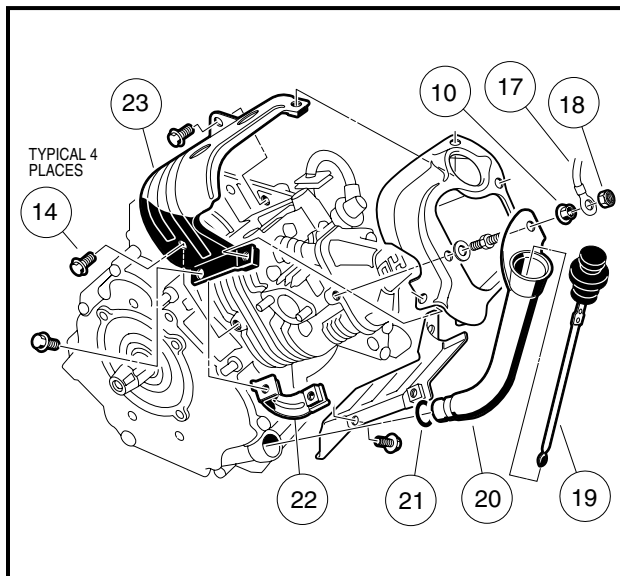


Figure 13-8 Upper Shroud & Oil Filler Removal

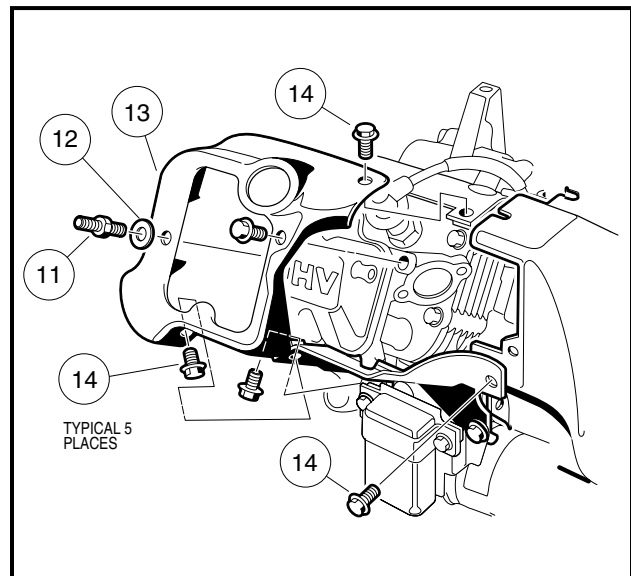


Figure 13-9 Head Shroud Removal

ROCKER ARM AND PUSH ROD REMOVAL

NOTE: The FE350 and FE400 engines are equipped with hydraulic lifters, which automatically eliminate all clearance in the valve train. Therefore, the rocker arms (3) and the push rods (5) do not need to be put back in their original positions (**Figure 13-11, Page 13-11**).

1. Remove the two bolts (1) and remove the rocker cover (2) along with the breather tube (3) (**Figure 13-10, Page 13-11**).
2. Remove the E-ring (1) and pull the rocker shaft (2) out of the cylinder head (**Figure 13-11, Page 13-11**).
3. Lift out the rocker arms (3), washer (4), and push rods (5).

CYLINDER HEAD REMOVAL

1. Remove the six bolts (1) and take off the cylinder head assembly (2) (**Figure 13-12, Page 13-11**).
2. Remove head gasket (3). Note the position of the two dowels (4) as shown (**Figure 13-13, Page 13-11**).

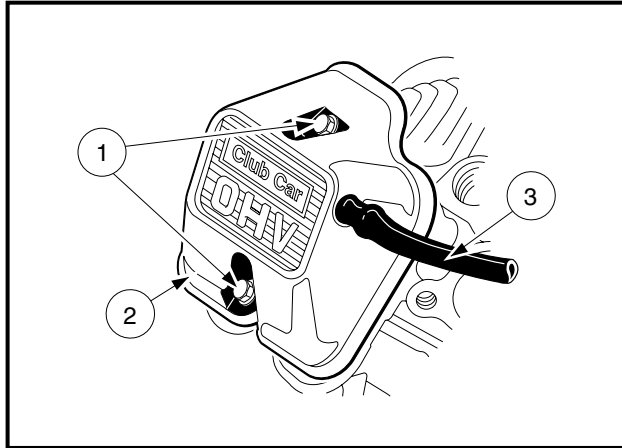


Figure 13-10 Remove Rocker Cover and Breather Tube

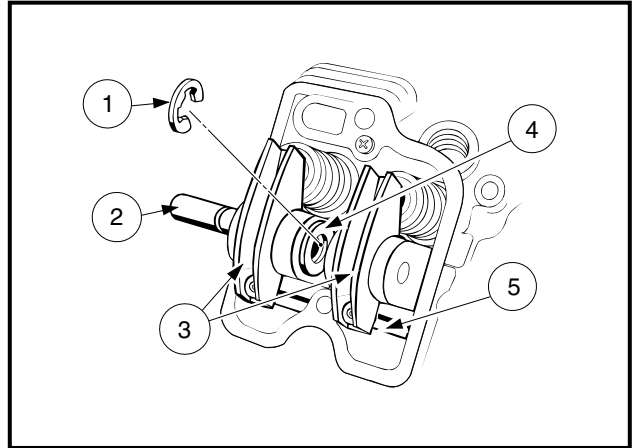


Figure 13-11 Remove Rocker Arms and Push Rods

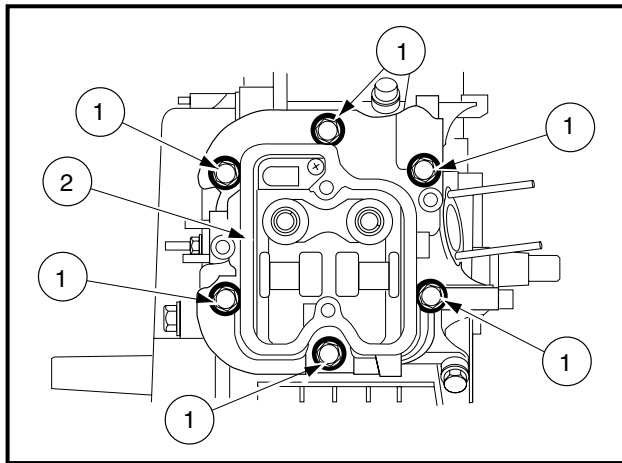


Figure 13-12 Remove Cylinder Head

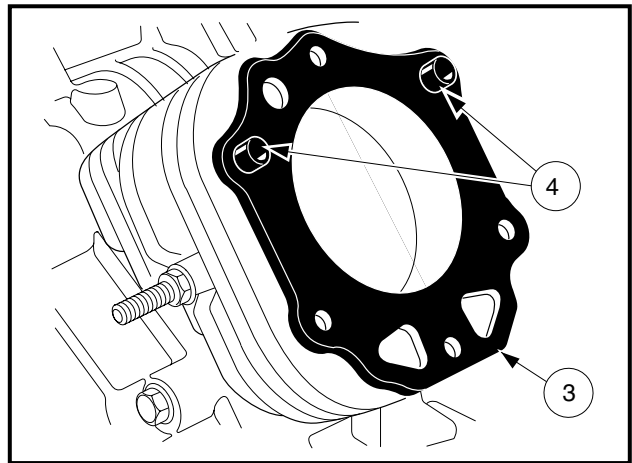


Figure 13-13 Remove Head Gasket

VALVE REMOVAL

1. Compress the valve spring using a valve spring compressor (5) (CCI P/N 101641101) and remove the collet halves (6) (Figure 13-14, Page 13-12).
2. Remove spring compressor, and take out the upper retainer (7) and the spring (8).
3. Remove valve (10).
4. Remove valve stem seal (11) with a screwdriver (Figure 13-15, Page 13-12). See following CAUTION.

▲ CAUTION

- To keep the screwdriver from damaging the cylinder head flange surface, place a piece of heavy cardboard or wood between them (Figure 13-15, Page 13-12).
- The valve stem seal cannot be reused. Replace valve stem seal with a new one.

5. Remove spring seat (9) (Figure 13-15, Page 13-12).

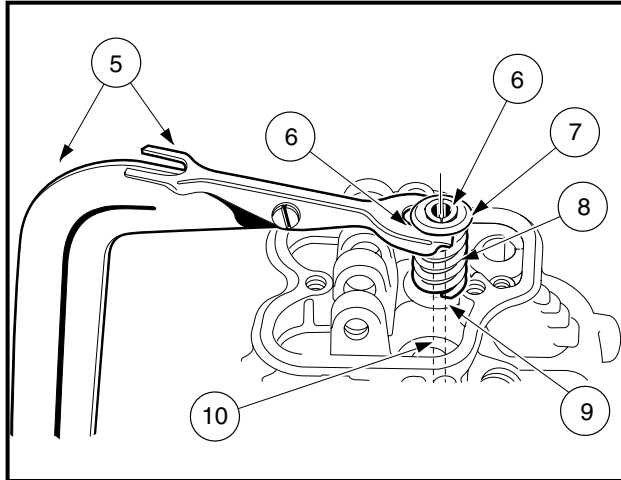


Figure 13-14 Valve Removal

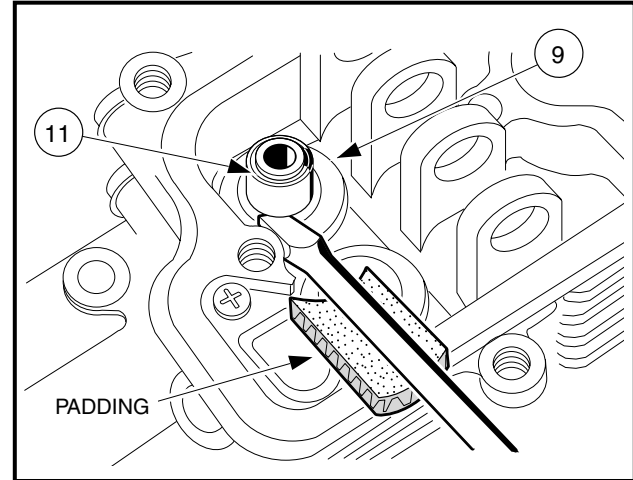


Figure 13-15 Spring Seat Removal

BREATHER VALVE (REED VALVE)

General Information

The function of the breather is to create a vacuum in the crankcase which prevents oil from being forced out of the engine through the piston rings, oil seals or gaskets. The breather has a reed valve which limits the direction of air flow caused by the piston moving up and down. Air can flow out of the crankcase, but the one-way reed valve blocks return flow. It thus maintains a vacuum in the crankcase.

Oil laden air in the crankcase passes through the reed valve and expands into the rocker chamber. In the rocker chamber most oil separates from the air and drains back to the crankcase. The air passes through a tube and vents to the intake manifold.

Breather Valve (Reed Valve) Removal

1. Unscrew the mounting screw (1) and remove the back plate (2) and reed valve (3) (Figure 13-16, Page 13-12). For installation, see **Breather Valve Installation** on page 13-20.

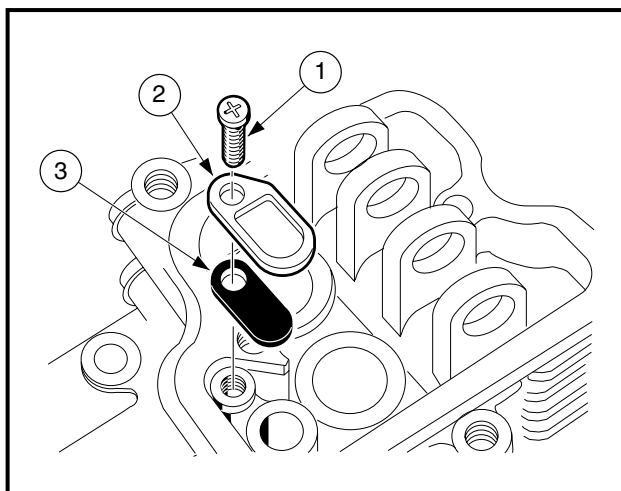


Figure 13-16 Reed Valve

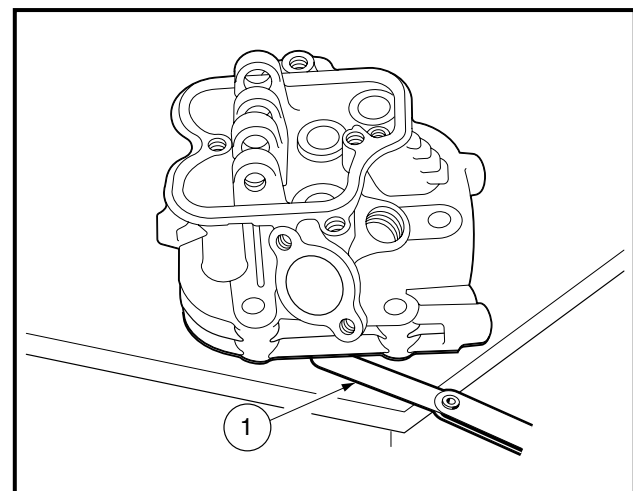


Figure 13-17 Check Flatness of Head Surface

CYLINDER HEAD CLEANING AND INSPECTION

1. Clean the head with a non-flammable solvent and dry thoroughly.
2. Bead blast or scrape carbon deposits from head. When scraping carbon deposits, be careful to avoid scratching or nicking the cylinder head.
3. Inspect the spark plug port threads for damage. If threads are damaged, replace the head.
4. Place the cylinder head on a surface plate (**Figure 13-17, Page 13-12**).
5. Measure the space between the surface plate and the head with a feeler gauge (1) to check the flatness of the head surface (**Figure 13-17, Page 13-12**).
6. If the head is warped more than 0.002 inch (0.05 mm), replace the head. **See following CAUTION.**

▲ CAUTION

- Smooth out any damaged spots in the combustion chamber (1) using a small grinder. Sharp edges in the combustion chamber may cause pre-ignition. Do not remove any more material than is necessary or change the shape of the combustion chamber (**Figure 13-18, Page 13-13**).
- Do not grind the valve seats or the gasket surface.

VALVE GUIDES

Valve Guide Inspection

1. Measure the inside diameter of each guide with a telescoping gauge (**Figure 13-19, Page 13-13**).
2. If the inside diameter exceeds 0.2781 inch (7.065 mm), replace the guide.

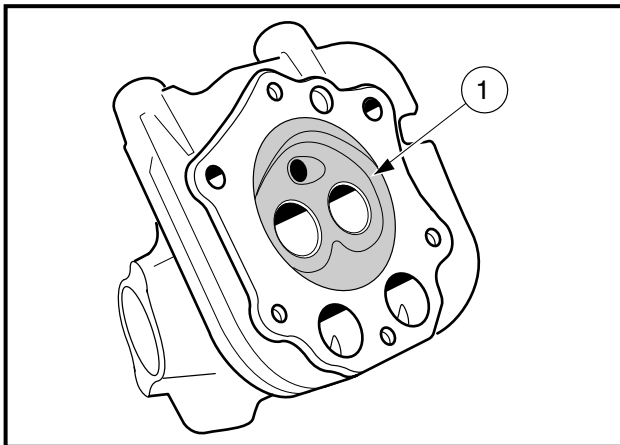


Figure 13-18 Combustion Chamber

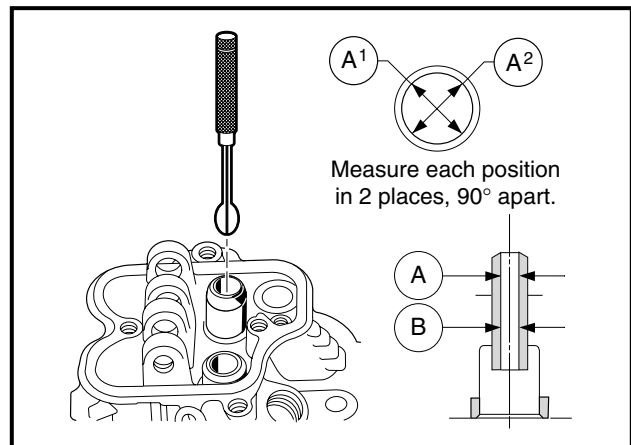


Figure 13-19 Measure I.D. of Valve Guides

Valve Guide Replacement

1. With the combustion chamber side of the head facing up, drive the guide out of the head with a valve guide arbor (1) (CCI P/N 101641202) (**Figure 13-20, Page 13-14**).
2. Install the snap ring (2) on the new valve guide (**Figure 13-21, Page 13-14**).
3. Coat the guide with a light film of clean engine oil.
4. With the rocker arm side of the head facing up, drive the new valve guide into the head with the valve guide arbor (3) until the snap ring (2) just seats on the head (**Figure 13-21, Page 13-14**).
5. Ream the guide with a stanisol or kerosene lubricant and a valve guide reamer (CCI P/N 101641201). The valve guide inside diameter should be 0.2756 - 0.2762 inch (7.000 - 7.015 mm) (**Figure 13-22, Page 13-14**).

VALVE SEATS

Valve Seat Inspection

1. Inspect the valve seats for damage. If the seats are warped or distorted beyond reconditioning, replace the cylinder head.
2. Using prussian blue metal die, coat the valve seat.
3. Push the valve into the guide.
4. Rotate the valve against the seat with a lapping tool (1) (**Figure 13-23, Page 13-14**).

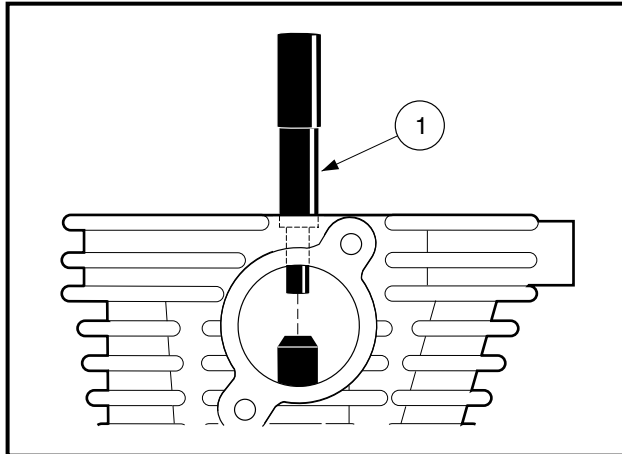


Figure 13-20 Valve Guide Removal

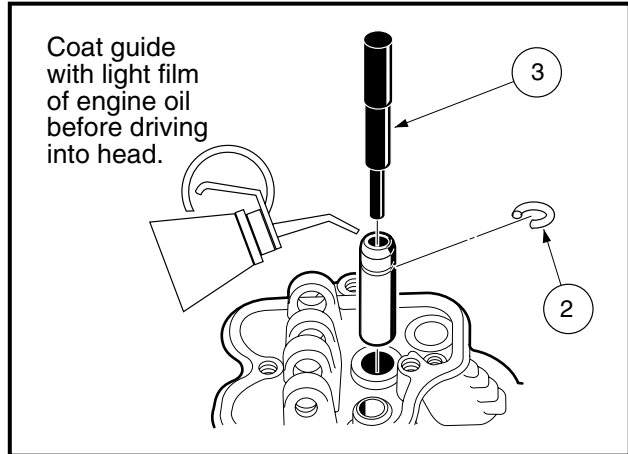


Figure 13-21 Valve Guide Installation

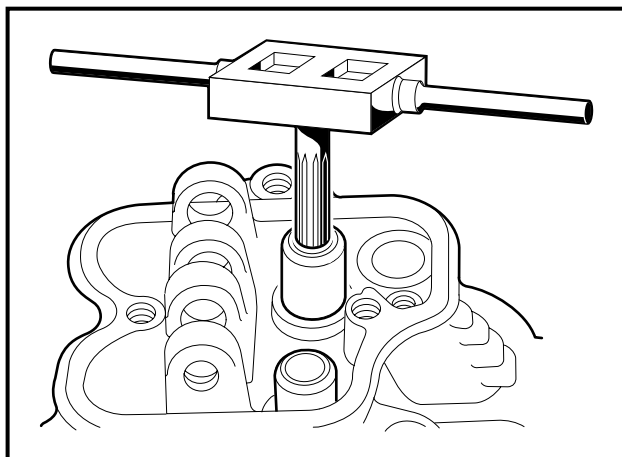


Figure 13-22 Ream Valve Guide

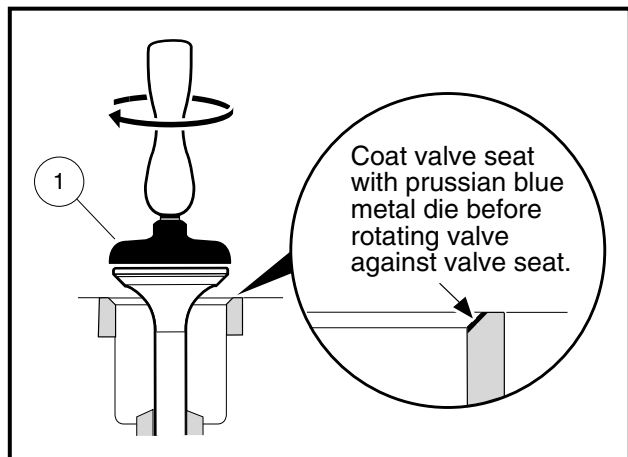


Figure 13-23 Rotate Valve Against Valve Seat

5. Pull the valve out, and check the mark on the valve head. It must be 0.0197 - 0.0433 inch (0.50 - 1.10 mm) in width, and even all the way around the seat and valve (**Figure 13-24, Page 13-15**)

NOTE: The valve stem and guide must be in good condition or step 5 will not be valid.

6. If the valve seating surface is not correct, repair the seat.
7. Pitted or worn valve seats can be resurfaced. Make sure to lap the valves to the seats after refacing. **See Valve Seat Repair on page 13-15.**

Valve Seat Repair

⚠ CAUTION

- If you are unfamiliar with the following procedures, Club Car suggests that the cylinder head be taken to a professional engine machine shop for reconditioning.

1. Clean the cylinder head thoroughly. **See Cylinder Head Cleaning and Inspection on page 13-13.**
2. Recondition the valve seats with the valve seat cutters (45° x 35 mm, 30° x 35 mm) and lap the valves (**Figure 13-26, Page 13-16**).

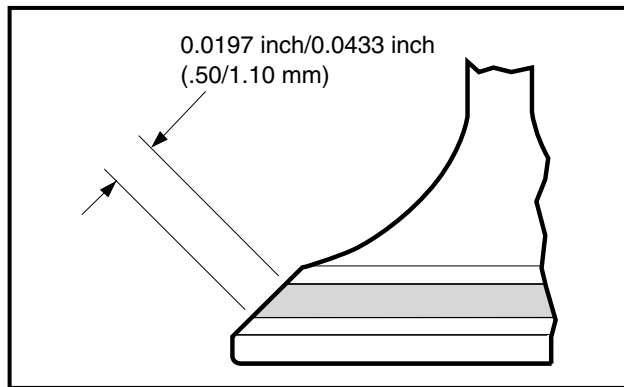


Figure 13-24 Check Mark on Valve Head

- 2.1. Using prussian blue metal die, check the seats for good contact all the way around. **See Valve Seat Inspection on page 13-14.**
- 2.2. Measure the seat width of the 45° angle portion of the seat at several places around the seat (**Figure 13-25, Page 13-16**).
- 2.3. If the seat width is more than 0.079 inch (2.0 mm), the seating surface should be resurfaced (**Figure 13-26, Page 13-16**).
- 2.4. Resurface the valve seat with a 45° (exhaust port) or a 30° (intake port) cutter (CCI P/N 101655401), removing only enough material to produce a smooth and concentric seat (**Figure 13-26, Page 13-16**).

⚠ CAUTION

- Use care not to dull the cutter. Do not turn the cutter counterclockwise or allow it to hit a metal object.

- 2.5. Use a 60° x 35 mm seat cutter (1) to narrow the seat width to the standard width.
- 2.6. Turn the seat cutter (1) clockwise one turn at a time while pressing down very lightly. Recheck the width after each cutter revolution. **See following CAUTION and NOTE.**

⚠ CAUTION

- The 60° seat cutter removes material very quickly. Check the seat outside diameter frequently to prevent over-cutting.

Valve Seat Repair, Continued:

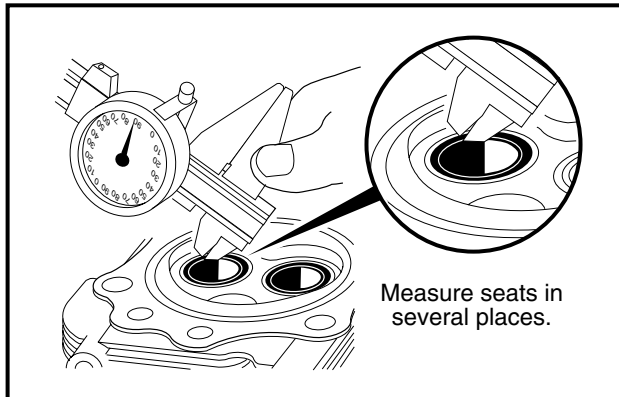


Figure 13-25 Measuring Valve Seats

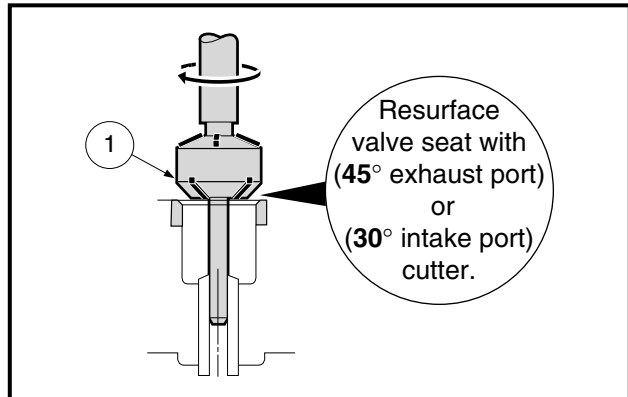


Figure 13-26 Resurfacing Valve Seat

NOTE: Keep the seat width as close as possible to 0.031 inch (0.8 mm).

- 2.7. Make a light pass with the 45° cutter to remove any possible burrs at the edge of the seat.
3. After applying a coat of prussian blue metal die to the valve face, insert the valve, and snap it closed against the seat several times. The valve surface should show good contact all the way around. Be sure the valve seat is centered on the valve face. The position of the valve in the seat is evident after lapping the valve.
4. If the seat does not make proper contact, lap the valve into the seat with a vacuum cup tool.
 - 4.1. Coat the surface of the valve sparingly with a fine lapping compound.
 - 4.2. Use the vacuum cup lapping tool (1) to grip the top of the valve. Rotate the valve in a circular motion to lap the valve to the seat (**Figure 13-27, Page 13-16**).
 - 4.3. Lift the valve slightly from the seat every 8 to 10 strokes, continuing the lapping operation until a uniform ring appears around the entire surface of the valve face.
5. When lapping is completed, wash all parts in solvent to remove lapping compound. Dry the parts thoroughly.
6. Note the position of the lapping mark on the valve face. The lapping mark should appear on or near the center of the face.

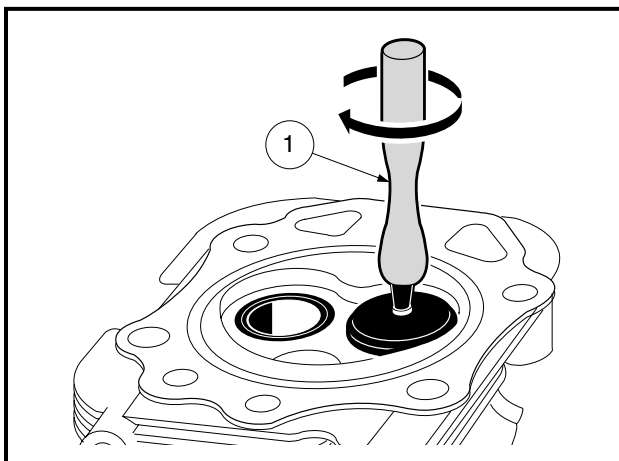


Figure 13-27 Lap Valve To Valve Seat

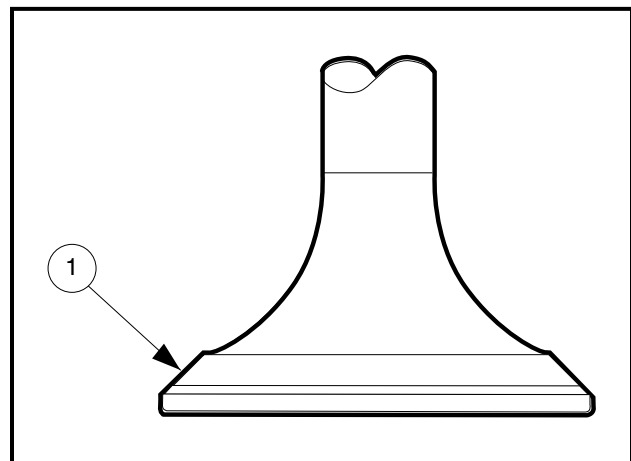


Figure 13-28 Valve Head Seating Area

VALVES

Visual Inspection

1. Inspect the valve head seating area (1) for erosion, nicks and warping, etc. (**Figure 13-28, Page 13-16**).
See following **NOTE**.

NOTE: The valve seating surface angle is 30° (Intake), 45° (Exhaust) (**Figure 13-29, Page 13-17**).

2. If the valve head seating area is worn, replace the valve.
3. If the valve head seating area is eroded or nicked, it may be possible to repair the valve on a valve refacing machine. Follow the refacing machine manufacturer's instructions.
4. Inspect the stem for obvious wear, discoloration, and stem end damage.
5. If the stem is obviously worn or discolored, replace the valve.

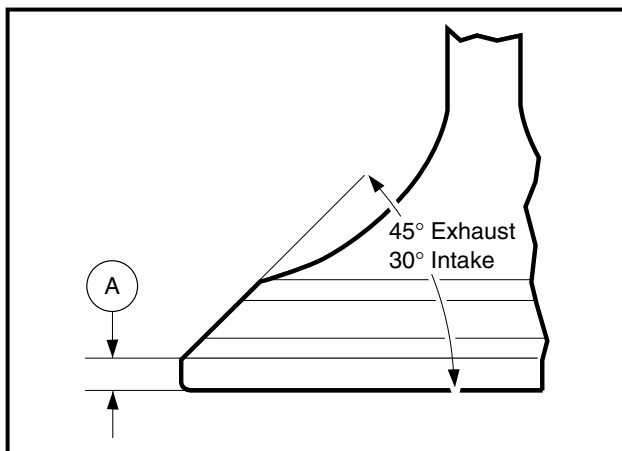


Figure 13-29 Valve Seating Surface Area

Valve Head Thickness

1. Measure the thickness of the valve head, as shown (**Figure 13-29, Page 13-17**).
2. If the valve head thickness (A) is less than 0.024 inch (0.610 mm), replace the valve (**Figure 13-29, Page 13-17**).

Valve Stem Bend

1. Support the valve in V-blocks at each end of the stem (**Figure 13-30, Page 13-18**).
2. Position a dial gauge perpendicular to the stem.
3. Turn the valve and read the variation on the dial gauge.
4. If stem bend is greater than the service limit of 0.0012 inch (0.0305 mm), replace the valve.

Valve Stem Diameter

1. Using a micrometer, measure the diameter of the stem at several points along its length (**Figure 13-31, Page 13-18**).
2. If the outside diameter is less than the service limit of 0.2728 inch (6.930 mm) intake; 0.2722 inch (6.915 mm) exhaust, replace the valve.

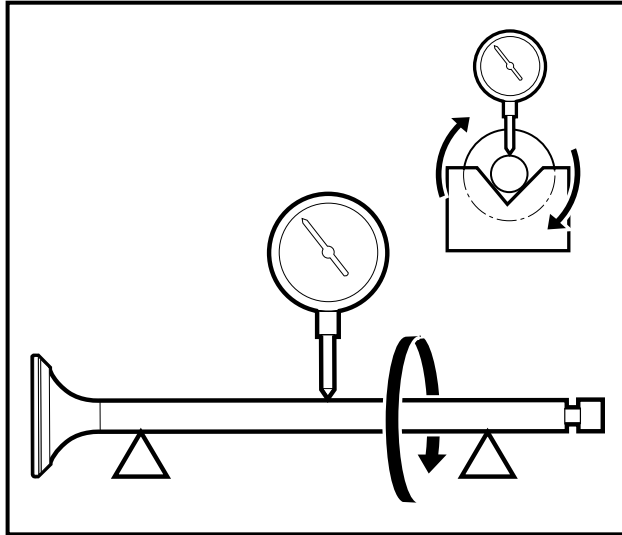


Figure 13-30 Measure Valve Stem Bend

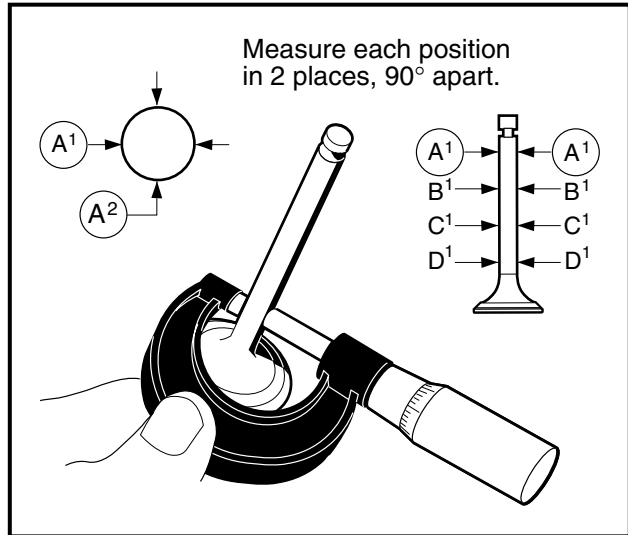


Figure 13-31 Measure Valve Stem Diameter

Valve Spring Inspection

1. Inspect the valve springs (1) for pitting, cracks, corrosion and burrs. Replace the springs if necessary (Figure 13-32, Page 13-18).
2. Measure the free length of the spring. If the measurement is less than the service limit of 1.51 inch (38.50 mm), replace the spring (Figure 13-32, Page 13-18).

ROCKER ARM AND ROCKER SHAFT INSPECTION

1. Using a dial bore or telescoping gauge, measure the inside diameter of each rocker arm bearing at several points along its length (Figure 13-33, Page 13-18).
2. If the inside diameter is more than the service limit of 0.4803 inch (12.20 mm), replace the rocker arm.
3. Using a micrometer, measure the diameter of the rocker shaft at several points along its length (Figure 13-34, Page 13-19).
4. If the outside diameter is less than the service limit of 0.4704 inch (11.949 mm), replace the shaft.

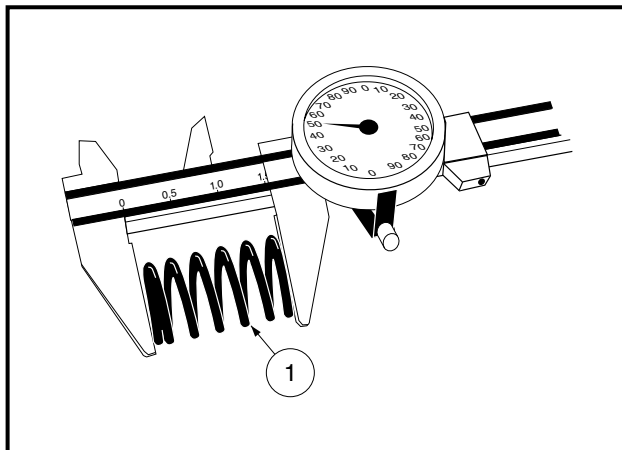


Figure 13-32 Measure Valve Spring Length

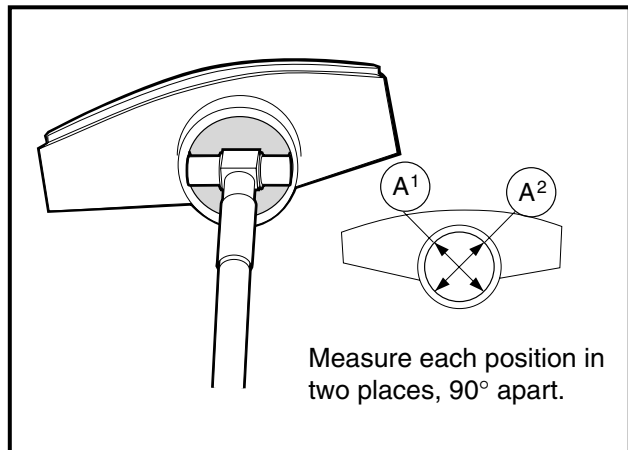


Figure 13-33 Measure Rocker Arm Bearing I.D.

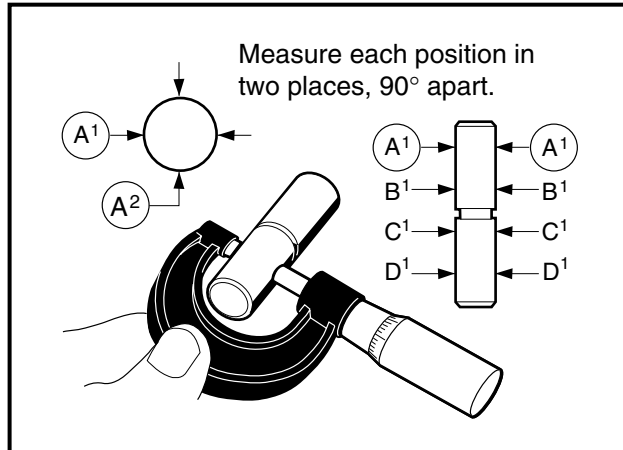


Figure 13-34 Measure Rocker Shaft O.D.

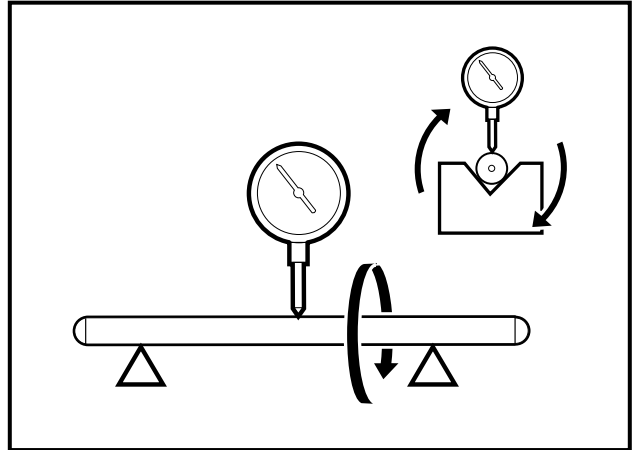


Figure 13-35 Check For Push Rod Distortion

PUSH ROD INSPECTION

1. Support the rod in V blocks at each end of the rod. Position a dial gauge perpendicular to the rod (Figure 13-35, Page 13-19).
2. Turn the rod slowly and read the variation on the gauge.
3. If the push rod is bent more than 0.019 inch (0.5 mm), replace the push rod.

CYLINDER HEAD INSTALLATION

Read **DANGER** and **WARNING** on page 13-1.

1. Installation is the reverse of removal. See **Cylinder Head Removal** on page 13-10.
2. Making sure that each push rod (5) is in place between the rocker arm (3) and the hydraulic lifter as shown, put the rocker shaft (2) into the posts through the rocker arm (3) and washer (4) (Figure 13-36, Page 13-20).
3. Slide the washer (4) against the exhaust rocker, and fit the E-ring (1) into the groove in the rocker shaft (2) (Figure 13-36, Page 13-20).
4. Install cylinder head assembly to engine.
5. Tighten the bolts down evenly by hand.
6. Using a torque wrench, tighten the six bolts in the sequence shown (Figure 13-37, Page 13-20).
7. Increase the torque in four increments of 50 in-lb (6 N·m) and then tighten to final torque of 220 in-lb (25 N·m). See following **CAUTION**.

CAUTION

- Do not turn any one bolt down completely before tightening the others. Doing so may cause the cylinder head to warp.

VALVE CLEARANCE CHECK AND ADJUSTMENT

No clearance check and no clearance adjustments are required. The FE350 and FE400 engines are equipped with hydraulic lifters that automatically eliminate all clearance in the valve train components.

BREATHER VALVE (REED VALVE)

General Information

The function of the breather is to create a vacuum in the crankcase that prevents oil from being forced out of the engine through the piston rings, oil seals or gaskets.

The breather has a reed valve which limits the direction of air flow caused by the piston moving up and down. Air can flow out of the crankcase, but the one-way reed valve blocks return flow. It thus maintains a vacuum in the crankcase.

Oil laden air in the crankcase passes through the reed valve and expands into the rocker chamber. In the rocker chamber most oil separates from the air and drains back to the crankcase. The air passes through a tube and vents to the intake manifold.

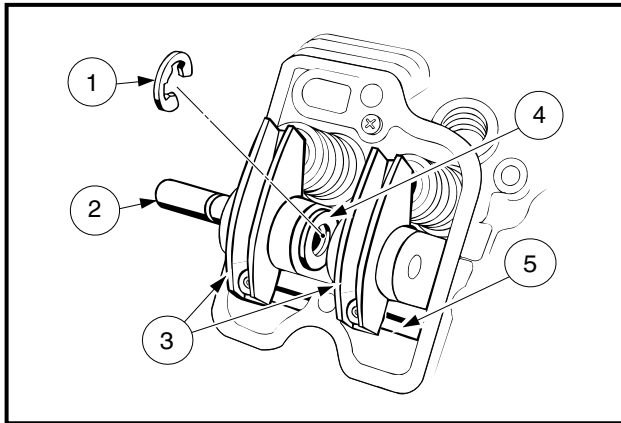


Figure 13-36 Cylinder Head Assembly

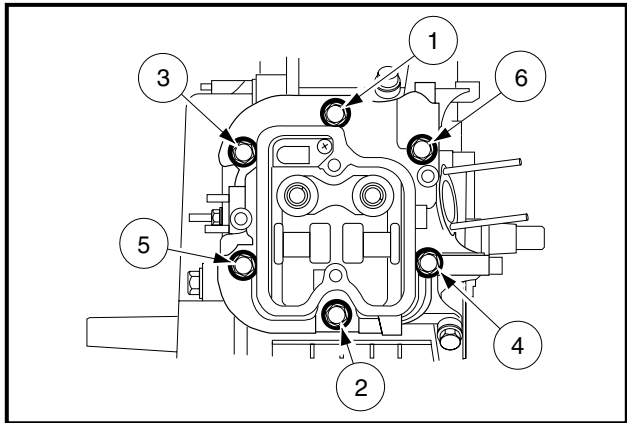


Figure 13-37 Cylinder Head Bolt Tightening Sequence

Breather Valve Inspection

1. Inspect the reed valve (1) for sticking or binding. Replace if necessary (**Figure 13-38, Page 13-20**).
2. Inspect the reed valve for hairline cracks, distortion or breakage. Replace if necessary.
3. Inspect the reed valve (1) seating surface. It must not have any nicks or burrs.

Breather Valve Installation

1. Installation is the reverse of removal. **See Breather Valve (Reed Valve) Removal on page 13-12.**

NOTE: Place the reed valve on the seat so there is a slight gap (2) 0.008 inch maximum (0.203 mm) between the valve and the seat (**Figure 13-38, Page 13-20**).

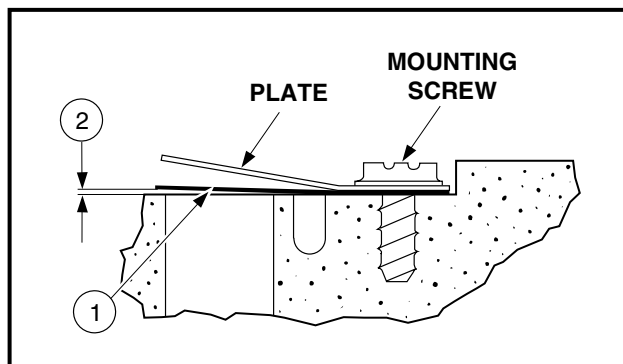


Figure 13-38 Reed Valve

INSTALLATION OF REMAINING ENGINE COMPONENTS

1. Install rocker cover.
2. Install lower, upper, and head shrouds (1) along with two-ended bolt (2) (**Figure 13-39, Page 13-21**).

NOTE: The shorter end of the two-ended bolt (2) goes through washer and upper shroud.

To prevent leaks, apply a light coat of clean engine oil to the O-ring seal (7) before installation. Care should be taken during installation to avoid cutting or nicking the o-ring seal (**Figure 13-39, Page 13-21**).

3. Install oil filler tube (6) and O-ring (7) into the large hole in the crankcase cover. Install the upper end of the oil filler tube (6) onto the two-ended bolt (2). Install flange nut (8) and tighten to 50 in-lb (5.7 N-m) (**Figure 13-39, Page 13-21**).
4. Connect the ground wire (3) to the two-ended bolt and install and tighten the nylon lock nut (4) to 50 in-lb (5.6 N-m). Insert the dip stick (5) (**Figure 13-39, Page 13-21**).
5. Connect muffler. **See Muffler Installation, Section 15, Page 15-3.**
6. Install carburetor (11), throttle spring (12) and the throttle spring bracket (13). Tighten to 50 in-lb (5.6 N-m) (**Figure 13-40, Page 13-21**).
7. Connect fuel lines. **See Fuel Tank Installation, Section 14, Page 14-30.** Tighten fuel line hose clamp at the carburetor to 9 in-lb (1.0 N-m) (**Figure 13-7, Page 13-9**).
8. Install the spark plug. Thread it in until finger tight, then tighten the plug to 20 ft-lb (27 N-m).

NOTE: Before installing the plug, check the condition of the threads in the cylinder head. Soften deposits in cylinder head threads with penetrating oil and clean the threads with a tap if necessary.

9. Install governor cable clevis pin (9) through cable clevis and throttle valve, and install a new cotter pin (10) (**Figure 13-40, Page 13-21**).
10. Apply a light film of clean engine oil onto the seal of the new oil filter and install the filter. Tighten the filter 2/3 turn after gasket contact. Fill crankcase with the correct level of oil (**Figure 13-107, Page 13-50 and Figure 13-108, Page 13-50**). **See Periodic Service Schedule, Section 10, Page 10-4.**
11. Run the engine for three minutes to check for leaking oil.

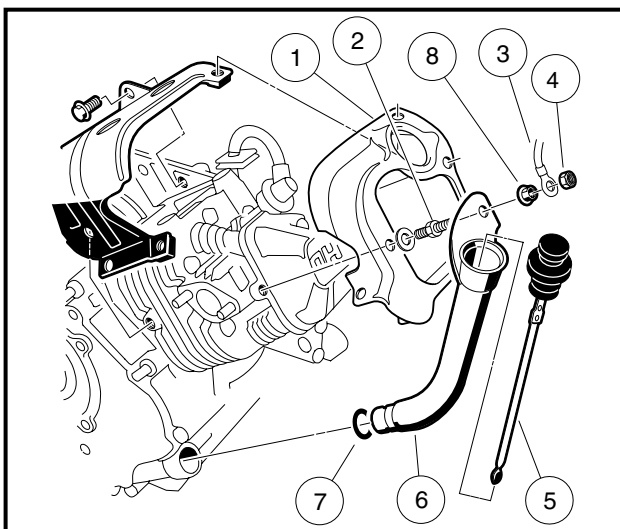


Figure 13-39 Oil Filler Tube and Ground Wire

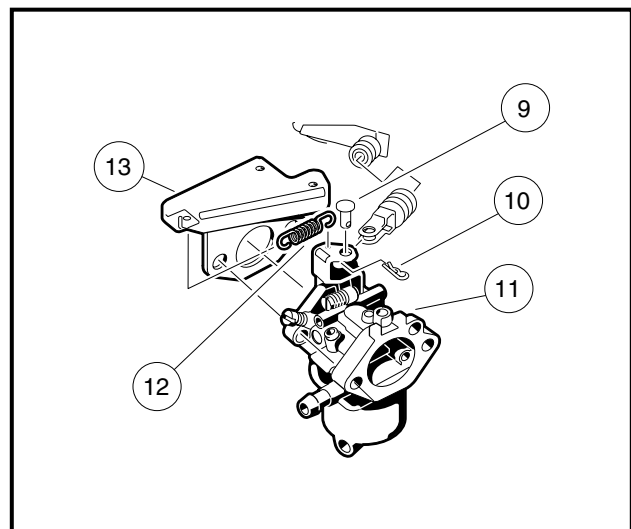


Figure 13-40 Governor Cable Connection

CRANKCASE

Read **DANGER** and **WARNING** on page 13-1.

ENGINE REMOVAL

To perform repairs on crankcase components, the engine must be removed from the vehicle.

⚠ CAUTION

- Before removal and disassembly, clean the engine.

1. Remove the powertrain. See **Unitized Transaxle Removal, Section 16a, Page 16a-9**. See following **NOTE**.

NOTE: The crankshaft has left-hand threads at the clutch mounting hole.

2. Remove starter/generator. See **Starter/Generator, Section 12b, Page 12b-2**.
3. Remove drive clutch. See **Drive Clutch, Section 17, Page 17-5**.
4. Remove muffler. See **Muffler, Section 15, Page 15-2**.
5. Remove engine mounting hardware (items 1, 2, 5 and 6) (**Figure 13-41, Page 13-23**).
6. Lift engine from the mounting plate.
7. Remove crankcase oil drain plug and filler tube. Tip the engine slightly to allow all of the oil to drain from the crankcase. Dispose of engine oil properly.

CRANKCASE COVER REMOVAL

1. Remove yellow jumper wire (11) from cord connector (12) (**Figure 13-43, Page 13-24**).
2. Remove nuts and clamps at two-ended bolts (1 and 2) (**Figure 13-42, Page 13-24**).
3. Remove eight bolts (3) and remove the crankcase cover (4) (**Figure 13-42, Page 13-24**). See following **NOTE**.

NOTE: If the crankcase cover sticks, tap lightly with a plastic mallet on alternate sides near the dowel pins (5) (**Figure 13-42, Page 13-24**).

4. Remove the crankcase cover gasket completely. It may stick to the flanged surface of the crankcase.

OIL LEVEL SENSOR

Testing the Oil Level Sensor

5. See **Ignition Coil – Bench Test, Section 11b, Page 11b-43**. Or see **Ignition Coil – Bench Test, Section 11a, Page 11a-43**.

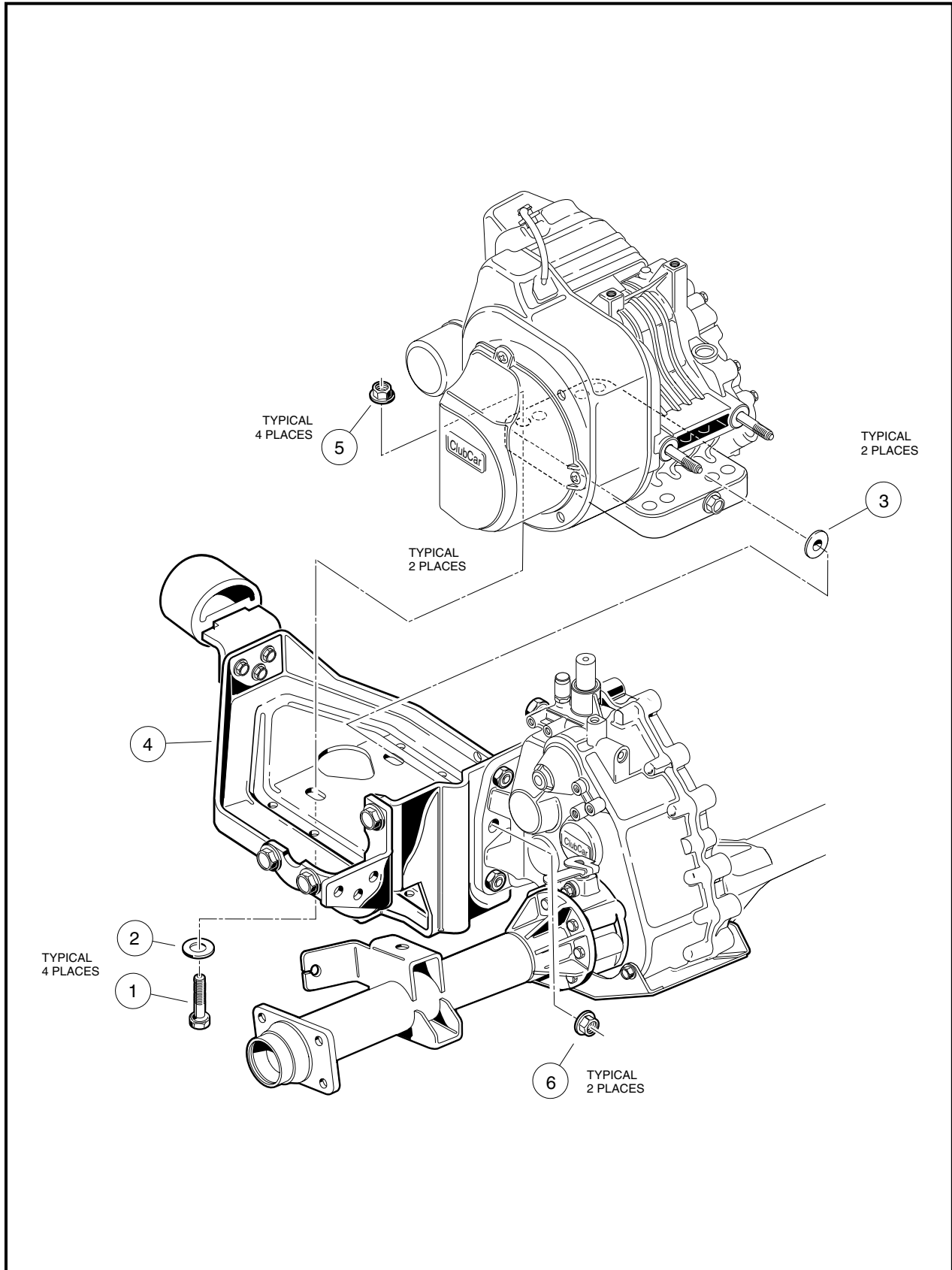


Figure 13-41 Engine Mounting Plate - with MC012C-AS00 Transaxle

Oil Level Sensor Removal

1. If not already removed, remove crankcase cover. **See Crankcase Cover Removal on page 13-22.**
2. Disconnect the oil level sensor wire (2) from the cord connection (1) (**Figure 13-44, Page 13-24**).
3. Remove the two mounting screws (8) from inside of the crankcase cover and remove the oil level sensor and bracket.

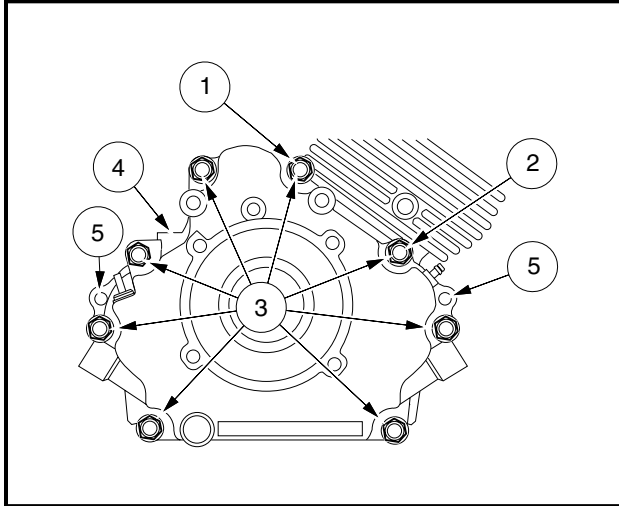


Figure 13-42 Crankcase Cover

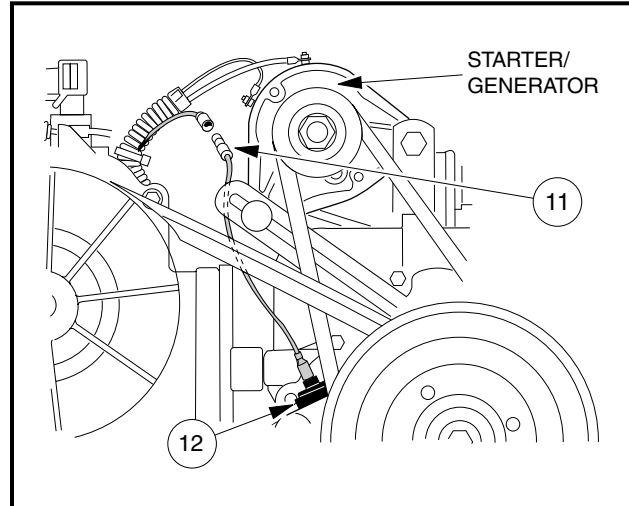


Figure 13-43 Oil Level Sensor Wire

Oil Level Sensor Installation

1. If the oil level sensor was removed from the bracket, install sensor (6) into bracket (5) and secure with three screws (7) and tighten to 17 in-lb (1.9 N·m) (**Figure 13-44, Page 13-24**).
2. Position the sensor and bracket on inside of crankcase and install two mounting screws (8).
3. Connect sensor wire (2) to cord connector (1) (**Figure 13-44, Page 13-24**).
4. Install screw (3) through wire clamp and into crankcase cover. Tighten to 30 in-lb (3.4 N·m).

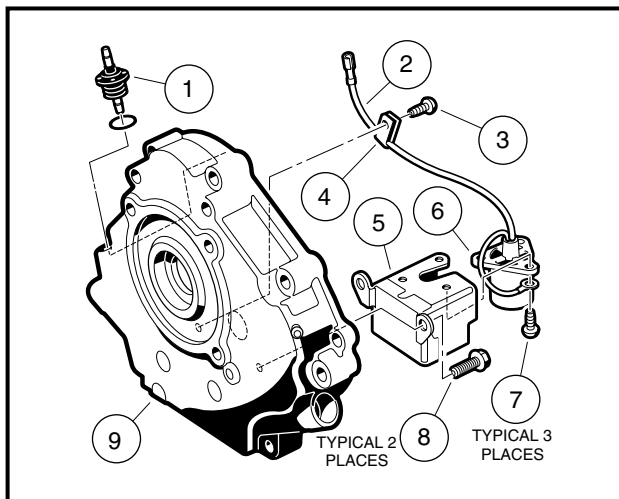


Figure 13-44 Oil Level Sensor

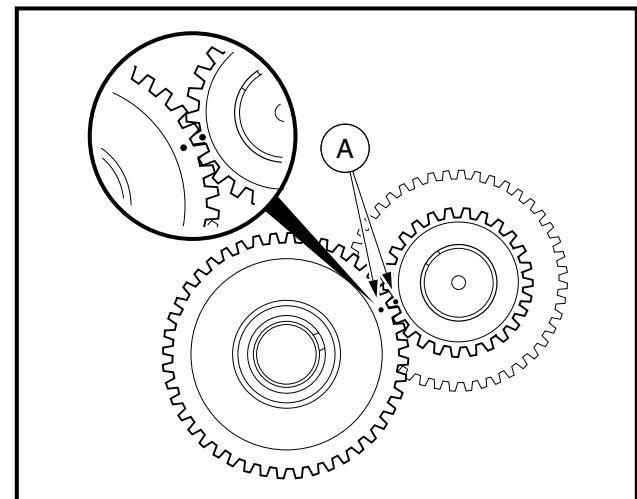


Figure 13-45 Timing Mark Alignment

CAMSHAFT AND HYDRAULIC LIFTERS

Camshaft and Hydraulic Lifter Removal

1. Keep the timing marks (A) aligned during removal (**Figure 13-45, Page 13-24**).
2. With cylinder head removed, pull the hydraulic lifters out of their bores to the top of the cylinder. **See Cylinder Head Removal on page 13-10. See following CAUTION.**
3. Take the camshaft out of the engine block.

⚠ CAUTION

- Do not depress the socket (1) (**Figure 13-46, Page 13-25**). This will cause the engine oil to leak out of the high pressure chamber during storage. Keep the hydraulic lifters upright to prevent the engine oil from spilling out of the lifters during storage.
- Do not attempt to disassemble a hydraulic lifter because the engine oil will drain out of the high pressure chamber in the lifter.

Camshaft and Hydraulic Lifter Inspection

If the engine typically remains noisy for two minutes after it starts, the hydraulic lifter might be worn between the plunger (2) and the body (3). Proceed with the following to check the hydraulic lifter for wear (**Figure 13-46, Page 13-25**).

1. Put the hydraulic lifter vertically on a measuring stand to measure leak-down distance.
2. Push the socket (1) down and measure the distance that it sinks (**Figure 13-46, Page 13-25**).
3. If the distance exceeds 0.0197 inch (0.5 mm), replace both hydraulic lifters as a set.
4. Inspect the camshaft for wear or broken gear teeth.
5. Measure the camshaft journals and cam lobes with a micrometer at the points shown (**Figure 13-47, Page 13-25 and Figure 13-48, Page 13-26**).
6. If the camshaft journal diameter is less than 0.9026 inch (22.927 mm) at either end of the shaft, replace the camshaft.
7. If the lobe height is less than 1.3086 inches (33.24 mm) for either lobe, replace the camshaft.

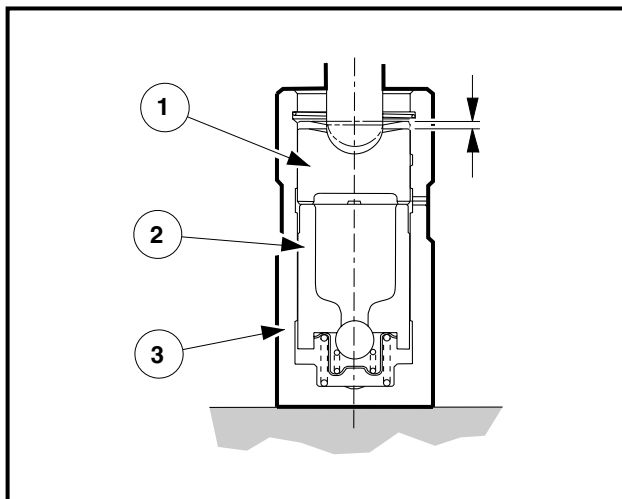


Figure 13-46 Inspect for Hydraulic Lifter Wear

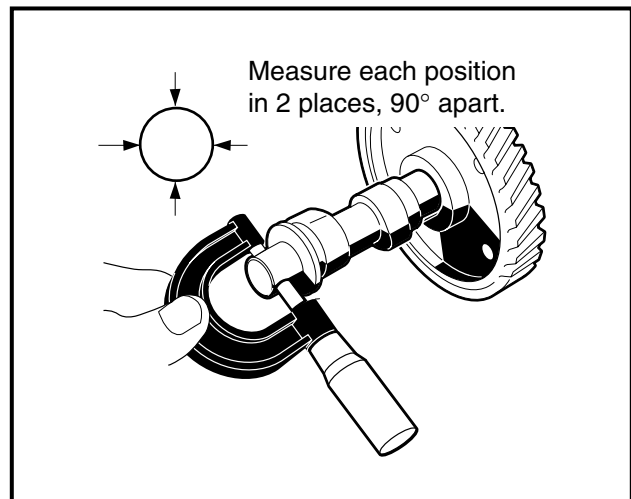


Figure 13-47 Measure O.D. of Camshaft Journals

Camshaft and Hydraulic Lifters, Continued:**8. Key-Start Engines:**

- 8.1. Check the automatic compression release valve (ACR) arms to make sure they move freely and are not binding. Clean the arms if needed. Make sure the take-up spring is properly installed. Replace the spring if it is broken. If the arms are damaged, the camshaft assembly must be replaced.

Automatic Compression Release Valve (ACR) Inspection

- **Pedal-Start Engines:** FE350 engines on pedal-start vehicles do not have automatic compression release valves (ACR).
- **Key-Start Engines:** FE350 and FE400 engines have an automatic compression release valve (ACR) that is activated during the starting procedure (**Figure 13-49, Page 13-26**). As the engine is cranked at a normal 550 to 600 RPM, the ACR opens and reduces compression in the cylinder, allowing the starter to turn the engine with a minimal amount of starter energy, and helping to reduce starter/generator brush wear. A tapping noise will be heard while the ACR is in an open condition. It is normal for the ACR to click, or tap, during normal cranking RPM. When the engine starts and accelerates to 700 RPM, the ACR will close, the tapping noise will stop, and full compression will be reached. After the engine starts, it will idle at 1150 to 1200 RPM.

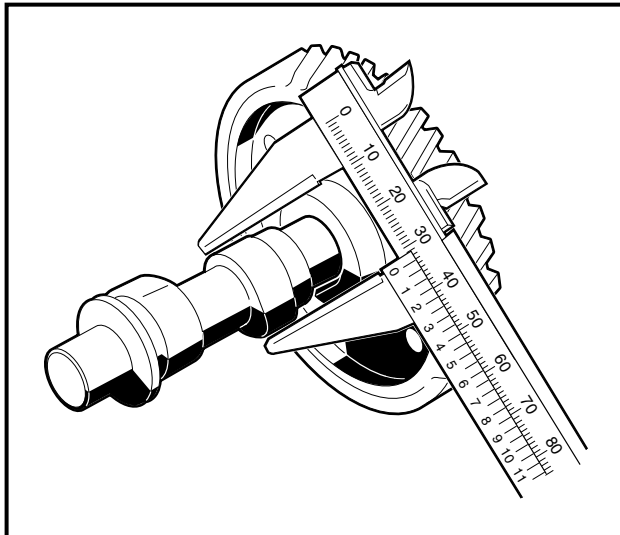


Figure 13-48 Measure O.D. of Camlobes

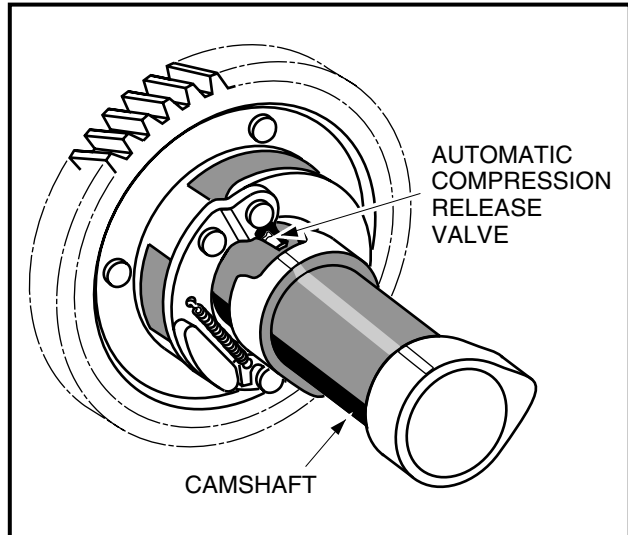


Figure 13-49 ACR Valve Inspection

If the ACR fails to hold the valve open during the cranking function, the engine will have too much compression and may not turn over when the starter is activated. If, after the engine starts and reaches 700 RPM, the ACR fails to allow the exhaust valve to close, the engine will not reach required running compression, and will not have complete acceleration power. The return spring on the ACR is the only serviceable part. The ACR is a component part of the camshaft assembly and if the ACR fails, the camshaft assembly must be replaced.

PISTON AND CONNECTING ROD

Read DANGER and WARNING on page 13-1.

NOTE: The connecting rod and cap must stay together as a set. Do not mix with parts from any other engine.

Piston and Connecting Rod Removal

1. Turn crankshaft to expose the two connecting rod cap bolts (1) (**Figure 13-50, Page 13-27**).
2. Loosen the cap bolts and take them out together with the connecting rod cap (2).
3. With cylinder head removed, push the piston/connecting rod assembly out of the cylinder.

Piston and Connecting Rod Separation

1. Remove two retaining rings holding the piston pin in place.
2. Remove the piston pin.

Piston Inspection and Repair

1. Remove all deposits from the piston.
2. Clean the carbon from the piston ring grooves. **See following CAUTION.**

⚠ CAUTION

- **Never clean the piston head with the engine assembled. Carbon particles will fall between the piston and cylinder wall and may cause severe cylinder wear.**

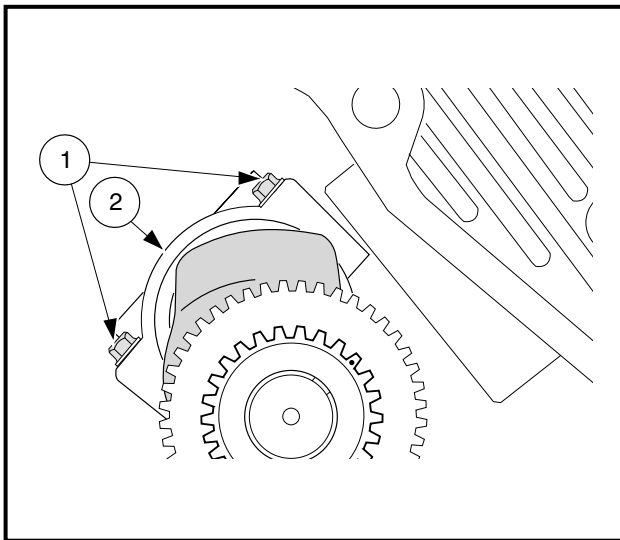


Figure 13-50 Connecting Rod Cap Bolts

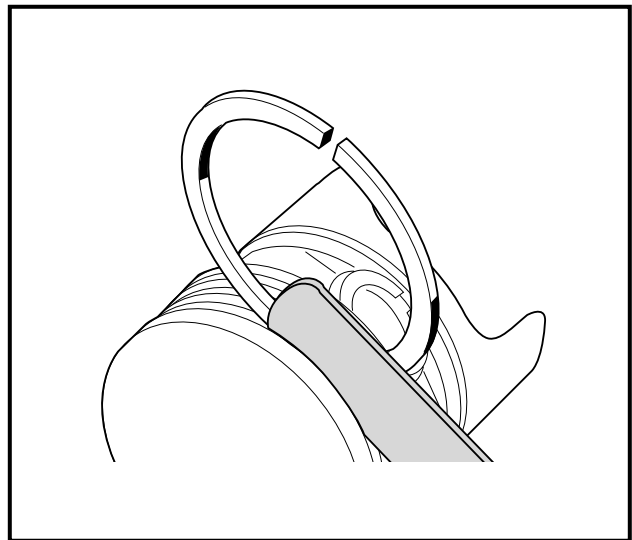


Figure 13-51 Measure Piston Ring and Groove Clearance

3. Be sure the oil return passages in the ring grooves are open.
4. Visually inspect the piston rings and ring grooves for uneven wear or damage. Replace the piston and/or piston rings if uneven wear or damage is present or if they exceed the wear limits.
5. Using a new piston ring and a feeler gauge, measure the clearance between the grooves and ring at several points around the grooves (**Figure 13-51, Page 13-27**).
6. If the top groove has a clearance greater than 0.0063 inch (0.16 mm), replace the piston.
7. If the second groove has a clearance greater than 0.0055 inch (0.14 mm), replace the piston.
8. The oil ring is made of three pieces: upper and lower rails and expander. It is difficult to measure the ring groove clearance and thickness. Inspect visually for wear or damage.

Piston Ring Inspection

1. Insert the ring squarely into the cylinder bore to a point approximately 1 inch (25 mm) down from the top of the cylinder. **See following NOTE.**

NOTE: Use the top of the piston to push the ring into the bore to be sure it is square.

2. Using a feeler gauge, measure the ring end-gap (**Figure 13-52, Page 13-28**).
3. If the end-gap of any ring is greater than 0.0472 inch (1.199 mm), replace the entire set of rings.
4. Using a micrometer, measure the thickness of both piston rings at several points around the rings (**Figure 13-53, Page 13-28**).
5. If either ring thickness is less than 0.0566 inch (1.438 mm), replace the the entire set of rings.

NOTE: It is difficult to measure exactly the oil ring thickness. Replace the oil ring whenever the compression rings (top and second) are replaced.

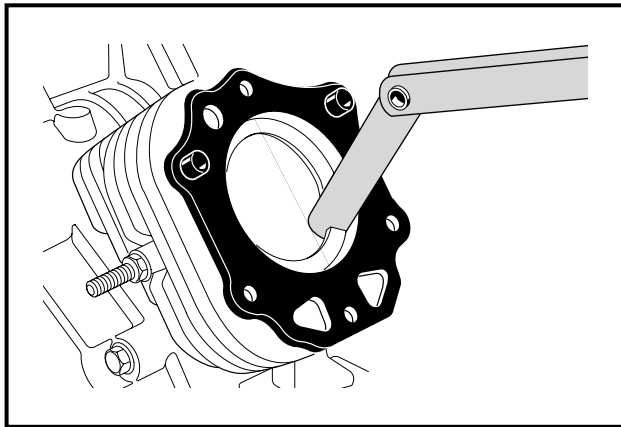


Figure 13-52 Measure Ring End-Gap

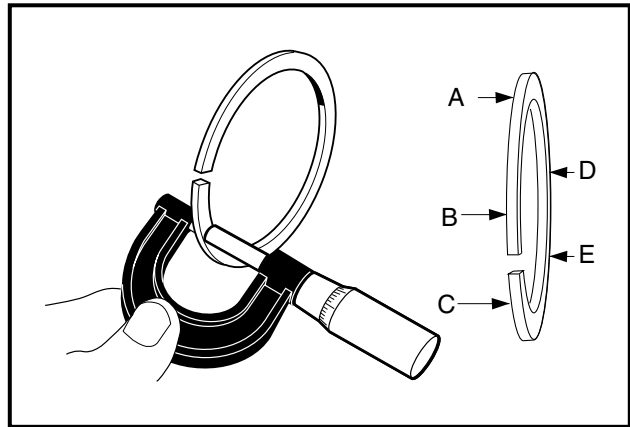


Figure 13-53 Measure Piston Ring Thickness

Piston Pin Inspection

1. Using a micrometer, measure the outside diameter of the piston pin at several points along its length (**Figure 13-54, Page 13-29**).
2. If the pin diameter is smaller than 0.7864 inch (19.975 mm), replace the piston pin.
3. Using an inside micrometer or telescoping gauge, measure the inside diameter of the piston pin hole in the piston at several points (**Figure 13-55, Page 13-29**).
4. If the inside diameter exceeds 0.7887 inch (20.033 mm), replace the piston.

Connecting Rod Inspection

1. Clean and inspect the bearing surfaces of the connecting rod and cap. Replace parts if scored.
2. Using a telescoping gauge, measure the inside diameter of the connecting rod small bore at several points along its length (**Figure 13-56, Page 13-29**).
3. If the inside diameter exceeds 0.7887 inch (20.033 mm), replace the connecting rod.
4. Remount the connecting rod cap to the connecting rod at the large bore end, aligning the pilot groove on the rod. Screw in the connecting rod bolts and tighten them to 16.5 ft-lb (23 N·m).
5. Using a telescoping gauge or an inside micrometer, measure the inside diameter of the large bore at several points along its length (**Figure 13-57, Page 13-29**).

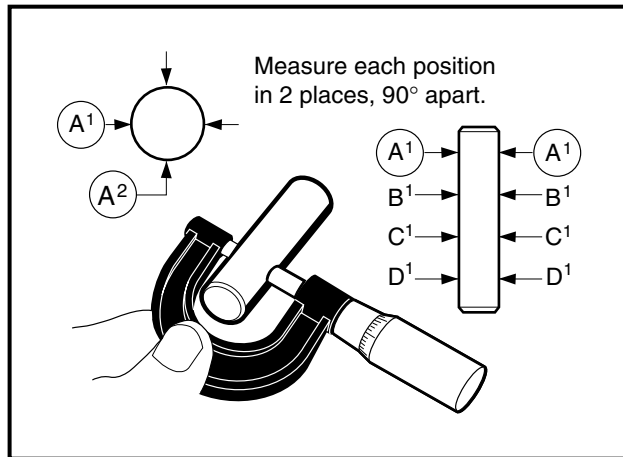


Figure 13-54 Measure Piston Pin O.D.

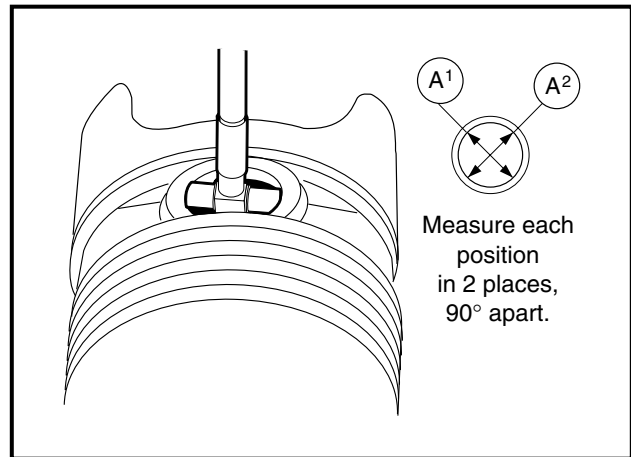


Figure 13-55 Measure Piston Pin Hole I.D.

6. If the inside diameter exceeds 1.479 inches (37.567 mm), replace the connecting rod. **See following NOTE.**

NOTE: If the connecting rod is bent or twisted, it must be replaced.

The connecting rod and cap must stay together as a set. Do not mix with parts from any other engine.

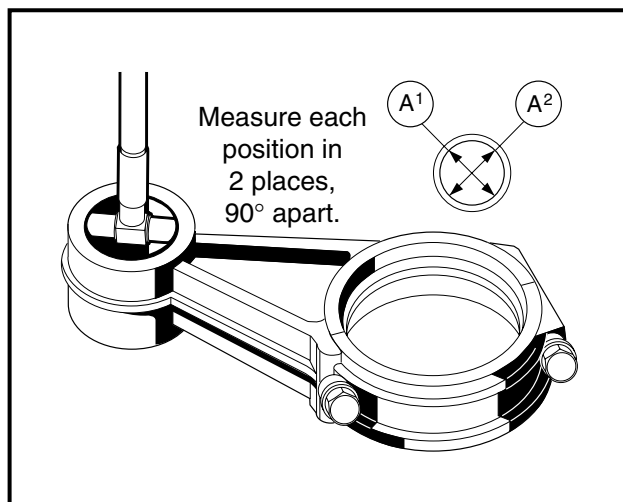


Figure 13-56 Measure Connecting Rod Small Bore I.D.

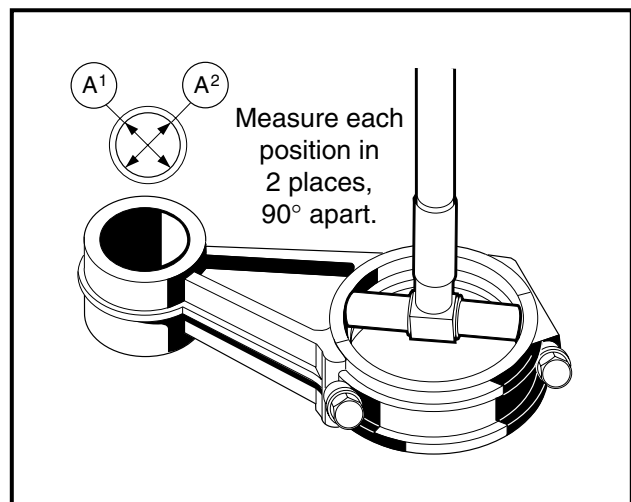


Figure 13-57 Measure Connecting Rod Large Bore I.D.

CYLINDER BLOCK

Read **DANGER** and **WARNING** on page 13-1.

While the engine is disassembled, inspect the cylinder block for cracks, stripped bolt holes, broken fins, or cylinder wall scoring. Repair or replace as necessary.

1. Use an inside micrometer or telescoping gauge, together with a micrometer, to measure the cylinder bore.

Cylinder Block, Continued:

2. Make the first measurement parallel with the crankshaft and the second at right angles to the crankshaft at three different locations in the bore. The first measurement location is 0.4 inch (10 mm) from the top of the cylinder. The second location is in the center or 2.4 inches (60 mm) from the top, and the third location is 0.3 inch (8 mm) from the bottom of the cylinder or bottom of ring travel. **See locations 1, 2, and 3 (Figure 13-58, Page 13-30).**
3. Engine Bore Dimensions:
 - 3.1. **FE350**
 - 3.1.1. The standard bore diameter is 3.2669 - 3.2677 inches (82.980 - 83.000 mm).
 - 3.1.2. The maximum cylinder bore diameter wear limit is 3.2703 inches (83.067 mm).
 - 3.1.3. The maximum acceptable out of round cylinder bore is 0.022 inches (0.56 mm).
 - 3.2. **FE400**
 - 3.2.1. The standard bore diameter is 3.4278 inches (87.067 mm).
 - 3.2.2. The maximum cylinder bore diameter wear limit is 3.4278 inches (87.067 mm).
 - 3.2.3. The maximum acceptable out of round cylinder bore is 0.022 inches (0.56 mm).
4. If the cylinder bore is not within these measurements, the cylinder bore will need to be resized where applicable.

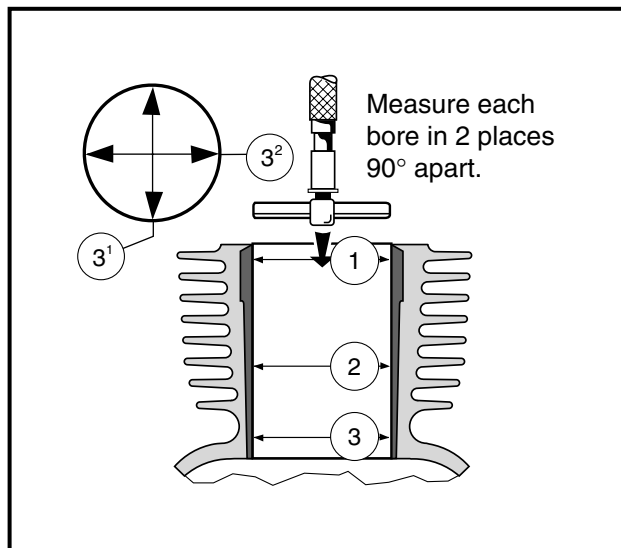


Figure 13-58 Measure Cylinder Bore

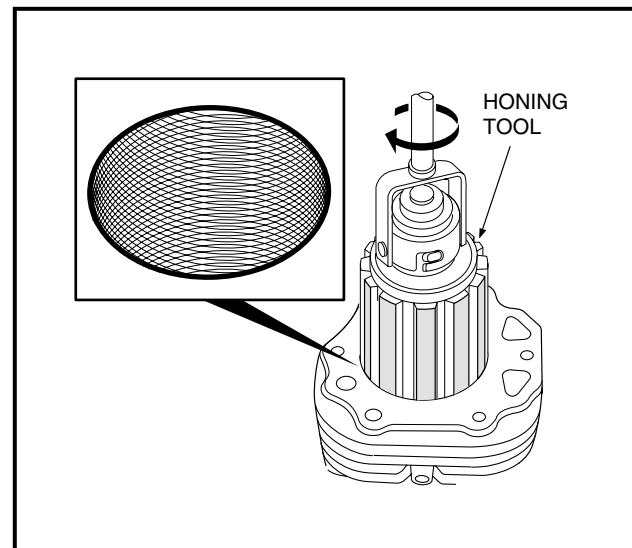


Figure 13-59 Hone Cylinder

To Resize Bore to Next Oversize

Always resize the bore to exactly 0.020 inches (0.50 mm) over standard size.

1. The bore size 0.020 inches over standard size is 3.2858 - 3.2866 inches (83.460 - 83.480 mm). **See Specifications for Resizing Cylinder Bore on page 13-52.**

NOTE: Allow for shrinkage (from the final size) of 0.0003 - 0.0004 inches (0.0007 - 0.0009 mm), which will occur when the cylinder cools down.

2. Hone the cylinder to the final bore diameter of 3.2866 - 3.2874 inches (83.480 - 83.500 mm). **See Specifications for Resizing Cylinder Bore on page 13-52. See following NOTE.**

NOTE: Important: The cylinder wall finish should have a 40° to 60° cross-hatch pattern (**Figure 13-59, Page 13-30**).

Do not use solvents or gasoline to clean cylinder after honing. Solvents and gasoline allow the grindings to remain in the honed surface and will not provide a surface suited for ring seating.

3. After honing, clean the cylinder wall thoroughly using soap, warm water and clean rags.
4. Dry the cylinder and coat with engine oil. **See following CAUTION.**

⚠ CAUTION

- The cylinder must be thoroughly cleaned after honing to eliminate all grit.

IGNITION COIL AND FLYWHEEL

Read **DANGER** and **WARNING** on page 13-1.

Ignition Coil and Flywheel Removal

1. Loosen three screws and remove the remaining four screws attaching the flywheel housing as shown, then remove the housing (**Figure 13-60, Page 13-32**).
2. Disconnect the ignition coil (1) from its primary lead wire at the connector (2). Remove the two bolts (3) and take out the ignition coil (**Figure 13-61, Page 13-32**).
3. Hold the flywheel (4), not the fan (7), with a strap wrench (5) and, using a 25 mm socket, remove the flywheel nut (and flat washer) by turning it counterclockwise (**Figure 13-60, Page 13-32**). **See following CAUTION.**

⚠ CAUTION

- The flywheel nut has right-hand threads. Turn it clockwise to tighten, or counterclockwise to loosen.
 - Do not damage the fan blades with the strap wrench. Do not place screwdriver or pry bar in the fan blades.
4. Remove the flywheel with a puller.
 5. Remove the flywheel key from its groove.

Flywheel Installation

See Engine Assembly on page 13-49.

Ignition Coil Inspection and Repair

See Test Procedures, Section 11b, Page 11b-23.

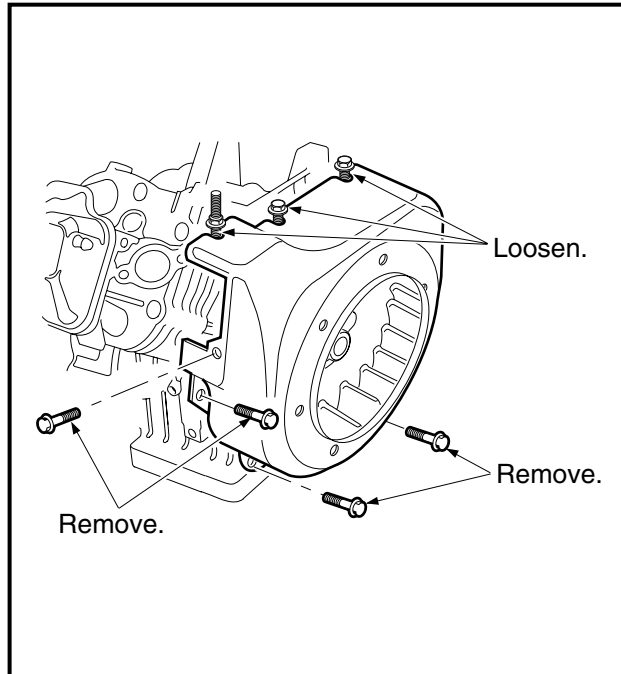


Figure 13-60 Flywheel Housing

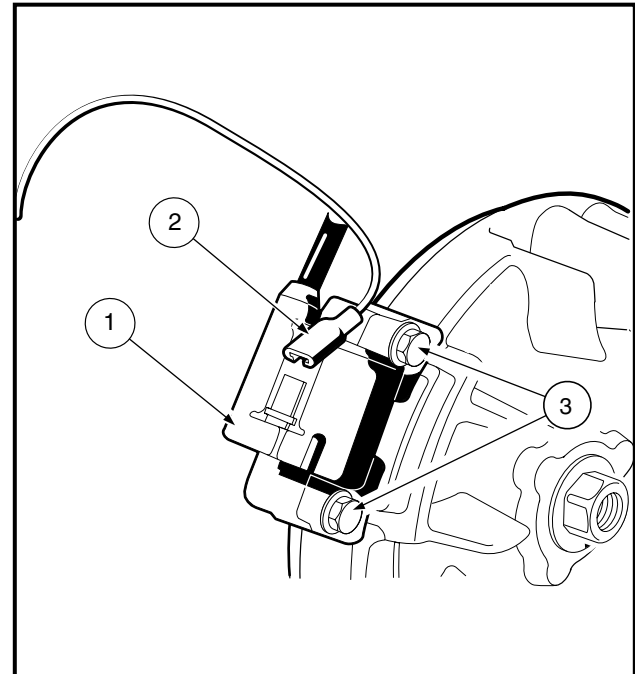


Figure 13-61 Ignition Coil

Ignition Coil Installation

1. Installation is the reverse of removal.
2. While tightening the two bolts (3), use a bronze feeler gauge to adjust the ignition coil air gap to 0.012 inch (0.304 mm) (**Figure 13-63, Page 13-32**).
3. Tighten the two ignition coil bolts to 30 in-lb (3.4 N·m).

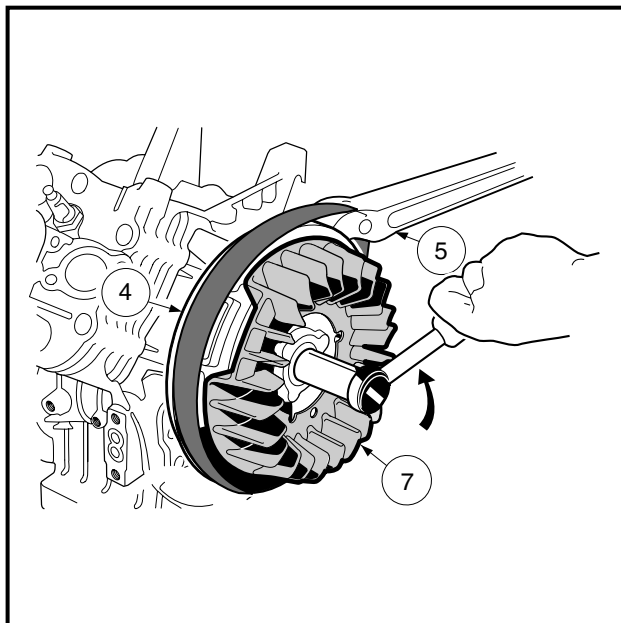


Figure 13-62 Flywheel Nut Removal

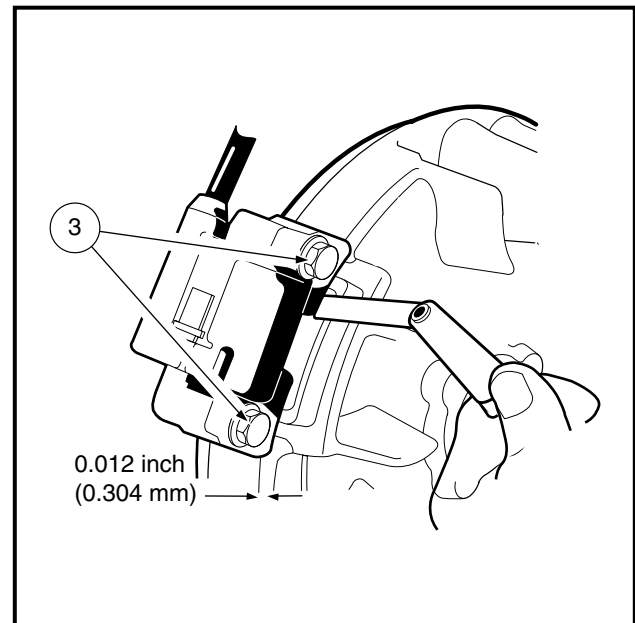


Figure 13-63 Adjust Ignition Coil Air Gap

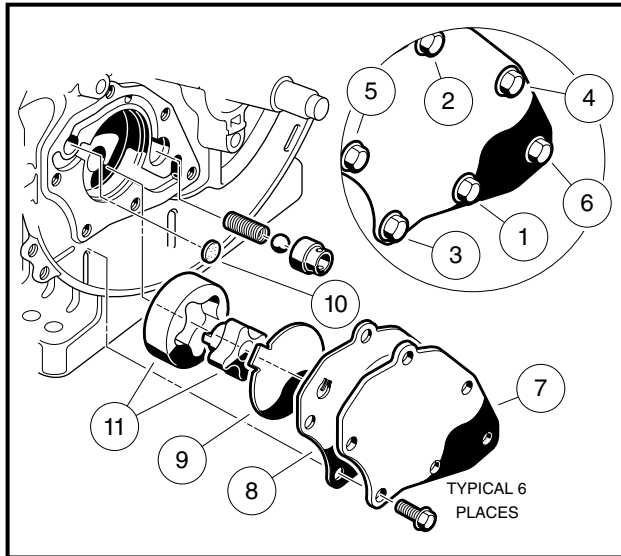


Figure 13-64 Oil Pump Removal

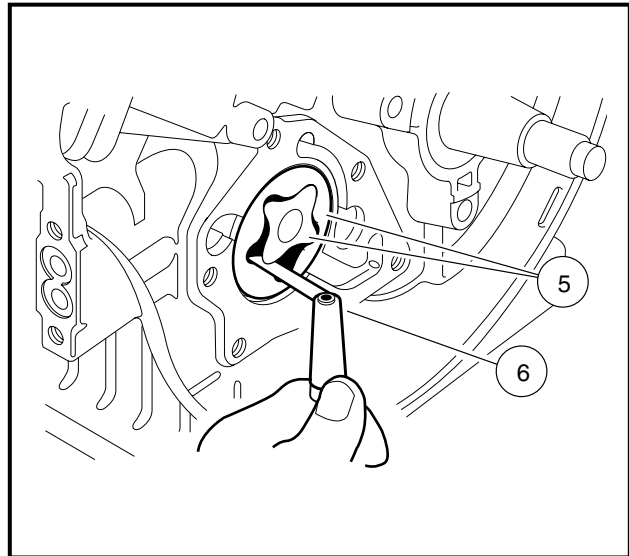


Figure 13-65 Measure Rotor Clearance

OIL PUMP

Read **DANGER** and **WARNING** on page 13-1.

Oil Pump Cover Removal

1. Remove the six screws (1-6) and remove the oil pump cover (7) (**Figure 13-64, Page 13-33**).
2. Peel off the oil pump cover gasket (8).
3. Remove the pump gear cover plate (9) and filter screen (10).

Oil Pump Inspection

1. Check the clearance between the inner and outer rotors (5) with a feeler gauge (6). Measure the clearance between the high point of the inner rotor and the high point of the outer rotor (**Figure 13-65, Page 13-33**).
2. Replace both rotors as a set if the measurement exceeds 0.012 inch (0.3 mm).
3. Remove inner and outer rotors (11) (**Figure 13-64, Page 13-33**).
4. Inspect the inner and outer oil pump rotors. If the rotors are worn or damaged, replace them.
 - 4.1. Measure the pump shaft bearing surface. Replace both rotors as a set if the measurement is less than 0.4971 inch (12.627 mm) (**Figure 13-66, Page 13-34**).
 - 4.2. Using a micrometer, measure the diameter of the outer rotor at several points (**Figure 13-67, Page 13-34**).
 - 4.3. If the rotor diameter is less than 1.5923 inches (40.467 mm), replace both rotors.
 - 4.4. Using a micrometer, measure the thickness of the outer rotor at several points (**Figure 13-68, Page 13-34**).
 - 4.5. If the rotor thickness is less than 0.3905 inch (9.920 mm), replace both rotors.

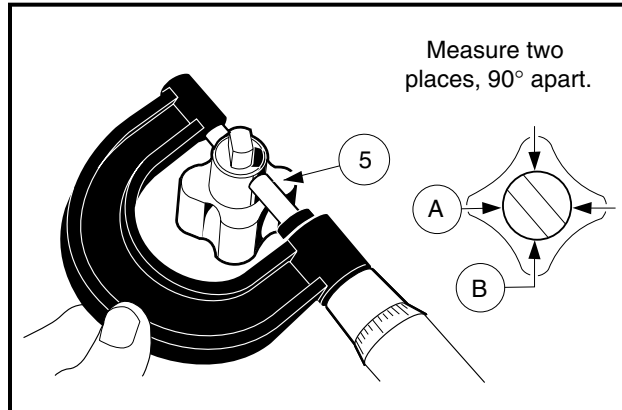


Figure 13-66 Measure Pump Shaft Bearing Surface

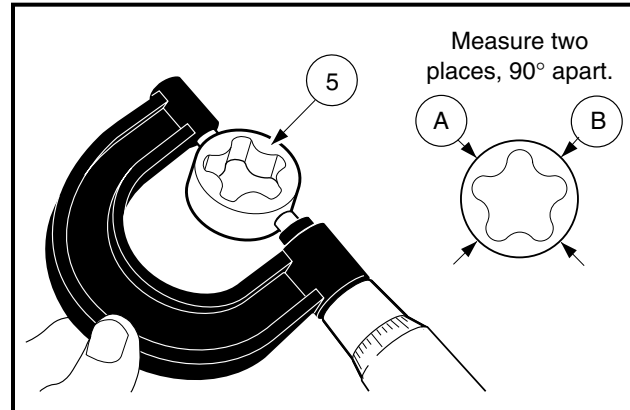


Figure 13-67 Measure Outer Rotor O.D.

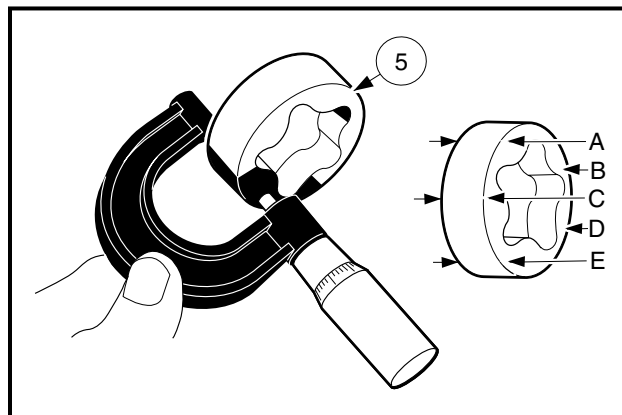


Figure 13-68 Measure Outer Rotor Thickness

OIL PRESSURE RELIEF VALVE

Oil Pressure Relief Valve Removal

1. Remove the oil pump cover. **See Oil Pump Cover Removal on page 13-33.**
2. Remove the valve seat (1), ball (2) and spring (3) (**Figure 13-69, Page 13-35**).

Oil Pressure Relief Valve Inspection

1. Note the condition of the ball (2) and the valve seat (1). They must not have any nicks or burrs. Replace if necessary (**Figure 13-69, Page 13-35**).
2. Inspect the relief valve spring (3) for pitting, cracks, rusting and burrs. Replace if necessary.
3. Measure free length of the spring (3) with a vernier caliper (**Figure 13-70, Page 13-35**). If the free length of the relief valve spring is less than 0.748 inches (19.00 mm), replace the spring.

Oil Pressure Relief Valve Installation

1. Installation is the reverse of removal. If necessary, put the ball in position and lightly tap with a plastic hammer to form a perfect seat.

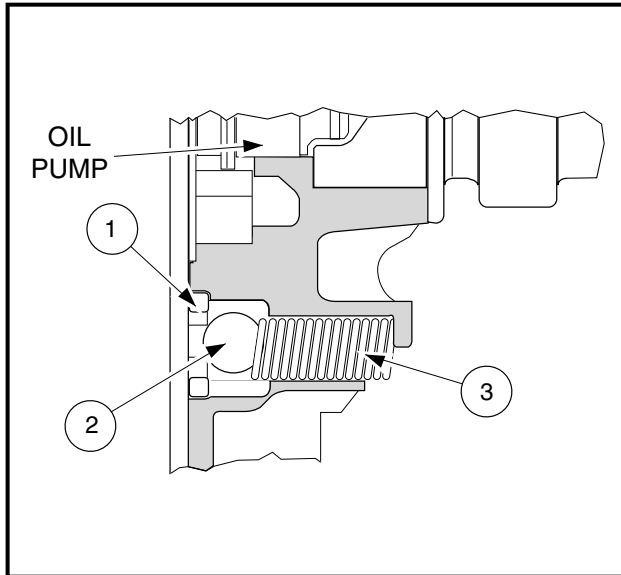


Figure 13-69 Oil Pressure Relief Valve

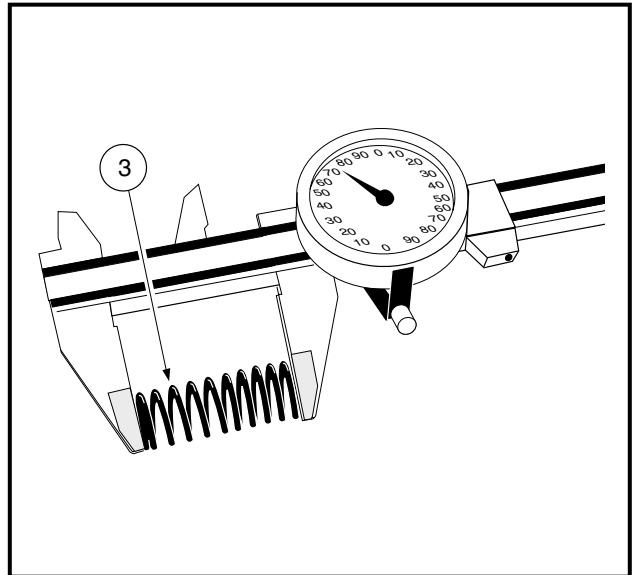


Figure 13-70 Measure Free Length of Spring

Oil Pump Installation

▲ CAUTION

- Do not allow any dust or other foreign matter into the oil pump.

1. Installation is the reverse of removal.
2. Install the inner rotor with its tang in the slot in the end of the camshaft (**Figure 13-71, Page 13-35**).
3. Install six bolts (1-6) and finger-tighten. Then tighten to 7 ft-lb (9.5 N-m) in the sequence shown (**Figure 13-64, Page 13-33**). After tightening bolts, check the torque of the first bolt.

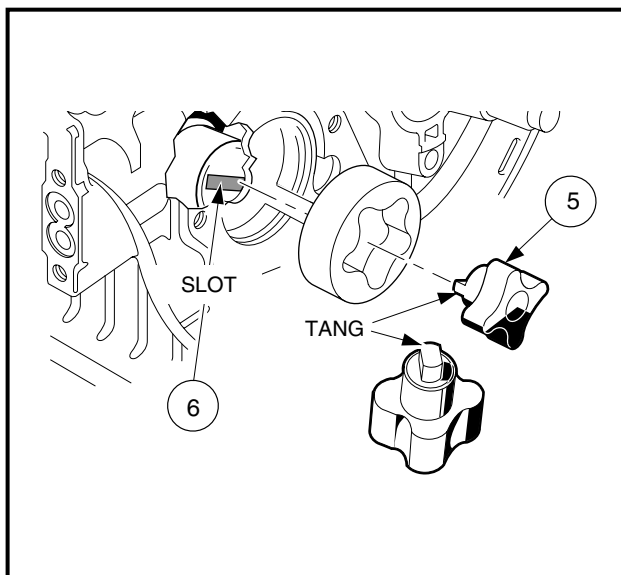


Figure 13-71 Install Inner Rotor

CRANKSHAFT AND COUNTERBALANCE

Read **DANGER** and **WARNING** on page 13-1.

Crankshaft and Counterbalance Removal

1. Remove the four nuts (1) and pull out the counterbalance guide shaft (2) and the O-ring (3) (**Figure 13-72, Page 13-36**).
2. Pull out the crankshaft and the counterbalance together as an assembly (**Figure 13-73, Page 13-36**).

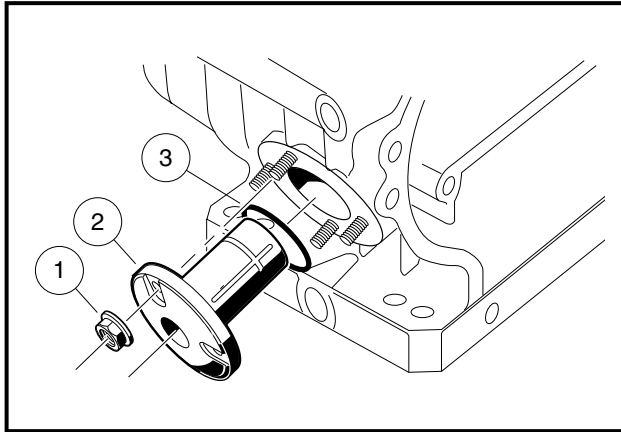


Figure 13-72 Counterbalance Guide Shaft and O-Ring Removal

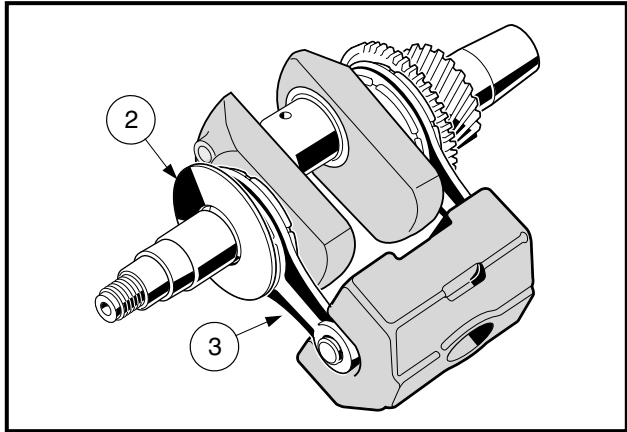


Figure 13-73 Crankshaft and Counterbalance

Crankshaft and Counterbalance Disassembly

1. Slide the spacer (2) and the link rod (3) off the flywheel end of the crankshaft. Remove the counterbalance from the remaining link rod (**Figure 13-73, Page 13-36**). **Go to Link Rod Inspection on page 13-37.**
2. If the link rods need replacing, place the gear yoke (CCI P/N 1016418) under the spur gear with the small end of the connecting rod located opposite the crankpin (**Figure 13-74, Page 13-37**).
3. Position the gear yoke with the side blocks positioned as close to the crankshaft as possible (**Figure 13-75, Page 13-37**).
4. Using a press, push on the end of the crankshaft to pull the spur gear and the helical gear off the crankshaft (**Figure 13-75, Page 13-37**). **See following WARNING and CAUTION.**

⚠ WARNING

- Support the crankshaft while pressing. This will prevent the crankshaft from dropping to the floor after the gear has been removed.

⚠ CAUTION

- Always use a press when removing the spur gear and helical gear from, or installing them on the crankshaft.

5. Remove the woodruff key.
6. Slide the remaining link rod off the crankshaft.

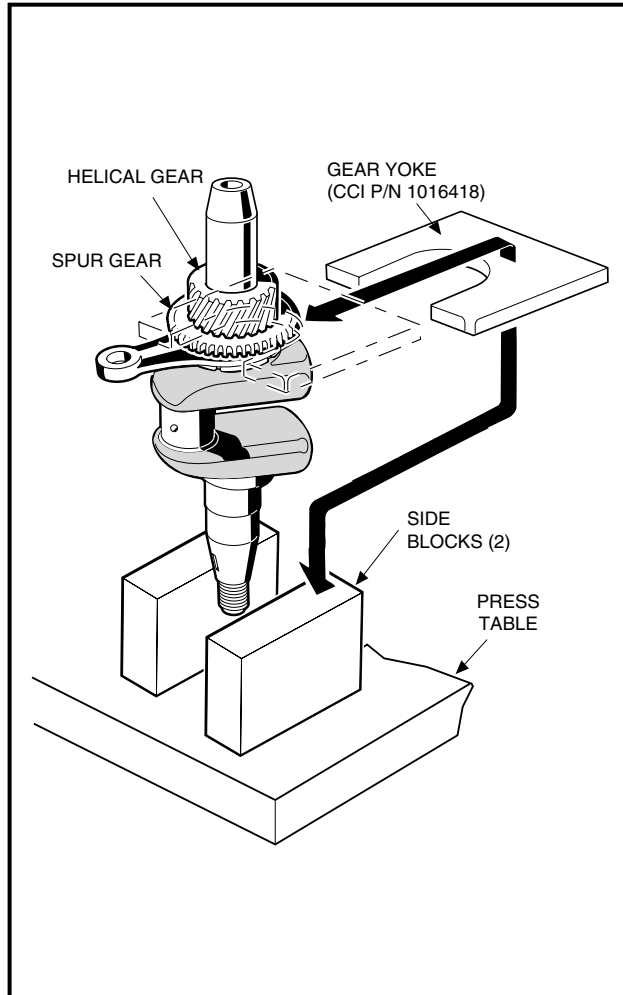


Figure 13-74 Place Assembly in Press

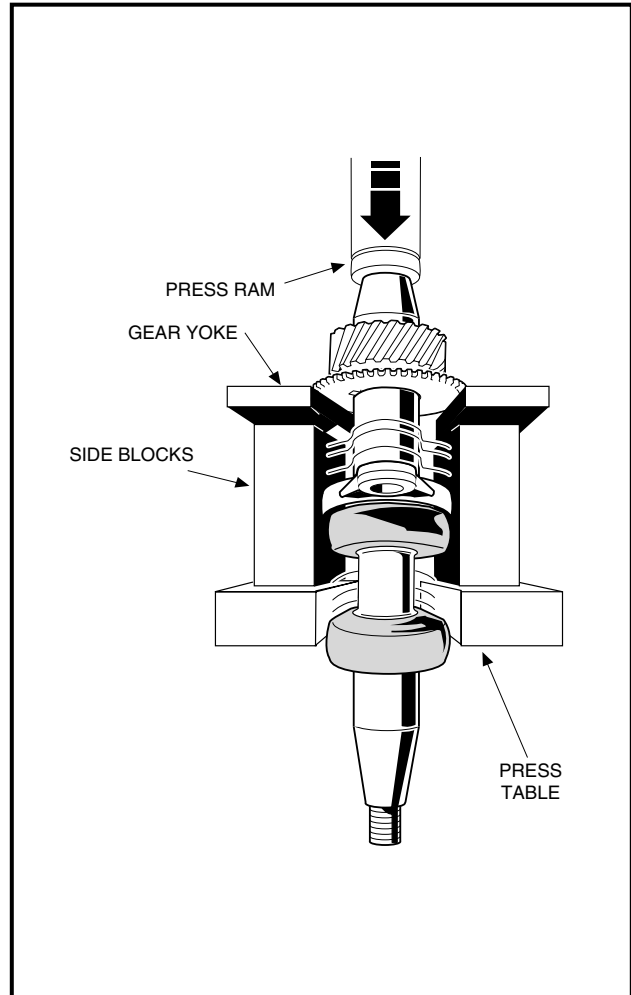


Figure 13-75 Remove Helical and Spur Gears

Link Rod Inspection

1. Clean and inspect the link rod (1) bearing surfaces. If the bearing surface of the small end is scored or damaged, replace the link rod. If the large end bearing is scored or damaged, the link rod must be replaced (**Figure 13-77, Page 13-38 and Figure 13-78, Page 13-38**).
 - 1.1. Using a telescoping gauge and micrometer, measure both inside bearing surfaces at several points.
 - 1.2. If the inside diameter of the small end is greater than 0.4746 inch (12.057 mm), replace the link rod (**Figure 13-77, Page 13-38**).
 - 1.3. If the inside diameter of the large end is greater than 1.9726 inches (50.106 mm), replace the link rod (**Figure 13-78, Page 13-38**). See following NOTE.

NOTE: Do not remove the link rod on the PTO (power take-off) side unless link rod on the opposite end needs replacement. The crank-gear is very tightly fitted to the crankshaft so that it can transfer engine torque to the camshaft (which also functions as a PTO shaft) (**Figure 13-76, Page 13-38**). Ignore Crankshaft and Counterbalance Disassembly (steps 2 through 6, page 13-36), if the link rod opposite of the PTO side passes inspection (**Figure 13-76, Page 13-38**).

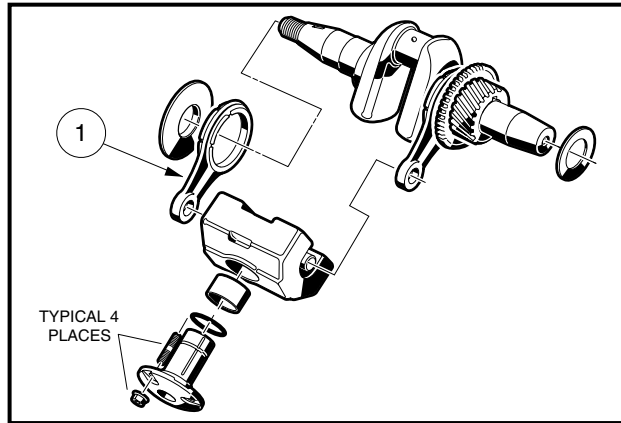


Figure 13-76 Inspect Link Rod

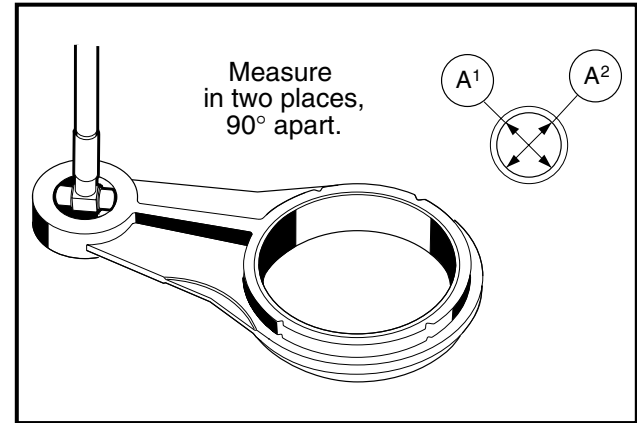


Figure 13-77 Measure Link Rod Small Bore I.D.

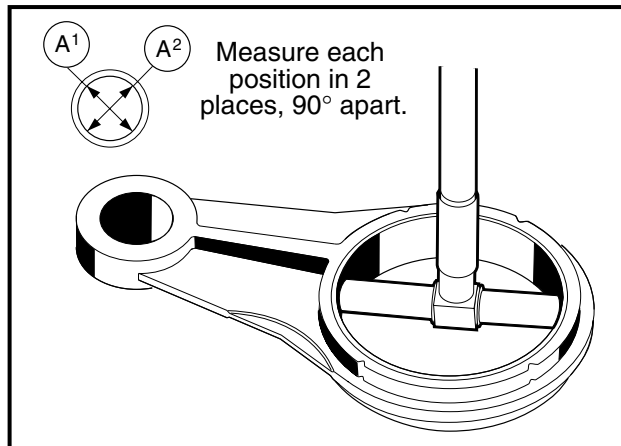


Figure 13-78 Measure Link Rod Large Bore I.D.

COUNTERBALANCE WEIGHT

NOTE: The wrist pins are tightly pressed into the weight and normally require no maintenance.

Counterbalance Weight Inspection

1. Clean the inside bearing surface and inspect it for wear or damage.
2. Using a telescoping gauge and micrometer, measure the inside diameter of the bearing surface (**Figure 13-79, Page 13-39**).
3. If the inside diameter is greater than 1.0274 inches (26.097 mm), or the bearing shows signs of wear or damage, replace the counterbalance weight bearing.

Counterbalance Weight Bearing Replacement

1. Support the weight around the bearing hole and drive the bearing out of the counterbalance weight with a bearing drive. **See following NOTE.**

NOTE: Install the new bearing with its oil hole aligned with the oil passage in the counterbalance weight.

2. Clean the parts thoroughly in a high flash-point solvent and wipe dry.
3. Coat new bearing with clean engine oil.
4. Press the new bearing into the counterbalance weight.

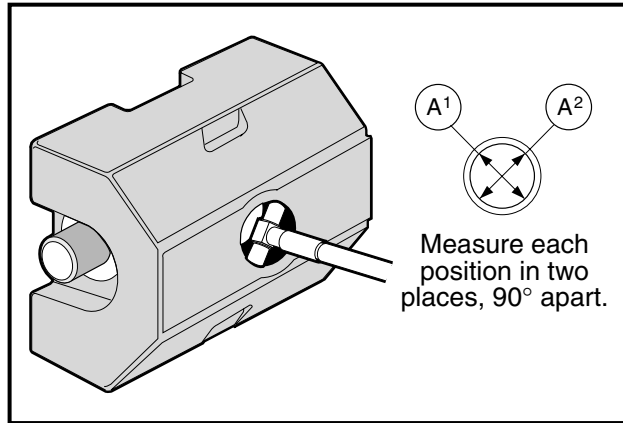


Figure 13-79 Measure Counterbalance Bearing Surface I.D.

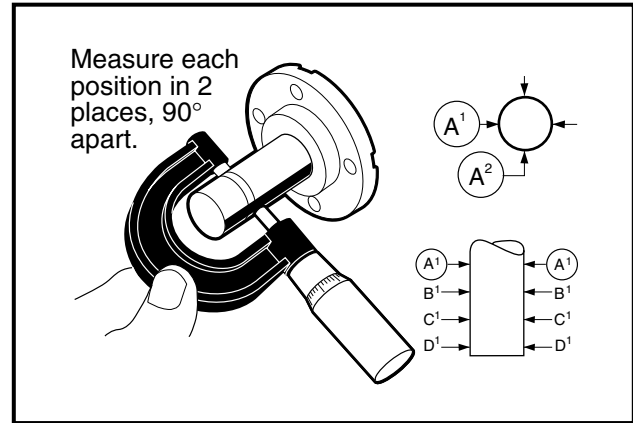


Figure 13-80 Measure O.D. of Counterbalance Guide Shaft

Counterbalance Guide Shaft Inspection

1. Clean the shaft surface and inspect it for wear or damage.
2. With an outside micrometer, measure the outside diameter of the guide shaft surface (**Figure 13-80, Page 13-39**).
3. If the outside diameter is smaller than 1.0593 inches (25.907 mm), or the shaft shows signs of wear or damage, replace the guide shaft.
4. Check the O-ring seal to make sure the O-ring is not damaged. Replace if necessary.

Crankshaft Inspection

NOTE: The crankshaft for a unitized (clockwise) engine has left-hand threads at the clutch mounting hole, and there is a machined groove in the outside diameter of the counterweight as shown below (**Figure 13-81, Page 13-40**).

1. Clean and inspect the journals for scoring. Inspect the crankshaft gear for cracks, scoring or broken teeth. Replace parts if necessary.
2. Using a micrometer, measure both main journals (PTO side and flywheel side) at several points along their lengths (**Figure 13-82, Page 13-40**).
3. If either journal diameter is less than 1.3752 inches (34.930 mm), replace the crankshaft.
4. Using a micrometer, measure the connecting rod journal at several points along its length (**Figure 13-83, Page 13-40**).
5. If the journal diameter is less than 1.4742 inches (37.444 mm), replace the crankshaft.
6. Using a micrometer, measure crankshaft link rod journals at several points (**Figure 13-84, Page 13-40**).
7. If the diameter of either journal is less than 1.9655 inches (49.924 mm), replace the crankshaft.
8. Check the crankshaft alignment.
 - 8.1. Place the crankshaft in an alignment jig.
 - 8.2. Turn crankshaft (1) slowly and measure total indicated run-out at the location shown (**Figure 13-85, Page 13-40**).
 - 8.3. If total run-out exceeds 0.002 inch (0.05 mm), replace the crankshaft.

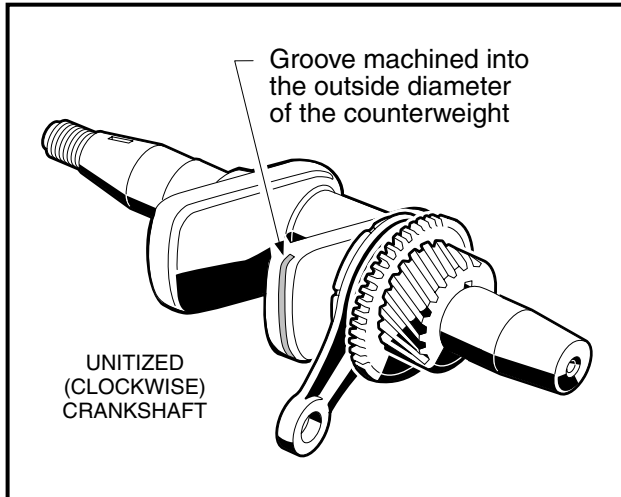


Figure 13-81 Crankshaft Inspection

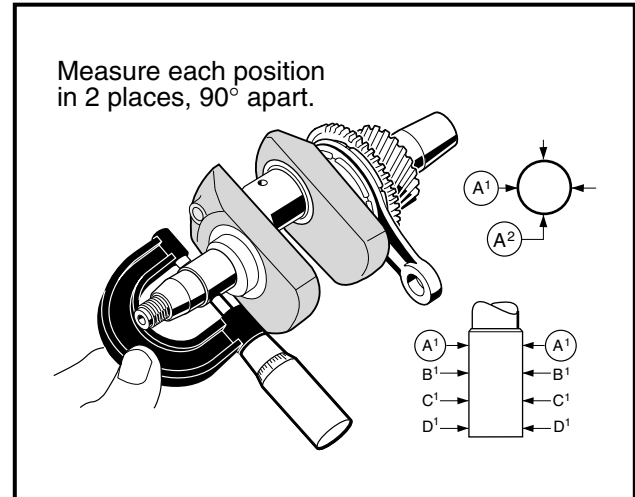


Figure 13-82 Measure Crankshaft Journals

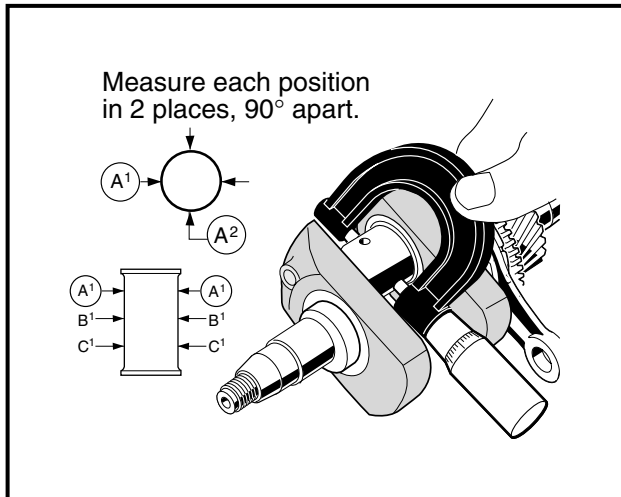


Figure 13-83 Measure Connecting Rod Journal

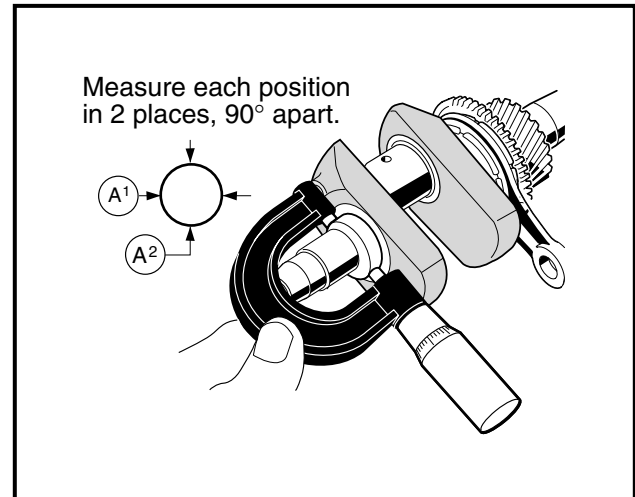


Figure 13-84 Measure Link Rod Journals

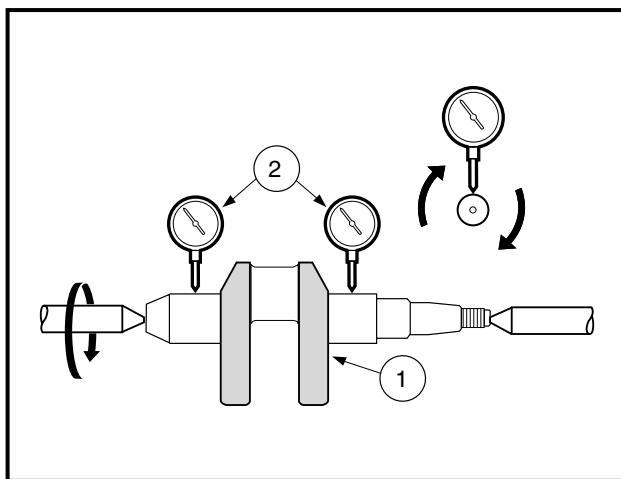


Figure 13-85 Check Crankshaft Alignment

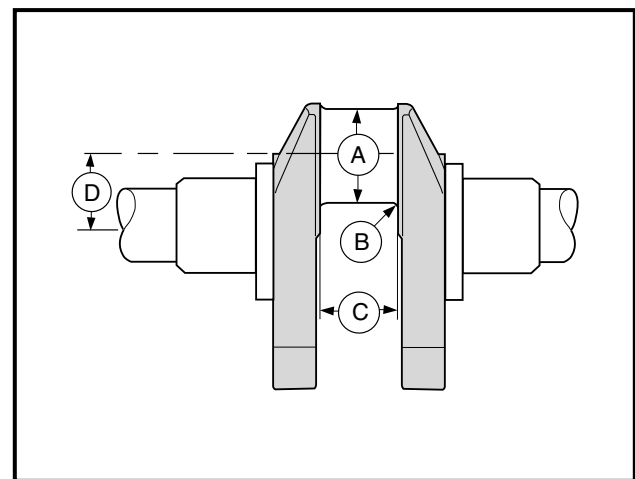


Figure 13-86 Undersized Connecting Rod Journal

Undersized Connecting Rod

The connecting rod journal can accept an undersized connecting rod with a 1.3779 inches (35.0 mm) inside diameter. Grinding the crankshaft is required before using the undersized connecting rod.

1. Have a reliable repair shop grind the crankshaft journal (A) (**Figure 13-86, Page 13-40**).
2. The final finishing dimensions are as follows (**Figure 13-86, Page 13-40**).
 - 2.1. (A) 1.4759 - 1.4763 inches (37.489 - 37.500 mm)
 - 2.2. (B) 0.110 - 0.126 inch (2.80 - 3.20 mm)
 - 2.3. (C) 1.1968 inches maximum (30.4 mm)
 - 2.4. (D) 1.2775 - 1.2814 inches (32.45 - 32.55 mm)
3. The connecting rod journal (A) must be concentric and cylindrical within 0.0002 inch (0.005 mm) at full indicator reading (**Figure 13-86, Page 13-40**).
4. Finish should be very smooth. Use a super fine finishing stone.

OIL SCREEN

Oil Screen Removal

1. Remove the two bolts (1) to take out the oil screen plate (2) and the oil screen (3) (**Figure 13-87, Page 13-41**).
2. Clean the oil screen thoroughly with a high flash-point solvent, then dry the screen.

Oil Screen Installation

1. To install the oil screen, reverse the removal procedure.
2. Tighten bolts (1) to 30 in-lb (3.4 N·m).

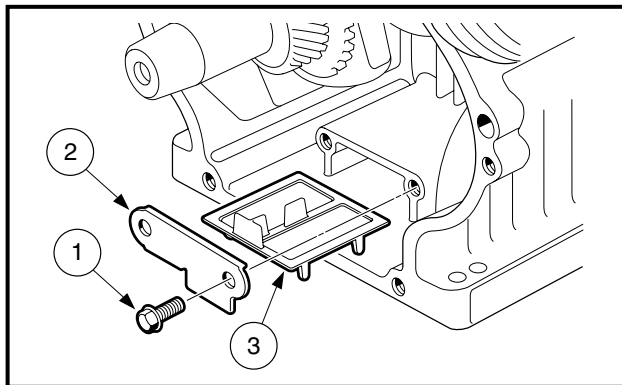


Figure 13-87 Oil Screen Removal

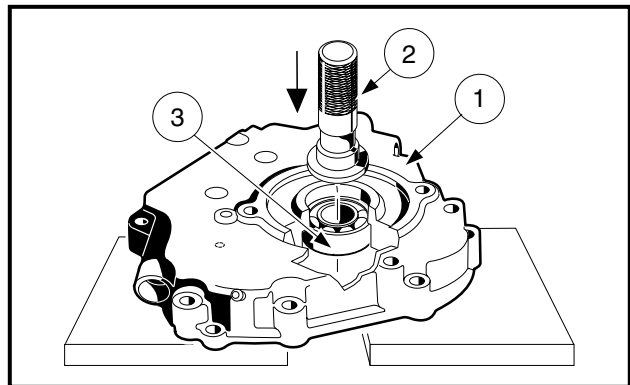


Figure 13-88 Ball Bearing Removal

BALL BEARING

Ball Bearing Removal

1. Remove the oil seal in the crankcase cover. **See following NOTE.**

NOTE: Never reuse an oil seal. Replace the oil seal with a new one.

2. Place the crankcase cover (1) on a bench with its outside up (gasket surface against bench) (**Figure 13-88, Page 13-41**).
3. Using a bearing driver (2) (part of Club Car Bearing Driver Kit, CCI P/N 1016416), drive out the ball bearing (3) as shown.

Ball Bearing Inspection

1. Clean the ball bearing thoroughly in high flash-point solvent and dry it.

NOTE: Never use compressed air to dry bearing. Use of compressed air will result in premature bearing failure.

2. Spin the ball bearing by hand and check for (A) axial play and (B) radial play. Replace the ball bearing if it is noisy, does not spin smoothly, or if it has any play (**Figure 13-89, Page 13-42**).

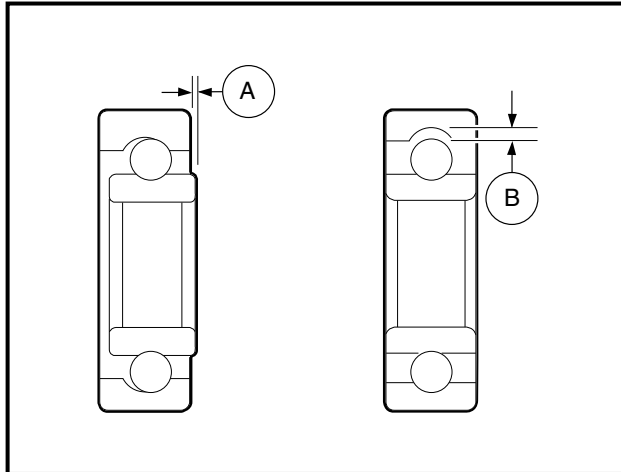


Figure 13-89 Check Ball Bearing

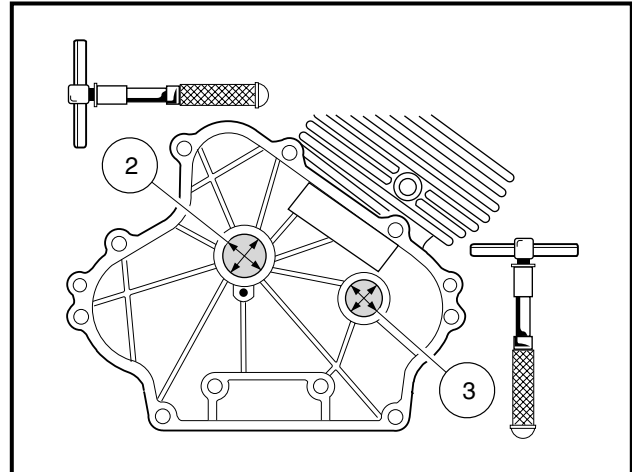


Figure 13-90 Inspect Bearing Surfaces in Crankcase

OIL SEALS

Oil seals are used on both ends of the crankshaft. Any time the crankshaft is removed from the seals, the seals must be replaced with new ones.

Oil Seal Removal

Use an oil seal remover to press or drive the seal out of the casing.

Oil Seal Installation

NOTE: Never reuse an oil seal. Always replace the oil seal with a new one.

1. Put a light coating of clean engine oil on the outside edge and the inner lip of the oil seal to assist installation.
2. Install all oil seals with their lips facing the center of the engine.
3. Using the 1.37 inch (35 mm) seal driver, press the oil seal into the flywheel side of the crankcase until it is flush with the hole.
4. Using the 1.97 inch (50 mm) seal driver, press the oil seal into the crankcase cover until it is 0.157 inch (4 mm) below the outside surface.

Plain Bearing Surface Inspection

Plain bearing surfaces are used for both ends of the camshaft and the flywheel end of the crankshaft.

1. Inspect the camshaft surfaces, one in the crankcase (3) (**Figure 13-90, Page 13-42**) and the other in the crankcase cover (1) (**Figure 13-91, Page 13-43**). Using an inside micrometer or telescoping gauge, measure the inside diameter of each bearing surface. If the inside diameter is greater than 0.9080 inch (23.063 mm), replace the crankcase and/or the crankcase cover.
2. Inspect the crankshaft bearing surface (2) in the crankcase. Using an inside micrometer or telescoping gauge, measure the inside diameter of the bearing surface. If the inside diameter is greater than 1.1841 inch (30.075 mm), replace the crankcase (**Figure 13-90, Page 13-42**).

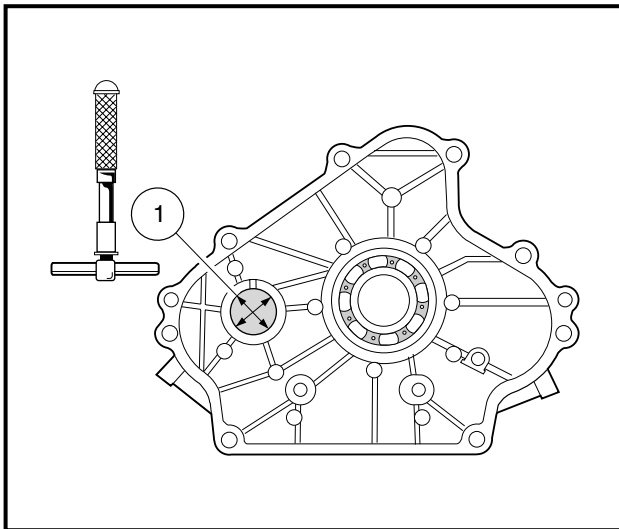


Figure 13-91 Inspect Camshaft Bearing Surface in Crankcase Cover

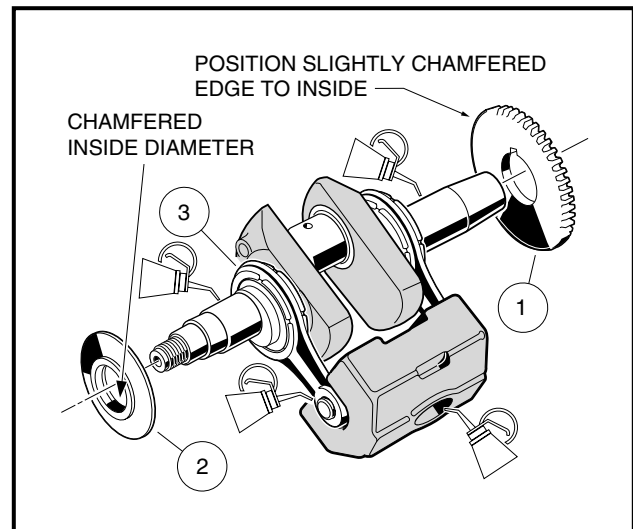


Figure 13-92 Crankshaft Assembly

Crankshaft Installation

⚠ WARNING

- Before assembly, make sure all parts are clean.

NOTE: When reassembling the crankshaft and the counterbalance weight, apply a light film of engine oil to the crankshaft journals and guide shaft (**Figure 13-92, Page 13-43**).

1. Installation is the reverse of removal. **See Crankshaft and Counterbalance Removal on page 13-36.**
2. Tighten the four nuts (1) for counterbalance guide shaft to 50 in-lb (5.9 N·m) (**Figure 13-72, Page 13-36**).
3. If the link rod was removed from the PTO side of the crankshaft, support the crankweb as shown, slide the link rod onto the crankshaft, and install the key. Press the spur gear and helical gear onto the crankshaft (**Figure 13-93, Page 13-44 and Figure 13-94, Page 13-44**). **See following CAUTION and NOTE.**

⚠ CAUTION

- Always use a press when removing or installing the spur gear and helical gear on the crankshaft.
- If the spur gear was warped while being removed, install a new one.

Crankshaft Installation, Continued:

NOTE: Make sure the chamfered inside diameters of the spur gear and helical gear are oriented downward on the crankshaft as shown (**Figure 13-93, Page 13-44**).

Make sure the link rods rotate smoothly after the gears are pressed on.

- Slide the link rod, then the spacer, onto the flywheel end of the crankshaft.

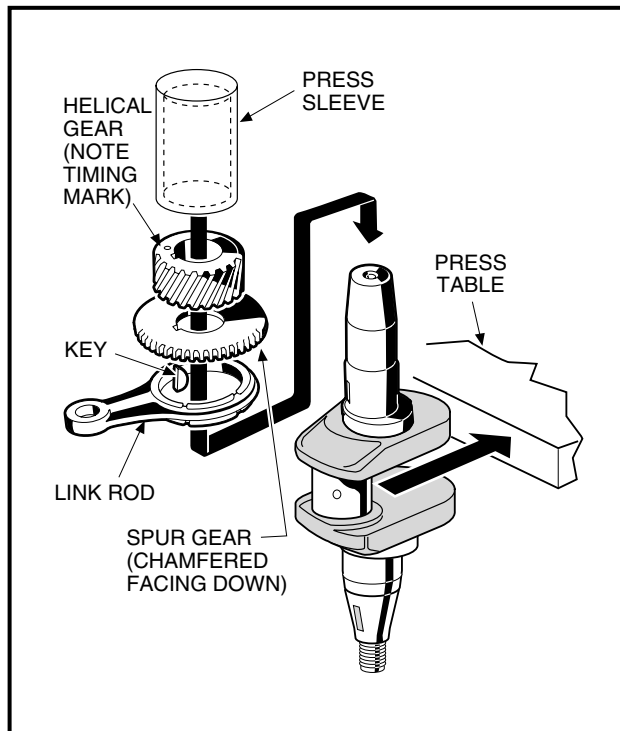


Figure 13-93 Crankshaft Installation

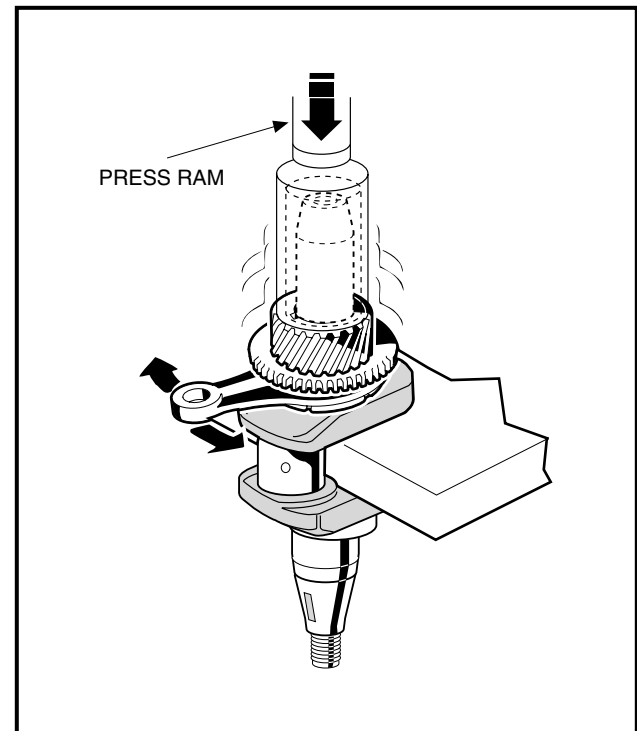


Figure 13-94 Press on Spur Gear and Helical Gear

Piston and Connecting Rod Installation

- Installation is the reverse of removal.
- Reassemble the piston and the connecting rod into a unit, if disassembled. Align the L mark (1) on the piston head toward the lettering MADE IN JAPAN (2) on the connecting rod (**Figure 13-95, Page 13-45**).
- Apply a light film of engine oil to the connecting rod bearing surfaces, and the two connecting rod bolts.
- Put the piston/connecting rod into the cylinder bore with the lettering MADE IN JAPAN on the connecting rod oriented toward the flywheel side of the engine. Position piston ring gaps so that they are oriented toward the corresponding letters (**Figure 13-96, Page 13-45**): (A) Top Ring Gap, (B) Second Ring Gap, (C) Upper Side Rail Gap, (D) Lower Side Rail Gap.

NOTE: The **R** mark on the top two piston rings should be facing up when installed.

- Tighten the two connecting rod bolts to 16.5 ft-lb (23 N·m).

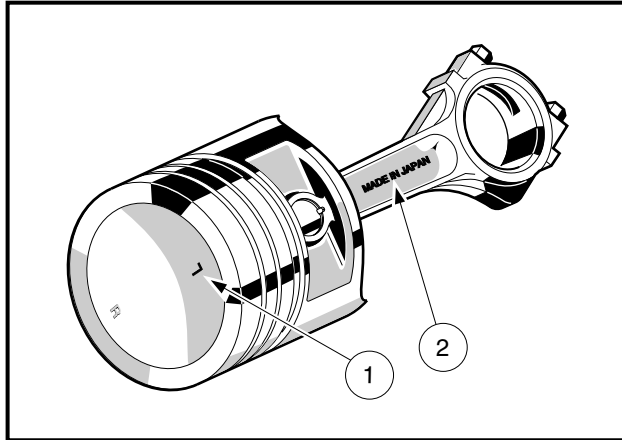


Figure 13-95 Piston/Connecting Rod Alignment

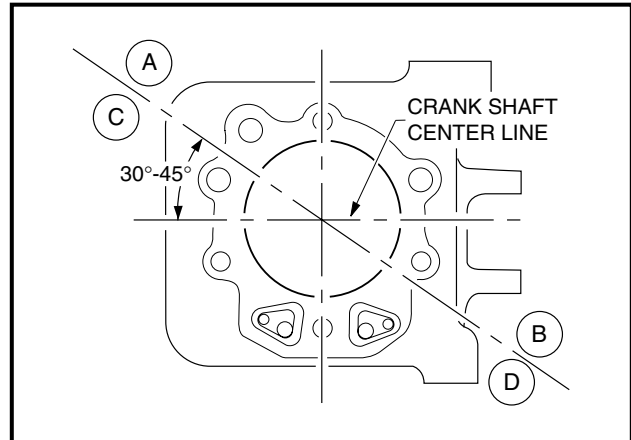


Figure 13-96 Piston Ring Gap Alignment

CRANKSHAFT AXIAL PLAY ADJUSTMENT

Read **DANGER** and **WARNING** on page 13-1.

1. With the gasket installed on the crankcase, measure from the gasket surface (1) to the helical gear surface (2). Record measurement (A) (Figure 13-97, Page 13-45).
2. Measure from the crankcase cover (3) mounting face to the crankshaft bearing inner end (4). Record measurement (B) (Figure 13-97, Page 13-45).
3. Locate the measurements on the Crankshaft Shim Table. Follow lines to where the recorded measurements intersect (Figure 13-99, Page 13-46).
4. Choose the next smaller shim from the table. Example: Measurement A is 15.87 mm and B is 17.66 mm. The correct crankshaft shim is 1.53 mm (Figure 13-99, Page 13-46). See following **NOTE**.
5. Install the shim (5) on the crankshaft (6) (Figure 13-98, Page 13-45).

NOTE: Crankshaft shim sizes for FE350 and FE400 engines range from 1.11 to 1.81 mm.

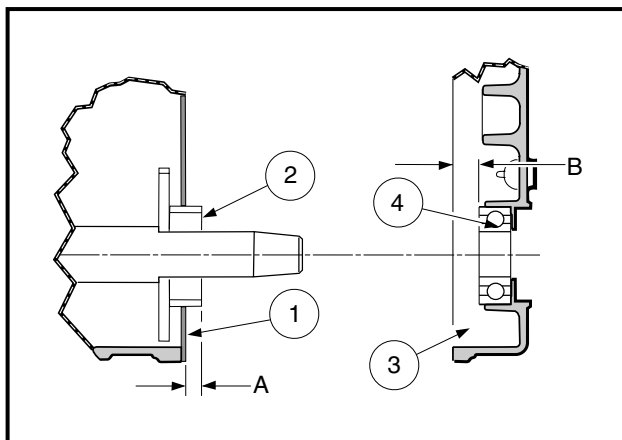


Figure 13-97 Determine Crankshaft Shim Size

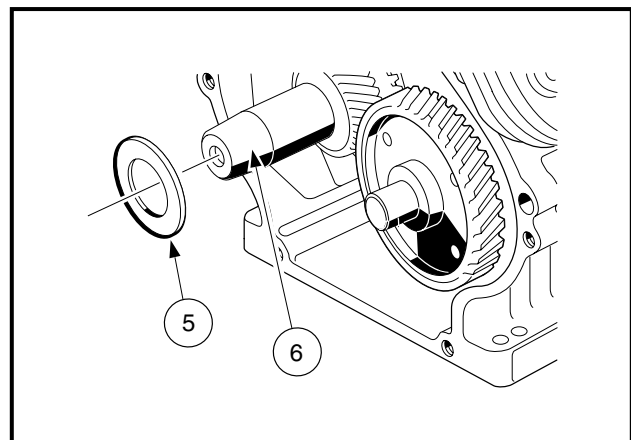


Figure 13-98 Install Shim On Crankshaft

Camshaft Installation

⚠ CAUTION

- When installing the camshaft, make sure that the tang (1) on the oil pump rotor seats in the slot (2) in end of the camshaft (Figure 13-100, Page 13-47). If the oil pump tang is not seated in the slot in the camshaft, serious engine damage will result.

1. Installation is the reverse of removal. **See Camshaft and Hydraulic Lifter Removal on page 13-25.**
2. Apply a light film of engine oil to the camshaft journals and cam lobes.
3. Align the timing marks (3) (Figure 13-101, Page 13-47). **See following NOTE.**

NOTE: If the outside edges of the camshaft and crankshaft gears are not flush, and the crankcase cover will not easily make full contact with the crankcase, make sure the tang on the oil pump rotor is seated in the camshaft slot.

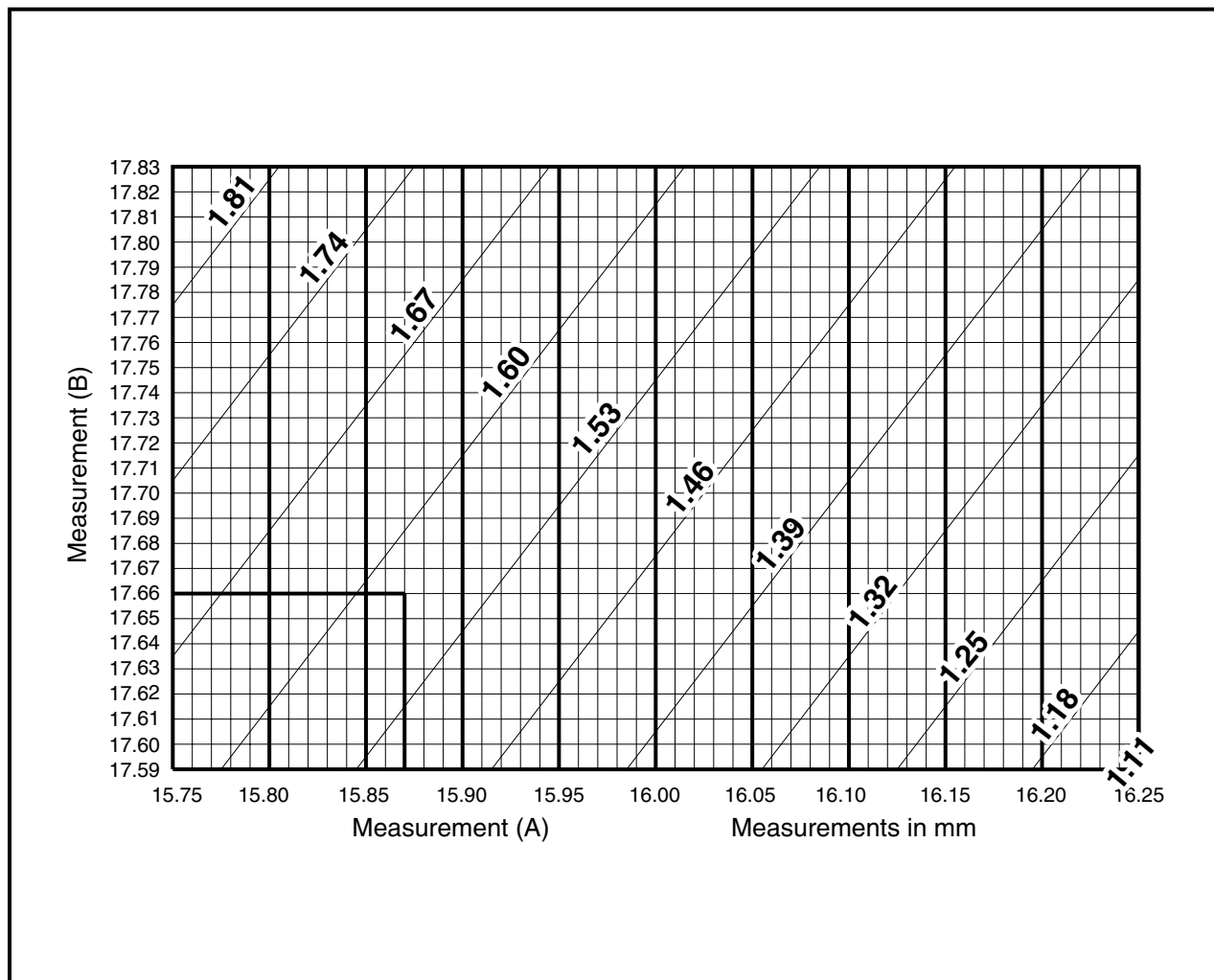


Figure 13-99 Crankshaft Shim Table

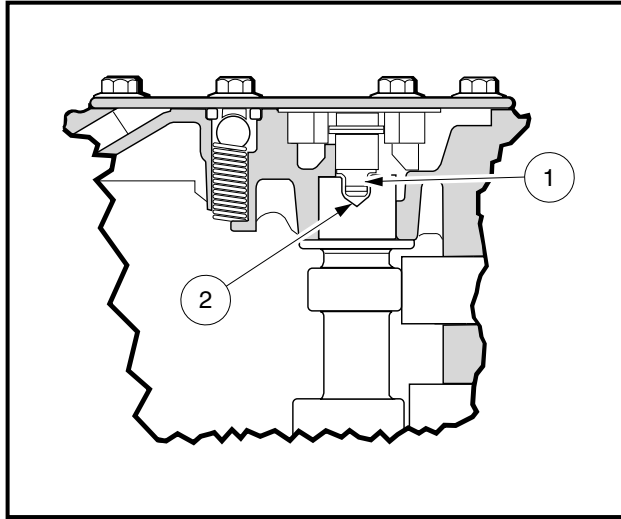


Figure 13-100 Proper Seating of Tang into Camshaft Slot

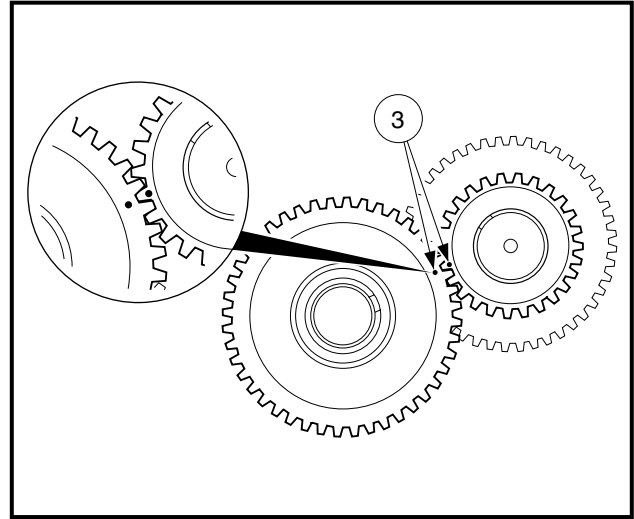


Figure 13-101 Align Timing Marks between Camshaft and Crankshaft

Camshaft Axial Play Adjustment

1. With the gasket (1) installed on the crankcase, measure from the gasket surface to the camgear surface (2). Record this measurement (A) (**Figure 13-102, Page 13-47**).
2. Measure from the crankcase cover (3) mounting face to the camshaft bearing inner end (4). Record this measurement (B).
3. Locate the measurements on the Camshaft Shim Table. Follow the lines to where the recorded measurements intersect (**Figure 13-104, Page 13-48**).
4. Choose the next smaller shim from the table. Example: Measurement A is 13.41 mm and B is 14.09 mm. The correct camshaft shim is 0.4 mm.
5. Install the shim (1) on the camshaft (2) (**Figure 13-103, Page 13-47**).

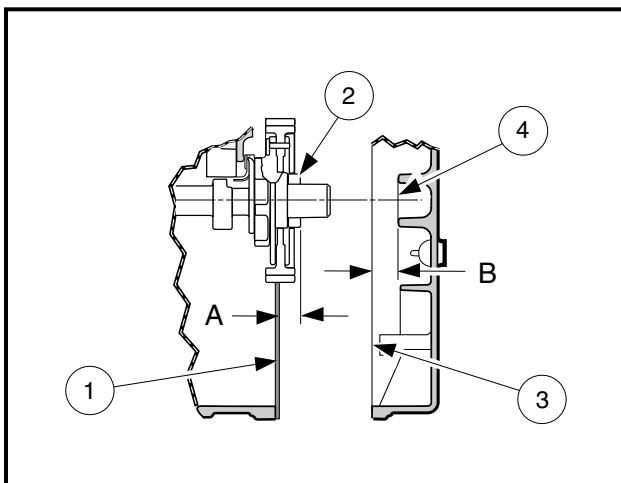


Figure 13-102 Measurements to be Recorded for Camshaft Shim Table

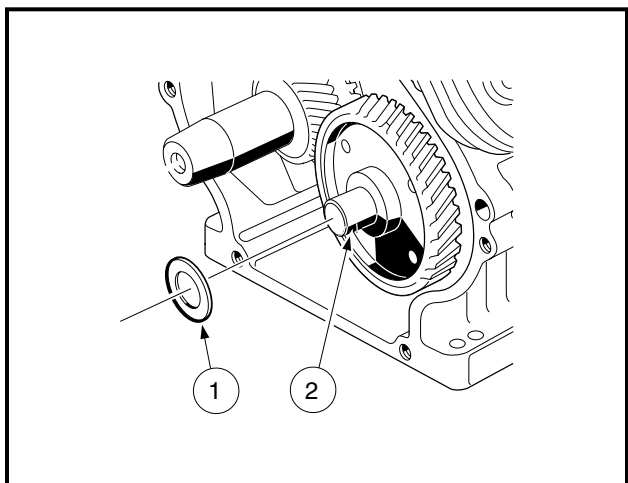


Figure 13-103 Install Shim on Camshaft

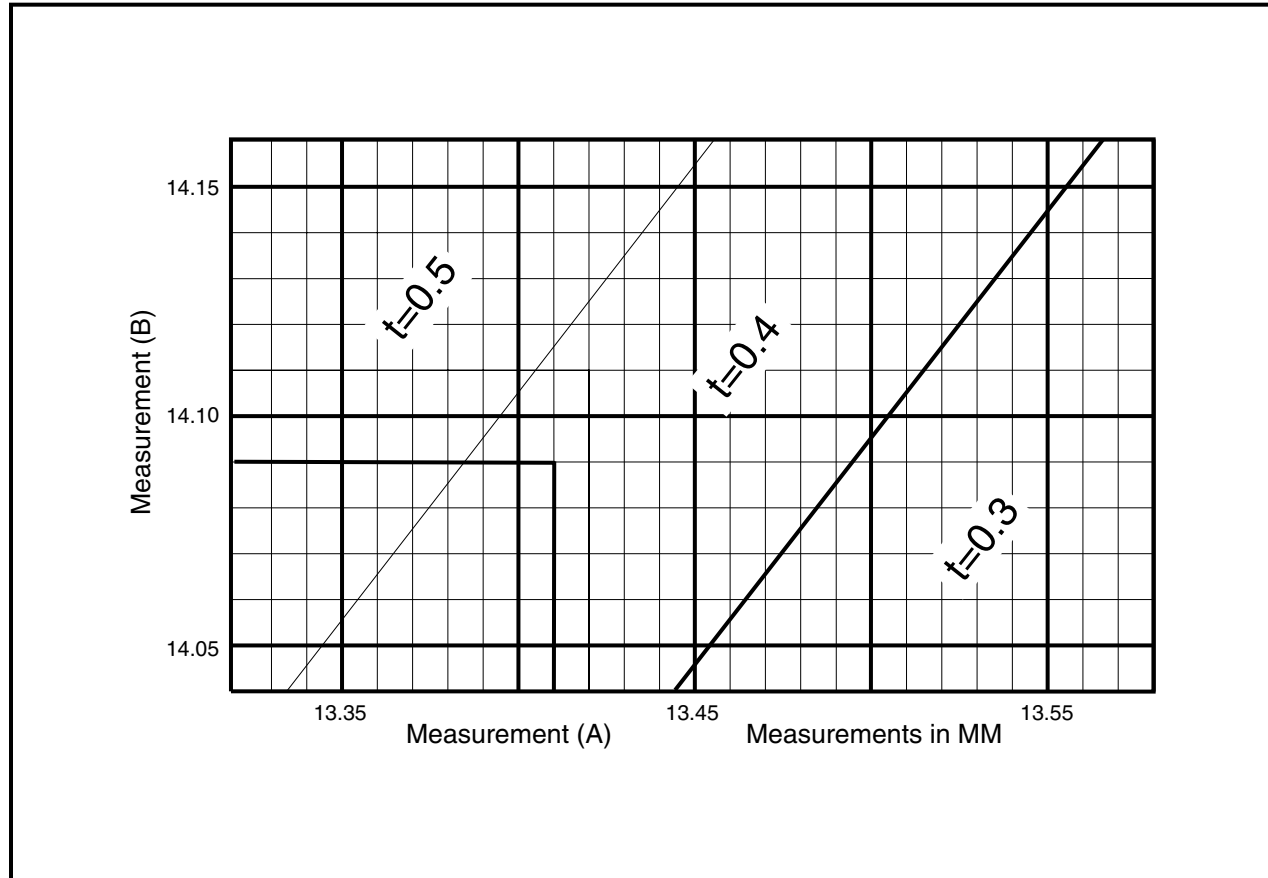


Figure 13-104 Camshaft Shim Table

CRANKCASE COVER INSTALLATION

⚠ CAUTION

- Before assembly, make sure parts are clean.
 - Do not reuse the gasket. Install a new one.
 - Install and tighten crankcase cover bolts as instructed. Failure to do so could cause the cover to become warped.
1. Clean the gasket surfaces on the crankcase cover to fit a new gasket during installation and inspect the oil seal for wear and damage.
 2. Install crankcase cover. Using HANDS ONLY, seat cover completely against the crankcase. If the cover will not seat, the camshaft is not installed correctly.
 3. Install and finger-tighten evenly the eight cover mounting bolts (**Figure 13-105, Page 13-49**).
 4. Tighten the cover mounting bolts in two steps. First, in the sequence shown, tighten all eight bolts to approximately 130 in-lb (14 N·m). Then, repeating the sequence, tighten them to 250 in-lb (28.2 N·m).
 5. Connect the yellow jumper wire (11) to the cord connector (12) (**Figure 13-43, Page 13-24**).

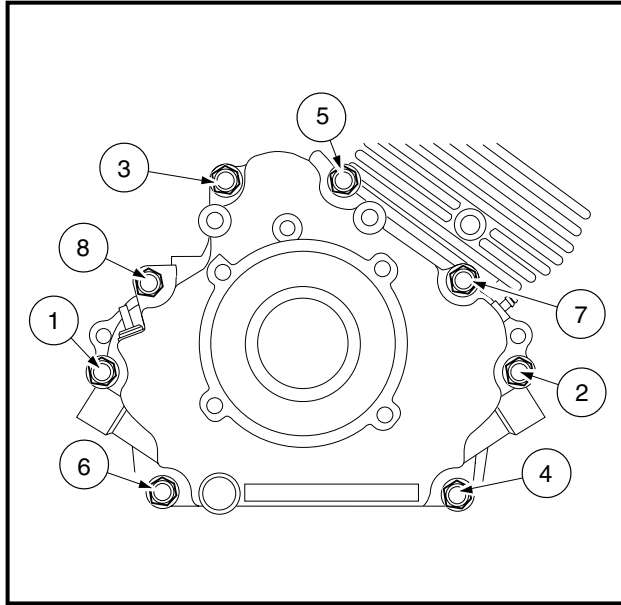


Figure 13-105 Crankcase Cover Installation

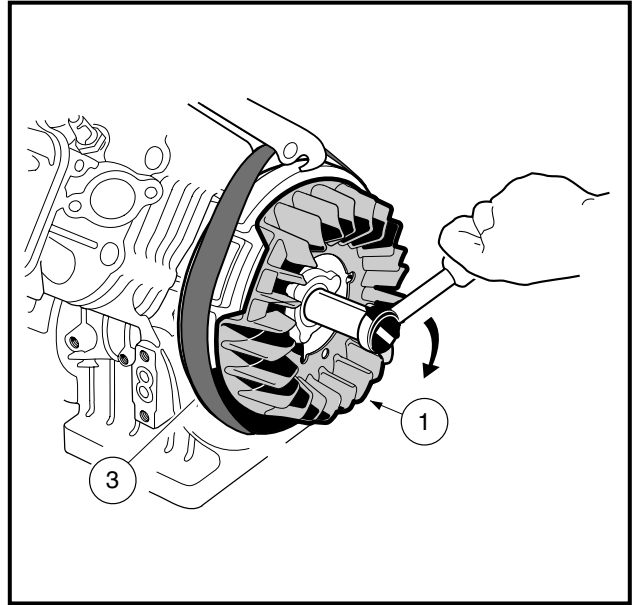


Figure 13-106 Fan and Flywheel Assembly

ENGINE ASSEMBLY

Read **DANGER** and **WARNING** on page 13-1.

CAUTION

- Before assembly, make sure parts are clean.

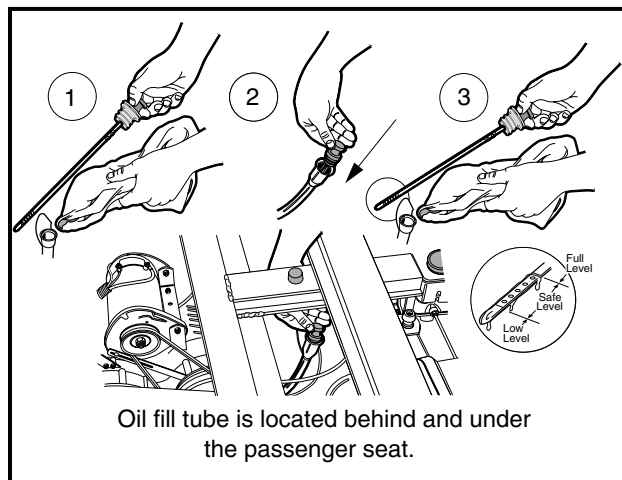
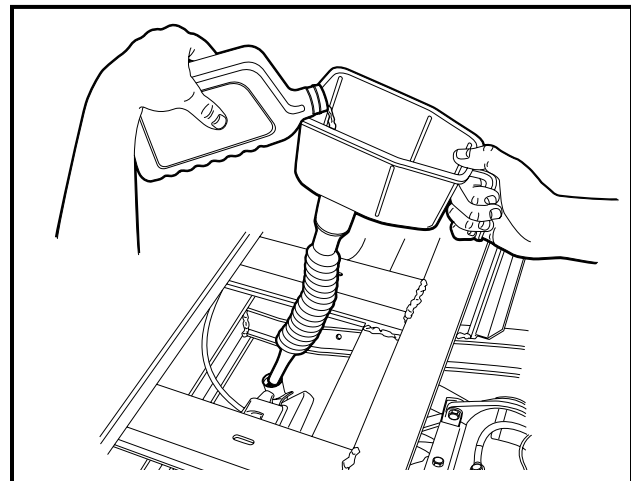
1. Install cylinder head. **See Cylinder Head Installation on page 13-19.**
2. Insert the flywheel key into the keyway in the crankshaft. Then align the keyway in the flywheel to the key and push the flywheel and fan assembly onto the crankshaft until it seats. Install flat washer and nut finger-tight.
3. Use a strap wrench (3) to keep the flywheel and fan assembly (1) from turning while tightening the flywheel nut to 63 ft-lb (85.4 N·m) (**Figure 13-106, Page 13-49**). **See following CAUTION.**

CAUTION

- The flywheel nut has right-hand threads. Turn it clockwise to tighten, or counterclockwise to loosen.
 - Be careful not to damage the fan blades. Use a strap wrench to hold flywheel. Do not place screwdriver or pry bar between fan blades.
4. Install ignition coil. **See Ignition Coil Installation on page 13-32.**
 5. Install cylinder head shrouds. Installation is the reverse of removal. **See steps 12 through 13, Cylinder Shroud Removal on page 13-10.**
 6. Install carburetor. **See Carburetor, Section 14, Page 14-5.**

Engine Assembly, Continued:

7. Place engine onto engine mounting plate and tighten the mounting hardware (1, 2 and 5) to 21 ft-lb (28.4 N-m). Tighten nuts (6) to 17 ft-lb (23.1 N-m) (**Figure 13-41, Page 13-23**).
8. Install drive clutch. **See Drive Clutch Installation, Section 17, Page 17-13.**
9. Install drive belt. **See Drive Belt Installation, Section 17, Page 17-5.**
10. Install muffler. **See Muffler Installation, Section 15, Page 15-3.**
11. Install starter/generator and belt. **See Starter/Generator Assembly, Section 12b, Page 12b-5.**
12. Install the powertrain by performing steps 14 through 35, pages 16a-43 through 16a-48 in Section 16a – MC012C-AS00 Unitized Transaxle with Differential Lock.
13. Install oil drain plug in the crankcase and tighten to 20 ft-lb (27.1 N-m). Apply a light film of oil on the seal of a new oil filter and install the filter on the crankcase. Fill the crankcase to the proper level with the correct type of oil. This engine should be regarded as a new engine for next scheduled oil change (**Figure 13-108, Page 13-50**). **See Engine Oil, Section 10, Page 10-6.**

**Figure 13-107 Check Engine Oil Level****Figure 13-108 Add Engine Oil**

14. Check all hardware for proper torque/tightness.
15. Check engine oil level (**Figure 13-107, Page 13-50**).
 - 15.1. Vehicle should be on a level surface when checking oil. Do not overfill with oil.
16. Install a new or cleaned spark plug, gap 0.027 - 0.031 inch (0.69 - 0.79 mm), and connect plug wire to plug.
17. Connect the battery cables, positive (+) first, and tighten to 20 ft-lb (27.1 N-m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
18. Adjust the engine RPM setting. **See Engine RPM Adjustment, Section 14, Page 14-14.**
19. If initial checks indicate the engine is functional, place the neutral lockout cam in OPERATE position.
20. Test-drive vehicle to ensure all systems are functional and correctly adjusted.

SERVICE SPECIFICATIONS

ITEM	SERVICE LIMIT FE350 ENGINE	SERVICE LIMIT FE400 ENGINE
Breather reed valve (valve tip air gap)	0.008 in. (0.2 mm) max.	
Camshaft axial play	0.0137 in. (0.35 mm)	0.024 in. (0.06 mm)
Camshaft bearing	0.9080 in. (23.063 mm) inner diameter max.	
Camshaft cam lobes (exhaust, intake)	1.3086 in. (33.24 mm) outer diameter min.	
Camshaft flywheel-side journal	0.9026 in. (22.927 mm) outer diameter min.	
Camshaft PTO-side journal	0.9026 in. (22.927 mm) outer diameter min.	
Connecting rod big-end bearing	1.4790 in. (37.567 mm) inner diameter max.	
Connecting rod small-end bearing	0.7894 in. (20.051 mm) inner diameter max.	
Counterbalance guide shaft	1.0199 in. (25.907 mm) outer diameter min.	
Counterbalance weight bearing	1.0274 in. (26.097 mm) inner diameter max.	
Counterbalancer link rod big-end bearing	1.9726 in. (50.106 mm) inner diameter max.	
Counterbalancer link rod small-end bearing	0.4746 in. (12.057 mm) inner diameter max.	
Crankcase cover camshaft bearing	0.9079 in. (23.063 mm) inner diameter max.	
Crankshaft axial play	0.0137 in. (0.35 mm)	
Crankshaft balancer – link-rod journals	1.9655 in. (49.924 mm) outer diameter min.	
Crankshaft bearing	1.3809 in. (35.075 mm) inner diameter max.	
Crankshaft crankpin journal	1.4741 in. (37.444 mm) outer diameter min.	
Crankshaft flywheel- side journal	1.3751 in. (34.930 mm) outer diameter min.	
Crankshaft PTO-side journal	1.3751 in. (34.930 mm) outer diameter min.	
Cylinder bore	3.2703 in. (83.067 mm) inner diameter max.	3.4278 in. (87.067 mm) inner diameter max.
Cylinder bore	3.2669 to 3.2677 in. (82.980 to 83.000 mm) inner diameter standard	3.4278 in. (87.067 mm)
Cylinder bore (out of round)	0.0022 in. (0.056 mm) max.	
Oil pump housing	1.6050 in. (40.766 mm) inner diameter max.	
Oil pump housing	0.4004 in. (10.170 mm) max.	
Oil pump shaft	0.4971 in. (12.627 mm) outer diameter min.	
Oil pump shaft bearing	0.5028 in. (12.770 mm) inner diameter max.	
Outer rotor	1.5932 in. (40.467 mm) outer diameter min.	
Outer rotor width	0.3905 in. (9.92 mm) min.	
Piston oil-ring groove clearance and end gap	Visual inspection only	
Piston pin	0.7864 in. (19.975 mm) outer diameter min.	
Piston pin hole	0.7887 in. (20.033 mm) inner diameter max.	
Piston second ring groove clearance (with new ring)	0.0055 in. (0.14 mm) max.	
Piston top ring groove clearance (with new ring)	0.0063 in. (0.16 mm) max.	
Specifications continued on next page...		

ITEM	SERVICE LIMIT FE350 ENGINE	SERVICE LIMIT FE400 ENGINE
Push rod (rod bend)	0.0196 in. (0.50mm) max.	
Relief valve spring (free length)	0.748 in. (19.0 mm) min.	
Rocker arm bearing	0.4754 in. (12.074 mm) inner diameter max.	
Rocker shaft	0.4704 in. (11.949 mm) outer diameter min.	
Valve face angle (exhaust, intake)	45° (ex.), 30° (in.) standard	
Valve guide (exhaust, intake)	0.2756 to 0.2762 in. (7.00 to 7.015 mm) inner diameter standard	
Valve guide hole (exhaust)	0.2781 in. (7.065 mm) inner diameter max.	
Valve guide hole (intake)	0.2781 in. (7.065 mm) inner diameter max.	
Valve margin (exhaust, intake)	0.024 in. (0.6 mm) max.	
Valve seat angle (exhaust, intake)	45° (Ex.), 30° (in.) standard	
Valve seat width	0.0197 to 0.0433 in. (0.50 to 1.10mm) standard	
Valve seat width	0.075 in. (1.9 mm) max.	
Valve spring (free length)	1.5157 in. (38.50 mm) min.	
Valve stem (exhaust)	0.2722 in. (6.915 mm) outer diameter min.	
Valve stem (exhaust, intake) (stem bend)	0.0012 in. (0.03 mm) max.	
Valve stem (intake)	0.2728 in. (6.930 mm) outer diameter min.	

SPECIFICATIONS FOR RESIZING CYLINDER BORE

ITEM	OVERSIZE	FE350 AND FE400 LIMITS
Final boring bore diameter	0.020 in. (0.50 mm)	3.2858 to 3.2866 in. (83.460 to 83.480 mm)
Finished honed bore diameter	0.020 in. (0.50 mm)	3.2866 to 3.2874 in. (83.480 to 83.500 mm)

TORQUE SPECIFICATIONS

ITEM	SIZE	FE350 AND FE400 LIMITS
Cylinder head bolts	M8	17.5 ft-lb (24 N·m)
Connecting rod bolts (coat threads with engine oil)	M7	16.5 ft-lb (23 N·m)
Flywheel retaining nut	M18	100 ft-lb (135 N·m)
Crankcase cover to block bolts	M8	22 ft-lb (31 N·m)
Starter/Generator bracket to block bolts	M8	16.5 ft-lb (23 N·m)
Oil drain plug	M14	16.5 ft-lb (23 N·m)
Fan housing screws	M6	90 in-lb (10 N·m)
Fan shroud screws	M6	25 in-lb (2.8 N·m)
Bolts marked with "4" (when used with nuts)	M8	130 in-lb (15 N·m)
	M6	50 in-lb (5.9 N·m)
	M5	30 in-lb (3.4 N·m)

ADJUSTMENT AND SETTINGS

ITEM	SERVICE LIMIT FE350 ENGINE	SERVICE LIMIT FE400 ENGINE
Spark plug gap (standard)	0.027 to 0.031 in. (0.69 to 0.79 mm)	
Ignition coil air gap (standard)	0.012 in. (0.304 mm)	
Oil pressure (min.) at fast idle speed	45.5 psi (3.14 Bars)	
Oil filter: bypass-valve opening pressure	11.4 to 17.0 psi (.78 to 1.18 Bars)	
Compression pressure (min.) (with automatic compression release)	71 psi (4.83 Bars)	
Crankcase vacuum (min.) at fast idle speed	1.18 in. (30 mmHg)	
Cylinder head-gasket surface flatness (max.)	0.002 in. (0.05 mm)	
ACR lift (standard)	0.059 in. (1.5 mm)	
ACR lift (min.)	0.0354 in. (0.9 mm)	
Engine RPM	3800 (±30) RPM	3850 (±30) RPM

SECTION 14 – FUEL SYSTEM

▲ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

▲ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

The FE350 and FE400 engines are equipped with a float bowl type carburetor with fixed jets that require no adjustment. The carburetor atomizes the fuel, mixes it with air, and feeds the combustible mixture into the cylinder. The size of the jets are determined by the altitude where the engine will be operating. The engines are equipped with the jets sized for the operating elevation at the time of manufacture.

HOW THE CARBURETOR WORKS

MAIN SYSTEM

The main system of the carburetor consists of the main jet, the main nozzle, and the main air passage. The main system meters fuel to the engine during moderate to heavy load conditions. Fuel flows through the main jet and into the main nozzle, where it meets air from the main air passage. The resulting mixture flows out the end of the main nozzle and into the carburetor bore, where it is atomized by high-speed air flow and then carried into the engine (**Figures 14-1, 14-2 and 14-3, beginning on page 14-3**).

During the intake stroke of the engine, a negative pressure (vacuum) is created in the venturi of the carburetor. In this venturi tube, the intake air has high velocity and low static pressure. Subsequently, fuel is drawn out of the carburetor float chamber, atomized to fine particles, then drawn into the cylinder as a combustible mixture (**Figure 14-2, Page 14-3**).

Trouble in the main system is usually indicated by poor performance, or lack of power under heavy load conditions. A dirty or clogged main jet will cause the mixture to become too lean. An overly rich mixture could be caused by a clogged air passage, clogged air holes in the main nozzle, a loose main jet, or by a loose main nozzle.

If the engine exhibits symptoms of overly rich or lean fuel mix after all maintenance and adjustments are correctly performed, the main jet should be replaced. A smaller numbered jet gives a leaner mixture and a larger numbered jet gives a richer mixture. It is recommended that any change be limited to one jet size difference from the standard jet.

STANDARD JETTING	FE350 ENGINE	FE400 ENGINE
Pilot air screw	Middle of Travel	
Pilot jet	40 (x1/100)	45 (x1/100)
Main jet	85 (x1/100)	88 (x1/100)
Throttle valve stop screw	1200-1250 RPM	

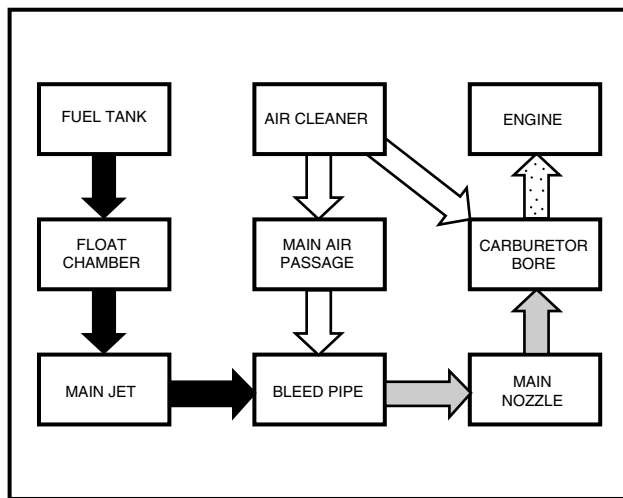


Figure 14-1 Fuel Flow Sequence

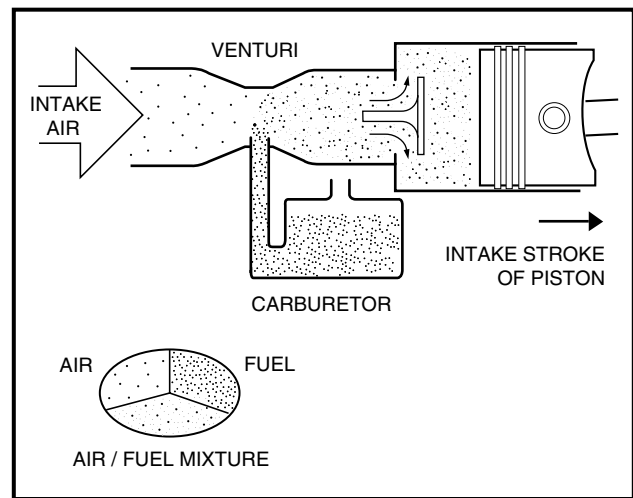


Figure 14-2 Air/Fuel Mixture

SLOW SPEED SYSTEM

The slow speed system supplies fuel during low speed running. Low speed running without load requires very low intake airflow. The throttle valve (**Figure 14-3, Page 14-4**) is almost closed when this is the case, and as high negative pressure is created on the back side of the throttle valve, intake air is drawn in and metered through the pilot air jet. The intake air draws fuel, metered by the pilot jet (**Figure 14-3, Page 14-4**), from the carburetor float chamber. The combustible mixture of air and fuel is then delivered into the venturi through the pilot outlet and bypass. When the engine is operating at low speed, fuel is supplied mainly through the pilot outlet (**Figure 14-3, Page 14-4**).

The air/fuel mixture is adjusted by the pilot screw (needle valve) (**Figure 14-3, Page 14-4**).

CHOKE AND FRESH AIR SYSTEM

The choke system aids in starting the engine in cold weather. When starting a cold engine, the choke cable handle (1) (**Figure 14-4, Page 14-5**) is pulled. This restricts the air flow to the venturi, causing a very high vacuum that draws fuel into the venturi at a high rate and thus creates a “fuel rich” mixture. The choke handle is pulled until the engine starts, and then released when the engine begins to run smoothly.

An air duct provides the engine with clean, cool air from outside the engine compartment. This feature increases engine horsepower and greatly extends air filter life.

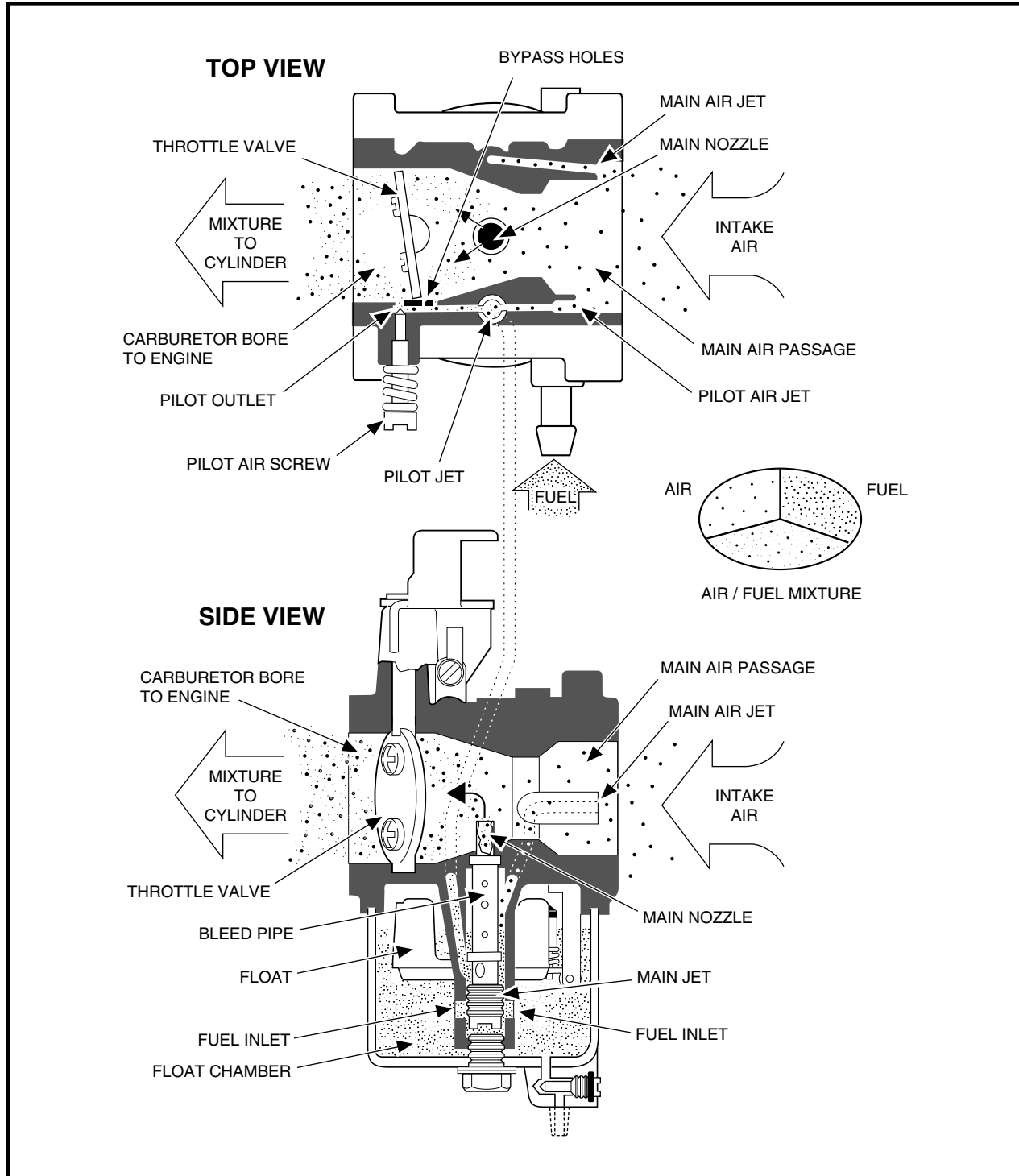


Figure 14-3 Carburetor

FLOAT SYSTEM

The carburetor is a float bowl type, with the float chamber located just below the carburetor body. The float system keeps the fuel in the float chamber at the correct level while the engine is running (**Figure 14-5, Page 14-5**).

Fuel is supplied to the carburetor float chamber by an external impulse pump that draws fuel from the fuel tank and through the fuel filters (**Figure 14-4, Page 14-5**). The fuel then passes through the inlet valve (5) and into the float bowl. The fuel entering the bowl causes the float (4) to rise until it shuts off the inlet valve, preventing the fuel from exceeding a level predetermined by the float level setting.

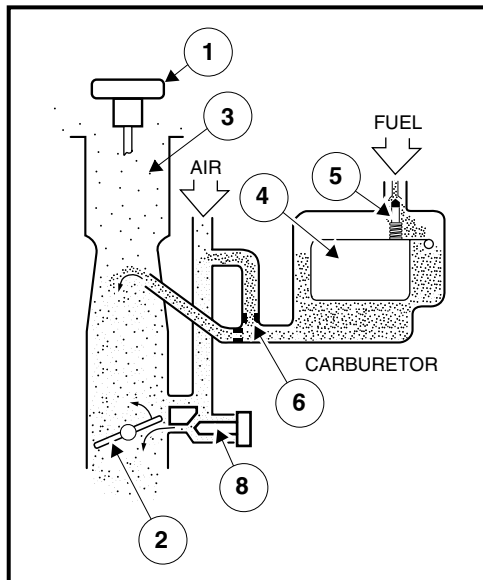


Figure 14-4 Choke System

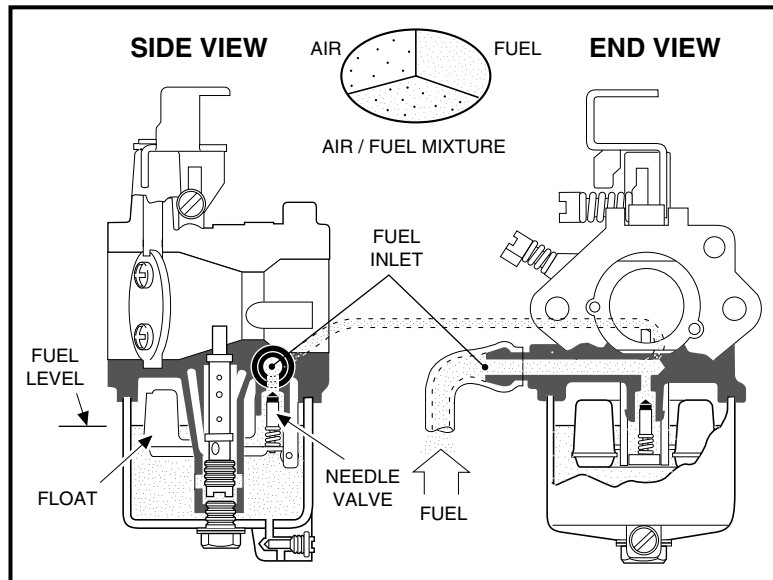


Figure 14-5 Float System

CARBURETOR

Read **DANGER** and **WARNING** on page 14-1.

Before suspecting the carburetor as the cause of poor engine performance, make sure the fuel and ignition systems are in proper operating condition. Check the following items:

- Spark plug and gap condition. **See Spark Plug, Section 13, Page 13-7.**
- Air filter element. **See Air Filter on page 14-20.**
- Fuel filters. **See Fuel Filters on page 14-21.**
- Choke and air intake system (for restriction of air flow). **See Choke and Air Intake System on page 14-16.**
- Fuel pump. **See Fuel Pump on page 14-22.**
- Fuel lines (from fuel tank to filter to pump to filter to carburetor). **See Fuel Lines on page 14-31.**
- Exhaust system (for restrictions). **See Section 15 – Exhaust System.**

If the carburetor floods or leaks fuel at the float bowl gasket or carburetor vent tube, the fuel inlet valve could be worn or dirty. Another cause of this condition may be a damaged float that has filled with fuel and sinks.

For elevations above 3000 feet, main jets other than standard operate more effectively. The following chart lists the elevation ratings for various jet sizes. No adjustment is required for the pilot jet. If the vehicle idles roughly, turn the pilot air screw (**Figure 14-3, Page 14-4**) out until the vehicle idles smoothly.

MAIN JET ELEVATION/SIZE CHART

ALTITUDE	FE350 ENGINE MAIN JET SIZE
0-3000 ft. (0-914.4 m)	85
3000-5000 ft. (914.4-1524 m)	82
5000-8000 ft. (1524-2438.4 m)	80
8000-10,000 ft. (2438.4-3048 m)	78
10,000 ft. and over (3048 m and over)	75

ALTITUDE	FE400 ENGINE MAIN JET SIZE
0-3280 ft. (0-1000 m)	88
3280-6562 ft. (1000-2000 m)	85
6562 ft. and over (2000 m and over)	82

CHANGING THE MAIN JET

Read **DANGER** and **WARNING** on page 14-1.

1. Remove the carburetor (**Figure 14-7, Page 14-8**).
 - 1.1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
 - 1.2. Access engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 1.2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 1.3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 14-1.**
 - 1.4. Turn fuel shut-off valve on gas tank to the closed (OFF) position.
 - 1.5. Loosen the intake air hose clamp (22) and disconnect the hose (23) at the carburetor end only.
 - 1.6. Remove the governor cable cotter pin (25) and clevis pin (24) (carburetor end only).
 - 1.7. Disconnect the carburetor vent line (14).
 - 1.8. Disconnect the fuel supply line (26) at the carburetor end only. Temporarily plug the end of the fuel line to prevent fuel leakage.
 - 1.9. Chock the front wheels and place a floor jack under the engine mounting plate, and raise the engine until the front bracket snubber is fully compressed. This will allow the carburetor to pass the electrical box assembly. (**Figure 14-6, Page 14-7**).
 - 1.10. Remove the carburetor retaining nuts (19), intake pipe (17), and carburetor (12). **See following NOTE.**

NOTE: Note the orientation of the gasket (16), between the carburetor intake pipe (17) and the carburetor body (12) so that it can be replaced in the same orientation (**Figure 14-7, Page 14-8**).

When removing the carburetor body, the throttle return spring (11) must be disconnected. Note its proper orientation so that it can be replaced with the same orientation.

The carburetor must be kept upright during removal.

2. Position the carburetor with the drain screw (11) over a catch basin (**Figure 14-8, Page 14-9**).
3. Turn the carburetor bowl drain screw counterclockwise two or three turns and drain all the fuel from the bowl into the catch basin (**Figure 14-8, Page 14-9**). Tighten the drain screw to 10 in-lb (1.1 N·m). Return fuel to the gas tank or dispose of properly.
4. Mark the body of the carburetor and the carburetor fuel bowl with an indelible ink marker so that, after removal, the bowl can be installed again in the same position (**Figure 14-8, Page 14-9**).

- Remove the carburetor fuel bowl retaining screw and washer (12), then remove the fuel bowl (10) and clean it with a nonflammable solvent (**Figure 14-8, Page 14-9**). See following **NOTE**.

NOTE: Make sure the fuel bowl gasket (9) remains properly seated in the carburetor body when the fuel bowl is removed (**Figure 14-8, Page 14-9**).

During normal operation, the fuel bowl retains the float pivot pin (6). Make sure that the float pivot pin does not fall out of the carburetor body after the fuel bowl is removed.

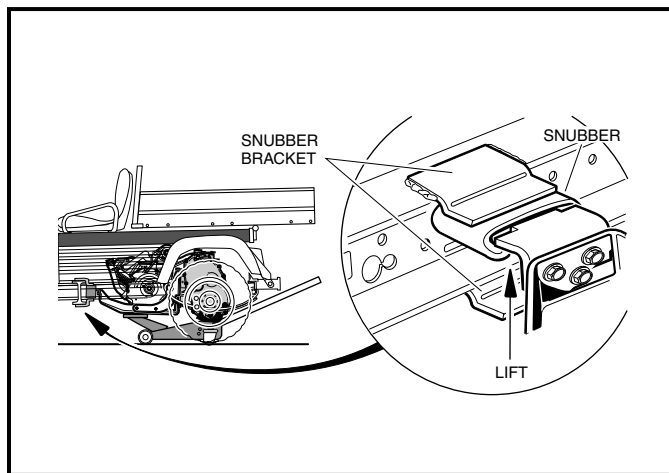


Figure 14-6 Compress Engine Snubber

- Remove the main jet (8) from the carburetor body and discard it (**Figure 14-8, Page 14-9**).

NOTE: Make sure the fuel nozzle (7) does not fall out of the carburetor body after removal of the main jet. This is best accomplished by positioning the carburetor upside down during main jet removal (**Figure 14-8, Page 14-9**).

- Select the proper size main jet. See chart on page 14-6. Check the size designation on the jet to make sure it is the correct part.
- Install the new main jet and tighten it to 12 in-lb (1.4 N·m). See following **CAUTION** and **NOTE**.

CAUTION

Do not remove the valve/spring assembly from the float assembly. Doing so will damage the spring.

NOTE: Inspect the main jet nozzle (7) and pilot jet (4) to ensure they are free from contamination. Replace any part that is clogged with contamination. Replace the float if it is damaged, or if the float valve is damaged or worn. Examine the float valve/spring assembly to make sure the spring is installed correctly (**Figure 14-8, Page 14-9**).

- Install the fuel bowl. Make sure that it is positioned properly by aligning the marks applied in step 4. See following **CAUTION**.

CAUTION

- Make sure the fuel bowl is properly seated against the carburetor fuel bowl gasket, and the gasket is not pinched.

Changing the Main Jet, Continued:

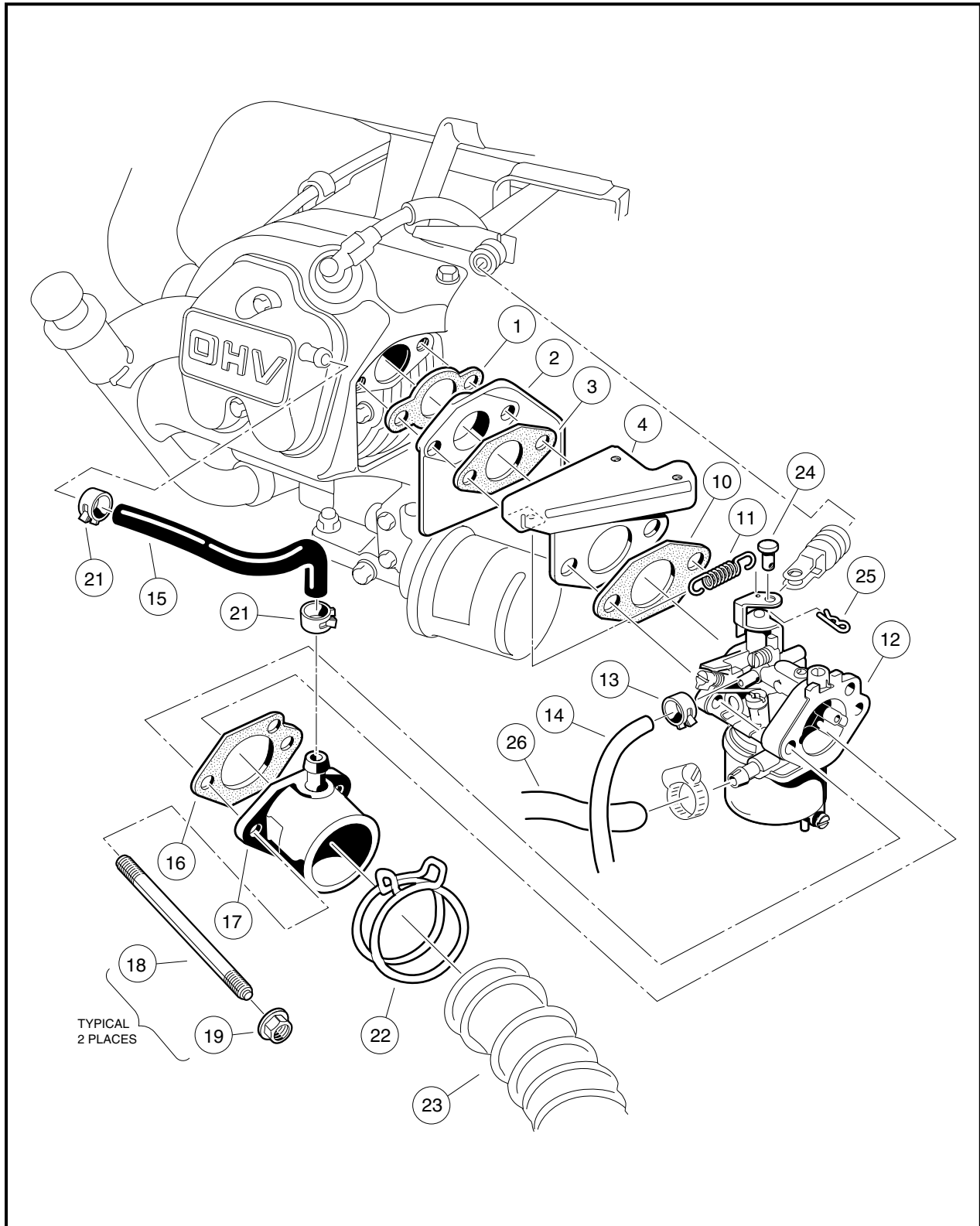


Figure 14-7 Carburetor Installation

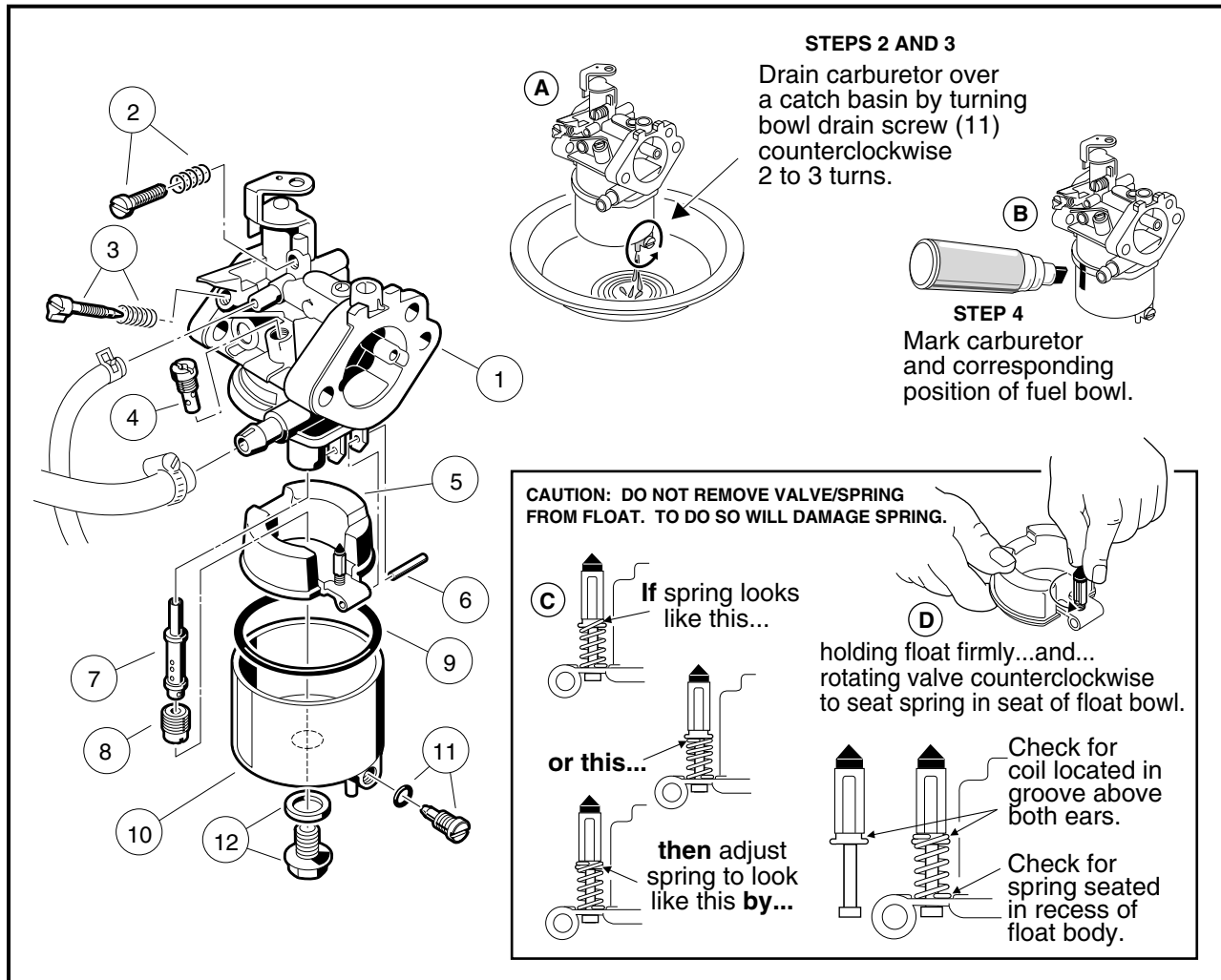


Figure 14-8 Changing the Main Jet

10. Install the fuel bowl retaining screw and tighten it to 61 in-lb (6.9 N·m).
11. Write the size of the main jet on the fuel bowl with an indelible ink marker. This should be written in a location that will be visible when the carburetor is installed on the engine.
12. Loosely attach the throttle return spring (11) to the carburetor throttle (12) and throttle bracket (4).
13. Install the carburetor (12), gasket (10), throttle spring (11), bracket (4), gaskets (1) and (3), and carburetor insulator (2) onto the manifold bolts (18) (**Figure 14-7, Page 14-8**).
14. Install the intake pipe gasket (16) (check for proper orientation) and intake pipe (17).
15. Install the carburetor retaining nuts (19) and tighten them to 50 in-lb (5.7 N·m).
16. Lower the floor jack from under the engine mounting plate, allowing the front bracket snubber to return to normal condition (**Figure 14-6, Page 14-7**).
17. Connect fuel supply line (26) and tighten screw clamp to 9 in-lb (1.0 N·m) (**Figure 14-7, Page 14-8**).
18. Install carburetor vent line (14) and clamp (13).
19. Install the governor cable clevis pin (24) and cotter pin (25).
20. Install the intake hose (23) and secure with hose clamp.

Changing the Main Jet, Continued:

NOTE: Make sure the intake hose is not twisted during installation.

21. Turn fuel shut-off valve (on gas tank) to the ON position (**Figure 14-23, Page 14-32, and Figure 14-24, Page 14-33**).
22. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
23. **Pedal-Start vehicles:**
 - 23.1. Place the neutral lockout cam in the OPERATE position.
24. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
25. Test drive the vehicle.

ENGINE CONTROL LINKAGE

Read **DANGER** and **WARNING** on page 14-1.

GENERAL INFORMATION

For proper vehicle operation, it is important the accelerator pedal, governor linkage, and throttle adjustments are done correctly and in the proper sequence. **See following CAUTION.**

⚠ CAUTION

- Improper adjustment can result in poor vehicle performance and/or damage to the engine components.

ACCELERATOR ROD

⚠ DANGER

- To ensure the vehicle does not run over you while you disconnect or adjust the accelerator push rod, do the following:
 - Turn key switch OFF, place Forward/Reverse handle in the NEUTRAL position, and remove key before servicing the vehicle.
 - Disconnect battery cables, negative (-) first.
 - Disconnect the spark plug wire from the spark plug.

Accelerator Rod Removal

1. Raise the front of the vehicle. Place chocks at the rear wheels and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the outer front frame I-beam of the vehicle. **See Figure 5-2, Section 5, Page 5-4. See preceding DANGER. See WARNING "Lift only one end..." on page 14-2.**
2. Remove the accelerator rod by disconnecting the ball joint (1) from the ball stud (2) on the accelerator pedal (**Figure 14-9, Page 14-11**) and from the bell crank at the electrical box (**Figure 14-11, Page 14-13**).

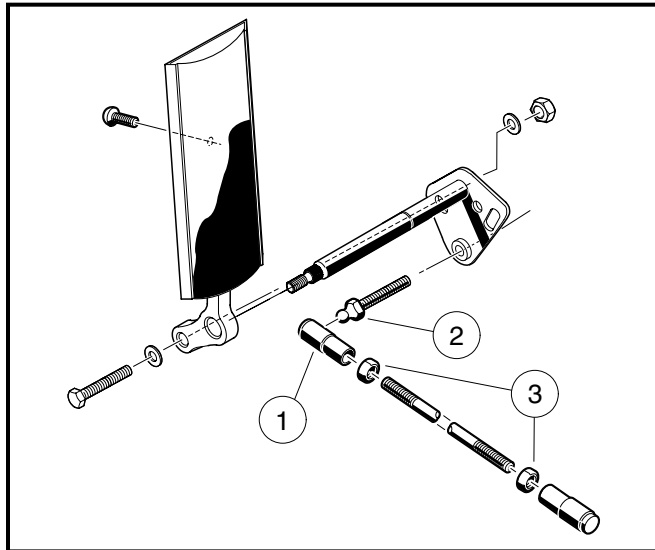


Figure 14-9 Accelerator Rod

Accelerator Rod Installation and Adjustment

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Before installing the accelerator rod, adjust accelerator pedal position. **See Accelerator Pedal Adjustment, Section 5, Page 5-7.**
3. Install the ball joint on the ball stud at the accelerator pedal (**Figure 14-9, Page 14-11**).
4. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 4.1. Tilt the bed and ensure that the prop rod is engaged.
5. Remove the electrical box screw and cover.
6. Adjust length of accelerator rod. With the ball joint jam nuts (3) loose (**Figure 14-9, Page 14-11**), adjust the length of the rod so the indicated cam edge is parallel with the edge of the electrical component box as shown (**Figure 14-10, Page 14-13**). **See following CAUTION.**

⚠ CAUTION

- After accelerator rod adjustment, make sure that approximately the same number of threads are exposed at each end of the accelerator rod.

7. Install the accelerator rod on the bell crank ball joint on the electrical component box (**Figure 14-11, Page 14-13**). **See following CAUTION and NOTE.**

⚠ CAUTION

- Inspect the limit switch inside the electrical box. If the limit switch lever is bent, replace the switch.

NOTE: Use the inside hole location, or hole closest to the bell crank shaft as shown.

8. Before tightening the jam nuts, check for proper accelerator rod operation:
 - 8.1. **Pedal-Start vehicles:**
 - 8.1.1. Begin by pressing the accelerator pedal 4° to 8°. The starter solenoid should click, indicating activation. Continue by pressing the accelerator pedal 8° to 12°. The carburetor throttle should begin to actuate.

Accelerator Rod Installation and Adjustment, Continued:**8.2. Key-Start vehicles:**

- 8.2.1. While pressing the accelerator pedal, the carburetor throttle should begin to move when the pedal is depressed approximately 8° to 12°.
9. While holding the accelerator ball joint with pliers, tighten the jam nuts against the ball joints, accelerator ball joint first, at each end of the accelerator rod.
10. Again check rod adjustment for proper switch activation.
11. After the accelerator pedal and rod are properly adjusted, adjust the engine RPM setting. **See Engine RPM Adjustment on page 14-14.**
12. Install the electrical component box cover and tighten retaining screw to 18 in-lb (2.0 N·m).
13. Lower the cargo box. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
14. Remove jack stands and return the vehicle to ground operation.

GOVERNOR CABLE**Governor Cable Removal**

1. Make sure the key switch is OFF and Forward/Reverse handle is in NEUTRAL. Chock the wheels
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Remove the cotter pin (25) and clevis pin (24) at the carburetor throttle bracket (**Figure 14-7, Page 14-8**).
4. Remove the E-ring (7) at the governor cable engine bracket (11), and governor cable support bracket (10) (**Figure 14-12, Page 14-15**).
5. Remove the cotter pin (9) and clevis pin (8) from the governor lever arm (15).
6. Remove the cable (2).

Governor Cable Installation and Adjustment

1. Install the cable onto the governor cable support bracket (10) and the engine bracket (11) and attach an E-ring (7) at each end (**Figure 14-12, Page 14-15**).
2. Push the cable dust shields onto the ends of the cable conduit.
3. Install governor cable end into carburetor throttle clevis and install clevis pin (8) and cotter pin (9).
4. Install governor cable clevis over governor lever arm and install clevis pin (8) and cotter pin (9).
5. With the governor lever arm loose on the governor shaft, use a 1/8-inch punch or scratch awl to turn the governor arm shaft counterclockwise until it stops. Then pull the governor lever arm rearward until the carburetor throttle is in the "wide open throttle" (WOT) position.
6. While holding the arm and shaft in the fully counterclockwise position, tighten the governor arm lever nut to 36 in-lb (4.0 N·m).
7. Check engine RPM adjustment. **See Engine RPM Adjustment on page 14-14.**
8. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

ACCELERATOR CABLE**Accelerator Cable Removal**

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

- 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 14-1.**
4. Remove the electrical component box cover and loosen the cable housing retaining nuts (**Figure 14-10, Page 14-13**).
5. Disconnect cable (1) from cam (17) (**Figure 14-12, Page 14-15**) in the electrical component box (**Figure 14-10, Page 14-13**).

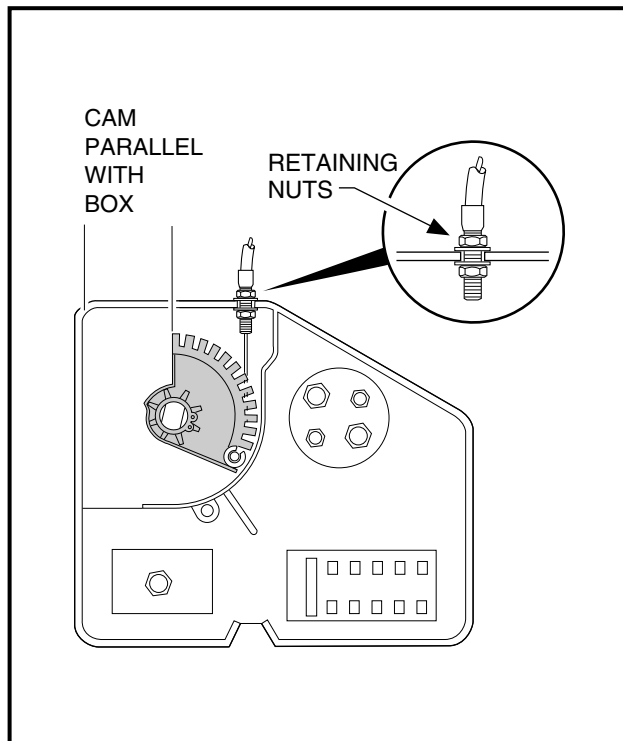


Figure 14-10 Cam Position

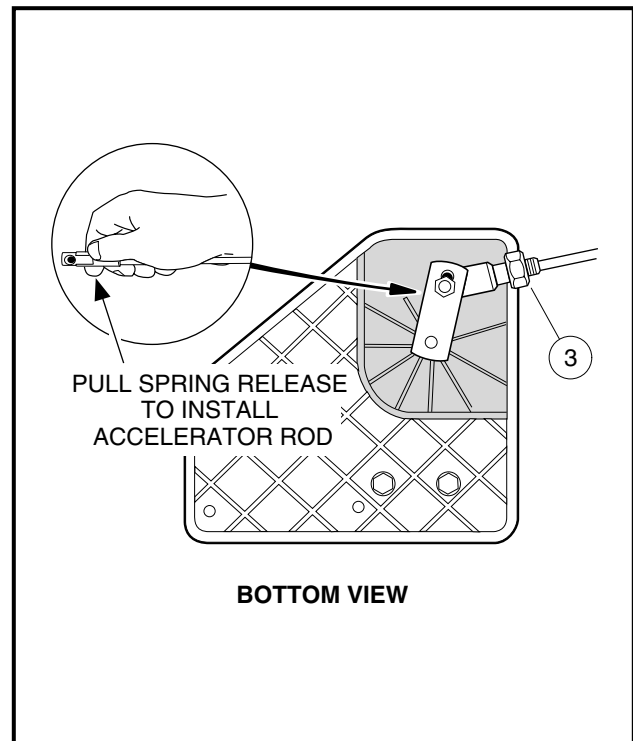


Figure 14-11 Accelerator Rod

6. Remove the E-ring (7) on the spring end of the cable at the accelerator cable bracket (5) (**Figure 14-12, Page 14-15**). Pull the cable housing out of the bracket.
7. Disconnect the spring (16) from the engine governor arm by rotating the arm counterclockwise one-half turn. Remove the cable assembly from the vehicle.

Accelerator Cable Installation

1. Connect the cable to the cam (17) in the electrical box (**Figure 14-12, Page 14-15**).
2. Insert the cable housing into the mounting slot in the wall of the electrical box, with approximately the same number of threads visible between the jam nuts as are visible from the nut inside the box to the end of the cable housing (**Figure 14-10, Page 14-13**). Tighten the nuts finger tight.
3. Connect the spring (16) to the engine governor arm (**Figure 14-12, Page 14-15**).
4. Install cable in accelerator cable bracket (5) and secure it with E-ring (7).
5. Push the cable dust shield onto the spring end of the cable conduit.
6. Before tightening the cable housing retaining nuts, make sure the engine RPM adjustment is correct. **See Engine RPM Adjustment on page 14-14.**

Accelerator Cable Installation, Continued:

7. Install the electrical component box cover, and tighten the retaining screw to 18 in-lb (2.0 N-m).
8. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27 N-m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
9. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

CLOSED THROTTLE OR IDLE ADJUSTMENT**1. Pedal-Start vehicles:**

- 1.1. When the accelerator pedal is released, the engine will stop. Therefore, it is not possible to measure or set idling speed under normal vehicle operating conditions. Set throttle valve as follows:
 - 1.1.1. Loosen the carburetor idle screw so that it is not touching the throttle lever (**Figure 14-13, Page 14-16**).
 - 1.1.2. Slowly tighten the idle screw until it lightly touches the throttle lever, then tighten it an additional 3/4 turn.

2. Key-Start vehicles:

- 2.1. With the engine running and the Forward/Reverse handle in NEUTRAL, attach a tachometer (CCI P/N 1016112) to the spark plug wire and adjust the low idle screw on the carburetor until the tachometer reads 1200 to 1250 RPM (**Figure 14-13, Page 14-16**).

ENGINE RPM ADJUSTMENT** DANGER**

- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**
1. If the governor is adjusted, proceed to step 2; otherwise, adjust the governor. **See Governor Cable Installation and Adjustment on page 14-12.**
 2. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N-m).
 - 2.1. **Pedal-Start vehicles:**
 - 2.1.1. Place the Forward/Reverse handle in the NEUTRAL position and place the neutral lockout cam in the SERVICE position. Chock the wheels.
 - 2.2. **Key-Start vehicles:**
 - 2.2.1. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
 3. Connect a tachometer (CCI P/N 1016112) to the spark plug lead.
 4. With the tachometer connected, and the engine at normal operating temperature, check high speed RPM. With the accelerator pedal pressed to the floor, the tachometer should read:
 - FE350 Engine: 3800 (±30) RPM
 - FE400 Engine: 3850 (±30) RPM
 5. To reduce RPM, loosen the accelerator cable retaining nut on the outside of the electrical box wall and tighten the retaining nut on the inside of the wall until the specified RPM is reached (**Figure 14-10, Page 14-13**). To increase RPM, loosen the cable retaining nut inside the electrical box and tighten the nut outside the box until the desired RPM is reached.

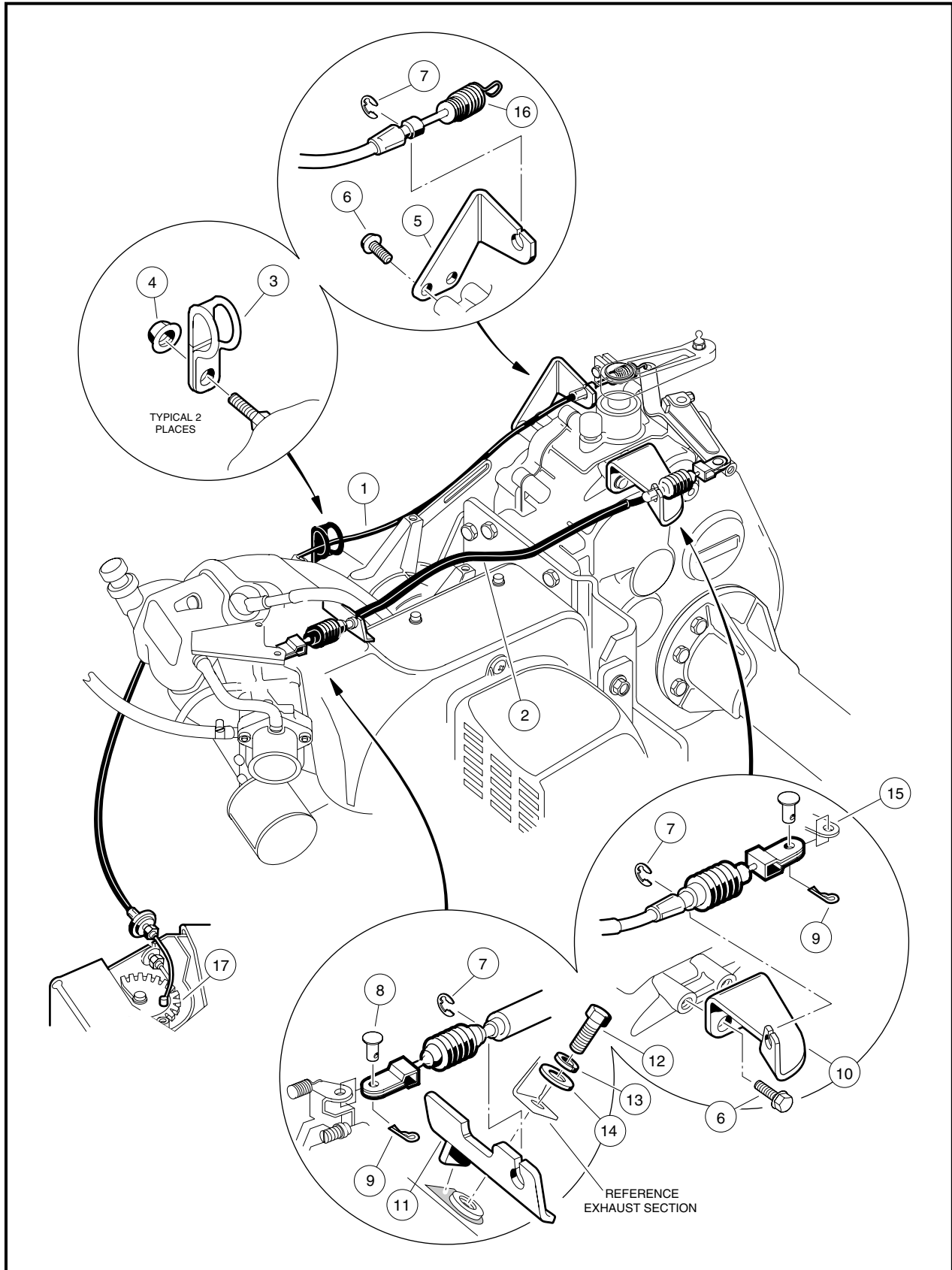
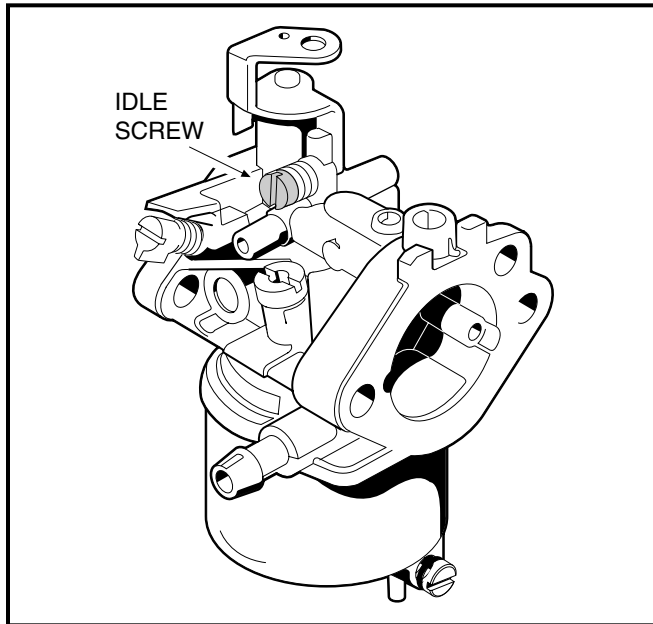


Figure 14-12 Governor and Accelerator Cables

Engine RPM Adjustment, Continued:**Figure 14-13 Idle Screw**

6. Be sure both retaining nuts are locked against the electrical box and then check the RPM again. If the RPM needs to be adjusted, repeat step 5.
7. If more adjustment is required than the cable housing will allow, make sure the spring on the other end of the accelerator cable is properly positioned. Excessive belt and torque converter wear can also prevent proper RPM adjustment. Check them for excessive wear. **See Section 17 – Torque Converter.**

CHOKE AND AIR INTAKE SYSTEM

Read **DANGER** and **WARNING** on page 14-1.

GENERAL INFORMATION

The choke system is a simple mechanism requiring very little or no maintenance. The system consists of a choke assembly that is attached to the driver side of the front body, an air filter housing with a hose that is attached to the carburetor, and an air duct that provides the engine with air from outside the engine compartment. Clean, cool air is drawn through the choke assembly and into the air cleaner intake. This feature increases engine horsepower and extends air filter life.

The choke system aids in starting the engine in cold weather. When starting a cold engine, the choke cable handle is pulled. This restricts the air flow, creating a “fuel rich” mixture in the carburetor. The choke cable handle is pulled until the engine starts, and then is released. The air flow to the engine is no longer restricted, and the engine operates normally.

The choke assembly is adjusted at the factory and does not require field adjustment. However, if the choke assembly is subjected to abuse or damaged, it may become necessary to replace the assembly.

CHOKE CABLE REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Remove the screw (17) securing cable to air box and detach cable end from choke lever (6) (**Figure 14-15, Page 14-23**).
4. Remove three screws (19), nuts (21) and washers (20) from body and remove choke cable assembly from body (**Figure 14-15, Page 14-23**).

CHOKE CABLE INSTALLATION

1. Insert choke cable through hole in body until choke lever assembly seats against body.
2. Install three screws (19), washers (20), and lock nuts (21) as shown and tighten to 18 in-lb (2.0 N·m) (**Figure 14-15, Page 14-23**).
3. Check the hex nut on the cable at the back of the choke lever assembly. If it is loose, tighten it until the lock washer beside it collapses completely.
4. Attach choke cable to choke lever (6) on air box. Install screw (17) to secure cable to air box and tighten to 18 in-lb (2.0 N·m) (**Figure 14-15, Page 14-23**).
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

AIR BOX REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is engaged.
3. Remove the air intake box from the vehicle by removing intake hose (16) and three screws (23) and washers (22) (**Figure 14-15, Page 14-23**).

AIR BOX INSTALLATION

NOTE: The intake duct must be in place before the air box can be installed.

1. Check to be sure the intake seal (13) is seated correctly (**Figure 14-15, Page 14-23**). The seal fits tightly onto the bottom side of the air box. If seal is not in place, moisture will enter the air intake system.
2. Place the air box assembly into vehicle and install three flat washers (22) and screws (23) from underside of air box mounting plate into air box (**Figure 14-15, Page 14-23**). Tighten to 33 in-lb (3.7 N·m).
3. Place hose onto air box and secure with wire clamp.
4. Attach the choke cable to the air box top. **See Choke Cable Installation on page 14-17.**
5. Test choke for proper operation.
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

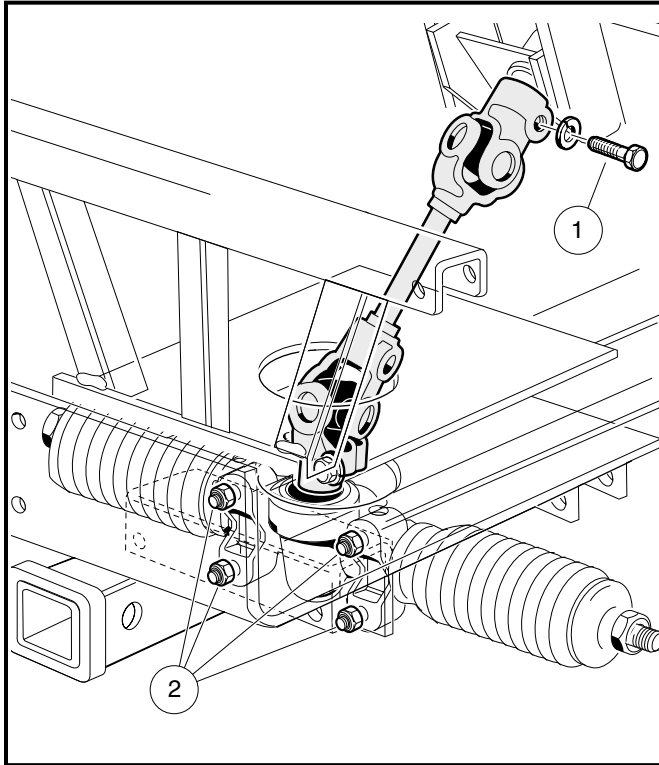


Figure 14-14 Compound Steering Joint

INTAKE DUCT REPAIR

If the air intake duct has a crack of 1/16-inch (1.5 mm) or less, and does not exceed 11 inches (27.5 cm) in length, or has a round shaped hole no greater than 1/2-inch (12.7 mm) in diameter, it may be repairable with an Air Duct Repair Kit (CCI P/N 101971001). The kit includes repair materials and procedures for small cracks and holes. If the intake duct is badly torn or has larger holes, it will need to be replaced.

INTAKE DUCT REMOVAL

NOTE: This procedure is best accomplished using two people.

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Remove the front body. **See Front Body Removal, Section 4, Page 4-4.**
3. Slightly loosen the lug nuts on the both front wheels.
4. Place wheel chocks in front of the two rear wheels and raise the front of the vehicle with a floor jack.
5. Place jack stands under the vehicle frame to support the front of the vehicle with the front wheels off of the ground and lower the vehicle onto the jack stands.
6. Remove the lug nuts from both front wheels and remove the wheels.
7. Remove the bolt (1) that connects the steering joint to the steering column shaft (**Figure 14-14, Page 14-18**).

NOTE: The bolt must be removed completely before the splined coupling can be separated.

Make an alignment mark on the steering column shaft and the steering joint for use during replacement.

8. Remove the four bolts and lock nuts (2) from the rack and pinion assembly mount and gently disconnect the steering joint from steering column shaft at the bolt (1) location (**Figure 14-14, Page 14-18**). Gently allow both the rack and pinion assembly and the steering column shaft to drop down, remaining suspended between both rod ball joint ends.
9. Remove the two bolts (26), lock nuts and flat washers that secure the top of the strap plate (27) to the vehicle frame (**Figure 14-15, Page 14-23**).
10. Remove the two bolts (28) and nuts that connect the upper shock mounts to the shock tower and bottom of the strap plate (27) (**Figure 14-15, Page 14-23**).

⚠ CAUTION

- **When removing the two bottom bolts (28) from the strap plate and shock tower, the A-arm assemblies will drop. It's best to have one person hold the front brake drum assembly while a second person removes each bolt from their respective shock and shock tower, and gently allow the A-arm assembly to rest in a suspended condition.**

11. Remove the strap plate (27) (**Figure 14-15, Page 14-23**).
12. Roll the floormat from underneath the dashboard and drill out the one bottom pop rivet (30) that secures the air intake shield (29) to the floorboard.
13. The shield has a strip of double-sided tape laminated to the top edge of the shield. It may be necessary to bend the shield outward to pry apart this attachment area using a putty knife or other thin blade device so that the inlet port of the duct can pass the shield.

NOTE: *It may become necessary to re-form the shield prior to installation if deformation occurs during removal.*

14. Remove the shield (29) from the vehicle frame.
15. Drill out the pop rivet (24) securing the top of the intake duct to the floorboard (**Figure 14-15, Page 14-23**).
16. Remove the air box assembly. **See Air Box Removal on page 14-17.**
17. Lift air box assembly off the intake duct. Be careful that the intake seal on the bottom of the air box assembly is not dislodged in the process.
18. Pull the intake duct forward, and out of the vehicle.

INTAKE DUCT INSTALLATION

NOTE: *This procedure is best accomplished using two people.*

The intake duct assembly is installed from the front of the vehicle, in reverse order of removal.

1. Slide the intake duct between the round crossmember and the floorboard, moving it to the rear along the underside of the floorboard.

NOTE: *It is best to have a second person guide the air box end of the duct into position as it is pushed from the front of the vehicle. Insert the end of the intake duct through the slot in the front of the air box mounting plate.*

2. Secure the front of the duct to the underside of the floorboard with pop rivet (24) and flat washers (25) (**Figure 14-15, Page 14-23**).
3. Place a piece of double-sided adhesive tape on the intake shield and remove the adhesive backing.

NOTE: *If necessary reform any minor deformation of the shield and clean the old double-sided adhesive tape cleanly from both the shield and vehicle frame before installation of the shield.*

Intake Duct Installation, Continued:

4. Install the shield to the frame with the adhesive strip and pop rivet (30).
5. Install air box. **See Air Box Installation on page 14-17.**
6. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
7. Assemble front end components.

NOTE: *This procedure is best accomplished using two people.*

- 7.1. Attach each of the front A-arms to the to the shock tower at the top shock mount and bottom hole locations of the strip plate (27) using bolts (28) and lock nuts. Do not tighten (**Figure 14-15, Page 14-23**).
 - 7.2. Position the top edge of the strap plate (27) on the frame and install the two bolts (26), flat washers and lock nuts. Do not tighten.
 - 7.3. Tighten bolts (28) at the shock tower and strip plate (27) to 20 ft-lb (27 N·m).
 - 7.4. Tighten bolts (26) at the top of the strip plate (27) and frame to 20 ft-lb (27 N·m).
8. Install steering joint. **See following NOTE.**

NOTE: *Make sure steering wheel and front wheels are properly aligned before installing steering joint.*

The steering column shaft has a machined flat area provided for passage of the bolt when assembled to the steering joint.

- 8.1. Slip the splined steering joint over the splined steering column shaft, aligning with the mark made during disassembly. Attach the bolt (1) through the steering joint flange and loosely attach the nut (**Figure 14-14, Page 14-18**).
 - 8.2. Attach the rack and pinion assembly to the shock tower plate using the four bolts (2) and lock nuts (**Figure 14-14, Page 14-18**). Tighten to 20 ft-lb (27 N·m).
 - 8.3. Tighten the bolt (1) of the steering joint flange to 15 ft-lb (20.3 N·m).
9. Install the front wheels. Tighten the wheel lug nuts finger tight.
 10. Lower the vehicle and tighten the wheel lug nuts, using a crisscross pattern, to 55 ft-lb (75 N·m).
 11. Install front body. **See Front Body Installation, Section 4, Page 4-6.**
 12. Check for proper operation.
 13. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

AIR FILTER**General Information**

The air filter should be checked every year or 100 hours. More frequent service may be required in extremely dirty operating environments. Need for immediate servicing will be indicated by a loss of power, sluggish acceleration or an engine that runs roughly with excessive black exhaust smoke.

Air Filter Replacement

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 2.2. Remove driver side seat.
3. Lift two latches (3) on the side of the air box (**Figure 14-15, Page 14-23**).
4. Remove the hose clamp (15) from the air hose and remove hose from the air box assembly.
5. Standing on driver side of vehicle, grasp air hose mounting inlet and open box fully. Remove filter element (11).

6. Using a clean cloth, wipe away any dust or dirt from inside the air box. Remove all dirt build-up around the inside lip of the box or the box will not seal properly.
7. Install new air filter by inserting back edge first, and pushing down using the palm of your hand to seat filter evenly onto inside lip of air box. Ensure filter fits correctly and that the wire latches are not caught between lid and air box. Close the lid.
8. Fasten wire latches (3). Make sure latches securely engage the bottom half of the box. **See following CAUTION.**

⚠ CAUTION

- **Engine damage will occur if the air box cover is not properly secured.**
 - **If air box is extremely dirty, remove air box from vehicle and clean thoroughly.**
 - **Use only Club Car replacement air filters (CCI P/N 1015426). The use of other air filters could result in engine damage. If the air filter is too thin, the cover will seat before the filter can seal, leaving space for dirt to pass into the engine on all sides of the element. This will damage the engine and void the warranty.**
9. Install hose (16) and hose clamp (15) (**Figure 14-15, Page 14-23**). Make sure clamp ends are located in the 12:00 o'clock position.
 10. Install the driver side seat.
 11. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

FUEL FILTERS

Read DANGER and WARNING on page 14-1.

GENERAL INFORMATION

Fuel is supplied to the fuel pump and carburetor through flexible lines. Two in-line filters are installed between the fuel tank and the carburetor (**Figure 14-18, Page 14-27**). Fuel filters, fuel lines, and the fuel tank vent should be inspected periodically for leaks.

The fuel filters should be replaced when necessary, but under no circumstance should the period of time between filter changes exceed two years or 200 hours.

FUEL FILTER REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 2.2. Lift both seats.
3. Disconnect the spark plug. **See WARNING "To avoid unintentionally starting..." on page 14-1.**
4. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 14-1.**
5. **Pedal-Start vehicles:**
 - 5.1. Place the neutral lockout cam in the SERVICE position.
6. To prevent gasoline drainage, turn the fuel shut-off valve (15) (**Figure 14-18, Page 14-27**) on the gas tank to the closed (OFF) position (**Figure 14-22, Page 14-32**).
7. Remove the primary fuel filter (17) (**Figure 14-18, Page 14-27**).
 - 7.1. Remove the clamps (16) and fuel lines (1) and (2) from the filter and plug the fuel lines (**Figure 14-18, Page 14-27**).

Fuel Filter Removal, Continued:

8. Remove the secondary filter (22) (**Figure 14-18, Page 14-27**).
 - 8.1. Remove the clamps (16) and fuel lines (3 and 4) from the filter and plug the fuel lines (3 and 4) (**Figure 14-18, Page 14-27**).

FUEL FILTER INSTALLATION** CAUTION**

- **Fuel filters are marked with flow direction arrows. Make sure that filters are installed with arrows pointing in the direction of fuel flow from tank to carburetor.**
1. Install the primary fuel filter (17) in the fuel line. Use new clamps (16) (**Figure 14-18, Page 14-27**).
 2. Install the secondary fuel filter (22) in the fuel line. Use new clamps (16).
 3. Turn the fuel shut-off valve to the ON position (**Figure 14-23, Page 14-32**).
 4. Connect the spark plug wire to the spark plug.
 5. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
 6. Start the engine and check for fuel leaks. **See following DANGER.**
 - 6.1. **Pedal-Start vehicles:**
 - 6.1.1. With the neutral lockout cam in the SERVICE position, start the engine and check for fuel leaks. **See owners manual, Controls and Indicators. Also see Neutral Lockout Cam, Section 12b, Page 12b-20.**
 - 6.1.2. Place the neutral lockout cam in the OPERATE position.
 - 6.2. **Key-Start vehicles:**
 - 6.2.1. Start the engine and check for fuel leaks.

 DANGER

- **Repair any fuel leaks before operating the vehicle.**
7. Lower both seats.
 8. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

FUEL PUMP

Read DANGER and WARNING on page 14-1.

GENERAL INFORMATION

The gasoline vehicle is equipped with an impulse fuel pump. If the fuel pump is not operating properly, perform the following tests:

- Make sure all hose clamps are tight.
- Inspect the impulse line and fuel lines for damage or clogging.
- Make sure the air vent on the fuel pump is not clogged with dirt.
- Make sure the fuel filters are not clogged.

To clean the air vent, the fuel pump must be disassembled.

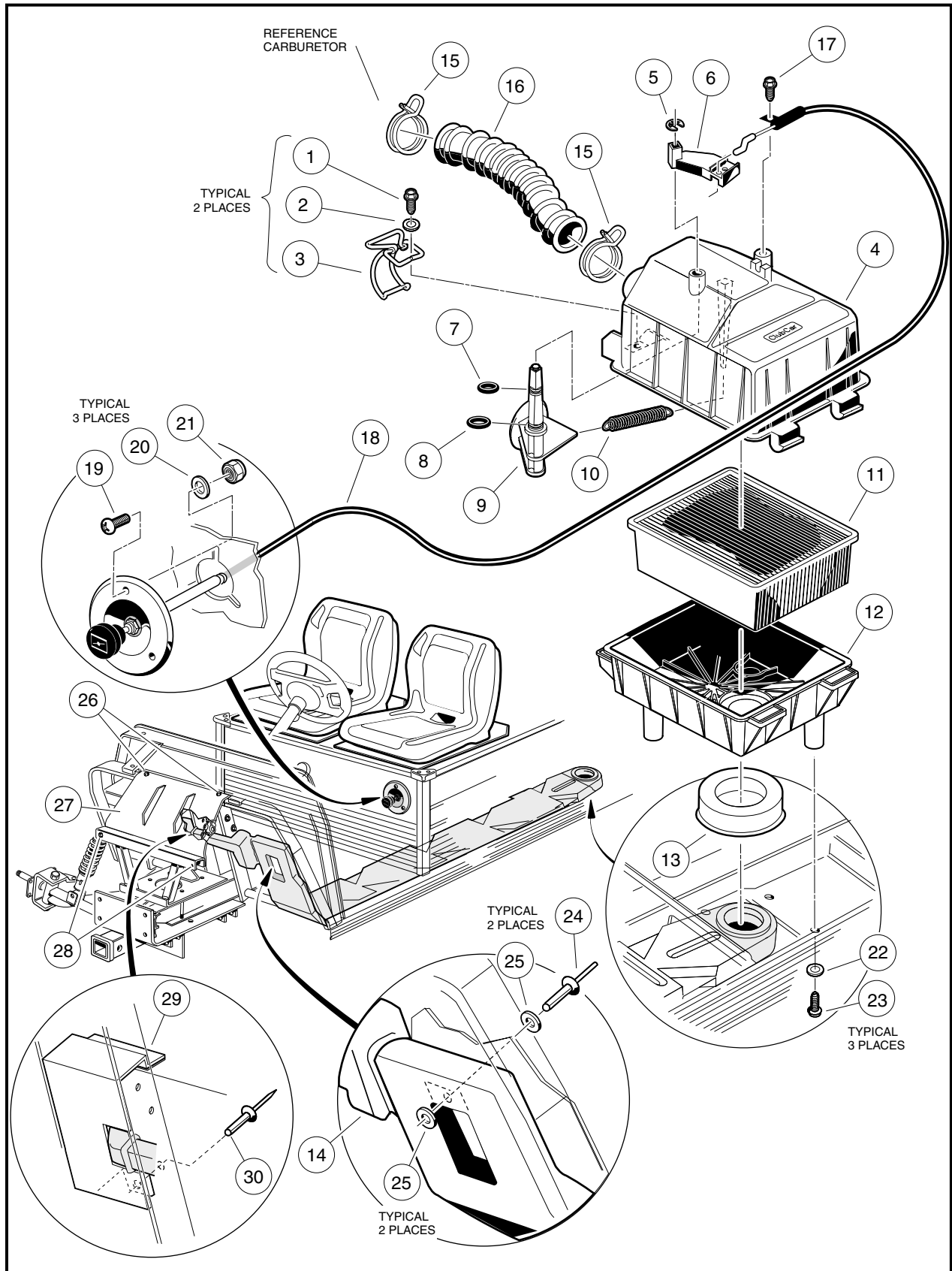


Figure 14-15 Air Intake and Choke Assemblies

FUEL PUMP REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 2.2. Lift the passenger side seat.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 14-1.**
4. **Pedal-Start vehicles:**
 - 4.1. Place the neutral lockout cam in the SERVICE position.
5. Turn fuel shut-off valve on top of the gas tank to the closed (OFF) position (**Figure 14-22, Page 14-32**).
6. Remove hardware (25) attaching the fuel pump (18) and lift the fuel pump out of the engine compartment (**Figure 14-18, Page 14-27**).
7. Remove the clamp (20) and impulse line (7) from fuel pump (**Figure 14-18, Page 14-27**).
8. Disconnect the fuel lines (2 and 3) from the pump and plug them to prevent gasoline leakage (**Figure 14-18, Page 14-27**). **See following WARNING.**

⚠ WARNING

- **Carefully drain any fuel remaining in the pump into a container. Add drained fuel back into gas tank or dispose of properly.**

9. Remove the back cover (36), the fuel diaphragm (34) and gasket (35) (**Figure 14-16, Page 14-25**).

FUEL PUMP DISASSEMBLY

NOTE: A fuel pump rebuild kit is available from Club Car (CCI P/N 1014524). This kit includes all gaskets, diaphragms, and valves.

1. Remove four screws (24) and lock washers (25) from front of the fuel pump (**Figure 14-16, Page 14-25**).
2. Remove the front cover of the fuel pump while holding the rest of the pump intact.
3. Note the orientations of the impulse gasket (27), the diaphragm (28), and the gasket (29), then remove them from the pump (**Figure 14-16, Page 14-25**). **See following CAUTION.**

⚠ CAUTION

- **Fuel pump gaskets and diaphragms must be reinstalled in exactly the same positions and orientations they were in before disassembly, or the pump could leak. If leaking occurs, all new gaskets and diaphragms must be installed.**
4. If the impulse gasket (27) and the diaphragm (28) come off with the front cover, note their orientations and remove them (**Figure 14-16, Page 14-25**).
 5. Remove the pumping chamber (30) (**Figure 14-16, Page 14-25**).
 6. Remove the back cover (36), the fuel diaphragm (34), and gasket (35).

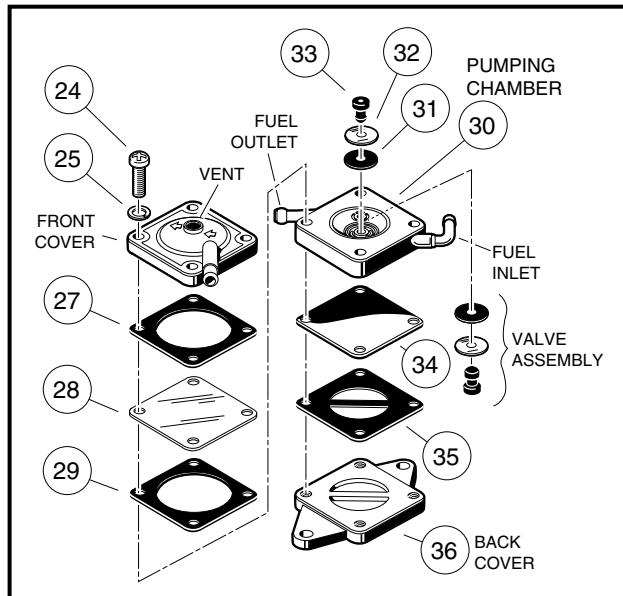


Figure 14-16 Fuel Pump

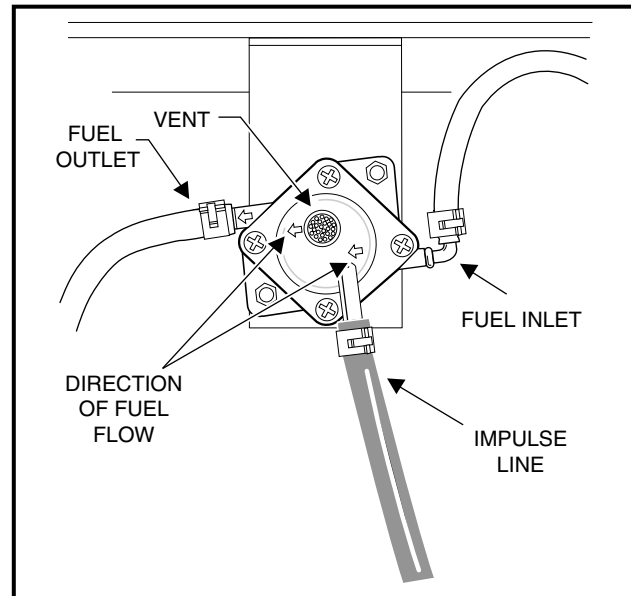


Figure 14-17 Fuel Pump Orientation

FUEL PUMP CLEANING AND INSPECTION

1. Using a nonflammable solvent, clean the front cover, pumping chamber, and back cover. Be sure the vent on the front cover is clean both inside and out.
2. Inspect the valve assemblies (31, 32, and 33) and all gaskets and diaphragms for damage (Figure 14-16, Page 14-25).
3. If a valve assembly is damaged, the rubber retaining plug (33) and valve assembly must be replaced (Figure 14-16, Page 14-25).

FUEL PUMP ASSEMBLY

1. Install the fuel gasket (35) and diaphragm (34) on the back cover (36) (Figure 14-16, Page 14-25).
2. Install the valve assembly in the pumping chamber (30) (Figure 14-16, Page 14-25). See following CAUTION.

CAUTION

- If the valve assembly is not installed exactly as shown, the impulse fuel pump will not operate properly.
3. Install the pumping chamber (30) on top of the fuel diaphragm (34). Be sure the fuel inlet and the fuel outlet align with the arrows on the front of the front cover (Figure 14-16, Page 14-25).
 4. Install the gasket (29), clear impulse diaphragm (28), and the paper impulse gasket (27) to the pumping chamber (30).
 5. Install the front cover and then the lock washers (25) and four screws (24) on the assembly (Figure 14-16, Page 14-25). Be sure the arrows on the front cover point from the fuel inlet to the fuel outlet (Figure 14-17, Page 14-25). Tighten the screws to 26 in-lb (3.0 N·m).

FUEL PUMP INSTALLATION

1. Connect the fuel line (2) that comes from the fuel filter (17) to the fuel pump (18). Install a new clamp (16) (**Figure 14-18, Page 14-27**). **See same figure for proper routing of fuel lines.**

NOTE: Be sure to connect the fuel line (2), that comes from the primary fuel filter (17), to the inlet nipple on the pump. Direction of fuel flow is indicated by the arrows on the fuel pump (**Figure 14-18, Page 14-27**).

2. Connect the fuel line (3) to the fuel pump (18) that goes to the secondary fuel filter (22) (**Figure 14-18, Page 14-27**). Install a new clamp (16).
3. Connect the impulse line (7) to the bottom nipple on the fuel pump (18) (**Figure 14-18, Page 14-27**). Use a new clamp (20).
4. Install the fuel pump onto the mounting bracket with two thread-rolling screws (25) and tighten to 40 in-lb (4.5 N·m) (**Figure 14-18, Page 14-27**).
5. Turn the fuel shut-off valve on top of the gas tank to the open position (**Figure 14-23, Page 14-32 and Figure 14-24, Page 14-33**).
6. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
7. Start the engine and check for fuel leaks. **See following DANGER.**
 - 7.1. **Pedal-Start vehicles:**
 - 7.1.1. Place the neutral lockout cam in the SERVICE position. Start the engine and check for fuel leaks. If the fuel pump leaks, a rebuild kit or new fuel pump must be installed to replace all gaskets and diaphragms, or entire pump. **See owners manual, Controls and Indicators. See also Neutral Lockout Cam, Section 12b, Page 12b-20.**
 - 7.1.2. Place the neutral lockout cam in the OPERATE position.
 - 7.2. **Key-Start vehicles:**
 - 7.2.1. Start the engine and check for fuel leaks. If the fuel pump leaks, a rebuild kit or new fuel pump must be installed to replace all gaskets and diaphragms, or entire pump.

DANGER

- Repair any fuel leaks before using the vehicle.

8. Lower the passenger side seat.
9. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

FUEL TANK

Read **DANGER** and **WARNING** on page 14-1.

WARNING

- If the fuel tank is damaged, replace it. Do not attempt to repair it. See the following tank removal and disposal procedure.

CAUTION

- Add only unleaded gasoline to the tank. Do not put oil into the fuel tank.

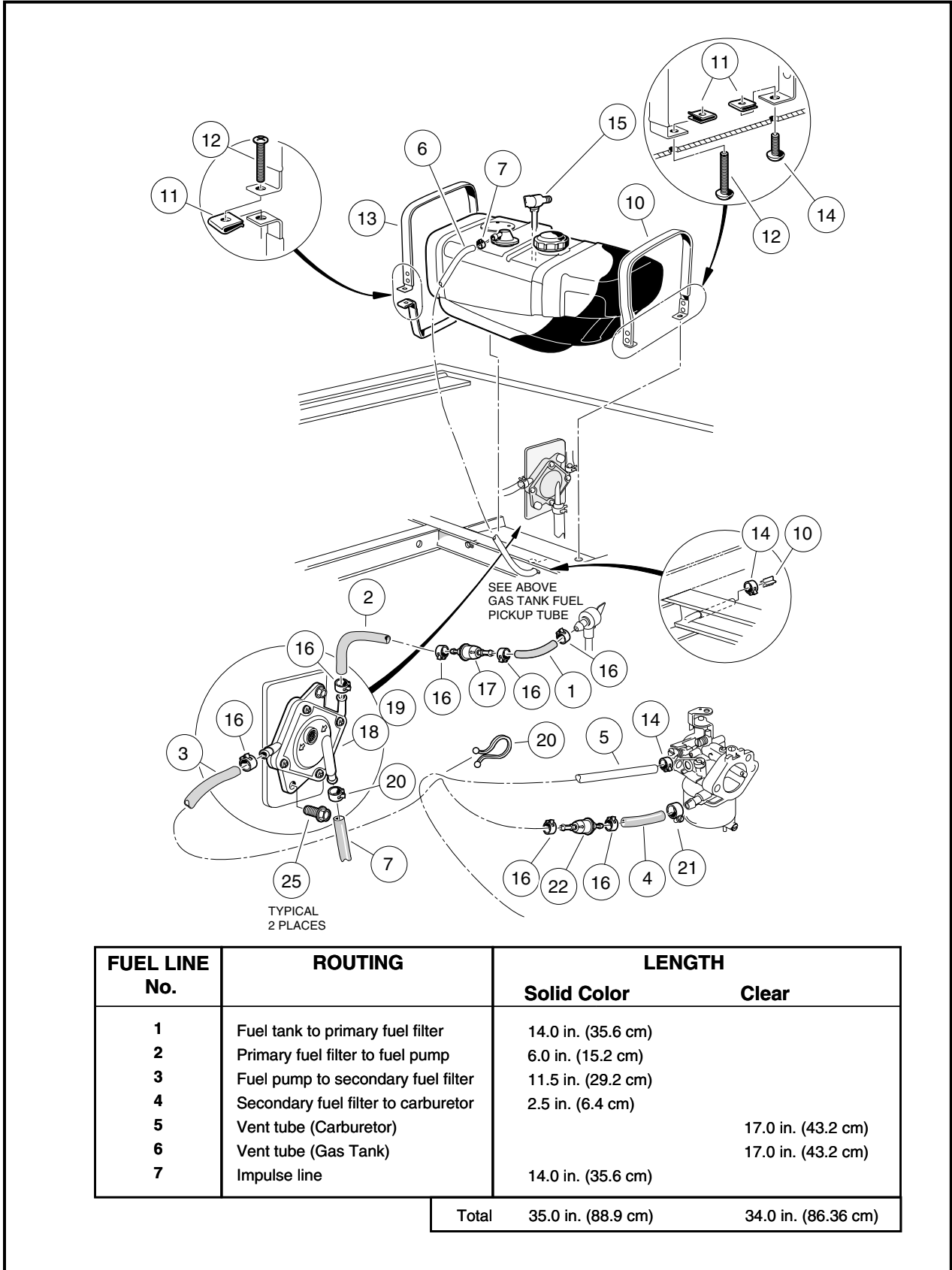


Figure 14-18 Fuel and Vent Lines

GENERAL INFORMATION

The vehicle is equipped with a high impact plastic, seven gallon (26.5 liter) fuel tank.

FUEL TANK REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 14-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Completely remove both seats from the vehicle.
4. Turn fuel shut-off valve to the closed (OFF) position (**Figure 14-22, Page 14-32**).
5. **Pedal-Start vehicles:**
 - 5.1. Place the neutral lockout cam in the SERVICE position.
6. Run the engine until fuel remaining in the carburetor, fuel pump, and fuel lines is used up and the engine stalls.
7. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 14-1.**
8. Remove the four bolts (8), eight washers (9) and four lock nuts (10) from the seat support and remove the two armrests (11 and 12) from the vehicle. **See Figure 4-3, Section 4, Page 4-10.**
9. Carefully remove and rotate the seat support (7) 90° clockwise and allow it to rest on the vehicle body as illustrated (**Figure 14-19, Page 14-28**). **See following NOTE.**

NOTE: It is not necessary to remove the park brake cable or differential lock cable to service or remove the fuel tank.

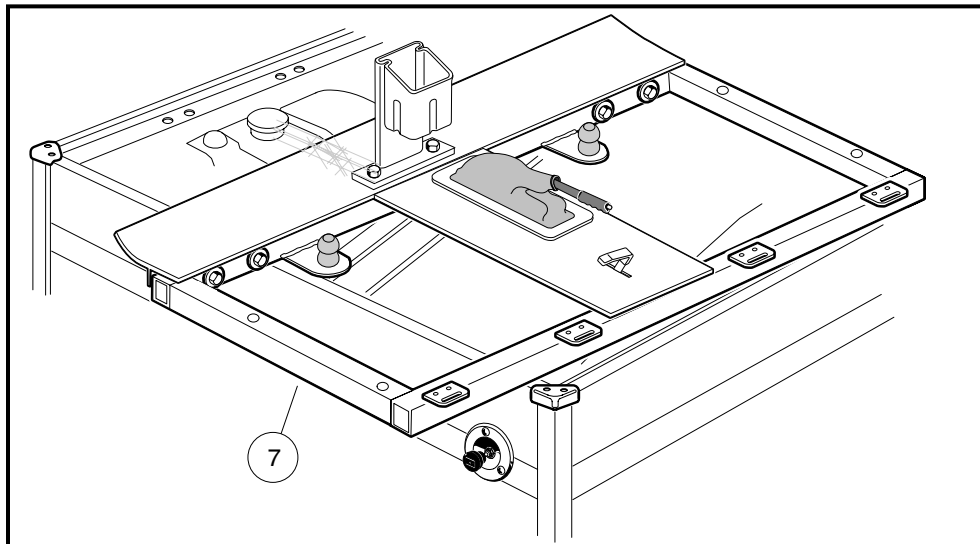


Figure 14-19 Fuel Tank Removal

10. Loosen, but do not remove, the carburetor drain screw (11) (**Figure 14-8, Page 14-9**) and drain fuel remaining in the carburetor bowl into an approved container.
11. Using a siphon with a suction device, siphon all fuel out of the tank and into an approved container. **See following DANGER and WARNING.**

▲ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

▲ WARNING

- **Never attempt to siphon fuel using a hose that does not have a built-in suction device.**
 - **Never attempt to siphon fuel using your mouth.**
12. Disconnect the black wire and orange wire from the fuel level sending unit on the tank (**Figure 14-20, Page 14-30**). Do NOT remove the lower nut on the center stud of the sending unit. **See following WARNING.**

▲ WARNING

- **Make sure the key switch is OFF before disconnecting wiring.**
13. Remove the vent tube (6) and fuel line (1) from the fuel tank (**Figure 14-18, Page 14-27**).
14. Loosen the straps (13 and 10) by removing the screws (12 and 14) from the speed nuts (11) (**Figure 14-18, Page 14-27**).
15. Lift the fuel tank out of the vehicle.

FUEL TANK DISPOSAL

1. Remove the cap from the tank and thoroughly rinse it with water. The cap may be discarded or kept as a spare.
2. In a well-ventilated area, flush the fuel tank with water to remove any remaining gasoline.
3. In a well-ventilated area, set the tank upside down so that the water can drain out of it. To make sure that the tank dries completely, allow the tank to sit for 24 hours. **See following CAUTION.**

▲ CAUTION

- **Dispose of wastewater and fuel tank in accordance with federal, state and local laws and ordinances.**

FUEL TANK STORAGE

1. Remove the cap from the tank and thoroughly rinse it with water.
2. In a well-ventilated area, flush the fuel tank with water to remove any remaining gasoline.
3. In a well-ventilated area, set the tank upside down so that the water can drain out of it. To make sure that the tank dries completely, allow the tank to sit for 24 hours.
4. Store the tank upside down, with the cap installed, in a well-ventilated area.

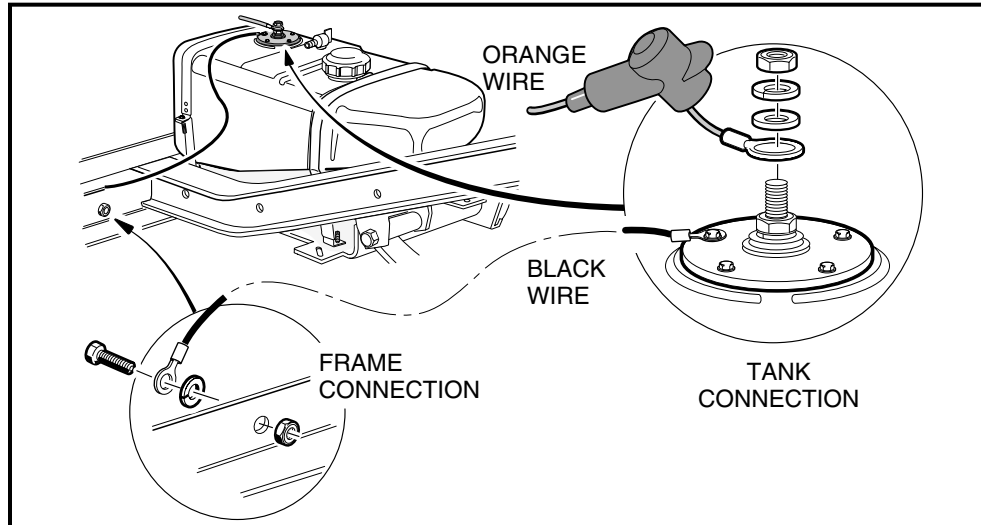


Figure 14-20 Fuel Level Sending Unit

FUEL TANK INSTALLATION

1. With the retaining straps correctly positioned, install the fuel tank in the vehicle (**Figure 14-18, Page 14-27**).
2. Secure the tank with the retaining straps (13 and 10) (**Figure 14-18, Page 14-27**).
 - 2.1. Position the straps in the indentions on the tank.
 - 2.2. Install the screws (12 and 14) into the speed nuts (11). Tighten screws to 25 in-lb (2.8 N·m) (**Figure 14-18, Page 14-27**).
3. Return the seat support (1) to its original position by rotating it 90° counterclockwise (**Figure 14-19, Page 14-28**) and install the seat support and armrests. Tighten bolts (8) to 13 ft-lb (17.6 N·m). **See Figure 4-3, Section 4, Page 4-10.**
4. Connect the vent tube (6) to the gas tank vent (**Figure 14-18, Page 14-27**).
5. Connect fuel line (1) to the fuel tank shut-off valve (15). Use a new clamp.
6. Connect the black wire from the fuel gauge to one of the fuel level sending unit screws. Connect the orange wire to the center stud (**Figure 14-20, Page 14-30**) and install the flat washer, lock washer and nut. Tighten to 18 in-lb (2.0 N·m).
7. Slide the rubber boot over the stud (**Figure 14-20, Page 14-30**).
8. Check the park brake and differential lock lever for proper adjustment and operation.
9. Add gasoline to the tank.
10. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
11. Check to be sure the fuel shut-off valve on top of the gas tank is in the open (ON) position (**Figure 14-23, Page 14-32 and Figure 14-24, Page 14-33**).
12. Start the engine and allow it to idle.
 - 12.1. **Pedal-Start vehicles:**
 - 12.1.1. Place the neutral lockout cam in the OPERATE position.
 - 12.1.2. Turn the key switch to the ON position.
 - 12.1.3. Press the accelerator pedal to start the engine, and idle. **See following DANGER.**
 - 12.2. **Key-Start vehicles:**
 - 12.2.1. Use the key to start the engine, and idle. **See following DANGER.**

▲ DANGER

- The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.
 - After installing the fuel tank and adding gasoline, carefully check all fuel lines and connections for leaks. Repair any leaks before using the vehicle.
13. Allow the engine to run for a few minutes to ensure that the fuel lines are full of fuel.
 14. Inspect each fuel line for leaks.
 - 14.1. Check all of the fuel line clamps at the carburetor, fuel filters, fuel pump, and fuel tank for leaks.
 - 14.2. Inspect each fuel line to ensure that the lines are not cracked, cut, or worn.
 15. Install both seats.
 16. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 14-2.**

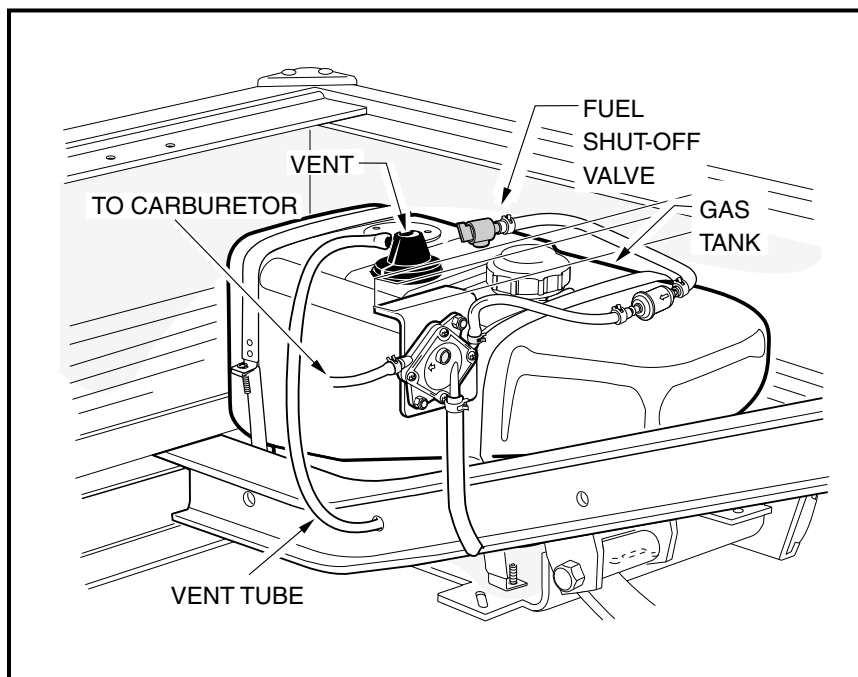


Figure 14-21 Fuel Tank

FUEL LINES

Read **DANGER** and **WARNING** on page 14-1.

The fuel lines must be properly routed, and all hose clamps must be tight. The fuel lines should be kept clean. See following **WARNING**.

▲ WARNING

- Make sure fuel lines are the right length and are properly routed. Failure to heed this warning could result in damage to fuel lines and fire.

Fuel Lines Continued:Fuel Lines, Continued:

Fuel line no. 1 runs directly from the fuel tank to the primary fuel filter (17). The primary fuel filter (17) has an arrow indicating fuel flow direction (**Figure 14-18, Page 14-27**).

Fuel line no. 2 runs directly from the primary fuel filter to the fuel inlet of the fuel pump.

Fuel line no. 3 runs directly from the fuel outlet of the fuel pump to the secondary fuel filter (22) (**Figure 14-18, Page 14-27**). The secondary fuel filter has an arrow indicating fuel flow direction and is identical to the primary fuel filter.

Fuel line no. 4 runs from the outlet of the secondary fuel filter to the carburetor (**Figure 14-18, Page 14-27**).

Small spring steel band clamps are used on all hose connections except at the carburetor. A screw band clamp should be used at the carburetor (**Figure 14-18, Page 14-27**).

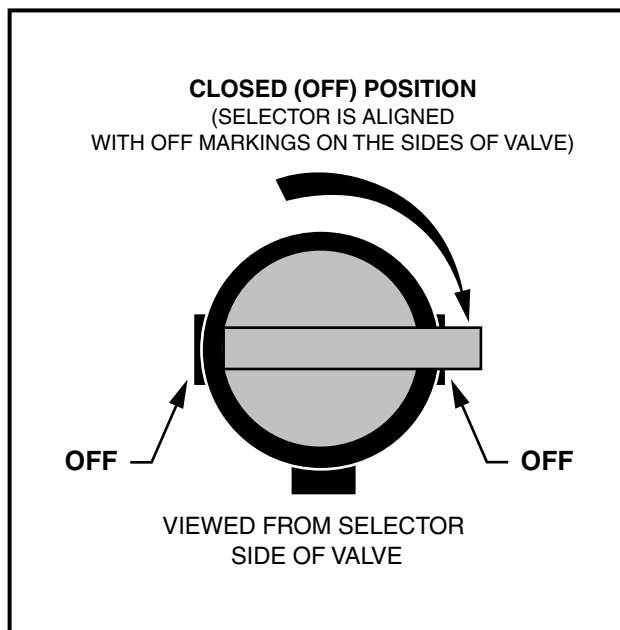


Figure 14-22 Closed Fuel Shut-off Valve

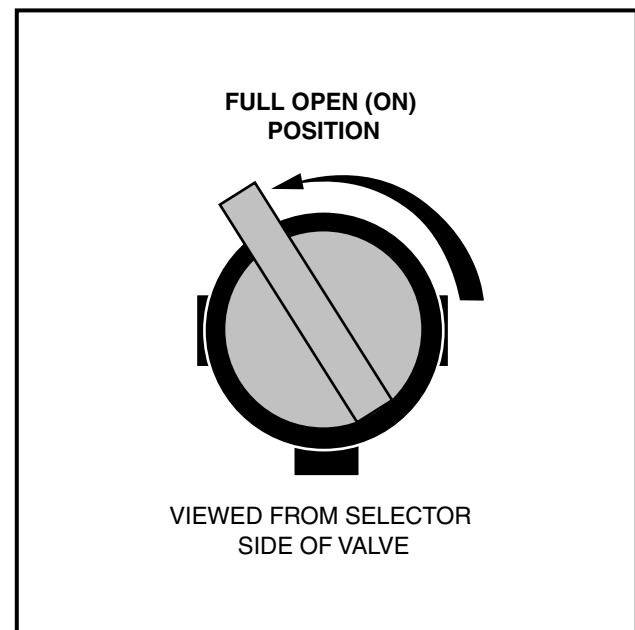


Figure 14-23 Open Fuel Shut-off Valve

FUEL SHUT-OFF VALVE

Read DANGER and WARNING on page 14-1.

The fuel shut-off valve is located on top of the fuel tank (**Figure 14-21, Page 14-31**). The fuel shut-off valve should always be turned to the closed (OFF) position during vehicle storage, towing or trailering (**Figure 14-22, Page 14-32**). The fuel shut-off valve should also be closed (OFF) before performing maintenance or service procedures unless the engine will be run as part of the procedure.

Fully Open Position

The valve's open position differs from standard valve configurations. For the valve to be fully open, it must be turned approximately 120° from the closed (OFF) position (until it cannot be turned any further) (**Figure 14-23, Page 14-32**). If the valve becomes partially closed, (**Figure 14-24, Page 14-33**), the engine will not run properly due to fuel starvation.

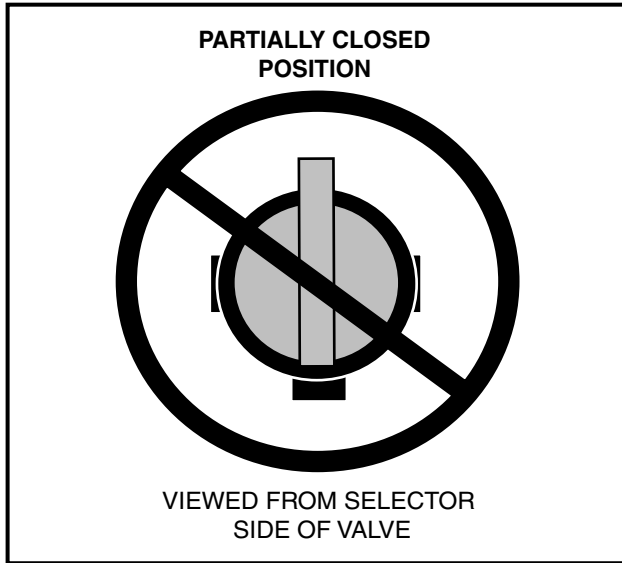


Figure 14-24 Incorrect Fuel Shut-off Valve

SECTION 15 – EXHAUST SYSTEM

▲ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

▲ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

The exhaust system is designed to provide quiet vehicle operation. If the muffler should ever need to be removed for repairs or replacement, follow the instructions below.

MUFFLER

MUFFLER REMOVAL

NOTE: The following procedure is the same for both FE350 and FE400 engines.

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 15-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **Also see WARNING "To avoid unintentionally starting..." on page 15-1.**
4. Disconnect the spark plug wire from the spark plug. **See WARNING "To avoid unintentionally starting..." on page 15-1.**
5. Remove the hex nuts (10) and lock washers (11) from the manifold (**Figure 15-1, Page 15-3 or Figure 15-2, Page 15-4**).
6. Remove the hex-head cap screw (7), lock washer (8), and flat washer (9) from mounting bracket. Retain the governor cable bracket (13).
7. Remove bolts (5), lock washers (4), and flat washers (3) from the muffler clamp bracket (2).
8. Remove the muffler (1) and clamp bracket assembly (2) from the vehicle.
9. Remove the muffler clamp (6) from the muffler clamp bracket (2).

MUFFLER INSTALLATION

NOTE: The following procedure is the same for both FE350 and FE400 engines.

Any time the muffler is removed from the vehicle, install a new muffler clamp (6) (CCI P/N 1017689) and muffler gasket (12) (**Figure 15-1, Page 15-3** or **Figure 15-2, Page 15-4**).

The gasket (12) is different for each of the two engines: FE350 and FE400.

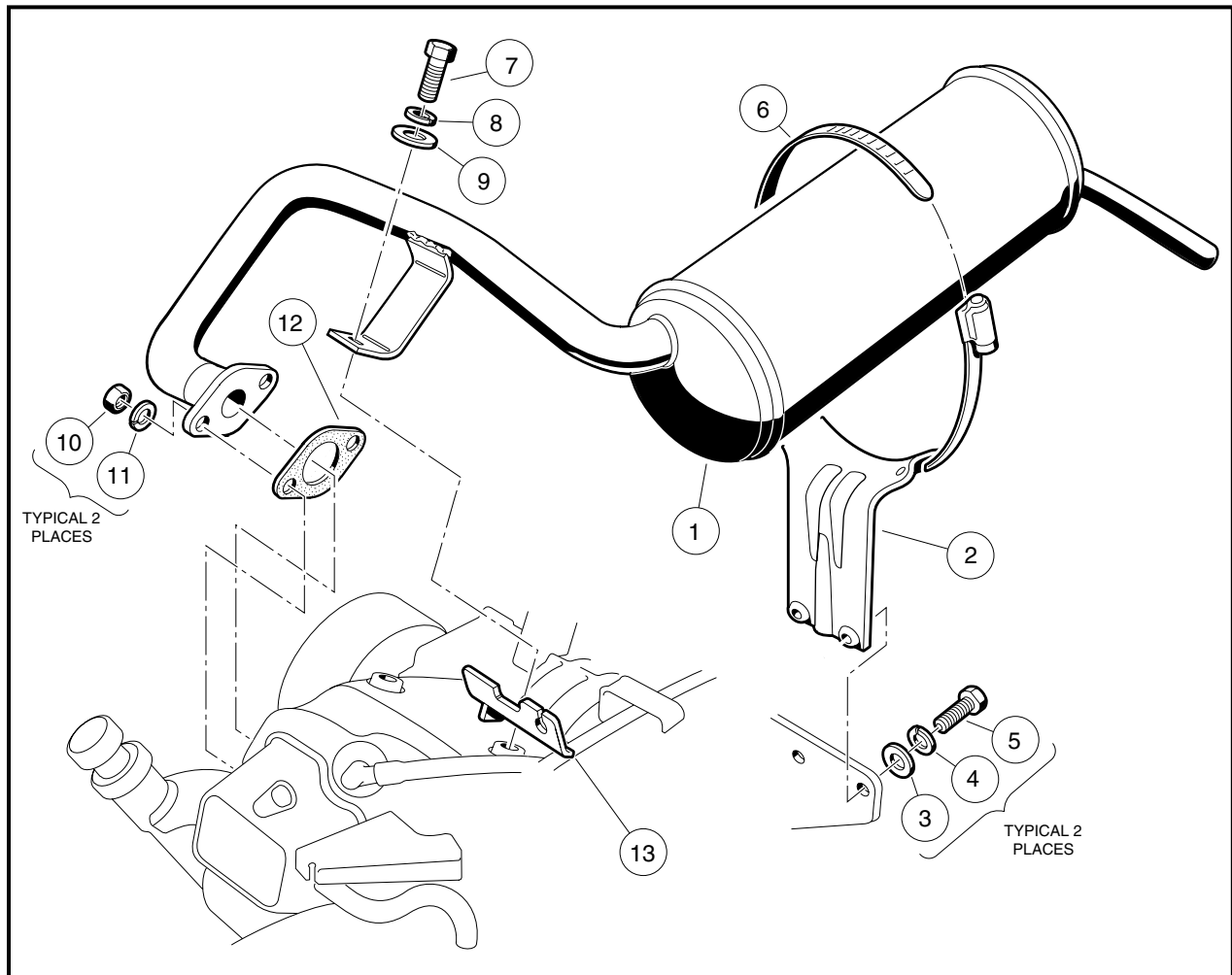


Figure 15-1 Exhaust System – FE400 Engine

1. Use the muffler clamp (6) to attach the muffler bracket (2) to the muffler as shown (**Figure 15-1, Page 15-3** or **Figure 15-2, Page 15-4**). Leave the muffler clamp loose enough to allow the muffler to move as the mounting hardware is tightened. If installing a new muffler, use the old muffler as a positioning guide for the clamp and bracket.
2. Place a new gasket (12) on the exhaust manifold mounting flange as shown.
3. Position the muffler and bracket assembly, and the governor cable bracket (13) and install the bolts (5), lock washers (4), and flat washers (3). Thread the bolts in only enough to support the muffler and bracket assembly (**Figure 15-1, Page 15-3** or **Figure 15-2, Page 15-4**).
4. Install the lock washers (11) and hex nuts (10) on the manifold bolts. Tighten the nuts finger-tight.
5. Install the hex-head cap screw (7), lock washer (8), and flat washer (9). Tighten the cap screw finger-tight.

Muffler Installation, Continued:

6. Tighten the manifold hex nuts (10) to 11 ft-lb (14.9 N·m). Tighten the muffler bracket hex cap screw (7) to 14 ft-lb (18.9 N·m).
7. Tighten the muffler clamp bracket mounting bolts (5) to 75 in-lb (8.5 N·m).
8. Tighten the muffler clamp (6) to 40 in-lb (4.5 N·m).
9. Connect the spark plug wire.
10. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

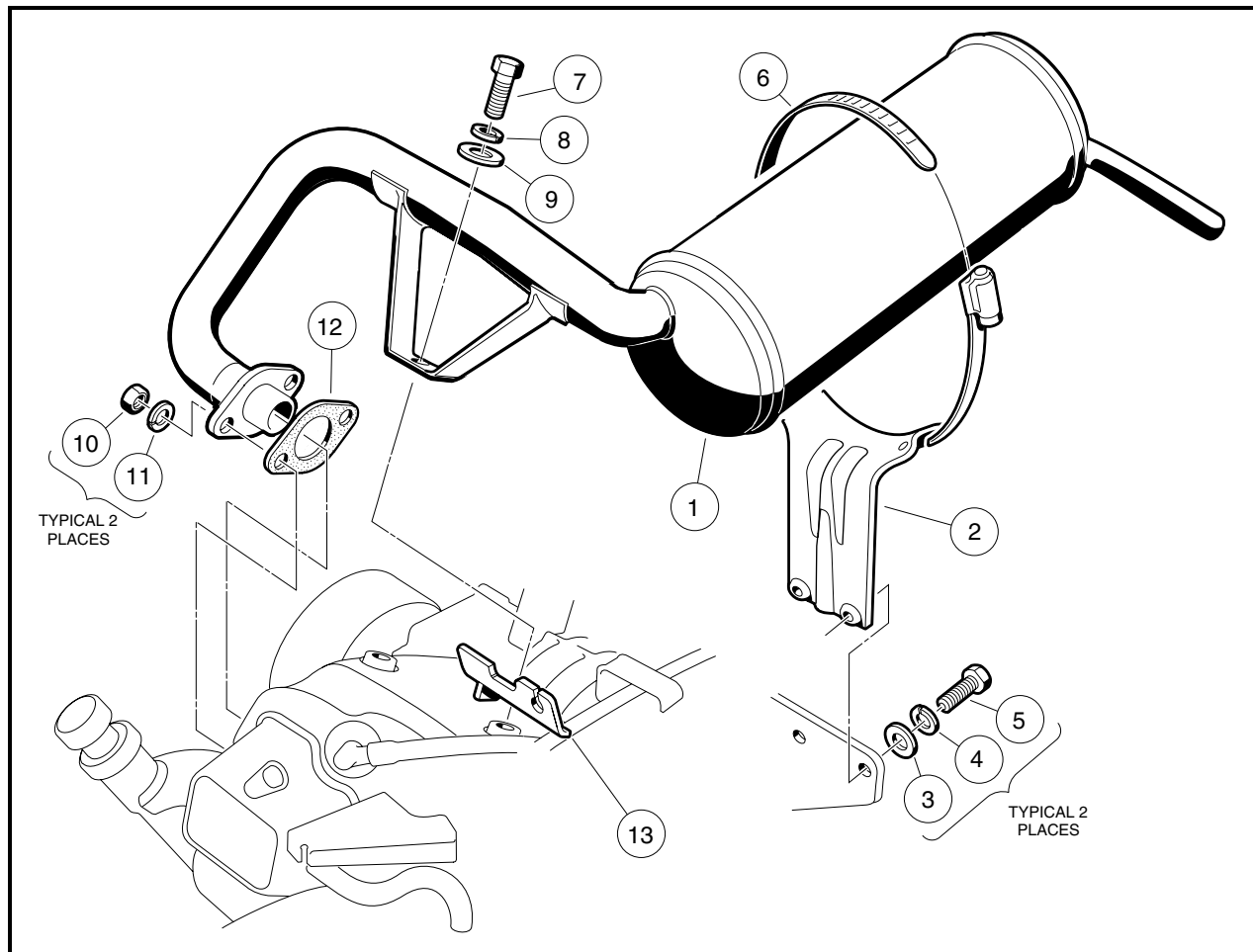


Figure 15-2 Exhaust System – FE350 Engine

11. With the Forward/Reverse handle in the NEUTRAL position, start the engine and check for exhaust leaks and proper engine operation. **See following DANGER.**
 - 11.1. **Pedal-Start vehicles:**
 - 11.1.1. Place the neutral lockout cam in the SERVICE position.
 - 11.1.2. Use the accelerator to start the engine and check for exhaust leaks and proper engine operation. **See following DANGER.**
 - 11.1.3. After checking the exhaust and engine for proper operation, return the lockout cam to the OPERATE position.

11.2. Key-Start vehicles:

11.2.1. Start the engine and check for exhaust leaks and proper engine operation. **See following DANGER**

 DANGER

- **The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.**

12. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 15-2.**

SECTION 16A – MC012C-AS00 UNITIZED TRANSAXLE WITH DIFFERENTIAL LOCK

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

The 272 vehicle is equipped with a heavy-duty, fully-synchronized unitized transaxle with differential lock. The unitized transaxle utilizes fully-synchronized internal gearing to change vehicle direction. Because the unitized transaxle is used to reverse vehicle direction, the engine, drive clutch, belt, and driven clutch rotate in the same direction; therefore, the engine and clutches are not subjected to reversing loads. This reduces maintenance requirements on the engine and clutches. With the unitized transaxle, power is transferred from the engine through the drive clutch, the drive belt, the driven clutch, and then through the unitized transaxle to the wheels.

TRANSAXLE MODELS AND IDENTIFICATION

The 272 vehicle may be equipped with either of two transaxle designs. Both operate the same internally, but utilize a few, slightly different, gear components. These components are identified in their respective illustrated parts list manuals.

Each transaxle is also different in their axle-to-wheel hub designs. The MC010C-BS00 transaxle is designed with the wheel hub permanently attached to the outside end of each axle shaft (**Figure 16a-1, Page 16a-3**). The MC012C-AS00 transaxle is designed with a removable wheel bolt flange and attaches to the ends of the axle shafts using a splined coupling configuration (**Figure 16a-2, Page 16a-3**).

Both transaxles have physical attachment provisions and dimensional differences and therefore are not interchangeable.

Section 16a deals specifically with the MC012C transaxle. Section 16b deals specifically with the MC010C transaxle. **See Section 16b – MC010C-BS00 Unitized Transaxle with Differential Lock.**

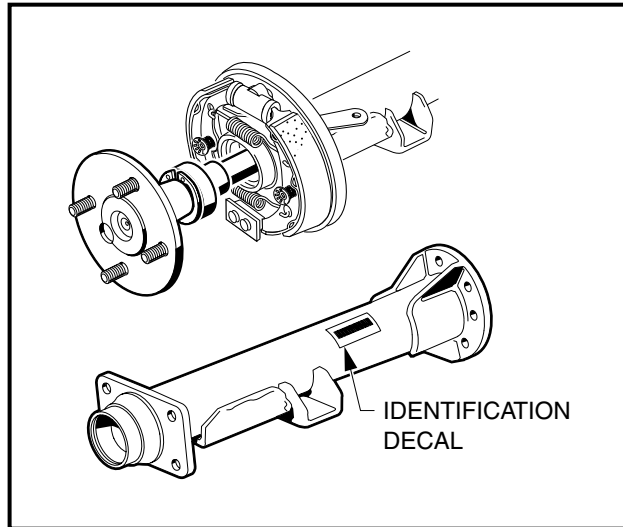


Figure 16a-1 MC010C-BS00 Transaxle

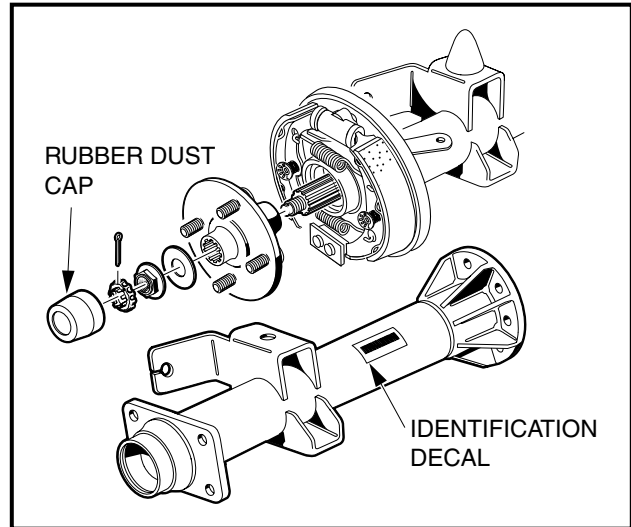


Figure 16a-2 MC012C-AS00 Transaxle

Shifter Lever

A shifter lever, connected to a shifter arm on the unitized transaxle, is used to change the gears to one of three shift positions: FORWARD (F), NEUTRAL (N), or REVERSE (R) (Figure 16a-3, Page 16a-3). The vehicle should come to a complete stop before changing FORWARD or REVERSE direction.

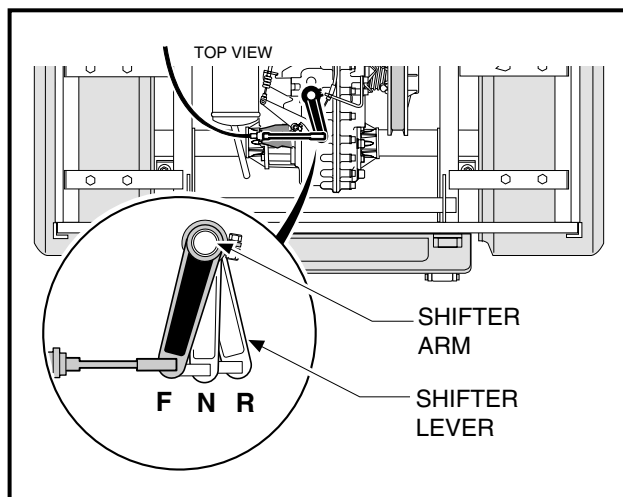


Figure 16a-3 Shifter Positions

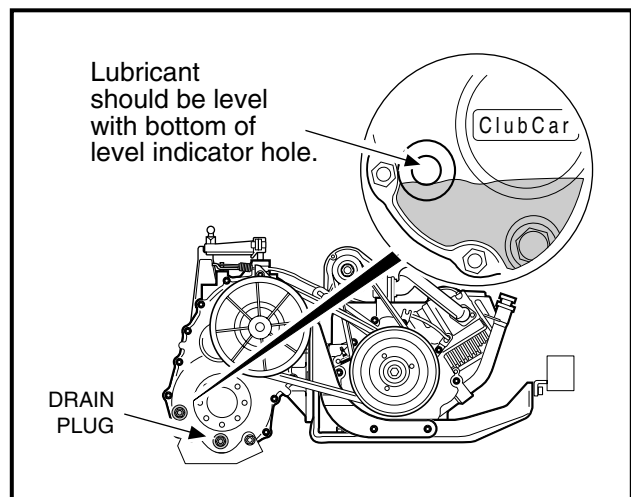


Figure 16a-4 Lubricant Level

LUBRICATION

There are two plugs located on the right (driven clutch) side of the unitized transaxle (Figure 16a-4, Page 16a-3). When the vehicle is on a level surface, the upper plug is used as a lubricant level indicator. Lubricant level should be even with the bottom of level indicator hole. The lower plug is used for draining lubricant from the transaxle. When draining lubricant, both plugs should be removed to allow the lubricant to drain faster. Be sure the drain plug and gasket are cleaned and reinstalled before filling the transaxle with new lubricant. Use a funnel when filling the transaxle through the lubricant level indicator hole. Fill with 29 oz. (.85 liters) 80-90 WT. API class GL-3 or 80-90 WT. AGMA class 5 EP gear lubricant. Lubricant should fill to lower edge of indicator hole. Tighten the plug to 20 ft-lb (27.1 N·m).

Differential Lock Lever

The MC012C-AS00 unitized transaxle has a differential lock, controlled by a differential lock lever. The lever is located between the driver and passenger seats (**Figure 16a-5, Page 16a-4**).

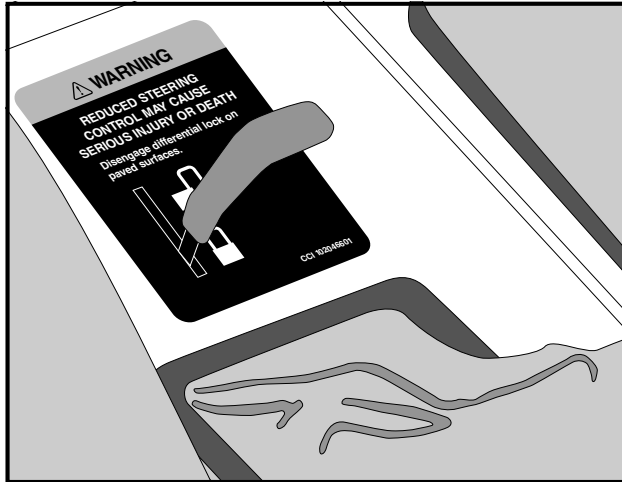


Figure 16a-5 Differential Lock Lever

Neutral Lockout

- **Pedal-Start Vehicles:**

During normal vehicle operation, the neutral lockout feature on pedal-start vehicles prevents the engine from running when the Forward/Reverse handle is in the NEUTRAL position. If the vehicle is started in FORWARD or REVERSE and then shifted to NEUTRAL, the engine will stop running.

For the convenience of the trained technician, there is a neutral lockout cam (yellow knob) located on the back of the Forward/Reverse shifter, inside the engine compartment. If the neutral lockout cam is pulled out approximately 3/8-inch (10 mm) and then rotated one-half turn until it snaps into place, the cam will be in the SERVICE position.

When the cam is in the SERVICE position, it will allow the technician to run the engine in NEUTRAL for certain maintenance procedures. With the cam in this position, the vehicle will not operate if the Forward/Reverse handle is placed in either the FORWARD or REVERSE position.

To put the cam back into the OPERATE position, pull the cam out approximately 3/8-inch (10 mm) and rotate it one-half turn until it snaps into place. **See Neutral Lockout Circuit, Section 11b, Page 11b-13.**

- **Key-Start Vehicles:**

The neutral lockout feature is not a serviceable component on key-start vehicles with neutral 'rev'. It should remain in the OPERATE position at all times.

Governor System

The governor system is a flyweight type, and regulates vehicle ground speed. It is mounted inside the unitized transaxle and is driven by transaxle gears. Because the governor is mounted inside the transaxle, it is protected from abuse and damage common to externally mounted governor systems. If any of the governor linkages are removed in order to service other components, readjustment of the governor linkage is required. **See Governor Cable Installation and Adjustment, Section 14, Page 14-12.**

Unitized Transaxle Service

The unitized transaxle is extremely durable and should require very little service under normal operating conditions. The only service required on the unitized transaxle is to maintain proper lubricant level. **See Periodic Lubrication Schedule, Section 10, Page 10-5.** Under normal operating conditions, adjustment to the system should not be required.

Tools Required For This Section

Hydraulic floor jack (or chain hoist)	12 to 18-in. straight edge	17 mm socket, 3/8-in. drive
Jack stands (2) (one-ton capacity)	Small ball peen hammer (10 oz.)	7/16-in. combination wrench
Hydraulic press	Plastic or rubber mallet	1/2-in. combination wrench
Bench vise	Ratchet wrench, 3/8-in. drive	9/16-in. combination wrench
Standard slip joint pliers	Torque wrench, 3/8-in. drive	11/16-in. combination wrench (2)
External snap ring pliers (.070 in. tip)	3/8-in. Socket, 3/8-in. drive	17 mm combination wrench
External snap ring pliers (.047 in. tip)	7/16-in. Socket, 3/8-in. drive	Small flat blade screwdriver
90° Internal snap ring pliers (.090 in. tip)	10 mm Combination wrench	Medium flat blade screwdrivers (2)
Feeler gauge	1/2-in. Socket, 3/8-in. drive	No. 2 phillips-head screwdriver
16 in. rolling head prybar	9/16-in. Socket, 3/8-in. drive	1/4-in. nut driver
Small punch or scratch awl	5/8-in. Socket, 3/8-in. drive	5/16-in. nut driver
1/4-in. diameter drift or metal rod	12 mm Socket, 3/8-in. drive	Small knife or wire snippers
Bearing puller wedge attachment (CCI P/N 1012812)	Axle seal tool (CCI P/N 1014162)	Governor gear shaft installation tool (CCI P/N 101933101)

AXLE SHAFT

Read **DANGER** and **WARNING** on page 16a-1.

Removal of the unitized transaxle is not required for servicing or replacing axle shafts, axle bearings, or axle shaft oil seals. If the unitized transaxle is to be removed from the vehicle, then do not remove the wheels, axle shafts, or axle tubes first. Instructions for removing the unitized transaxle from the vehicle begin on page 16a-9.

AXLE SHAFT, BEARING, AND OIL SEAL REMOVAL

- Loosen the lug nuts on the wheel to be removed.
- Place chocks at the front wheels and lift the rear of the vehicle with a floor jack. Then place jack stands under the axle tubes to support the vehicle. **See WARNING "Lift only one end..." on page 16a-2.**
- Remove all lug nuts and wheel from the vehicle.
- Remove the brake drum. If the brake drum was easily removed, proceed to step 6.
- To remove tight brake drums:
 - On the back of each brake cluster assembly, locate the bolt heads of the two brake shoe adjusters.
 - Using a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolt in order to increase the clearance between the brake shoes and the brake drum. **See Figure 6a-5, Section 6a, Page 6a-10.**
 - Rotate the brake drum slightly and remove it from the brake shoe cluster assembly.

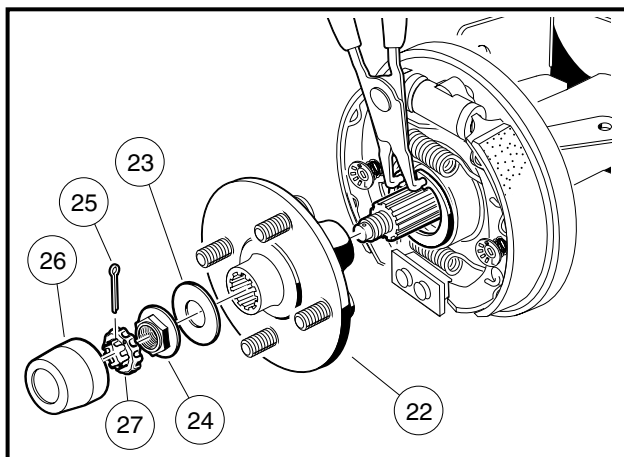
Axle Shaft, Bearing, and Oil Seal Removal, Continued:

Figure 16a-6 Axle Retaining Ring Pliers

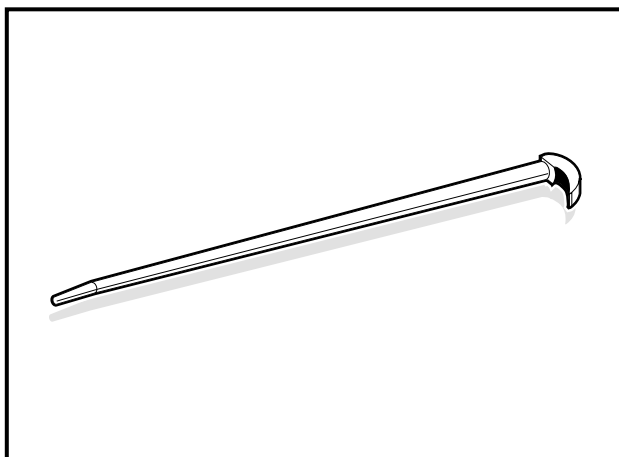


Figure 16a-7 Rolling Head Prybar

6. To remove the wheel bolt flange on the MC012C transaxle (**Figure 16a-6, Page 16a-6**):
 - 6.1. Remove rubber boot (26) from large flat washer (23).
 - 6.2. Remove cotter pin (25) from locking nut cap (27).
 - 6.3. Remove the locking nut cap (27) from the flanged nut (24).
 - 6.4. Remove the flanged nut (24) and large flat washer (23) from the axle end.
 - 6.5. Remove the wheel bolt flange (22) from the splined axle end.
7. Using a 90° internal snap ring pliers (.090 tip), remove internal retaining ring from axle tube (**Figure 16a-6, Page 16a-6**).
8. Carefully pull the axle shaft straight out of the axle tube. The axle bearing will slide out of the axle tube with the axle shaft.
9. Use a 16 inch (40 cm) rolling head prybar to remove the oil seal (**Figure 16a-7, Page 16a-6**). Insert the prybar under the inside lip of the seal and pull the oil seal out (**Figure 16a-8, Page 16a-6**). Discard the oil seal. **See following CAUTION.**

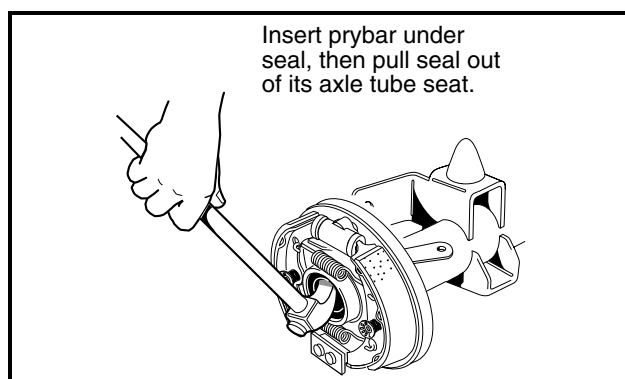


Figure 16a-8 Seal Lip

⚠ CAUTION

- Do not scar or damage the inside surfaces of the tube when removing the oil seal. A damaged tube might have to be replaced.

10. Inspect the bearing. If the bearing is damaged or worn, replace it.

AXLE BEARING REMOVAL

1. Slip the bearing (88) off of the machined journal and over the outside splined end of the axle (**Figure 16a-9, Page 16a-8**).

AXLE SHAFT, BEARING, AND OIL SEAL INSTALLATION

1. Replace the old bearing with a new bearing (88). Slip the new bearing onto the machined journal, adjacent to the machined seal hub on the end of the axle (**Figure 16a-9, Page 16a-8**).
2. Replace the old oil seal with a new seal (89). Make sure the axle tube hub is free of debris that would keep the outside race of the oil seal from seating against the back of the axle tube hub.
3. Clean the axle shaft and spline and carefully slide the axle back into the axle tube, passing through the axle seal, and advance until the gear end of the axle meshes with the splined hub inside the gear box assembly, and the bearing slips into the axle tube hub adjacent to the oil seal.
4. Using a 90° internal snap ring pliers, insert the internal retaining ring (87) into the axle tube hub, adjacent to the outside surface of the bearing. Make sure the retaining ring seats into the groove provided in the axle tube hub. **See following WARNING.**

⚠ WARNING

- **Be sure retaining ring is properly seated in its groove. If ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.**

5. To install the wheel bolt flange (22) on the MC012C transaxle (**Figure 16a-6, Page 16a-6**):

NOTE: Clean splined area in the wheel bolt flange and on the splined end of axle before installation. Using a small brush, carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning® BR2-Plus or equivalent) to both prior to assembly.

- 5.1. Slide wheel bolt flange (22) onto splined end of the axle.
- 5.2. Slide the large flat washer (23) onto the end of the axle and up against the wheel bolt flange. **See following NOTE.**

NOTE: It is recommended that a light film of white lithium NLGI Number 2 grease (Dow Corning BR2-Plus or equivalent) be applied to both surfaces of the large washer (23) before the flanged nut (24) is installed and tightened to specification.

- 5.3. Attach the flanged nut (24) and tighten to 150 ft-lb (203 N·m).
- 5.4. Install the locking nut cap (27) onto the flanged nut (24).
- 5.5. Position the locking nut cap (27) to provide clear passage for a new cotter pin (25).
- 5.6. Install a new cotter pin (25) through the locking nut cap and axle, bending the split ends of the pin to secure the locking nut cap (27). **See following WARNING.**

⚠ WARNING

- **Make sure to install and bend the cotter pin. Failure to bend the cotter pin could result in the separation of the wheel bolt flange from the splined end of the axle. Loss of vehicle control could result, causing severe personal injury.**

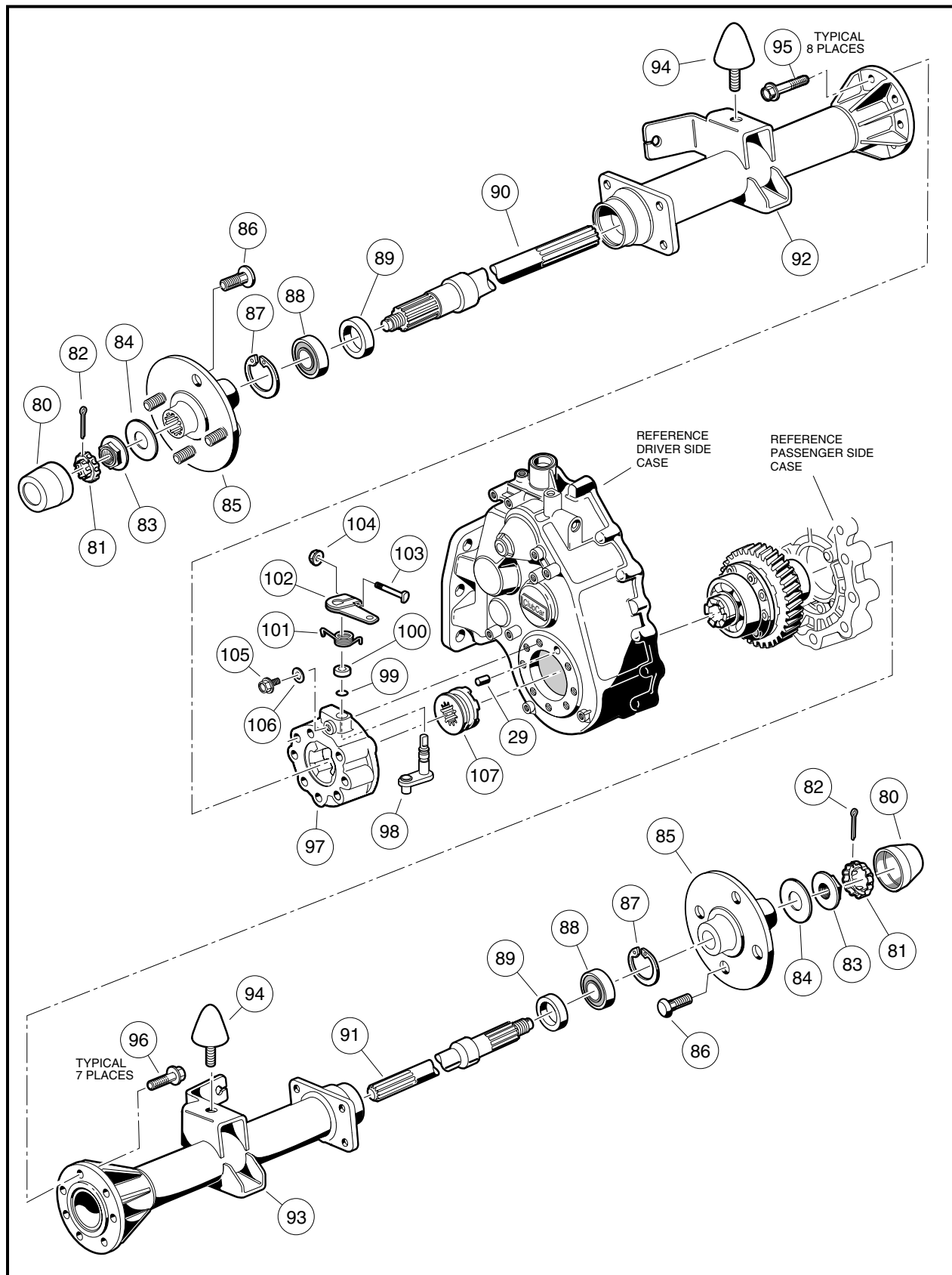


Figure 16a-9 Differential Gear Case/Axle Tubes

Axle Shaft, Bearing, and Oil Seal Installation, Continued:

- 5.7. Install the rubber boot (26) onto the large washer (23) (**Figure 16a-6, Page 16a-6**).

NOTE: Push the rubber boot onto the washer so that the washer edge fits into the boot-lip groove.

- 5.8. Install the brake drum and wheel.
6. Repeat steps 1 through 5 for the remaining rear axle if necessary.

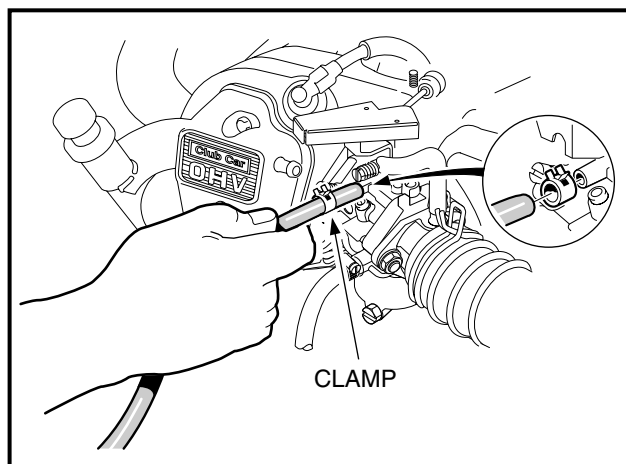
UNITIZED TRANSAXLE REMOVAL

Read **DANGER** and **WARNING** on page 16a-1.

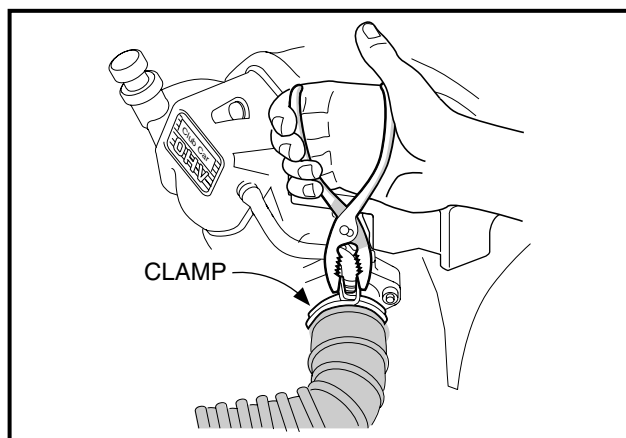
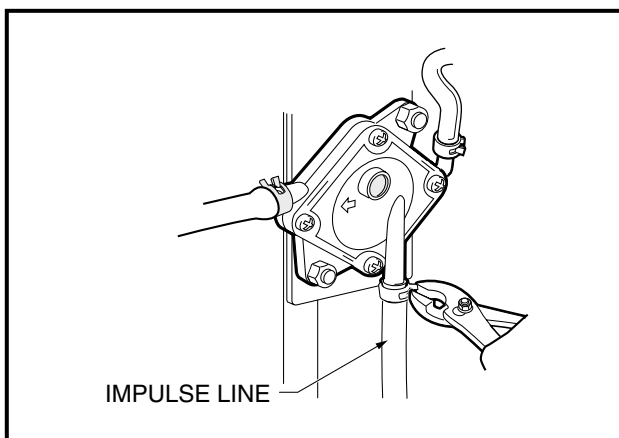
WARNING

- To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System, Section 6a, Page 6a-33**.

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the front wheels.
2. Access the engine compartment. See **WARNING "For vehicles with cargo beds..." on page 16a-2**.
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 2.2. Lift the passenger side seat.
3. Disconnect the battery cables, negative (-) cable first. See **WARNING "To avoid unintentionally starting..." on page 16a-1**.
4. Close the fuel shut-off valve on fuel tank. See **Fuel Shut-Off Valve, Section 14, Page 14-32**.
5. Detach all wires, hoses, etc. connecting the powertrain to the vehicle.
 - 5.1. Disconnect the carburetor vent tube from the carburetor (**Figure 16a-10, Page 16a-10**).
 - 5.2. Disconnect the air intake hose from the carburetor (**Figure 16a-11, Page 16a-10**).
 - 5.3. Disconnect impulse line from fuel pump (**Figure 16a-12, Page 16a-10**).
 - 5.4. Loosen the hose clamp and then disconnect the fuel line from the carburetor. To prevent spilling fuel, the disconnected end of the line should be pushed onto the impulse line fitting of the fuel pump (**Figure 16a-15, Page 16a-12**).
 - 5.5. Remove the differential lock cable.
 - 5.5.1. Place differential lock handle in the disengaged direction.
 - 5.5.2. Using a pair of pliers, apply pressure to the locking tabs of the cable end (1) where it attaches to the differential lock handle mounting bracket (**Figure 16a-13, Page 16a-11**).
 - 5.5.3. While maintaining pressure on the locking tabs, pull the differential lock cable toward the rear of the vehicle to disconnect the cable from the bracket (**Figure 16a-13, Page 16a-11**).
 - 5.5.4. With handle in the engaged position and the cable disconnected from the bracket, rotate the cable connector toward the driver side of the vehicle to disconnect the cable from the differential lock lever (1) (**Figure 16a-14, Page 16a-11**).
 - 5.5.5. Remove wire tie (6) securing the cable to the vertical support (**Figure 16a-117, Page 16a-54**).
 - 5.6. Remove the cover from the electrical component box. Then loosen the hardware securing the accelerator cable to the box. Disconnect the cable from the actuator cam and remove it from the box (**Figure 16a-16, Page 16a-12**).

Unitized Transaxle Removal, Continued:**Figure 16a-10 Carburetor Vent Tube**

- 5.7. Disconnect the engine ground wire from the oil filler tube mounting bracket (**Figure 16a-17, Page 16a-12**).
- 5.8. Loosen nuts securing shifter cable to shifter cable mounting bracket. Then disconnect the shifter cable rod end from the shifter arm on the unitized transaxle and remove the cable from the cable mounting bracket (**Figure 16a-18, Page 16a-12**).
- 5.9. Remove screws (2) securing the Forward/Reverse shifter cable bracket (1) to transaxle and remove the shifter bracket (**Figure 16a-40, Page 16a-19**).
- 5.10. Loosen nut (3) and bolt (7) on transaxle shifter lever and remove lever from shaft (15) (**Figure 16a-40, Page 16a-19**).
- 5.11. Remove woodruff key (9) from shifter shaft (15) (**Figure 16a-40, Page 16a-19**).
- 5.12. Mark for proper reconnection and then disconnect the 6-gauge white wire (F2 post), 6-gauge black ground wire (A2 post), and 16-gauge yellow wire (DF post) from starter/generator (**Figure 16a-19, Page 16a-12**).
- 5.13. Disconnect the engine oil level sensor wire (18-gauge yellow) at the bullet connector just to the rear of the starter/generator (**Figure 16a-20, Page 16a-12**).

**Figure 16a-11 Air Intake Hose****Figure 16a-12 Impulse Line**

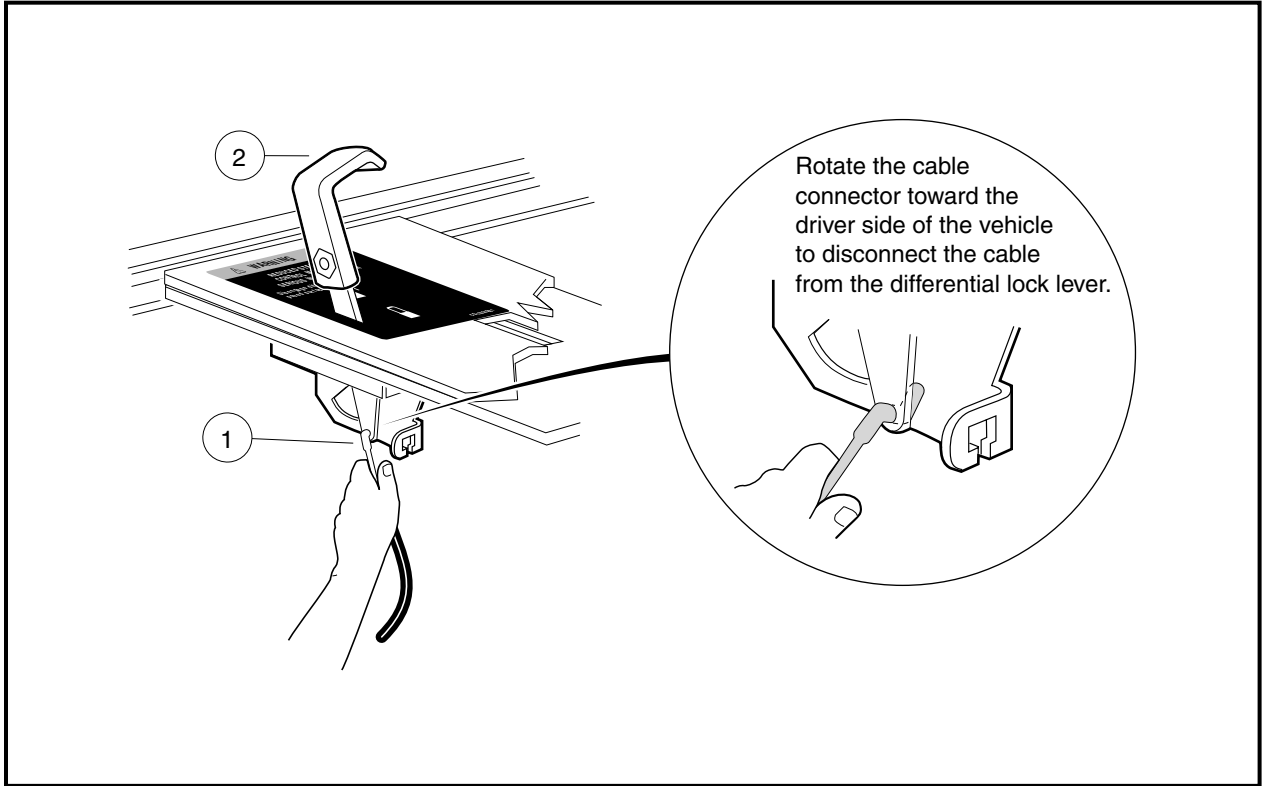


Figure 16a-13 Differential Lock Cable Bracket

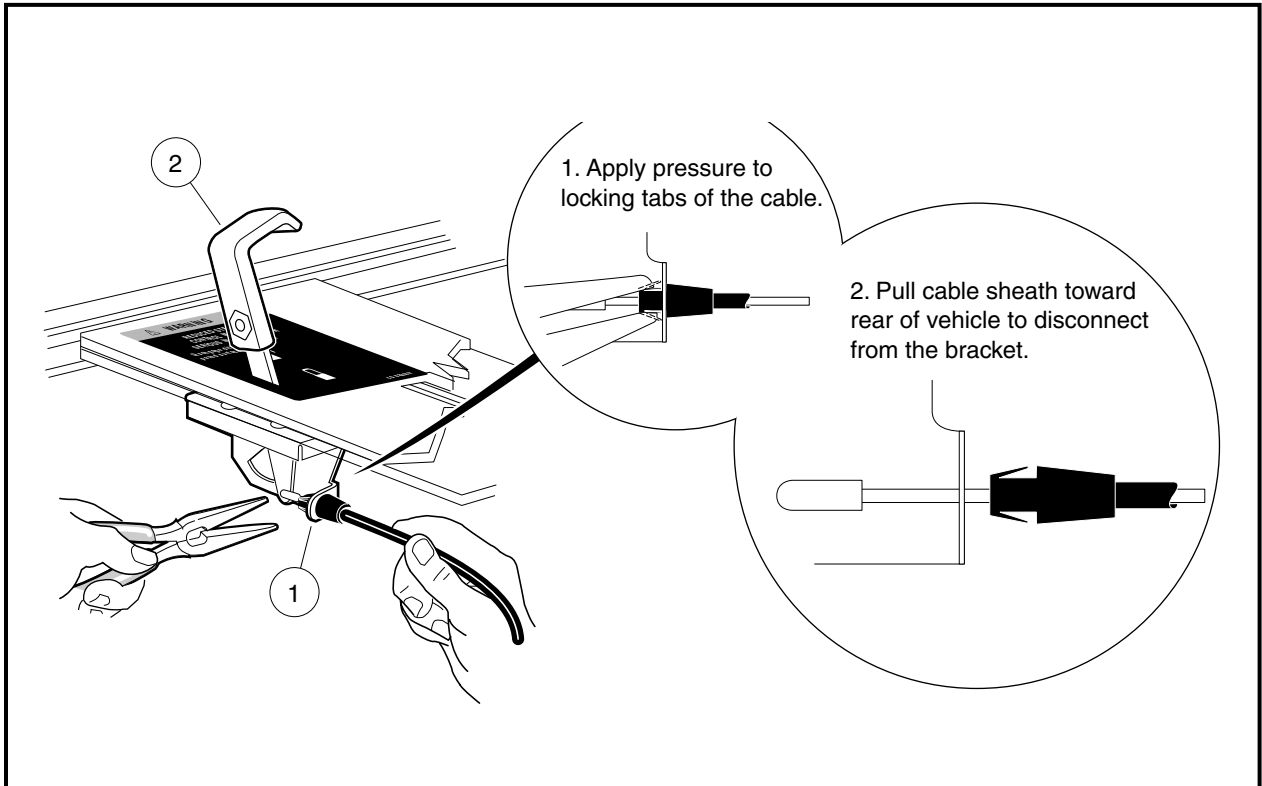


Figure 16a-14 Differential Lock Cable Removal

Unitized Transaxle Removal, Continued:

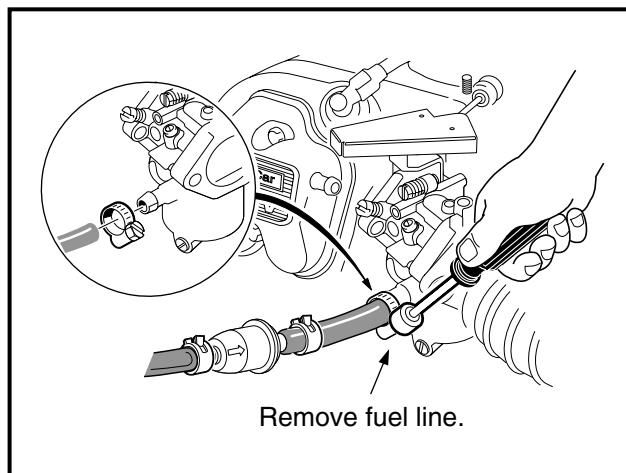


Figure 16a-15 Fuel Line

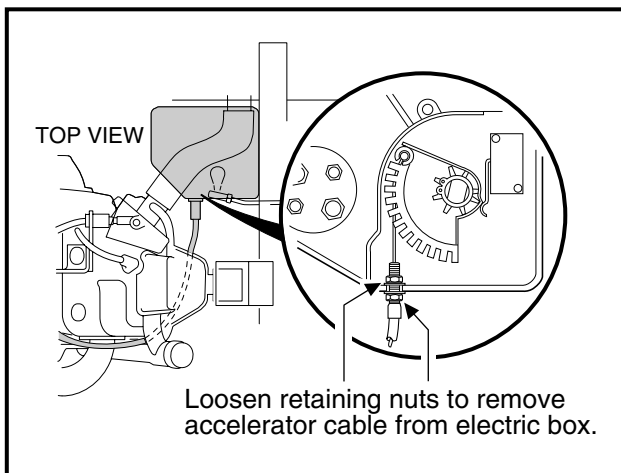


Figure 16a-16 Accelerator Cable

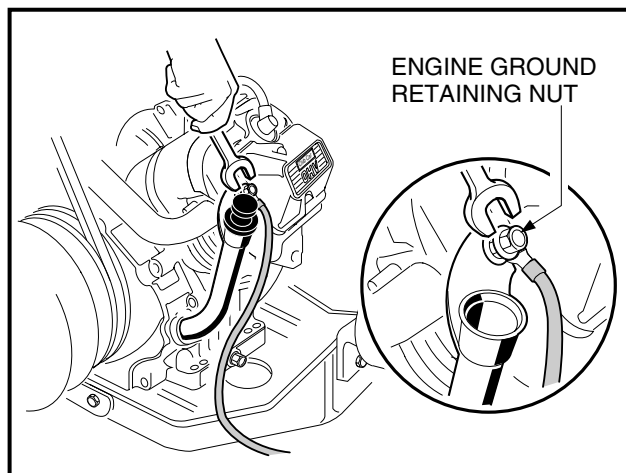


Figure 16a-17 Engine Ground Wire

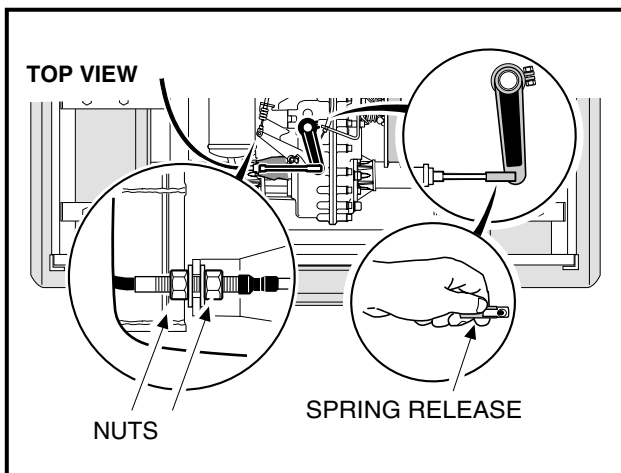


Figure 16a-18 Shifter Cable

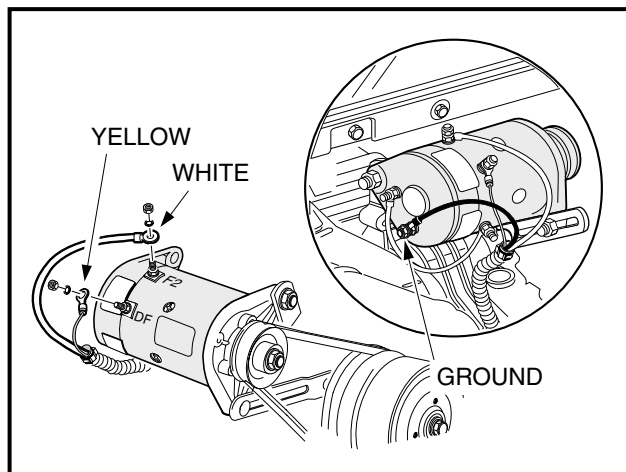


Figure 16a-19 Generator Wires

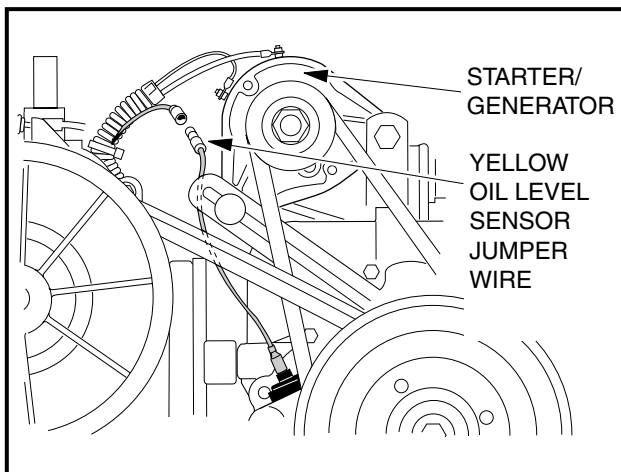


Figure 16a-20 Oil Level Sensor Jumper Wire

- 5.14. Disconnect the engine kill switch wire (18-gauge white/black) from the bullet connector at the lower right front of the engine (**Figure 16a-24, Page 16a-14**).
- 5.15. Cut away the wire ties securing the kill switch wire at the lower right front of the engine (below the exhaust header), the wire harness at the governor cable bracket, and the wire harness to the plate beneath the muffler.
6. Remove the lower shock mounting hardware from both rear shocks (**Figure 16a-25, Page 16a-14**).
7. Disconnect the brake hoses and park brake cables.
 - 7.1. Remove the park brake cable clip (1), hair spring cotter pin (2) and clevis pin (3) (**Figure 16a-22, Page 16a-13**).
 - 7.2. Remove the cable from the cable support bracket (**Figure 16a-22, Page 16a-13**).
 - 7.3. Remove the upper shock mounting hardware from the rear shock absorber and remove the shock absorber.
 - 7.4. Using a 3/8 inch flare nut wrench, remove the brake hose from the rear brake cluster. To avoid spilling brake fluid, lift the hose above the brake cluster assembly (**Figure 16a-23, Page 16a-13**).
 - 7.5. To ensure that no dirt or trash enters the hydraulic braking system, place the hose fitting in a plastic bag and secure to the vehicle frame as shown (**Figure 16a-21, Page 16a-13**).
 - 7.6. Repeat steps 7.1 through 7.5 for the opposite side of the vehicle.
8. Using a hydraulic jack placed under the transaxle (**Figure 16a-26, Page 16a-15**), raise the vehicle and place jack stands, set at approximately 17-1/2 inches (44.5 cm) in height, under the frame as shown (**Figure 16a-27, Page 16a-15**).

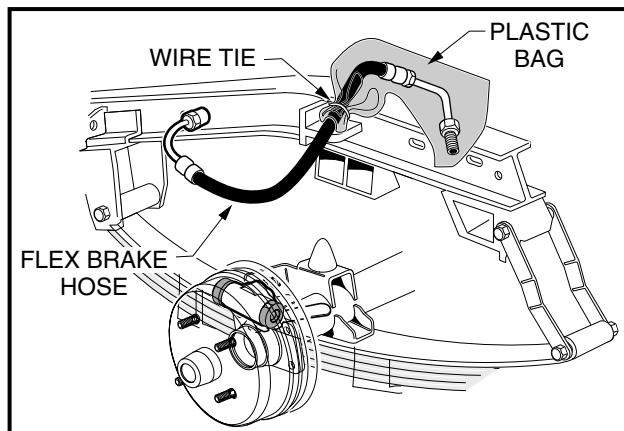


Figure 16a-21 Cover Brake Hose Fitting

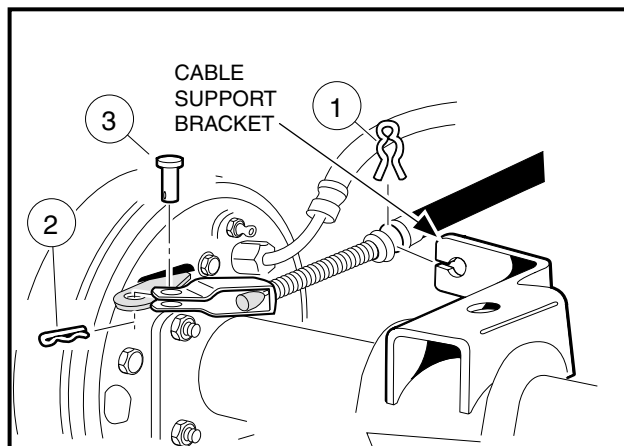


Figure 16a-22 Park Brake Cable

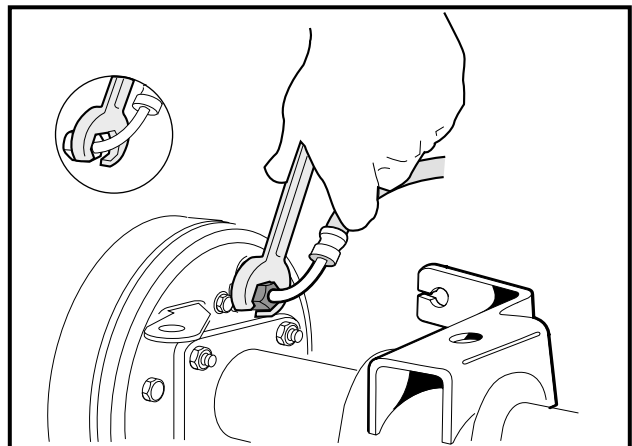


Figure 16a-23 Brake Hose

Unitized Transaxle Removal, Continued:

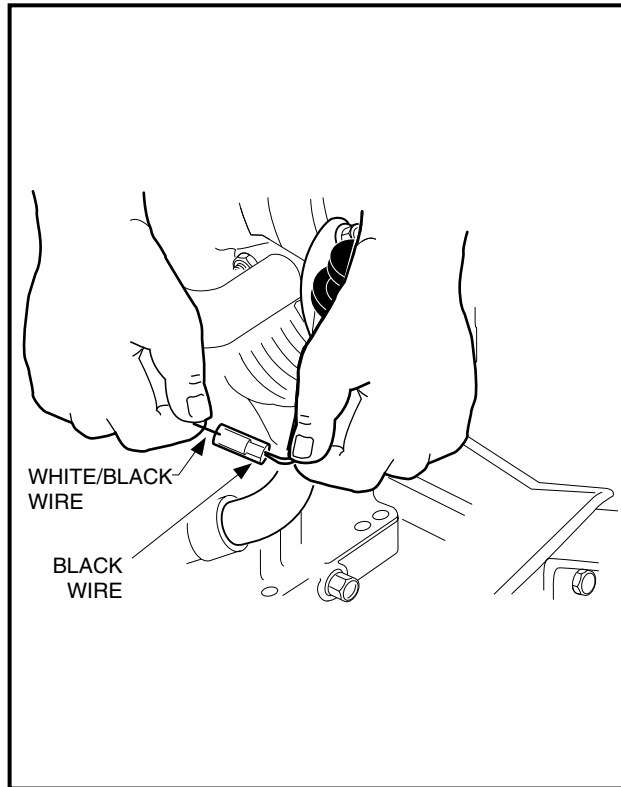


Figure 16a-24 Engine Kill Switch Wire

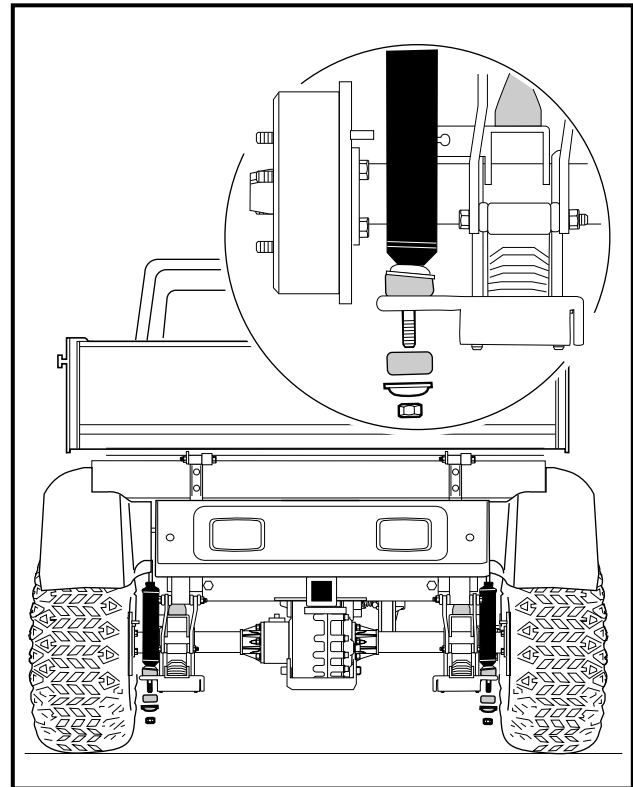


Figure 16a-25 Shock Absorbers

9. Lower the hydraulic jack, allowing the vehicle I-beam frame to rest on the jack stands but allow the jack to remain under, and in contact with, the transaxle case guard (Figure 16a-27, Page 16a-15).
10. Remove the bolts securing the leaf springs to their front mounts (Figure 16a-28, Page 16a-15).
11. Remove the bolts that secure the leaf springs to the shackles (Figure 16a-29, Page 16a-15).
12. With the hydraulic jack, slowly lower the powertrain until both of the rear tires are resting on the floor.
13. Carefully lift the snubber out of the snubber bracket in the vehicle frame and lower it to the floor (Figure 16a-30, Page 16a-16). The powertrain should be completely disconnected from the vehicle and resting on the floor.
14. Grasp the ends of the leaf springs at the rear of the vehicle and roll the powertrain out from under the vehicle (Figure 16a-31, Page 16a-16).
15. Place blocks under the engine pan so they will completely support the engine and keep it level to the floor (Figure 16a-32, Page 16a-16). See following NOTE.

NOTE: Place the blocks so they will support the engine when the transaxle is detached and moved away from the engine.

16. Remove the drive belt.
 - 16.1. Grasp belt midway between drive and driven clutch and pull up on belt to force the driven clutch sheaves apart. Roll the belt counterclockwise while pulling it off driven clutch (Figure 16a-33, Page 16a-16).
17. Remove the driven clutch retaining bolt and remove the driven clutch from the unitized transaxle (Figure 16a-34, Page 16a-17).

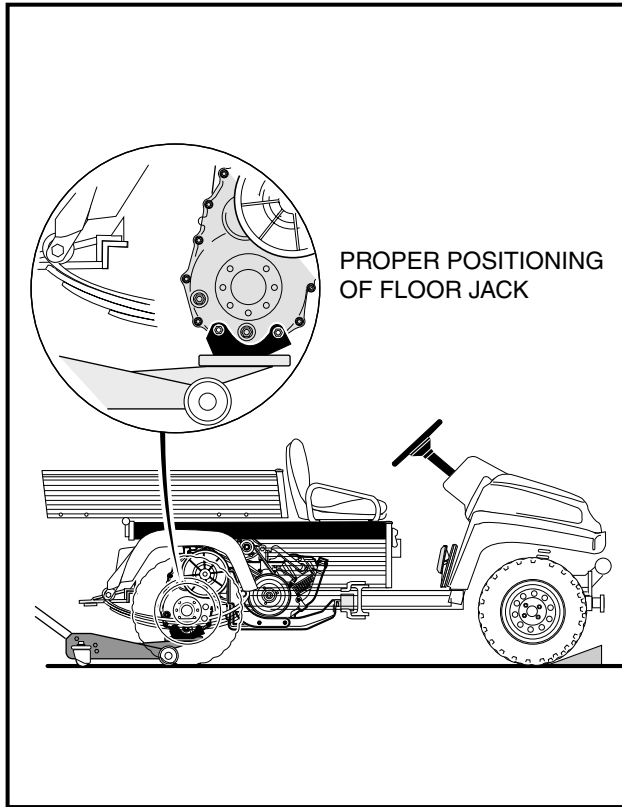


Figure 16a-26 Raise Vehicle

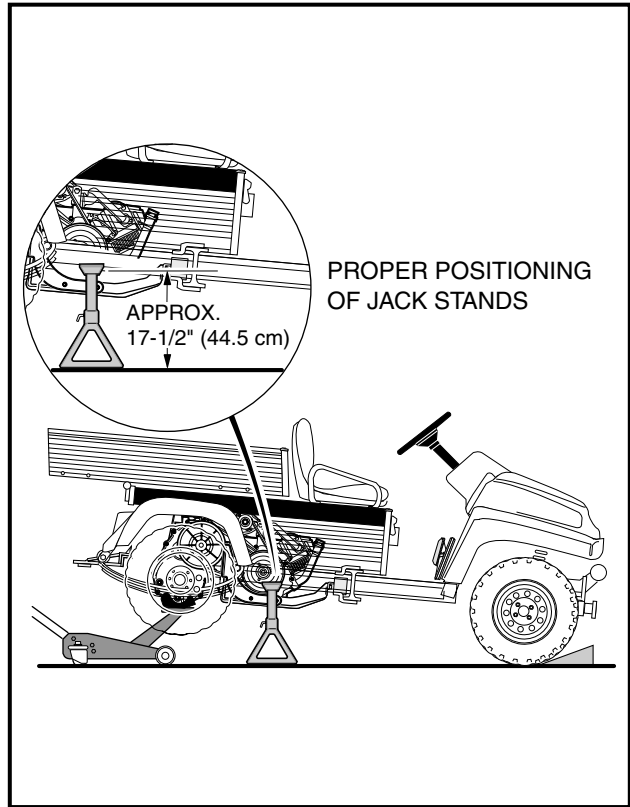


Figure 16a-27 Position Jack Stands

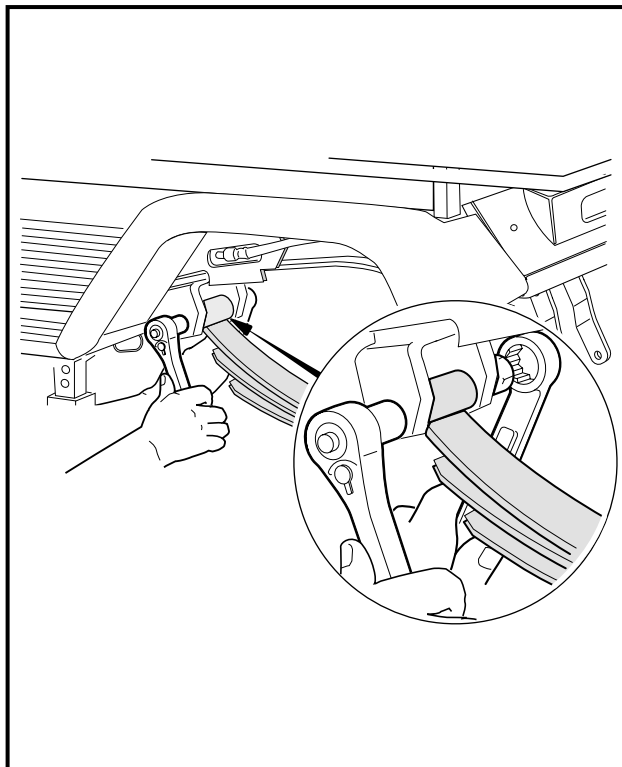


Figure 16a-28 Spring Retainer Bolts

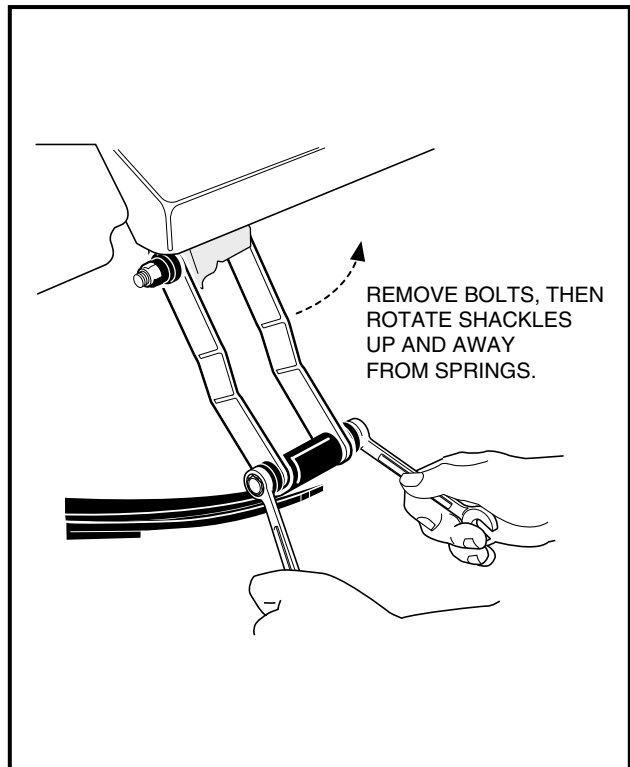


Figure 16a-29 Rear Shackles

Unitized Transaxle Removal, Continued:

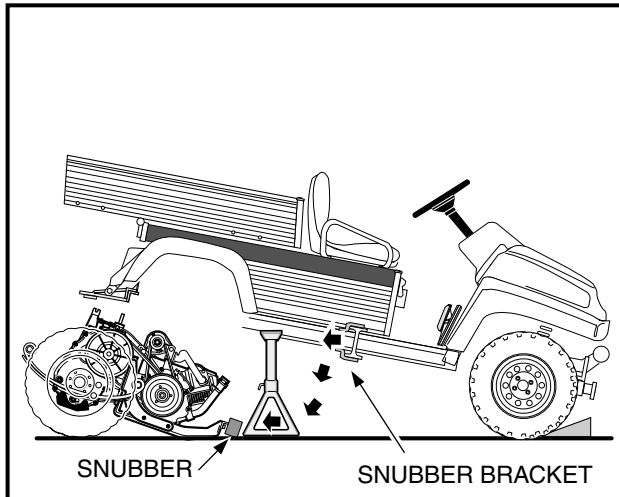


Figure 16a-30 Snubber

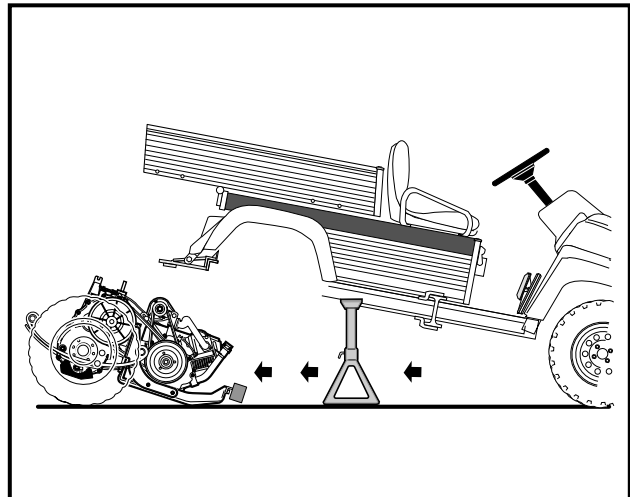


Figure 16a-31 Remove Powertrain

18. Loosen, but do not remove, the governor arm retaining bolt. Remove the governor arm from the shaft (**Figure 16a-35, Page 16a-17**).
19. Remove screws securing the governor cable bracket to transaxle (**Figure 16a-36, Page 16a-17**).
20. Remove screws securing the accelerator cable bracket to transaxle (**Figure 16a-37, Page 16a-17**).

NOTE: The governor cable and the accelerator cable should remain attached to the governor arm.

21. Remove the two bolts that secure the differential lock cable bracket to the transaxle housing and unhook the cable spring from the differential lock arm (**Figure 16a-38, Page 16a-17**).
22. Remove the six bolts mounting the unitized transaxle to the engine.
 - 22.1. Remove four transaxle mounting bolts (one at each corner of the transaxle mounting plate) as shown (**Figure 16a-39, Page 16a-17**).
 - 22.2. Remove two middle transaxle mounting nuts as shown (**Figure 16a-39, Page 16a-17**).
23. Remove leaf springs, wheels and brake assemblies from transaxle.

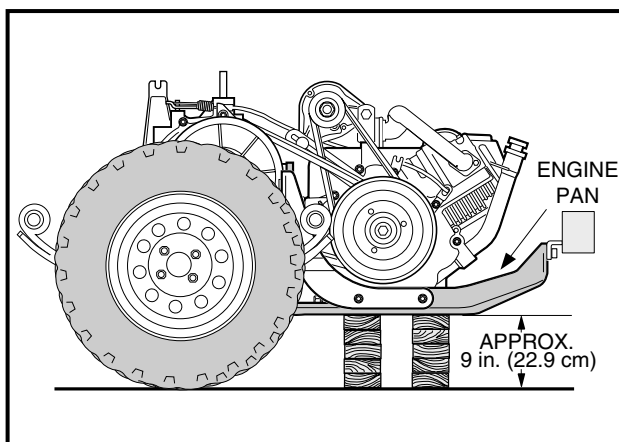


Figure 16a-32 Position Powertrain

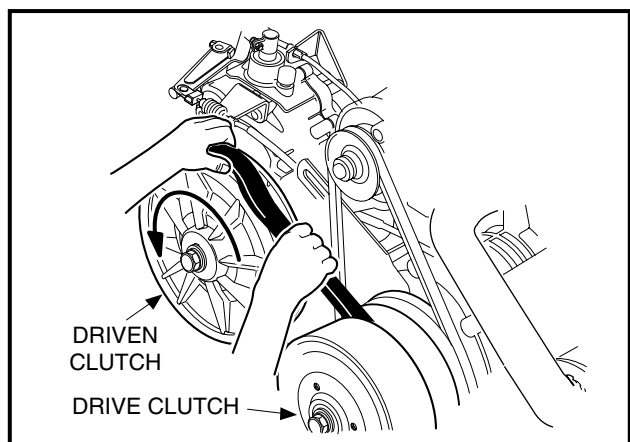


Figure 16a-33 Remove Drive Belt

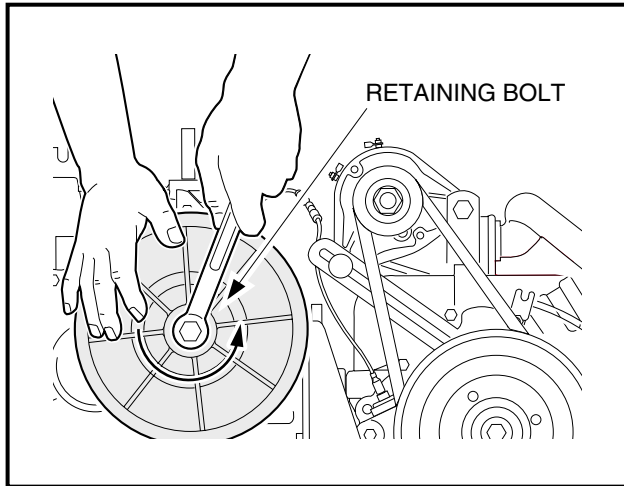


Figure 16a-34 Driven Clutch

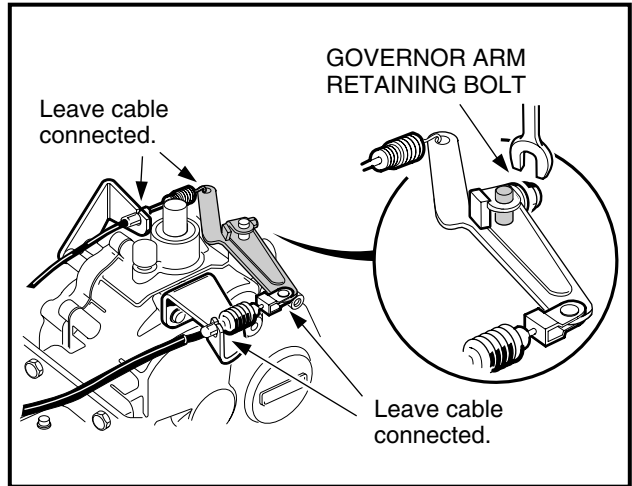


Figure 16a-35 Governor Arm

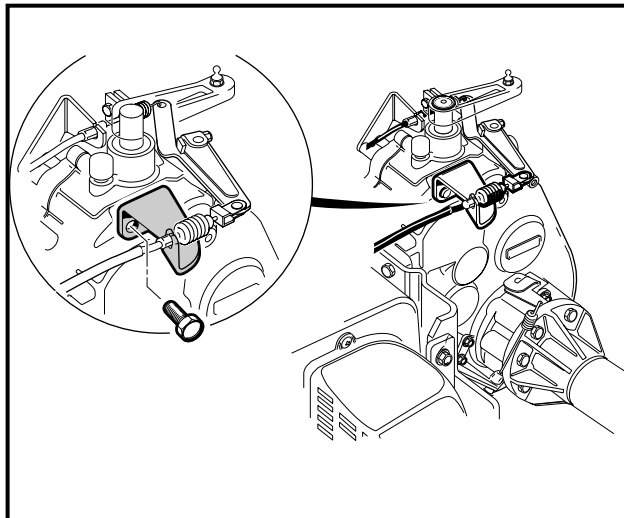


Figure 16a-36 Governor Cable Bracket

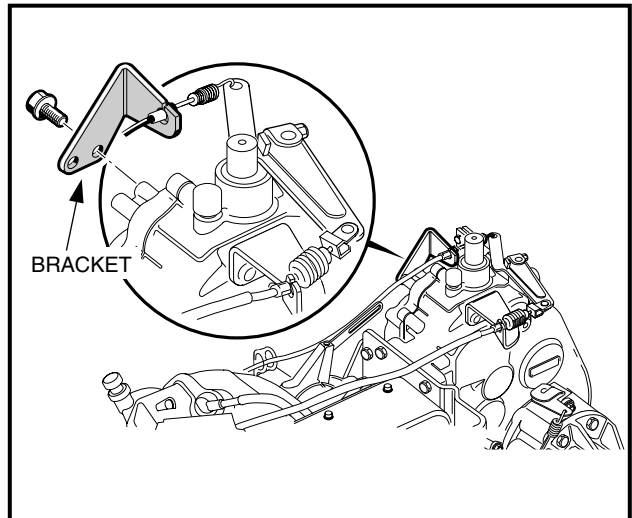


Figure 16a-37 Accelerator Cable Bracket

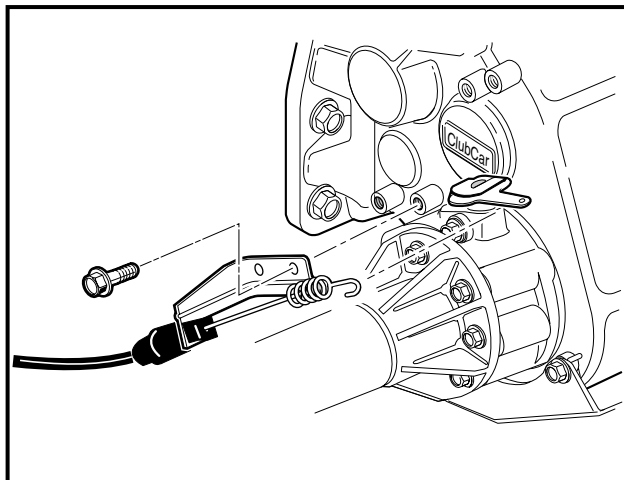


Figure 16a-38 Differential Lock Arm and Bracket

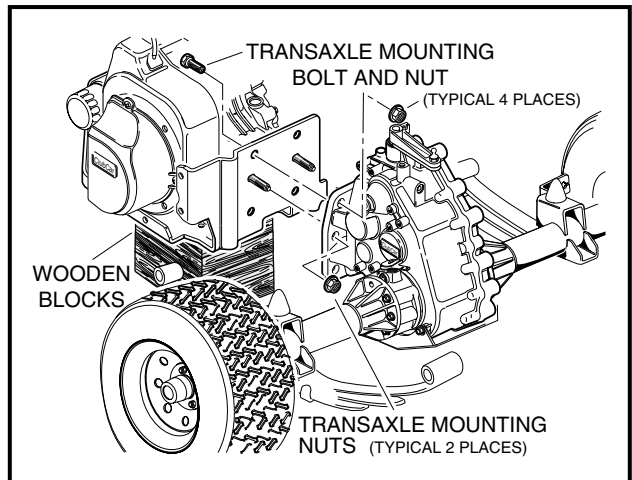


Figure 16a-39 Transaxle Mounting

UNITIZED TRANSAXLE DISASSEMBLY

Read **DANGER** and **WARNING** on page 16a-1.

NOTE: The following information provides instructions for disassembling the unitized transaxle; however, the transaxle case can be separated and gears accessed without removing the axles or axle tubes from the case.

1. Remove the drain plug and gasket. Drain and dispose of the oil properly (**Figure 16a-4, Page 16a-3**).

NOTE: It is easier to remove the axles when the wheel bolt flanges have been removed. To remove the wheel bolt flanges, **see Axle Shaft, Bearing, and Oil Seal Removal on page 16a-5**.

2. With the wheel bolt flanges attached to the axle ends, use a 90° (0.090 tip) internal snap ring pliers, and remove the internal retaining rings from the axle tubes (**Figure 16a-6, Page 16a-6**).
3. Pull the axles (90 and 91) and wheel bolt flange assemblies out of the axle tubes (**Figure 16a-9, Page 16a-8**).
4. Remove eight bolts (95) and seven bolts (96) mounting each axle tube to the transaxle case (**Figure 16a-9, Page 16a-8**). Then remove axle tubes from the transaxle case and differential lock housing. **See following NOTE.**

NOTE: It may be necessary to tap the axle tube with a rubber or plastic mallet to break it free from the transaxle case or differential lock housing.

5. Remove the differential lock housing (36) from the driver side of the transaxle case (27) (**Figure 16a-40, Page 16a-19**).
6. Remove the four differential guard bolts (35) and remove the guard (34) from the housing.
7. Remove the fifteen bolts (28) that hold the transaxle housing together (**Figure 16a-40, Page 16a-19**).
8. The unitized transaxle is equipped with a slot for prying the housing apart. Use the slot to open the case. Pull the housing apart, making sure all gear assemblies inside the transaxle stay together in one (either side of the case). **See following CAUTION.**

CAUTION

- To prevent damage to the mating seal surfaces of the case, use care when separating the halves.
9. Turn the case section containing the gearing on edge as shown (**Figure 16a-41, Page 16a-20**). While holding it in this position, gently rock all the gear assemblies to slightly loosen them in their seating. **See following CAUTION.**

CAUTION

- To prevent damage to the gears, use extreme care when handling them.
10. When all the gear assemblies are slightly loosened, remove the differential gear case assembly by gently rocking it while pulling it from the case (**Figure 16a-42, Page 16a-20**).
 11. Continue to rock and loosen the remaining gear assemblies until the intermediate gear assembly can be removed from the case. Then remove the idler shaft assembly (**Figure 16a-43, Page 16a-21**).
 12. Remove the synchronizer gear assembly and shifter fork assembly as a unit from the case (**Figure 16a-43, Page 16a-21**).

13. Use a seal puller (CCI P/N 1012809) or rolling head prybar to remove the input shaft oil seal from the case (**Figure 16a-44, Page 16a-21**).
14. Remove the oil flow guide from the case (**Figure 16a-45, Page 16a-21**).
15. Remove the shifter shaft and oil seal from the case (**Figure 16a-45, Page 16a-21**).
 - 15.1. Use snap ring pliers (0.047 tip) to remove the retaining ring (16) on the shifter shaft (**Figure 16a-40, Page 16a-19**).
 - 15.2. Remove flat washer (17) from the shifter shaft on the outside of the case as shown, then remove the shifter shaft by pushing it through the case toward the interior of transaxle (**Figure 16a-40, Page 16a-19**).
 - 15.3. Use a seal puller to remove the shifter shaft oil seal (18) from the case (**Figure 16a-40, Page 16a-19**).

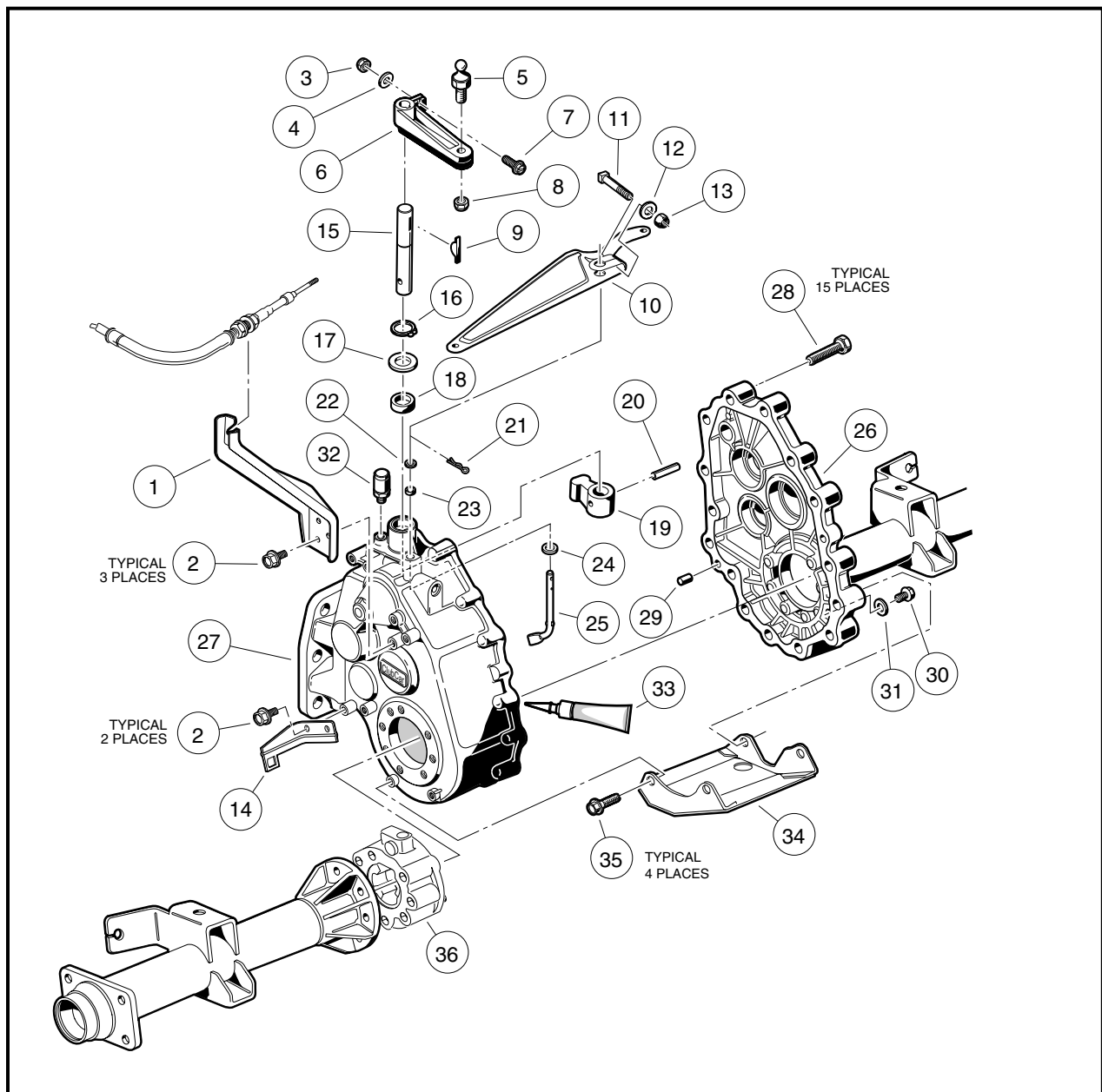


Figure 16a-40 Transaxle Gear Casing and Brackets

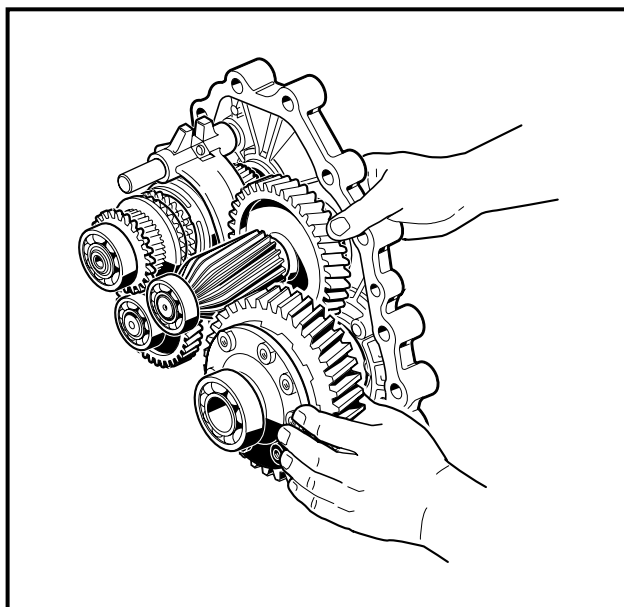
Unitized Transaxle Disassembly, Continued:

Figure 16a-41 Loosen Gears

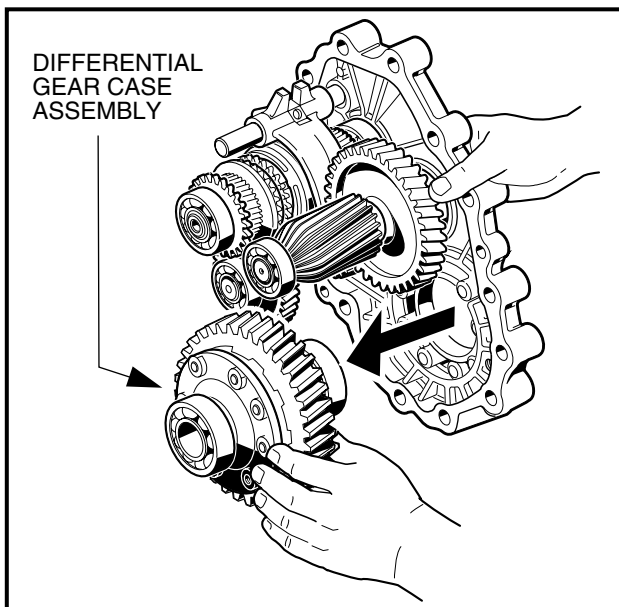


Figure 16a-42 Remove Differential Gear Case

16. Remove the breather (32) from the case (**Figure 16a-40, Page 16a-19**).
17. Remove the governor assembly from the case.
 - 17.1. Remove the cotter pin (21) and flat washer (22) from the pivot arm (25) (**Figure 16a-40, Page 16a-19**).
 - 17.2. Remove the pivot arm (25) by pulling it through the wall to the interior of the case, along with the inside support washer (24).
 - 17.3. Use a small chisel or similar pointed instrument to pry the pivot arm oil seal (23) (**Figure 16a-40, Page 16a-19**) out of the case (**Figure 16a-46, Page 16a-21**).
 - 17.4. Remove the governor gear assembly (64 and 65) and flat washer (63) (**Figure 16a-48, Page 16a-23**) by lightly tapping the gear shaft through the case wall, from the outside, with a hammer and drift. **See also Figure 16a-49, Page 16a-24.**

COMPONENT DISASSEMBLY

Read **DANGER** and **WARNING** on page 16a-1.

DIFFERENTIAL GEAR LOCK HOUSING DISASSEMBLY

1. Rotate the arm (99) and remove the differential lock cog (104) (**Figure 16a-47, Page 16a-22**).
2. Loosen, but do not remove, the differential lock arm retaining nut (101) and remove the arm (99) and spring (98) from the differential lock shaft (95).
3. Remove the spacer (97) from the differential lock shaft (95).
4. Remove the shaft retaining screw (102) and washer (103) from the differential lock housing.
5. Press the shaft (95) toward the center of the differential lock housing and remove the shaft (95) from the housing (94).
6. If necessary, gently pry the O-ring from the groove in the differential lock shaft with a small screwdriver (**Figure 16a-73, Page 16a-34**).

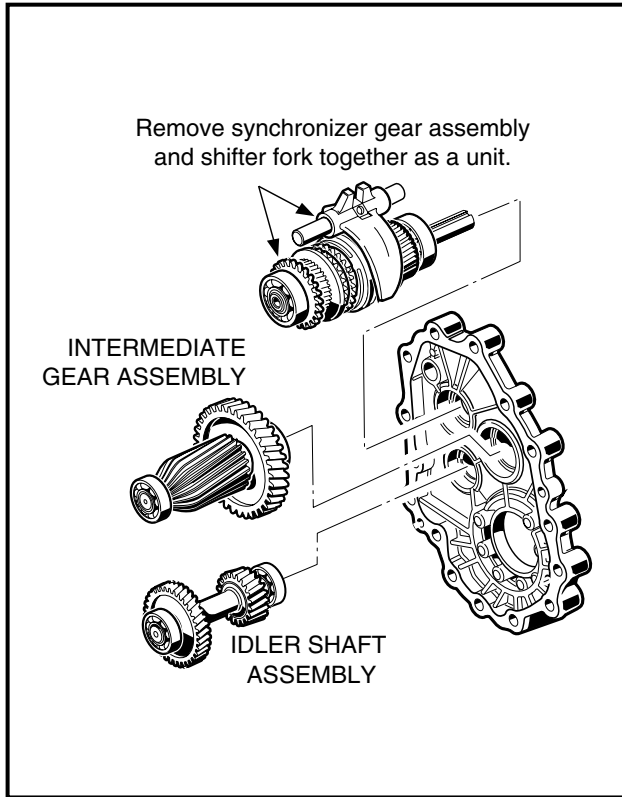


Figure 16a-43 Remove Intermediate Gear

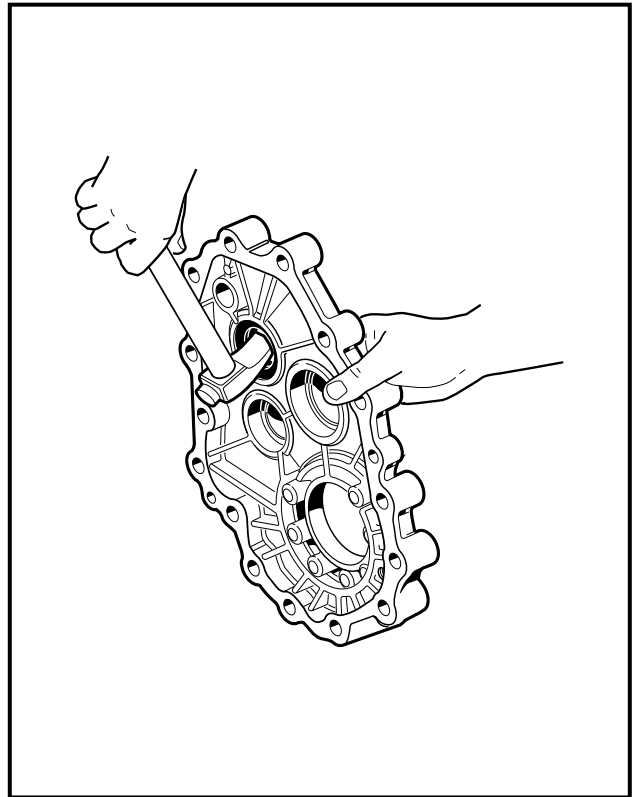


Figure 16a-44 Input Shaft Oil Seal

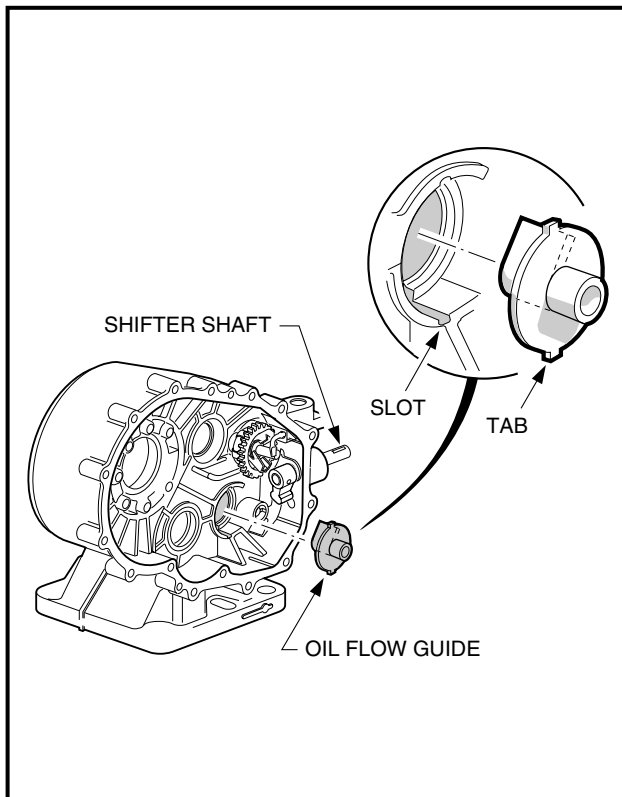


Figure 16a-45 Oil Flow Guide

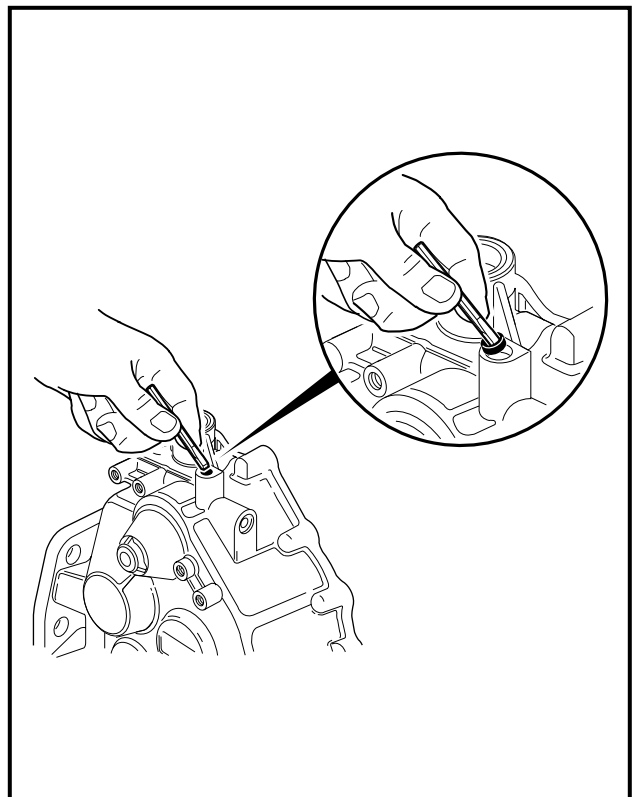


Figure 16a-46 Pivot Arm Oil Seal

GOVERNOR GEAR DISASSEMBLY

NOTE: It will be necessary to disassemble the governor gear assembly in order to reinstall it into the transaxle case.

1. Secure the governor gear assembly in a vise as shown. Wrap shaft in a cloth to prevent damage (Figure 16a-50, Page 16a-24).
2. Use two small screwdrivers to pry the gear and flyweight off the shaft as shown.

DIFFERENTIAL GEAR CASE DISASSEMBLY

⚠ CAUTION

- Mark parts for identification as they are disassembled. Parts must be reassembled in their original locations and orientations.

1. Remove eight ring gear retaining bolts (70), and remove the ring gear from the assembly. It may be necessary to tap the ring gear off with a plastic or rubber mallet (Figure 16a-51, Page 16a-24). See following NOTE.

NOTE: Because Loctite was applied to the bolts during assembly, it may be necessary to place the differential gear case in a vise to remove the bolts.

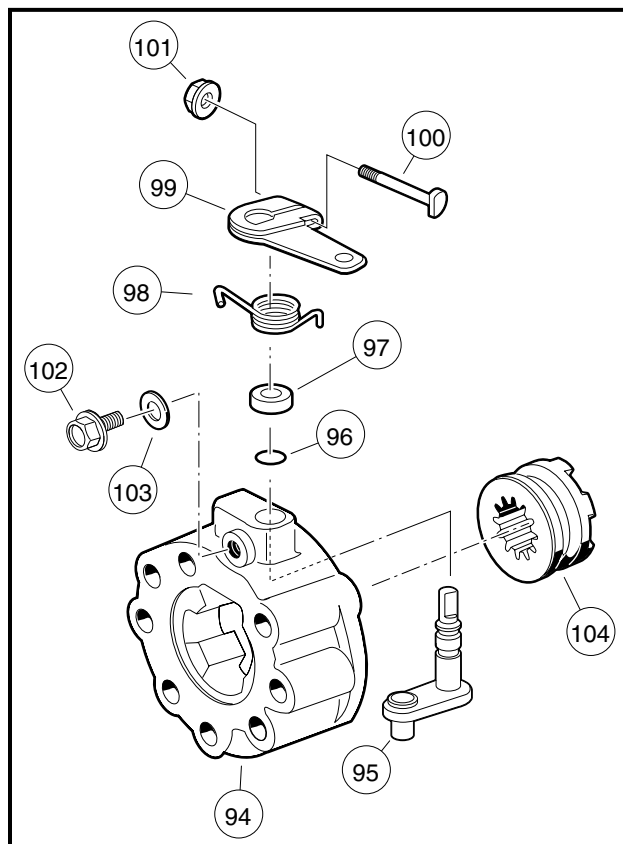


Figure 16a-47 Differential Lock Housing Disassembly

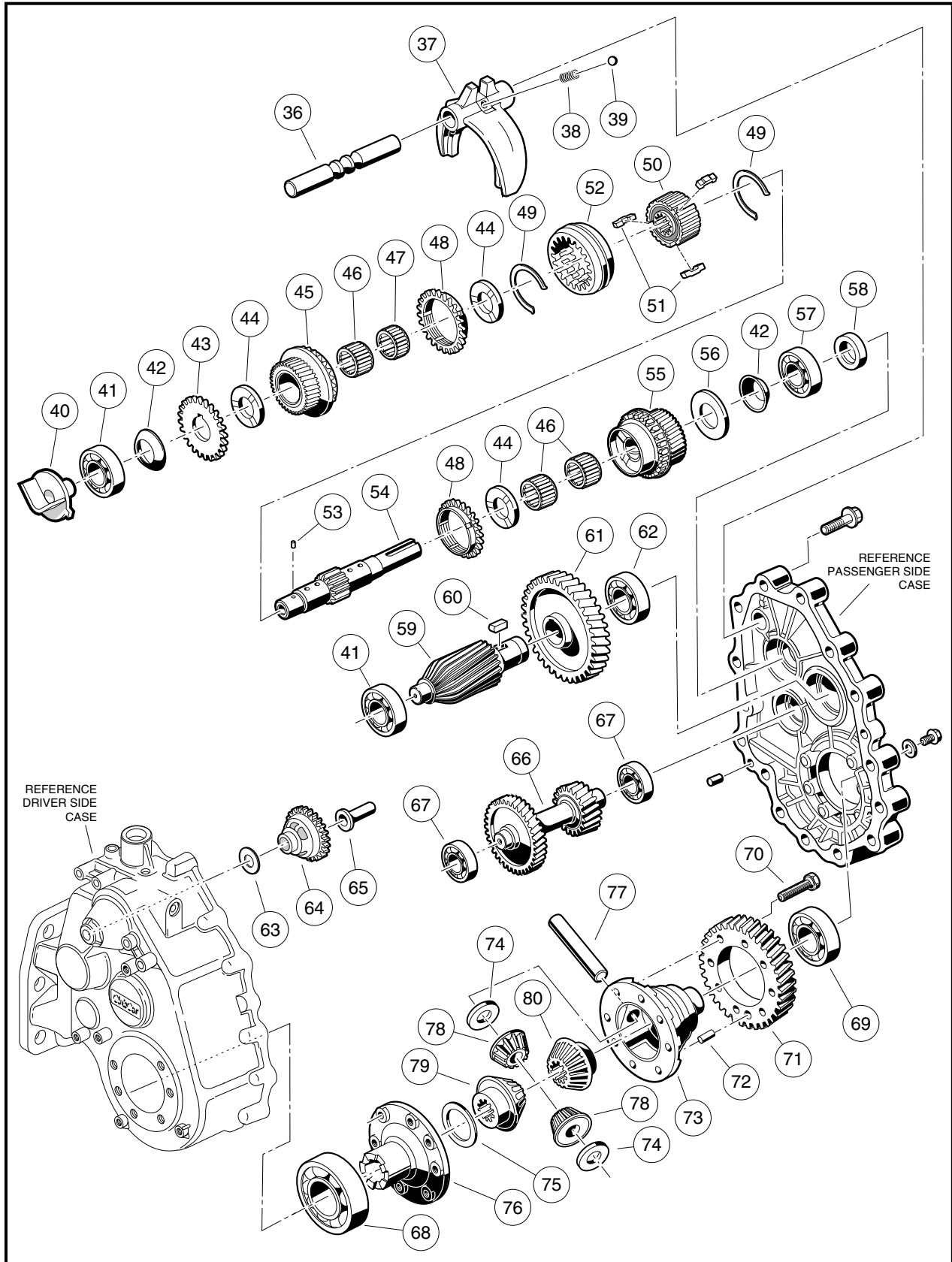


Figure 16a-48 Unitized Transaxle with Differential Lock

Differential Gear Case Disassembly, Continued:

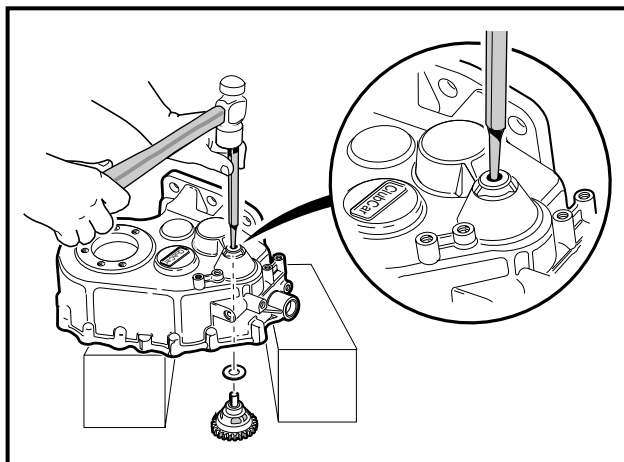


Figure 16a-49 Remove Governor Gear

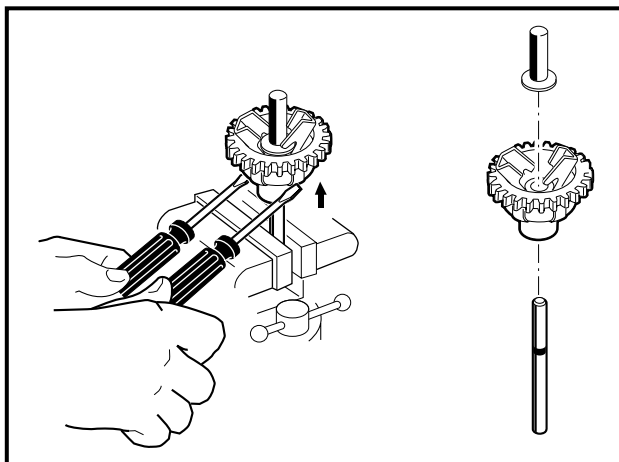


Figure 16a-50 Pry Gear from Shaft

2. Pull the cover (76) and thrust plate (75) from the differential gear carrier case (**Figure 16a-48, Page 16a-23**).
3. Remove the differential gear (79) from the differential gear carrier case.
4. Remove the differential pin (77) (**Figure 16a-48, Page 16a-23**) by pushing it through from one side (**Figure 16a-52, Page 16a-25**).
5. Remove the two differential idler gears (78) and two idler gear thrust plates (74) as the pin is driven through (**Figure 16a-48, Page 16a-23**).

NOTE: It may be necessary to drive the differential pin out with a hammer and punch.

6. Remove the remaining (opposite side) differential gear (80) from the carrier case (**Figure 16a-48, Page 16a-23**).

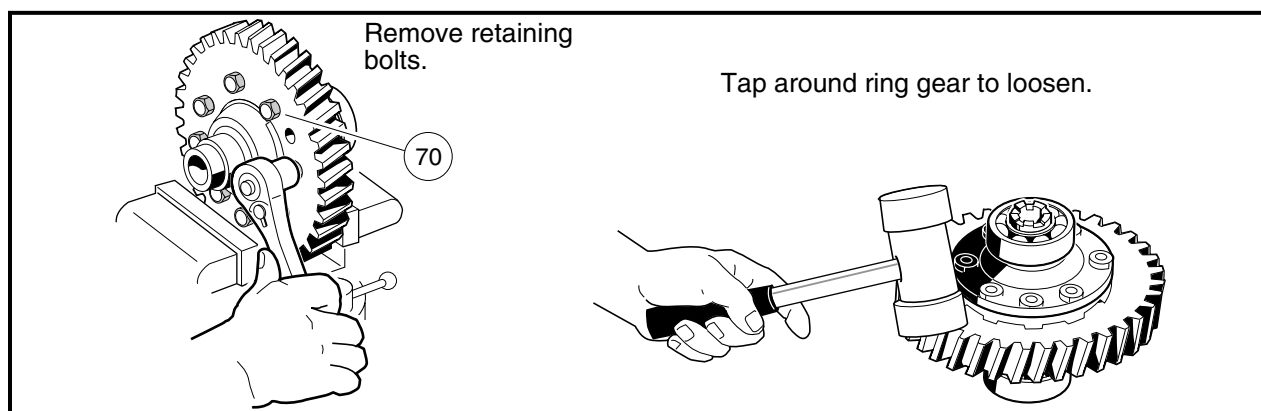


Figure 16a-51 Remove Ring Gear

7. If the bearings (68 and 69) are to be removed, place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing (69) and gear case (73) (**Figure 16a-48, Page 16a-23**) and press the bearing off as shown (**Figure 16a-53, Page 16a-25**). Repeat the process for the bearing (68) on the carrier cover (76) (**Figure 16a-48, Page 16a-23**). See following **CAUTION**.

⚠ CAUTION

- Do not tighten the bearing puller wedge attachment against the shaft. This could damage the shaft.

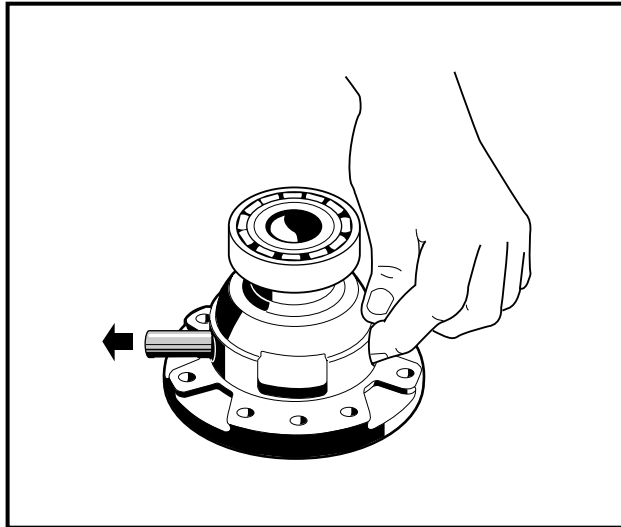


Figure 16a-52 Differential Pin

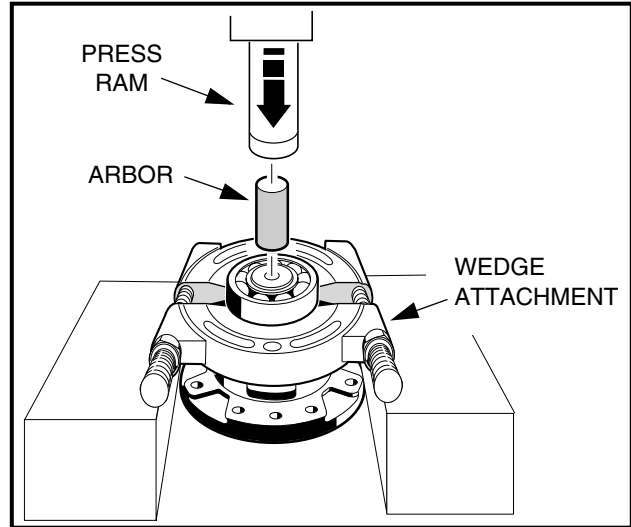


Figure 16a-53 Remove Bearing

SHIFTER FORK DISASSEMBLY

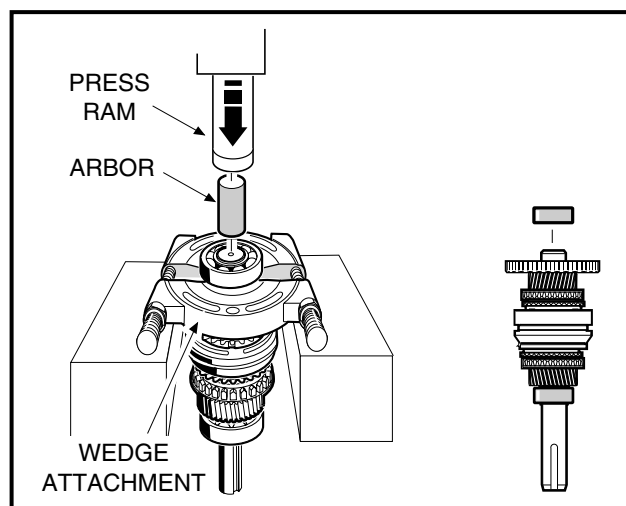
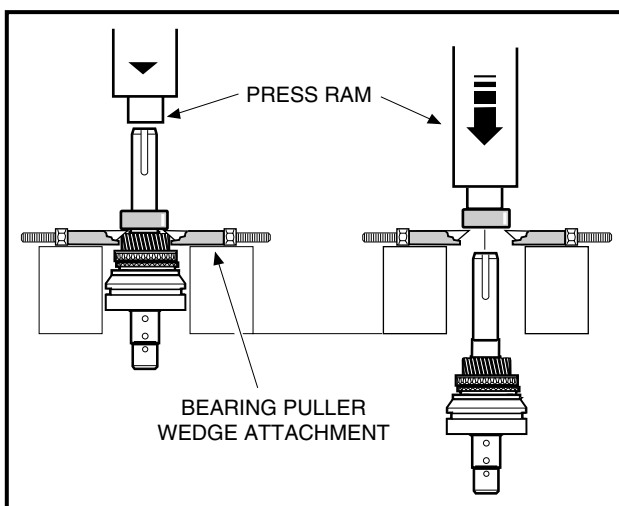
1. Push the shift rod (36) out of the shifter fork (37) (Figure 16a-48, Page 16a-23).
2. Shake the shifter fork (37) to remove the spring (38) and ball (39) (Figure 16a-48, Page 16a-23).

SYNCHRONIZER GEAR DISASSEMBLY**⚠ CAUTION**

- Mark parts for identification as they are disassembled. Parts must be reassembled in their original locations and orientations.
 - Do not tighten the bearing puller wedge attachment against the shaft. This could damage the shaft.
1. Place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing (41) and spur (governor drive) gear (43) (Figure 16a-48, Page 16a-23), then press the bearing off the input shaft as shown (Figure 16a-54, Page 16a-26). See preceding CAUTION.
 2. Pull the spring washer (42), spur gear (43), dowel pin (53), thrust plate (44), input gear assembly (45), large needle bearing (46), small needle bearing (47), synchronizer ring (48), and thrust plate (44) from the input shaft (Figure 16a-48, Page 16a-23).
 3. Place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing (57) and input gear assembly (55) (Figure 16a-48, Page 16a-23), then press the bearing off the input shaft as shown (Figure 16a-55, Page 16a-26). See following CAUTION.

Synchronizer Gear Disassembly, Continued:**⚠ CAUTION**

- Do not tighten the bearing puller wedge attachment against the shaft. This could damage the shaft.
4. Pull the spring washer (42), thrust washer (56), input gear assembly (55), two needle bearings (46), thrust plate (44), and synchronizer ring (48) from the input shaft (**Figure 16a-48, Page 16a-23**).

**Figure 16a-54 Remove Bearing****Figure 16a-55 Remove Bearing**

5. Use a small flat-blade screwdriver to remove two synchronizer springs (snap rings) (49), and then slide the synchronizer clutch hub (52) from the input shaft (54) (**Figure 16a-48, Page 16a-23**). **See following NOTE:**

NOTE: There are three synchronizer inserts (51) set into slots in the synchronizer sleeve (50) (**Figure 16a-48, Page 16a-23**). These may fall free when the synchronizer clutch hub (52) is removed. Do not lose these inserts.

6. Remove the three synchronizer inserts (51) from the synchronizer sleeve (**Figure 16a-48, Page 16a-23**).
7. Press the synchronizer sleeve (50) from the input shaft (**Figure 16a-48, Page 16a-23**).

INTERMEDIATE GEAR DISASSEMBLY

1. Place bearing puller wedge attachment (CCI P/N 1012812) between bearing (41) and shaft/gear (59) (**Figure 16a-48, Page 16a-23**), then press bearing off shaft (**Figure 16a-56, Page 16a-27**). **See following CAUTION.**

⚠ CAUTION

- Do not tighten the bearing puller wedge attachment against the shaft. This could damage the shaft.
2. Place the bearing puller wedge attachment under the bearing (62) and press the bearing from the shaft (**Figure 16a-48, Page 16a-23**). **See preceding CAUTION.**
 3. Press the gear (61) from the shaft (59), then remove the key (60) (**Figure 16a-48, Page 16a-23**).

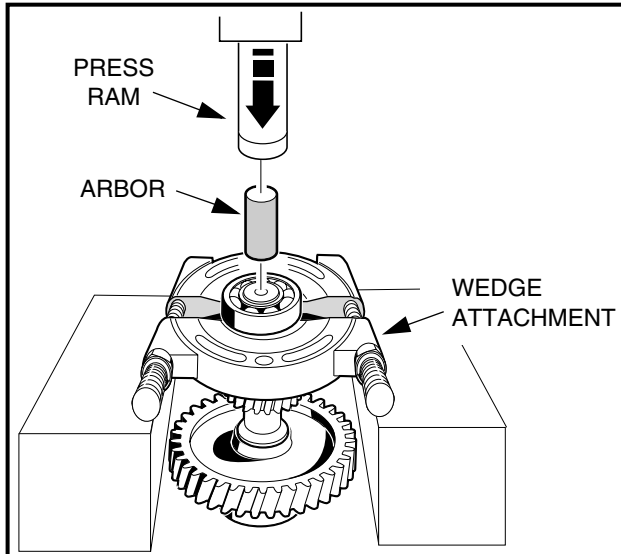


Figure 16a-56 Remove Bearing

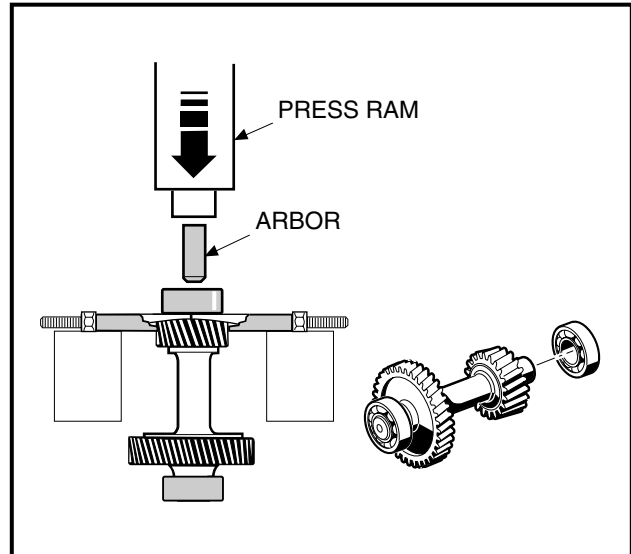


Figure 16a-57 Remove Bearing

IDLER SHAFT DISASSEMBLY

1. Place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing (67) (**Figure 16a-48, Page 16a-23**) and the small gear on the idler shaft (66) (**Figure 16a-48, Page 16a-23**), then press the bearing off the shaft as shown (**Figure 16a-57, Page 16a-27**). See following **CAUTION**.

CAUTION

- Do not tighten the bearing puller wedge attachment against the shaft. The shaft could be damaged when pressing the bearing off.
2. Place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing and the larger gear on the idler shaft, then press the bearing off the shaft (68) (**Figure 16a-48, Page 16a-23**) as shown (**Figure 16a-58, Page 16a-27**).

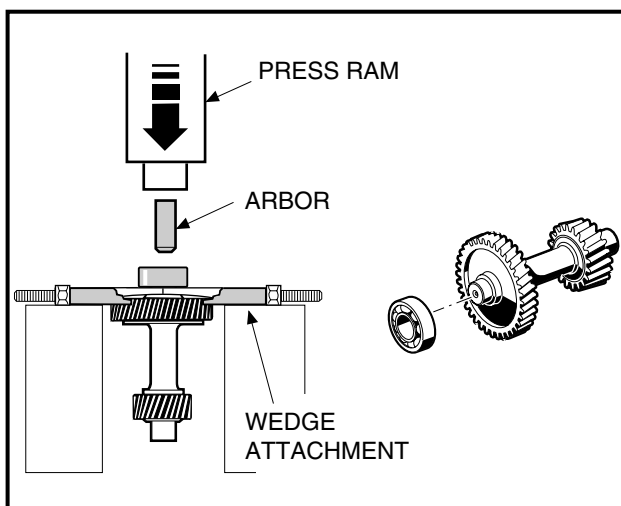


Figure 16a-58 Remove Idler Shaft

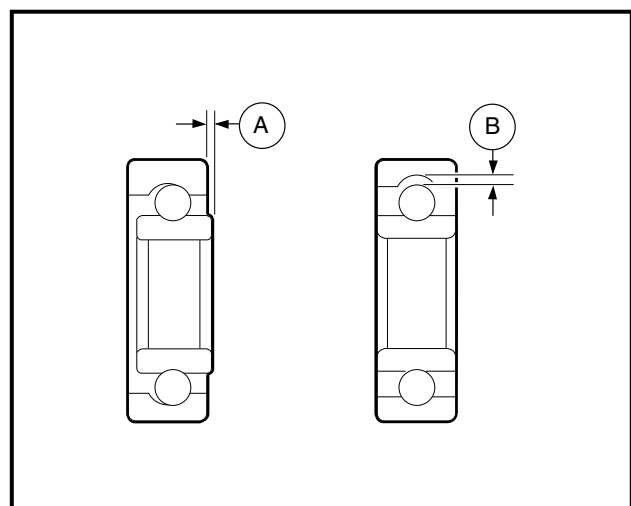


Figure 16a-59 Inspect Bearings

UNITIZED TRANSAXLE COMPONENT INSPECTION

Read **DANGER** and **WARNING** on page 16a-1.

1. Clean all of the component parts of the transaxle in a high flash-point solvent and then dry them. Inspect all components for excessive wear or damage.
2. Inspect all bearings by spinning them by hand. Check the bearings for excessive axial (A) and radial (B) play (**Figure 16a-59, Page 16a-27**). Replace bearings if they do not spin smoothly, if they are noisy, or if they have excessive play. Replace bearings if they are rusted, worn, cracked, pitted or discolored.
3. Gears should be inspected for tooth surface damage or fractures.
4. Synchronizer ring teeth should be inspected for severe wear, fractures, or other damage.
5. Using a feeler gauge, measure the distance X at several points around the assembly. The synchro ring should be replaced when X is 0.02 inch (0.5 mm) or less (**Figure 16a-60, Page 16a-28**).
6. Inspect the O-ring (96) on the differential lock shaft (**Figure 16a-47, Page 16a-22**).

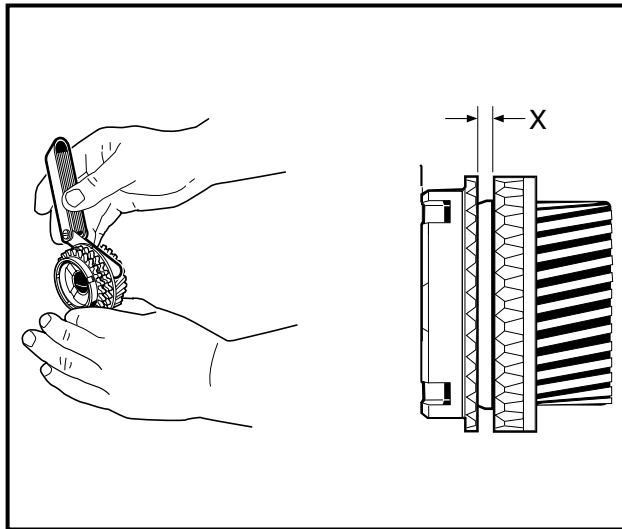


Figure 16a-60 Synchro. Ring

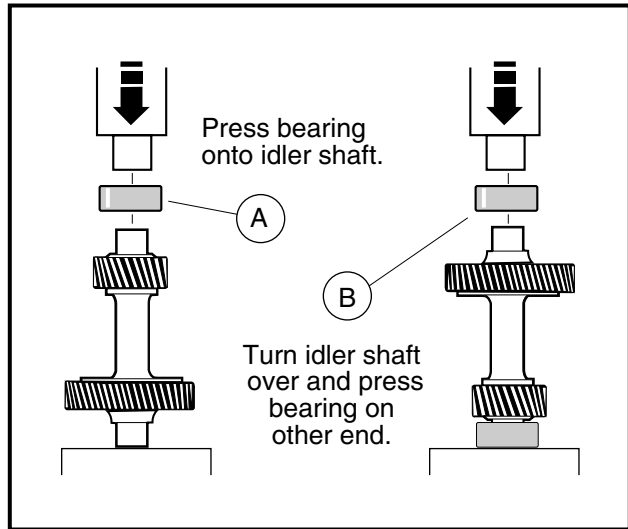


Figure 16a-61 Idler Shaft

COMPONENT ASSEMBLY

Read **DANGER** and **WARNING** on page 16a-1.

IDLER SHAFT ASSEMBLY

1. Press a new bearing (67) (**Figure 16a-48, Page 16a-23**) onto each end of the idler shaft (**Figure 16a-61, Page 16a-28**). See following **CAUTION**.

CAUTION

- Apply pressure against the inner race of the bearing only. Applying pressure anywhere else will damage the bearing.

INTERMEDIATE GEAR ASSEMBLY

1. If the gear (61) was removed from the shaft, install the key (60) into the slot and then position the gear on the shaft with keyway properly aligned with key. Press gear into place on the key (**Figure 16a-48, Page 16a-23**).
2. Press the bearing (62) onto the end of the shaft next to the large gear that was installed in step one (**Figure 16a-48, Page 16a-23**). See preceding **CAUTION**.
3. Press a new bearing (41) onto the other end of the shaft (**Figure 16a-48, Page 16a-23**).

SYNCHRONIZER GEAR ASSEMBLY

1. Press the synchronizer sleeve (50) onto the splines of the input shaft (54) (**Figure 16a-48, Page 16a-23**). No particular orientation of the sleeve is necessary, but toward the short end of the shaft, the machined circular face surrounding the ends of the internal splines in the sleeve must be flush with the machined lip of the shaft at the ends of the shaft splines (**Figure 16a-62, Page 16a-29**).
2. Install the synchronizer springs (49) (**Figure 16a-48, Page 16a-23**) in the sleeve as shown (**Figure 16a-63, Page 16a-29**).

NOTE: Make sure the ends of the springs are positioned between the synchronizer insert slots (**Figure 16a-63, Page 16a-29**).

3. Install the three synchronizer inserts (51) into the slots in the sleeve (**Figure 16a-48, Page 16a-23**). Make sure the notched surfaces of the inserts are facing outward as shown (**Figure 16a-64, Page 16a-30**).

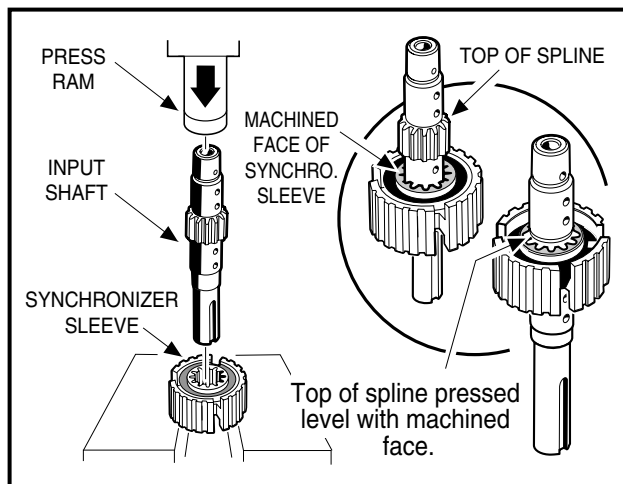


Figure 16a-62 Synchro. Gear Assembly

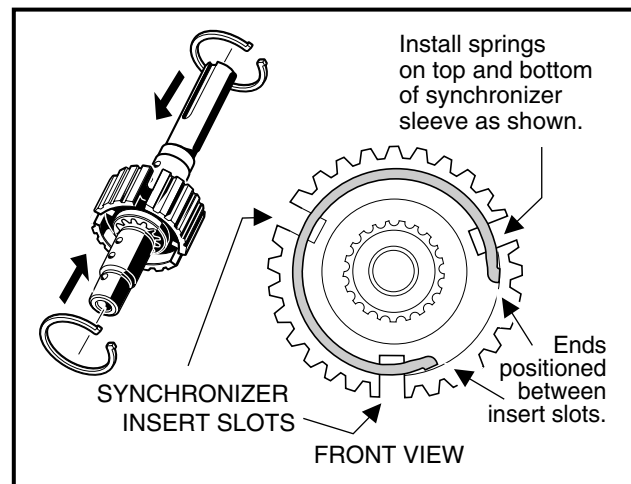


Figure 16a-63 Synchro. Springs

4. Install the synchronizer clutch hub (52) (**Figure 16a-48, Page 16a-23**) onto the synchronizer sleeve. Make sure the chamfered end of the hub is oriented toward the long end of the input shaft as shown (**Figure 16a-65, Page 16a-30**).
5. On the long end of the shaft, install the synchronizer ring (48) (**Figure 16a-48, Page 16a-23**) with the smooth collar of the ring towards the clutch hub. Make sure the three notches in the collar mate with the synchronizer inserts in the synchronizer sleeve as shown (**Figure 16a-66, Page 16a-30**).
6. Install the thrust washer (44) and two bearings (46) as shown (**Figure 16a-48, Page 16a-23**).

Synchronizer Gear Assembly, Continued:

7. Install the input gear assembly (55), with the smooth collar toward the synchronizer ring as shown (Figure 16a-48, Page 16a-23). The input gear should seat in the synchronizer ring.
8. Install the thrust washer (56) and then the spring washer (42). The spring washer should be oriented with the raised center toward the end of the shaft (Figure 16a-48, Page 16a-23).
9. Press new bearing (57) (Figure 16a-48, Page 16a-23) onto the shaft until it seats. Make sure the input gear turns freely. **See following CAUTION.**

⚠ CAUTION

- Apply pressure against the inner race of the bearing only. Applying pressure anywhere else will damage the bearing.

10. On the other end of the input shaft, install the thrust washer (44), and the synchronizer ring (48). The smooth collar of the synchronizer ring should be oriented toward the clutch hub, and the notches in it should mate with the synchronizer inserts as shown (Figure 16a-48, Page 16a-23).

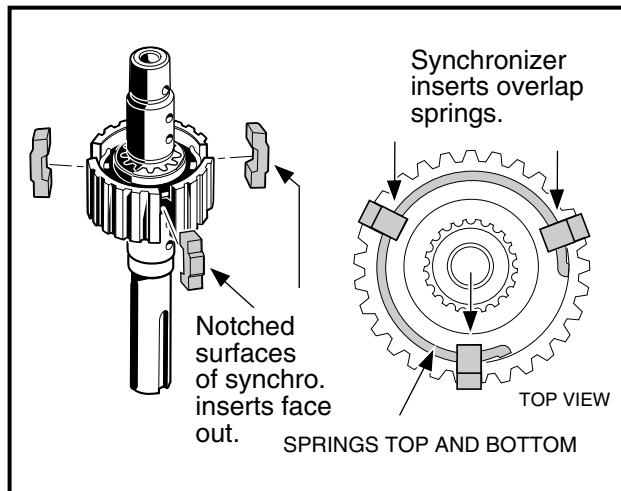


Figure 16a-64 Synchronizer Inserts

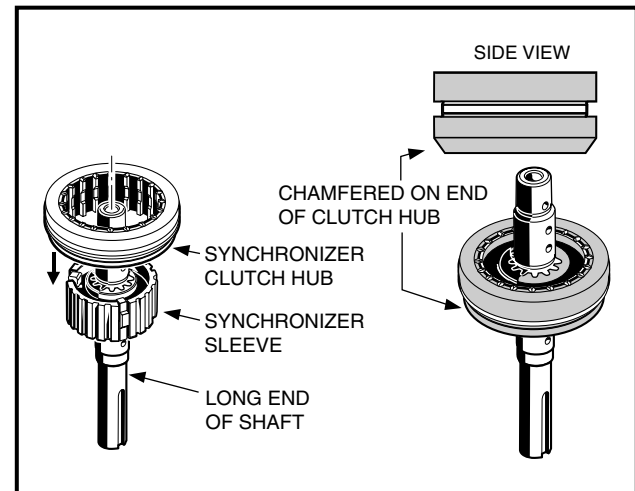


Figure 16a-65 Synchronizer Clutch Hub

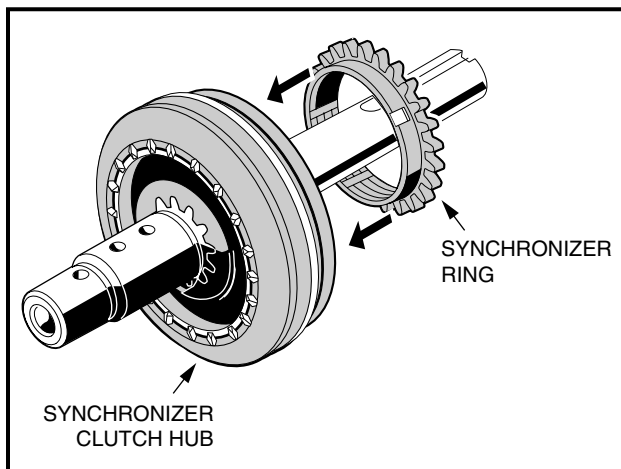


Figure 16a-66 Synchronizer Ring

11. Install the narrow bearing (47), wide bearing (46), and input gear (45) onto the shaft. The smooth collar of the input gear should be oriented toward the synchronizer ring as shown (**Figure 16a-48, Page 16a-23**). The gear should seat inside the ring.
12. Install thrust plate (44) onto the shaft, and the dowel pin (53) into the shaft as shown (**Figure 16a-48, Page 16a-23**).
13. Install the spur (governor drive) gear (43) onto the shaft with either side down. Mate the notch in the gear with the dowel pin as shown (**Figure 16a-48, Page 16a-23**).
14. Install the spring washer (42) onto shaft with the raised center toward the end of the shaft (**Figure 16a-48, Page 16a-23**).
15. Press a new bearing (41) onto the end of the shaft until it seats (**Figure 16a-48, Page 16a-23**). Make sure the input gears turn freely. **See following CAUTION.**

▲ CAUTION

- **Apply pressure against the inner race of the bearing only. Applying pressure anywhere else will damage the bearing.**

SHIFTER FORK ASSEMBLY

1. Install the spring (38) and ball (39) into the shifter fork (37) as shown (**Figure 16a-48, Page 16a-23**).
2. Use a no. 1 tip phillips screwdriver to depress the ball and spring while inserting shift rod (36) into the shifter fork (37). Remove screwdriver when the shift rod is inserted far enough for it to depress the ball and spring, then continue to insert rod until the ball is positioned in the middle detent on the rod (**Figure 16a-48, Page 16a-23**).

DIFFERENTIAL GEAR CASE ASSEMBLY

1. If the bearings (68 or 69) were removed, press new ones onto the differential gear carrier case (73) and carrier case cover (76) (**Figure 16a-48, Page 16a-23**). **See following CAUTION.**

▲ CAUTION

- **Apply pressure against the inner race of the bearing only. Applying pressure anywhere else will damage the bearing.**
2. Install differential gear (80) into carrier case (73) (**Figure 16a-48, Page 16a-23**) as shown (**Figure 16a-67, Page 16a-32**).
 3. Start the differential pin (77) into the carrier case by lightly tapping it in with a plastic or rubber hammer. Before the pin enters the inside of the carrier case, position the thrust plate (74) and idler gear (78) in the case and continue tapping the pin through the thrust plate and idler gear as shown (**Figure 16a-68, Page 16a-32**).
 4. Position the other thrust plate (74) and idler gear (78) in the carrier case. Continue to drive the pin (77) through them and the wall of the carrier case until the ends of the pin are flush with the sides of the carrier case (**Figure 16a-69, Page 16a-32**).
 5. Install the thrust plate (75) and differential gear (79) into the carrier case cover (76) (**Figure 16a-48, Page 16a-23**) as shown (**Figure 16a-70, Page 16a-32**). While holding the thrust plate and differential gear in place, position the carrier case cover on the carrier case (**Figure 16a-70, Page 16a-32**).

Differential Gear Case Assembly, Continued:

6. Position the output ring gear (71) (**Figure 16a-48, Page 16a-23**) on the carrier case, visually aligning the dowel hole in the carrier case with the dowel pin in the ring gear. Using a plastic or rubber mallet, tap the ring gear into place on the dowel pin as shown (**Figure 16a-71, Page 16a-33**).
7. Apply Loctite 277 on the threads of the eight mounting bolts and install them through the ring gear, carrier case, and into the carrier case cover. Tighten the bolts to 18 ft-lb (24.4 N·m) in the sequence shown (**Figure 16a-72, Page 16a-33**).

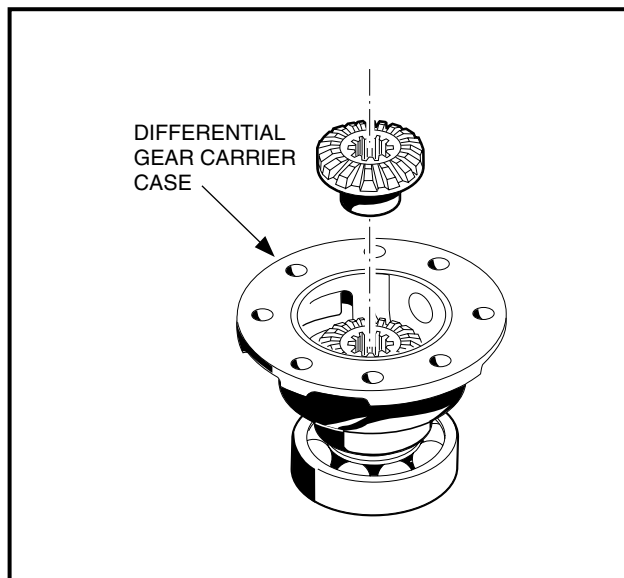


Figure 16a-67 Differential Gear

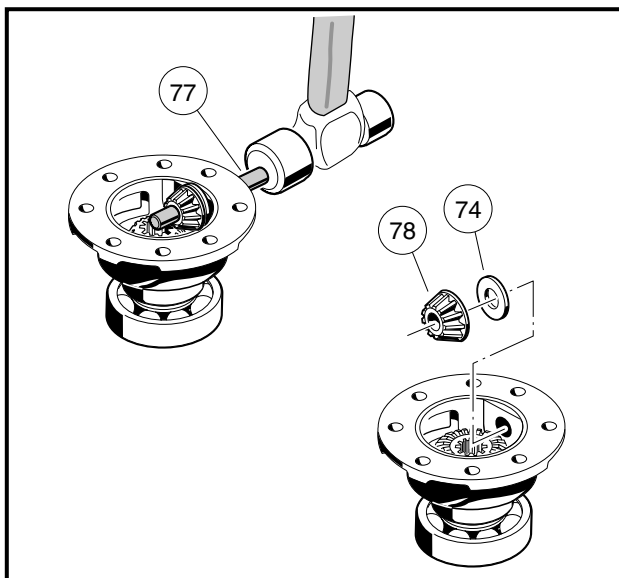


Figure 16a-68 Idler Gear

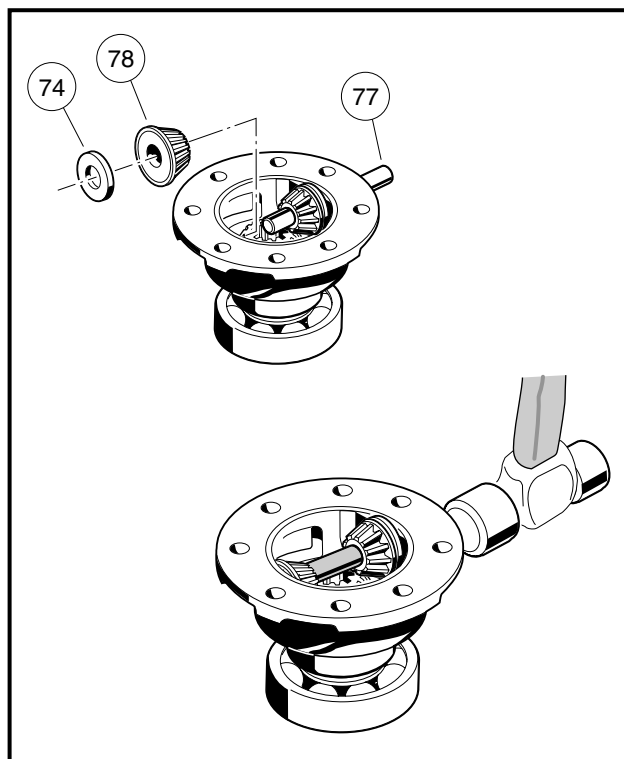


Figure 16a-69 Second Idler Gear

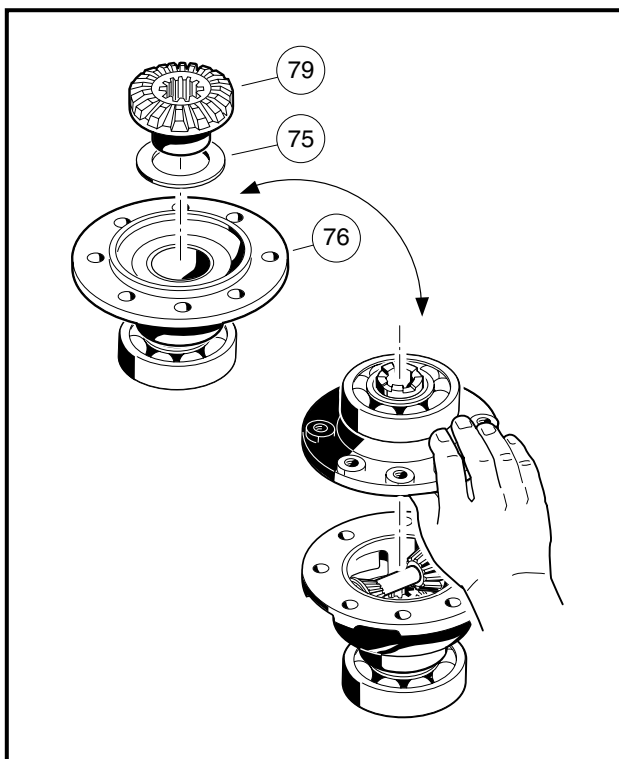


Figure 16a-70 Carrier Case

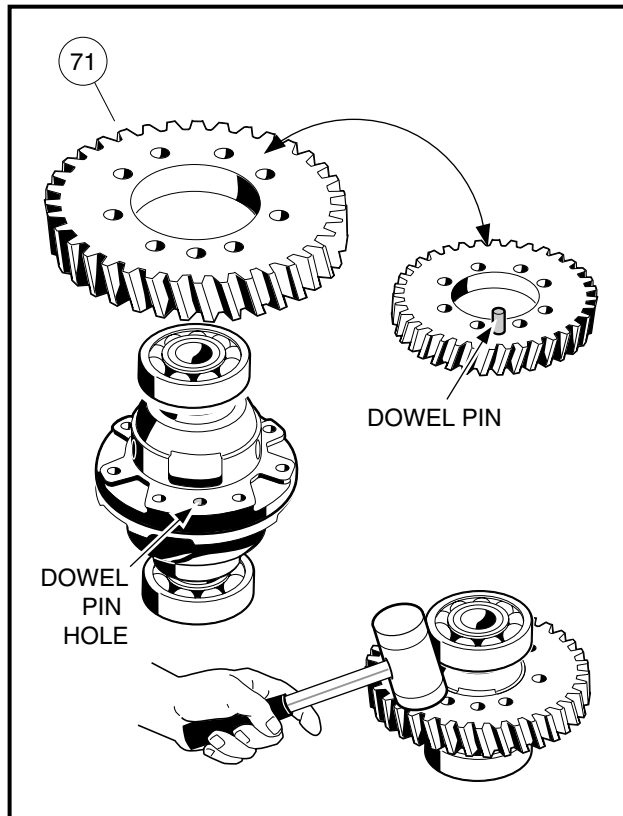


Figure 16a-71 Ring Gear

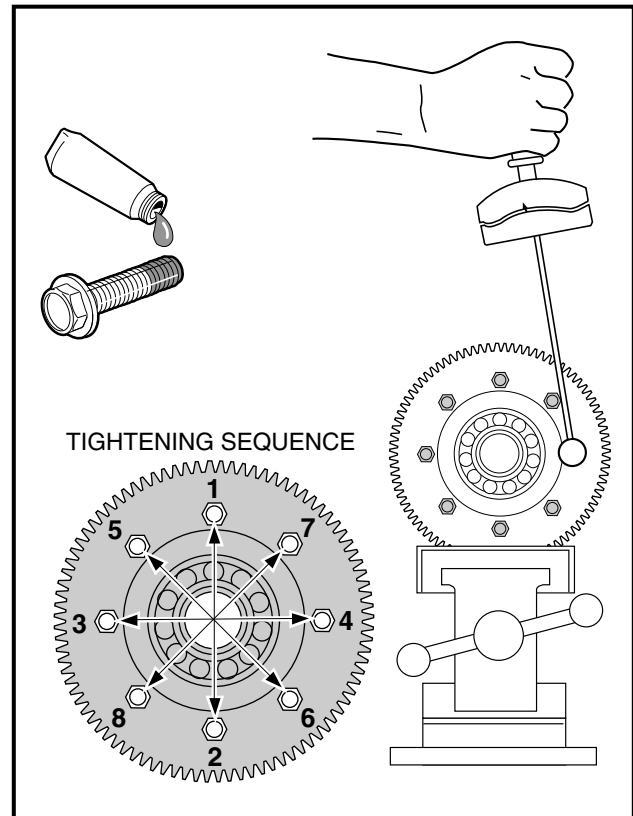


Figure 16a-72 Retaining Bolts

GOVERNOR GEAR ASSEMBLY

The governor gear is not assembled before installing it in the unitized transaxle case. The governor gear shaft is installed into the case and then the rest of the governor gear assembly is installed on the shaft. Proceed with unitized transaxle assembly.

DIFFERENTIAL GEAR LOCK HOUSING ASSEMBLY

1. If previously removed, slide the O-Ring into the top groove of the differential lock shaft (**Figure 16a-73, Page 16a-34**).
2. Place the shaft (95) into the hole in the differential lock housing (94) (**Figure 16a-74, Page 16a-34**).
3. Install the retaining screw (102) and washer (103) into the differential lock housing. Ensure that the screw is aligned with the second groove in the differential lock shaft before continuing to tighten the screw (**Figure 16a-74, Page 16a-34**). Tighten the screw to 69 in-lb (7.8 N·m).
4. Place the spacer (97) onto the differential lock shaft (**Figure 16a-74, Page 16a-34**).
5. Install the spring over the spacer so that the straight end of the spring will rest on the axle tube side of the differential lock housing (**Figure 16a-74, Page 16a-34**).
6. Place the differential lock arm (99) on the shaft (95) and place the hooked end of the spring (98) on the arm (**Figure 16a-74, Page 16a-34**).
7. Tighten the differential lock arm retainer nut (101) to 60 in-lb (6.8 N·m) (**Figure 16a-74, Page 16a-34**).

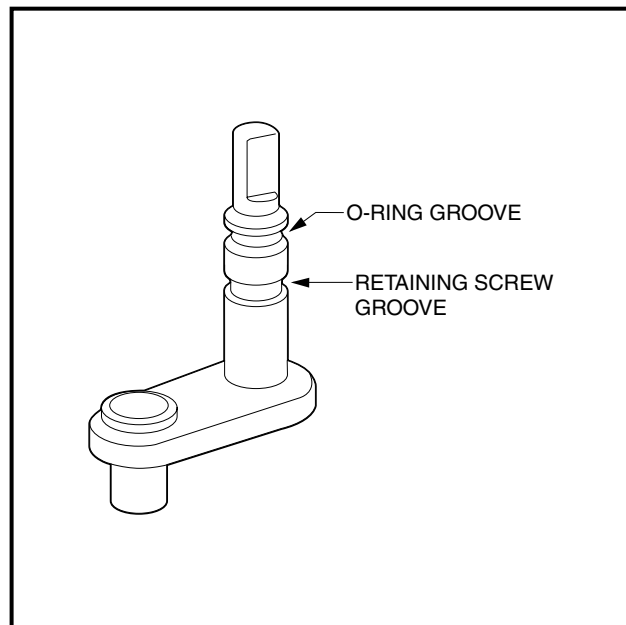


Figure 16a-73 Differential Lock Shaft

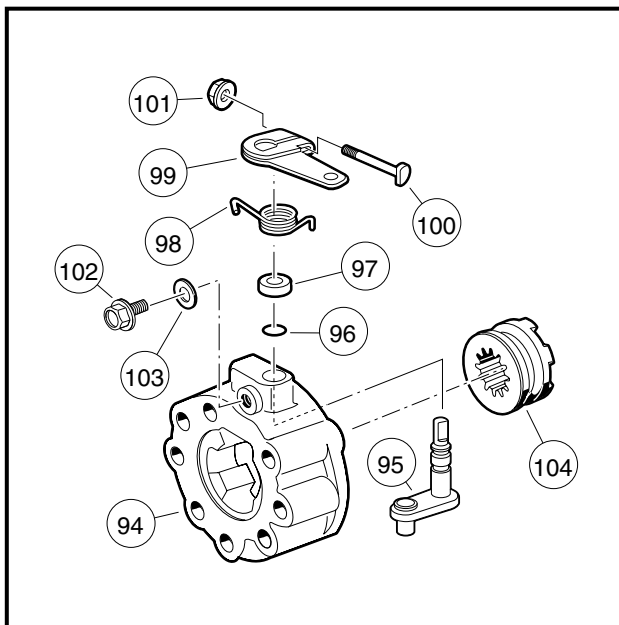


Figure 16a-74 Differential Lock Housing Assembly

UNITIZED TRANSAXLE ASSEMBLY

Read **DANGER** and **WARNING** on page 16a-1.

NOTE: Although the following drawings show the transaxle being assembled in an upright position, laying the transaxle on its left (driver) side will simplify the assembly process.

1. Make sure both parts of the case are clean and free of any contaminants. Make sure the machined mating surfaces are free of residue and are not scratched or damaged in any way.
2. Put a light coating of clean transmission oil on the outside edge of the seal to make installation easier. Press two new oil seals (18 and 23) (**Figure 16a-40, Page 16a-19**) into the top of the left (driver) side case. Use an oil seal installation tool (CCI P/N 1014160) to install a new oil seal (58) (**Figure 16a-48, Page 16a-23**) into the right (passenger side) case. **See also Figure 16a-75, Page 16a-35.**
3. Position the governor gear shaft installation tool (CCI P/N 101933101) over the shaft bore in the inside of the left (driver) side case and insert the governor gear shaft into the tool, long end (from the groove) first, as shown (**Figure 16a-76, Page 16a-35**). Make sure the shaft is started into the bore and then, using a plastic or rubber hammer, carefully tap the governor gear shaft into the bore until the end being tapped is flush with the end of the tool. Remove installation tool.
4. Install the washer, governor gear, and sleeve together onto the governor shaft (**Figure 16a-77, Page 16a-35**). Make sure the sleeve is properly positioned within the flyweight brackets of the gear as shown (**Figure 16a-78, Page 16a-35**), and then push them onto the shaft until the gear snaps into the groove on the shaft.
5. Position the interior washer on the pivot arm, then install the pivot arm and washer into the left (driver side) case as shown (**Figure 16a-79, Page 16a-36**). Install the exterior washer and cotter pin on the pivot arm outside the case as shown (**Figure 16a-79, Page 16a-36**). Bend the legs of the cotter pin.

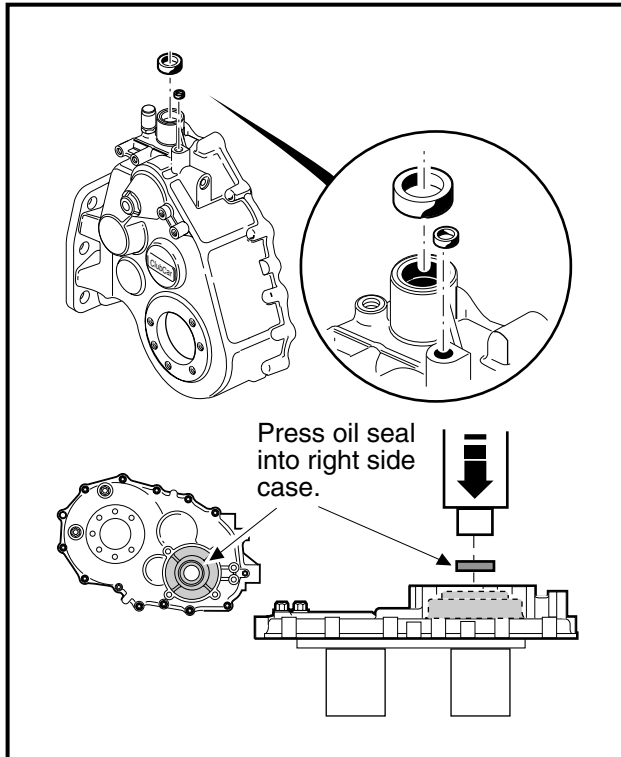


Figure 16a-75 Install Seals

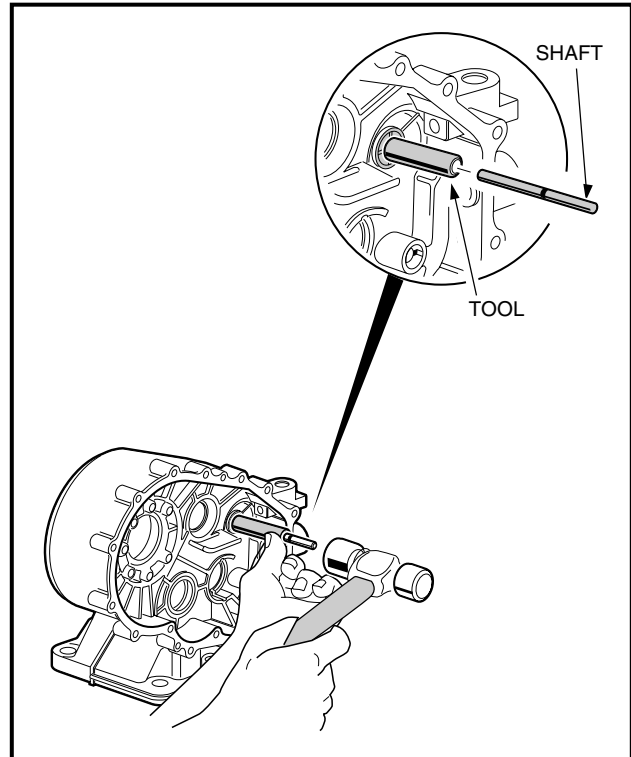


Figure 16a-76 Governor Gear Shaft

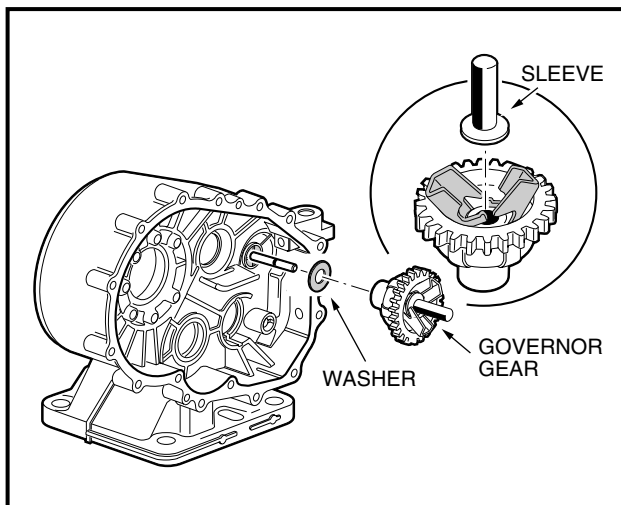


Figure 16a-77 Position Governor Gear

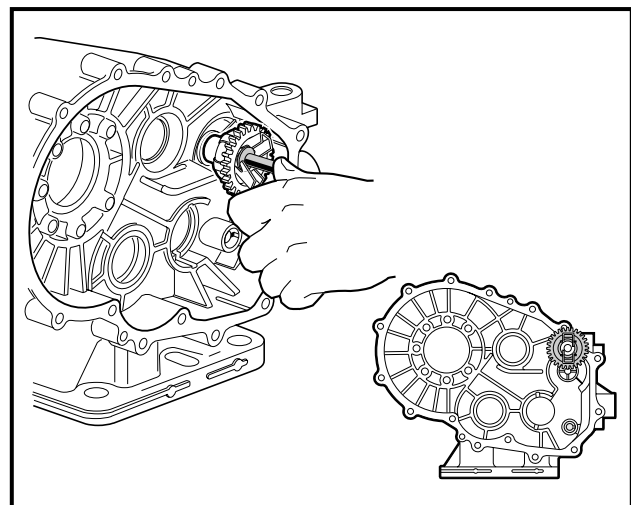


Figure 16a-78 Install Governor Gear

6. Install the shifter shaft into the left (driver side) case as shown (**Figure 16a-80, Page 16a-36**). Then install the washer and using external snap ring pliers (0.070 tip), install retaining ring on the shifter shaft outside of the case. Make sure the retaining ring is in the groove of the shaft.
7. Install the gear assemblies into the left (driver side) case.
 - 7.1. Stand the left side case on the mounting plate, then install the differential gear case assembly as shown (**Figure 16a-81, Page 16a-37**). Do not seat the assembly in the bore, but insert it just far enough that it will not fall out.

Unitized Transaxle Assembly, Continued:

- 7.2. Install the idler gear assembly into case as shown. Do not seat the assembly in the bore, but insert far enough that it will not fall out. No gears mesh at this time (**Figure 16a-82, Page 16a-37**).
- 7.3. Install the oil guide with the baffle toward the case wall as shown (**Figure 16a-83, Page 16a-37**). Make sure the two tabs on the guide are positioned in the slots in the case.
- 7.4. Position the shifter fork assembly on the synchronizer gear assembly as shown, and install them together, bearing end first, into the bore containing the oil guide (**Figure 16a-84, Page 16a-37**). Do not seat the assembly, but make sure the spur gear (43) is meshed with the governor gear (66) (**Figure 16a-48, Page 16a-23**), and the shifter lever (19) (**Figure 16a-40, Page 16a-19**) is positioned in the bracket on the shifter fork. **See also Figure 16a-85, Page 16a-38.**
- 7.5. Install the intermediate gear assembly into the case as shown (**Figure 16a-86, Page 16a-38**). Do not seat the assembly into the bore, but make sure the output ring gear meshes with the input drive gear (55) on the synchronizer gear assembly, and with the small gear on the idler shaft (66) (**Figure 16a-48, Page 16a-23**).
- 7.6. As a group and while keeping the gears meshed, work all of the gear assemblies into the bores until they are seated. When all of the assemblies are correctly seated, the outside edges of the input drive gear (55) and the intermediate gear (61) (**Figure 16a-48, Page 16a-23**) should be flush (in the same plane) as shown (**Figure 16a-87, Page 16a-38**). Also, the outside surfaces of the idler gear bearing, the intermediate gear bearing, and the differential gear bearing should be flush (**Figure 16a-87, Page 16a-38**). **See following CAUTION.**

⚠ CAUTION

- If the edges of the input drive gear and intermediate gear are not flush, then the oil guide (40) (**Figure 16a-48, Page 16a-23**) may not be properly positioned in the bore.

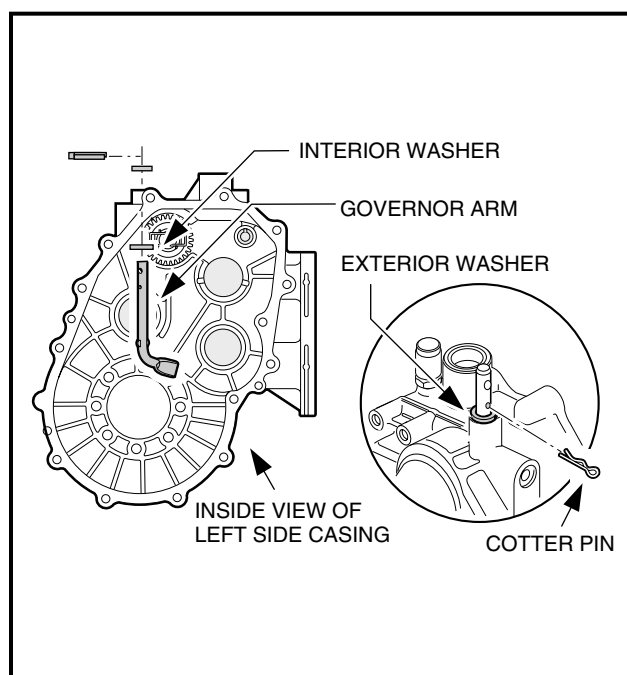


Figure 16a-79 Pivot Arm

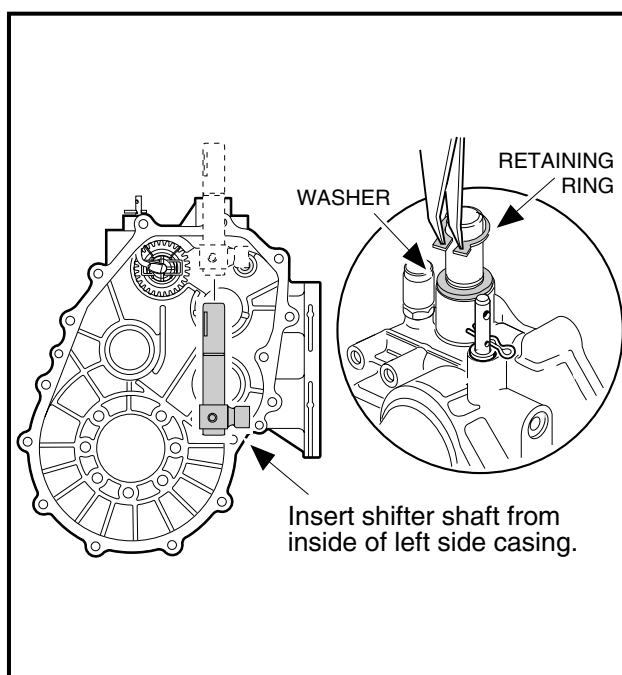


Figure 16a-80 Insert Shifter Shaft

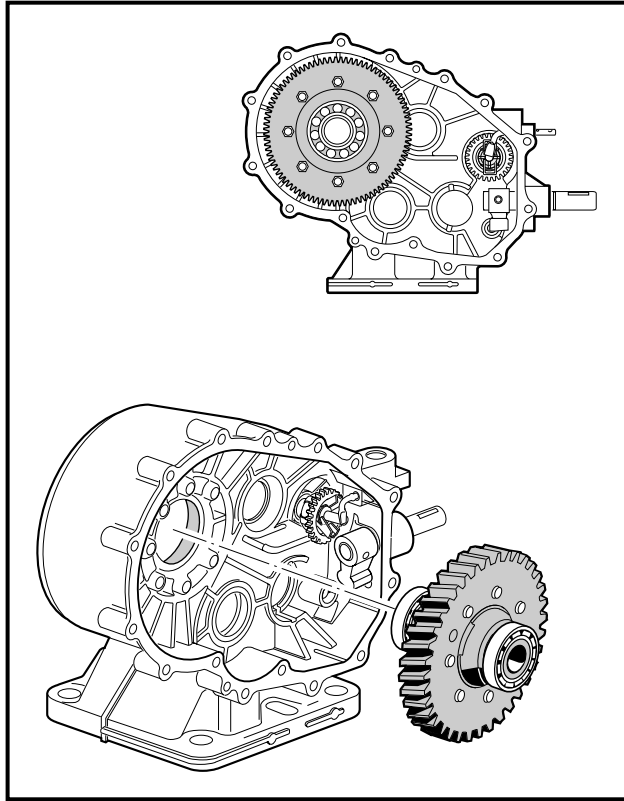


Figure 16a-81 Differential Gear Assembly

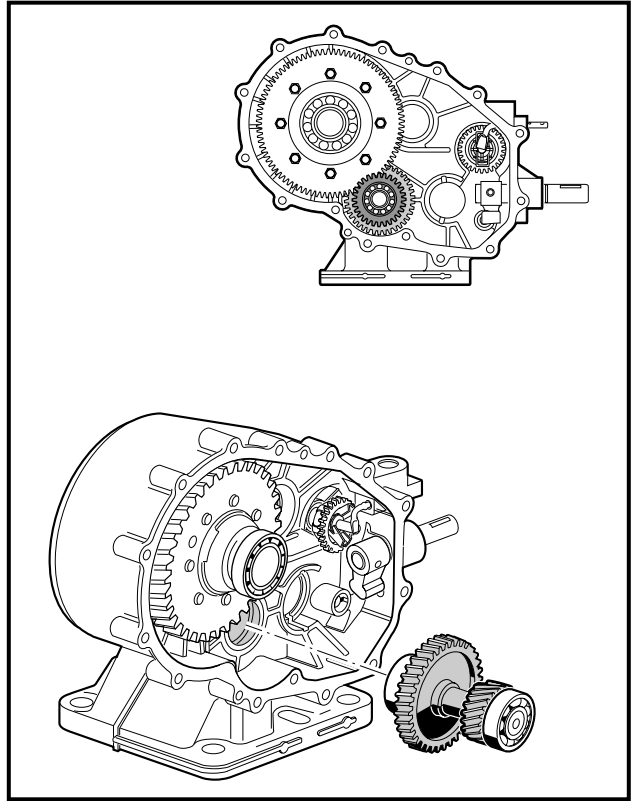


Figure 16a-82 Idler Gear Assembly

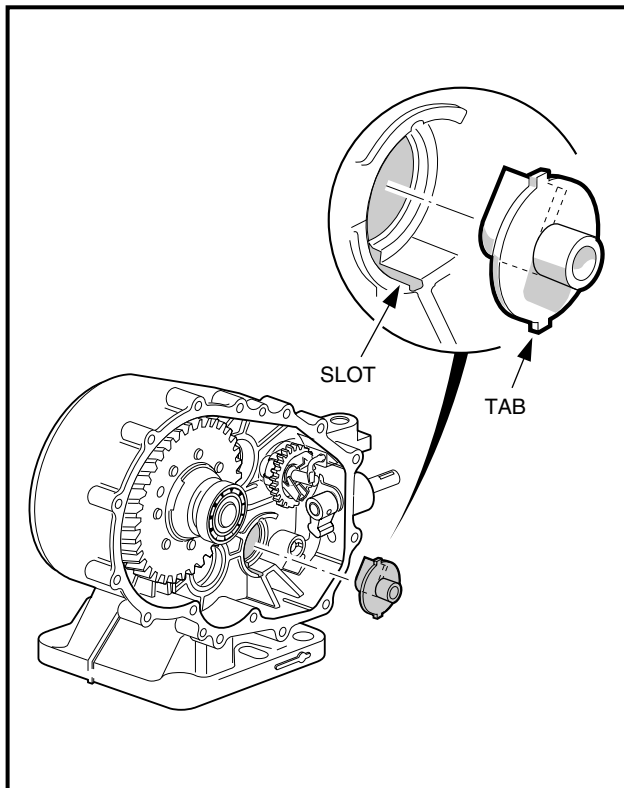


Figure 16a-83 Oil Guide

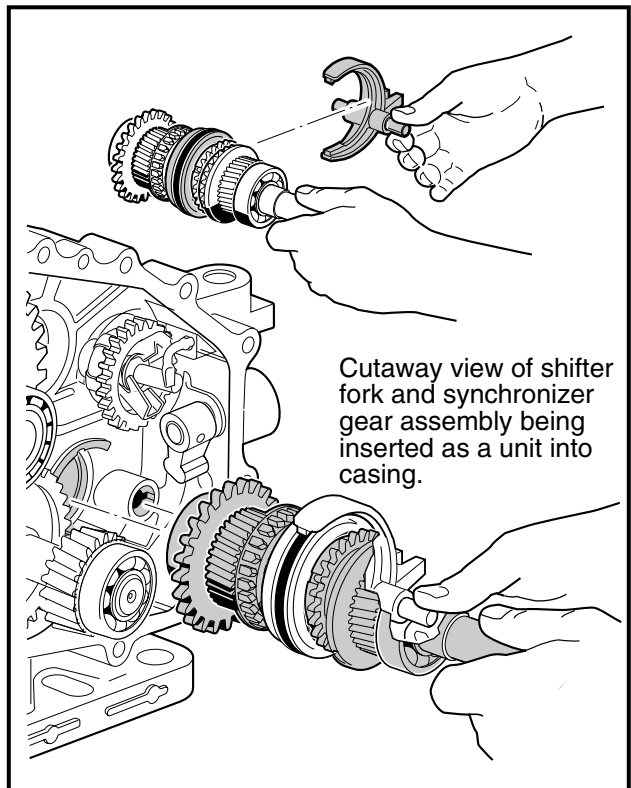


Figure 16a-84 Synchronizer Ring Gear

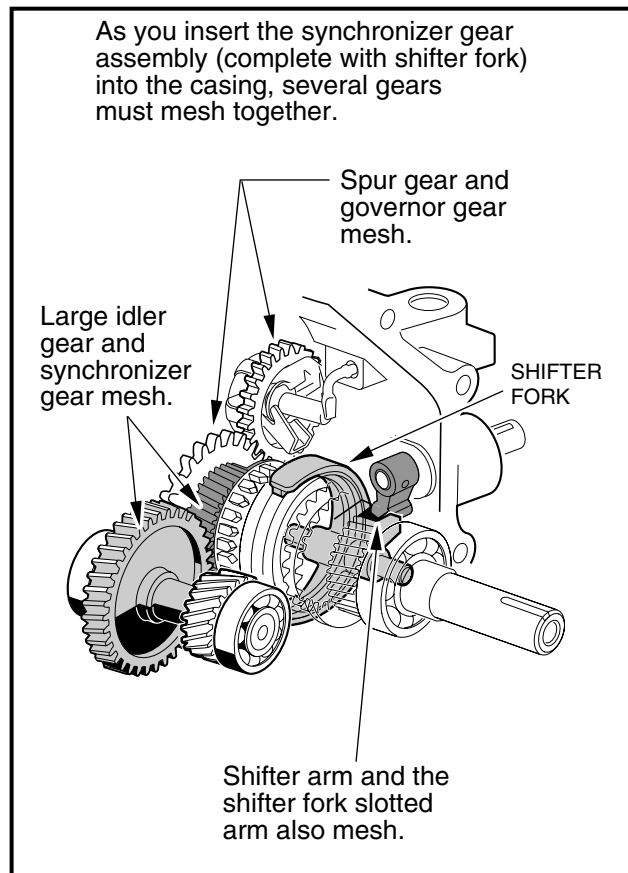


Figure 16a-85 Gear Alignment

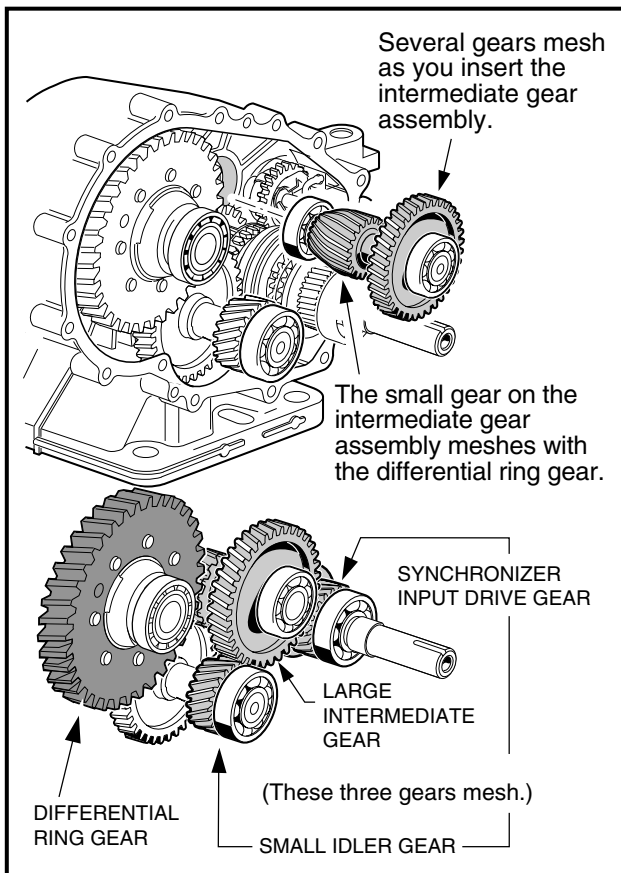


Figure 16a-86 Gear Alignment

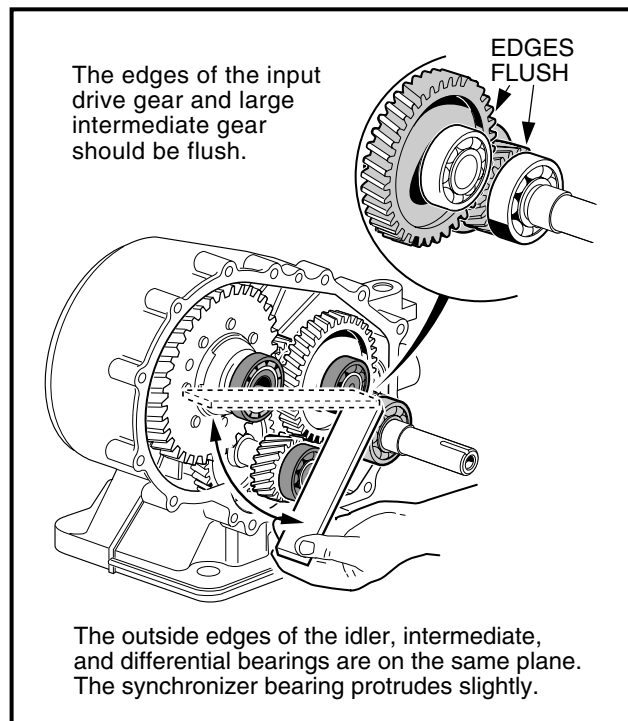


Figure 16a-87 Assembly Gear Alignment

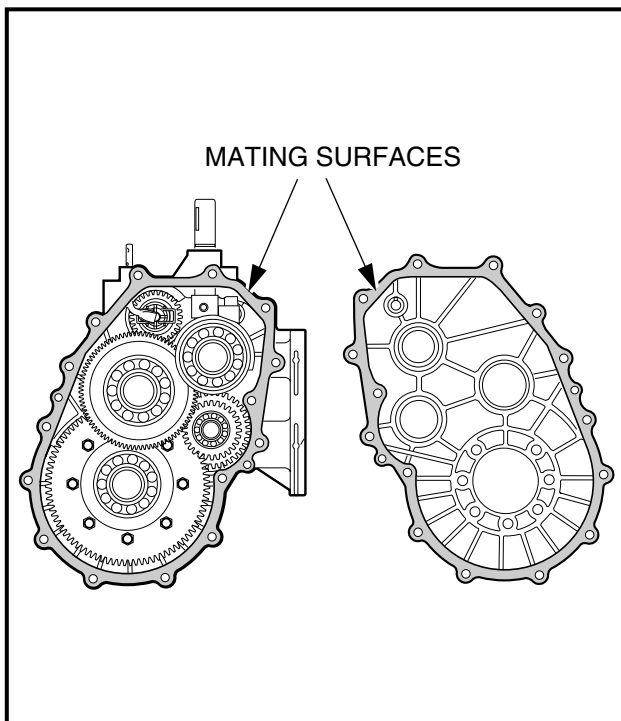


Figure 16a-88 Prepare Mating Surfaces

Unitized Transaxle Assembly, Continued:

8. Make sure the mating surfaces of the left and right sides of the case are clean and free of oil, grease, or residue of any kind, and they are not scratched or damaged in any way.
9. Apply a continuous bead of Three Bond No. 1215 (CCI P/N 101928701) sealant to the mating surface, around the complete profile of the right (passenger side) case (**Figure 16a-88, Page 16a-38**). See following **CAUTION**.

 CAUTION

- Use only Three Bond No. 1215 sealant to seal case. Do not use a substitute.
 - If the two sides of the case cannot be easily closed or do not make complete contact, do not force them together. Check that all internal components are properly seated and then try again.
10. Install and finger-tighten the fifteen bolts (28) (**Figure 16a-40, Page 16a-19**) that secure the left and right sides of the case together. Then, in sequence shown, tighten the bolts to 17 ft-lb (23.1 N·m) (**Figure 16a-89, Page 16a-40**).
 11. Install the differential lock housing to the transaxle.
 - 11.1. Make sure the mating surfaces of the differential lock housing and the transaxle case are clean and free of oil, grease or residue of any kind.
 - 11.2. Ensure that the alignment pin is installed to the transaxle case (**Figure 16a-90, Page 16a-40**).
 - 11.3. Apply a continuous bead of Three Bond No. 1215 (CCI P/N 101928701) around the opening on the mating surface of the differential lock housing (transaxle side) (**Figure 16a-90, Page 16a-40**).
 - 11.4. Rotate the differential lock shaft (95) and insert the cog (104) into the differential lock housing (94) (**Figure 16a-74, Page 16a-34**).
 - 11.5. Using the alignment pin as a guide, position the differential lock housing onto the driver side of the transaxle case (**Figure 16a-90, Page 16a-40**).
 12. Install axle tubes (92 and 93) and brake cluster assemblies (if previously removed) on the transaxle case (**Figure 16a-9, Page 16a-8**).
 - 12.1. Make sure the mating surfaces of the axle tubes, transaxle case, and differential lock housing are clean and free of oil, grease, or residue of any kind.
 - 12.2. Apply a continuous bead of Three Bond No. 1215 (CCI P/N 101928701) around the opening on the (driver) side axle tube as shown (**Figure 16a-90, Page 16a-40**). Then position the axle tube on the left side (95) of the transaxle case to the differential lock housing as shown and install eight mounting bolts (**Figure 16a-9, Page 16a-8**) finger-tight. In the sequence shown, tighten the bolts to 36 ft-lb (48.8 N·m) (**Figure 16a-91, Page 16a-41**).
 - 12.3. Install seven mounting bolts (96) on the right (passenger) side axle tube directly to the transaxle case (**Figure 16a-89, Page 16a-40**).
 - 12.4. If previously removed, install left and right brake cluster assemblies to the axle tubes. See **Brake Cluster Assembly Replacement, Section 6a, Page 6a-20**.
 - 12.5. Install the right (passenger side) axle shaft (91) in the right axle tube (93) (**Figure 16a-9, Page 16a-8**). Using 90° angle (0.90 tip) snap ring pliers, install the retaining ring as shown (**Figure 16a-92, Page 16a-41**).
 - 12.6. Place a 1/4 to 3/8-inch (6-10 mm) diameter rod against the retaining ring and tap lightly at four to five locations to ensure it is properly seated. See following **WARNING**.

 WARNING

- Be sure retaining ring is properly seated in its groove. If ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.

Unitized Transaxle Assembly, Continued:

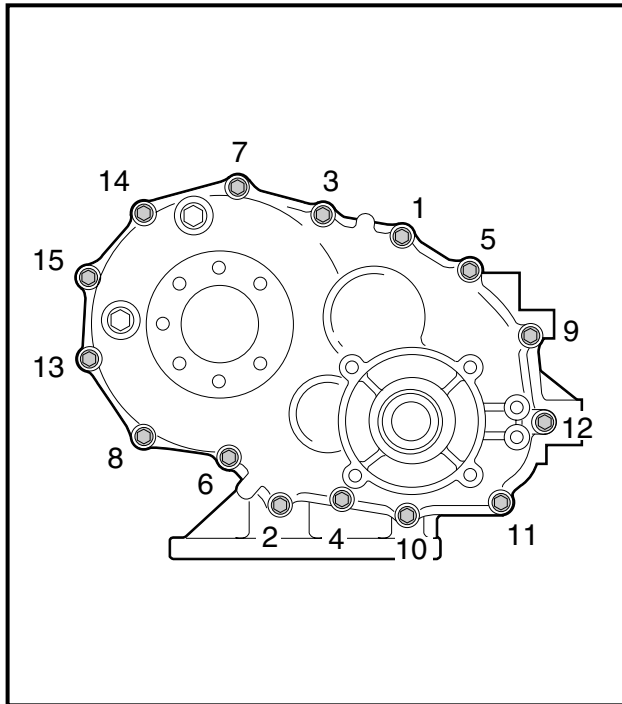


Figure 16a-89 Casing Torque Sequence

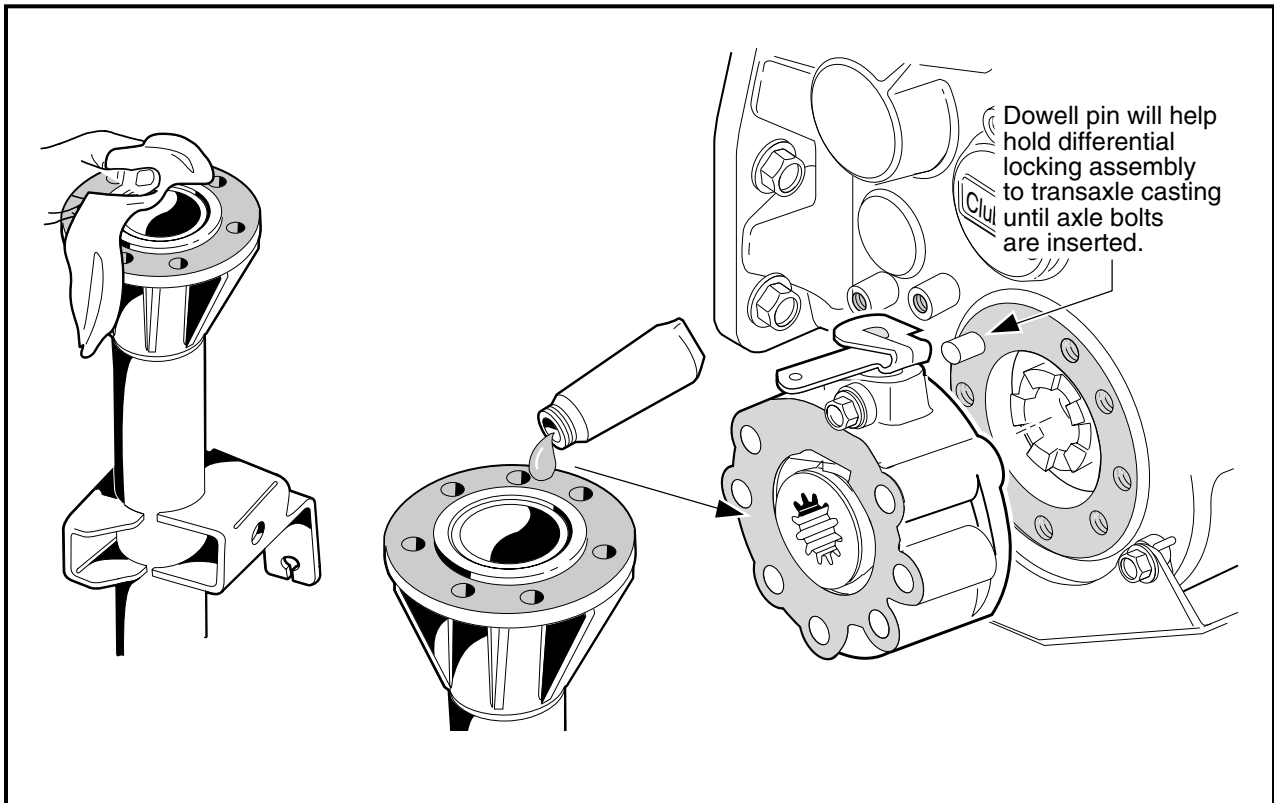


Figure 16a-90 Seal Axle Tube Surface

- 12.7. Install the left (driver side) axle shaft (90) in the left axle tube (92) (**Figure 16a-9, Page 16a-8**). Using 90° angle (0.090 tip) snap ring pliers, install the retaining ring as shown (**Figure 16a-92, Page 16a-41**).
- 12.8. Place a 1/4 to 3/8-inch (6-10 mm) diameter rod against the retaining ring and tap lightly at four to five locations to ensure it is properly seated. **See preceding WARNING.**
13. Install driver side wheel bolt flange (22) on the MC012C transaxle (**Figure 16a-92, Page 16a-41**).

NOTE: Clean splined area in the wheel bolt flange and on the splined end of axle before installation. Using a small brush, carefully apply a light coat of white lithium NLGI Number 2 grease (Dow Corning BR2-Plus or equivalent) to both prior to assembly.

- 13.1. Slide the wheel bolt flange (22) onto splined end of the axle.
- 13.2. Slide the large washer (23) onto the threaded end of the axle and up against the wheel bolt flange. **See following NOTE.**

NOTE: It is recommended that a light film of white lithium NLGI Number 2 grease (DowCorning BR2-Plus or equivalent) be applied to both surfaces of the large washer (23) before the flanged nut (24) is installed and tightened to specification.

- 13.3. Attach the flanged nut (24) and tighten to 150 ft-lb (203 N·m).
- 13.4. Install the locking nut cap (27) onto the flanged nut (24).
- 13.5. Position the locking nut cap (27) to provide clear passage for a new cotter pin (25).
- 13.6. Install a new cotter pin (25) through the locking nut cap and axle, bending the split ends of the pin to secure the locking nut cap (27). **See following WARNING.**

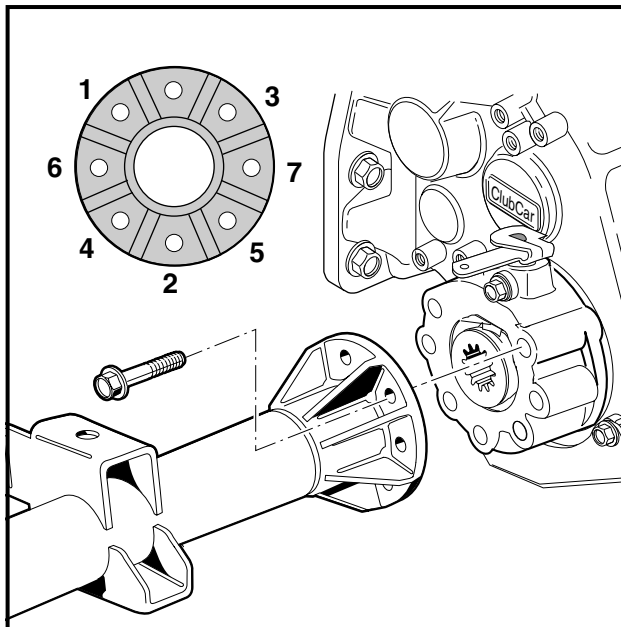


Figure 16a-91 Install Axle Tubes

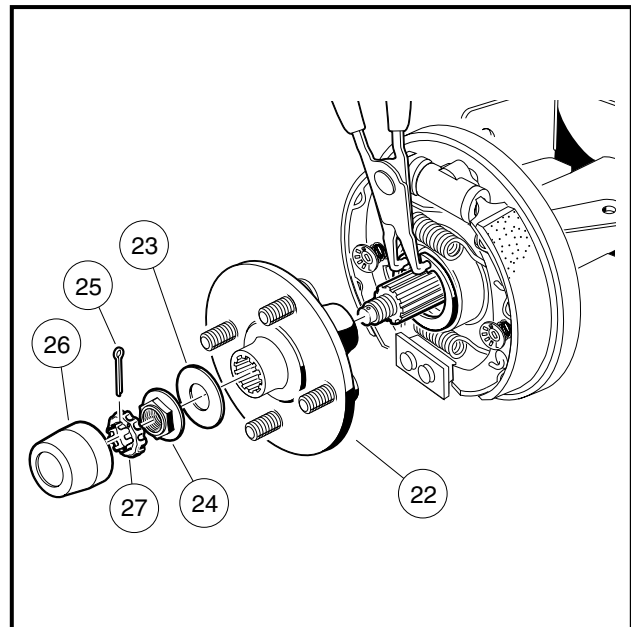


Figure 16a-92 Retaining Ring and Wheel Bolt Flange

⚠ WARNING

- Make sure to install and bend the cotter pin. Failure to bend the cotter pin could result in the separation of the wheel bolt flange from the splined end of the axle. Loss of vehicle control could result, causing severe personal injury.

- 13.7. Install the rubber boot (26) onto the large washer (23). **See following NOTE.**

Unitized Transaxle Assembly, Continued:

NOTE: Push the rubber boot onto the washer so that the washer edge fits into the boot-tip groove.

14. Install rear wheel brake drum.
15. Repeat steps 13 and 14 for the passenger side rear axle and wheel bolt flange.

UNITIZED TRANSAXLE INSTALLATION**Read DANGER and WARNING on page 16a-1.**

1. Install the wheels. **See Wheel Installation, Section 8, Page 8-3.**
2. Install the leaf springs. **See Multi-Leaf Spring Installation, Section 9, Page 9-6.**
3. Position the transaxle mounting plate on the two mounting studs at the rear of the engine, and then install the two mounting nuts (**Figure 16a-93, Page 16a-42**).
4. Install the remaining four mounting bolts and four nuts (one bolt and nut at each corner of the mounting plate).
5. Tighten the four corner nuts (with bolts) to 30 ft-lb (40.7 N·m). Tighten the two center nuts (on the studs) to 17 ft-lb (23.1 N·m) (**Figure 16a-93, Page 16a-42**).
6. Install the differential lock cable and bracket.
 - 6.1. Connect the differential lock cable spring (1) to the differential lock arm on the differential lock housing (**Figure 16a-94, Page 16a-42**).
 - 6.2. Install the two bolts (2) to secure the cable bracket to the transaxle case (**Figure 16a-94, Page 16a-42**). Tighten the two screws to 134 in-lb (15.1 N·m).

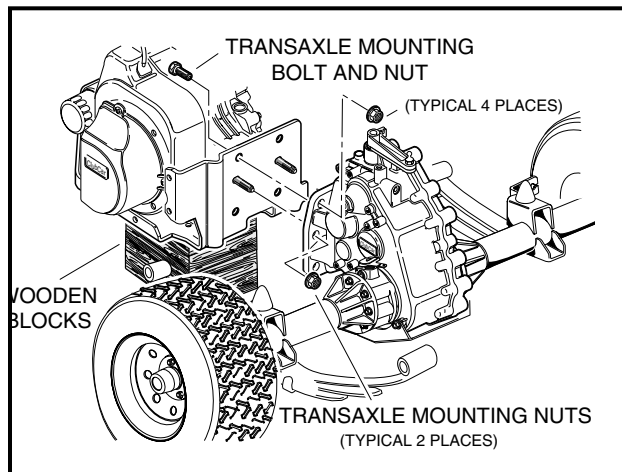


Figure 16a-93 Transaxle Mounting

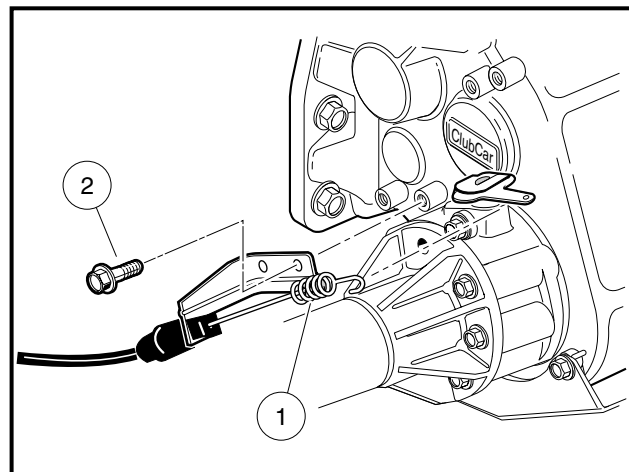


Figure 16a-94 Differential Lock Bracket Installation

7. Install the accelerator cable bracket on transaxle case. Tighten the mounting screws to 134 in-lb (15.1 N·m) (**Figure 16a-95, Page 16a-43**).
8. Install the governor cable bracket on transaxle case. Tighten the mounting screws to 134 in-lb (15.1 N·m) (**Figure 16a-96, Page 16a-44**).
9. Install governor lever arm on governor shaft (**Figure 16a-97, Page 16a-44**). With the governor lever arm loose on the governor shaft, turn the governor arm shaft counterclockwise until it stops. Then pull the governor lever arm rearward until the carburetor throttle is in the "wide open throttle" (WOT) position (**Figure 16a-97, Page 16a-44**).

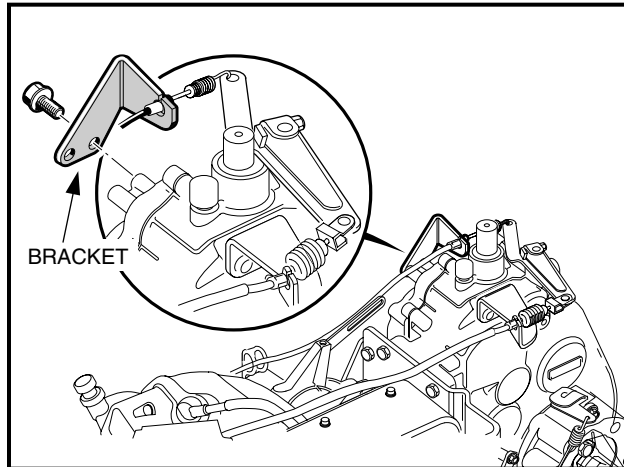


Figure 16a-95 Accelerator Cable Bracket

10. While holding the arm and shaft in the fully counterclockwise position, tighten the governor arm lever nut to 35 in-lb (4.0 N·m) (**Figure 16a-97, Page 16a-44**).
11. Install the key onto the input shaft (**Figure 16a-98, Page 16a-44**).
12. Position the driven clutch on the transaxle input shaft and install the washer (yellow side facing out) and mounting bolt. Tighten the mounting bolt to 14 ft-lb (19.0 N·m) (**Figure 16a-98, Page 16a-44**).
13. Install the drive belt. **See Section 17 – Torque Converter.**
14. Remove the blocks from under the engine and roll the powertrain into position under the vehicle. Then lift the front of the powertrain and place the snubber into the snubber bracket in the vehicle frame (**Figure 16a-99, Page 16a-44**).
15. With the floor jack under the transaxle, position the leaf springs in the front spring mounts and install the grade eight bolts and lock nuts. Torque to 15 ft-lb (20.3 N·m) (**Figure 16a-100, Page 16a-45**). **See following CAUTION.**

▲ CAUTION

- **Use only grade eight bolts for the front leaf spring supports.**

16. Using the floor jack, adjust vehicle height to position the leaf springs for mounting in the shackles. Install the mounting bolts and lock nuts (**Figure 16a-101, Page 16a-45**). Tighten to 15 ft-lb (20.3 N·m).
17. Raise the vehicle with the floor jack and remove the jack stands. With the jack stands removed, gently lower the vehicle and finish tightening the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
18. Position shocks in the shock mounts and install cushions, mounting washers and nuts (**Figure 16a-103, Page 16a-46**). Tighten nuts until cushions expand to be the same size as the mounting washers.
19. Connect the park brake cables. **See Park Brake Cable Installation, Section 6a, Page 6a-37.**
20. Using a flare nut wrench, connect the brake hoses to the left rear and right rear brake clusters and bleed the air from the brake lines. **See Bleeding the Hydraulic Brake System, Section 6a, Page 6a-33.**

Unitized Transaxle Installation, Continued:

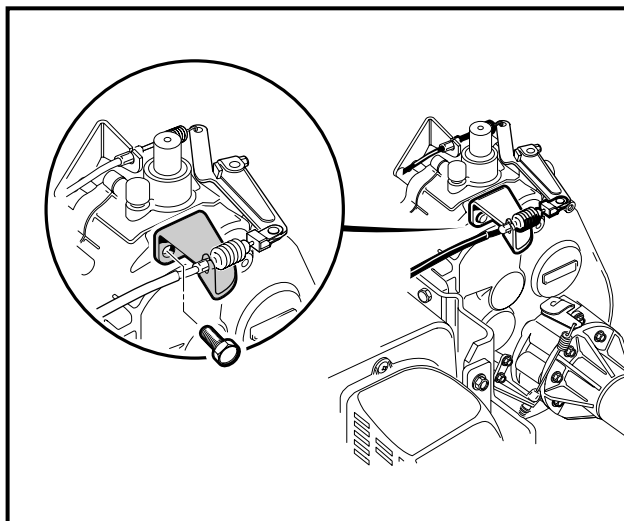


Figure 16a-96 Governor Cable Bracket

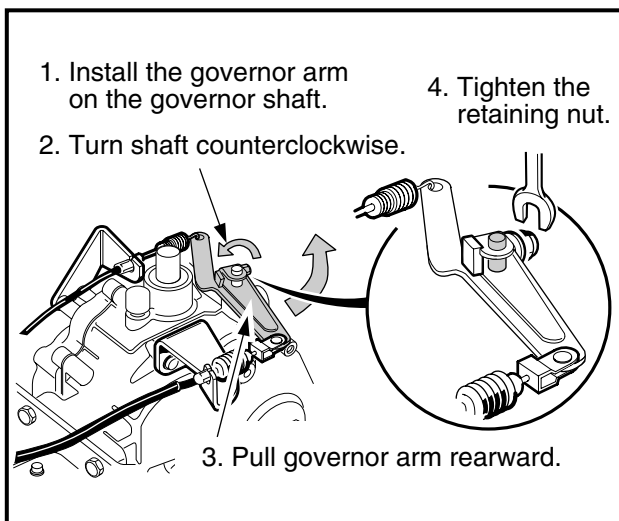


Figure 16a-97 Governor Arm

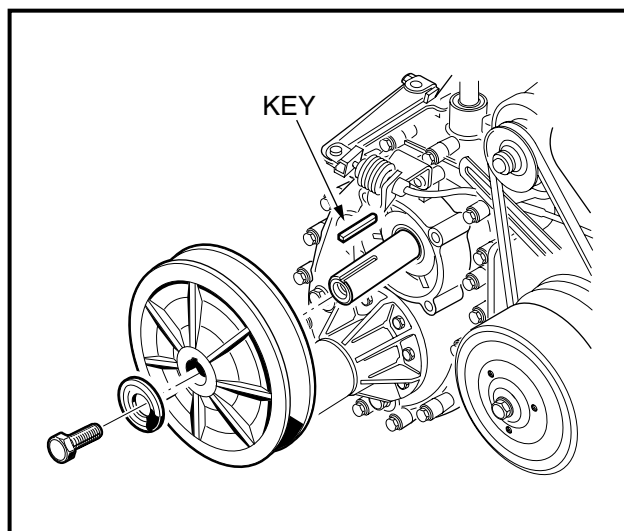


Figure 16a-98 Driven Clutch

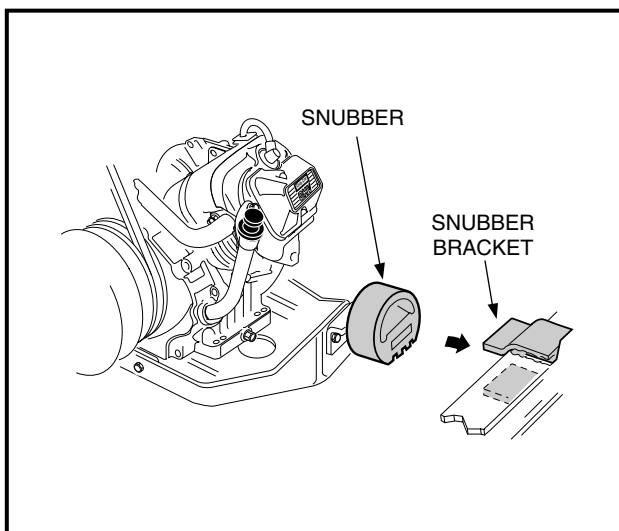


Figure 16a-99 Snubber

21. Check the brake system to ensure that there are no leaks and that proper brake operation has been restored. **See following WARNING.**

⚠ WARNING

- The brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. See Bleeding the Hydraulic Brake System, Section 6a, Page 6a-33.
22. Connect the engine kill switch wire (18-gauge white/black stripe) to the bullet connector at the lower right front of the engine (**Figure 16a-102, Page 16a-45**).

23. Install three wire ties to secure the engine kill wire to the accelerator cable where they both route together on the passenger side of the engine.
24. Connect the oil level sensor wire (18-gauge yellow) to the jumper wire (**Figure 16a-104, Page 16a-47**).

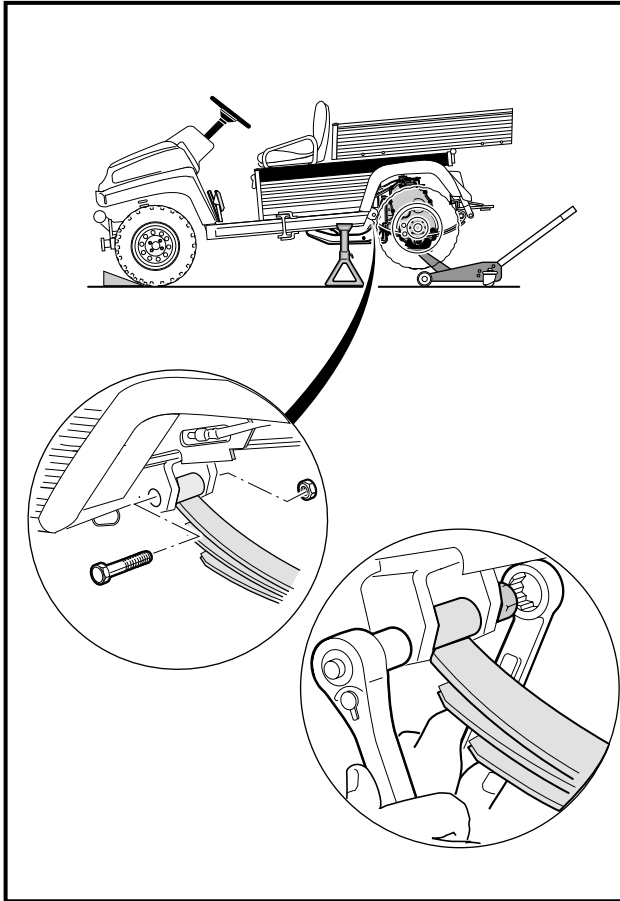


Figure 16a-100 Leaf Springs

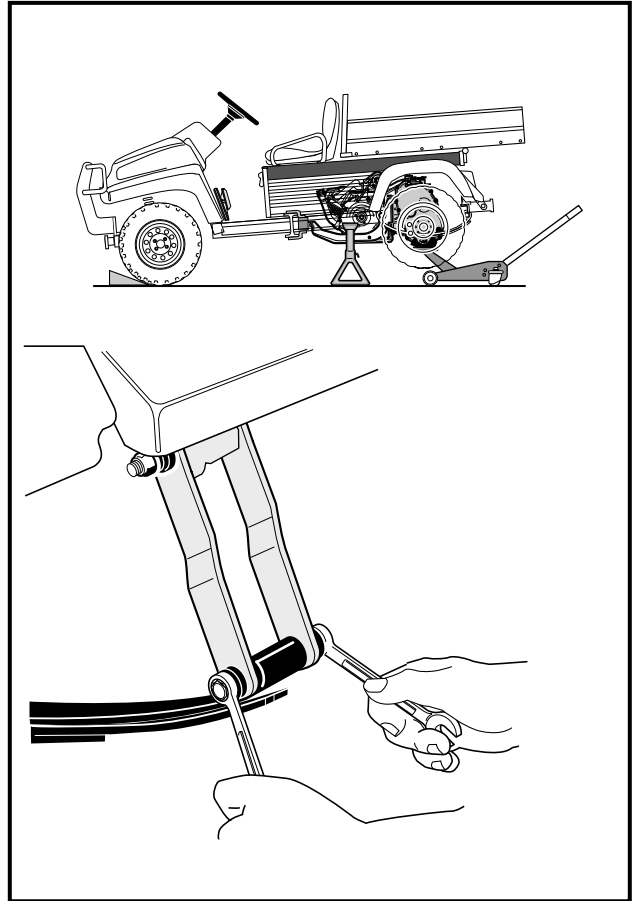


Figure 16a-101 Leaf Springs and Shackles

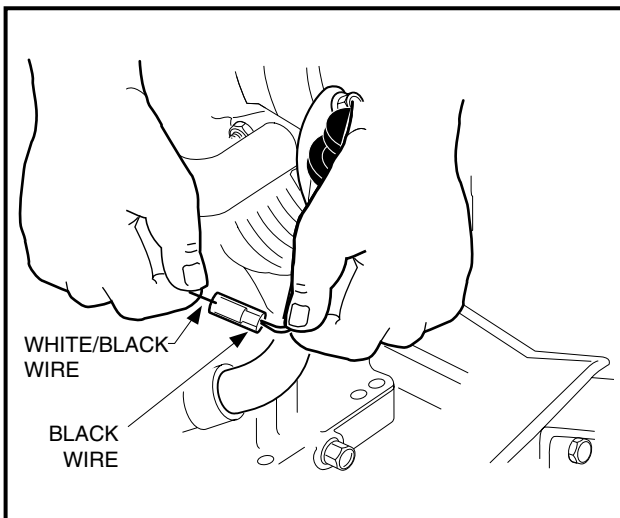
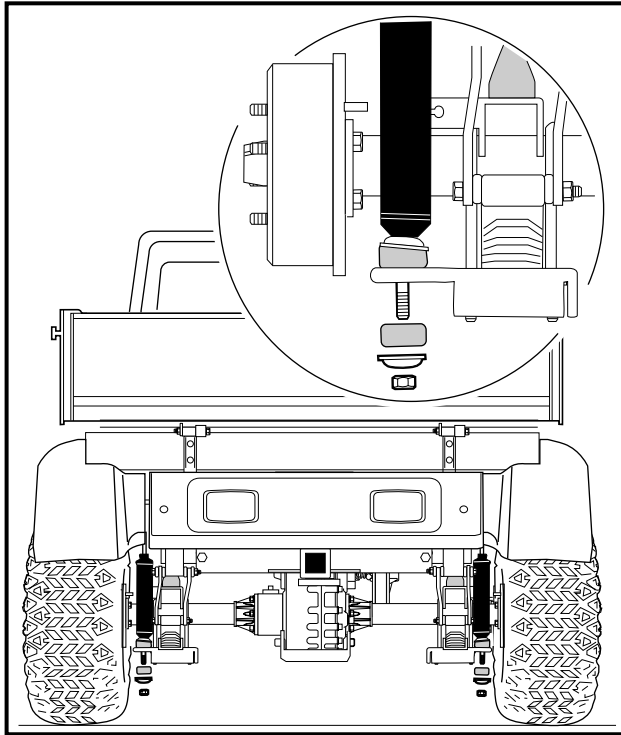


Figure 16a-102 Ignition Kill Wire

Unitized Transaxle Installation, Continued:**Figure 16a-103 Shock Absorber**

25. Connect the 6-gauge white wire to the F2 post, the 6-gauge black ground wire to the A2 post and tighten to 48 in-lb (5.4 N·m). Connect the 16-gauge yellow wire to the DF post on the starter/generator and tighten to 30 in-lb (3.4 N·m) (**Figure 16a-105, Page 16a-47**).
26. Connect the Forward/Reverse shifter and bracket to the transaxle.
 - 26.1. Install the three screws (2) securing the Forward/Reverse shifter cable bracket (1) to transaxle and tighten them to 135 in-lb (15.3 N·m) (**Figure 16a-40, Page 16a-19**).
 - 26.2. Place the woodruff key (9) on the shifter shaft (**Figure 16a-40, Page 16a-19**).
 - 26.3. Place the shifter lever (6) (aligned with the woodruff key) onto the Forward/Reverse shaft (15).
 - 26.4. Install the nut (3), washer (4), and bolt (7) on the Forward/Reverse shifter lever and tighten to 23 in-lb (2.6 N·m) (**Figure 16a-40, Page 16a-19**).
 - 26.5. Position the shifter cable in the shifter cable mounting bracket on the transaxle and tighten the mounting nuts to 22 ft-lb (29.8 N·m). Connect shifter cable rod end to the shifter arm (**Figure 16a-106, Page 16a-47**).
27. Attach the ground wire to the mounting screw on the oil filler tube mounting bracket and tighten to 50 in-lb (5.7 N·m) (**Figure 16a-107, Page 16a-47**).
28. Connect accelerator cable to actuator cam in the electrical box. Position the accelerator cable in mounting slot in the wall of the electrical box and tighten mounting nuts to 18 in-lb (2.0 N·m) (**Figure 16a-108, Page 16a-47**). Install electrical box cover and tighten mounting screw.
29. Pull fuel line from impulse line fitting of the fuel pump, connect it to the carburetor and secure with a hose clamp (**Figure 16a-109, Page 16a-47**).

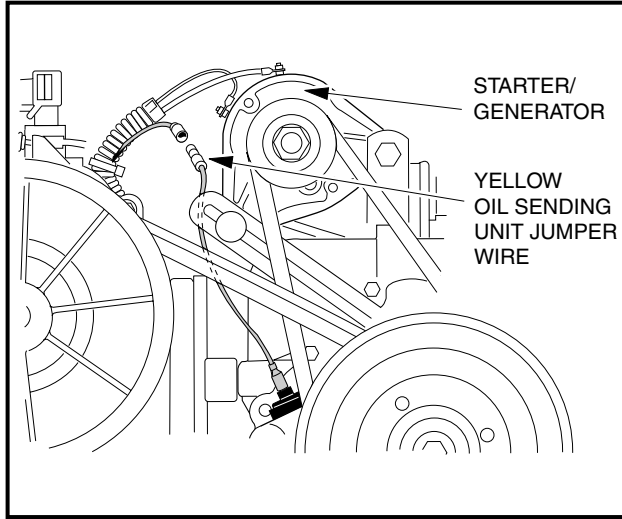


Figure 16a-104 Oil Level Sensor Jumper Wire

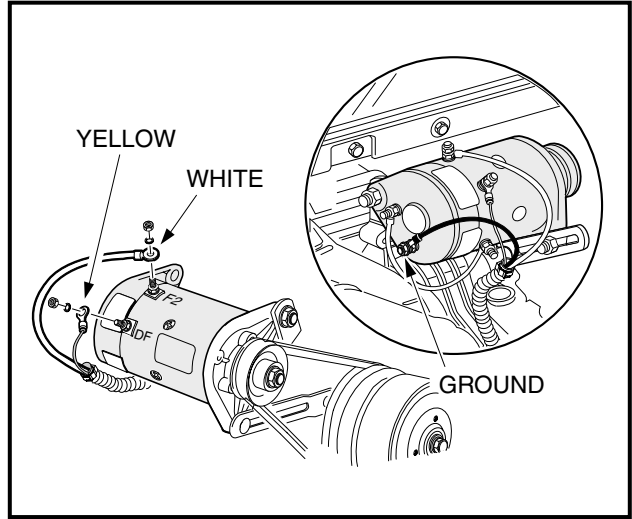


Figure 16a-105 Starter/Generator

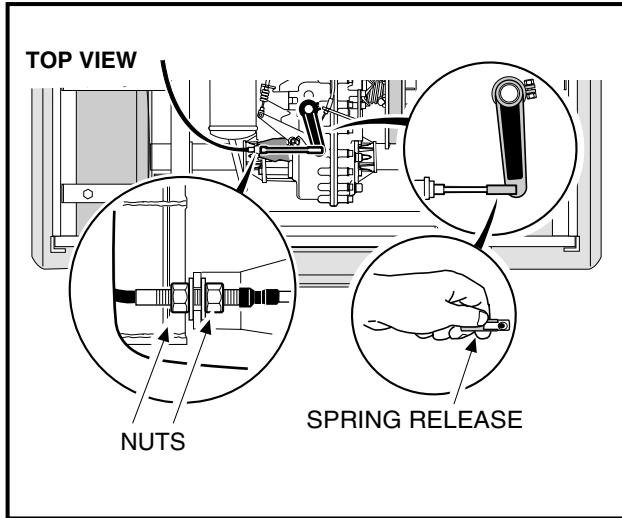


Figure 16a-106 Connect Shifter Cable

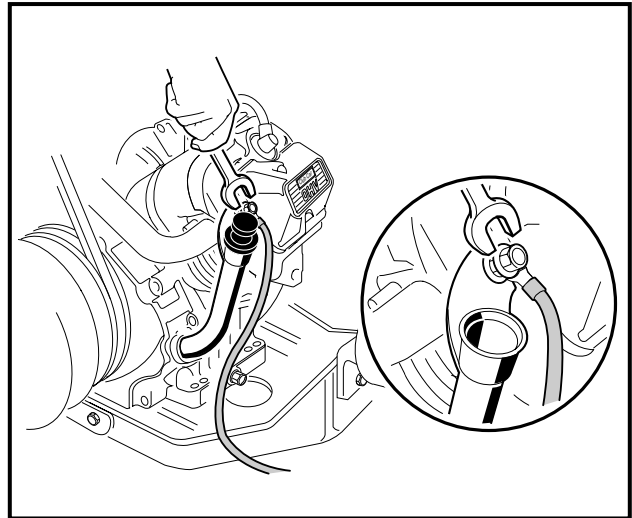


Figure 16a-107 Engine Ground

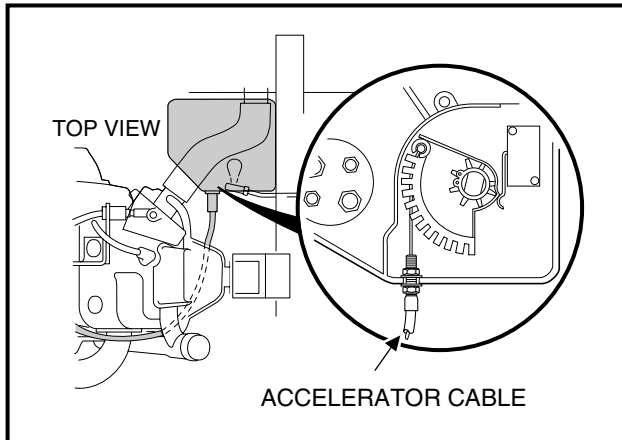


Figure 16a-108 Connect Cable to Cam

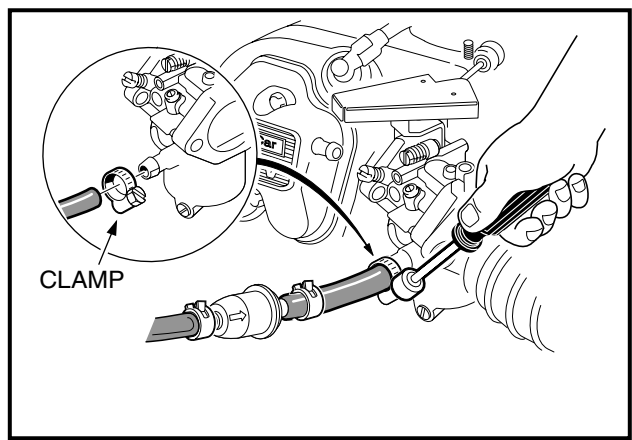


Figure 16a-109 Connect Fuel Line

Unitized Transaxle Installation, Continued:

30. Connect the impulse line to the fuel pump and secure it with the hose clamp (**Figure 16a-110, Page 16a-48**).
31. Connect air intake hose to carburetor and secure hose clamp (**Figure 16a-111, Page 16a-48**).
32. Connect carburetor vent tube to carburetor and secure with hose clamp (**Figure 16a-112, Page 16a-49**).
33. Connect the differential lock cable end to the differential lock handle.
 - 33.1. Connect the end of the differential lock cable to the differential lock handle (Step 1) (**Figure 16a-113, Page 16a-49**).
 - 33.2. Push down on the cable to secure the end of the cable to the differential lock handle (Step 2).
 - 33.3. Rotate the cable counterclockwise to route the cable through the bracket (Step 3).
 - 33.4. Push the cable sheath toward the front of the vehicle to secure the cable to the bracket (**Figure 16a-117, Page 16a-54**).
 - 33.5. Secure the cable to the vertical support with a wire tie (6) as shown.
34. Install transaxle drain plug and tighten to 21 ft-lb (28.5 N·m).
35. Fill transaxle with 30.4 oz. (.9 liter) 80-90 WT. API Class GL-3 or 80-90 WT. AGMA Class EP gear lube. Install and tighten the level indicator hole plug to 21 ft. lb. (28.5 N·m).

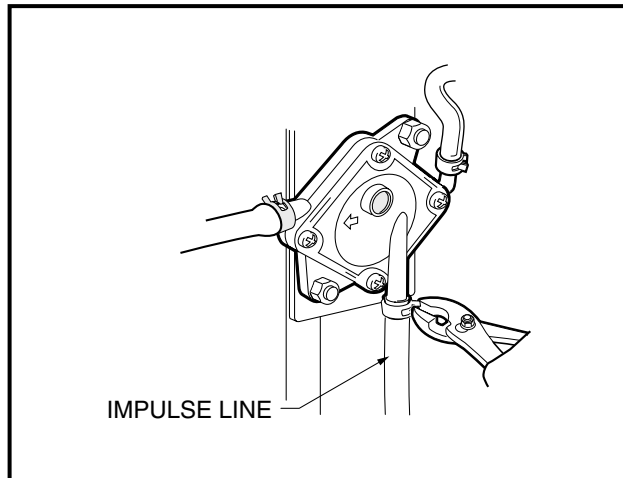


Figure 16a-110 Impulse Line

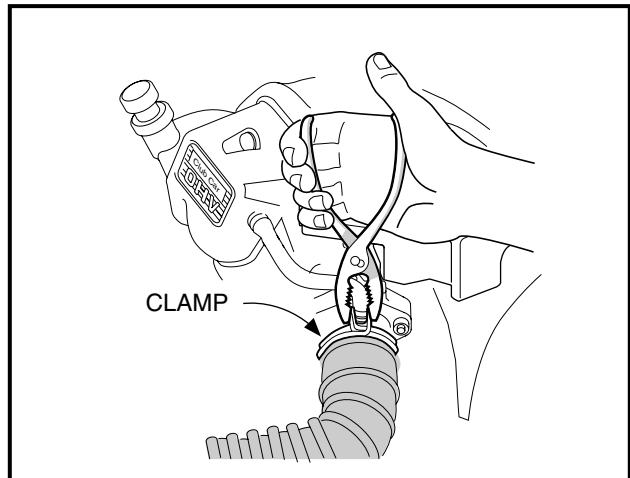


Figure 16a-111 Air Intake Hose

36. Check that all wiring is secured properly. **See following WARNING.**

⚠ WARNING

- If wires are removed or replaced make sure wiring and wiring harness is properly routed and secured to vehicle frame. Failure to properly route and secure wiring could result in vehicle malfunction, property damage or personal injury.

37. Connect the spark plug wire.
38. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
39. Adjust the engine RPM setting. **See Engine RPM Adjustment, Section 14, Page 14-14.**

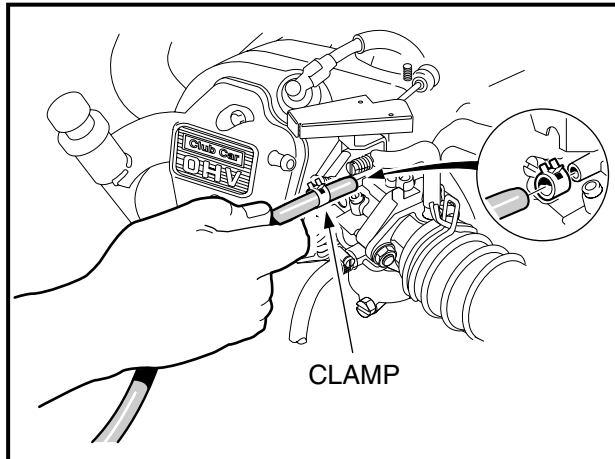


Figure 16a-112 Carburetor Vent Tube

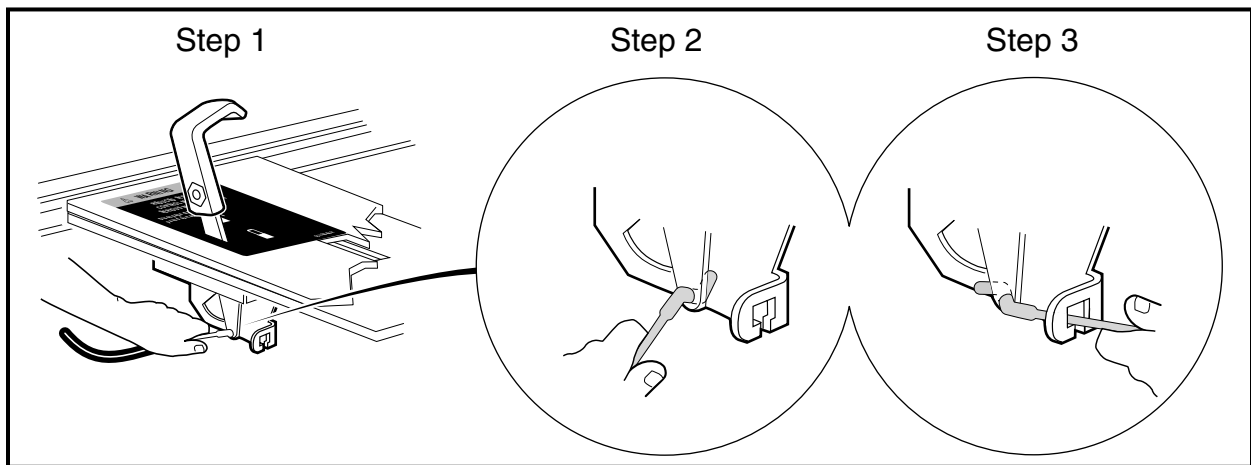


Figure 16a-113 Differential Cable End Installation

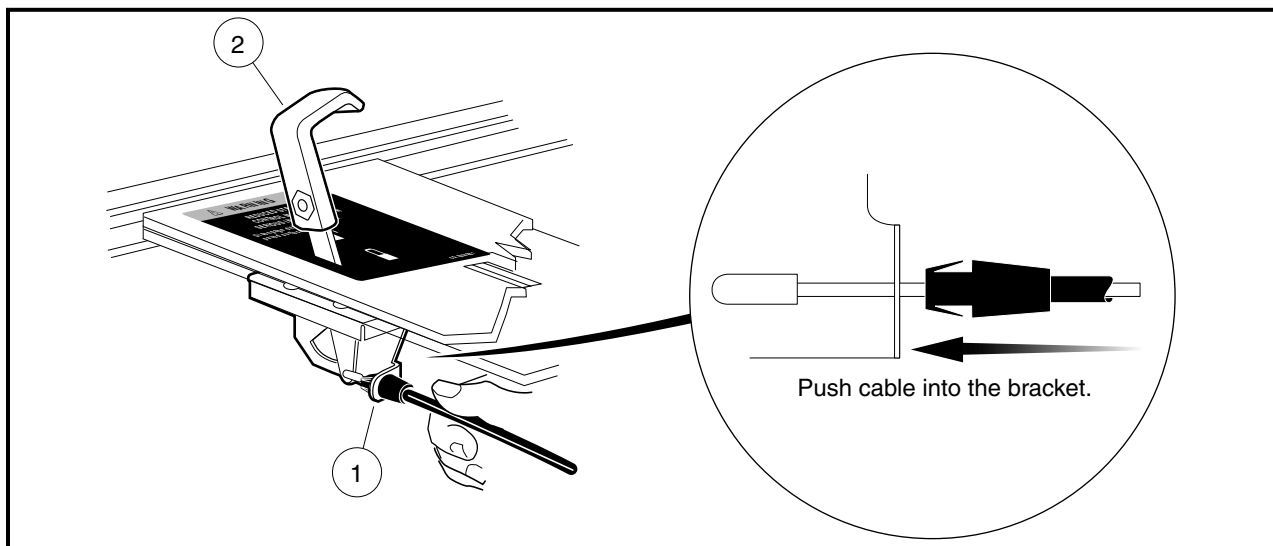


Figure 16a-114 Differential Cable Installation

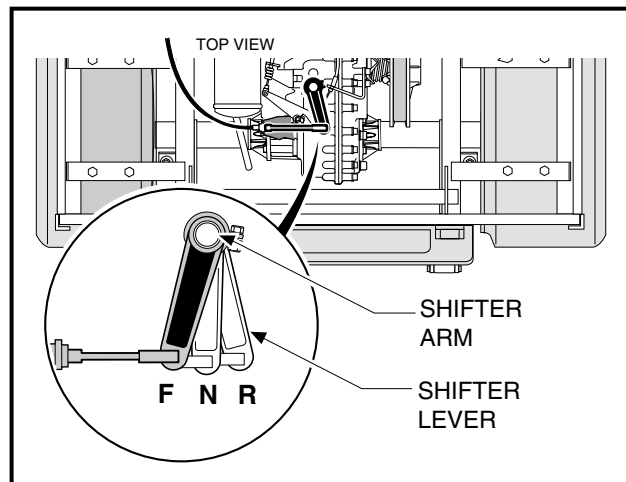


Figure 16a-115 Forward/Reverse Positions

FORWARD/REVERSE SHIFTER CABLE

Read **DANGER** and **WARNING** on page 16a-1.

If the Forward/Reverse shifter cable is damaged in any way, it must be replaced.

FORWARD/REVERSE SHIFTER CABLE REMOVAL

NOTE: Before removing cable, note cable routing and positions of wire ties or other devices securing the cable to the vehicle. When reinstalled, cable must be routed and secured as it was originally.

1. Remove the ball joint socket (2) from the Forward/Reverse shifter assembly ball stud (3) (**Figure 16a-116, Page 16a-51**).
2. Remove the ball joint socket (10) from the shifter arm ball stud (11) on the transaxle.
3. Loosen the retaining nuts (5) on both ends of the cable and remove the wire tie.
4. Remove cable from the vehicle.

FORWARD/REVERSE SHIFTER CABLE INSTALLATION

1. From the Forward/Reverse shifter, route the cable exactly as it was originally, to the transaxle shifter lever.
2. Secure the cable with retaining nut (5) on each side of the shifter cable support bracket at the transaxle (**Figure 16a-116, Page 16a-51**). Tighten nuts to 22 ft-lb (29.8 N·m).
3. Secure the cable with retaining nut (5) on each side of the shifter cable support bracket at the Forward/Reverse assembly. Tighten nuts to 22 ft-lb (29.8 N·m).
4. Install the ball joint socket (10) on the shifter lever ball stud (11) on the transaxle.
5. Install the ball joint socket (2) on the Forward/Reverse shifter assembly ball stud (3).
6. Install wire tie (8) to secure wire harness to cable at the support bracket near the Forward/Reverse shifter assembly. **See following WARNING.**

⚠ WARNING

- If wires are removed or replaced, make sure wiring and/or wiring harness is properly routed and secured to vehicle frame. Failure to properly route and secure wiring could result in vehicle malfunction, property damage or personal injury.

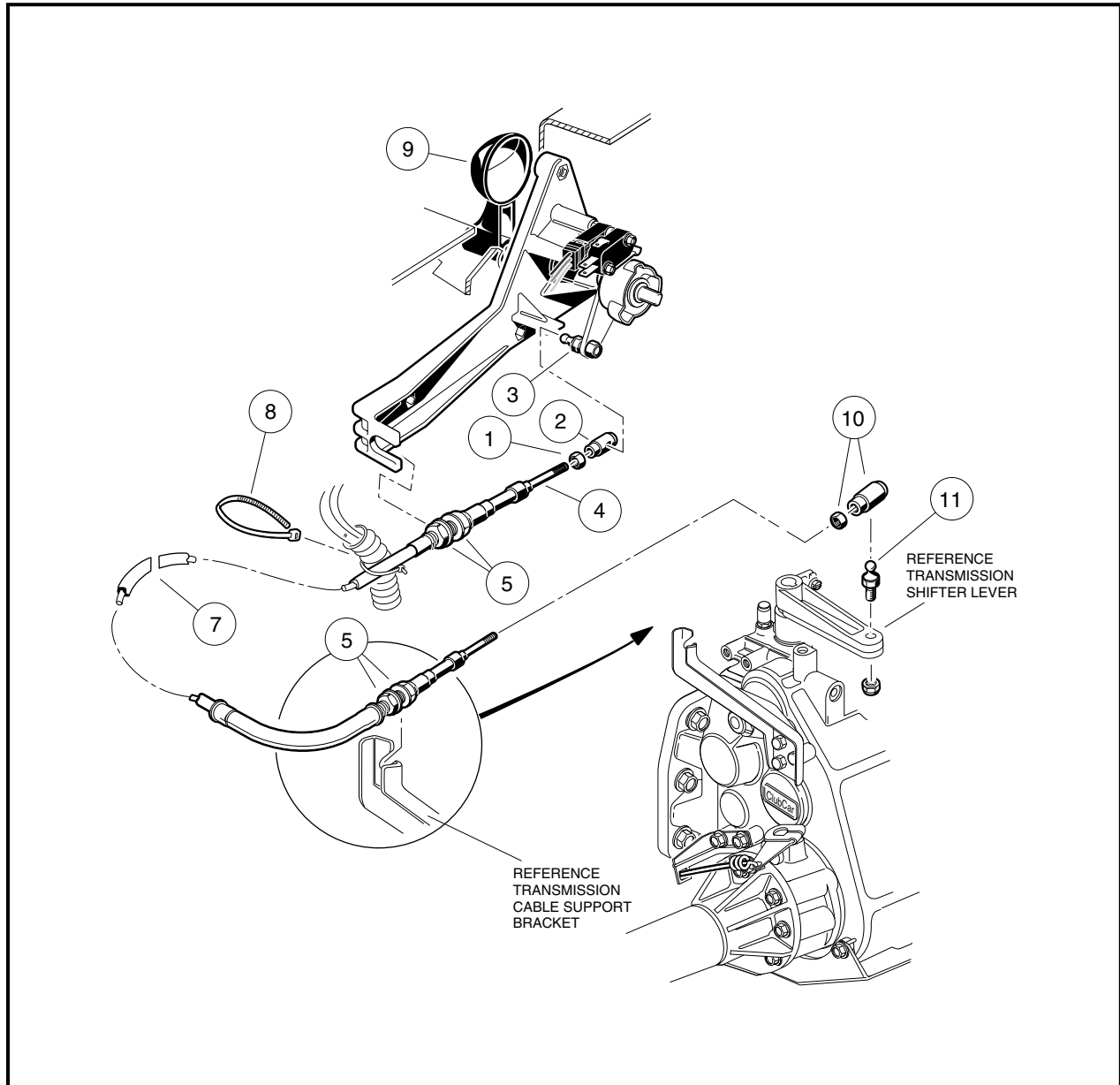


Figure 16a-116 Forward/Reverse Shifter Cable

FORWARD/REVERSE SHIFTER CABLE ADJUSTMENT

With the shifter lever of the unitized transaxle in the NEUTRAL position (**Figure 16a-115, Page 16a-50**), the Forward/Reverse handle (9) (**Figure 16a-116, Page 16a-51**) should be straight up. For minor adjustments, the nut (1) may be loosened and the ball joint socket (2) rotated to get the proper adjustment (**Figure 16a-116, Page 16a-51**). See following **CAUTION**.

Forward/Reverse Shifter Cable Adjustment, Continued:

CAUTION

- Be sure threads of cable are engaged in ball joint socket at least 1/4-inch (6.35 mm). If ball joint socket comes loose from the cable, the Forward/Reverse shifter will not operate properly.

For major adjustments, the cable retaining nuts (5) must be loosened and adjusted. When the cable is properly adjusted, with the Forward/Reverse handle (9) (**Figure 16a-116, Page 16a-51**) in the NEUTRAL position, the shifter lever of the transaxle will also be in the NEUTRAL position (**Figure 16a-115, Page 16a-50**). Retighten nuts to 22 ft-lb (29.8 N·m).

DIFFERENTIAL LOCK SYSTEM

Read DANGER and WARNING on page 16a-1.

If the differential lock cable is damaged in any way, it must be replaced. See following WARNING.

WARNING

- If for any reason the differential lock system is not operating correctly, the system must be repaired or replaced before attempting to operate the vehicle. With the differential lock engaged, vehicle turning functions are greatly reduced. Failure to heed this warning could result in loss of vehicle control and severe personal injury.

DIFFERENTIAL LOCK SYSTEM INSPECTION

The differential lock system should periodically be inspected for proper operation.

1. Place chocks at the front wheels and lift the rear of the vehicle with a floor jack. Then place jack stands under the axle tubes to support the vehicle. See WARNING "Lift only one end..." on page 16a-2.
2. With the differential lock handle in the forward position (unlocked), rotate one of the rear wheels by hand. The wheel should be fairly easy to rotate and the other rear wheel should rotate in the opposite direction, indicating that the differential lock is not engaged. If this is not the case, the differential handle, cable or housing must be repaired or replaced before attempting to drive the vehicle.
3. With the wheels at rest, pull the differential lock handle toward the rear of the vehicle (locked position). Observe the cable end and differential lock arm on the differential lock housing. The cable should move freely when the handle is moved. Initially, there may be slack in the cable at the differential housing. Rotation of the rear tire will eliminate this slack when the differential lock is fully engaged.
4. With the differential lock handle in the rear position (locked), rotate one of the rear wheels by hand. The wheel should be a great deal harder to rotate and the other rear wheel should rotate in the same direction, indicating that the differential lock is engaged. If this is not the case, the differential handle, cable or housing must be repaired or replaced before attempting to drive the vehicle.

DIFFERENTIAL LOCK CABLE REMOVAL

1. Place the differential lock handle in the disengaged position.
2. Remove wire tie (6) securing the cable to the vertical support (**Figure 16a-117, Page 16a-54**).
3. Using a pair of pliers, apply pressure to the locking tabs of the cable end (1) where it attaches to the differential lock handle mounting bracket (**Figure 16a-13, Page 16a-11**).

4. While maintaining pressure on the locking tabs, pull the differential lock cable toward the rear of the vehicle to disconnect the cable from the bracket (**Figure 16a-13, Page 16a-11**).
5. With the cable disconnected from the bracket, rotate the cable connector toward the driver side of the vehicle to disconnect the cable from the differential lock lever (1) (**Figure 16a-14, Page 16a-11**).
6. Unhook the cable spring (1) from the differential lock arm (3) (**Figure 16a-117, Page 16a-54**).
7. Using a pair of pliers, apply pressure to the locking tabs of the cable end (4) where it attaches to the cable mounting bracket (2) at the transaxle.
8. Pull cable (5) toward the front of the vehicle in order to remove the cable from the bracket (2).
9. Remove the cable from the vehicle.

DIFFERENTIAL LOCK CABLE INSTALLATION

1. Route the cable through the engine mounting plate as illustrated (**Figure 16a-117, Page 16a-54**).
2. Route the cable spring (1) through the cable bracket (2) as illustrated.
3. Connect the differential lock cable spring end (1) to the differential lock arm (3) on the differential lock housing.
4. Push the cable (5) toward the rear of the vehicle in order to secure the cable to the bracket (2).
5. Connect the differential lock cable end to the differential lock handle.
 - 5.1. Connect the end of the differential lock cable to the differential lock handle (Step 1) (**Figure 16a-113, Page 16a-49**).
 - 5.2. Push down on the cable to secure the end of the cable to the differential lock handle (Step 2).
 - 5.3. Rotate the cable sheath counterclockwise to route the cable through the bracket (Step 3).
 - 5.4. Push the cable toward the front of the vehicle to secure the cable to the bracket (**Figure 16a-114, Page 16a-49**).
 - 5.5. Secure the cable to the vertical support as shown with a wire tie (6) (**Figure 16a-117, Page 16a-54**).
6. Inspect the differential lock system for proper operation. **See Differential Lock System Inspection on page 16a-52.**

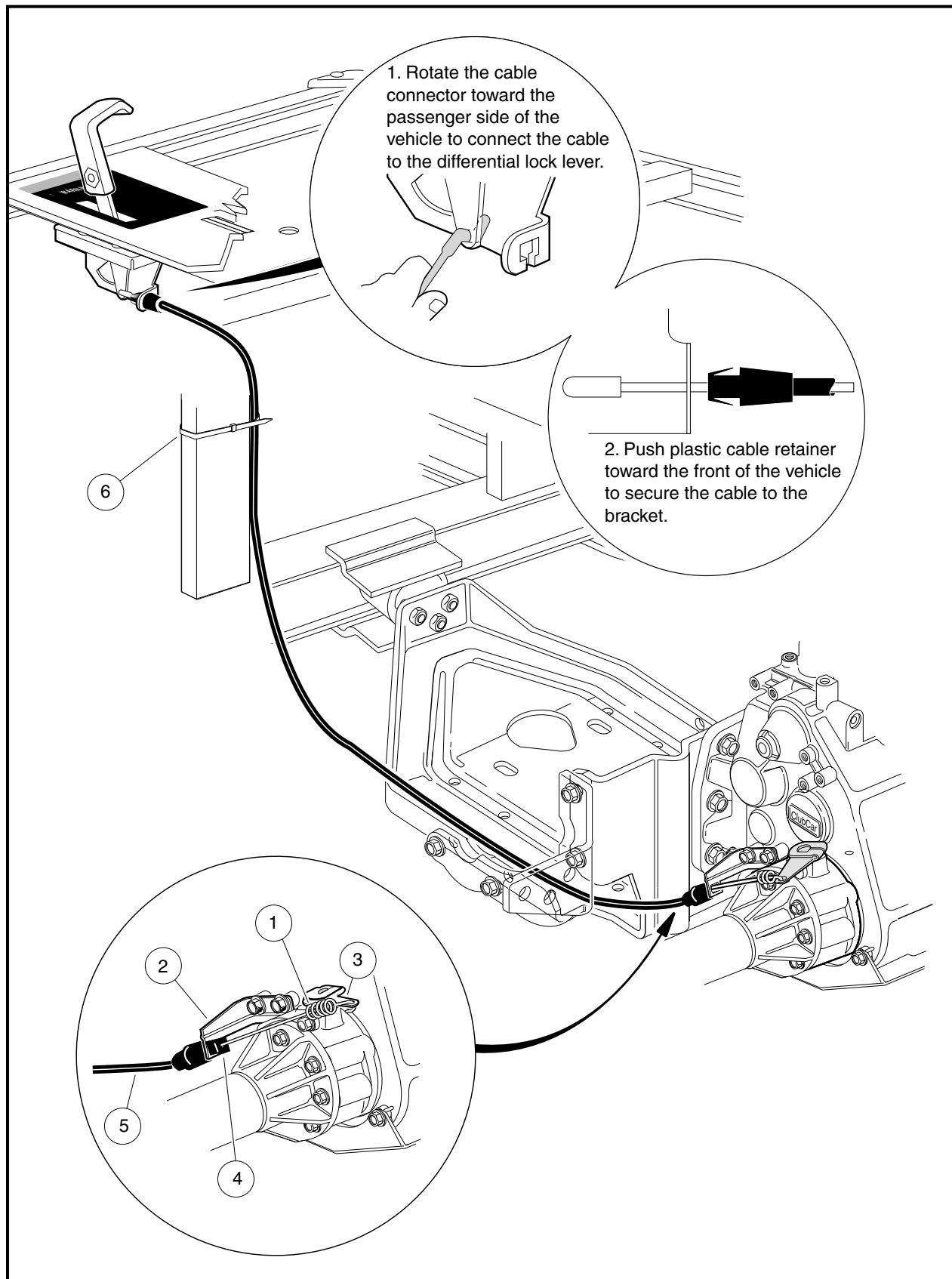


Figure 16a-117 Differential Lock Cable Routing

SECTION 16B – MC010C-BS00 UNITIZED TRANSAXLE WITH DIFFERENTIAL LOCK

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (-) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

The 272 vehicle is equipped with a heavy-duty, fully-synchronized unitized transaxle with differential lock. The unitized transaxle utilizes fully-synchronized internal gearing to change vehicle direction. Because the unitized transaxle is used to reverse vehicle direction, the engine, drive clutch, belt, and driven clutch rotate in the same direction; therefore, the engine and clutches are not subjected to reversing loads. This reduces maintenance requirements on the engine and clutches. With the unitized transaxle, power is transferred from the engine through the drive clutch, the drive belt, the driven clutch, and then through the unitized transaxle to the wheels.

TRANSAXLE MODELS

The 272 vehicle may be equipped with either of two transaxle designs. Both operate the same internally, but utilize a few, slightly different, gear components. These components are identified in their respective illustrated parts list manuals.

Each transaxle is also different in their axle-to-wheel hub designs. The MC010C-BS00 transaxle is designed with the wheel hub permanently attached to the outside end of each axle shaft (**Figure 16b-1, Page 16b-3**). The MC012C-AS00 transaxle is designed with a removable wheel bolt flange and attaches to the ends of the axle shafts using a splined coupling configuration (**Figure 16b-2, Page 16b-3**).

Both transaxles have physical attachment provisions and dimensional differences and therefore are not interchangeable.

Section 16a deals specifically with the MC012C transaxle. **See Section 16a – MC012C-AS00 Unitized Transaxle with Differential Lock.** Section 16b deals specifically with the MC010C transaxle.

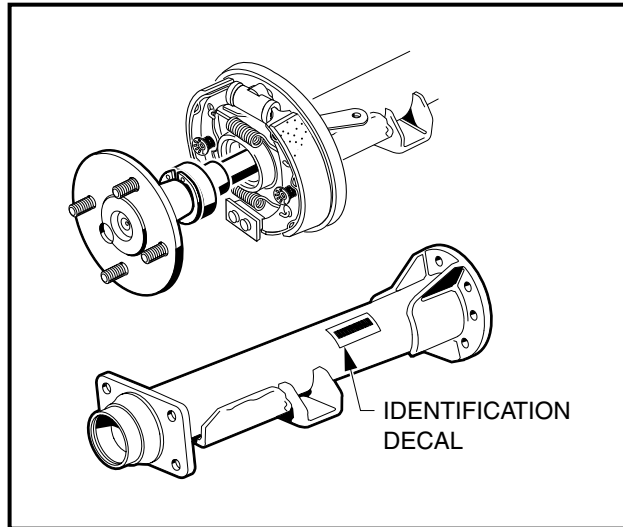


Figure 16b-1 MC010C-BS00

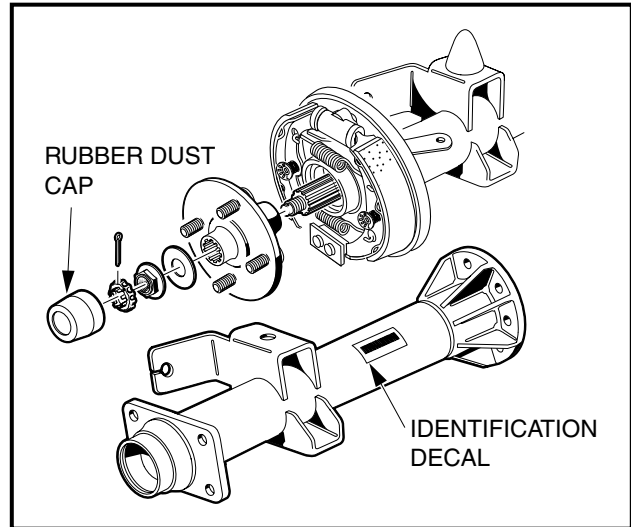


Figure 16b-2 MC012C-AS00

Shifter Lever

A shifter lever, connected to a shifter arm on the unitized transaxle, is used to change the gears to one of three shift positions: FORWARD (F), NEUTRAL (N), or REVERSE (R) (**Figure 16b-3, Page 16b-3**). The vehicle should come to a complete stop before changing FORWARD or REVERSE direction.

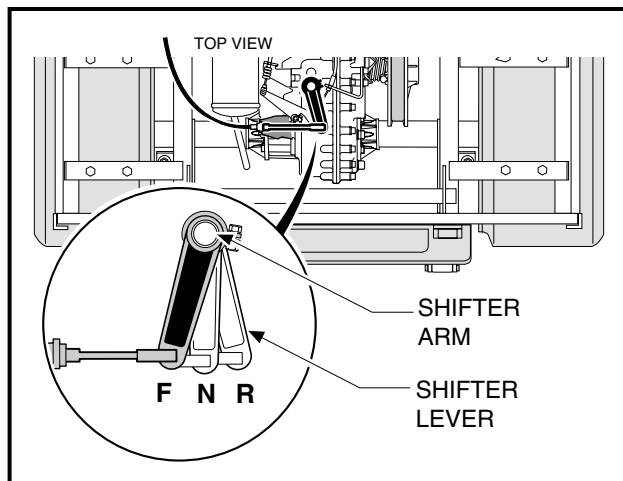


Figure 16b-3 Shifter Positions

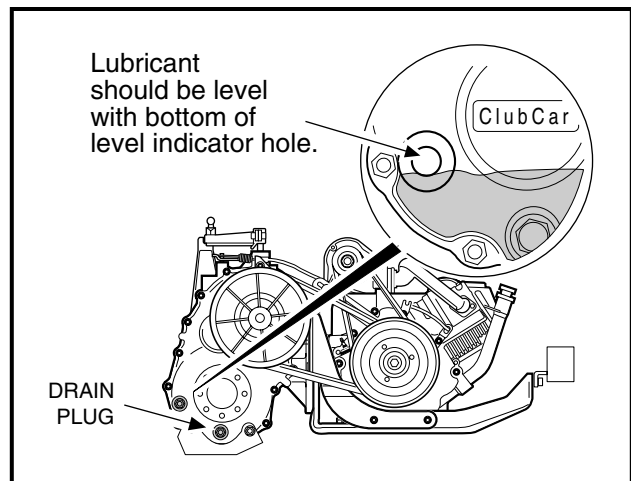


Figure 16b-4 Lubricant Level

LUBRICATION

There are two plugs located on the right (driven clutch) side of the unitized transaxle (**Figure 16b-4, Page 16b-3**). When the vehicle is on a level surface, the upper plug is used as a lubricant level indicator. Lubricant level should be even with the bottom of level indicator hole. The lower plug is used for draining lubricant from the transaxle. When draining lubricant, both plugs should be removed to allow the lubricant to drain faster. Be sure the drain plug and gasket are cleaned and reinstalled before filling the transaxle with new lubricant. Use a funnel when filling the transaxle through the lubricant level indicator hole. Fill with 31 oz. (.92 liters) 80-90 WT. API class GL-3 or 80-90 WT. AGMA class 5 EP gear lubricant. Lubricant should fill to lower edge of indicator hole. Tighten the plug to 20 ft-lb (27.1 N·m).

Differential Lock Lever

The MC010C-BS00 unitized transaxle has a differential lock, controlled by a differential lock lever. The lever is located between the driver and passenger seats (**Figure 16b-5, Page 16b-4**).



Figure 16b-5 Differential Lock Lever

Neutral Lockout

- **Pedal-Start vehicles:**

During normal vehicle operation, the neutral lockout feature prevents the engine from running when the Forward/Reverse handle is in the NEUTRAL position. If the vehicle is started in FORWARD or REVERSE and then shifted to NEUTRAL, the engine will stop running.

For the convenience of the trained technician, there is a neutral lockout cam (yellow knob) located on the back of the Forward/Reverse shifter, inside the engine compartment. If the neutral lockout cam is pulled out approximately 3/8-inch (10 mm) and then rotated one-half turn until it snaps into place, the cam will be in the SERVICE position.

When the cam is in the SERVICE position, it will allow the technician to run the engine in NEUTRAL for certain maintenance procedures. With the cam in this position, the vehicle will not operate if the Forward/Reverse handle is placed in either the FORWARD or REVERSE position.

To put the cam back into the OPERATE position, pull the cam out approximately 3/8-inch (10 mm) and rotate it one-half turn until it snaps into place. **See Neutral Lockout Circuit, Section 11b, Page 11b-13.**

- **Key-Start vehicles:**

The neutral lockout feature is not a serviceable component on key-start vehicles with neutral 'rev'. It should remain in the OPERATE position at all times.

Governor System

The governor system is a flyweight type, and regulates vehicle ground speed. It is mounted inside the unitized transaxle and is driven by transaxle gears. Because the governor is mounted inside the transaxle, it is protected from abuse and damage common to externally mounted governor systems. If any of the governor linkages are removed in order to service other components, readjustment of the governor linkage is required. **See Governor Cable Installation and Adjustment, Section 14, Page 14-12.**

Unitized Transaxle Service

The unitized transaxle is extremely durable and should require very little service under normal operating conditions. The only service required on the unitized transaxle is to maintain proper lubricant level. **See Periodic Lubrication Schedule, Section 10, Page 10-5.** Under normal operating conditions, adjustment to the system should not be required.

Tools Required For This Section

Hydraulic floor jack (or chain hoist)	12 to 18 in. straight edge	17 mm socket, 3/8-in. drive
Jack stands (2) (one-ton capacity)	Small ball peen hammer (10 oz.)	7/16-in. combination wrench
Hydraulic press	Plastic or rubber mallet	1/2-in. combination wrench
Bench vise	Ratchet wrench, 3/8-in. drive	9/16-in. combination wrench
Standard slip joint pliers	Torque wrench, 3/8-in. drive	11/16-in. combination wrench (2)
External snap ring pliers (.070 in. tip)	3/8-in. Socket, 3/8-in. drive	17 mm combination wrench
External snap ring pliers (.047 in. tip)	7/16-in. Socket, 3/8-in. drive	Small flat blade screwdriver
90° Internal snap ring pliers (.090 in. tip)	10 mm Combination wrench	Medium flat blade screwdrivers (2)
Feeler gauge	1/2-in. Socket, 3/8-in. drive	No. 2 phillips head screwdriver
16 in. rolling head prybar	9/16-in. Socket, 3/8-in. drive	1/4-in. nut driver
Small punch or scratch awl	5/8-in. Socket, 3/8-in. drive	5/16-in. nut driver
1/4-in. diameter drift or metal rod	12 mm Socket, 3/8-in. drive	Small knife or wire snippers
Bearing puller wedge attachment (CCI P/N 1012812)	Axle seal tool (CCI P/N 1014162)	Governor gear shaft installation tool (CCI P/N 101933101)

AXLE SHAFT

Read DANGER and WARNING on page 16b-1.

Removal of the unitized transaxle is not required for servicing or replacing axle shafts, axle bearings, or axle shaft oil seals. If the unitized transaxle is to be removed from the vehicle, then do not remove the wheels, axle shafts, or axle tubes first. Instructions for removing the unitized transaxle from the vehicle begin on page 16b-9.

AXLE SHAFT AND OIL SEAL REMOVAL

1. Loosen the lug nuts on the wheel to be removed.
2. Place chocks at the front wheels and lift the rear of the vehicle with a floor jack. Then place jack stands under the axle tubes to support the vehicle. **See WARNING "Lift only one end..." on page 16b-2.**
3. Remove all lug nuts and wheel from the vehicle.
4. Remove the brake drum. If the brake drum was easily removed, proceed to step 6.
5. To remove tight brake drums:
 - 5.1. On the back of each brake cluster assembly, locate the bolt heads of the two brake shoe adjusters.
 - 5.2. Using a torque wrench and a Torx #T-27 driver, or hydraulic brake adjuster (CCI P/N 102169401), gently rotate the adjuster bolt in order to increase the clearance between the brake shoes and the brake drum. **See Figure 6b-5, Section 6b, Page 6b-10.**
 - 5.3. Rotate the brake drum slightly and remove it from the brake shoe cluster assembly.
6. Using 90° internal snap ring pliers (.090 tip), remove internal bearing retaining ring from inside the axle tube hube (**Figure 16b-6, Page 16b-6**).
7. Carefully pull the axle shaft straight out of the axle tube.
8. Use external snap ring pliers (0.047 tip) to remove the internal oil seal retaining ring from inside the axle tube hub.
9. Use a 16-inch (40 cm) rolling head prybar (**Figure 16b-7, Page 16b-6**) to remove the oil seal. Insert the prybar under the seal and pull oil seal out (**Figure 16b-8, Page 16b-6**). **See following CAUTION.**

Axle Shaft and Oil Seal Removal, Continued:**CAUTION**

- Do not scar or damage the inside surfaces of the tube when removing the oil seal. A damaged tube might have to be replaced.

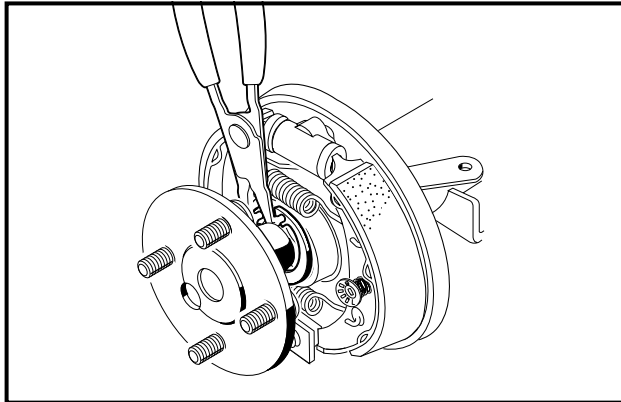


Figure 16b-6 Retaining Ring

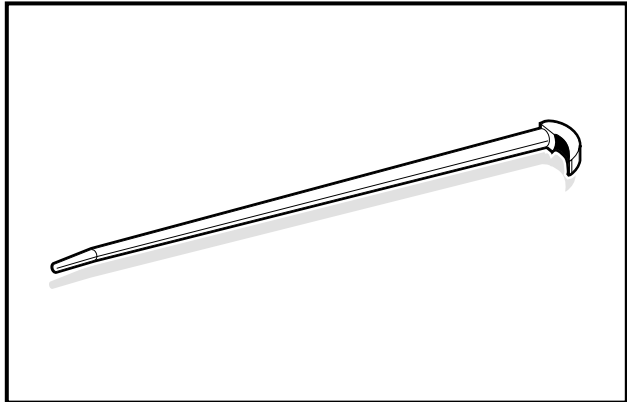


Figure 16b-7 Rolling Head Prybar

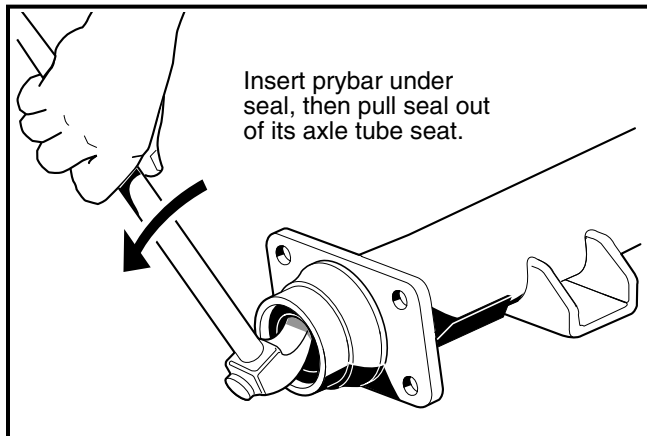


Figure 16b-8 Seal Lip

10. Inspect the axle shaft assembly to be sure the bearing (86) and collar (87) have not slipped and the bearing is still seated against the shoulder on the axle shaft (**Figure 16b-9, Page 16b-7**).
11. Inspect the bearing. If the bearing is damaged or worn, replace it.

AXLE BEARING**Axle Bearing Removal**

1. Place a bearing puller wedge attachment (CCI P/N 1012812) on the axle shaft between the wheel mounting flange and the bearing. **See following CAUTION.**

CAUTION

- Do not tighten the bearing puller wedge attachment against the axle shaft. This could damage the axle shaft when pressing the bearing and collar off.

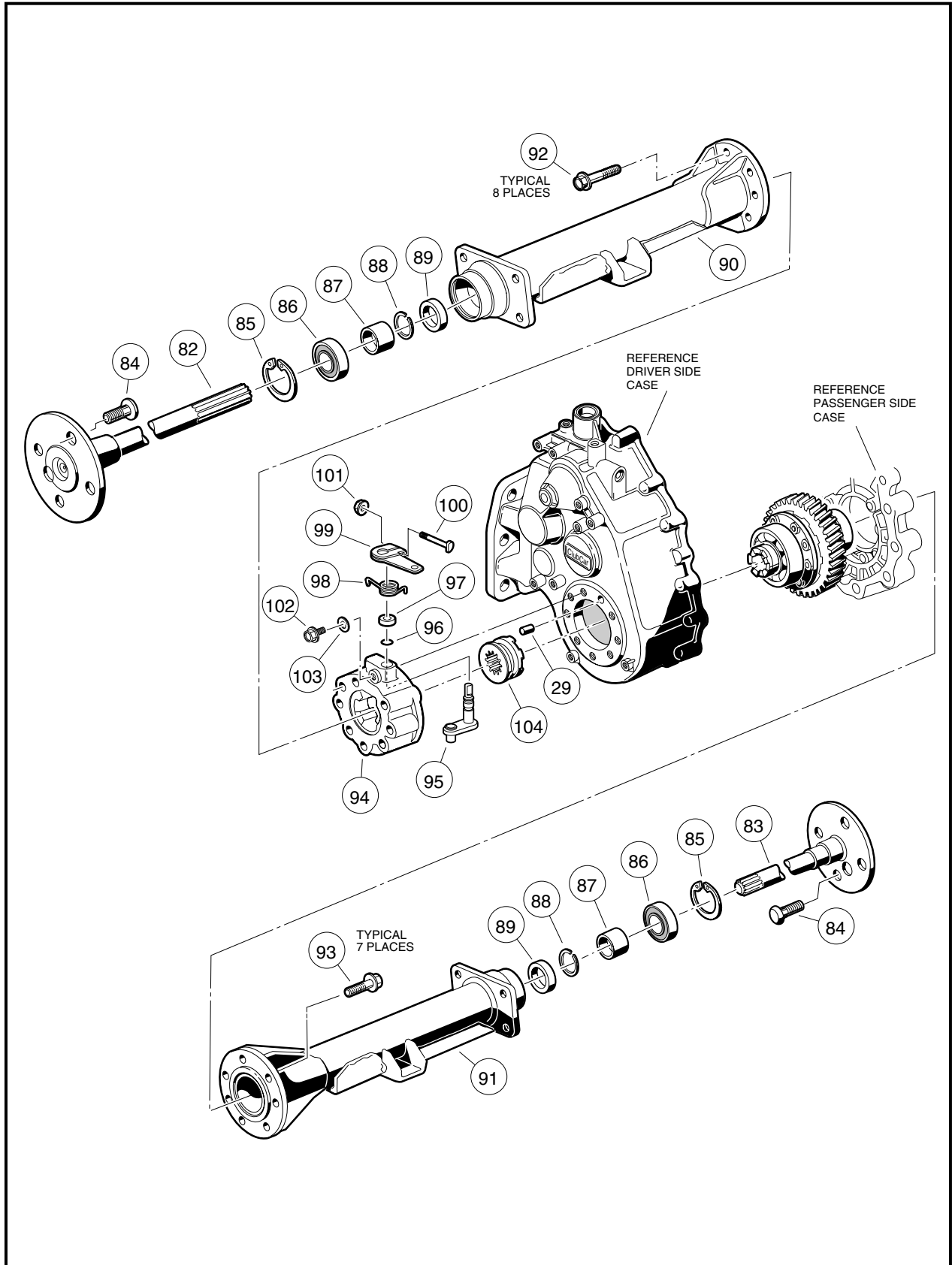


Figure 16b-9 Differential Gear Case/Axle Tubes

Axle Bearing Removal, Continued:

2. Press the bearing (86) and collar (87) off together of either axle (82 or 83) (**Figure 16b-9, Page 16b-7**). See also **Figure 16b-10, Page 16b-8**. See following **NOTE**.

NOTE: It may be necessary to heat the collar to remove it.

Axle Bearing Installation

1. Install axle bearing (86) on axle (82 or 83). Push bearing onto axle until bearing is flush against axle shoulder (**Figure 16b-9, Page 16b-7**).
2. Apply two drops of Loctite 271[®] to inside of the collar. See following **CAUTION**.

⚠ CAUTION

- Apply Loctite 271 to the inside of the collar only, not to the shaft, so that the Loctite will be pushed away from the bearing as the collar and bearing are pressed on. If Loctite gets on or in the bearing, the bearing must be replaced.
 - The collar should be removed no more than two times. If a collar is removed a third time, the shaft and collar will not fit properly.
3. Install collar (87) (**Figure 16b-9, Page 16b-7**) onto axle shaft. Place axle assembly on bearing puller wedge attachment and press collar onto axle.
 4. Place a new (sealed) bearing (86) and collar (87) on shaft (82 or 83).
 5. Place the bearing puller wedge attachment against collar and press both bearing and collar onto shaft. Install the retaining ring (88) (**Figure 16b-9, Page 16b-7**). See following **CAUTION**.

⚠ CAUTION

- If the bearing was removed from the shaft, replace it with a new one.
- Do not tighten the bearing puller wedge attachment against the axle shaft. This could damage the axle shaft when the bearing and collar are pressed on.

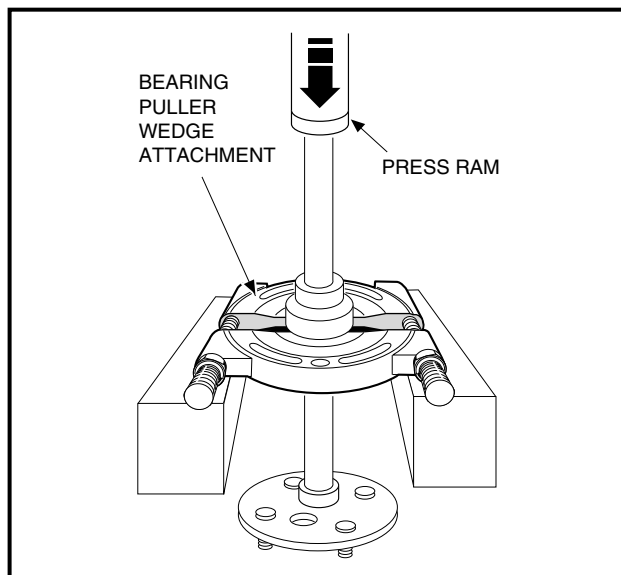


Figure 16b-10 Bearing and Collar

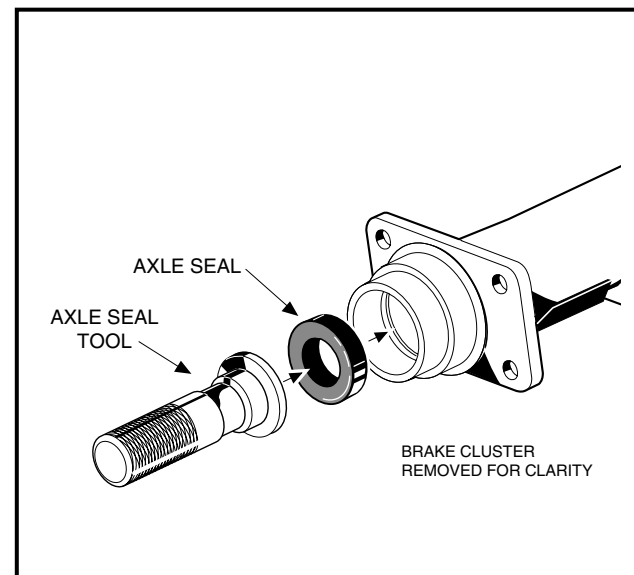


Figure 16b-11 Axle Seal Tool

AXLE SHAFT AND OIL SEAL INSTALLATION

1. Clean bearing and seal seats inside axle tube (90 or 91) hubs (**Figure 16b-9, Page 16b-7**).
2. Place a new seal (89) (**Figure 16b-9, Page 16b-7**) in axle tube with seal lip facing inside of the axle tube. Use an axle seal tool (CCI P/N 1014162) to press it in until it seats firmly in position (**Figure 16b-11, Page 16b-8**). **See following NOTE.**

NOTE: The new seal can be installed by tapping the axle seal tool with a mallet.

3. Use an internal retaining ring pliers (0.047 tip) and install an oil seal retaining ring (88) inside the axle tube hub next to the oil seal.
4. Clean the axle shaft and splines and then insert the shaft, splined end first, through the seal and into the axle tube. Be careful not to damage the seal. Then advance the shaft through the inner bearing and rotate it to align the shaft splines with the splined bore of the differential side gear. Continue advancing the shaft until the bearing seats against the axle tube shoulder.
5. Install retaining ring (85) (**Figure 16b-9, Page 16b-7**) in the axle tube hub. **See also Figure 16b-6, Page 16b-6.**
6. Place a 1/4 to 3/8-inch (6-10 mm) diameter rod against the retaining ring and tap lightly at four to five locations to ensure that the retaining ring is properly seated. **See following WARNING.**

▲ WARNING

- **Be sure retaining ring is properly seated in its groove. If ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.**

UNITIZED TRANSAXLE REMOVAL

Read **DANGER** and **WARNING** on page 16b-1.

▲ WARNING

- **To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System, Section 6b, Page 6b-33.**

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 16b-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
 - 2.2. Lift the passenger side seat.
3. Disconnect the battery cables, negative (-) cable first. **See WARNING "To avoid unintentionally starting..." on page 16b-1.**
4. Close the fuel shut-off valve on fuel tank. **See Fuel Shut-Off Valve, Section 14, Page 14-32.**
5. Detach all wires, hoses, etc. connecting the powertrain to the vehicle.
 - 5.1. Disconnect the carburetor vent tube from the carburetor (**Figure 16b-12, Page 16b-10**).
 - 5.2. Disconnect the air intake hose from the carburetor (**Figure 16b-13, Page 16b-10**).
 - 5.3. Disconnect impulse line from fuel pump (**Figure 16b-14, Page 16b-10**).
 - 5.4. Loosen the hose clamp and then disconnect the fuel line from the carburetor. To prevent spilling fuel, the disconnected end of the line should be pushed onto the impulse line fitting of the fuel pump (**Figure 16b-17, Page 16b-12**).

Unitized Transaxle Removal, Continued:

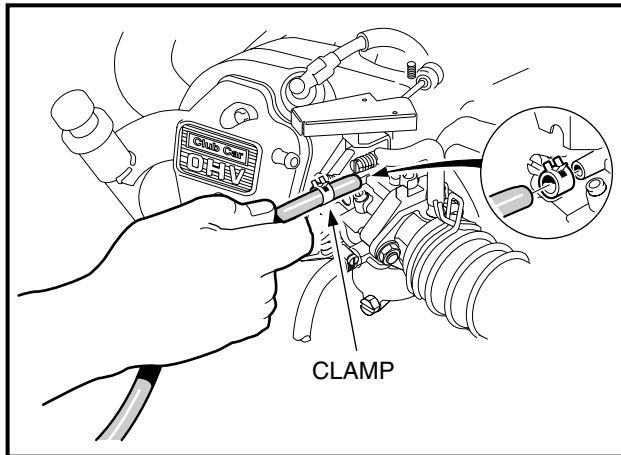


Figure 16b-12 Carburetor Vent Tube

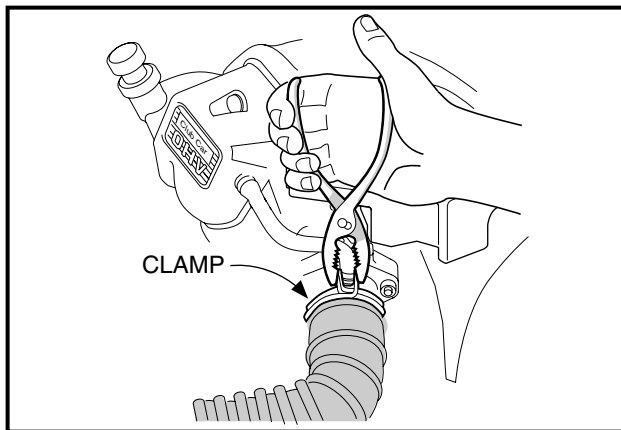


Figure 16b-13 Air Intake Hose

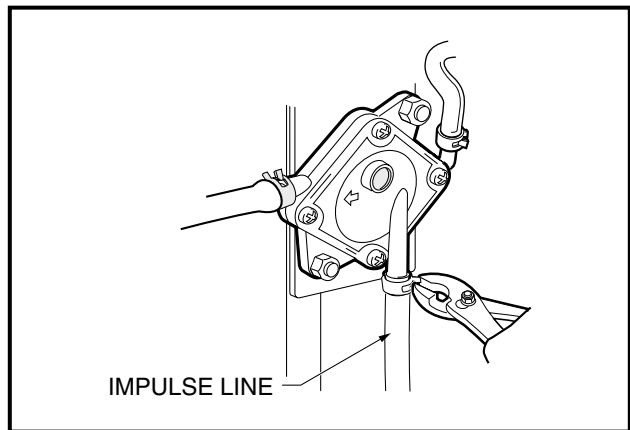


Figure 16b-14 Impulse Line

- 5.5. Remove the differential lock cable.
 - 5.5.1. Place differential lock handle in the disengaged direction.
 - 5.5.2. Using a pair of pliers, apply pressure to the locking tabs of the cable end (1) where it attaches to the differential lock handle mounting bracket (**Figure 16b-15, Page 16b-11**).
 - 5.5.3. While maintaining pressure on the locking tabs, pull the differential lock cable toward the rear of the vehicle to disconnect the cable from the bracket (**Figure 16b-15, Page 16b-11**).
 - 5.5.4. With handle in the engaged position and the cable disconnected from the bracket, rotate the cable connector toward the driver side of the vehicle to disconnect the cable from the differential lock lever (1) (**Figure 16b-16, Page 16b-12**).
 - 5.5.5. Remove wire tie (6) securing the cable to the vertical support (**Figure 16b-119, Page 16b-53**).
- 5.6. Remove the cover from the electrical component box. Then loosen the hardware securing the accelerator cable to the box. Disconnect the cable from the actuator cam and remove it from the box (**Figure 16b-18, Page 16b-12**).
- 5.7. Disconnect the engine ground wire from the oil filler tube mounting bracket (**Figure 16b-19, Page 16b-12**).

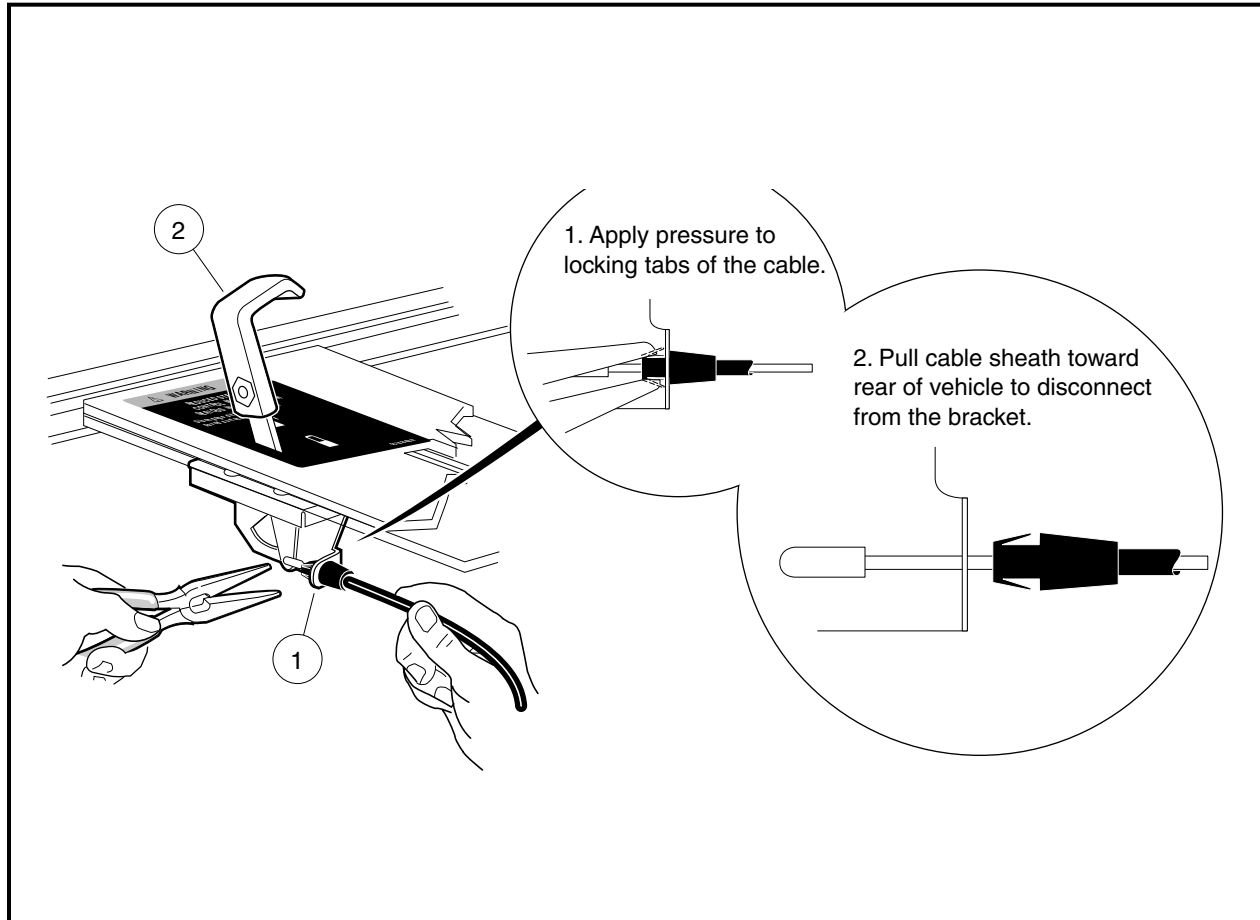


Figure 16b-15 Differential Lock Cable Bracket

- 5.8. Loosen nuts securing shifter cable to shifter cable mounting bracket. Then disconnect the shifter cable rod end from the shifter arm on the unitized transaxle and remove the cable from the cable mounting bracket (**Figure 16b-20, Page 16b-12**).
- 5.9. Remove screws (2) securing the Forward/Reverse shifter cable bracket (1) to transaxle and remove the shifter bracket (**Figure 16b-42, Page 16b-19**).
- 5.10. Loosen nut (3) and bolt (7) on transaxle shifter lever and remove lever from shaft (15) (**Figure 16b-42, Page 16b-19**).
- 5.11. Remove woodruff key (9) from shifter shaft (15) (**Figure 16b-42, Page 16b-19**).
- 5.12. Mark for proper reconnection and then disconnect the 6-gauge white wire (F2 post), 6-gauge black ground wire (A2 post), and 16-gauge yellow wire (DF post) from starter/generator (**Figure 16b-21, Page 16b-13**).
- 5.13. Disconnect the engine oil level sensor wire (18-gauge yellow) at the bullet connector just to the rear of the starter/generator (**Figure 16b-22, Page 16b-13**).
- 5.14. Disconnect the engine kill switch wire (18-gauge white/black) from the bullet connector at the lower right front of the engine (**Figure 16b-23, Page 16b-13**).
- 5.15. Cut away the wire ties securing the kill switch wire at the lower right front of the engine (below the exhaust header), the wire harness at the governor cable bracket, and the wire harness to the plate beneath the muffler.

Unitized Transaxle Removal, Continued:

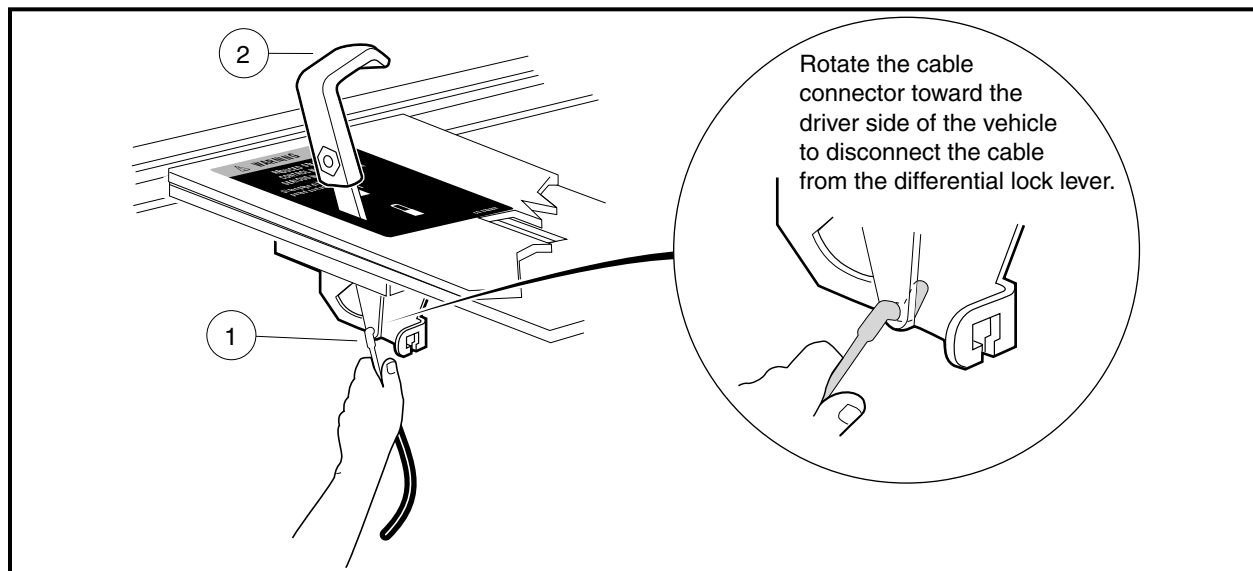


Figure 16b-16 Differential Lock Cable Removal

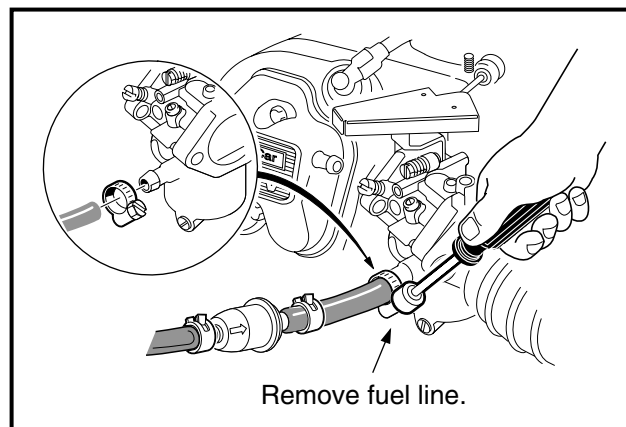


Figure 16b-17 Fuel Line

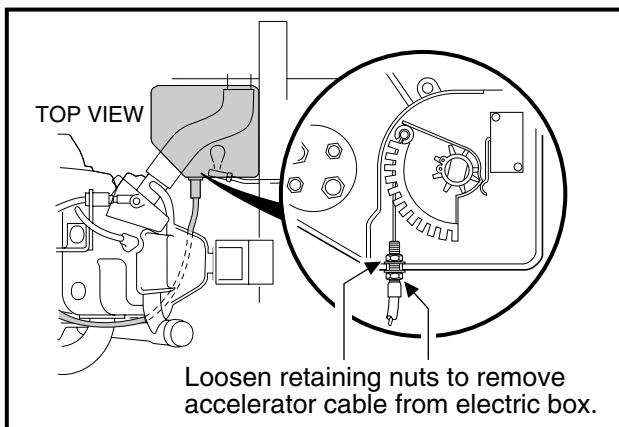


Figure 16b-18 Accelerator Cable

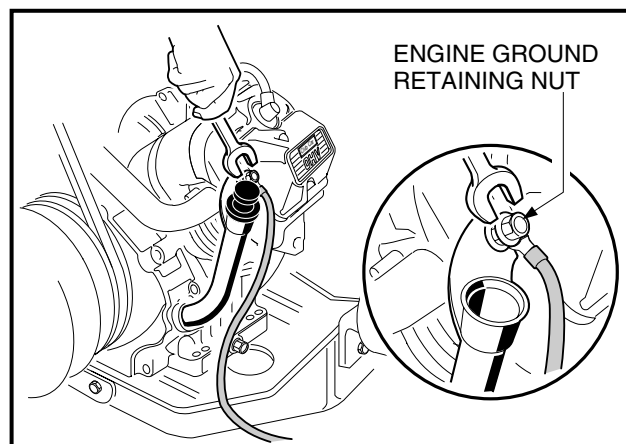


Figure 16b-19 Engine Ground Wire

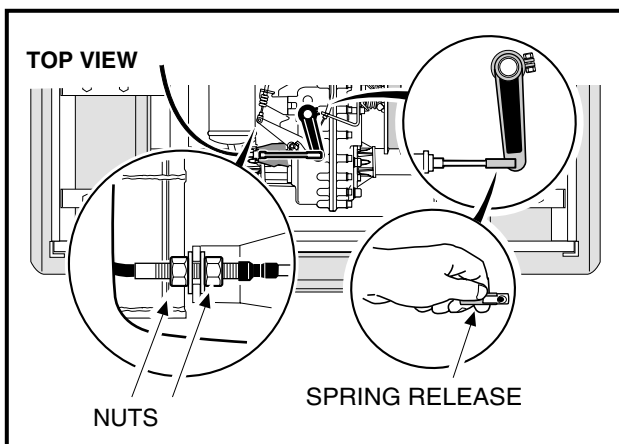


Figure 16b-20 Shifter Cable

6. Remove the lower shock mounting hardware from both rear shocks (**Figure 16b-24, Page 16b-13**).
7. Disconnect the brake hoses and park brake cables.
 - 7.1. Remove the park brake cable clip (1), hair spring cotter pin (2) and clevis pin (3) (**Figure 16b-25, Page 16b-14**).

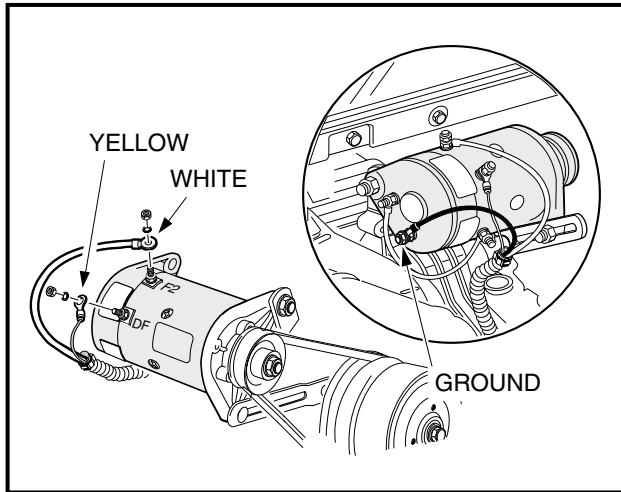


Figure 16b-21 Generator Wires

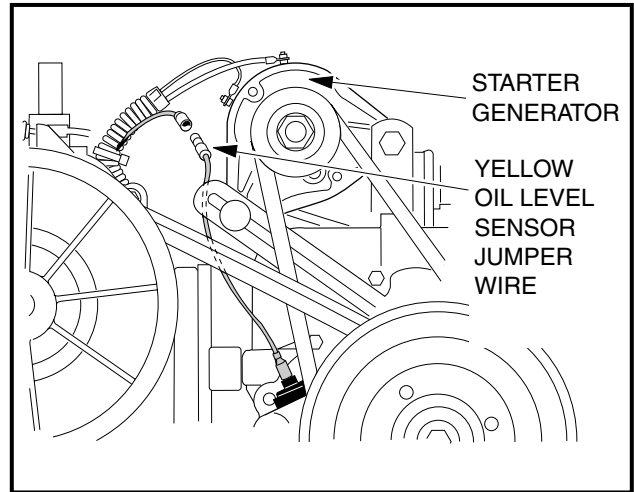


Figure 16b-22 Oil Level Sensor Jumper Wire

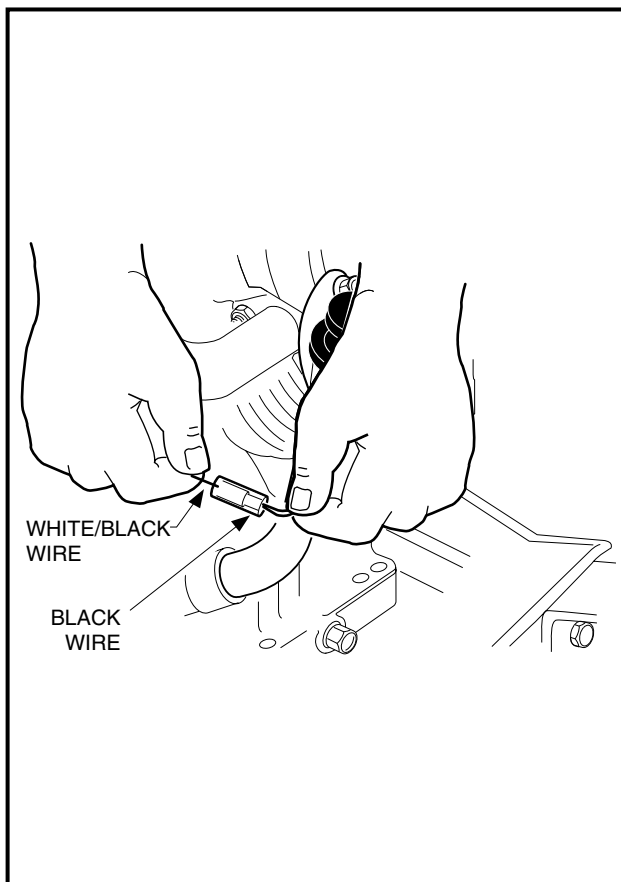


Figure 16b-23 Engine Kill Switch Wire

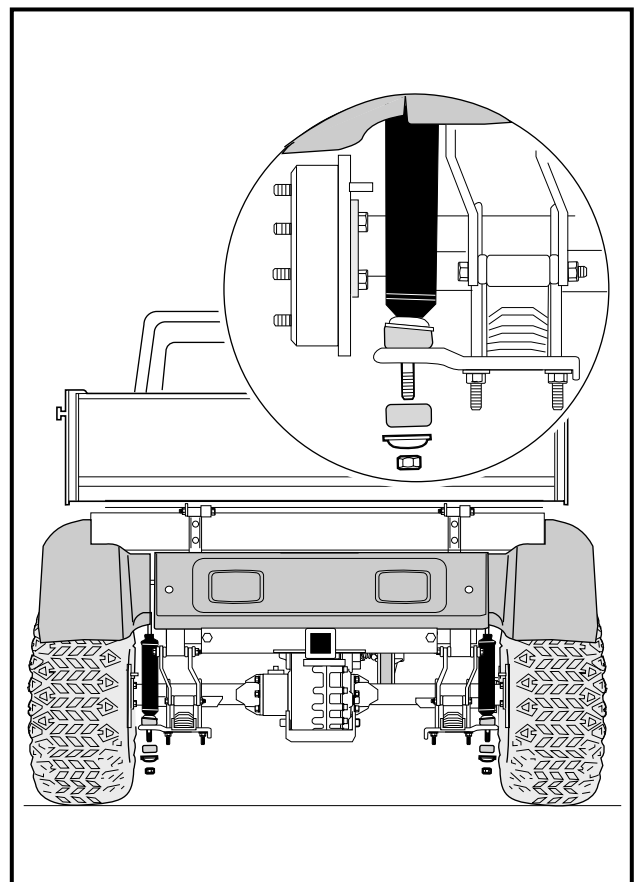


Figure 16b-24 Shock Absorbers

Unitized Transaxle Removal, Continued:

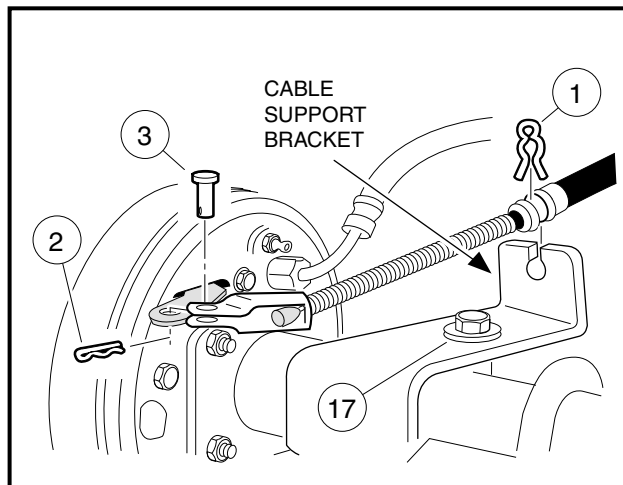


Figure 16b-25 Park Brake Cable

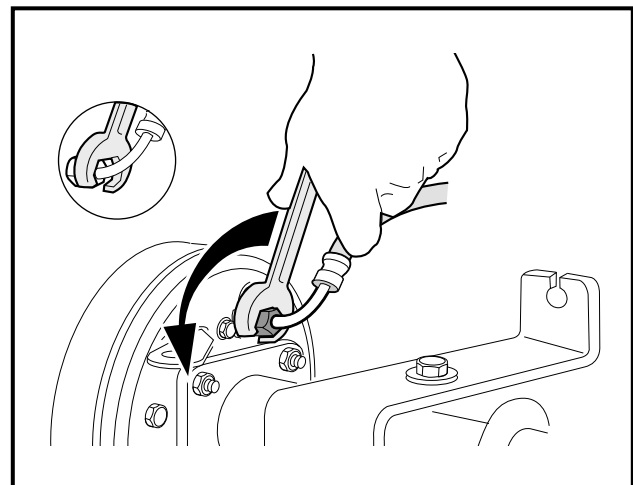


Figure 16b-26 Brake Hose

- 7.2. Remove the cable from the cable support bracket (**Figure 16b-25, Page 16b-14**).
- 7.3. Remove the upper shock mounting hardware from the rear shock absorber and remove the shock absorber.
- 7.4. Using a 3/8-inch flare nut wrench, remove the brake hose from the rear brake cluster. To avoid spilling brake fluid, lift the hose above the brake cluster assembly (**Figure 16b-26, Page 16b-14**).
- 7.5. To ensure that no dirt or trash enters the hydraulic braking system, place the hose fitting in a plastic bag and secure to the vehicle frame as shown (**Figure 16b-27, Page 16b-14**).
- 7.6. Repeat steps 7.1 through 7.5 for the opposite side of the vehicle.

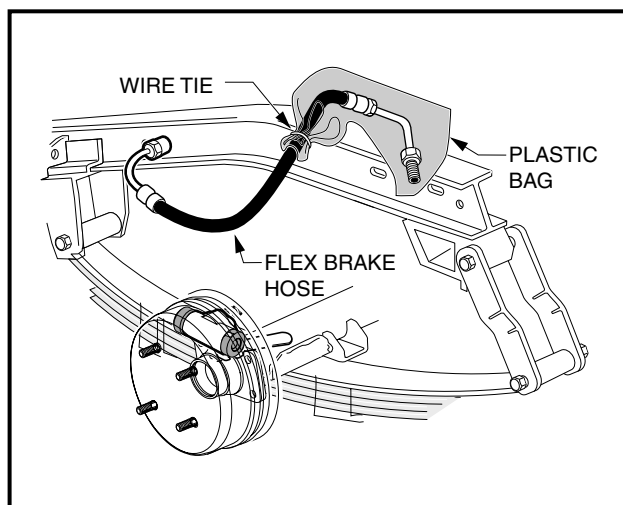


Figure 16b-27 Cover Brake Hose Fitting

8. Using a hydraulic jack placed under the transaxle (**Figure 16b-30, Page 16b-15**), raise the vehicle and place jack stands, set at approximately 17-1/2 inches (44.5 cm) in height, under the frame as shown (**Figure 16b-31, Page 16b-15**).
9. Lower the hydraulic jack, allowing the vehicle I-beam frame to rest on the jack stands but allow the jack to remain under, and in contact with, the transaxle case guard (**Figure 16b-31, Page 16b-15**).
10. Remove the bolts securing the leaf springs to their front mounts (**Figure 16b-28, Page 16b-15**).

11. Remove the bolts that secure the leaf springs to the shackles (**Figure 16b-29, Page 16b-15**).
12. With the hydraulic jack, slowly lower the powertrain until both of the rear tires are resting on the floor.

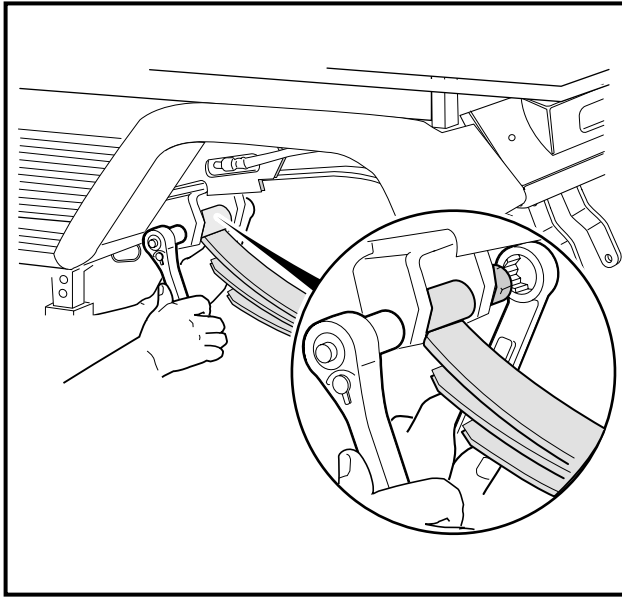


Figure 16b-28 Spring Retainer Bolts

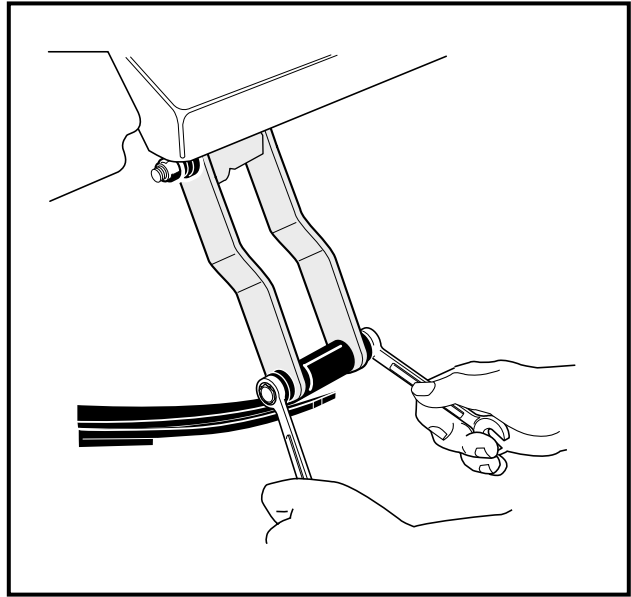


Figure 16b-29 Rear Shackles

13. Carefully lift the snubber out of the snubber bracket in the vehicle frame and lower it to the floor (**Figure 16b-32, Page 16b-16**). The powertrain should be completely disconnected from the vehicle and resting on the floor.

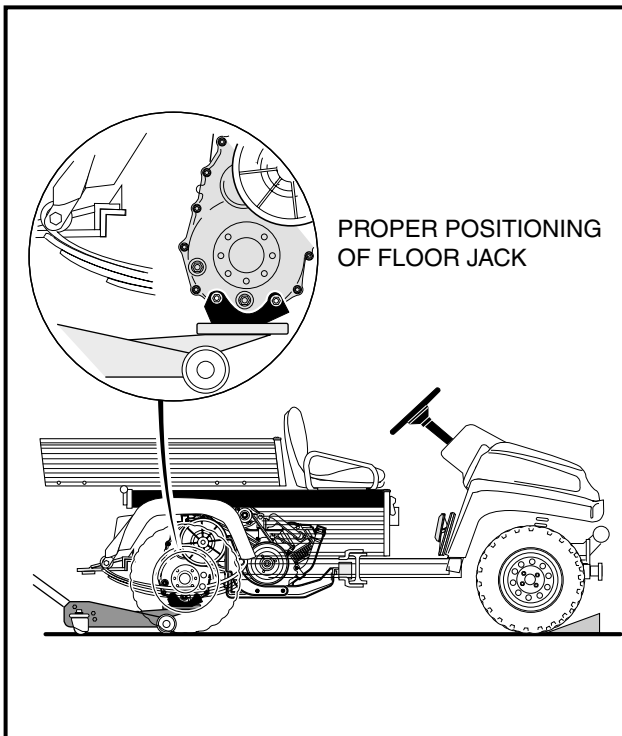


Figure 16b-30 Raise Vehicle

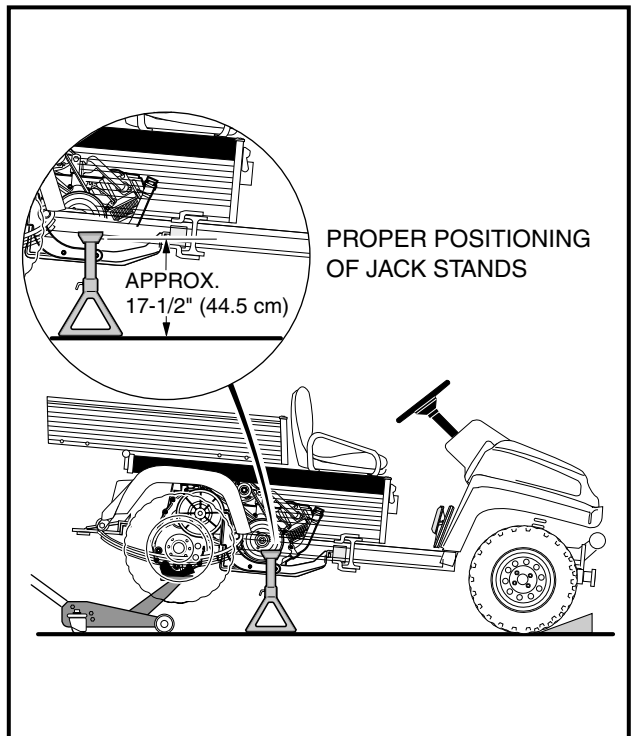


Figure 16b-31 Position Jack Stands

Unitized Transaxle Removal, Continued:

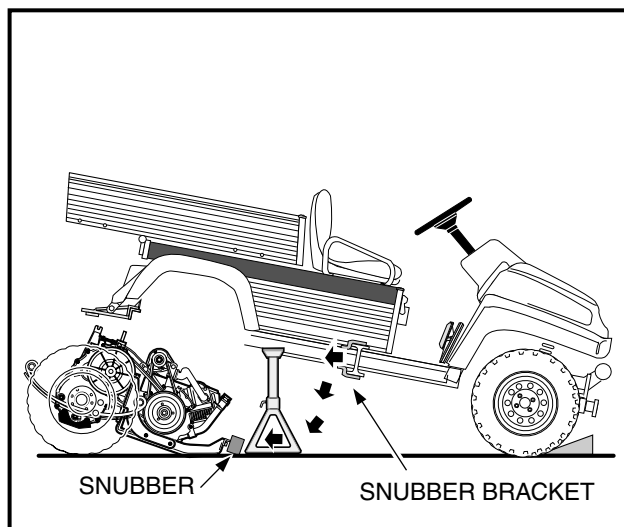


Figure 16b-32 Snubber

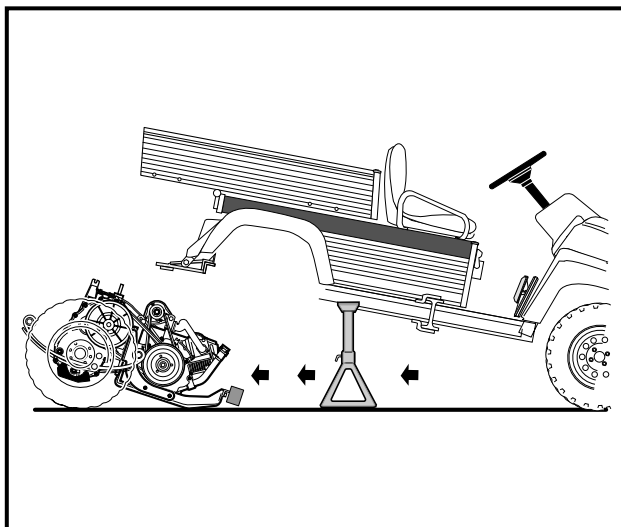


Figure 16b-33 Remove Powertrain

14. Grasp the ends of the leaf springs at the rear of the vehicle and roll the powertrain out from under the vehicle (**Figure 16b-33, Page 16b-16**).
15. Place blocks under the engine pan so they will completely support the engine and keep it level to the floor (**Figure 16b-34, Page 16b-16**). See following **NOTE**.

NOTE: Place the blocks so they will support the engine when the transaxle is detached and moved away from the engine.

16. Remove the drive belt.
 - 16.1. Grasp belt midway between drive and driven clutch and pull up on belt to force the driven clutch sheaves apart. Roll the belt counterclockwise while pulling it off driven clutch (**Figure 16b-35, Page 16b-16**).
17. Remove the driven clutch retaining bolt and remove the driven clutch from the unitized transaxle (**Figure 16b-36, Page 16b-17**).

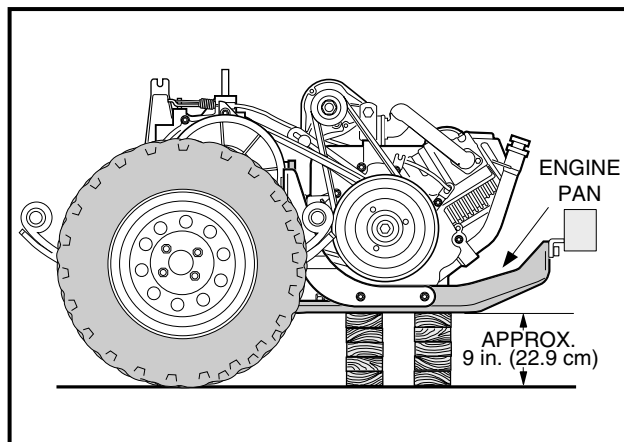


Figure 16b-34 Position Powertrain

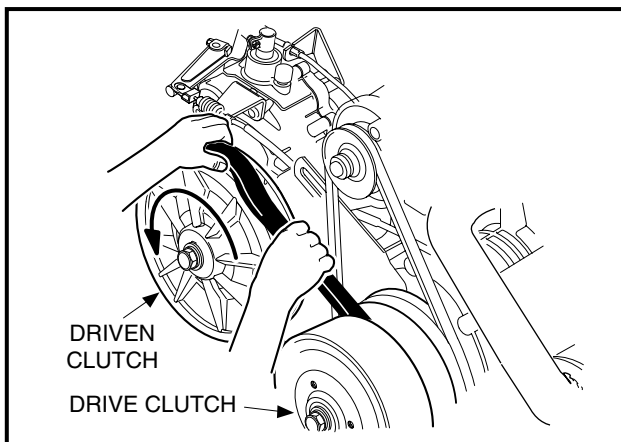


Figure 16b-35 Remove Drive Belt

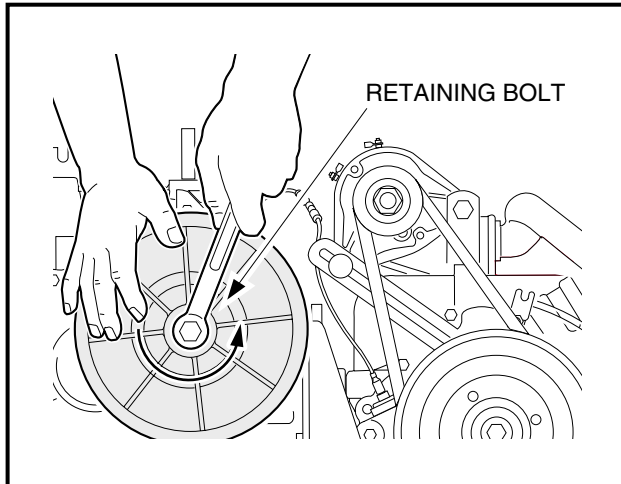


Figure 16b-36 Driven Clutch

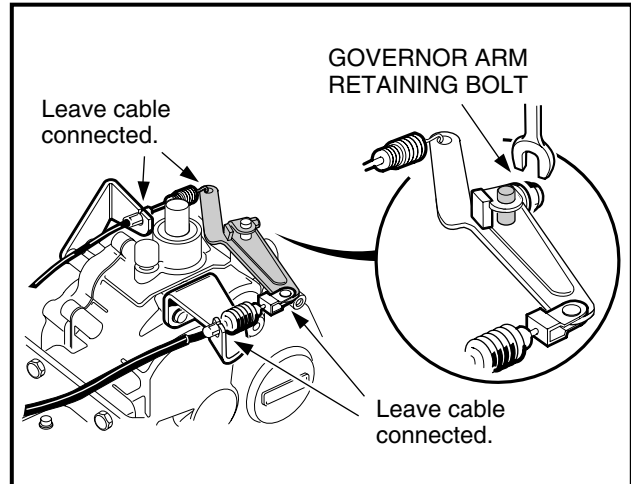


Figure 16b-37 Governor Arm

18. Loosen, but do not remove, the governor arm retaining bolt. Remove the governor arm from the shaft (**Figure 16b-37, Page 16b-17**).
19. Remove screws securing the governor cable bracket to transaxle (**Figure 16b-38, Page 16b-17**).
20. Remove screws securing the accelerator cable bracket to transaxle (**Figure 16b-39, Page 16b-17**).

NOTE: The governor cable and the accelerator cable should remain attached to the governor arm.

21. Remove the two bolts that secure the differential lock cable bracket to the transaxle housing and unhook the cable spring from the differential lock arm (**Figure 16b-40, Page 16b-18**).
22. Remove the six bolts mounting the unitized transaxle to the engine.
 - 22.1. Remove four transaxle mounting bolts (one at each corner of the transaxle mounting plate) as shown (**Figure 16b-41, Page 16b-18**).
 - 22.2. Remove two middle transaxle mounting nuts as shown (**Figure 16b-41, Page 16b-18**).
23. Remove leaf springs, wheels and brake assemblies from transaxle.

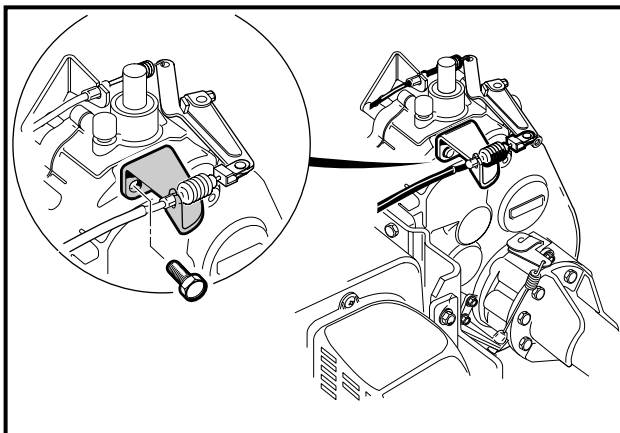


Figure 16b-38 Governor Cable Bracket

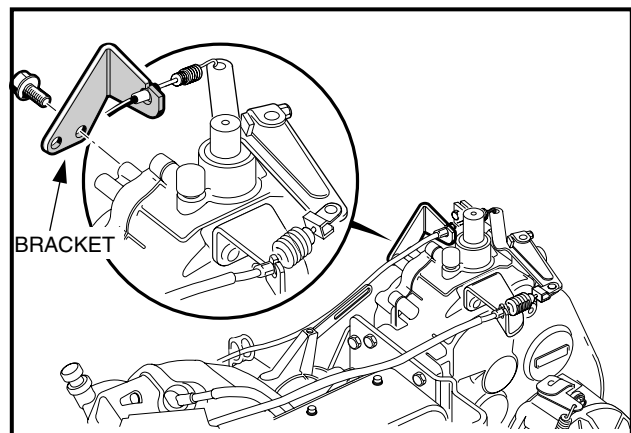


Figure 16b-39 Accelerator Cable Bracket

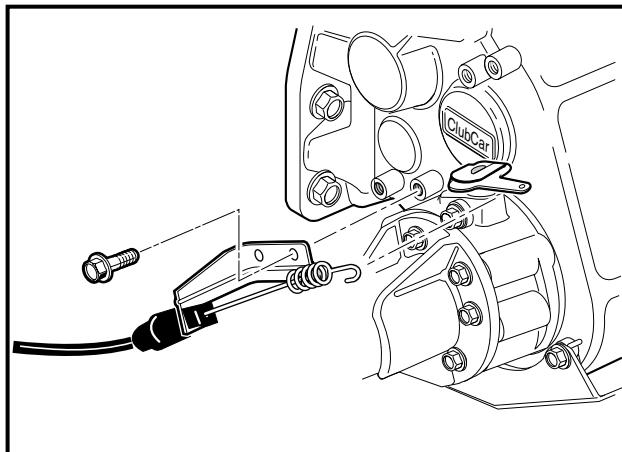


Figure 16b-40 Differential Lock Arm and Bracket

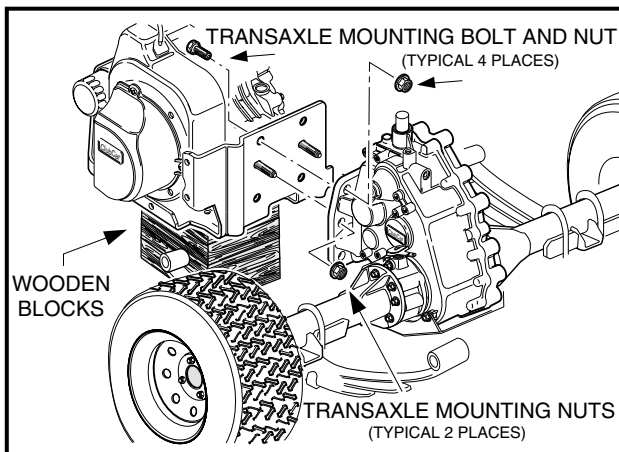


Figure 16b-41 Transaxle Mounting

UNITIZED TRANSAXLE DISASSEMBLY

Read **DANGER** and **WARNING** on page 16b-1.

NOTE: The following information provides instructions for disassembling the unitized transaxle; however, the transaxle case can be separated and gears accessed without removing the axles or axle tubes from the case.

1. Remove the drain plug and gasket. Drain and dispose of the oil properly (**Figure 16b-4, Page 16b-3**).
2. Using 90° (0.090 tip) internal snap ring pliers, remove the internal retaining rings (**Figure 16b-6, Page 16b-6**) from the axle tubes.
3. Pull the axles (82 and 83) out of the axle tubes (**Figure 16b-9, Page 16b-7**).
4. Remove eight bolts (92) and seven bolts (93), mounting each axle tube to the transaxle case (**Figure 16b-9, Page 16b-7**). Then remove axle tubes from the transaxle case and differential lock housing. **See following NOTE.**

NOTE: It may be necessary to tap the axle tube with a rubber or plastic mallet to break it free from the transaxle case or differential lock housing.

5. If necessary, remove the brake cable brackets from the axle tubes:
 - 5.1. Remove the bolt (17), washers, and lock nut from the bracket (**Figure 16b-25, Page 16b-14**).
6. Remove the differential lock housing (36) from the transaxle case (27) (**Figure 16b-42, Page 16b-19**).
7. Remove the four bolts (35) and the differential guard (34) from the transaxle.
8. Remove the fifteen bolts (28) that hold the transaxle housing together. (**Figure 16b-42, Page 16b-19**).
9. The unitized transaxle is equipped with a slot for prying the housing apart. Use the slot to open the case. Pull the housing apart, making sure all gear assemblies inside the transaxle stay together in one (either) side of the case. **See following CAUTION.**

CAUTION

- To prevent damage to the mating seal surfaces of the case, use care when separating the halves.

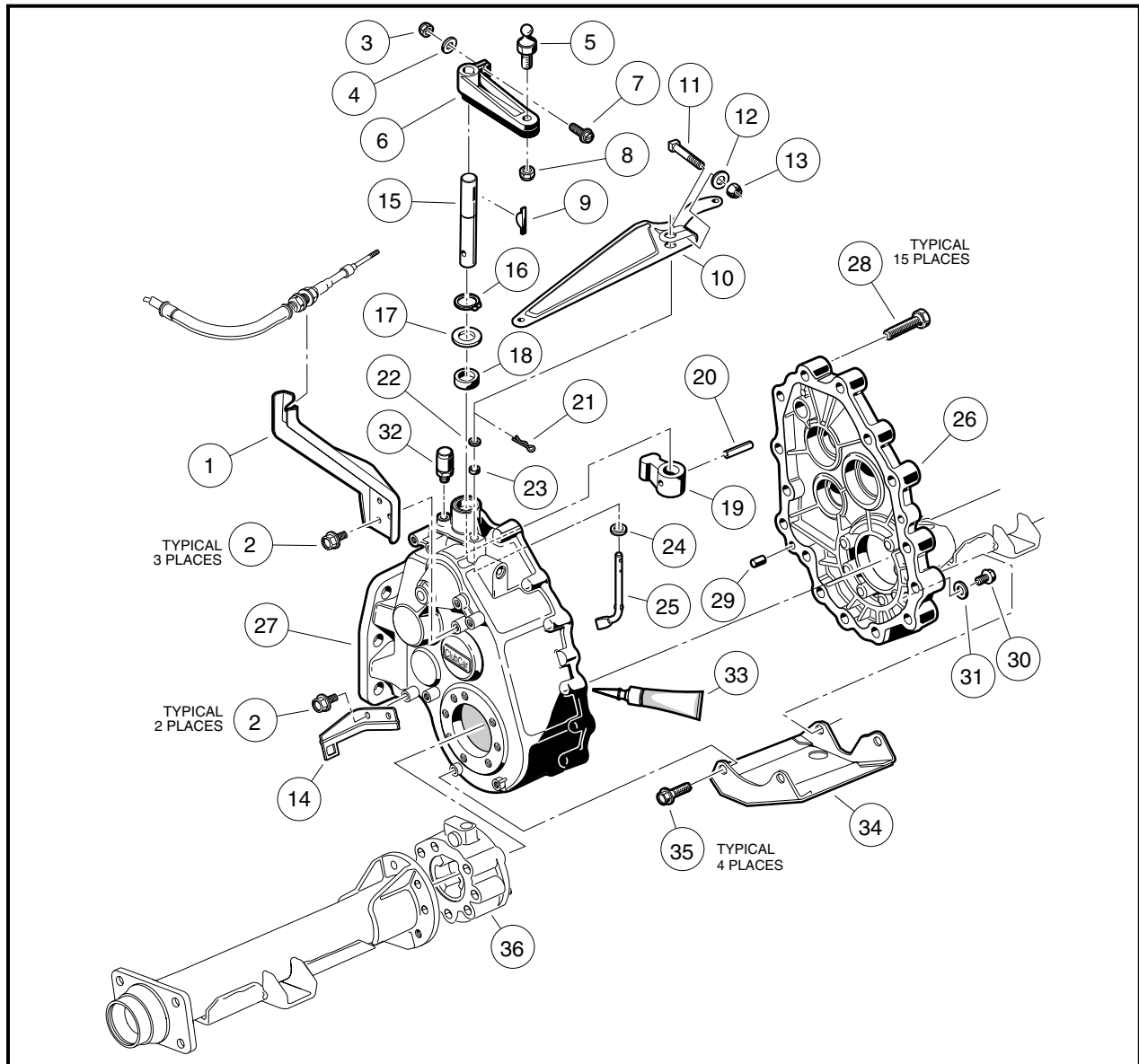


Figure 16b-42 Transaxle Gear Casing and Brackets

10. Turn the case section containing the gearing on edge as shown (**Figure 16b-43, Page 16b-20**). While holding it in this position, gently rock all the gear assemblies to slightly loosen them in their seating.

⚠ CAUTION

- To prevent damage to the gears, use extreme care when handling them.
11. When all the gear assemblies are slightly loosened, remove the differential gear case assembly by gently rocking it while pulling it from the case (**Figure 16b-44, Page 16b-20**).
12. Continue to rock and loosen the remaining gear assemblies until the intermediate gear assembly can be removed from the case. Then remove the idler shaft assembly (**Figure 16b-45, Page 16b-20**).
13. Remove the synchronizer gear assembly and shifter fork assembly as a unit from the case (**Figure 16b-45, Page 16b-20**).

Unitized Transaxle Disassembly, Continued:

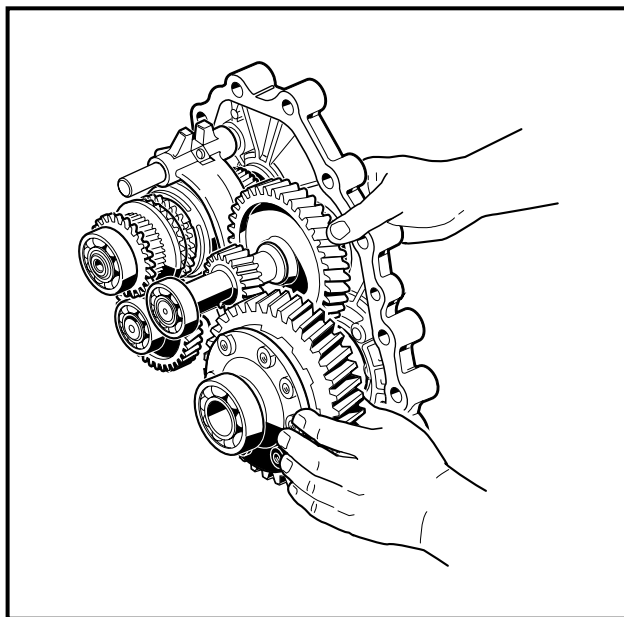


Figure 16b-43 Loosen Gears

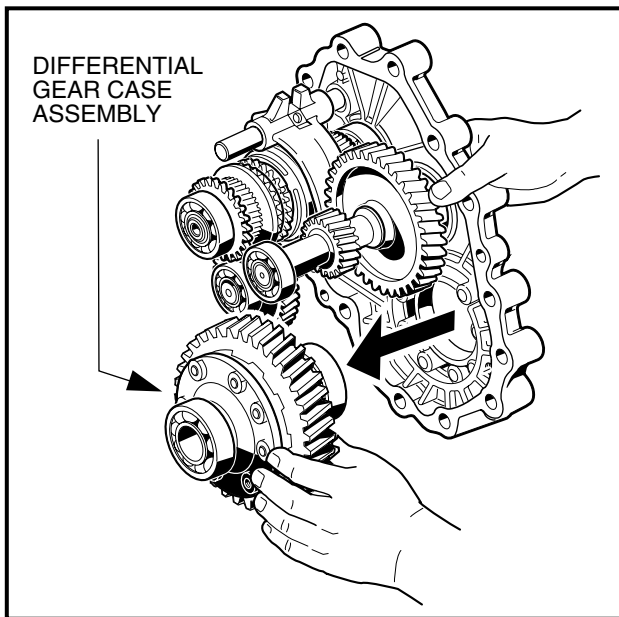


Figure 16b-44 Remove Differential Gear Case

14. Use a seal puller (CCI P/N 1012809) or rolling head prybar to remove the input shaft oil seal from the case (**Figure 16b-46, Page 16b-20**).
15. Remove the oil flow guide from the case (**Figure 16b-47, Page 16b-21**).
16. Remove the shifter shaft and oil seal from the case.
 - 16.1. Use snap ring pliers (0.047 tip) to remove the retaining ring (16) on the shifter shaft (**Figure 16b-42, Page 16b-19**).

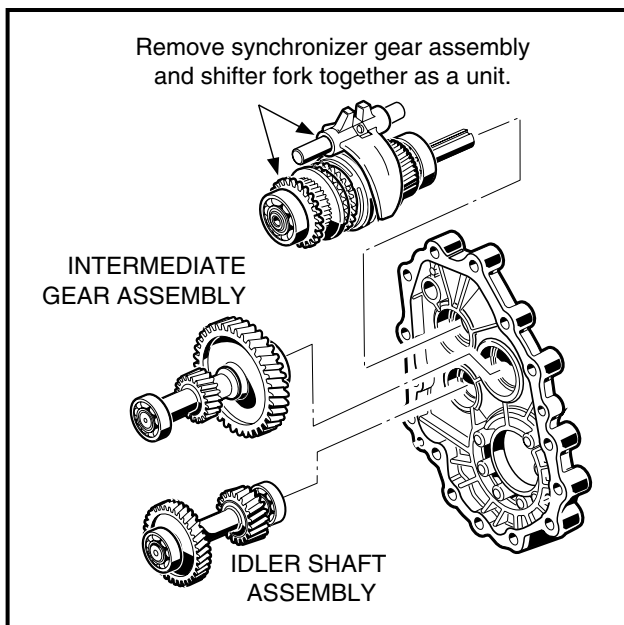


Figure 16b-45 Remove Intermediate Gear

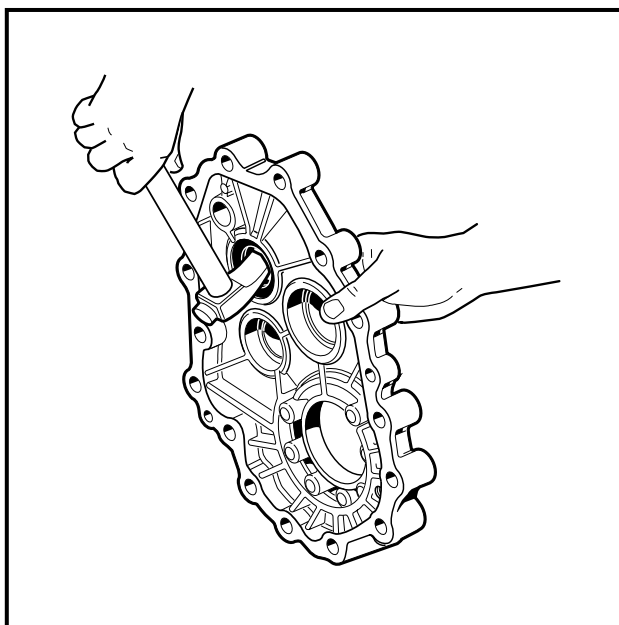


Figure 16b-46 Input Shaft Oil Seal

16.2. Remove flat washer (17) from the shifter shaft on the outside of the case as shown, then remove the shifter shaft by pushing it through the case toward the interior of transaxle.

16.3. Use a seal puller to remove the shifter shaft oil seal (18) from the case.

17. Remove the breather (32) from the case (**Figure 16b-42, Page 16b-19**).

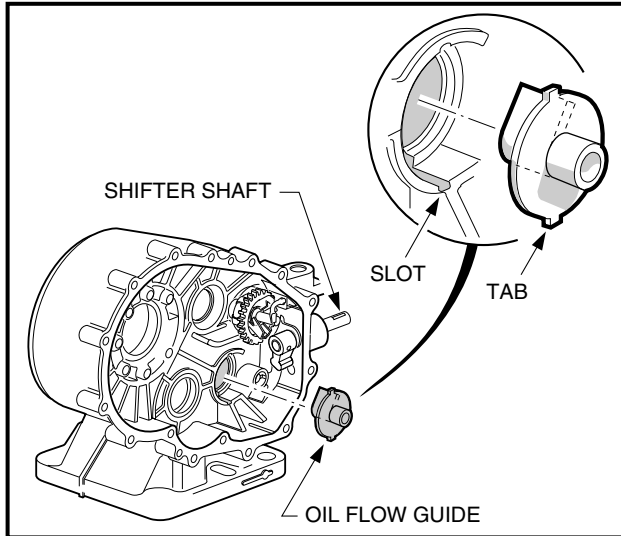


Figure 16b-47 Oil Flow Guide

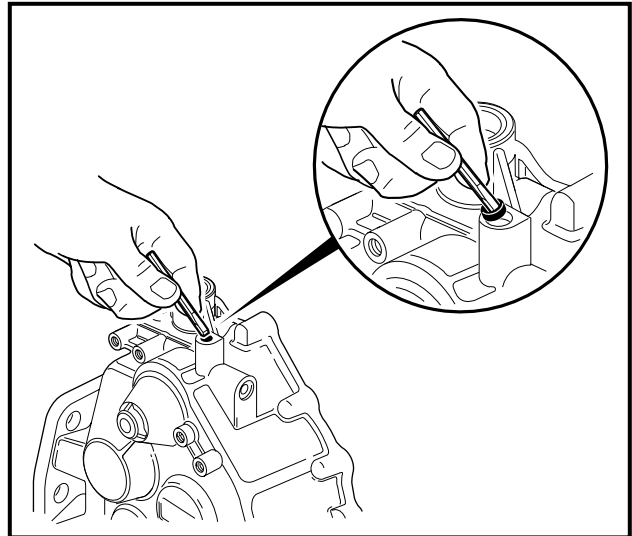


Figure 16b-48 Pivot Arm Oil Seal

18. Remove the governor assembly from the case.

18.1. Remove the cotter pin (21) and flat washer (22) from the pivot arm (25) (**Figure 16b-42, Page 16b-19**).

18.2. Remove the pivot arm (25) by pulling it through the wall to the interior of the case.

18.3. Use a small chisel or similar pointed instrument to pry the pivot arm oil seal (23) (**Figure 16b-42, Page 16b-19**) out of the case (**Figure 16b-48, Page 16b-21**).

18.4. Remove the governor gear assembly (66 and 67) and flat washer (65) (**Figure 16b-50, Page 16b-23**) by lightly tapping the gear shaft through the case wall, from the outside, with a hammer and drift. **See also Figure 16b-51, Page 16b-24.**

COMPONENT DISASSEMBLY

Read **DANGER** and **WARNING** on page 16b-1.

DIFFERENTIAL GEAR LOCK HOUSING DISASSEMBLY

1. Rotate the arm (99) and remove the differential lock cog (104) (**Figure 16b-49, Page 16b-22**).
2. Loosen but do not remove the differential lock arm retaining nut (101) and remove the arm (99) and spring (98) from the differential lock shaft (95).
3. Remove the spacer (97) from the differential lock shaft (95).
4. Remove the shaft retaining screw (102) and washer (103) from the differential lock housing.
5. Press the shaft (95) toward the center of the differential lock housing and remove the shaft (95) from the housing (94).
6. If necessary, gently pry the O-ring from the groove in the differential lock shaft with a small screwdriver (**Figure 16b-75, Page 16b-34**).

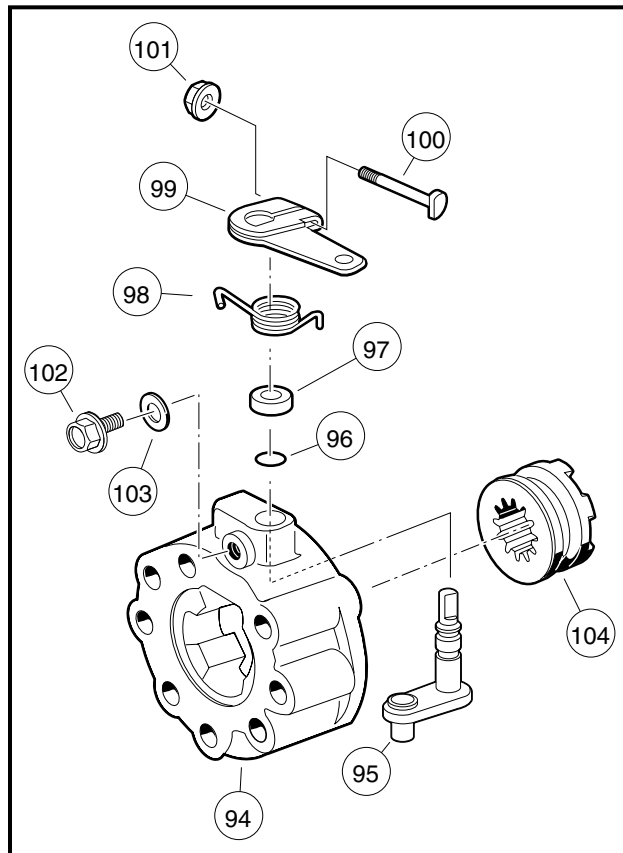
Differential Gear Lock Housing Disassembly, Continued:

Figure 16b-49 Differential Lock Housing Disassembly

GOVERNOR GEAR DISASSEMBLY

NOTE: It will be necessary to disassemble the governor gear assembly in order to reinstall it into the transaxle case.

1. Secure the governor gear assembly in a vise as shown. Wrap shaft in a cloth to prevent damage (Figure 16b-52, Page 16b-24).
2. Use two small screwdrivers to pry the gear and flyweight off the shaft as shown.

DIFFERENTIAL GEAR CASE DISASSEMBLY**⚠ CAUTION**

- Mark parts for identification as they are disassembled. Parts must be reassembled in their original locations and orientations.
1. Remove eight ring gear retaining bolts (72) (Figure 16b-53, Page 16b-24), and remove the ring gear from the assembly. It may be necessary to tap the ring gear off with a plastic or rubber mallet (Figure 16b-53, Page 16b-24). See following NOTE.

NOTE: Because Loctite was applied to the bolts during assembly, it may be necessary to place the differential gear case in a vise to remove the bolts.

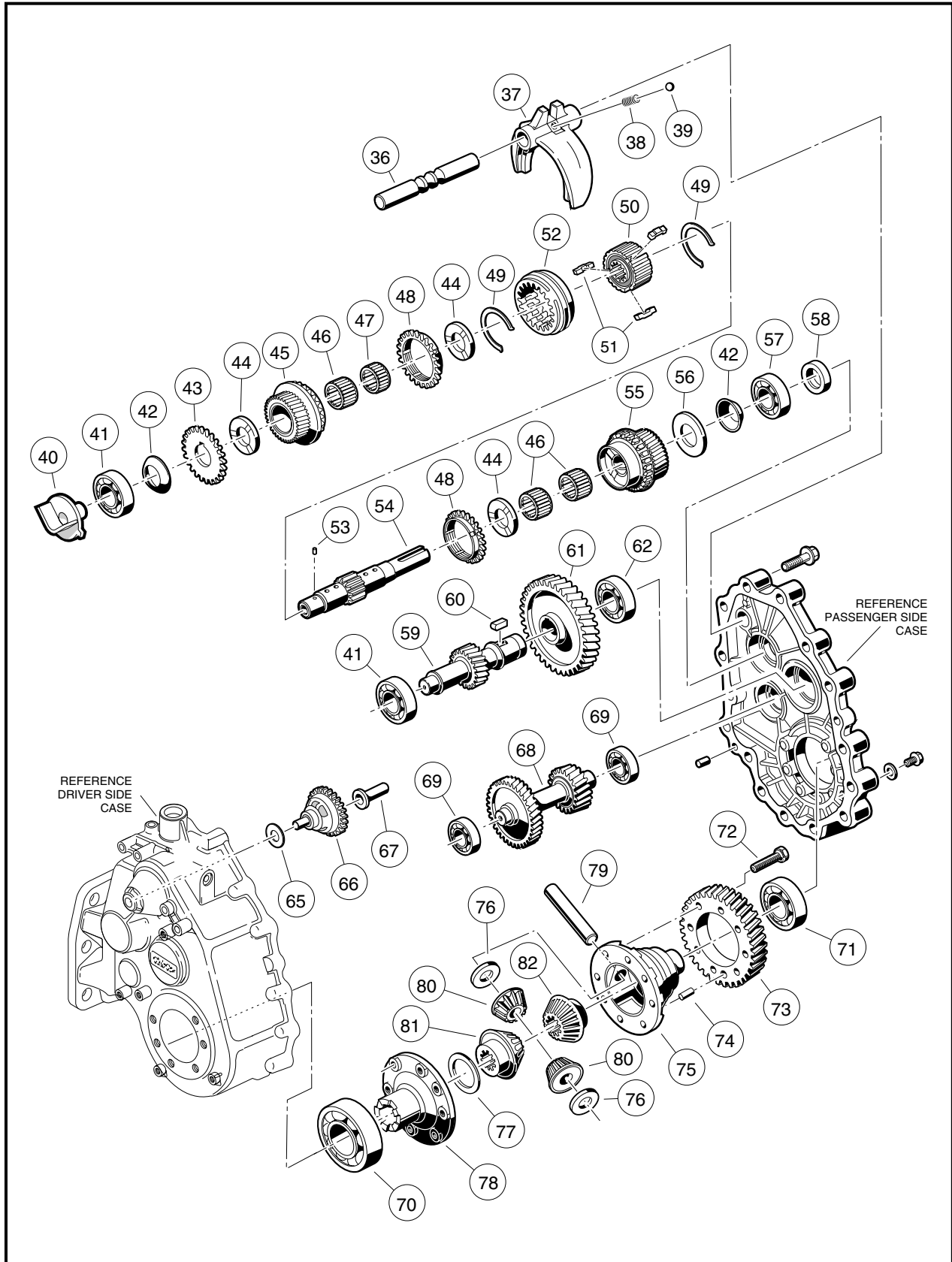
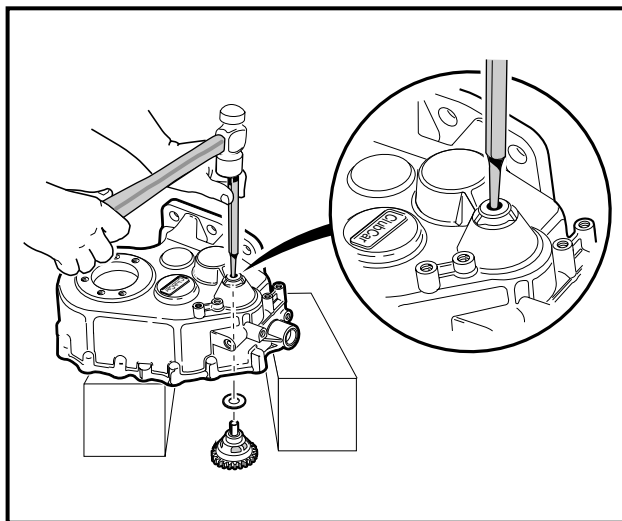
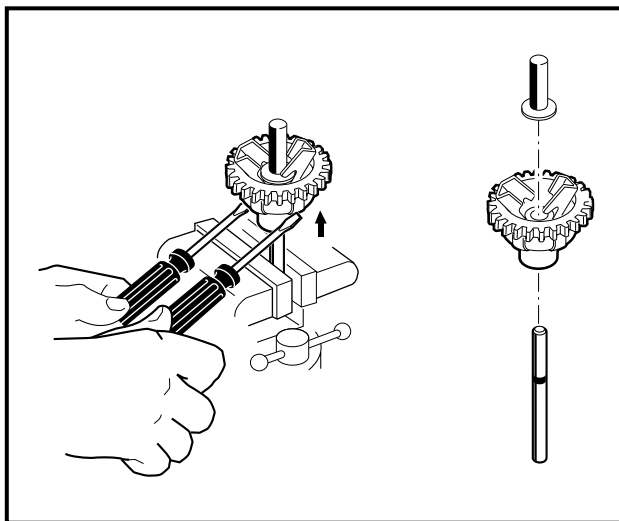


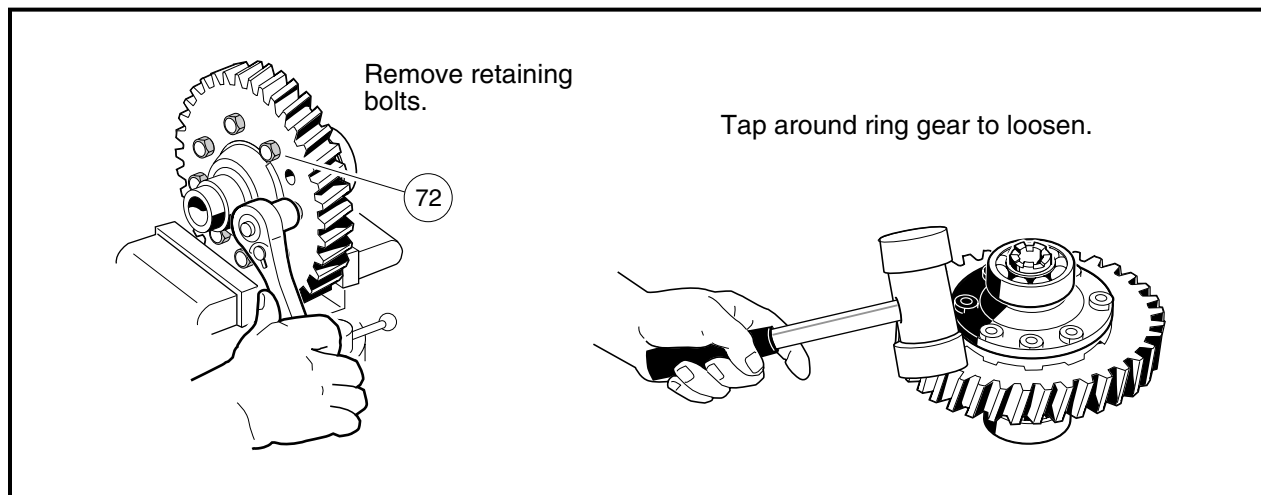
Figure 16b-50 Unitized Transaxle with Differential Lock

Differential Gear Case Disassembly, Continued:**Figure 16b-51 Remove Governor Gear****Figure 16b-52 Pry Gear from Shaft**

2. Pull the cover (78) and thrust plate (77) from the differential gear carrier case (**Figure 16b-50, Page 16b-23**).
3. Remove the differential gear (81) from the differential gear carrier case (**Figure 16b-50, Page 16b-23**).
4. Remove the differential pin (79) (**Figure 16b-50, Page 16b-23**) by pushing it through from one side (**Figure 16b-54, Page 16b-25**).
5. Remove the two differential idler gears (80) and two idler gear thrust plates (76) (**Figure 16b-50, Page 16b-23**) as the pin is driven through. **See following NOTE.**

NOTE: It may be necessary to drive the differential pin out with a hammer and punch.

6. Remove the differential gear (82) from the carrier case (**Figure 16b-50, Page 16b-23**).

**Figure 16b-53 Remove Ring Gear**

- If the bearings (70 and 71) are to be removed, place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing (71) and gear case (75) (**Figure 16b-50, Page 16b-23**) and press the bearing off as shown (**Figure 16b-55, Page 16b-25**). Repeat the process for the bearing (70) on the carrier cover (78) (**Figure 16b-50, Page 16b-23**). See following **CAUTION**.

▲ CAUTION

- Do not tighten the bearing puller wedge attachment against the shaft. This could damage the shaft.

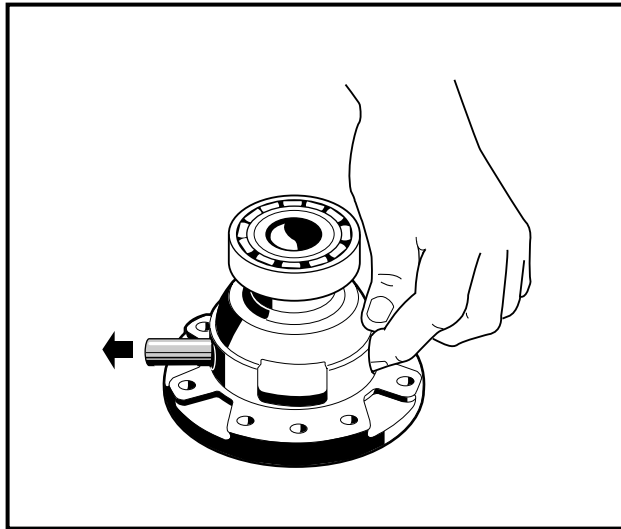


Figure 16b-54 Differential Pin

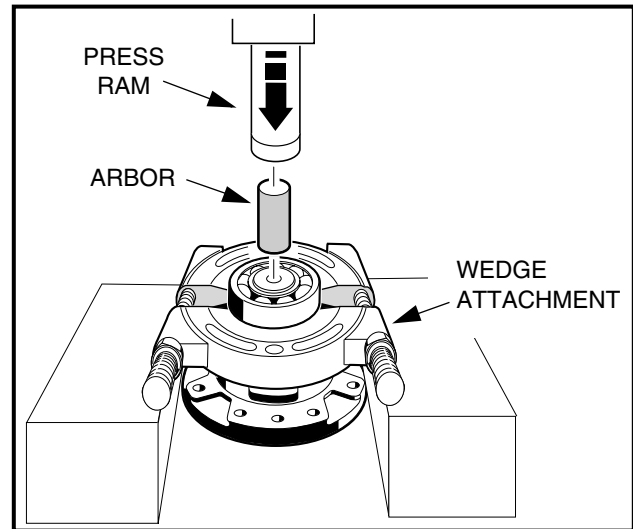


Figure 16b-55 Remove Bearing

SHIFTER FORK DISASSEMBLY

- Push the shift rod (36) out of the shifter fork (37) (**Figure 16b-50, Page 16b-23**).
- Shake the shifter fork (37) to remove the spring (38) and ball (39) (**Figure 16b-50, Page 16b-23**).

SYNCHRONIZER GEAR DISASSEMBLY

▲ CAUTION

- Mark parts for identification as they are disassembled. Parts must be reassembled in their original locations and orientations.
 - Do not tighten the bearing puller wedge attachment against the shaft. This could damage the shaft.
- Place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing (41) and spur (governor drive) gear (43) (**Figure 16b-50, Page 16b-23**), then press the bearing off the input shaft as shown (**Figure 16b-56, Page 16b-26**). See preceding **CAUTION**.
 - Pull the spring washer (42), spur gear (43), dowel pin (53), thrust plate (44), input gear assembly (45), large needle bearing (46), small needle bearing (47), synchronizer ring (48), and thrust plate (44) from the input shaft (**Figure 16b-50, Page 16b-23**).

Synchronizer Gear Disassembly, Continued:

- Place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing (57) and input gear assembly (55) (**Figure 16b-50, Page 16b-23**), then press the bearing off the input shaft as shown (**Figure 16b-57, Page 16b-26**). See following **CAUTION**.

CAUTION

- Do not tighten the bearing puller wedge attachment against the shaft. This could damage the shaft.
- Pull the spring washer (42), thrust washer (56), input gear assembly (55), two needle bearings (46), thrust plate (44), and synchronizer ring (48) from the input shaft (**Figure 16b-50, Page 16b-23**).

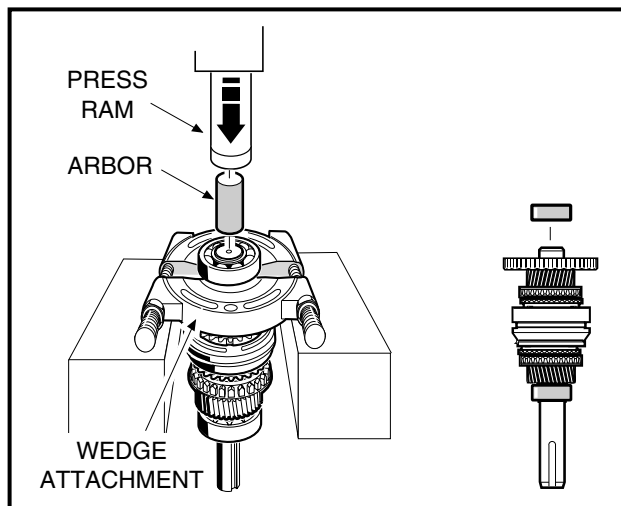


Figure 16b-56 Remove Bearing

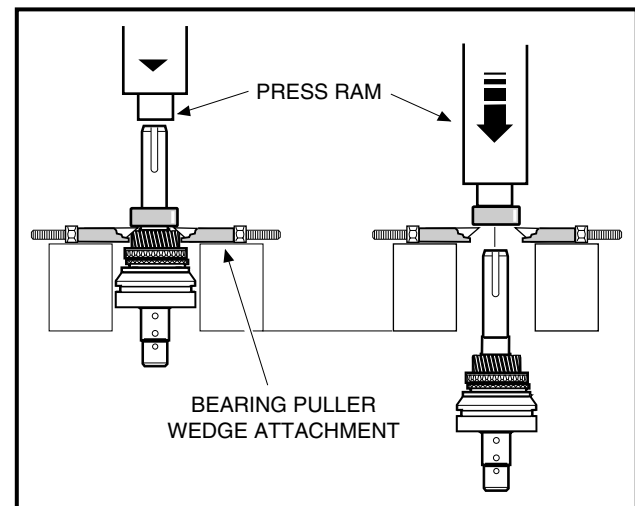


Figure 16b-57 Remove Bearing

- Use a small flat-blade screwdriver to remove two synchronizer springs (snap rings) (49), and then slide the synchronizer clutch hub (52) from the input shaft (54) (**Figure 16b-50, Page 16b-23**). See following **NOTE**.

NOTE: There are three synchronizer inserts (51) set into slots in the synchronizer sleeve (50) (**Figure 16b-50, Page 16b-23**). These may fall free when the synchronizer clutch hub (52) is removed. Do not lose these inserts.

- Remove the three synchronizer inserts (51) from the synchronizer sleeve (**Figure 16b-50, Page 16b-23**).
- Press the synchronizer sleeve (50) from the input shaft.

INTERMEDIATE GEAR DISASSEMBLY

- Place bearing puller wedge attachment (CCI P/N 1012812) between bearing (41) and shaft/gear (59) (**Figure 16b-50, Page 16b-23**), then press bearing off shaft (**Figure 16b-58, Page 16b-27**). See following **CAUTION**.

CAUTION

- Do not tighten the bearing puller wedge attachment against the shaft. This could damage the shaft.

- Place the bearing puller wedge attachment under the bearing (62) and press the bearing from the shaft (**Figure 16b-50, Page 16b-23**). See following **CAUTION**.
- Press the gear (61) from the shaft (59), then remove the key (60) (**Figure 16b-50, Page 16b-23**).

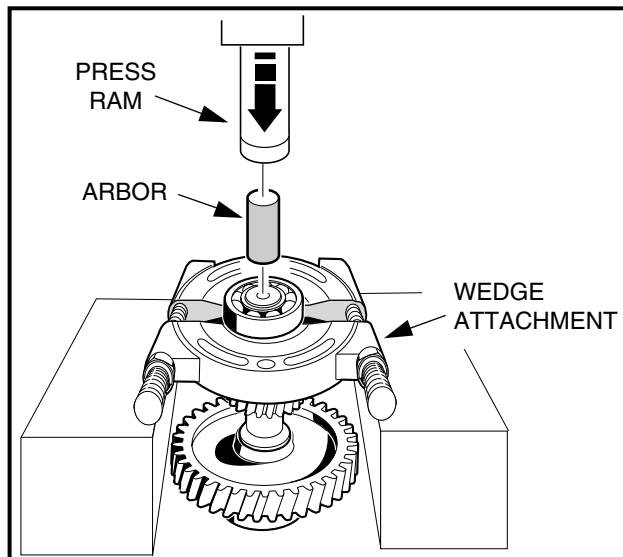


Figure 16b-58 Remove Bearing

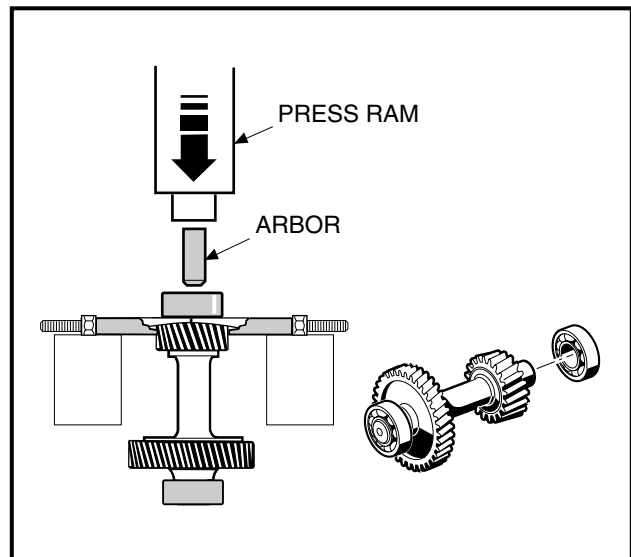


Figure 16b-59 Remove Bearing

IDLER SHAFT DISASSEMBLY

- Place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing (69) (**Figure 16b-50, Page 16b-23**) and the small gear on the idler shaft (68) (**Figure 16b-50, Page 16b-23**), then press the bearing off the shaft as shown (**Figure 16b-59, Page 16b-27**). See following **CAUTION**.

CAUTION

- Do not tighten the bearing puller wedge attachment against the shaft. The shaft could be damaged when pressing the bearing off.
- Place a bearing puller wedge attachment (CCI P/N 1012812) between the bearing and the larger gear on the idler shaft, then press the bearing off the shaft (68) (**Figure 16b-50, Page 16b-23**) as shown (**Figure 16b-60, Page 16b-27**).

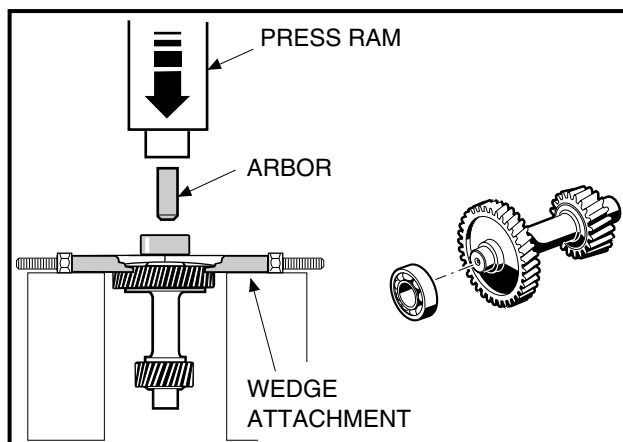


Figure 16b-60 Remove Idler Shaft

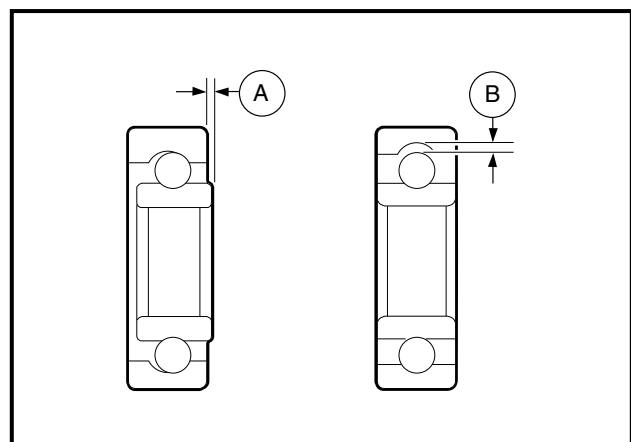


Figure 16b-61 Inspect Bearings

UNITIZED TRANSAXLE COMPONENT INSPECTION

Read **DANGER** and **WARNING** on page 16b-1.

1. Clean all of the component parts of the transaxle in a high flash-point solvent and then dry them. Inspect all components for excessive wear or damage.
2. Inspect all bearings by spinning them by hand. Check the bearings for excessive axial (A) and radial (B) play (**Figure 16b-61, Page 16b-27**). Replace bearings if they do not spin smoothly, if they are noisy, or if they have excessive play. Replace bearings if they are rusted, worn, cracked, pitted or discolored.
3. Gears should be inspected for tooth surface damage or fractures.
4. Synchronizer ring teeth should be inspected for severe wear, fractures, or other damage.
5. Using a feeler gauge, measure the distance X at several points around the assembly. The synchro ring should be replaced when X is 0.02-inch (0.5 mm) or less (**Figure 16b-62, Page 16b-28**).
6. Inspect the O-ring (96) on the differential lock shaft (**Figure 16b-49, Page 16b-22**).

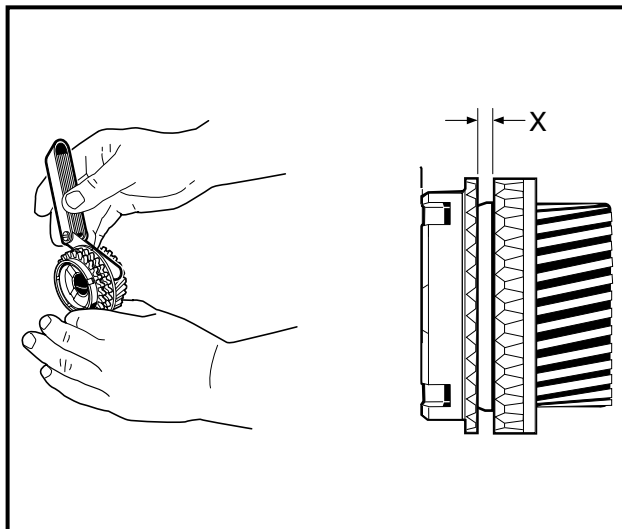


Figure 16b-62 Synchro. Ring

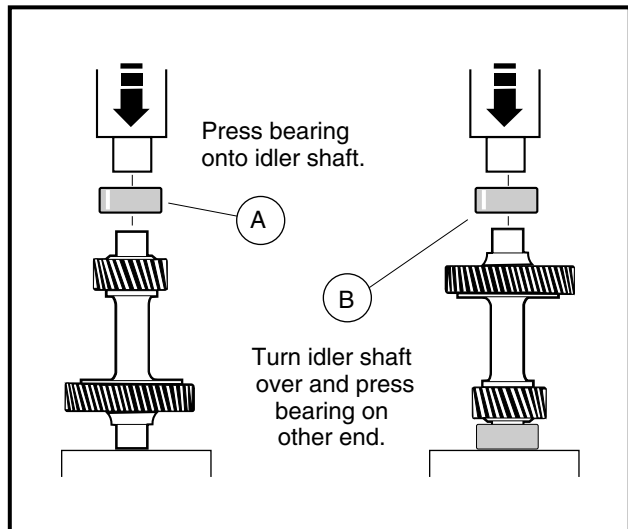


Figure 16b-63 Idler Shaft

COMPONENT ASSEMBLY

Read **DANGER** and **WARNING** on page 16b-1.

IDLER SHAFT ASSEMBLY

1. Press a new bearing (69) (**Figure 16b-50, Page 16b-23**) onto each end of the idler shaft (**Figure 16b-63, Page 16b-28**). See following **CAUTION**.

CAUTION

- Apply pressure against the inner race of the bearing only. Applying pressure anywhere else will damage the bearing.

INTERMEDIATE GEAR ASSEMBLY

1. If the gear (61) was removed from the shaft, install the key (60) into the slot and then position the gear on the shaft with keyway properly aligned with key. Press gear into place on the key (**Figure 16b-50, Page 16b-23**).
2. Press the bearing (62) onto the end of the shaft next to the large gear that was installed in step 1 (**Figure 16b-50, Page 16b-23**). **See preceding CAUTION.**
3. Press a new bearing (41) onto the other end of the shaft (**Figure 16b-50, Page 16b-23**).

SYNCHRONIZER GEAR ASSEMBLY

1. Press the synchronizer sleeve (50) onto the splines of the input shaft (54) (**Figure 16b-50, Page 16b-23**). No particular orientation of the sleeve is necessary, but toward the short end of the shaft, the machined circular face surrounding the ends of the internal splines in the sleeve must be flush with the machined lip of the shaft at the ends of the shaft splines (**Figure 16b-64, Page 16b-29**).
2. Install the synchronizer springs (49) (**Figure 16b-50, Page 16b-23**) in the sleeve as shown (**Figure 16b-65, Page 16b-29**).

NOTE: Make sure the ends of the springs are positioned between the synchronizer insert slots (**Figure 16b-65, Page 16b-29**).

3. Install the three synchronizer inserts (51) into the slots in the sleeve (**Figure 16b-50, Page 16b-23**). Make sure the notched surfaces of the inserts are facing outward as shown (**Figure 16b-66, Page 16b-30**).

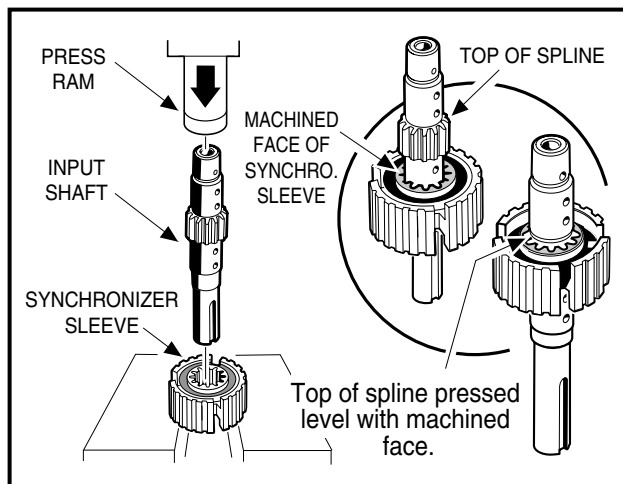


Figure 16b-64 Synchro. Gear Assembly

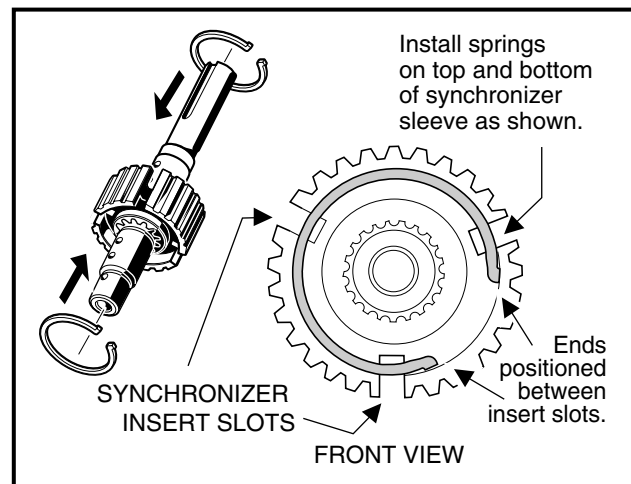


Figure 16b-65 Synchro. Springs

4. Install the synchronizer clutch hub (52) (**Figure 16b-50, Page 16b-23**) onto the synchronizer sleeve. Make sure the chamfered end of the hub is oriented toward the long end of the input shaft as shown (**Figure 16b-67, Page 16b-30**).
5. On the long end of the shaft, install the synchronizer ring (48) (**Figure 16b-50, Page 16b-23**) with the smooth collar of the ring towards the clutch hub. Make sure the three notches in the collar mate with the synchronizer inserts in the synchronizer sleeve as shown (**Figure 16b-68, Page 16b-30**).
6. Install the thrust washer (44) and two bearings (46) as shown (**Figure 16b-50, Page 16b-23**).

Synchronizer Gear Assembly, Continued:

7. Install the input gear assembly (55), with the smooth collar toward the synchronizer ring as shown (Figure 16b-50, Page 16b-23). The input gear should seat in the synchronizer ring.
8. Install the thrust washer (56) and then the spring washer (42). The spring washer should be oriented with the raised center toward the end of the shaft (Figure 16b-50, Page 16b-23).
9. Press new bearing (57) (Figure 16b-50, Page 16b-23) onto the shaft until it seats. Make sure the input gear turns freely. **See following CAUTION.**

⚠ CAUTION

- Apply pressure against the inner race of the bearing only. Applying pressure anywhere else will damage the bearing.

10. On the other end of the input shaft, install the thrust washer (44) and the synchronizer ring (48). The smooth collar of the synchronizer ring should be oriented toward the clutch hub, and the notches in it should mate with the synchronizer inserts as shown (Figure 16b-50, Page 16b-23).

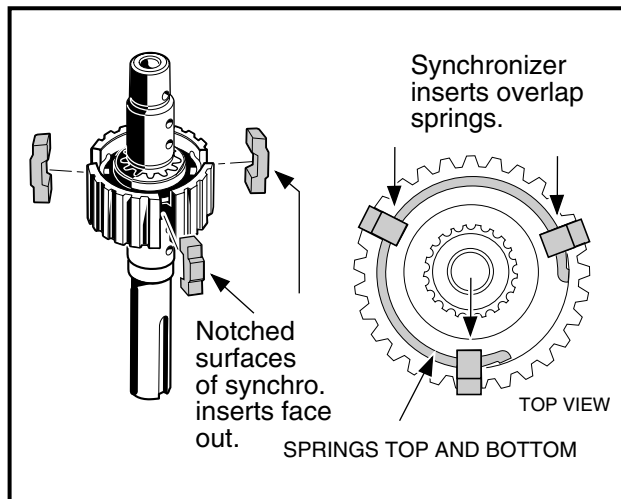


Figure 16b-66 Synchronizer Inserts

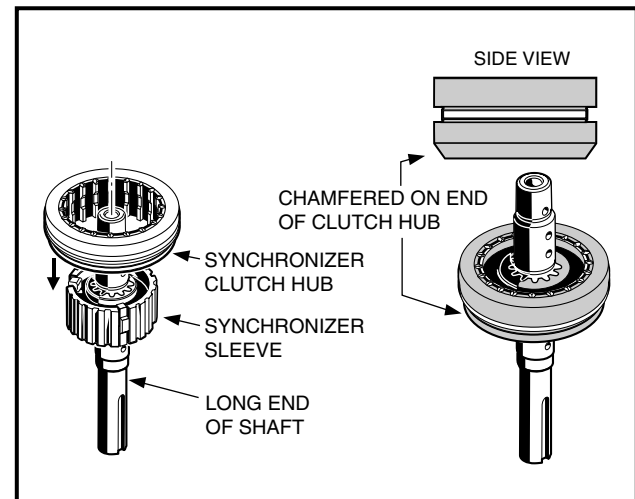


Figure 16b-67 Synchronizer Clutch Hub

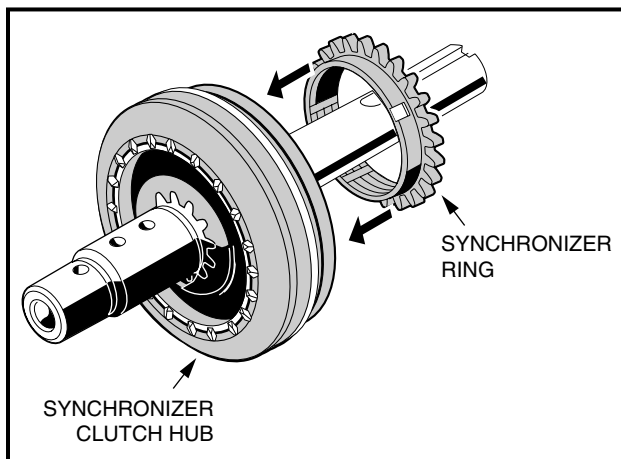


Figure 16b-68 Synchronizer Ring

11. Install the narrow bearing (47), wide bearing (46), and input gear (45) onto the shaft. The smooth collar of the input gear should be oriented toward the synchronizer ring as shown (**Figure 16b-50, Page 16b-23**). The gear should seat inside the ring.
12. Install thrust plate (44) onto the shaft, and the dowel pin (53) into the shaft as shown.
13. Install the spur (governor drive) gear (43) onto the shaft with either side down. Mate the notch in the gear with the dowel pin as shown.
14. Install the spring washer (42) onto shaft with the raised center toward the end of the shaft.
15. Press a new bearing (41) onto the end of the shaft until it seats (**Figure 16b-50, Page 16b-23**). Make sure the input gears turn freely. **See following CAUTION.**

▲ CAUTION

- Apply pressure against the inner race of the bearing only. Applying pressure anywhere else will damage the bearing.

SHIFTER FORK ASSEMBLY

1. Install the spring (38) and ball (39) into the shifter fork (37) as shown (**Figure 16b-50, Page 16b-23**).
2. Use a no. 1 tip phillips screwdriver to depress the ball and spring while inserting shift rod (36) into the shifter fork (37). Remove screwdriver when the shift rod is inserted far enough for it to depress the ball and spring, then continue to insert rod until the ball is positioned in the middle detent on the rod (**Figure 16b-50, Page 16b-23**).

DIFFERENTIAL GEAR CASE ASSEMBLY

1. If the bearings (70 or 71) were removed, press new ones onto the differential gear carrier case (75) and carrier case cover (78) (**Figure 16b-50, Page 16b-23**). **See following CAUTION.**

▲ CAUTION

- Apply pressure against the inner race of the bearing only. Applying pressure anywhere else will damage the bearing.
2. Install differential gear (82) into carrier case (75) (**Figure 16b-50, Page 16b-23**) as shown (**Figure 16b-69, Page 16b-32**).
 3. Start the differential pin (79) into the carrier case by lightly tapping it in with a plastic or rubber hammer. Before the pin enters the inside of the carrier case, position the thrust plate (76) and idler gear (80) in the case and continue tapping the pin through the thrust plate and idler gear as shown (**Figure 16b-70, Page 16b-32**).
 4. Position the other thrust plate (76) and idler gear (80) in the carrier case. Continue to drive the pin (79) through them and the wall of the carrier case until the ends of the pin are flush with the sides of the carrier case (**Figure 16b-71, Page 16b-32**).
 5. Install the thrust plate (77) and differential gear (81) into the carrier case cover (78) (**Figure 16b-50, Page 16b-23**) as shown (**Figure 16b-72, Page 16b-32**). While holding the thrust plate and differential gear in place, position the carrier case cover on the carrier case.
 6. Position the output ring gear (73) (**Figure 16b-50, Page 16b-23**) on the carrier case, visually aligning the dowel hole in the carrier case with the dowel pin in the ring gear. Using a plastic or rubber mallet, tap the ring gear into place on the dowel pin as shown (**Figure 16b-73, Page 16b-33**).
 7. Apply Loctite 277 on the threads of the eight mounting bolts and install them through the ring gear, carrier case, and into the carrier case cover. Tighten the bolts to 18 ft-lb (24.4 N·m) in the sequence shown (**Figure 16b-74, Page 16b-33**).

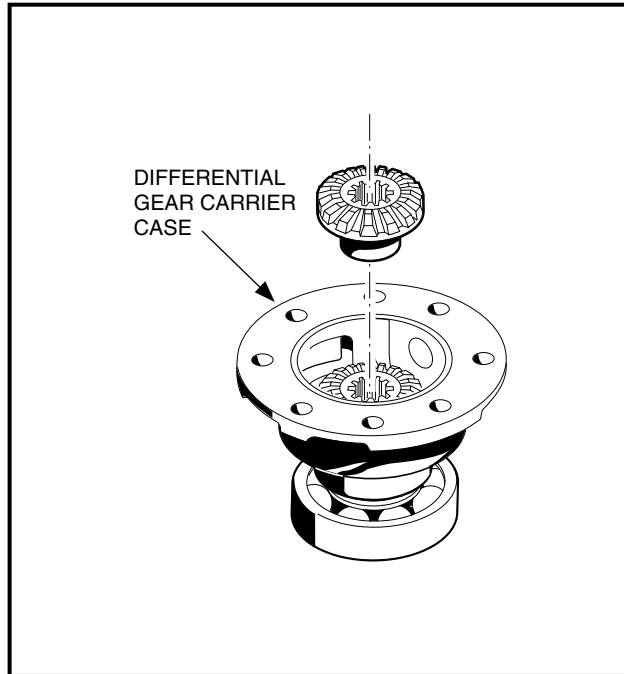


Figure 16b-69 Differential Gear

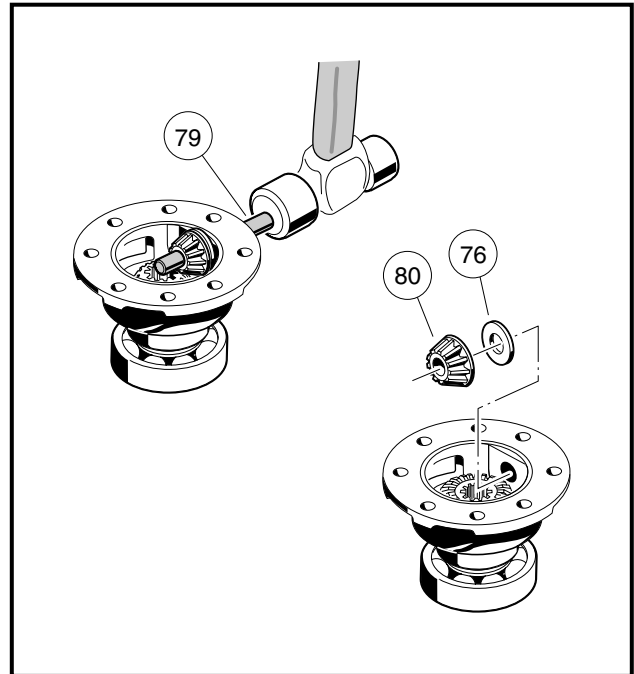


Figure 16b-70 Idler Gear

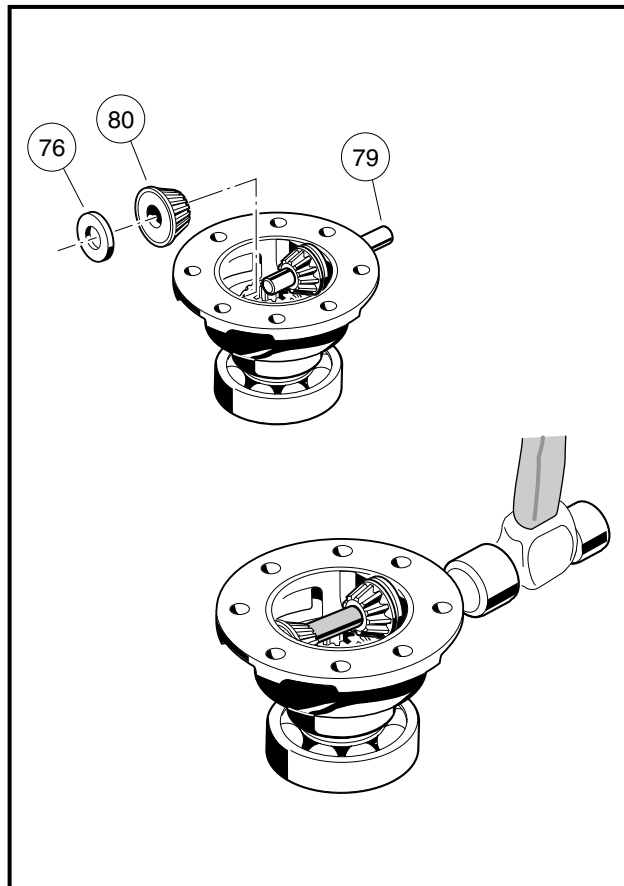


Figure 16b-71 Second Idler Gear

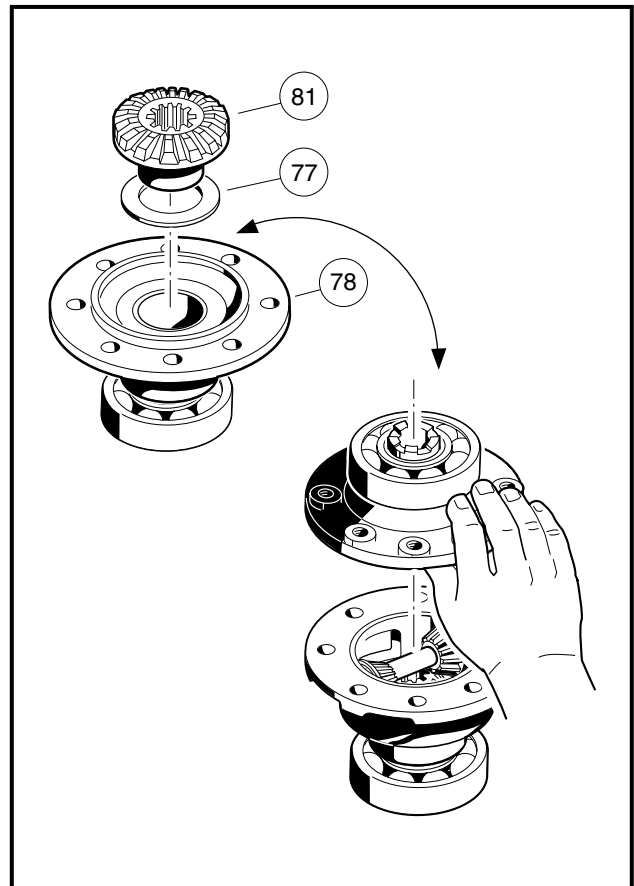


Figure 16b-72 Carrier Case

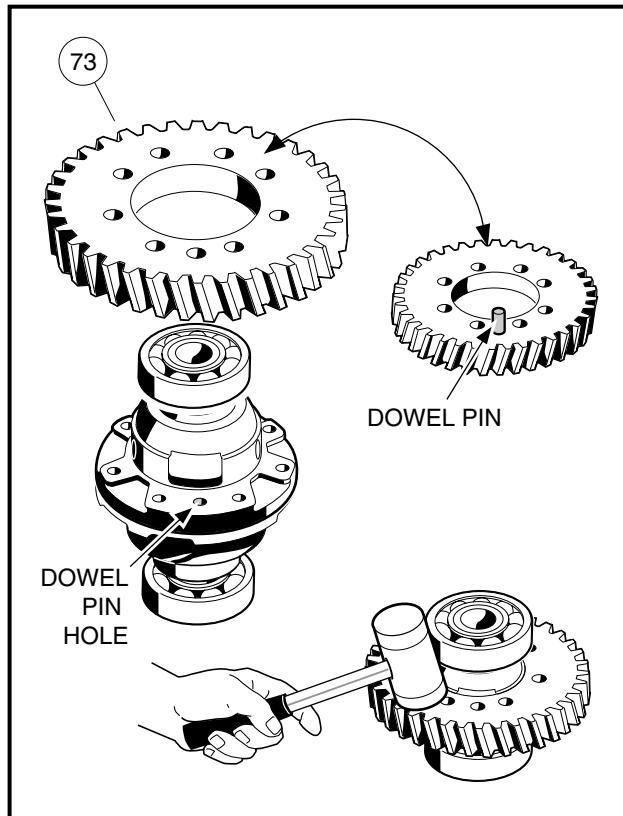


Figure 16b-73 Ring Gear

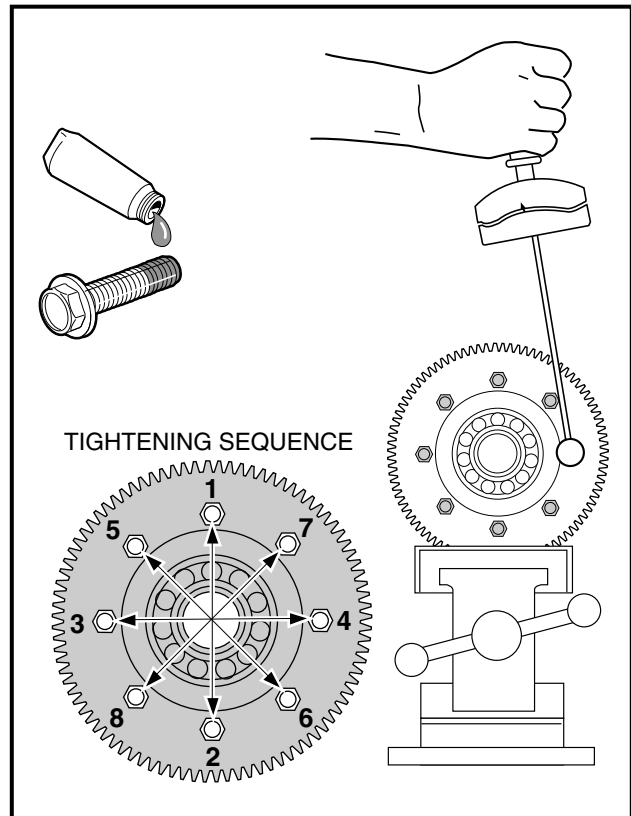


Figure 16b-74 Retaining Bolts

GOVERNOR GEAR ASSEMBLY

The governor gear is not assembled before installing it in the unitized transaxle case. The governor gear shaft is installed into the case and then the rest of the governor gear assembly is installed on the shaft. Proceed with unitized transaxle assembly.

DIFFERENTIAL GEAR LOCK HOUSING ASSEMBLY

1. If previously removed, slide the O-Ring into the top groove of the differential lock shaft (**Figure 16b-75, Page 16b-34**).
2. Place the shaft (95) into the hole in the differential lock housing (94) (**Figure 16b-76, Page 16b-34**).
3. Install the retaining screw (102) and washer (103) into the differential lock housing. Ensure that the screw is aligned with the second groove in the differential lock shaft before continuing to tighten the screw (**Figure 16b-76, Page 16b-34**). Tighten the screw to 69 in-lb (7.8 N·m).
4. Place the spacer (97) onto the differential lock shaft.
5. Install the spring over the spacer so that the straight end of the spring will rest on the axle tube side of the differential lock housing.
6. Place the differential lock arm (99) on the shaft (95) and place the hooked end of the spring (98) on the arm.
7. Tighten the differential lock arm retainer nut (101) to 60 in-lb (6.8 N·m) (**Figure 16b-76, Page 16b-34**).

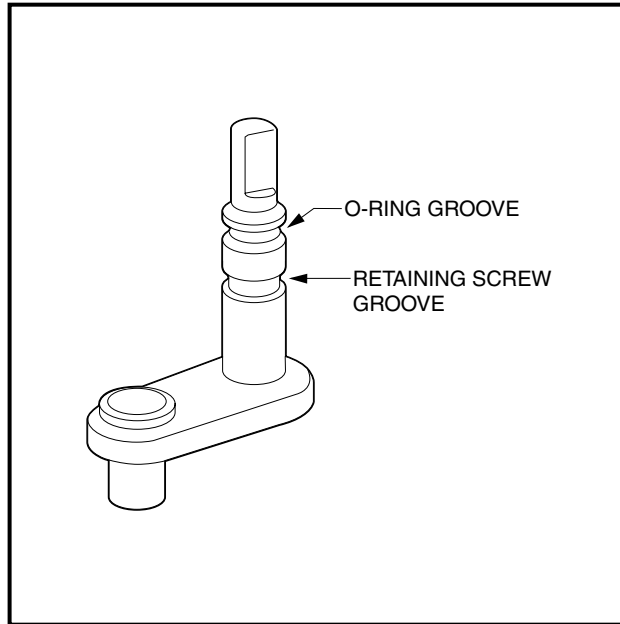


Figure 16b-75 Differential Lock Shaft

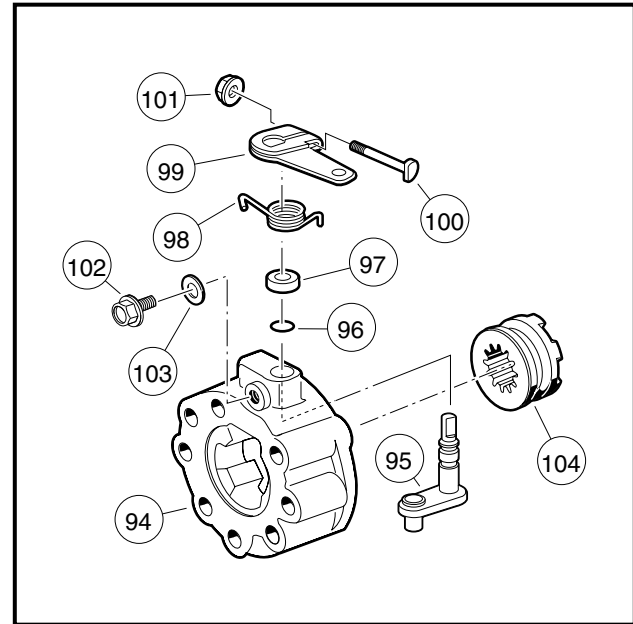


Figure 16b-76 Differential Lock Housing Assembly

UNITIZED TRANSAXLE ASSEMBLY

Read **DANGER** and **WARNING** on page 16b-1.

NOTE: Although the following drawings show the transaxle being assembled in an upright position, laying the transaxle on its left (driver) side will simplify the assembly process.

1. Make sure both parts of the case are clean and free of any contaminants. Make sure the machined mating surfaces are free of residue and are not scratched or damaged in any way.
2. Put a light coating of clean transmission oil on the outside edge of the seal to make installation easier. Press two new oil seals (18 and 23) (**Figure 16b-42, Page 16b-19**) into the left (driver) side case. Use an oil seal installation tool (CCI P/N 1014160) to install a new oil seal (58) (**Figure 16b-50, Page 16b-23**) into the right (passenger side) case. **See also Figure 16b-77, Page 16b-35.**
3. Position the governor gear shaft installation tool (CCI P/N 101933101) over the shaft bore in the inside of the left (driver) side case and insert the governor gear shaft into the tool, long end (from the groove) first, as shown (**Figure 16b-78, Page 16b-35**). Make sure the shaft is started into the bore and then, using a plastic or rubber hammer, carefully tap the governor gear shaft into the bore until the end being tapped is flush with the end of the tool. Remove installation tool.
4. Install the washer, governor gear, and sleeve together onto the governor shaft (**Figure 16b-79, Page 16b-35**). Make sure the sleeve is properly positioned within the flyweight brackets of the gear as shown (**Figure 16b-80, Page 16b-35**), and then push them onto the shaft until the gear snaps into the groove on the shaft.
5. Position the interior washer on the pivot arm, then install the pivot arm and washer into the left (driver side) case as shown (**Figure 16b-81, Page 16b-36**). Install the exterior washer and cotter pin on the pivot arm outside the case as shown (**Figure 16b-81, Page 16b-36**). Bend the legs of the cotter pin.

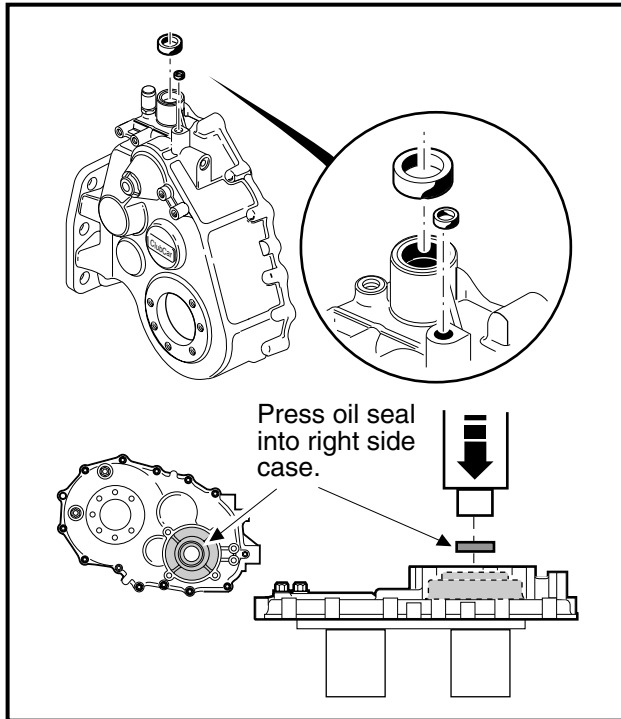


Figure 16b-77 Install Seals

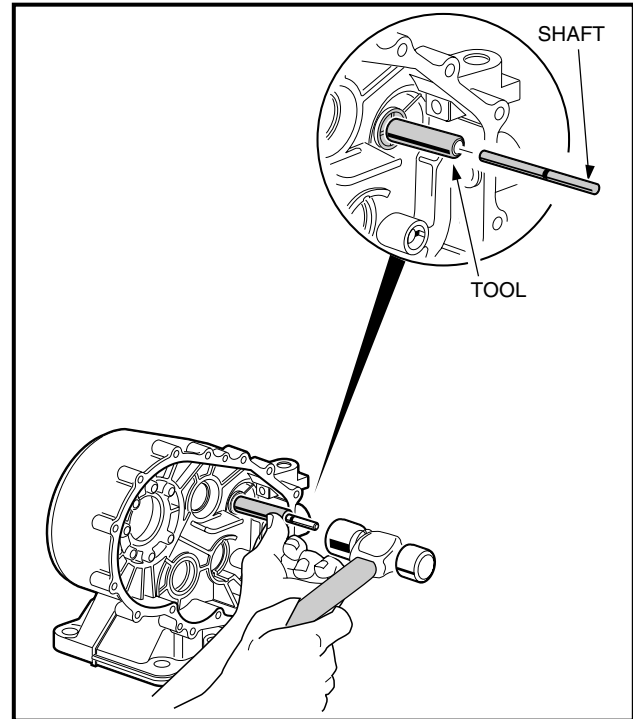


Figure 16b-78 Governor Gear Shaft

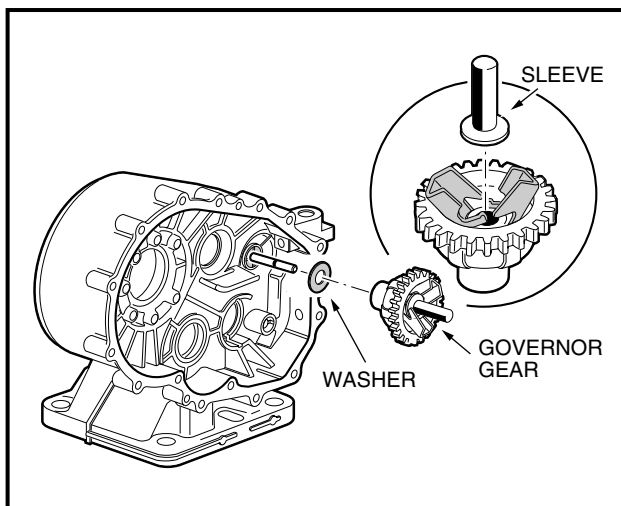


Figure 16b-79 Position Governor Gear

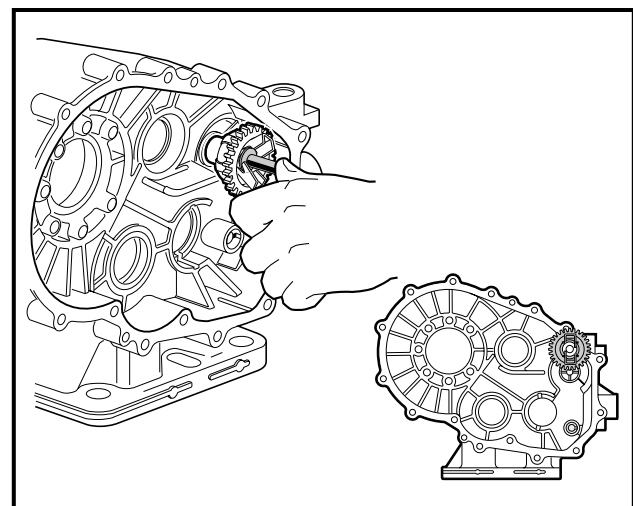


Figure 16b-80 Install Governor Gear

6. Install the shifter shaft into the left (driver side) case as shown (**Figure 16b-82, Page 16b-36**). Then install the washer and using external snap ring pliers (0.070 tip), install retaining ring on the shifter shaft outside of the case. Make sure the retaining ring is in the groove of the shaft.
7. Install the gear assemblies into the left (driver side) case.
 - 7.1. Stand the left side case on the mounting plate, then install the differential gear case assembly as shown (**Figure 16b-83, Page 16b-36**). Do not seat the assembly in the bore, but insert it just far enough that it will not fall out.
 - 7.2. Install the idler gear assembly into case as shown. Do not seat the assembly in the bore, but insert far enough that it will not fall out. No gears mesh at this time (**Figure 16b-84, Page 16b-36**).

Unitized Transaxle Assembly, Continued:

- 7.3. Install the oil guide with the baffle toward the case wall as shown (**Figure 16b-85, Page 16b-37**). Make sure the two tabs on the guide are positioned in the slots in the case.

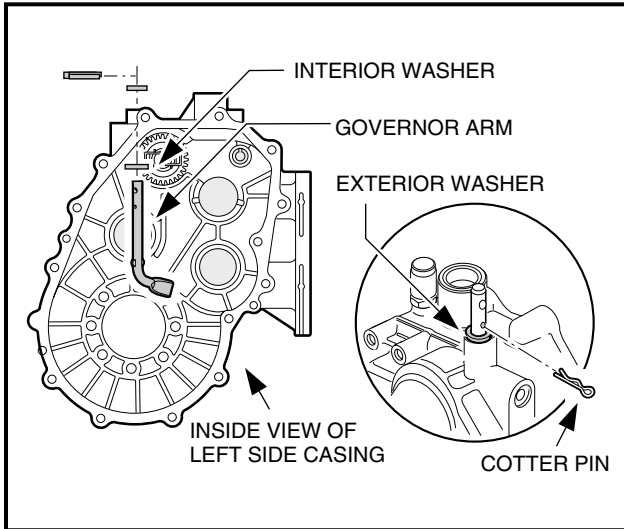


Figure 16b-81 Pivot Arm

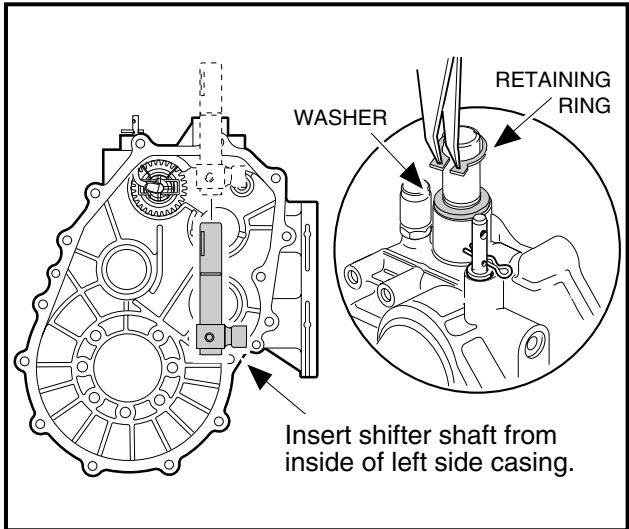


Figure 16b-82 Insert Shifter Shaft

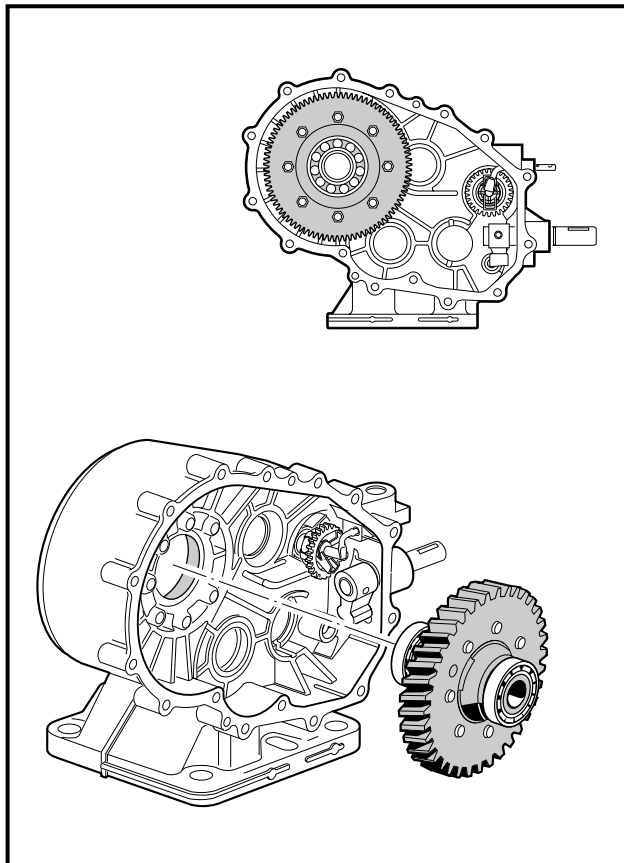


Figure 16b-83 Differential Gear Assembly

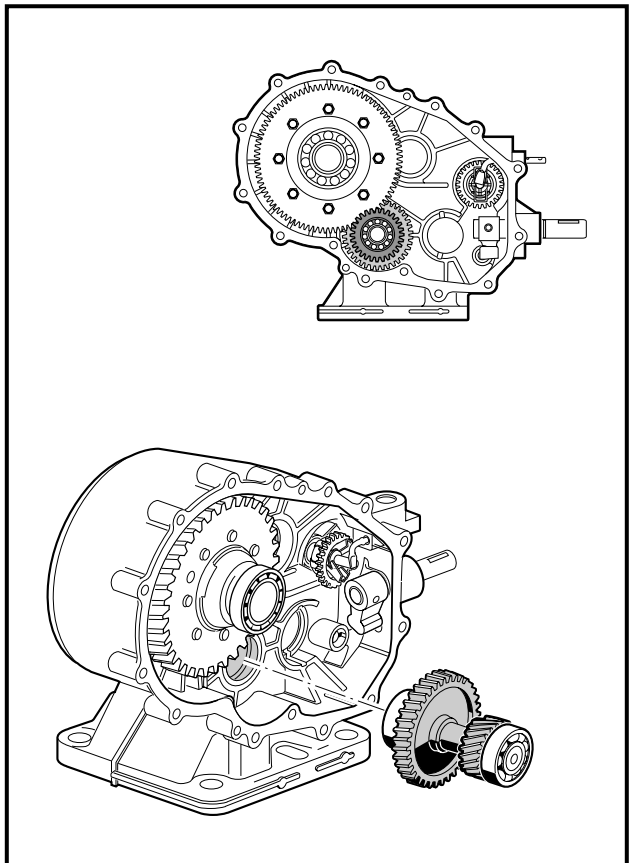


Figure 16b-84 Idler Gear Assembly

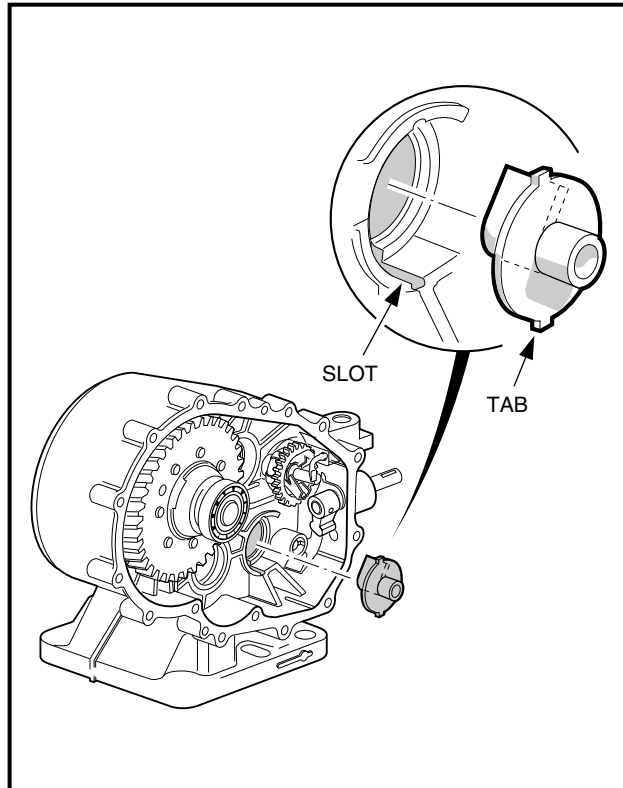


Figure 16b-85 Oil Guide

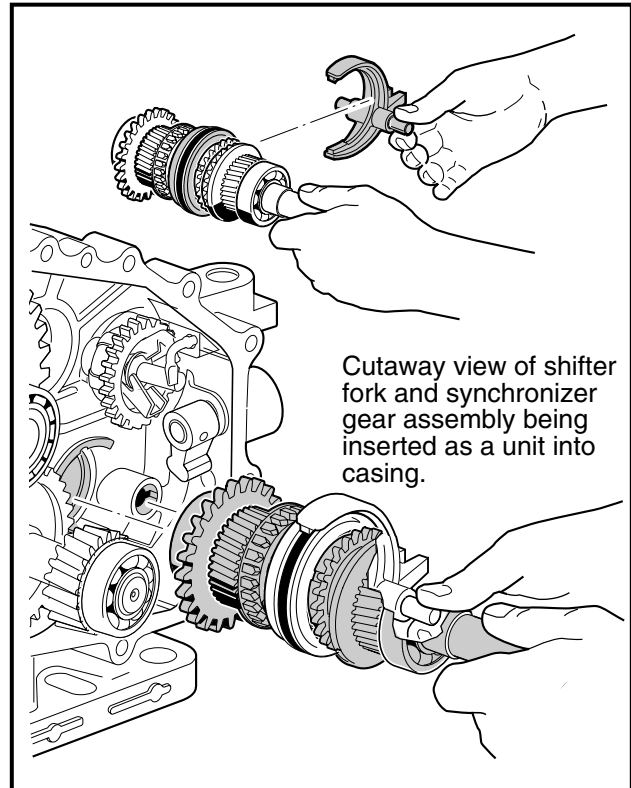


Figure 16b-86 Synchronizer Ring Gear

- 7.4. Position the shifter fork assembly on the synchronizer gear assembly as shown, and install them together, bearing end first, into the bore containing the oil guide (**Figure 16b-86, Page 16b-37**). Do not seat the assembly, but make sure the spur gear (43) is meshed with the governor gear (66) (**Figure 16b-50, Page 16b-23**), and the shifter lever (19) (**Figure 16b-42, Page 16b-19**) is positioned in the bracket on the shifter fork. **See also Figure 16b-87, Page 16b-38.**
- 7.5. Install the intermediate gear assembly into the case as shown (**Figure 16b-88, Page 16b-38**). Do not seat the assembly into the bore, but make sure the output ring gear meshes with the input drive gear (55) on the synchronizer gear assembly, and with the small gear on the idler shaft (68) (**Figure 16b-50, Page 16b-23**).
- 7.6. As a group and while keeping the gears meshed, work all of the gear assemblies into the bores until they are seated. When all of the assemblies are correctly seated, the outside edges of the input drive gear (55) and the intermediate gear (61) (**Figure 16b-50, Page 16b-23**) should be flush (in the same plane) as shown (**Figure 16b-89, Page 16b-39**). Also, the outside surfaces of the idler gear bearing, the intermediate gear bearing, and the differential gear bearing should be flush (**Figure 16b-89, Page 16b-39**). **See following CAUTION.**

▲ CAUTION

- If the edges of the input drive gear and intermediate gear are not flush, then the oil guide (40) (**Figure 16b-50, Page 16b-23**) may not be properly positioned in the bore.

8. Make sure the mating surfaces of the left and right sides of the case are clean and free of oil, grease, or residue of any kind, and they are not scratched or damaged in any way.

Unitized Transaxle Assembly, Continued:

9. Apply a continuous bead of Three Bond No. 1215 (CCI P/N 101928701) sealant to the mating surface, around the complete profile of the right (passenger side) case (**Figure 16b-90, Page 16b-39**). See following **CAUTION**.

⚠ CAUTION

- Use only Three Bond No. 1215 sealant to seal case. Do not use a substitute.
 - If the two sides of the case cannot be easily closed or do not make complete contact, do not force them together. Check that all internal components are properly seated and then try again.
10. Install and finger-tighten the fifteen bolts (28) (**Figure 16b-42, Page 16b-19**) that secure the left and right sides of the case together. Then, in sequence shown, tighten the bolts to 17 ft-lb (23.1 N·m) (**Figure 16b-91, Page 16b-40**).
11. Install the differential lock housing to the transaxle.
- 11.1. Make sure the mating surfaces of the differential lock housing and the transaxle case are clean and free of oil, grease or residue of any kind.
- 11.2. Ensure that the alignment pin is installed to the transaxle case (**Figure 16b-92, Page 16b-40**).

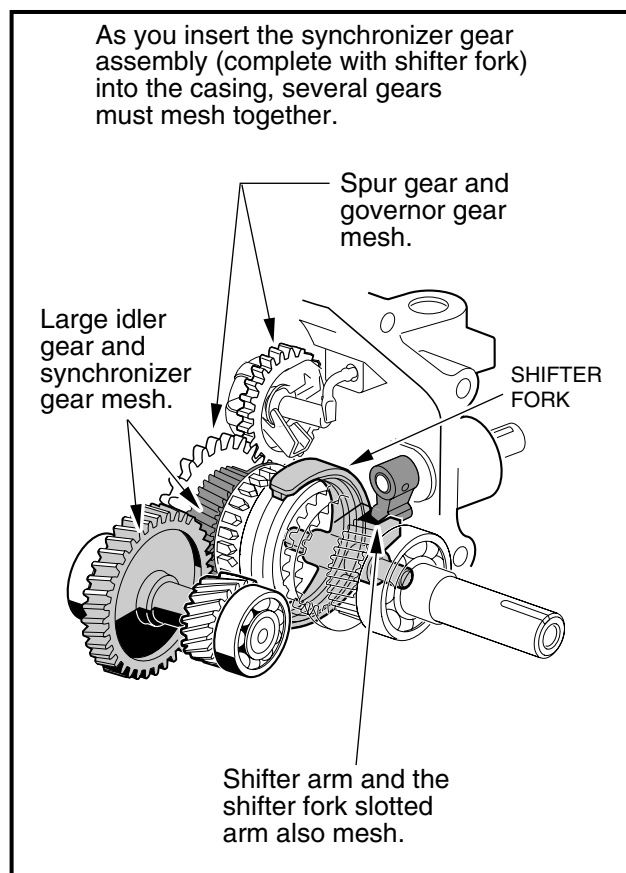


Figure 16b-87 Gear Alignment

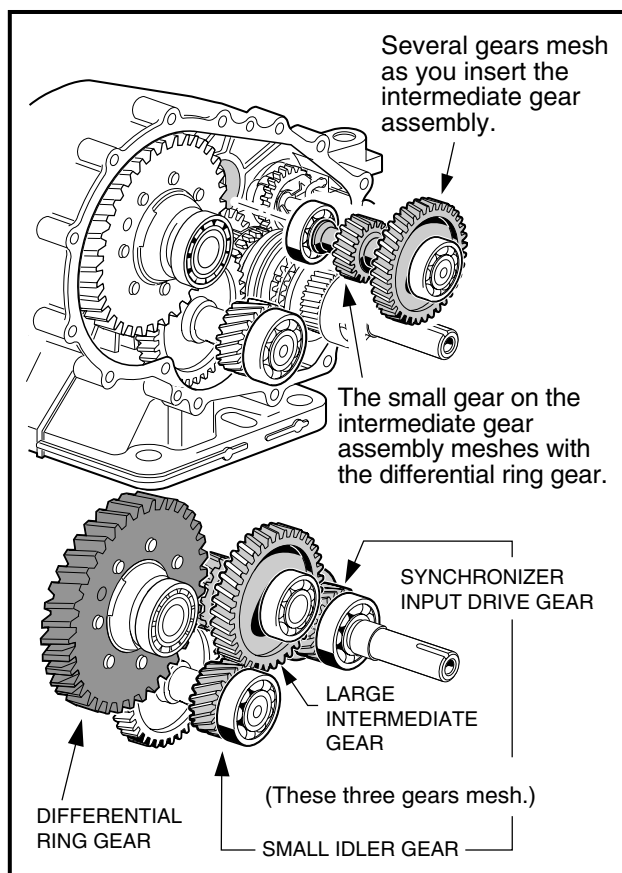


Figure 16b-88 Gear Alignment

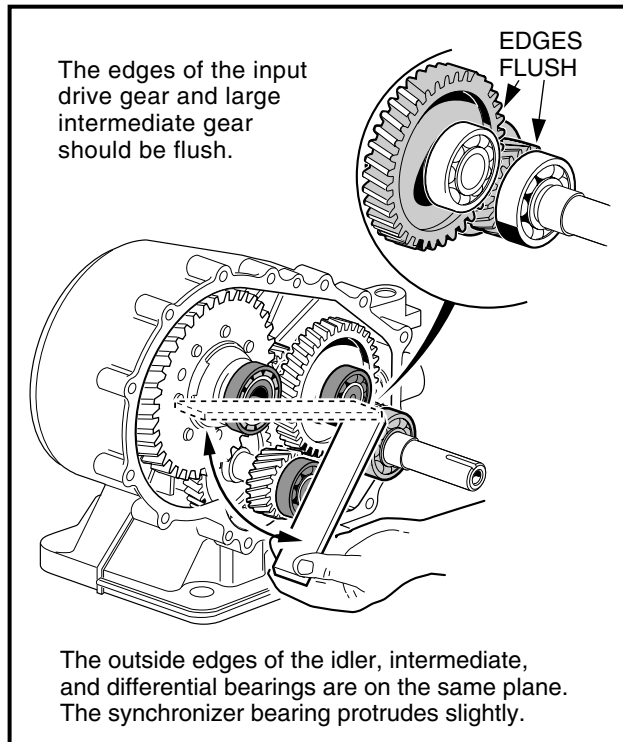


Figure 16b-89 Gear Alignment

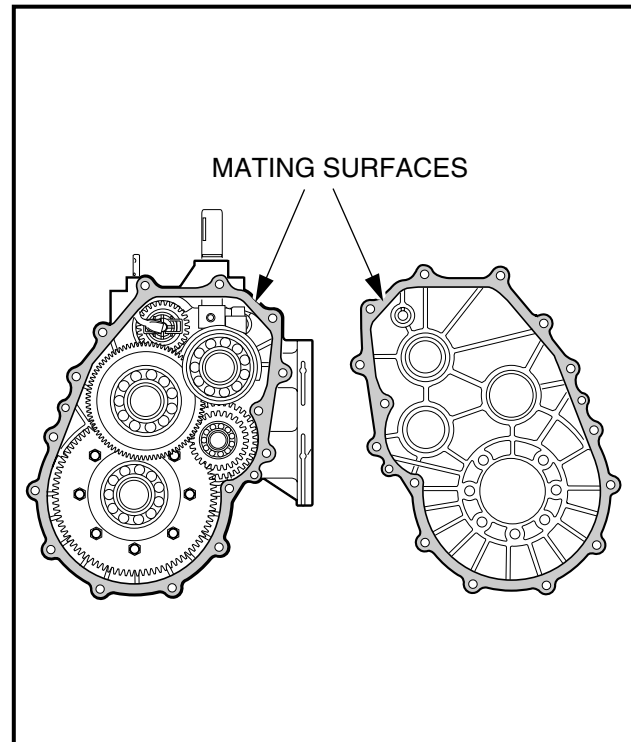


Figure 16b-90 Prepare Mating Surfaces

- 11.3. Apply a continuous bead of Three Bond No. 1215 (CCI P/N 101928701) around the opening on the mating surface of the differential lock housing (transaxle side) **(Figure 16b-92, Page 16b-40)**.
- 11.4. Rotate the differential lock shaft (95) and insert the cog (104) into the differential lock housing (94) **(Figure 16b-76, Page 16b-34)**.
- 11.5. Using the alignment pin as a guide, position the differential lock housing onto the driver side of the transaxle case **(Figure 16b-92, Page 16b-40)**.
12. Install axle tubes (90 and 91) and brake cluster assemblies (if previously removed) on the transaxle case **(Figure 16b-9, Page 16b-7)**.
 - 12.1. Make sure the mating surfaces of the axle tubes, transaxle case, and differential lock housing are clean and free of oil, grease, or residue of any kind.
 - 12.2. Apply a continuous bead of Three Bond No. 1215 (CCI P/N 101928701) around the opening on the left (driver) side axle tube as shown **(Figure 16b-92, Page 16b-40)**. Then position the axle tube on the left (driver) side of the transaxle case to the differential lock housing as shown and install eight mounting bolts (92) **(Figure 16b-9, Page 16b-7)** finger-tight. In the sequence shown, tighten the bolts to 36 ft-lb (48.8 N·m) **(Figure 16b-93, Page 16b-41)**.
 - 12.3. Install seven mounting bolts (96) on the right (passenger) side axle tube directly to the transaxle case **(Figure 16b-9, Page 16b-7)**.
 - 12.4. If previously removed, install left and right brake cluster assemblies to the axle tubes. **See Brake Cluster Installation in Section 6.**
 - 12.5. Install the right (passenger side) axle shaft (83) in the right axle tube (91) **(Figure 16b-9, Page 16b-7)**. Using 90° angle (0.90 tip) snap ring pliers, install the retaining ring as shown **(Figure 16b-94, Page 16b-41)**.
 - 12.6. Place a 1/4 to 3/8 inch (6-10 mm) diameter rod against the retaining ring and tap lightly at four to five locations to ensure it is properly seated. **See following WARNING.**

Unitized Transaxle Assembly, Continued:

⚠ WARNING

- Be sure retaining ring is properly seated in its groove. If ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.

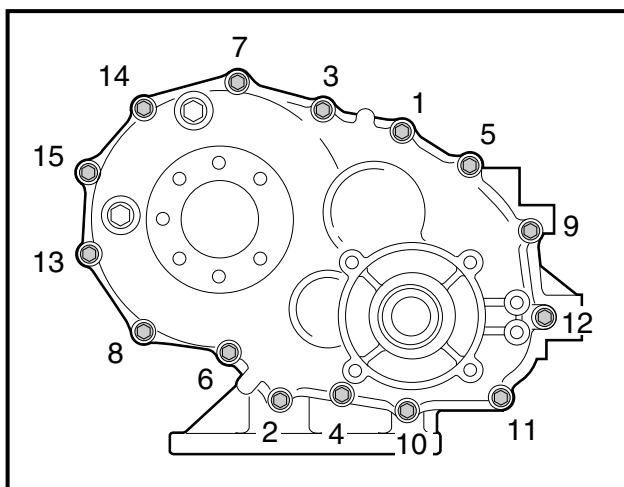


Figure 16b-91 Casing Torque Sequence

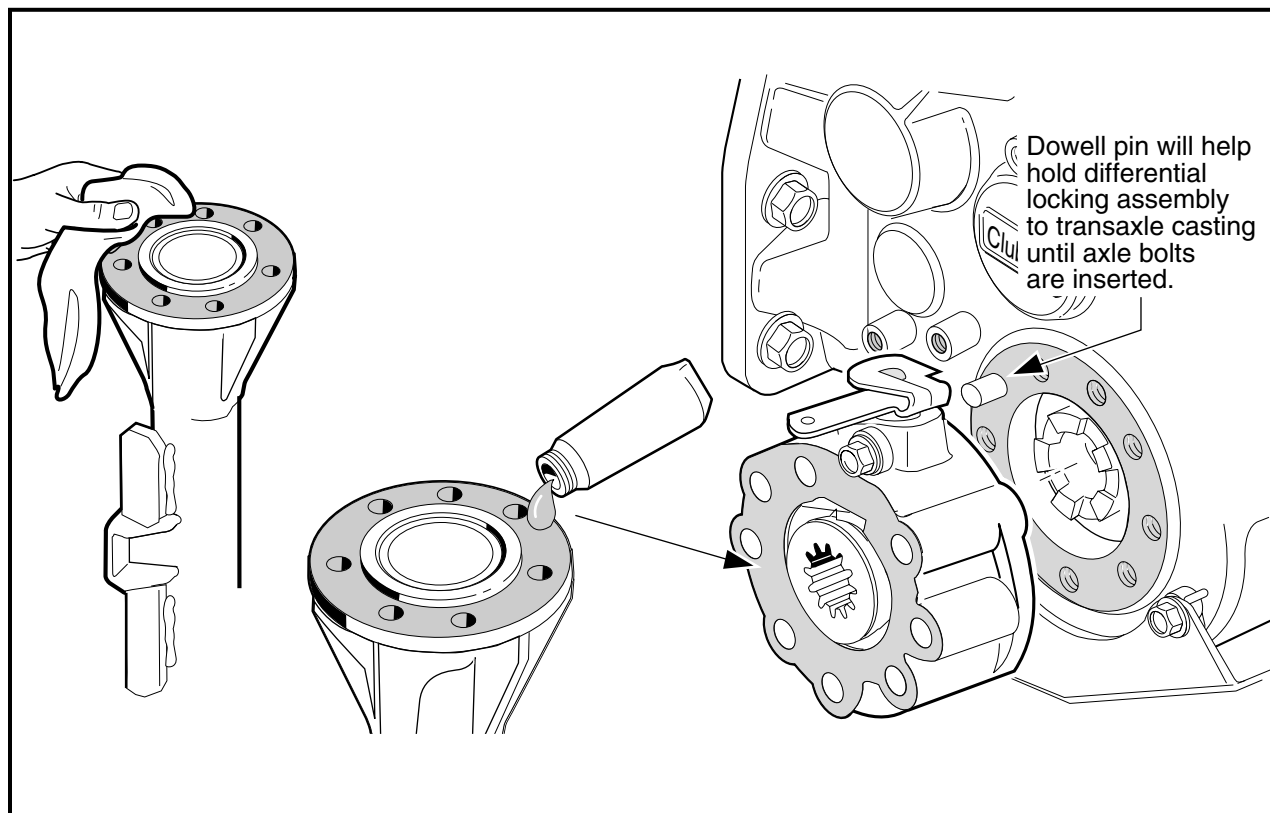


Figure 16b-92 Seal Axle Tube Surface

12.7. Install the left (driver side) axle shaft (82) in the left axle tube (90) (**Figure 16b-9, Page 16b-7**). Using 90° angle (0.090 tip) snap ring pliers, install the retaining ring as shown (**Figure 16b-94, Page 16b-41**).

12.8. Place a 1/4 to 3/8-inch (6-10 mm) diameter rod against the retaining ring and tap lightly at four to five locations to ensure it is properly seated. **See preceding WARNING.**

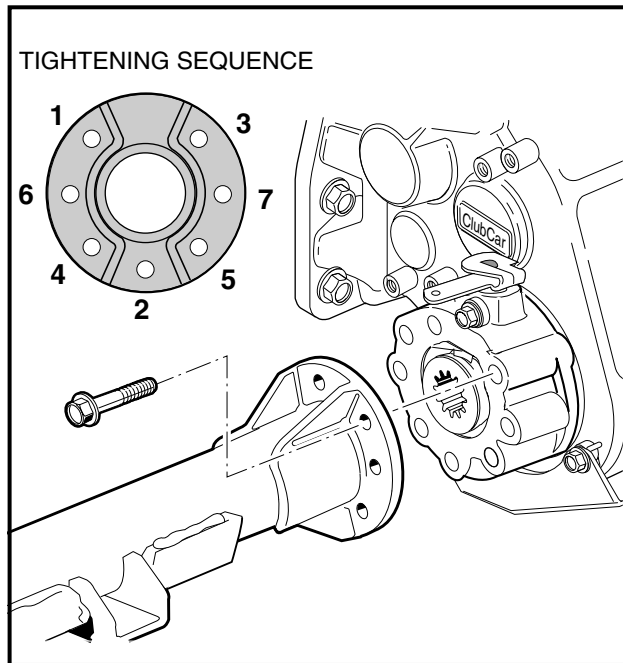


Figure 16b-93 Install Axle Tubes

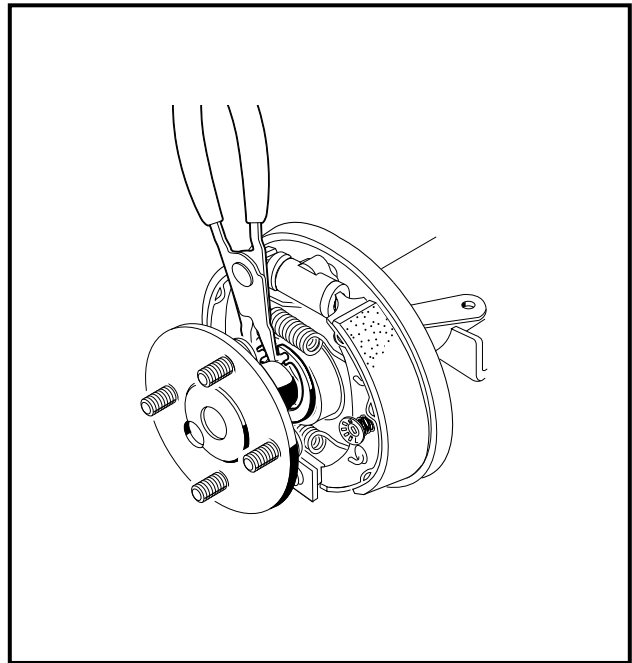
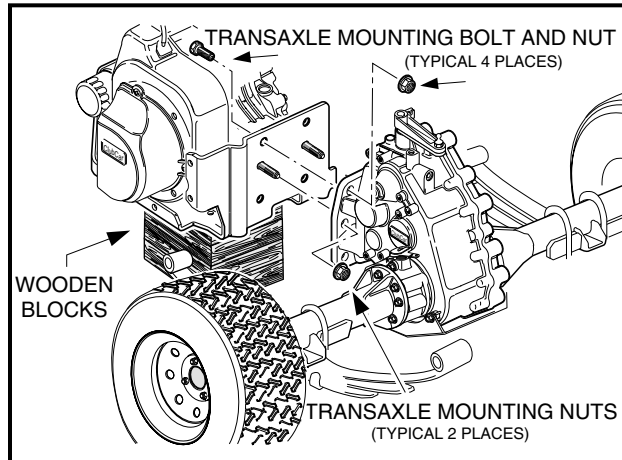


Figure 16b-94 Retaining Ring

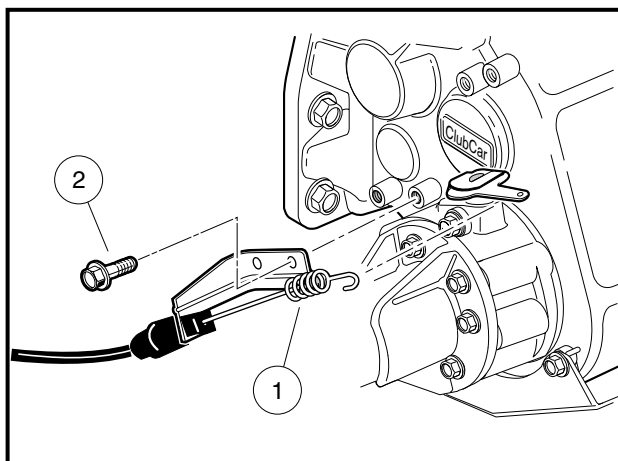
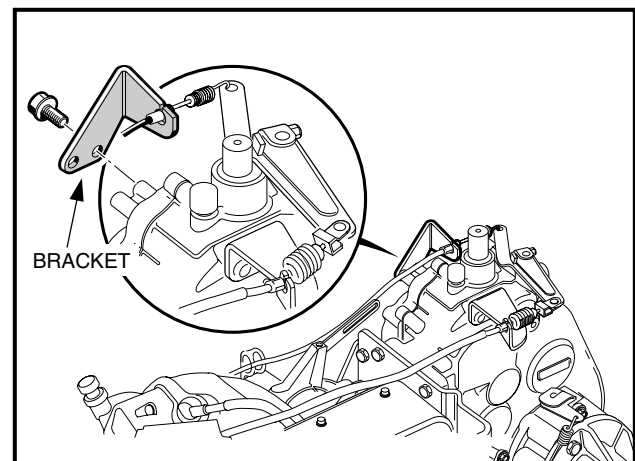
UNITIZED TRANSAXLE INSTALLATION

Read **DANGER** and **WARNING** on page 16b-1.

1. Install the wheels. **See Wheel Installation, Section 8, Page 8-3.**
2. Install the leaf springs. **See Multi-Leaf Spring Installation, Section 9, Page 9-6.**
3. Position the transaxle mounting plate on the two mounting studs at the rear of the engine, and then install the two mounting nuts (**Figure 16b-95, Page 16b-42**).
4. Install the remaining four mounting bolts and four nuts (one bolt and nut at each corner of the mounting plate).
5. Tighten the four corner nuts (with bolts) to 30 ft-lb (40.7 N·m). Tighten the two center nuts (on the studs) to 17 ft-lb (23.1 N·m).
6. Install the differential lock cable and bracket.
 - 6.1. Connect the differential lock cable spring (1) to the differential lock arm on the differential lock housing (**Figure 16b-96, Page 16b-42**).
 - 6.2. Install the two bolts (2) to secure the cable bracket to the transaxle case. Tighten the two screws to 134 in-lb (15.1 N·m).
7. Install the accelerator cable bracket on transaxle case. Tighten the mounting screws to 134 in-lb (15.1 N·m) (**Figure 16b-97, Page 16b-42**).

Unitized Transaxle Installation, Continued:**Figure 16b-95 Transaxle Mounting**

8. Install the governor cable bracket on transaxle case. Tighten the mounting screws to 134 in-lb (15.1 N·m) (**Figure 16b-98, Page 16b-43**).
9. Install governor lever arm on governor shaft (**Figure 16b-99, Page 16b-43**). With the governor lever arm loose on the governor shaft, turn the governor arm shaft counterclockwise until it stops. Then pull the governor lever arm rearward until the carburetor throttle is in the “wide open throttle” (WOT) position (**Figure 16b-99, Page 16b-43**).
10. While holding the arm and shaft in the fully counterclockwise position, tighten the governor arm lever nut to 35 in-lb (4.0 N·m) (**Figure 16b-99, Page 16b-43**).
11. Install the key onto the input shaft (**Figure 16b-100, Page 16b-44**).
12. Position the driven clutch on the transaxle input shaft and install the washer (yellow side facing out) and mounting bolt. Tighten the mounting bolt to 14 ft-lb (19.0 N·m) (**Figure 16b-100, Page 16b-44**).
13. Install the drive belt. **See Drive Belt Installation, Section 17, Page 17-5.**
14. Remove the blocks from under the engine and roll the powertrain into position under the vehicle. Then lift the front of the powertrain and place the snubber into the snubber bracket in the vehicle frame (**Figure 16b-101, Page 16b-44**).

**Figure 16b-96 Differential Lock Bracket Installation****Figure 16b-97 Accelerator Cable Bracket**

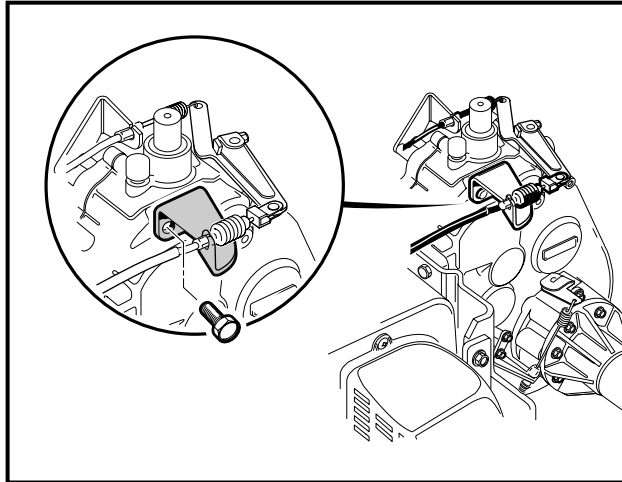


Figure 16b-98 Governor Cable Bracket

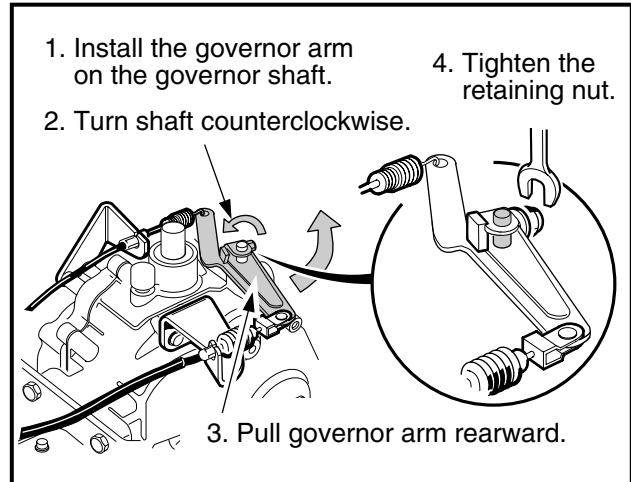


Figure 16b-99 Governor Arm

15. With the floor jack under the transaxle, position the leaf springs in the front spring mounts and install the grade eight bolts and lock nuts. Torque to 15 ft-lb (20.3 N·m) (**Figure 16b-102, Page 16b-44**).

▲ CAUTION

- Use only grade eight bolts for the front leaf spring supports.

16. Using the floor jack, adjust the powertrain height to position the leaf springs for mounting in the shackles. Install the mounting bolts and lock nuts (**Figure 16b-103, Page 16b-44**). Tighten to 15 ft-lb (20.3 N·m).
17. Raise the vehicle with the floor jack and remove the jack stands. With the jack stands removed, gently lower the vehicle and finish tightening the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
18. Position shocks in the shock mounts and install cushions, mounting washers and nuts (**Figure 16b-104, Page 16b-45**). Tighten nuts until cushions expand to be the same size as the mounting washers.
19. Connect the park brake cables. **See Park Brake Cable Installation, Section 6b, Page 6b-37.**
20. Using a flare nut wrench, connect the brake hoses to the left rear and right rear brake clusters and bleed the air from the brake lines. **See Bleeding the Hydraulic Brake System, Section 6b, Page 6b-33.**
21. Check the brake system to ensure that there are no leaks and that proper brake operation has been restored. **See following WARNING.**

▲ WARNING

- The brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. **See Bleeding the Hydraulic Brake System, Section 6a, Page 6a-33.**
22. Connect the engine kill switch wire (18-gauge white/black stripe) to the bullet connector at the lower right front of the engine (**Figure 16b-105, Page 16b-45**).
23. Install three wire ties to secure the engine kill wire to the accelerator cable where they both route together on the passenger side of the engine.
24. Connect the oil level sensor wire (18-gauge yellow) to the jumper wire (**Figure 16b-106, Page 16b-46**).

Unitized Transaxle Installation, Continued:

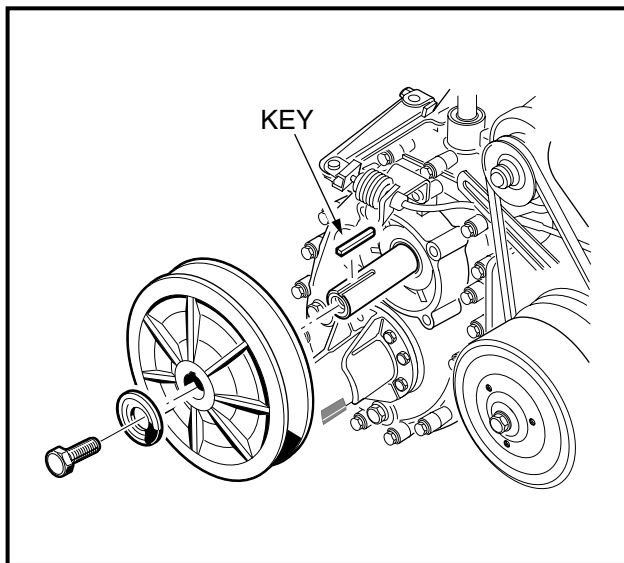


Figure 16b-100 Driven Clutch

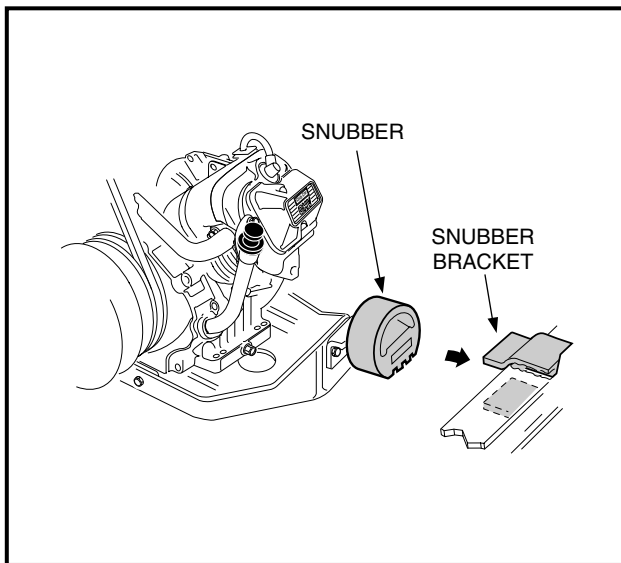


Figure 16b-101 Snubber

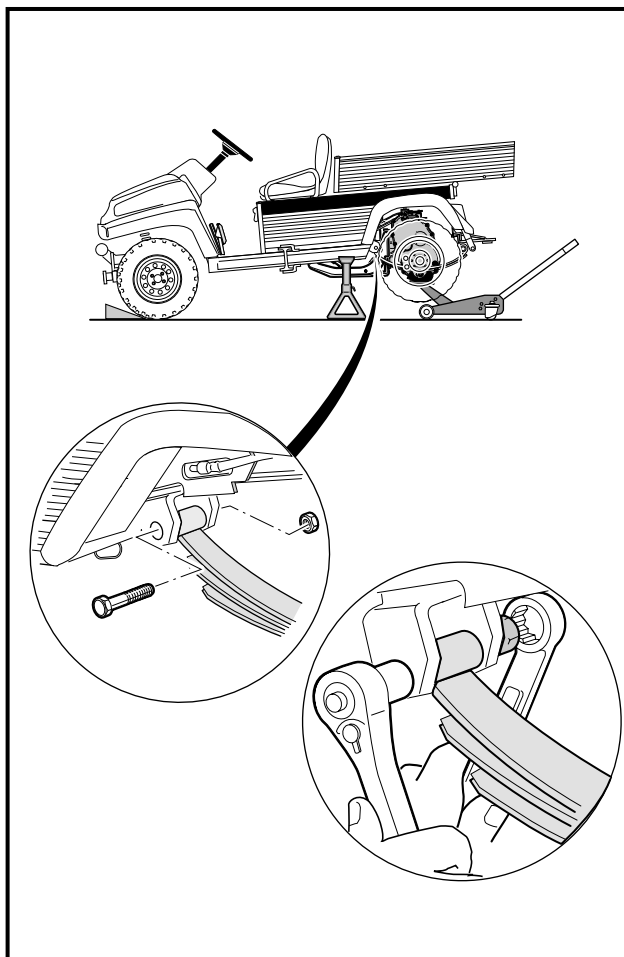


Figure 16b-102 Leaf Springs

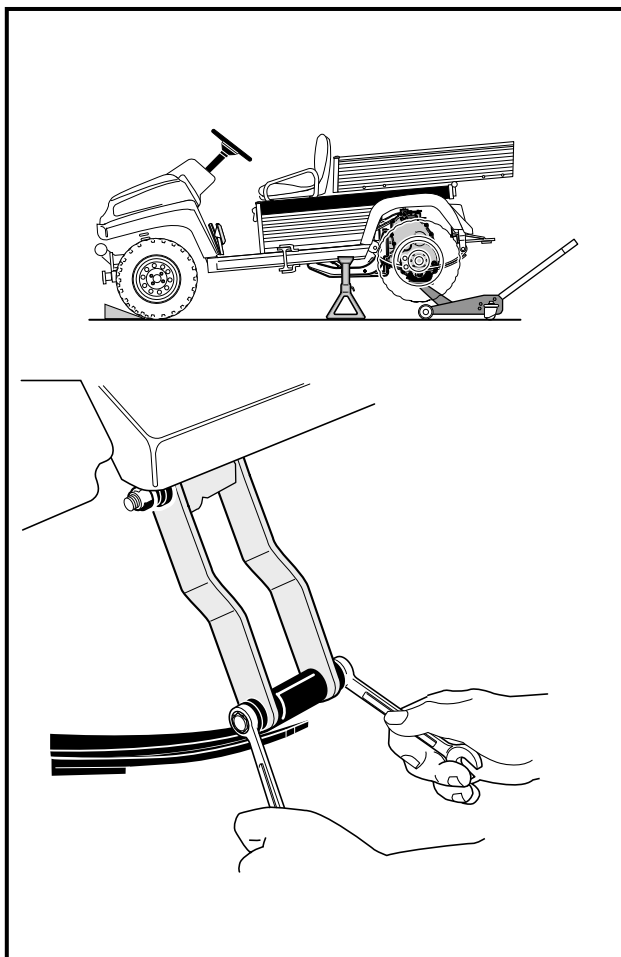


Figure 16b-103 Leaf Springs and Shackles

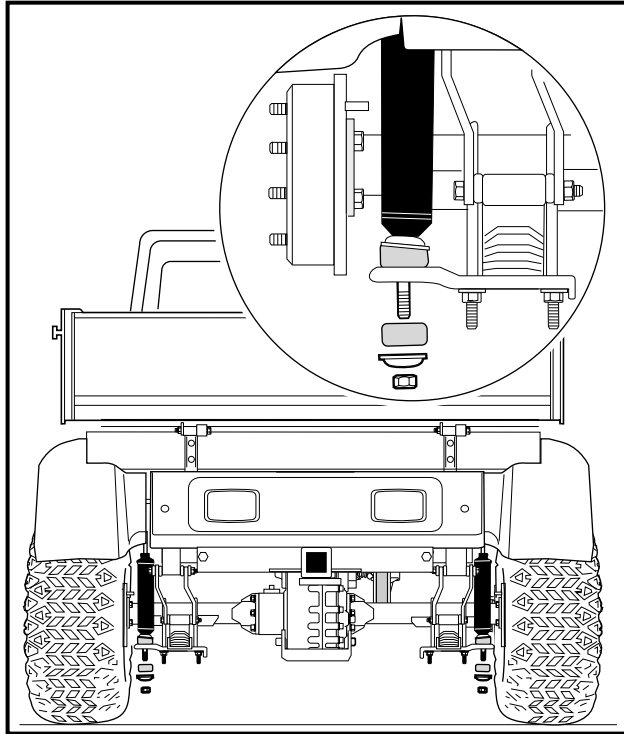


Figure 16b-104 Shock Absorber

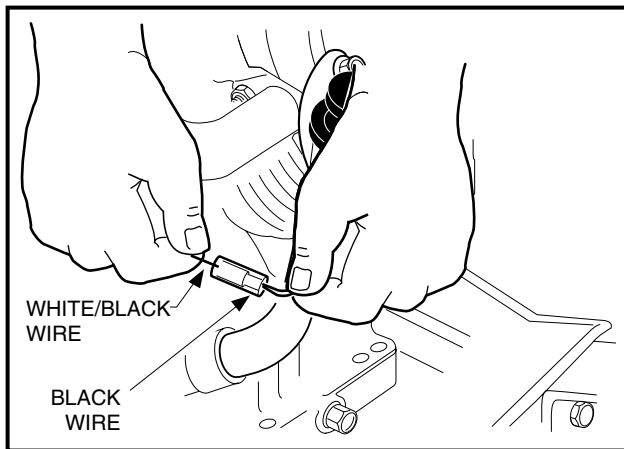


Figure 16b-105 Ignition Kill Wire

25. Connect the 6-gauge white wire to the F2 post, the 6-gauge black ground wire to the A2 post and tighten to 48 in-lb (5.4 N·m). Connect the 16-gauge yellow wire to the DF post on the starter/generator and tighten to 30 in-lb (3.4 N·m) (**Figure 16b-107, Page 16b-46**).
26. Connect the Forward/Reverse shifter and bracket to the transaxle.
 - 26.1. Install the three screws (2) securing the Forward/Reverse shifter cable bracket (1) to transaxle and tighten them to 135 in-lb (15.3 N·m) (**Figure 16b-42, Page 16b-19**).
 - 26.2. Place the woodruff key (9) on the shifter shaft (**Figure 16b-42, Page 16b-19**).
 - 26.3. Place the shifter lever (6) (aligned with the woodruff key) onto the Forward/Reverse shaft (15).
 - 26.4. Install the nut (3), washer (4), and bolt (7) on the Forward/Reverse shifter lever and tighten to 23 in-lb (2.6 N·m) (**Figure 16b-42, Page 16b-19**).

Unitized Transaxle Installation, Continued:

- 26.5. Position the shifter cable in the shifter cable mounting bracket on the transaxle and tighten the mounting nuts to 22 ft-lb (29.8 N·m). Connect shifter cable rod end to the shifter arm (**Figure 16b-108, Page 16b-46**).
27. Attach the ground wire to the mounting screw on the oil filler tube mounting bracket and tighten to 50 in-lb (5.7 N·m) (**Figure 16b-109, Page 16b-46**).
28. Connect accelerator cable to actuator cam in the electrical box. Position the accelerator cable in mounting slot in the wall of the electrical box and tighten mounting nuts to 18 in-lb (2.0 N·m) (**Figure 16b-110, Page 16b-47**). Install electrical component box cover and tighten mounting screw.
29. Pull fuel line from impulse line fitting of the fuel pump, connect it to the carburetor and secure with a hose clamp (**Figure 16b-111, Page 16b-47**).
30. Connect the impulse line to the fuel pump and secure it with the hose clamp (**Figure 16b-112, Page 16b-47**).

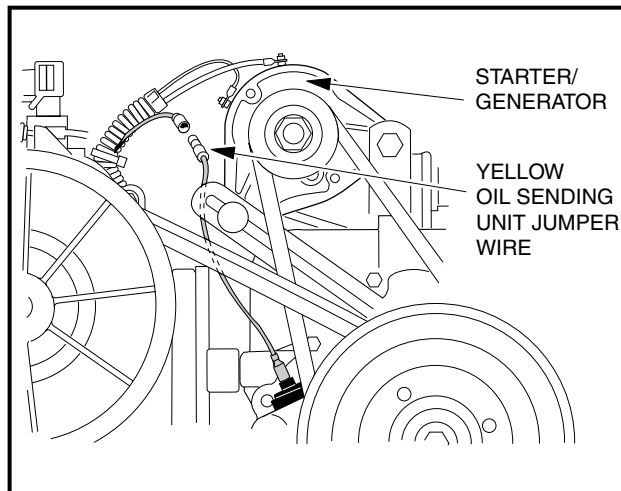


Figure 16b-106 Oil Level Sensor Jumper Wire

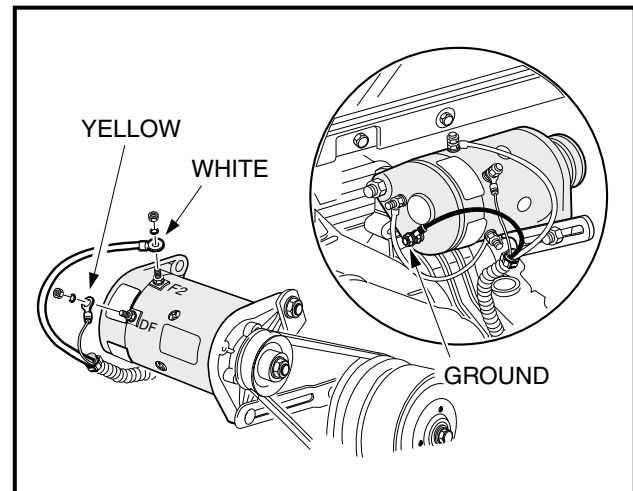


Figure 16b-107 Starter/Generator

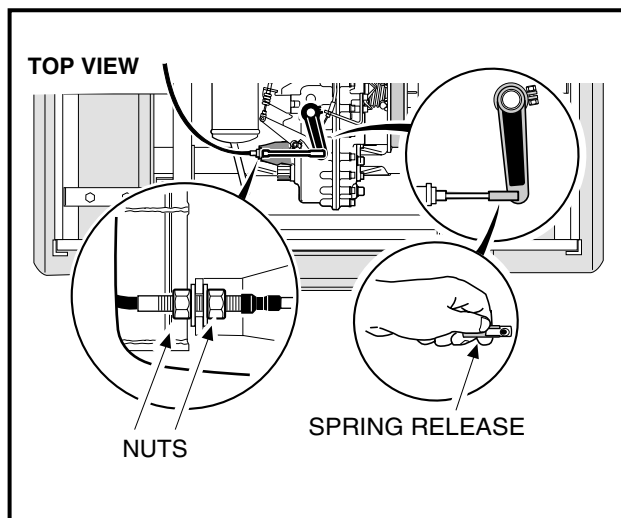


Figure 16b-108 Connect Shifter Cable

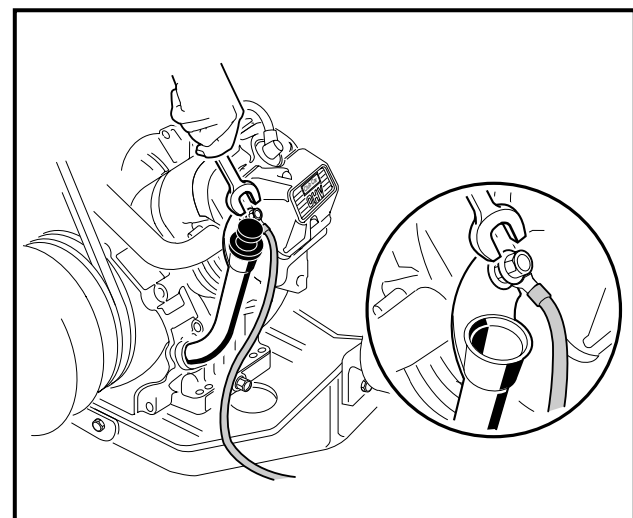


Figure 16b-109 Engine Ground

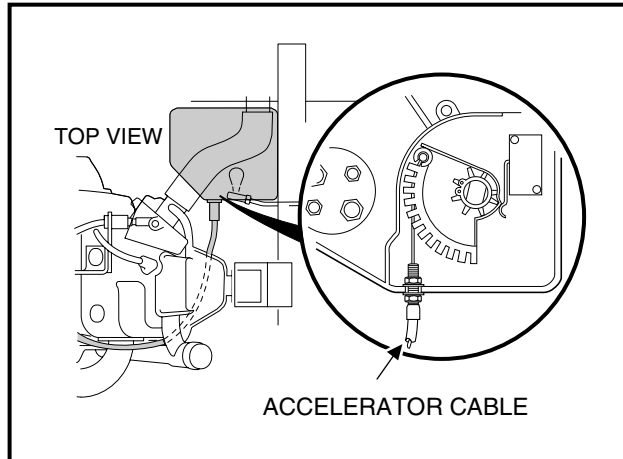


Figure 16b-110 Connect Cable to Cam

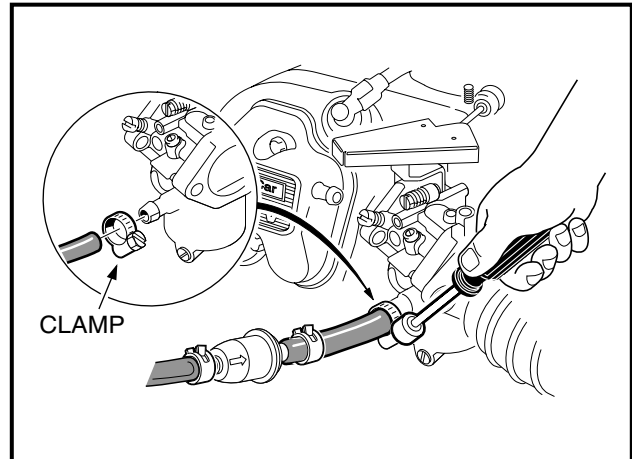


Figure 16b-111 Connect Fuel Line

31. Connect air intake hose to carburetor and secure hose clamp (Figure 16b-113, Page 16b-47).
32. Connect carburetor vent tube to carburetor and secure with hose clamp (Figure 16b-114, Page 16b-48).
33. Connect the differential lock cable end to the differential lock handle.
 - 33.1. Connect the end of the differential lock cable to the differential lock handle (Step 1) (Figure 16b-115, Page 16b-48).
 - 33.2. Push down on the cable to secure the end of the cable to the differential lock handle (Step 2).
 - 33.3. Rotate the cable counterclockwise to route the cable through the bracket (Step 3).
 - 33.4. Push the cable sheath toward the front of the vehicle to secure the cable to the bracket (Figure 16b-119, Page 16b-53).
 - 33.5. Secure the cable to the vertical support with a wire tie (6) as shown.
34. Install transaxle drain plug and tighten to 21 ft-lb (28.5 N·m).
35. Fill transaxle with 31 oz. (.92 liters) 80-90 WT. API class GL-3 or 80-90 WT. AGMA class 5 EP gear lubricant. Install and tighten the level indicator hole plug to 21 ft-lb (28.5 N·m).

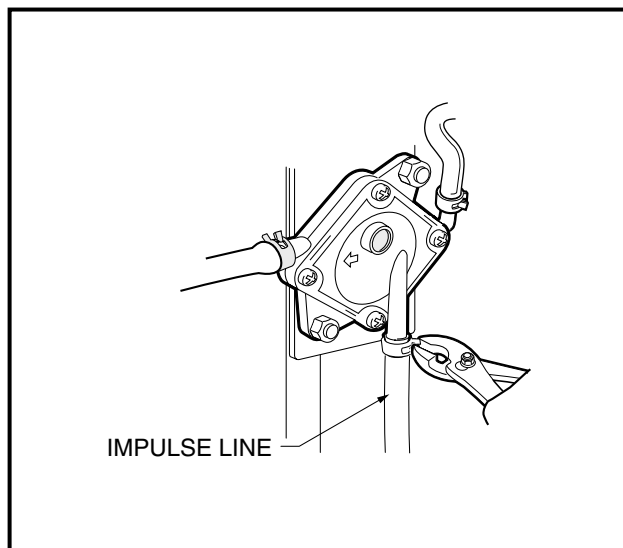


Figure 16b-112 Impulse Line

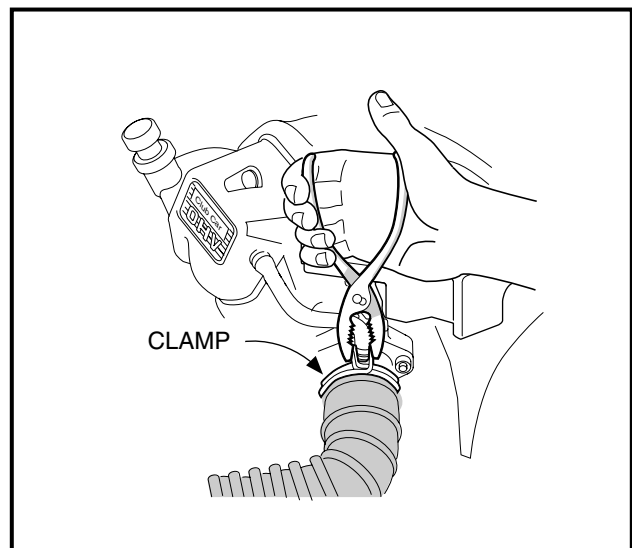


Figure 16b-113 Air Intake Hose

Unitized Transaxle Installation, Continued:

36. Check that all wiring is secured properly. **See following WARNING.**

⚠ WARNING

- If wires are removed or replaced make sure wiring and wiring harness is properly routed and secured to vehicle frame. Failure to properly route and secure wiring could result in vehicle malfunction, property damage or personal injury.

37. Connect the spark plug wire.

38. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27.1 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

39. Adjust the engine RPM setting. **See Engine RPM Adjustment, Section 14, Page 14-14.**

40. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 16b-2.**

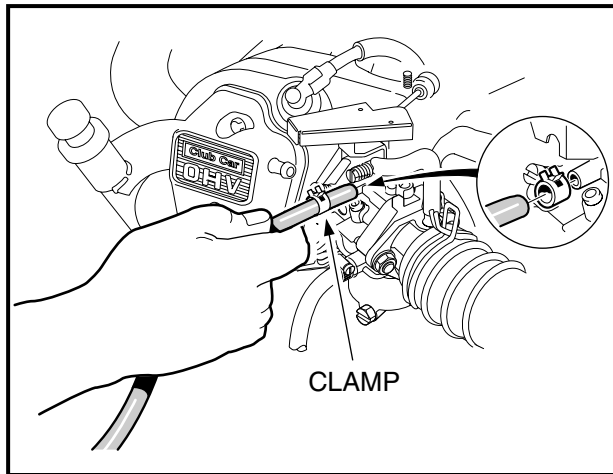


Figure 16b-114 Carburetor Vent Tube

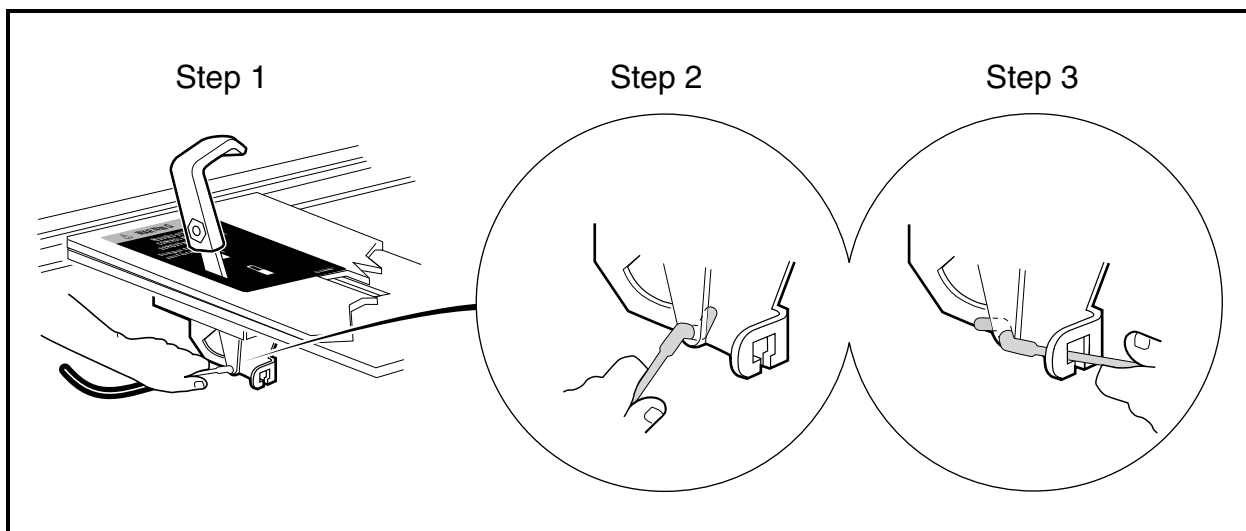


Figure 16b-115 Differential Cable End Installation

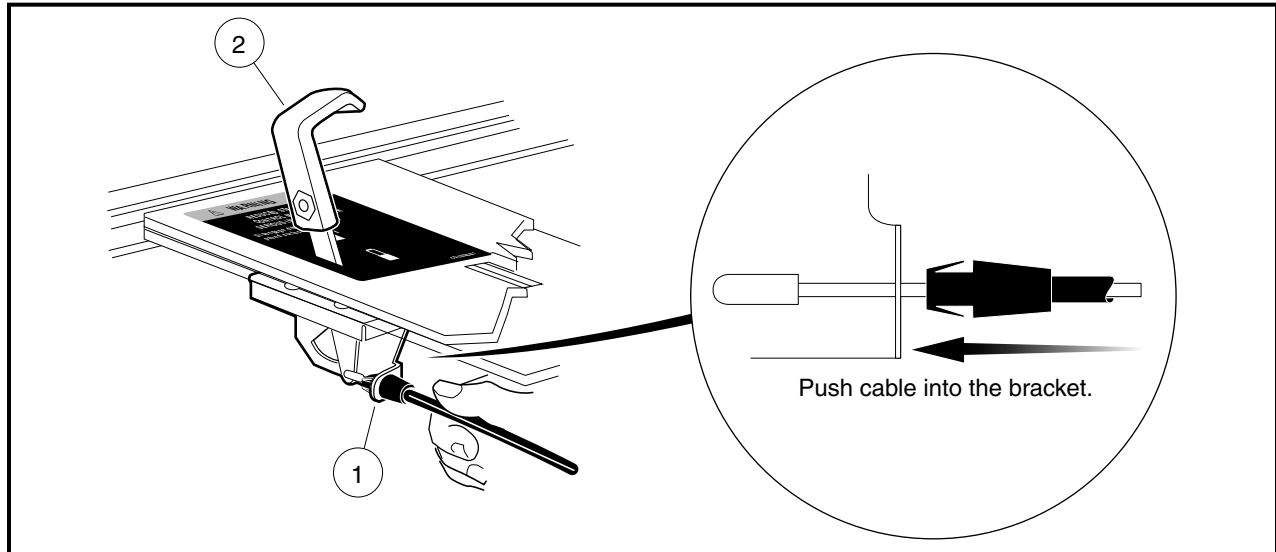


Figure 16b-116 Differential Cable Installation

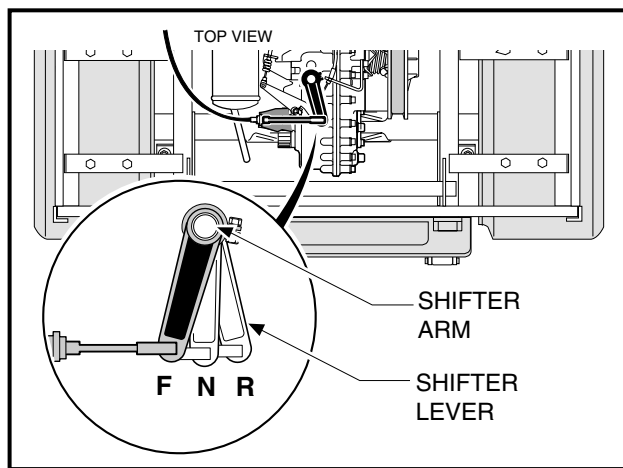


Figure 16b-117 Forward/Reverse Positions

FORWARD/REVERSE SHIFTER CABLE

Read **DANGER** and **WARNING** on page 16b-1.

If the Forward/Reverse shifter cable is damaged in any way, it must be replaced.

FORWARD/REVERSE SHIFTER CABLE REMOVAL

NOTE: Before removing cable, note cable routing and positions of wire ties or other devices securing the cable to the vehicle. When reinstalled, cable must be routed and secured as it was originally.

1. Remove the ball joint socket (2) from the Forward/Reverse shifter assembly ball stud (3) (**Figure 16b-118, Page 16b-50**).
2. Remove the ball joint socket (10) from the shifter arm ball stud (11) on the transaxle (**Figure 16b-118, Page 16b-50**).

Forward/Reverse Shifter Cable Removal, Continued:

- Loosen the retaining nuts (5) on both ends of the cable and remove the wire tie.
- Remove cable from the vehicle.

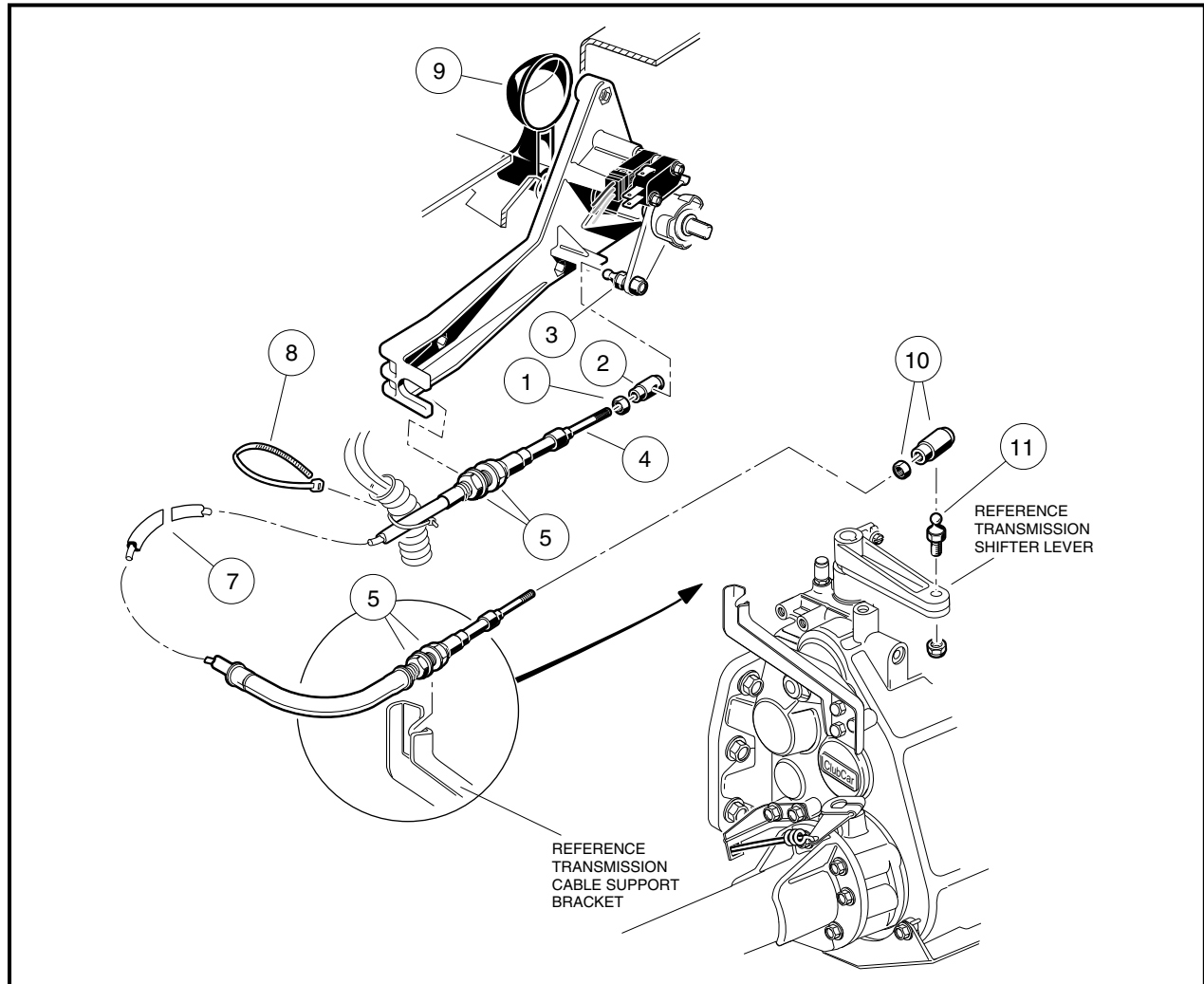


Figure 16b-118 Forward/Reverse Shifter Cable

FORWARD/REVERSE SHIFTER CABLE INSTALLATION

- From the Forward/Reverse shifter, route the cable exactly as it was originally, to the transaxle shifter lever.
- Secure the cable with retaining nut (5) on each side of the shifter cable support bracket at the transaxle (Figure 16b-118, Page 16b-50). Tighten nuts to 22 ft-lb (29.8 N·m).
- Secure the cable with retaining nut (5) on each side of the shifter cable support bracket at the Forward/Reverse assembly. Tighten nuts to 22 ft-lb (29.8 N·m).
- Install the ball joint socket (10) on the shifter lever ball stud (11) on the transaxle.
- Install the ball joint socket (2) on the Forward/Reverse shifter assembly ball stud (3).
- Install wire tie (8) to secure wire harness to cable at the support bracket near the Forward/Reverse shifter assembly. **See following WARNING.**

▲ WARNING

- If wires are removed or replaced, make sure wiring and/or wiring harness is properly routed and secured to vehicle frame. Failure to properly route and secure wiring could result in vehicle malfunction, property damage or personal injury.

FORWARD/REVERSE SHIFTER CABLE ADJUSTMENT

With the shifter lever of the unitized transaxle in the NEUTRAL position (**Figure 16b-117, Page 16b-49**), the Forward/Reverse handle (9) (**Figure 16b-118, Page 16b-50**) should be straight up. For minor adjustments, the nut (1) may be loosened and the ball joint socket (2) rotated to get the proper adjustment (**Figure 16b-118, Page 16b-50**). See following CAUTION.

▲ CAUTION

- Be sure threads of cable are engaged in ball joint socket at least 1/4-inch (6.35 mm). If ball joint socket comes loose from the cable, the Forward/Reverse shifter will not operate properly.

For major adjustments, the cable retaining nuts (5) must be loosened and adjusted. When the cable is properly adjusted, with the Forward/Reverse handle (9) (**Figure 16b-118, Page 16b-50**) in the NEUTRAL position, the shifter lever of the transaxle will also be in the NEUTRAL position (**Figure 16b-117, Page 16b-49**). Retighten nuts to 22 ft-lb (29.8 N·m).

DIFFERENTIAL LOCK SYSTEM

Read DANGER and WARNING on page 16b-1.

If the differential lock cable is damaged in any way, it must be replaced. See following WARNING.

▲ WARNING

- If for any reason the differential lock system is not operating correctly, the system must be repaired or replaced before attempting to operate the vehicle. With the differential lock engaged, vehicle turning functions are greatly reduced. Failure to heed this warning could result in loss of vehicle control and severe personal injury.

DIFFERENTIAL LOCK SYSTEM INSPECTION

The differential lock system should periodically be inspected for proper operation.

1. Place chocks at the front wheels and lift the rear of the vehicle with a floor jack. Then place jack stands under the axle tubes to support the vehicle. See WARNING "Lift only one end..." on page 16b-2.
2. With the differential lock handle in the forward position (unlocked), rotate one of the rear wheels by hand. The wheel should be fairly easy to rotate and the other rear wheel should rotate in the opposite direction, indicating that the differential lock is not engaged. If this is not the case, the differential handle, cable or housing must be repaired or replaced before attempting to drive the vehicle.
3. With the wheels at rest, pull the differential lock handle toward the rear of the vehicle (locked position). Observe the cable end and differential lock arm on the differential lock housing. The cable should move freely when the handle is moved. Initially, there may be slack in the cable at the differential housing. Rotation of the rear tire will eliminate this slack when the differential lock is fully engaged.
4. With the differential lock handle in the rear position (locked), rotate one of the rear wheels by hand. The wheel should be a great deal harder to rotate and the other rear wheel should rotate in the same direction, indicating that the differential lock is engaged. If this is not the case, the differential handle, cable or housing must be repaired or replaced before attempting to drive the vehicle.

DIFFERENTIAL LOCK CABLE REMOVAL

1. Place the differential lock handle in the disengaged position.
2. Remove wire tie (6) securing the cable to the vertical support (**Figure 16b-119, Page 16b-53**).
3. Using a pair of pliers, apply pressure to the locking tabs of the cable end (1) where it attaches to the differential lock handle mounting bracket (**Figure 16b-15, Page 16b-11**).
4. While maintaining pressure on the locking tabs, pull the differential lock cable toward the rear of the vehicle to disconnect the cable from the bracket (**Figure 16b-15, Page 16b-11**).
5. With the cable disconnected from the bracket, rotate the cable connector toward the driver side of the vehicle to disconnect the cable from the differential lock lever (1) (**Figure 16b-16, Page 16b-12**).
6. Unhook the cable spring (1) from the differential lock arm (3) (**Figure 16b-119, Page 16b-53**).
7. Using a pair of pliers, apply pressure to the locking tabs of the cable end (4) where it attaches to the cable mounting bracket (2) at the transaxle.
8. Pull cable (5) toward the front of the vehicle in order to remove the cable from the bracket (2).
9. Remove the cable from the vehicle.

DIFFERENTIAL LOCK CABLE INSTALLATION

1. Route the cable through the engine mounting plate as illustrated (**Figure 16b-119, Page 16b-53**).
2. Route the cable spring (1) through the cable bracket (2) as illustrated.
3. Connect the differential lock cable spring end (1) to the differential lock arm (3) on the differential lock housing.
4. Push the cable (5) toward the rear of the vehicle in order to secure the cable to the bracket (2).
5. Connect the differential lock cable end to the differential lock handle.
 - 5.1. Connect the end of the differential lock cable to the differential lock handle (Step 1) (**Figure 16b-115, Page 16b-48**).
 - 5.2. Push down on the cable to secure the end of the cable to the differential lock handle (Step 2).
 - 5.3. Rotate the cable sheath counterclockwise to route the cable through the bracket (Step 3).
 - 5.4. Push the cable toward the front of the vehicle to secure the cable to the bracket (**Figure 16b-116, Page 16b-49**).
 - 5.5. Secure the cable to the vertical support as shown with a wire tie (6) (**Figure 16b-119, Page 16b-53**).
6. Inspect the differential lock system for proper operation. **See Differential Lock System Inspection on page 16b-51.**

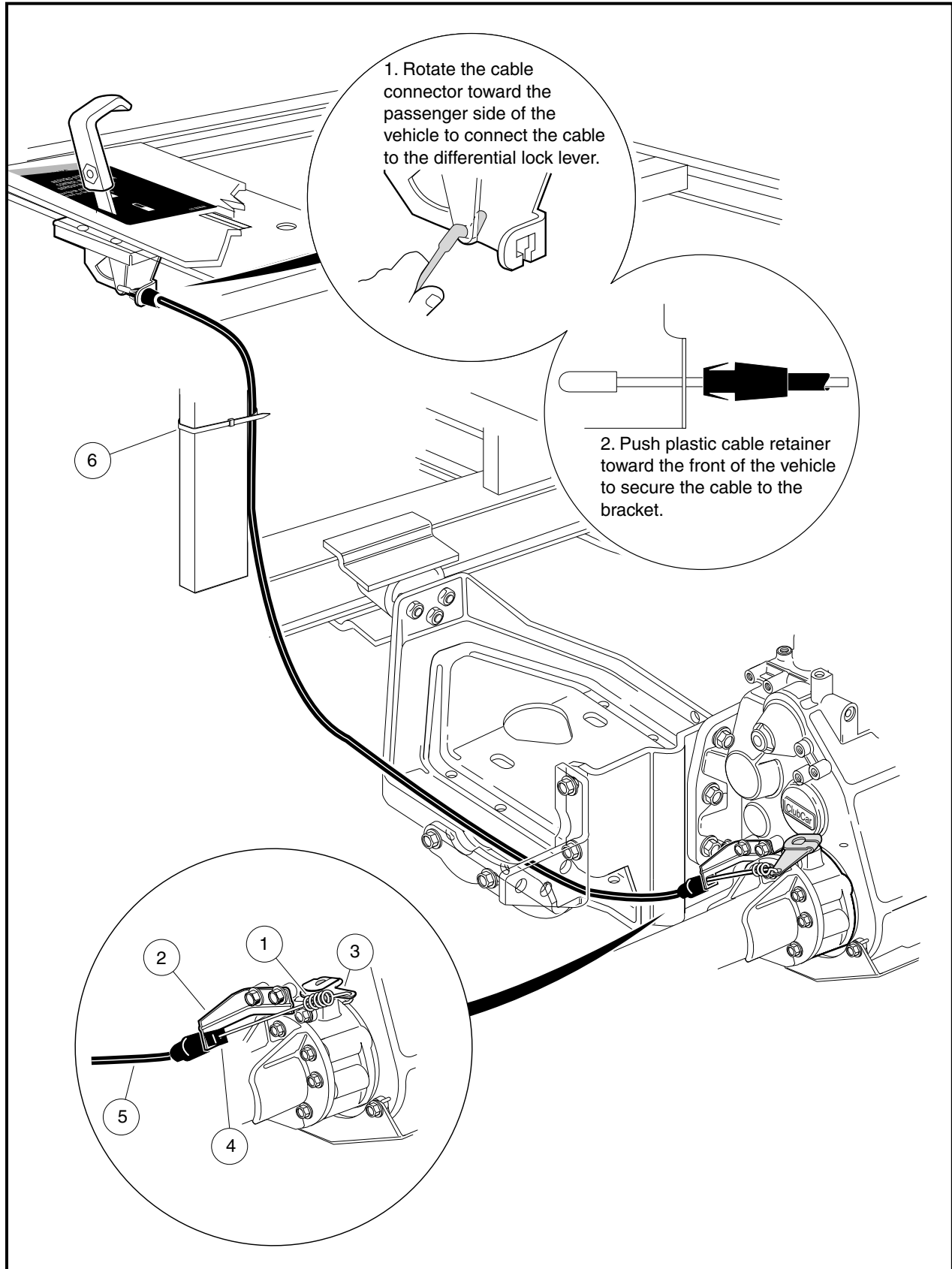


Figure 16b-119 Differential Lock Cable Routing

SECTION 17 – TORQUE CONVERTER

▲ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
 - **External: Flush with water. Call a physician immediately.**
 - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
 - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

▲ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
 - **Disconnect battery cables, negative (–) cable first. See Figure 1-1, Section 1, Page 1-3.**
 - **Disconnect the spark plug wire from the spark plug.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner’s manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.
- If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Do not leave children unattended on vehicle.

GENERAL INFORMATION

The torque converter consists of a drive clutch, a driven clutch, and a drive belt. The drive clutch, which is mounted to the engine, is in the open position when the engine is at idle. At this point, the belt is riding at a low position (smaller diameter) on the drive clutch. The driven clutch is mounted on the transaxle. When the engine is at idle, the driven clutch is in the closed position, and the drive belt is riding at its highest position (large diameter).

At the point of clutch engagement, the speed ratio of the drive clutch to the driven clutch is 3.5 to 1. This ratio provides excellent starting and low-speed torque.

As engine speed increases, centrifugal force on internal weights closes the drive clutch, pushing the belt up to a higher position on the clutch (increasing the diameter of the belt loop). As the diameter of the belt loop increases at the drive clutch, the driven clutch is forced open as the diameter of its belt loop decreases. At governed top speed, the ratio of drive clutch to driven clutch is .92 to 1.

On steep grades, or when the vehicle is heavily loaded, higher torques are achieved through the use of a torque-sensing ramp device on the driven clutch. This device overcomes the force of the centrifugal weights to close the driven clutch and open the drive clutch, thus increasing axle torque with little or no change in engine RPM.

The engine and torque converter rotate clockwise as viewed from the clutch side of the engine.

To provide optimum performance for the OHV engine and powertrain, the vehicle uses a pair of tuned clutches.

To properly assemble and disassemble the torque converter, the following tools should be used:

- Torque Converter Tool Kit (CCI P/N 1014510) (**Figure 17-1, Page 17-3**)
- Scribe or small pick (not included in torque converter tool kit)

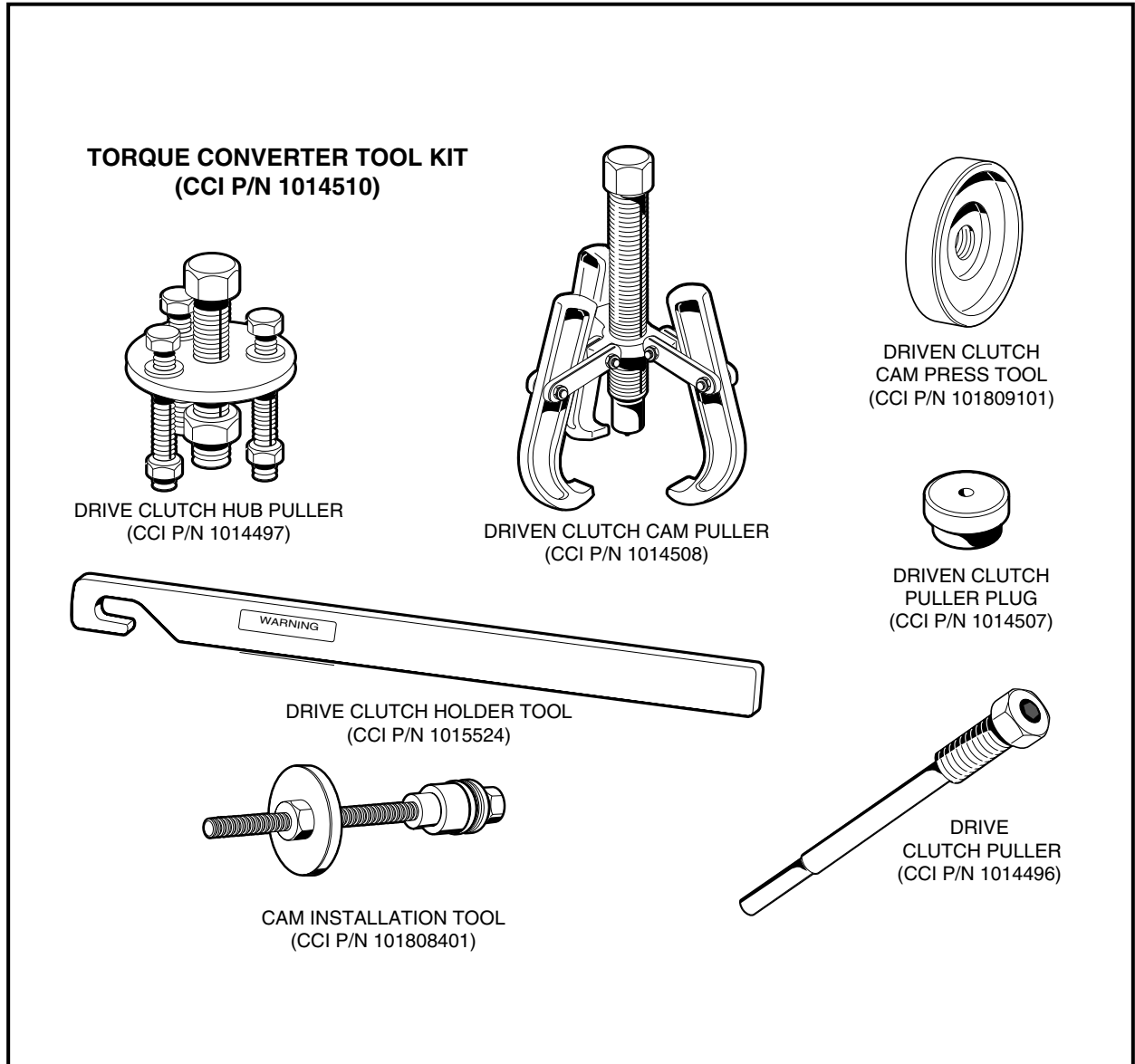


Figure 17-1 Torque Converter Tool Kit

TROUBLESHOOTING

Read **DANGER** and **WARNING** on page 17-1.

Maintaining proper adjustment of the engine, governor, and torque converter are critical to the overall performance of the vehicle. The interaction of these components are essential to the troubleshooting process. If the engine and governor adjustments are within Club Car specifications and, when climbing a steep hill, the engine begins to lose RPM before the drive belt reaches the top of the driven clutch, there is a torque converter problem.

If the torque converter is not operating properly:

1. Check the governor and throttle settings. **See Governor Cable Installation and Adjustment, Section 14, Page 14-12.**
2. Inspect the driven clutch for dirt and dust buildup on its component parts. Clean the driven clutch with water to remove any dust or dirt, then drive the vehicle and check for proper operation.
3. If cleaning the driven clutch does not solve the problem, disassemble and thoroughly clean all parts of the drive clutch. Be sure to clean the plastic drive buttons (10) (**Figure 17-7, Page 17-9**).

DRIVE BELT

Read **DANGER** and **WARNING** on page 17-1.

The drive belt should be inspected semiannually for wear and glazing. If it is excessively worn, frayed, or glazed, replace the belt.

As the drive belt wears, the engine RPM will increase to compensate for the change in torque converter ratio. This will keep the vehicle's maximum ground speed correct at 17-19 mph (27-31 km/h).

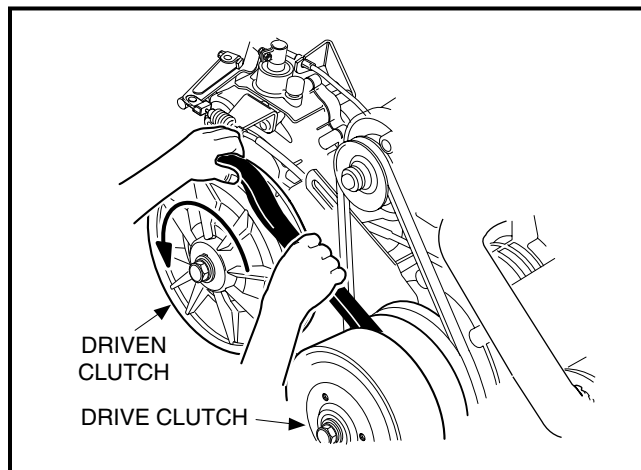


Figure 17-2 Drive Belt Removal

DRIVE BELT REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 17-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See Figure 1-1, Section 1, Page 1-3. See WARNING "To avoid unintentionally starting..." on page 17-1.**

4. Disconnect the spark plug wire from the spark plug. **See WARNING "To avoid unintentionally starting..." on page 17-1.**
5. **Pedal-Start Vehicles:** Place the Forward/Reverse handle in the NEUTRAL position and the neutral lock-out cam in the SERVICE position.
6. **Key-Start Vehicles:** Place the Forward/Reverse handle in the NEUTRAL position.
7. Grasp the belt midway between the drive and driven clutches. Lift upward on the belt to force the sheaves of the driven clutch apart, then roll the belt off the driven clutch by rotating the clutch counterclockwise (**Figure 17-2, Page 17-4**). **See following CAUTION.**

⚠ CAUTION

- **Make sure your fingers are not underneath the belt when rolling the belt off the driven clutch.**

8. Remove the belt from the drive clutch.

DRIVE BELT INSTALLATION

1. Position the new belt on the drive clutch, then start the belt over the top of the driven clutch.
2. With the belt started onto the driven clutch, rotate the driven clutch counterclockwise and roll the belt over the driven clutch sheaves and onto the clutch.
3. Connect the spark plug.
4. Connect the battery cables, positive (+) cable first, and tighten terminals to 20 ft-lb (27 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." see page 17-2.**

DRIVE CLUTCH

Read DANGER and WARNING on page 17-1.

⚠ CAUTION

- **Be very careful when handling the clutches. A clutch that has been dropped will not be properly balanced. If either clutch is dropped, assume that it is damaged and replace it.**

DRIVE CLUTCH REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 17-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 17-1.**
4. Disconnect the spark plug. **See WARNING "To avoid unintentionally starting..." on page 17-1.**
5. Remove the drive belt. **See Drive Belt Removal on page 17-4.**
6. Loosen the starter/generator mounting and adjusting hardware and then remove the starter belt. **See WARNING "To avoid unintentionally starting..." on page 17-1.**

Drive Clutch Removal, Continued:

- Remove the drive clutch retaining bolt (17) and mounting washer (19) (**Figure 17-7, Page 17-9**). See also **Figure 17-3, Page 17-6**.

NOTE: The drive clutch mounting bolt and crankshaft have left-hand threads.

- Lubricate threaded portion of clutch puller tool with a light oil and thread the clutch puller tool into the clutch retaining bolt hole.
- Using a 1/2-inch socket, tighten the clutch puller tool. The drive clutch will release free of the crankshaft (**Figure 17-4, Page 17-6**).
- Support the drive clutch assembly in your hand and back the clutch puller tool out of the crankshaft.

CAUTION

- Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.

DRIVE CLUTCH CLEANING AND INSPECTION

- Use a dry, lint-free cloth to clean clutch parts. See following **CAUTION**.

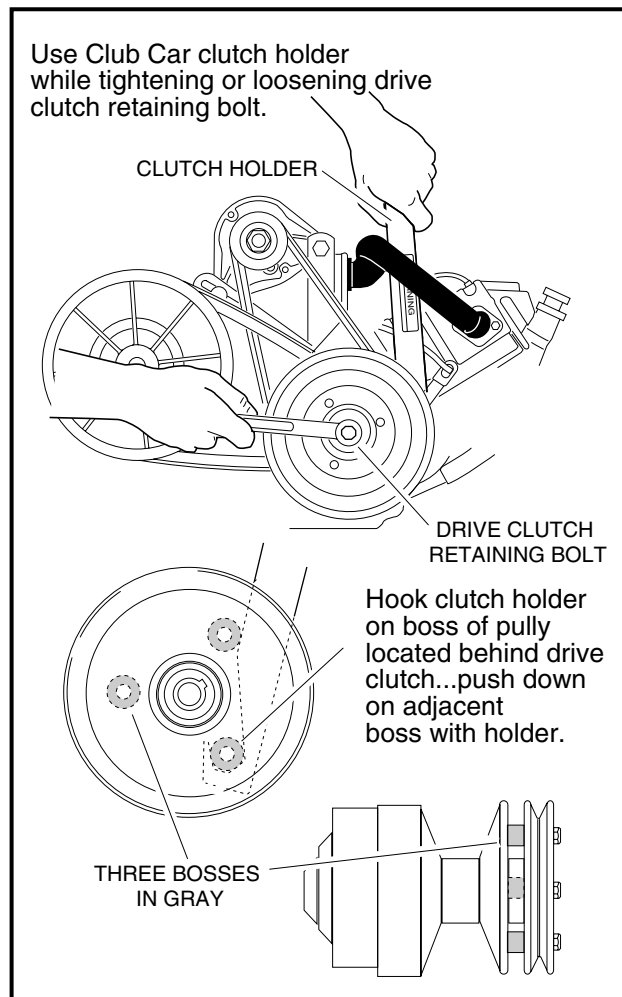


Figure 17-3 Loosen Retaining Bolt

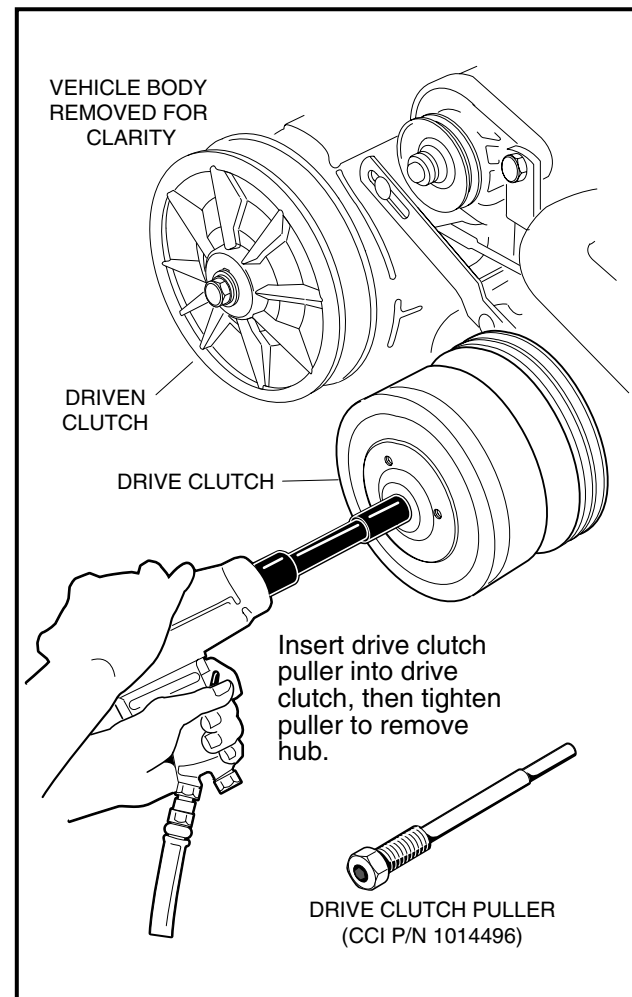


Figure 17-4 Drive Clutch Removal

⚠ CAUTION

- Do not lubricate the drive clutch. Lubricants attract dirt and dust, which interfere with proper clutch operation.
 - Use only a dry cloth to lightly wipe the shaft (7) of the fixed face assembly (Figure 17-7, Page 17-9). Do not use a brush or steel wool. These will damage the surface of the shaft.
 - Do not use solvents. Solvents will damage the lubricating characteristics of the bushings.
2. Inspect the belt contact surfaces of the clutch sheaves for wear. If any area of a sheave contact surface has wear of 0.060-inch (1.52-mm) or more, the clutch should be replaced.

DRIVE CLUTCH DISASSEMBLY

⚠ CAUTION

- The drive clutch is balanced as an assembly. Before disassembly, make match marks on the clutch cover and on the moveable face assembly so they can be reassembled in the same positions (Figure 17-5, Page 17-8).
1. Make match marks on the clutch drive hub and on the moveable face casting (Figure 17-5, Page 17-8).

NOTE: The following procedure applies to the Drive Clutch Hub Puller (CCI P/N 1014497). Other types of pullers may vary in operation and sequence of procedure.

2. To remove the clutch drive hub (1) (Figure 17-7, Page 17-9):
- 2.1. Remove the plastic plug ring (22) from the clutch puller attachment holes in the drive hub (1) (Figure 17-7, Page 17-9).
 - 2.2. Thread the center bolt of the Drive Clutch Hub Puller (CCI P/N 1014497) into clutch until the stop nut touches the clutch hub or the bolt bottoms out, then back the bolt out one-half turn (Figure 17-6, Page 17-8).

NOTE: The stop nut has been mechanically crimped and locked into position acting as an integrated assembly with the bolt.

- 2.3. Thread the three small bolts of the puller into the puller attachment holes in the clutch. Tighten bolts evenly, making sure the face of the puller plate is parallel to the clutch face (Figure 17-6, Page 17-8).

NOTE: The nuts on each of the three, small puller bolts are mechanically crimped and locked into position.

- 2.4. Unscrew the hub puller center bolt from the clutch, forcing the stop nut up against the puller plate, lifting the drive hub (1) from the fixed face shaft (7) (Figure 17-7, Page 17-9).
3. Remove the thrust washer (11) from the moveable face (14) (Figure 17-7, Page 17-9).
4. To remove the drive buttons:
- 4.1. Remove the screws, flat washers, drive button take-up spring, and drive buttons as shown (Figure 17-8, Page 17-10).

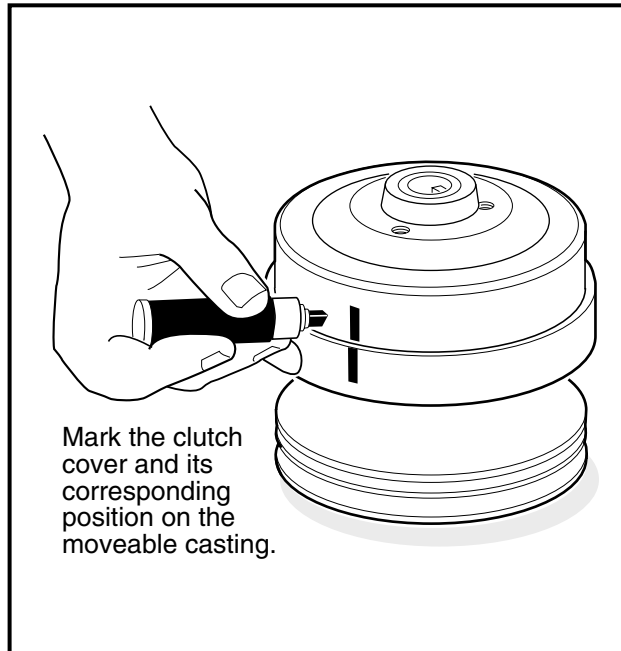
Drive Clutch Disassembly, Continued:

Figure 17-5 Mark Clutch Cover

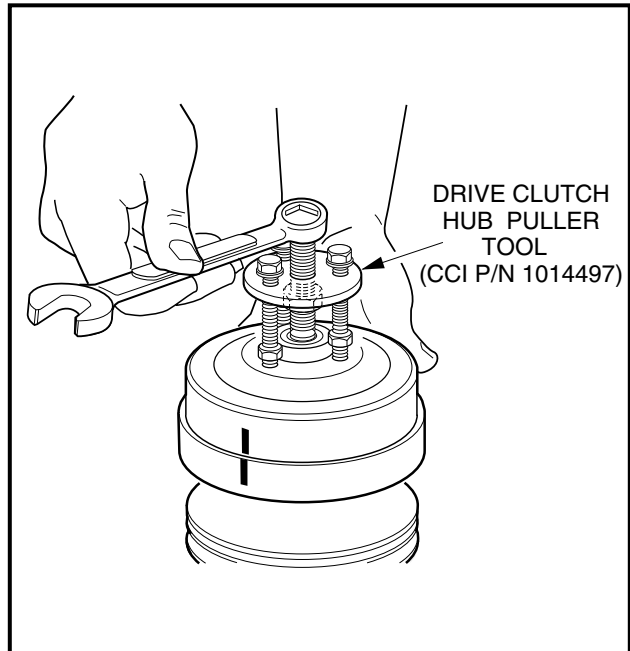


Figure 17-6 Remove Clutch Drive Hub

5. To remove the clutch weights:

- 5.1. Remove the screws and flat washers attaching the weights as shown (**Figure 17-9, Page 17-10**).
- 5.2. Pull the weight assemblies, with pins, from the clutch.
- 5.3. Remove the plastic washers, weights and wave washer from the pins. Before removing, note the orientations of the wave washer and of the primary and secondary weights to one another (**Figure 17-12, Page 17-11 and Figure 17-13, Page 17-11**). Retain all parts.

6. Remove the retaining ring (3) from the shaft of the fixed face assembly (7) and slide the moveable face (14) off the shaft (**Figure 17-7, Page 17-9**). See following NOTE.

NOTE: When the moveable face is removed from the hub of the fixed face, the spiral back-up rings (12) must be replaced with new ones at time of reassembly (**Figure 17-7, Page 17-9**).

7. Remove the spacer (13), spring (4), and retainer (5). The spring retainer (5) can be removed from the spring if necessary (**Figure 17-7, Page 17-9**).
8. If necessary, remove idler bearing. Use a press to remove the bearing (**Figure 17-10, Page 17-11**). See following NOTE.

NOTE: Do not remove the idler bearing unless it needs to be replaced. If idler bearing is removed, replace it with a new bearing.

9. Use a scribe or small pick to remove the spiral backup rings (12) from each end of the bore in the fixed face assembly (**Figure 17-7, Page 17-9**). See also **Figure 17-11, Page 17-11**. Discard the rings.

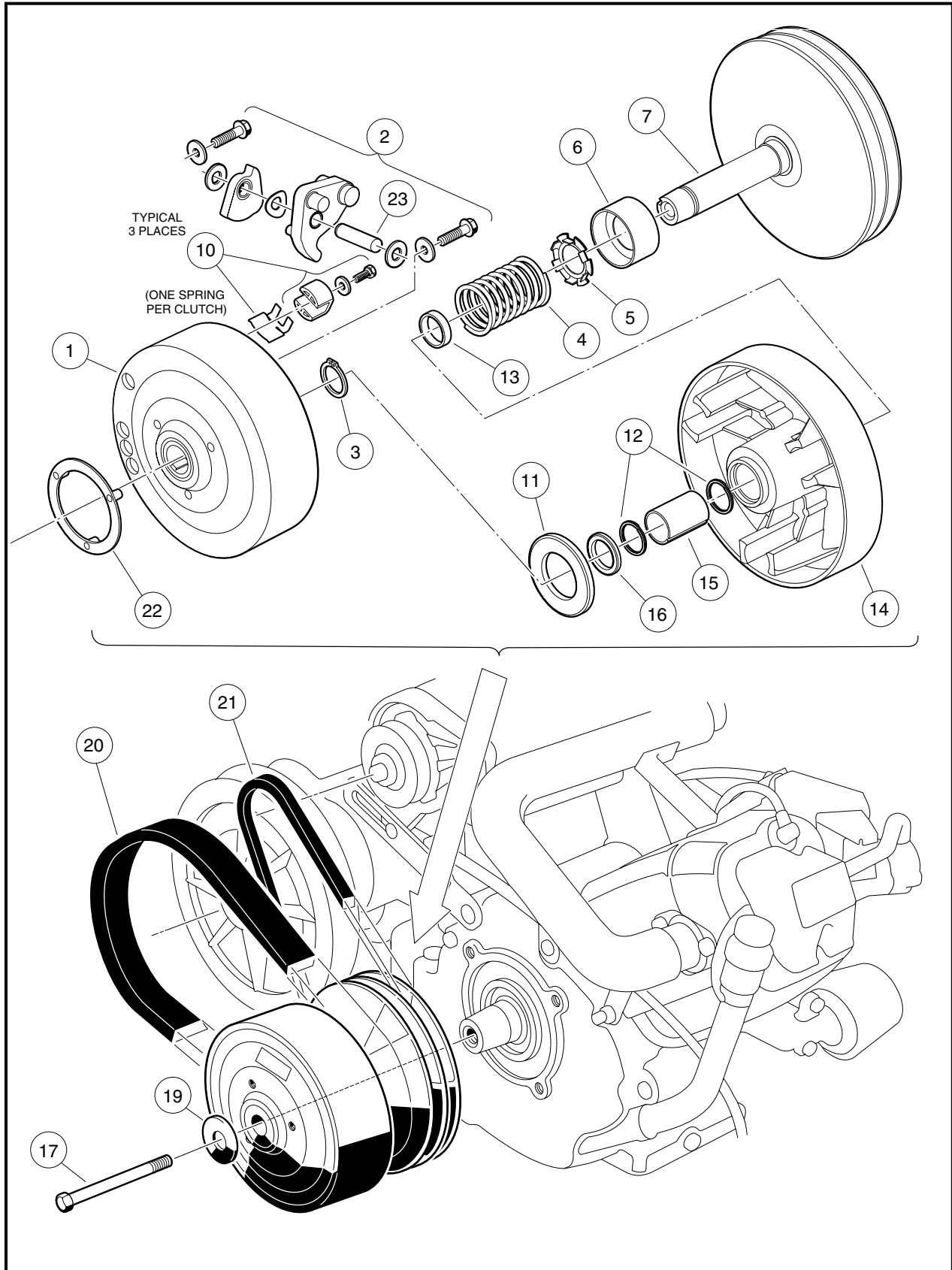


Figure 17-7 Drive Clutch Assembly

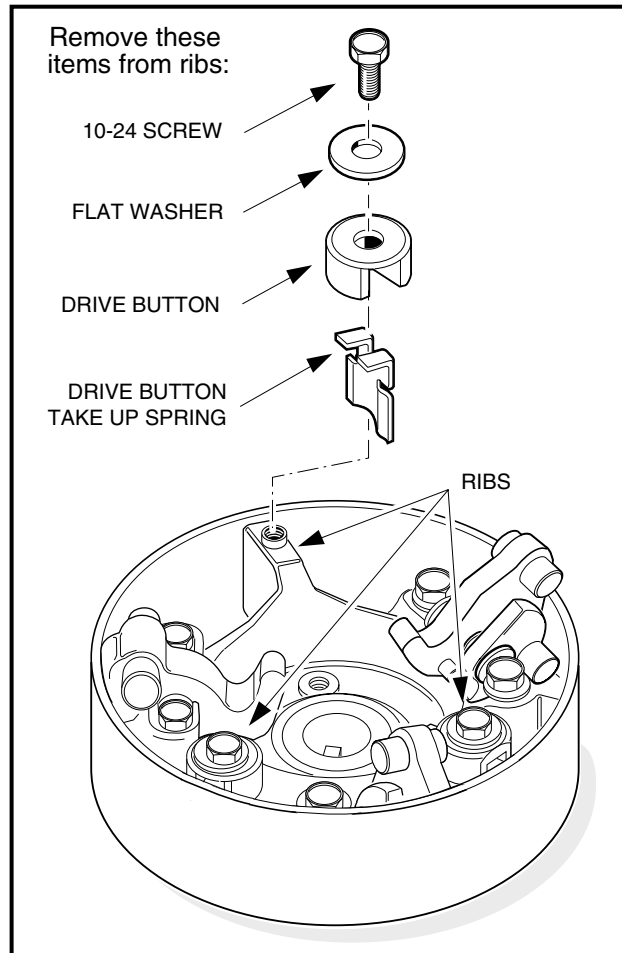


Figure 17-8 Drive Button Mounting

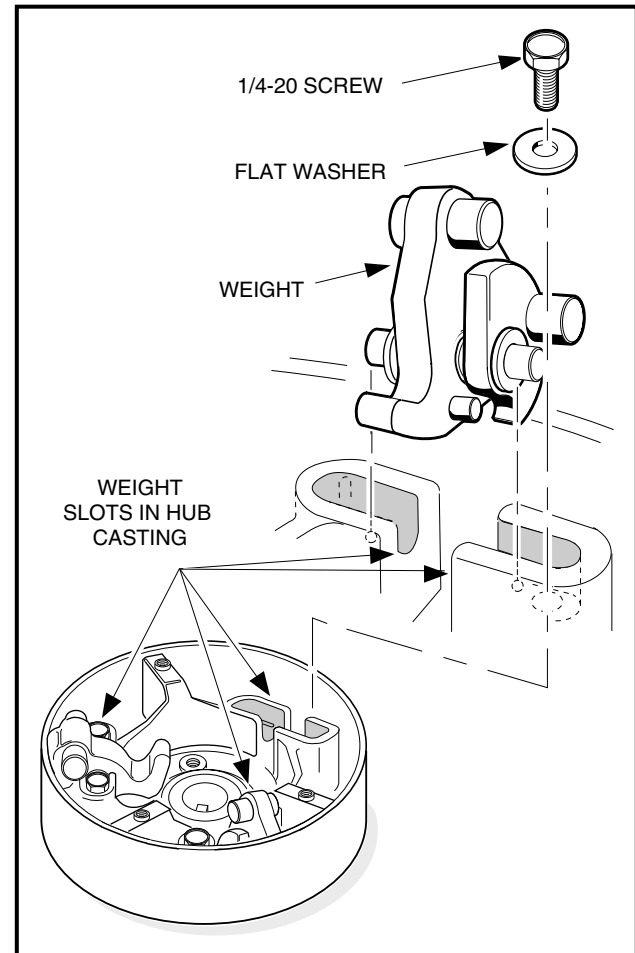


Figure 17-9 Weight Position

INSPECTION OF DRIVE CLUTCH PARTS

1. Inspect the idler bearing (6) for smooth rotation or seal damage (**Figure 17-7, Page 17-9**).

NOTE: It is normal for a small amount of grease to be present at the edge of seal.

2. Inspect the bore of the moveable face assembly (14) for scarring or wear. The moveable face assembly must be replaced if the bore is worn to a diameter of 0.883-inch (22.4-mm) or larger (**Figure 17-7, Page 17-9**).
3. Inspect the steel shaft (7) on the fixed face assembly. There should be no noticeable wear anywhere on the shaft. Replace the shaft if it is worn, scratched, or damaged (**Figure 17-7, Page 17-9**).
4. Inspect the thrust washer (11) for wear. If it is worn more than 0.030-inch (0.76-mm), turn it over or replace it with a new one.
5. Inspect the primary weights and the hub casting for wear. If the primary weights show signs they are touching the casting, the tips of the weights have worn beyond specification and they must be replaced (**Figure 17-12, Page 17-11**).
6. Inspect the pins on the primary weights. There should be no noticeable wear. Replace them if they are worn, scratched, or damaged.
7. Inspect the drive belt pulley sheaves for excessive wear or damage. If the sheaves are excessively worn or damaged, replace the entire fixed face drive assembly.

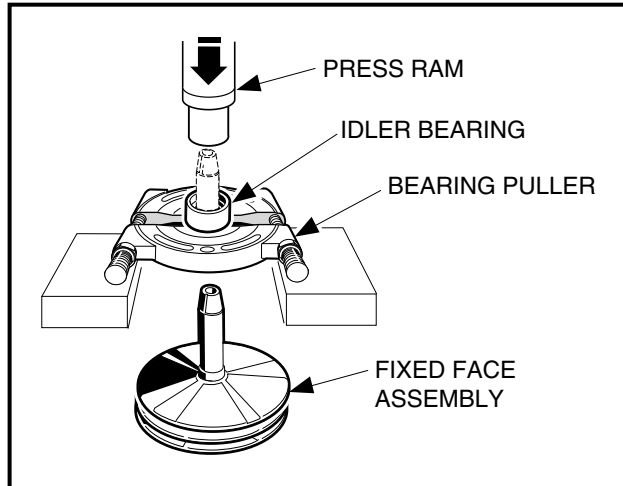


Figure 17-10 Remove Idler Bearing

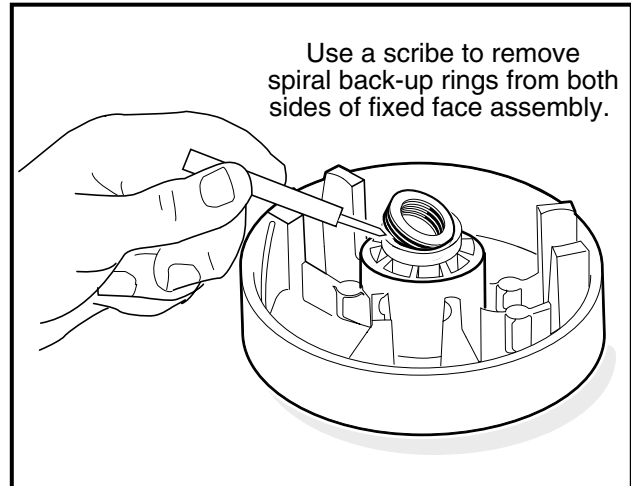


Figure 17-11 Spiral Back-up Rings

DRIVE CLUTCH ASSEMBLY

1. Press idler bearing (6) onto the shaft of the fixed face assembly (7). Press on the inner race of the bearing only. Make sure that the cup side of bearing is facing away from the fixed face (**Figure 17-7, Page 17-9**).
2. Using needle nose pliers, install the spring retainer (5) onto the spring (4).
3. Install the spring (4) and retainer (5) into the cup of the idler bearing (6).
4. Install the spacer (13) onto the shaft of the fixed face.
5. Install a new spiral backup ring (12) in each end of the bore of the moveable face assembly (14).
6. Install the moveable face assembly (14) onto the shaft of the fixed face assembly (7).

⚠ CAUTION

- To avoid damaging the spiral back-up rings, be very careful when installing the moveable face.

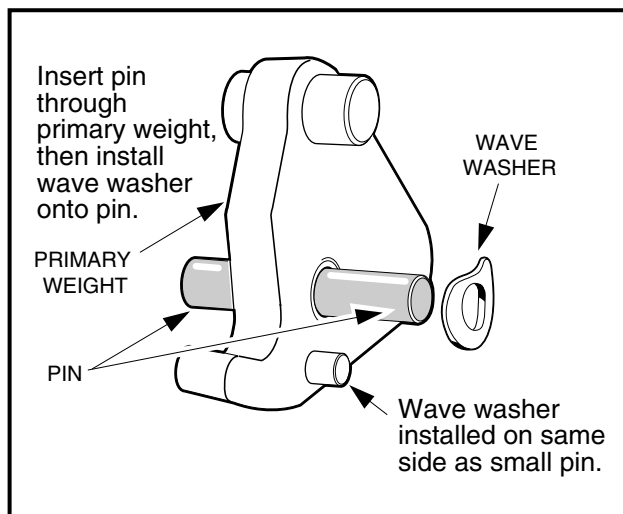


Figure 17-12 Install Pin and Washer

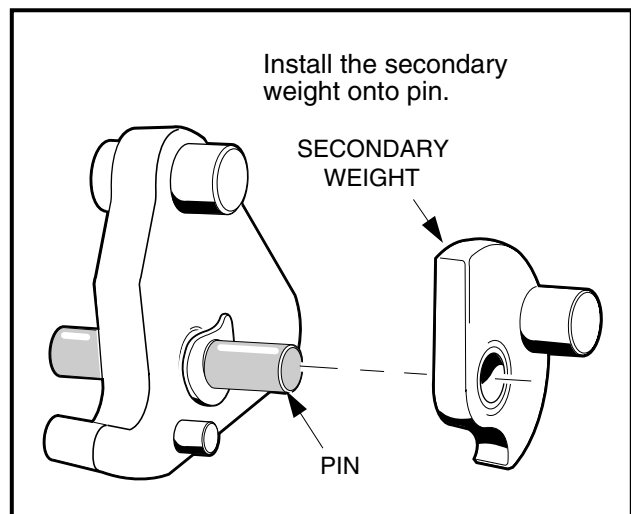


Figure 17-13 Install Secondary Weight

Drive Clutch Assembly, Continued:

- 6.1. Rotate the moveable face assembly clockwise while installing it onto the shaft.
- 6.2. Install the retaining ring (3) (**Figure 17-7, Page 17-9**).
7. Install the primary weights on the mounting pins (**Figure 17-12, Page 17-11**).
8. Install a wave washer on each mounting pin. Make sure that the concave side of the washer faces the side of the primary weight with the small guide pin protruding from it (**Figure 17-12, Page 17-11**).
9. Install the secondary weights onto the mounting pins with the weight pins on the secondary weights pointing away from the primary weights. The wave washers should be between the primary and secondary weights (**Figure 17-13, Page 17-11**).
10. Install white plastic flat washers on each end of the mounting pin and push them against the outside surfaces of the weights. Center the weights and washers on the mounting pin (**Figure 17-14, Page 17-12**).
11. Install the weight assemblies into the slots in the hub casting (**Figure 17-9, Page 17-10**). Make sure the mounting pin protrudes an equal amount on each side of the weights when the assemblies are in position (**Figure 17-14, Page 17-12**).

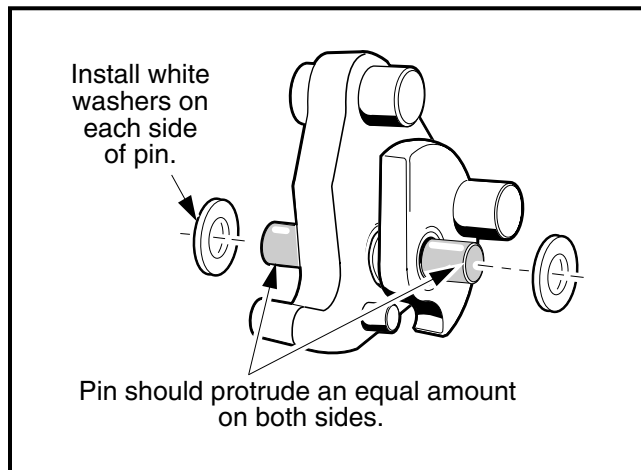


Figure 17-14 Install White Washers

12. Install the 1/4-20 screws and washers (2) and tighten them to 10 ft-lb (13 N·m) (**Figure 17-7, Page 17-9**).
- NOTE:** Make sure there is at least a (minimum) gap of 0.020-inch (0.51-mm) between each end of the mounting pin and the mounting screw.
13. Install one drive button take-up spring.
 - 13.1. Install spring on right side of any one of the three button mounting posts (when looking into the interior of the clutch drive hub, and with a rib at a twelve o'clock position) as shown (**Figure 17-15, Page 17-13**).
 14. While compressing the take-up spring, install the drive button over the rib and take-up spring as shown (**Figure 17-8, Page 17-10**).
 15. Install remaining two buttons.
 16. Install a no. 10-24 button retaining screw with flat washer through each button and into the rib. Tighten the screws to 34 in-lb (3.8 N·m) (**Figure 17-9, Page 17-10**).
 17. Install the thrust washer (11) onto the moveable face assembly (**Figure 17-7, Page 17-9**).

18. Install the hub assembly (1) on the moveable face assembly and align the match marks made before disassembling the clutch. Press the hub assembly on by hand (**Figure 17-7, Page 17-9**).
19. Replace the plastic ring (22) hole protector (**Figure 17-7, Page 17-9**).

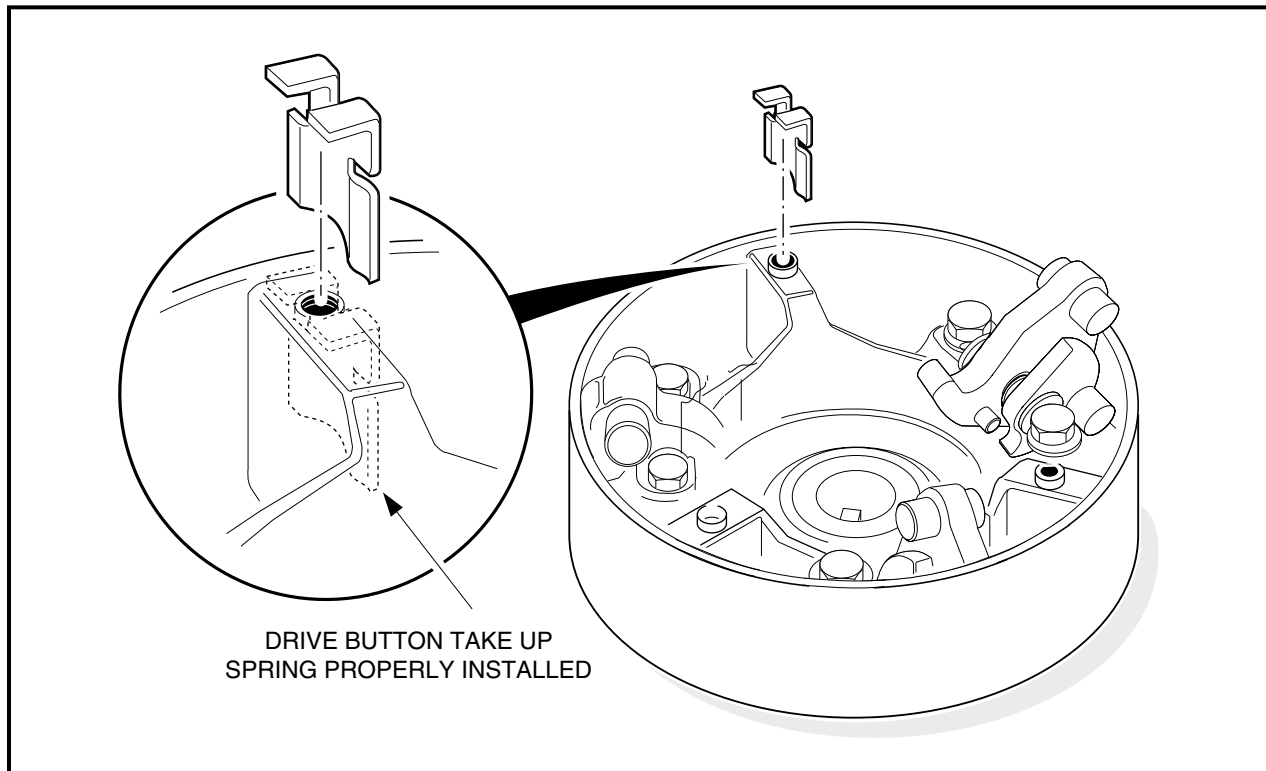


Figure 17-15 Correct Orientation of Drive Button Take-up Spring

DRIVE CLUTCH INSTALLATION

1. Place the drive clutch assembly on the crankshaft taper. Position the mounting washer (19) (with the green side facing out) on the bolt (17) and start the bolt into the crankshaft. **See following NOTE.**

NOTE: The drive clutch mounting bolt has left-hand threads.

2. Tighten the drive clutch retaining bolt (17) to 25 ft-lb (33.9 N·m) (**Figure 17-7, Page 17-9**).
3. Install the starter/generator belt and adjust belt tension as instructed. **See Starter/Generator Installation, Section 12b, Page 12b-11.** Tighten the starter/generator mounting hardware to 23 ft-lb (31.2 N·m) and the adjusting hardware to 13 ft-lb (17.6 N·m).
4. Install the drive belt as instructed. **See Drive Belt Installation on page 17-5.**
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27 N·m). Coat terminals with Battery Terminal Protector spray (CCI P/N 1014305).
6. Connect the spark plug.
7. Lower the carbo bed. **See WARNING "For vehicles with cargo beds..." on page 17-2.**
8. **Pedal-Start Vehicles:** Place the Forward/Reverse handle in the NEUTRAL position and the neutral lock-out cam in the OPERATE position. **See Figure 3-3, Section 3, Page 3-3.**
9. **Key-Start Vehicles:** Place the Forward/Reverse handle in the NEUTRAL position.
10. Drive the vehicle and check for proper operation.

DRIVEN CLUTCH

Read **DANGER** and **WARNING** on page 17-1.

DRIVEN CLUTCH REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in NEUTRAL. Chock the wheels.
2. Access the engine compartment. **See WARNING "For vehicles with cargo beds..." on page 17-2.**
 - 2.1. Tilt the bed and ensure that the prop rod is properly engaged.
3. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." on page 17-1.**
4. Disconnect the spark plug. **See WARNING "To avoid unintentionally starting..." on page 17-1.**
5. Remove the drive belt as instructed. **See Drive Belt Removal on page 17-4.**
6. Remove the bolt (11) and mounting washer (12) from the clutch shaft (**Figure 17-16, Page 17-15**).
7. Grasp the driven clutch assembly and slide it off the shaft.
8. Leave the key (9) in the keyway (**Figure 17-16, Page 17-15**).

DRIVEN CLUTCH DISASSEMBLY

1. Using external snap ring pliers, remove the retaining ring (2) (**Figure 17-17, Page 17-16**). **See following WARNING.**

⚠ WARNING

- **Do not place fingers under the cam when removing the cam. The moveable face may spin when the cam buttons release from the cam ramps, resulting in severe personal injury.**
2. Insert a puller plug (CCI P/N 1014507) (**Figure 17-18, Page 17-16**) into the shaft bore and use a driven clutch cam puller (CCI P/N 1014508) to remove the cam (4) from the fixed face shaft (8). Retain the key (3) (**Figure 17-16, Page 17-15**).
 3. Remove the spring (5) (**Figure 17-16, Page 17-15**).
 4. Slide the moveable face (7) off the fixed face shaft (8) (**Figure 17-16, Page 17-15**).

DRIVEN CLUTCH INSPECTION

1. Inspect the cam (4) for excessive wear. Replace it if necessary (**Figure 17-16, Page 17-15**).
2. Inspect the drive buttons (6) for excessive wear. Replace if necessary. To remove the drive buttons, remove the socket-head cap screws and then the buttons (**Figure 17-16, Page 17-15**).
3. Inspect the smooth surface on the fixed and moveable face assemblies. Assemblies must be replaced if surfaces are worn more than 0.060-inch (1.5-mm).
4. Inspect the bronze bearing in the moveable face. If the bearing bore diameter is more than 1.384-inch (35.15-mm), the entire moveable face assembly must be replaced.
5. Inspect the shaft of the fixed face assembly. There should be no noticeable wear. Replace the shaft if it is worn, scratched or damaged.

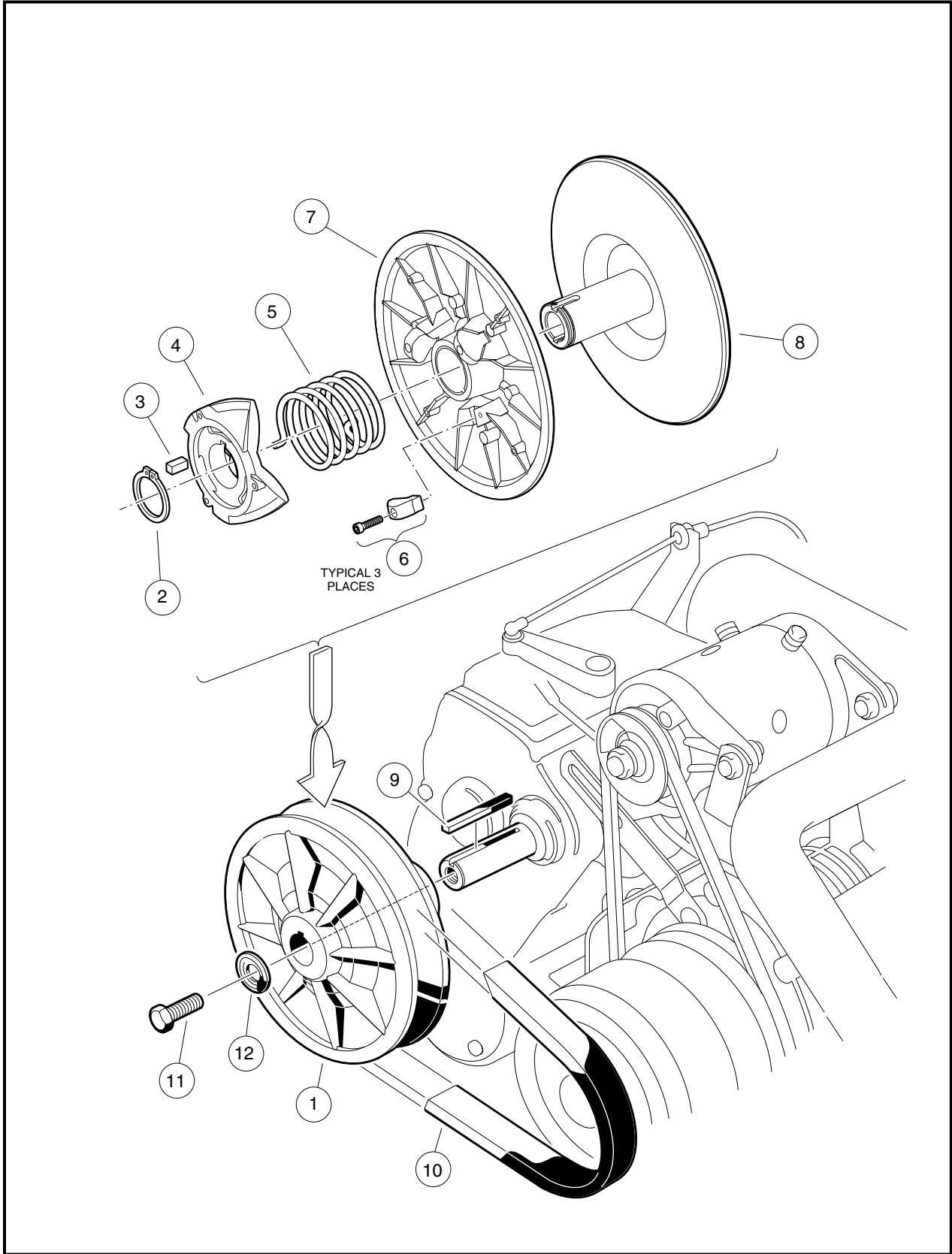


Figure 17-16 Driven Clutch Assembly

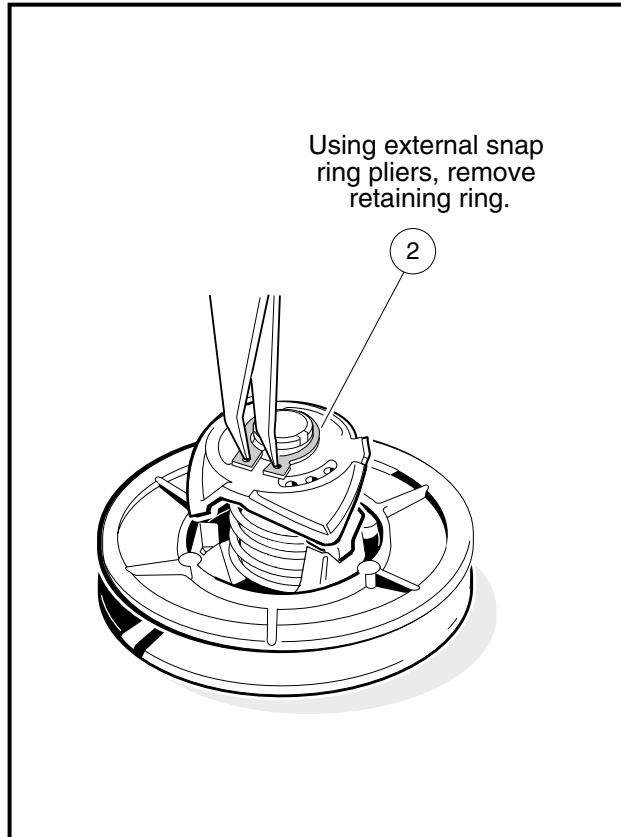


Figure 17-17 Remove Retaining Ring

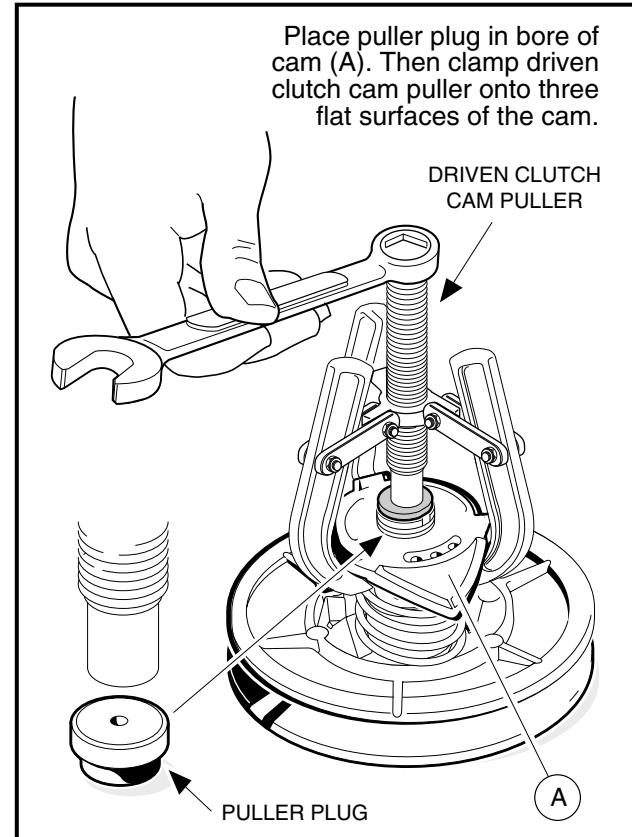


Figure 17-18 Driven Clutch Disassembly

DRIVEN CLUTCH ASSEMBLY

1. Place the three drive buttons (6) in position. Apply one drop of Loctite® 222 to each of the socket head cap screws and then install and tighten them to 8 in-lb (0.9 N-m) (**Figure 17-16, Page 17-15**).
2. Slide the moveable face assembly (7) onto the fixed face shaft (8).
3. Place the end of the spring (5) into hole in the moveable face assembly.
4. Install the key (3) into the keyway of the fixed face assembly (8) shaft.
5. Holding the cam (4) in position for assembly on the shaft, install the other end of the spring (5) into the center spring hole of the cam. Rotate the cam until the keyway is aligned with the key (3) on the fixed face assembly, and then start the cam onto the shaft approximately 1/4 to 3/8-inch (6.3 to 9.5-mm).

5.1. Press Assembly Process:

- 5.1.1. Place the clutch assembly in a press and position the cam press tool (CCI P/N 101809101) on the cam as shown (**Figure 17-19, Page 17-17**).
- 5.1.2. Hold the fixed face assembly (3) and rotate the moveable face assembly (1) one-third turn clockwise, then press the cam (2) onto the fixed face assembly (**Figure 17-19, Page 17-17**).
- 5.1.3. Install the retaining ring (2) (**Figure 17-16, Page 17-15**). See following NOTE.

NOTE: The cam has an interference fit with the keyed shaft and should remain in position when the cam installation tool is removed, providing for the assembly of the retaining ring.

The retaining ring can be reused provided the O.D. does not exceed 1.607 inches (40.82 mm). Otherwise it must be replaced with a new ring (CCI P/N 1014080).

- 5.1.4. While holding onto the cam, tap the end of the fixed face shaft lightly with a plastic mallet until the cam seats against the retaining ring. **See following CAUTION.**

CAUTION

- Do not use a metal hammer to tap the fixed face hub. A metal hammer will damage the shaft.

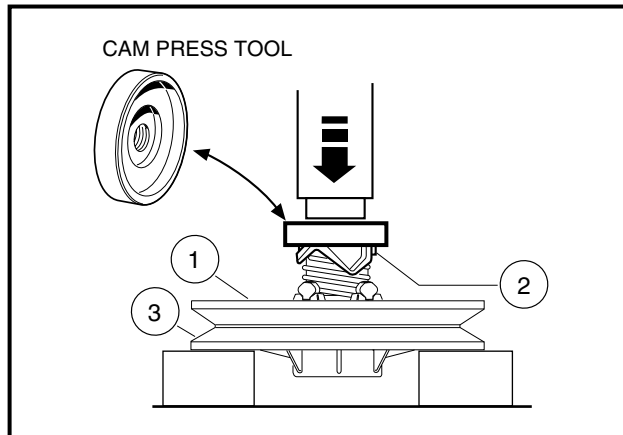


Figure 17-19 Cam Press Tool

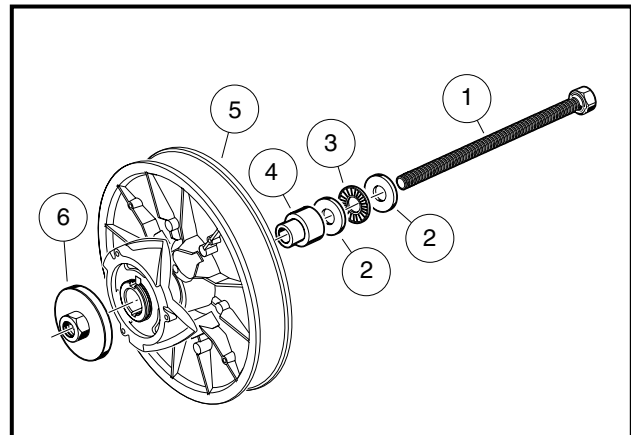


Figure 17-20 Cam Installation Tool

5.2. Field Assembly Process:

NOTE: This process is for field or remote assembly requirements where hydraulic and pneumatic press equipment is not available. Use the Cam Installation Tool (CCI P/N 101808401) for this process (Figure 17-20, Page 17-17).

- 5.2.1. With the clutch loosely assembled, set the edge of the clutch body (5) on a clean, flat surface (Figure 17-20, Page 17-17).
- 5.2.2. Assemble the threaded bolt (1) through the washer (2), the thrust bearing assembly 93, the second washer (2), and the hub guide (4).

NOTE: It is very important that the bolt, washers and thrust bearing assembly be assembled in the order described and shown.

- 5.2.3. Slide the bolt (1) through the clutch body (5) until the threaded bolt, washers, bearing, and hub guide are against the fixed face hub (Figure 17-20, Page 17-17).
- 5.2.4. Hold the clutch assembly and cam installation tool together and place the fixed face down on spaced blocks as illustrated (Figure 17-19, Page 17-17).
- 5.2.5. Place the cam press hub (6) onto the cam installation bolt and thread it down onto the cam hub, centering the press hub onto the cam hub.
- 5.2.6. Hold the fixed face assembly of the clutch (5) and rotate the moveable face of the clutch one-third turn clockwise.
- 5.2.7. Use two wrenches, and hold the bolt head while tightening the cam press hub (6), pressing the cam onto the keyed shaft. Advance the press hub until it is firm against the shaft end.
- 5.2.8. Remove the cam press hub (6) and installation tool, and install the retaining ring.
- 5.2.9. While holding onto the cam, tap the end of the fixed face shaft lightly with a plastic mallet until the cam seats against the retaining ring. **See following CAUTION.**

Driven Clutch Assembly Continued:** CAUTION**

- **Do not use a metal hammer to tap the fixed face hub. A metal hammer will damage the shaft.**

NOTE: The cam has an interference fit with the keyed shaft and should remain in position when the cam installation tool is removed, providing for the assembly of the retaining ring.

The retaining ring can be reused provided the O.D. does not exceed 1.607 inches (40.82 mm). Otherwise it must be replaced with a new ring (CCI P/N 1014080).

DRIVEN CLUTCH INSTALLATION

1. To install the driven clutch, reverse the removal procedure. Make sure that the washer (12) is mounted with the flat portion of the washer against the driven clutch as shown (**Figure 17-16, Page 17-15**). Secure with a *new* bolt (11). **See following NOTE.**

NOTE: The bolt (11) must be replaced with a new bolt (CCI P/N 102242101) containing a locking patch that will prevent the bolt from loosening.

2. Tighten the bolt (11) to 14 ft-lb (19.0 N·m).
3. Connect the spark plug.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 20 ft-lb (27 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower the cargo bed. **See WARNING "For vehicles with cargo beds..." on page 17-2.**

This index applies to key-start vehicles only. Refer to pedal-start index for references pertaining to pedal-start vehicles.

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Transportation and Utility Vehicles

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P.O. Box 204658

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