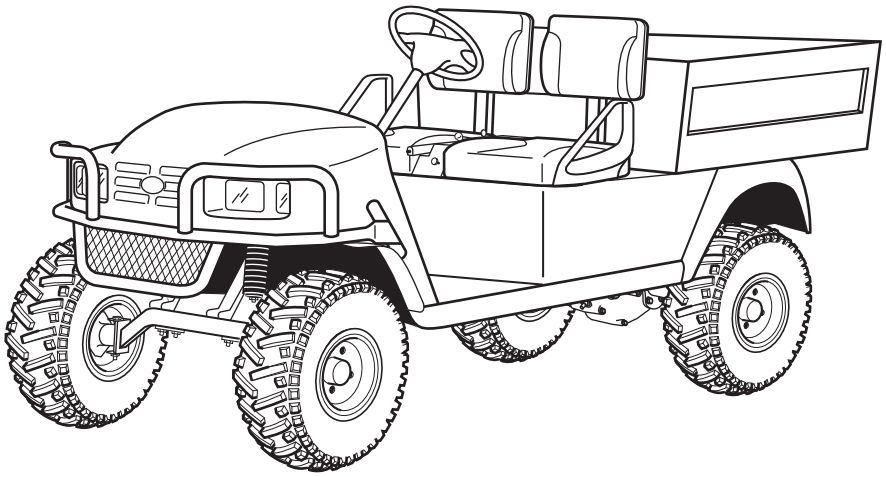
28580-G01

EZGO ST WorkHorse®

TECHNICIAN'S REPAIR AND SERVICE MANUAL



ST 480
GASOLINE POWERED UTILITY VEHICLE

ISSUED: 2001 REVISED: APRIL 2011

SAFETY

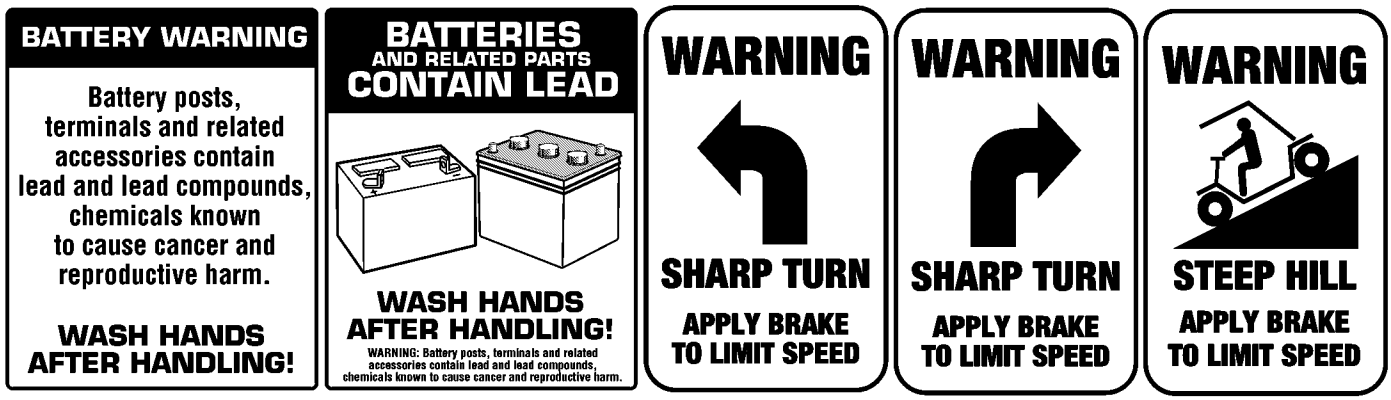
Read and understand all labels located on the vehicle. For any questions on any of the information, contact a representative for clarification.

Always replace any damaged or missing labels.

On steep hills it is possible for vehicles to coast at greater than normal speeds encountered on a flat surface. To prevent loss of vehicle control and possible serious injury, speeds should be limited to no more than the maximum speed on level ground. (See vehicle specification.) Limit speed by applying the service brake.

Catastrophic damage to the drive train components due to excessive speed may result from driving the vehicle above specified speed. Damage caused by excessive speed may cause a loss of vehicle control, is costly, is considered abuse and will not be covered under warranty.

If the vehicle is to be used in a commercial environment, signs similar to the ones illustrated should be used to warn of situations that could result in an unsafe condition.



Be sure that this manual remains as part of the permanent service record should the vehicle be re-sold.

NOTES, CAUTIONS AND WARNINGS

Throughout this guide **NOTE, CAUTION** and **WARNING** will be used.

NOTE *A **NOTE** indicates a condition that should be observed.*

CAUTION **A CAUTION indicates a condition that may result in damage to the vehicle.**

⚠ WARNING ⚠ ***A WARNING indicates a hazardous condition that could result in severe injury or death.***

Please observe these **NOTES, CAUTIONS** and **WARNINGS;** be aware that servicing a vehicle requires mechanical skill and a regard for conditions that could be hazardous. Improper service or repair may damage the vehicle or render it unsafe.

⚠ WARNING ⚠ ***Engine exhaust from this product contains chemicals known, in certain quantities, to cause cancer, birth defects, or other reproductive harm.***

NOTE *The exhaust emissions of this vehicles' engine is regulated by the Federal EPA. Significant fines could result from modifications or tampering with the engine, fuel, ignition or air intake systems.*

⚠ WARNING ⚠ ***Battery posts, terminals and related accessories contain lead and lead compounds. Wash hands after handling.***

NOTE *This spark ignition system meets all requirements of the Canadian Interference-Causing Equipment Regulations.*

Ce système d'allumage par étincelle de véhicule respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

(NOTES, CAUTIONS AND WARNINGS CONTINUED ON INSIDE OF BACK COVER)

TECHNICIAN'S REPAIR AND SERVICE MANUAL

GASOLINE POWERED UTILITY VEHICLE

VEHICLE

ST 480

CUSTOMER SERVICE DEPARTMENT IN USA PHONE: 1-800-241-5855 FAX: 1-800-448-8124

OUTSIDE USA PHONE: 010-1-706-798-4311, FAX: 010-1-706-771-4609

TEXTRON GOLF, TURF & SPECIALTY PRODUCTS, P.O.BOX 388, AUGUSTA, GEORGIA USA 30903-0388

NOTES

To obtain a copy of the limited warranty applicable to the vehicle, call or write a local distributor, authorized Branch or Warranty Department with vehicle serial number and manufacturer code.

The use of non Original Equipment Manufacturer (OEM) approved parts may void the warranty.

Overfilling battery may void the warranty.

Tampering with or adjusting the governor to permit vehicle to operate at above factory specifications will void the vehicle warranty.

When servicing engines, all adjustments and replacement components must be per original vehicle specifications in order to maintain Federal and State emission certification.

BATTERY PROLONGED STORAGE

All batteries will self discharge over time. The rate of self discharge varies depending on the ambient temperature and the age and condition of the batteries.

A fully charged battery will not freeze in winter temperatures unless the temperature falls below -75° F (-60° C).

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SAFETY INFORMATION

This manual has been designed to assist the owner-operator in maintaining the vehicle in accordance with procedures developed by the manufacturer. Adherence to these procedures and troubleshooting tips will ensure the best possible service from the product. To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed:

GENERAL

Many vehicles are used for a variety of tasks beyond the original intended use of the vehicle; therefore it is impossible to anticipate and warn against every possible combination of circumstances that may occur. No warnings can take the place of good common sense and prudent driving practices.

Good common sense and prudent driving practices do more to prevent accidents and injury than all of the warnings and instructions combined. The manufacturer strongly suggests that the owner-operator read this entire manual paying particular attention to the CAUTIONS and WARNINGS contained therein. It is further recommended that employees and other operators be encouraged to do the same.

If you have any questions, contact your closest representative or write to the address on the back cover of this publication, Attention: Product Service Department.

Textron Golf, Turf and Specialty Products reserves the right to make design changes without obligation to make these changes on units previously sold and the information contained in this manual is subject to change without notice.

Textron Golf, Turf and Specialty Products is not liable for errors in this manual or for incidental or consequential damages that result from the use of the material in this manual.

This vehicle conforms to the current applicable standard for safety and performance requirements.

These vehicles are designed and manufactured for off-road use. They do not conform to Federal Motor Vehicle Safety Standards and are not equipped for operation on public streets. Some communities may permit these vehicles to be operated on their streets on a limited basis and in accordance with local ordinances.

Refer to GENERAL SPECIFICATIONS for vehicle seating capacity.

Never modify the vehicle in any way that will alter the weight distribution of the vehicle, decrease its stability or increase the speed beyond the factory specification. Such modifications can cause serious personal injury or death. Modifications that increase the speed and/or weight of the vehicle will extend the stopping distance and may reduce the stability of the vehicle. Do not make any such modifications or changes. The manufacturer prohibits and disclaims responsibility for any such modifications or any other alteration which would adversely affect the safety of the vehicle.

Vehicles that are capable of higher speeds must limit their speed to no more than the speed of other vehicles when used in a golf course environment. Additionally, speed should be further moderated by the environmental conditions, terrain and common sense.

GENERAL OPERATION

Always use the vehicle in a responsible manner and maintain the vehicle in safe operating condition.

Always read and observe all warnings and operation instruction labels affixed to the vehicle.

Always follow all safety rules established in the area where the vehicle is being operated.

Always reduce speed to compensate for poor terrain or conditions.

Always apply service brake to control speed on steep grades.

Always maintain adequate distance between vehicles.

Always reduce speed in wet areas.

Always use extreme caution when approaching sharp or blind turns.

Always use extreme caution when driving over loose terrain.

Always use extreme caution in areas where pedestrians are present.

MAINTENANCE

Always maintain your vehicle in accordance with the manufacturer's periodic service schedule.

Always ensure that mechanics performing repairs are trained and qualified to do so.

Always follow the manufacturer's directions if you do any maintenance on your vehicle. Be sure to disable the vehicle before performing any maintenance. Disabling includes removing the key from the key switch and removal of a battery wire.

Always insulate any tools used within the battery area in order to prevent sparks or battery explosion caused by shorting the battery terminals or associated wiring. Remove the battery or cover exposed terminals with an insulating material.

Always use specified replacement parts. Never use replacement parts of lesser quality.

Always use recommended tools.

Always determine that tools and procedures not specifically recommended by the manufacturer will not compromise the safety of personnel nor jeopardize the safe operation of the vehicle.

Always support the vehicle using wheel chocks and safety stands. Never get under a vehicle that is supported by a jack. Lift the vehicle in accordance with the manufacturer's instructions.

Always empty the fuel tank or plug fuel hoses to prevent fuel leakage.

Never attempt to maintain a vehicle in an area where exposed flame is present or persons are smoking.

Always be aware that a vehicle that is not performing as designed is a potential hazard and must not be operated.

The manufacturer cannot anticipate all situations, therefore people attempting to maintain or repair the vehicle must have the skill and experience to recognize and protect themselves from potential situations that could result in severe personal injury or death and damage to the vehicle. Use extreme caution and, if unsure as to the potential for injury, refer the repair or maintenance to a qualified mechanic.

Always test drive the vehicle after any repairs or maintenance. All tests must be conducted in a safe area that is free of both vehicular and pedestrian traffic.

Always replace damaged or missing warning, caution or information labels.

Always keep complete records of the maintenance history of the vehicle.

VENTILATION

Always store gasoline vehicles in a well ventilated area. Ventilation prevents gasoline fumes from accumulating.

Never fuel a vehicle in an area that is subject to flame or spark. Pay particular attention to natural gas or propane water heaters and furnaces.

Never work around or operate a vehicle in an environment that does not ventilate exhaust gases from the area. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal.

Notes:

GENERAL INFORMATION & ROUTINE MAINTENANCE

TABLE OF CONTENTS FOR SECTION 'A'

LIST OF ILLUSTRATIONS

Notes:

GENERAL INFORMATION & ROUTINE MAINTENANCE

A

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

SERIAL NUMBER PLATE LOCATION

The serial and manufacturing numbers are stamped on a plate on the passenger side of the dash housing (Ref Fig. 1 on page A-1).

Design changes take place on an ongoing basis. In order to obtain correct components for the vehicle, the manufacturing date and serial number must be provided when ordering service parts.

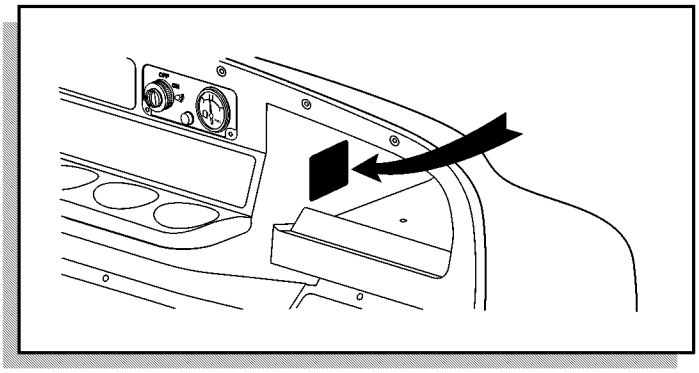


Fig. 1 Serial Number Plate Location

STARTING THE VEHICLE WITH A DISCHARGED BATTERY

⚠ WARNING ⚠ ***Do not attempt to 'jump start' a vehicle using another vehicle.***

The vehicle is equipped with a starter/generator. When starting the engine, the starter/generator functions as a starter and with the engine running, it functions as a generator.

With the running times associated with this kind of vehicle, the generator is more than adequate to maintain the battery charge level. The generator is not designed to charge a discharged battery.

Since the engine stops when the accelerator is released, **jump starting should not be attempted**.

If the vehicle is equipped with additional lights and/or a strobe light that is used when the vehicle is not in motion, the starter/generator may not be adequate to maintain battery charge. In this situation, the battery may require charging. If the vehicle battery has become discharged, it must be charged with a 12V charger rated at 10 amp or less. Observe all instructions provided by the manufacturer of the charger.

SERVICING THE VEHICLE

⚠ WARNING ⚠ ***To prevent severe injury or death, resulting from improper servicing techniques, observe the following Warnings:***

Do not attempt any type of servicing operations before reading and understanding all notes, cautions and warnings in this manual.

Any servicing requiring adjustments to be made to the powertrain while the motor is running must be made with both drive wheels raised.

Wear eye protection when working on the vehicle. In particular, use care when working around batteries, or using solvents or compressed air.

To reduce the possibility of causing an electrical arc, which could result in a battery explosion, turn off all electrical loads from the batteries before removing any heavy gauge battery wires.

To prevent the possibility of powertrain failure, never operate vehicle at full throttle for more than 4 - 5 seconds while vehicle is in a "no load" condition.

It is in the best interest of both vehicle owner and servicing dealer, to carefully follow the procedures recommended in this manual. Adequate preventative maintenance, applied at regular intervals, is the best guarantee for keeping the vehicle both dependable and economical.

In any product, components will eventually fail to perform properly as the result of normal use, age, wear or abuse.

It is virtually impossible to anticipate all possible component failures or the manner in which each component may fail.

A vehicle requiring repair indicates the vehicle is no longer functioning as designed and should be considered potentially hazardous. Use extreme care when working on a vehicle. When diagnosing, removing or replacing any components that are not operating properly, consider the safety of yourself and those around you, should the component move unexpectedly.

Some components are heavy, spring loaded, highly corrosive, explosive, may produce amperage or reach high temperatures. Gasoline, carbon monoxide, battery acid and hydrogen gas could result in serious bodily injury to the technician/mechanic and bystanders, if not treated with the utmost caution. Be careful not to place hands,

face, feet or body in a location that could expose them to injury should an unforeseen dangerous situation occur.

Always use the appropriate tools listed in the tool list and wear approved safety equipment.

Before a new vehicle is put into operation, it is recommended the items shown in the INITIAL SERVICE CHART be performed.

ITEM	SERVICE OPERATION
Battery	Charge battery
Seats	Remove protective plastic covering
Brakes	Check operation and adjust if necessary
	Check hydraulic brake fluid level
	Establish new vehicle braking distance
Tires	Check pressure
Fuel	Fill tank with correct fuel
Engine	Check oil level (Initial change after 5 - 8 hours)

Fig. 2 Initial Service Chart

TOWING

⚠ WARNING ⚠ ***This vehicle is not designed to be towed.***

It is recommended that the vehicle be moved by placing the entire vehicle on a trailer, flatbed truck or other suitable transport.

NEUTRAL LOCK

To prevent the driven clutch from turning the rear axle during any service operations, a neutral lock is located on the rear axle (Ref Fig. 3 on page A-2). To operate, place the direction selector in a position between 'F' and 'R'. Turn the key switch to 'OFF'. Raise bed for access to the rear axle. Rotate the tabs on the rear axle shift lever as shown. The attached pin will snap into a cavity in the differential case. When in this position, the rear axle remains locked in the neutral position. To make the direction selector functional, pull the tab out and rotate until the pointed portion of the tab fits into the detent position in the rear axle shift lever.

ROUTINE MAINTENANCE

This vehicle will give years of satisfactory service, providing it receives regular maintenance. Refer to the Periodic

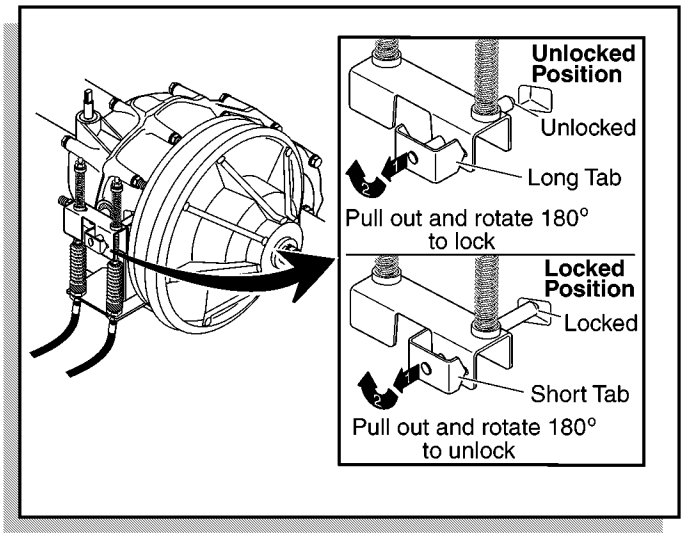


Fig. 3 Neutral Lock

Service Schedule for appropriate service intervals (Ref Fig. 6 on page A-6). Refer to 'Lubrication' in FRONT SUSPENSION AND STEERING section for appropriate lubrication locations.

CAUTION **Do not use more than three (3) pumps of grease in each grease fitting at any one time. Excess grease may cause grease seals to fail or grease migration into areas that could damage components.**

Putting more than three pumps of grease in a grease fitting could damage grease seals and cause premature bearing failure.

NOTE *Some items must be serviced more frequently on vehicles used under severe driving conditions.*

POWERTRAIN MAINTENANCE

Access the powertrain by raising or removing seats. Full access to powertrain may be obtained by raising the load bed. Some service procedures may require the vehicle be lifted. Refer to 'LIFTING THE VEHICLE' in Section B for proper lifting procedure and safety information.

⚠ WARNING ⚠ ***Always install a positive stop to prevent severe injury that could result if the load bed lift mechanism should unexpectedly fall.***

Wrap wrenches with vinyl tape to prevent the possibility of a dropped wrench 'shorting out' a battery, which could result in an explosion and severe personal injury or death.

To prevent accidental starting, remove and ground spark plug wires and disconnect battery at negative terminal before servicing.

For maintenance procedures relating to the engine, speed control, fuel system, transmission, and rear axle or suspension, refer to the particular section. See the TABLE OF CONTENTS for section location.

BRAKES

After the vehicle has been put into service, it is recommended that the brakes be checked by periodically conducting a brake performance test.

⚠ WARNING ⚠ ***To prevent severe injury or death resulting from operating a vehicle with improperly operating brake system, the braking system must be properly maintained. All driving brake tests must be done in a safe location with regard for the safety of all personnel.***

For test method and brake service, refer to BRAKES section.

TIRES

NOTE *Standard tires for this vehicle are uni-directional and should never be moved from one side of vehicle to the other. Left side tires should always remain on the left side of the vehicle. Right side tires should always remain on the right side of the vehicle. Uni-directional tires have an arrow on the sidewall indicating direction of rotation when moving forward.*

Tire condition should be inspected and inflation pressures checked per the Periodic Service Schedule when tires are cool. Be sure to install the valve dust cap after checking or inflating tire. For additional information, refer to WHEELS AND TIRES section.

CARE AND CLEANING OF THE VEHICLE

CAUTION **When pressure washing vehicle, do not use pressure in excess of 700 psi. To prevent cosmetic damage, do not use any abrasive or reactive solvents to clean plastic parts.**

It is important that proper techniques and cleaning materials be used.

Normal cleaning of vinyl seats and plastic or rubber trim requires the use of a mild soap solution applied with a sponge or soft brush and wipe with a damp cloth.

Removal of oil, tar, asphalt, shoe polish, etc. will require the use of a commercially available vinyl/rubber cleaner.

The painted surfaces of the vehicle provide attractive appearance and durable protection. Frequent washing with lukewarm or cold water is the best method of preserving the painted surfaces.

Do not use hot water, strong soap or harsh chemical detergents.

Rubber parts should be cleaned with non-abrasive household cleaner.

Occasional cleaning and waxing with non-abrasive products designed for 'clear coat' automotive finishes will enhance the appearance and durability of the painted surfaces.

Corrosive materials used as fertilizers or for dust control can collect on the underbody of the vehicle. These materials will accelerate corrosion of underbody parts. It is recommended that the underbody be flushed occasionally with plain water. Thoroughly clean any areas where mud or other debris can collect. Sediment packed in closed areas should be loosened to ease its removal, taking care not to chip or otherwise damage paint.

VEHICLE CARE PRODUCTS

There are several products, available through a local distributor, an authorized Branch, or the Service Parts Department, to help maintain the vehicle. Among them are:

- Touch-up paint specially formulated to match vehicle colors for use on both metal and TPE (plastic) bodies. (P/N 28140-G**, 28432-G** and 75831-G01)
- Multi-purpose Battery Protectant formulated to form a long-term, flexible, non-tacky, dry coating that will not crack, peel or flake over a wide temperature range. (P/N 75500-G01)
- White Lithium Grease designed to provide lubrication protection in areas where staining or discoloring is a problem, or in areas of extreme temperature ranges. (P/N 75502-G01)
- Penetrant/Lubricant, a 4-in-1 product that penetrates the most stubborn of frozen parts, lubricates leaving a light lubricating film, prevents corrosion by adhering to wet or dry surfaces and displaces

moisture, sealing against future moisture return. (P/N 75503-G01)

- Multi-purpose Cleaner and Degreaser that contains natural, environmentally safe solvents. (P/N 75504-G01)
- Multi-purpose Hand Cleaner is an industrial strength cleaner containing no harsh solvents, yet gently lifts grease off hands. May be used with or without water. (P/N 75505-G01)
- Battery Cleaner that promotes easy, non-violent neutralization of battery acids and battery acid crystals. The resulting sodium salts are water soluble and easily washed away. (P/N 75506-G01)
- Biodegradable Cleaner that cleans the toughest dirt and heavy soils by breaking down grease to be easily wiped or rinsed away. (P/N 75507-G01)
- Multi-purpose Value Pack sampler package including 4 ounce (118 ml) aerosol cans of Battery Protector, Penetrant/Lubricant, White Lithium Grease, and Carburetor and Choke Cleaner. (P/N 75508-G01)
- Plexus plastic cleaner and polish removes minor scratches from windshield. (P/N 28433-G**)

TOP AND WINDSHIELD (IF EQUIPPED)

⚠ WARNING ⚠ ***The top does not provide protection from roll over or falling objects.***

The windshield does not provide protection from tree limbs or flying objects.

The top and windshield are designed for weather protection only. For additional information, refer to WEATHER PROTECTION section.

TRAILERING

⚠ WARNING ⚠ ***To prevent personal injury to occupants of other highway vehicles, be sure that the vehicle and contents are adequately secured to trailer.***

Do not ride on vehicle being trailered.

Remove windshield before trailering.

Maximum speed with top is 50 mph (80 kph).

If the vehicle is to be transported on a trailer at highway speeds, the windshield and top must be removed and the seat bottoms secured. Always check that the vehicle and contents are adequately secured before trailering the vehicle. The rated capacity of the trailer must exceed the weight of the vehicle (see GENERAL SPECIFICATIONS for vehicle weight) and load. Lock the parking brake and secure the vehicle to the trailer using ratchet tie downs.

PROLONGED STORAGE

⚠ WARNING ⚠ ***To prevent serious injury or death resulting from a possible explosion:***

Do not handle fuel in an area that is not adequately ventilated. Do not smoke near the fuel tank or refuel near open flame or electrical items which could produce a spark.

Store vehicle in a clean, dry area. Do not store in same area as a stove, furnace, water heater, or other appliance that uses a pilot light or has a device that can create a spark.

Always wear safety glasses to prevent possible eye injury from gasoline or gasoline vapor.

Keep hands, clothing and jewelry away from moving parts. Use care not to contact hot objects. Raise the rear of the vehicle and support on jack stands before attempting to run the engine.

Preparing the engine for a prolonged storage period (30 days or more) calls for a few simple steps to prevent a build up of varnish and gum in the carburetor and corrosion in the engine.

- Raise the rear of the vehicle and support on jack stands. Refer to 'Lifting the Vehicle' in Section B for proper lifting procedure and safety information.
- If fuel tank contains oxygenated or reformulated gasoline (gasoline blended with an alcohol or ether), remove the passenger side seat bottom and disconnect the fuel hose **at the fuel tank**. Keep end of hose up near the top of the tank to prevent spilling fuel. With proper ventilation, depress the accelerator pedal and allow engine to run until it stops due to lack of fuel. Reattach fuel line to tank and replace seat bottom.

  -or-

  If fuel tank contains non-oxygenated or non-reformulated gasoline, add a gasoline additive to the tank in accordance with the manufacturer's recommendations. Drive the vehicle for several min-

utes to circulate the additive through the carburetor.

- While engine is still warm, change oil. See ENGINE section.
- Remove spark plugs and pour about 1 oz. (30 ml) of engine oil into each cylinder. Replace spark plugs, ground spark plug wires and use starter to turn engine over a few seconds to distribute oil.
- Clean body, chassis and engine of debris, mud, chaff or grass. See ENGINE section.

HARDWARE

Periodically, the vehicle should be inspected for loose fasteners. Fasteners should be tightened in accordance with the Torque Specifications table (Ref Fig. 5 on page A-5). Use care when tightening fasteners and refer to the sections in this manual for specific torque values

Generally, two grades of hardware are used in the vehicle. Grade 5 hardware can be identified by the three marks on the hexagonal head. Unmarked hardware is Grade 2. (Ref Fig. 4 on page A-5).

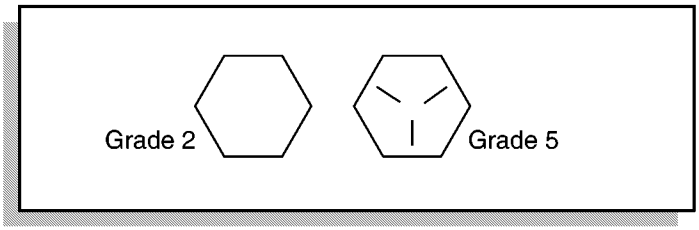


Fig. 4 Bolt Grades

TORQUE SPECIFICATIONS

ALL TORQUE FIGURES ARE IN FT. LBS. (NM)

Unless otherwise noted in text, tighten all hardware in accordance with this chart.
The table below specifies 'lubricated' torque figures. Fasteners that are plated or lubricated when installed are considered 'wet' and require approximately 80% of the torque required for 'dry' fasteners.

BOLT SIZE	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	3/4"	7/8"	1"
Grade 2	4 (5)	8 (11)	15 (20)	24 (33)	35 (47)	55 (75)	75 (102)	130 (176)	125 (169)	190 (258)
Grade 5	6 (8)	13 (18)	23 (31)	35 (47)	55 (75)	80 (108)	110 (149)	200 (271)	320 (434)	480 (651)

Fig. 5 Torque Specifications

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

PERIODIC SERVICE SCHEDULE

✓ Check ♦ Clean, Adjust, etc. ▲ Replace

***NOTE**: Some maintenance items must be serviced more frequently on vehicles used under severe driving conditions*

8 HOURS or DAILY	
ENGINE	✓ Check oil level (See Note 1)
SERVICE BRAKE	✓ Check brake performance, smooth operation and adjust if required
PARKING BRAKE	✓ Check brake performance and adjust if required
REVERSE WARNING DEVICE	✓ Check operation when direction selector is in reverse
TIRES	✓ Examine for cuts, excessive wear and pressure. See GENERAL SPECIFICATIONS section
WHEELS	✓ Check for bent rims, missing or loose lug nuts
FUEL GAUGE	✓ Check for proper operation (at fueling), and fuel cap vent is free of dirt
BODY	♦ Clean body components as required
COOLING SYSTEM	♦ Clean fins and inside blower housing (See Note 3)
25 HOURS (includes items listed in previous tables & the following)	
ENGINE	♦ Clean foam pre-cleaner (See Note 3) ✓ Check for unusual noise, vibration, acceleration, oil leaks
BATTERY	♦ Clean battery & terminals with 1/4 cup (60 ml) baking soda to 1 1/2 gallons (6 liters) water solution, rinse with clear water ✓ Check charge condition and all connections
WIRING	✓ Check all wiring for loose connections and broken/missing insulation
ACCELERATOR CABLE	✓ Check for smooth movement - DO NOT LUBRICATE CABLE
CHOKE CABLE	✓ Check for smooth movement and adjustment - DO NOT LUBRICATE CABLE
CARBURETOR LINKAGE	✓ Check attachment, adjust as required
DIRECTION SELECTOR	✓ Check for smooth movement and attachment, adjust as required
STARTER/GENERATOR BELT	✓ Check for tension, wear and cracks
STEERING ASSEMBLY	✓ Check for abnormal play, tightness of all hardware
TIE RODS/LINKAGES	✓ Check for excessive play, bent components or loose connections
REAR AXLE	✓ Check for leakage, add SAE 30 oil as required
50 HOURS (includes items listed in previous tables & the following)	
ENGINE	▲ Change oil, DO NOT OVERFILL (See Notes 1 and 2) ✓ Check spark plug wires for cracks/loose connections
EXHAUST	✓ Inspect/clean spark arrestor

Fig. 6 Periodic Service Schedule

FRONT AXLE	✓ Check for damage to axle and loose or missing hardware
FRONT SHOCK ABSORBERS	✓ Check for oil leakage and loose fasteners
FRONT SPRINGS	✓ Check for loose hardware, cracks at attachments
FRONT WHEEL ALIGNMENT	✓ Check for unusual tire wear, align as required. See FRONT SUSPENSION AND STEERING section
PARKING BRAKE	✓ Check for binding cables ✓ Check for damage or wear ♦ Lubricate, use light oil. DO NOT LUBRICATE CABLES
HYDRAULIC BRAKE FLUID	✓ Check level, add if required (DOT 3) and check for leakage
REAR SHOCK ABSORBERS	✓ Check for oil leakage, loose mounting hardware
FUEL SYSTEM	✓ Check for leaks at tank, cap, lines, filter, pump and carburetor ✓ Check fuel lines for cracks/deterioration
THROTTLE/GOVERNOR LINKAGE	✓ Check operation and governed speed
100 HOURS (includes items listed in previous tables & the following)	
ENGINE	▲ Change oil filter (See Note 1) ▲ Change air cleaner cartridge if damaged or dirty (See Note 3)
DIRECTION SELECTOR	✓ Check for wear and smooth movement (lubricate shaft with light oil if required) ✓ Check shift cable spring length
KING PINS	✓ Check for excessive play and tightness of retaining nuts ♦ Lubricate, use wheel bearing grease
STEERING ASSEMBLY	♦ Lubricate linkage, use wheel bearing grease
TIE RODS/LINKAGES	♦ Lubricate, use wheel bearing grease
REAR AXLE	✓ Check for unusual noise and loose missing mounting hardware
250-300 HOURS or YEARLY (includes items listed in previous tables & the following)	
ENGINE	▲ Replace or clean spark plugs ▲ Replace in-line fuel filter ✓ Check valve clearance, refer to Briggs & Stratton® Repair Manual (P/N 272144) for VANGUARD™ V-Twin Overhead Valve Engines
FRONT WHEEL BEARINGS	♦ Adjust. See FRONT SUSPENSION AND STEERING section ♦ Pack with wheel bearing grease
REAR AXLE	✓ Check lubricant, if oil seepage is evident, add lubricant (SAE 30) as required
SERVICE BRAKES	♦ Clean. See HYDRAULIC BRAKES section ✓ Check brake shoe linings, wear limit .06" (1.5 mm)
MUFFLER/EXHAUST	✓ Check mounting hardware; check for leaks at head and muffler gaskets

Fig. 6 Periodic Service Schedule

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

500 HOURS	
REAR AXLE	▲ Replace lubricant
ENGINE	♦ Clean combustion chamber deposits, refer to Briggs & Stratton® Repair Manual (P/N 272144) for VANGUARD™ V-Twin Overhead Valve Engines

Fig. 6 Periodic Service Schedule

Note 1 - Change oil after first 8 hours, then after every 50 hours.

Note 2 - Change oil every 25 hours when operating under heavy load or in high temperatures.

Note 3 - Clean more often under dusty conditions or when airborne debris is present. Clean foam pre-cleaner first and replace paper cartridge if dirty. Replace either if showing signs of damage.

TABLE OF CONTENTS FOR SECTION 'B'

LIST OF ILLUSTRATIONS

Notes:

Read all of Section A and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

GENERAL

The following text is provided as recommended by part II of ASME/ANSI B56.8-1988. E-Z-GO strongly endorses the contents of this specification.

PART II
FOR THE USER

4 GENERAL SAFETY PRACTICES

4.1 Introduction

4.1.1 Like other machines, carriers can cause injury if improperly used or maintained. Part II contains broad safety practices applicable to carrier operations. Before operation, the user shall establish such additional specific safety practices as may reasonably be required for safe operation.

4.2 Stability

4.2.1 Experience has shown that this vehicle, which complies with this standard, is stable when properly operated and when operated in accordance with specific safety rules and practices established to meet actual operating terrain and conditions. However, improper operation, faulty maintenance, or poor housekeeping may contribute to a condition of instability and defeat the purpose of the standard. Some of the conditions which may affect stability are failure of the user to follow safety practices; also, ground and floor conditions, grade, speed, loading, the operation of the carrier with improper loads, battery weight, dynamic and static forces, and the judgement exercised by the carrier operator.

(a) The user shall train carrier operators to adhere strictly to the operating instructions stated in this Standard.

(b) The user shall survey specific operating conditions and environment, and establish and train carrier operators to comply with additional, specific safety practices.

4.3 Nameplates, Markings, Capacity, and Modifications

4.3.1 The user shall maintain in a legible condition all nameplates, warnings, and instructions which are supplied by the manufacturer.

4.3.2 The user shall not perform any modification or addition which affects capacity or safe operation, or make any change not in accordance with the owner's manual without the manufacturer's prior written authorization. Where authorized modifications have been made, the user shall ensure that capacity, operation, warning, and maintenance instruction plates, tags, or decals are changed accordingly.

4.3.3 As required under paras. 4.3.1 or 4.3.2, the manufacturer shall be contacted to secure new nameplates, warnings, or instructions which shall then be affixed in their proper place on the carrier.

4.4 Fuel Handling and Storage

4.4.1 The user shall supervise the storage and handling of liquid fuels (when used) to be certain that it is in accordance with appropriate paragraphs of ANSI/NFPA 505 and ANSI/NFPA 30.

4.4.2 Storage and handling of liquefied petroleum gas fuels shall be in accordance with appropriate paragraphs of ANSI/NFPA 505 and ANSI/NFPA 58. If such storage or handling is not in compliance with these standards, the user shall prevent the carrier from being used until such storage and handling is in compliance with these standards.

4.5 Changing and Charging Storage Batteries for Electric Personnel and Burden Carriers

4.5.1 The user shall require battery changing and charging facilities and procedures to be in accordance with appropriate paragraphs of ANSI/NFPA 505.

4.5.2 The user shall periodically inspect facilities and review procedures to be certain that appropriate paragraphs of ANSI/NFPA 505, are strictly complied with, and shall familiarize carrier operators with it.

4.6 Hazardous Locations

4.6.1 The user shall determine the hazard classification of the particular atmosphere or location in which the carrier is to be used in accordance with ANSI/NFPA 505.

4.6.2 The user shall permit in hazardous areas only those carriers approved and of the type required by ANSI/NFPA 505.

4.7 Lighting for Operating Areas

4.7.1 The user, in accordance with his responsibility to survey the environment and operating conditions, shall determine if the carrier requires lights and, if so, shall equip the carrier with appropriate lights in accordance with the manufacturer's recommendations.

4.8 Control of Noxious Gases and Fumes

4.8.1 When equipment powered by internal combustion engines is used in enclosed areas, the atmosphere shall be maintained within limits specified in the American Conference of Governmental Industrial Hygienists publication, "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment". This shall be accomplished by ventilation provided by the user, and/or the installation, use, and proper maintenance of emission control equipment recommended or provided by the manufacturer of the equipment.

4.9 Warning Device(s)

4.9.1 The user shall make periodic inspections of the carrier to be certain that the sound-producing and/or visual device(s) are maintained in good operating condition.

4.9.2 The user shall determine if operating conditions require the carrier to be equipped with additional sound-producing and/or visual devices and be responsible for providing and maintaining such devices, in accordance with the manufacturer's recommendations.

5 OPERATING SAFETY RULES AND PRACTICES

5.1 Personnel and Burden Carrier Operator Qualifications

5.1.1 Only persons who are trained in the proper operation of the carrier shall be authorized to operate the carrier. Operators shall be qualified as to visual, auditory, physical, and mental ability to safely operate the equipment according to Section 5 and all other applicable parts of this Standard.

5.2 Personnel and Burden Carrier Operators' Training

5.2.1 The user shall conduct an operators' training program.

5.2.2 Successful completion of the operators' training program shall be required by the user before operation of the carrier. The program shall be presented in its entirety to all new operators and not condensed for those claiming previous experience.

5.2.3 The user should include in the operators' training program the following:

(a) instructional material provided by the manufacturer;

(b) emphasis on safety of passengers, material loads, carrier operator, and other employees;

(c) general safety rules contained within this Standard and the additional specific rules determined by the user in accordance with this Standard, and why they were formulated;

(d) introduction of equipment, control locations and functions, and explanation of how they work when used properly and when used improperly, and surface conditions, grade, and other conditions of the environment in which the carrier is to be operated;

(e) operational performance tests and evaluations during, and at completion of, the program.

5.3 Personnel and Burden Carrier Operator Responsibility

5.3.1 Operators shall abide by the following safety rules and practices in paras. 5.4, 5.5, 5.6, and 5.7.

5.4 General

5.4.1 Safeguard the pedestrians at all times. Do not drive carrier in a manner that would endanger anyone.

5.4.2 Riding on the carrier by persons other than the operator is authorized only on personnel seat(s) provided by the manufacturer. All parts of the body shall remain within the plan view outline of the carrier.

5.4.3 When a carrier is to be left unattended, stop carrier, apply the parking brake, stop the engine or turn off power, turn off the control or ignition circuit, and remove the key if provided. Block the wheels if machine is on an incline.

5.4.4 A carrier is considered unattended when the operator is 25 ft. (7.6 m) or more from the carrier which remains in his view, or whenever the operator leaves the carrier and it is not within his view. When the operator is dismounted and within 25 ft. (7.6 m) of the carrier still in his view, he still must have controls neutralized, and the parking brake(s) set to prevent movement.

5.4.5 Maintain a safe distance from the edge of ramps and platforms.

5.4.6 Use only approved carriers in hazardous locations, as defined in the appropriate safety standards.

5.4.7 Report all accidents involving personnel, building structures, and equipment.

5.4.8 Operators shall not add to, or modify, the carrier.

5.4.9 Carriers shall not be parked or left unattended such that they block or obstruct fire aisles, access to stairways, or fire equipment.

5.5 Traveling

5.5.1 Observe all traffic regulations, including authorized speed limits. Under normal traffic conditions keep to the right. Maintain a safe distance, based on speed of travel, from a carrier or vehicle ahead; and keep the carrier under control at all times.

5.5.2 Yield the right of way to pedestrians, ambulances, fire trucks, or other carriers or vehicles in emergency situations.

5.5.3 Do not pass another carrier or vehicle traveling in the same direction at intersections, blind spots, or at other dangerous locations.

5.5.4 Keep a clear view of the path of travel, observe other traffic and personnel, and maintain a safe clearance.

5.5.5 Slow down or stop, as conditions dictate, and activate the sound-producing warning device at cross aisles and when visibility is obstructed at other locations.

5.5.6 Ascend or descend grades slowly.

5.5.7 Avoid turning, if possible, and use extreme caution on grades, ramps, or inclines; normally travel straight up and down.

5.5.8 Under all travel conditions the carrier shall be operated at a speed that will permit it to be brought to a stop in a safe manner.

5.5.9 Make starts, stops, turns, or direction reversals in a smooth manner so as not to shift the load, endanger passengers, or overturn the carrier.

5.5.10 Do not indulge in dangerous activities, such as stunt driving or horseplay.

5.5.11 Slow down when approaching, or on, wet or slippery surfaces.

5.5.12 Do not drive carrier onto any elevator unless specifically authorized to do so. Approach elevators slowly, and then enter squarely after the elevator car is properly leveled. Once on the elevator, neutralize the controls, shut off power, and set parking brakes. It is advisable that all other personnel leave the elevator before a carrier is allowed to enter or exit.

5.5.13 Avoid running over loose objects, potholes, and bumps.

5.5.14 To negotiate turns, reduce speed to improve stability, then turn hand steering wheel or tiller in a smooth, sweeping motion.

5.6 Loading

5.6.1 Handle only stable and safely arranged loads. When handling off-center loads which cannot be centered, operate with extra caution.

5.6.2 Handle only loads within the capacity of the carrier as specified on the nameplate.

5.6.3 Handle loads exceeding the dimensions used to establish carrier capacity with extra caution. Stability and maneuverability may be adversely affected.

5.7 Operator Care of Personnel and Burden Carriers

5.7.1 At the beginning of each shift during which the carrier will be used, the operator shall check the carrier condition and inspect the tires, warning devices, lights, battery(s), speed and directional controllers, brakes, and steering mechanism. If the carrier is found to be in need of repair, or in any way unsafe, the matter shall be reported immediately to the designated authority and the carrier shall not be operated until it has been restored to safe operating condition.

5.7.2 If during operation the carrier becomes unsafe in any way, the matter shall be reported immediately to the designated authority, and the carrier shall not be operated until it has been restored to safe operating condition.

5.7.3 Do not make repairs or adjustments unless specifically authorized to do so.

5.7.4 The engine shall be stopped and the operator shall leave the carrier while refueling.

5.7.5 Spillage of oil or fuel shall be carefully and completely absorbed or evaporated and fuel tank cap replaced before starting engine.

5.7.6 Do not operate a carrier with a leak in the fuel system or battery(s).

5.7.7 Do not use open flames for checking electrolyte level in storage battery(s) or liquid level in fuel tanks.

6 MAINTENANCE PRACTICES

6.1 Introduction

6.1.1 Carriers may become hazardous if maintenance is neglected. Therefore, maintenance facilities,

trained personnel, and procedures shall be provided. Such facilities may be on or off the premises.

6.2 Maintenance Procedures

6.2.1 Maintenance and inspection of all carriers shall be performed in conformance with the manufacturer's recommendations and the following practices.

(a) A scheduled preventive maintenance, lubrication, and inspection system shall be followed.

(b) Only qualified and authorized personnel shall be permitted to maintain, repair, adjust, and inspect carriers.

(c) Before undertaking maintenance or repair, follow the manufacturer's recommendations for immobilizing the carrier.

(d) Block chassis before working underneath it.

(e) Before disconnecting any part of the engine fuel system of a gasoline or diesel powered carrier with gravity feed fuel systems, be sure shutoff valve is closed, and run engine until fuel system is depleted and engine stops running.

(f) Before disconnecting any part of the engine fuel system of LP gas powered carriers, close the LP gas cylinder valve and run the engine until fuel in the system is depleted and the engine stops running.

(g) Operation to check performance of the carrier shall be conducted in an authorized area where safe clearance exists.

(h) Before commencing operation of the carrier, follow the manufacturer's instructions and recommended procedures.

(i) Avoid fire hazards and have fire protection equipment present in the work area. Do not use an open flame to check level or leakage of fuel, battery electrolyte, or coolant. Do not use open pans of fuel or flammable cleaning fluids for cleaning parts.

(j) Properly ventilate the work area.

(k) Handle LP gas cylinders with care. Physical damage, such as dents, scrapes, or gouges, may dangerously weaken the tank and make it unsafe for use.

(l) Brakes, steering mechanisms, speed and directional control mechanisms, warning devices, lights, governors, guards, and safety devices shall be inspected regularly and maintained in a safe operating condition.

(m) Special carriers or devices designed and approved for hazardous area operation shall be inspected to ensure that maintenance preserves the original approved safe operating features.

(n) Fuel systems shall be checked for leaks and condition of parts. If a leak is found, action shall be taken to prevent the use of the carrier until the leak has been eliminated.

(o) The carrier manufacturer's capacity, operation, and maintenance instruction plates, tags, or decals shall be maintained in legible condition.

(p) Batteries, motors, speed and directional controllers, limit switches, protective devices, electrical conductors, and connections shall be inspected and maintained in conformance with manufacturers recommended procedures.

(q) Carriers shall be kept in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.

(r) Modifications and additions which affect capacity and safe machine operation shall not be performed by the customer or user without manufacturer's prior written authorization; where authorized modifications have been made, the user shall ensure that capacity, operation, warning, and maintenance instruction plates, tags, or decals are changed accordingly.

(s) Care shall be taken to ensure that all replacement parts are interchangeable with the original parts and of a quality at least equal to that provided in the original equipment.

End of ASME/ANSI B56.8-1988, Part II

NOTES, CAUTIONS AND WARNINGS

Throughout this manual, the following **NOTES, CAUTIONS** and **WARNINGS** are used. For the protection of all personnel and the vehicle, be aware of and observe the following:

NOTE *A **NOTE** indicates a condition that should be observed.*

CAUTION **A CAUTION indicates a condition that may result in damage to the vehicle or surrounding facilities.**

⚠ WARNING ⚠ ***A WARNING indicates a hazardous condition which could result in serious injury or death.***

IMPORTANT SAFETY WARNING

In any product, components will eventually fail to perform properly as the result of normal use, age, wear or abuse.

It is virtually impossible to anticipate all possible component failures or the manner in which each component may fail.

Be aware that a vehicle requiring repair indicates that the vehicle is no longer functioning as designed and therefore should be considered potentially hazardous. Use extreme care when working on any vehicle. When diagnosing, removing or replacing any components that are not operating correctly, take the time to consider the safety ramifications if the component should move unexpectedly.

Some components are heavy, spring loaded, highly corrosive, explosive or may produce high amperage or reach high temperatures. Gasoline, carbon monoxide, battery acid and hydrogen gas could result in serious bodily injury to the technician/mechanic and bystanders if not treated with utmost caution. Be careful not to place hands, face, feet or body in a location that could expose them to injury should an unforeseen situation occur.

Always use the appropriate tools listed in the tool list and wear approved safety equipment.

MODIFICATIONS TO VEHICLE

Do not modify the vehicle in any manner that will change the weight distribution of the vehicle.

⚠ WARNING ⚠ ***Changes to the weight distribution or the center of gravity may make the vehicle unstable or prone to roll over which could result in injury or death to the operator or passenger(s).***

GENERAL MAINTENANCE

⚠ WARNING ⚠ ***To prevent severe injury or death resulting from improper servicing techniques, do not attempt any type of servicing operations before reading and understanding all notes, cautions and warnings in this manual.***

When any maintenance procedure or inspection is performed, it is important that care be exercised to insure the safety of the technician/mechanic or bystanders and to prevent damage to the vehicle.

Always read and understand the **entire** relevant manual section (chapter) before attempting any inspection or service.

BEFORE SERVICING THE VEHICLE

Before attempting to inspect or service a vehicle, be sure to read and understand the following warnings:

⚠ WARNING ⚠ ***To prevent personal injury or death, observe the following:***

Before working on the vehicle, remove all jewelry (rings, watch, necklaces, etc.).

Be sure that no loose clothing or hair can become caught in the moving parts of the powertrain.

Use care not to contact hot objects.

Before attempting to operate or adjust the powertrain, the rear of the vehicle must be raised and supported on jack stands.

Wear OSHA approved clothing and eye protection when working on anything that could expose the body or eyes to potential injury. In particular, use care when working with or around batteries, compressed air or solvents.

Always turn the key switch to 'OFF' and remove the key before disconnecting a live circuit.

When connecting battery cables, pay particular attention to the polarity of the battery terminals. Never confuse the positive and negative cables.

The parking 'PARK' brake should always be set, except for cases where the powertrain must be allowed to rotate or service is being performed on the brake system.

If repairs are to be made that will require welding or cutting, the battery and fuel tank must be removed and the fuel system drained.

⚠ WARNING ⚠ ***To prevent explosion that could result in severe personal injury or death, keep all smoking materials, open flame or sparks away from gasoline and batteries.***

Never operate the starter with the spark plugs removed unless the ignition system has been disabled and the engine/exhaust are cold. Fuel expelled from the cylinders could be ignited by the ignition system or the hot exhaust system.

Never work on an engine that is hot.

Never test the ignition system without either connecting the spark plug lead to a tester or spare grounded spark plug.

If the spark function is to be observed at the spark plug, be sure to install a spare spark plug into the open cylinder before operating the starter.

Never test the function of a fuel pump in the vicinity of a hot engine or other source of flame or combustion.

Never confuse the hoses to and from the fuel pump. Verify that the carburetor and pulse lines are correctly installed before starting the engine (see FUEL SYSTEM section).

Wrap wrenches with vinyl tape to prevent the possibility of a dropped wrench from 'shorting out' a battery, which could result in an explosion and severe personal injury or death.

Aerosol containers of battery terminal protectant must be used with extreme care. Insulate metal container to prevent can from contacting battery terminals which could result in an explosion.

⚠ WARNING ⚠ ***To prevent illness or death, observe the following:***

Never work around or operate a vehicle in an environment that does not ventilate exhaust gases from the area.

Exhaust gas (carbon monoxide) is deadly.

Carbon monoxide is an odorless gas that is formed as a natural part of the incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal.

The following are symptoms of carbon monoxide inhalation:

- ***Dizziness***
- ***Vomiting***
- ***Intense headache***
- ***Muscular twitching***
- ***Weakness and sleepiness***
- ***Throbbing in temples***

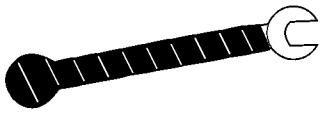
If experiencing any of these symptoms, get fresh air immediately.

BATTERY REMOVAL AND INSTALLATION

Tool List	Qty. Required
Insulated wrench, 1/2"	1
Socket, 1/2", 3/8" drive	1
Extension, 12", 3/8" drive	1
Ratchet, 3/8" drive	1
Battery carrier	1
Torque wrench, ft. lbs., 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1

NOTE *In the following text, there are references to removing/installing bolts etc. Additional hardware (nuts, washers, etc.) that is removed must always be installed in its original position unless otherwise specified. Non-specified torques are as shown in table contained in Section 'A'.*

⚠ WARNING ⚠



Wrap wrenches with vinyl tape to prevent the possibility of a dropped wrench from 'shorting out' a battery, which could result in an explosion and severe personal injury or death.

Turn vehicle key 'OFF' and remove. Insure all optional electrical accessories are turned OFF.

Remove hardware from the negative (-) cable **before** removing the positive (+) cable. Remove the bolt from the battery hold down and remove the battery (Ref Fig. 1 on page B-7). Be sure to remove all corrosion from terminals and hardware and wash battery tray. See 'PERIODIC SERVICE SCHEDULE' in Section A.

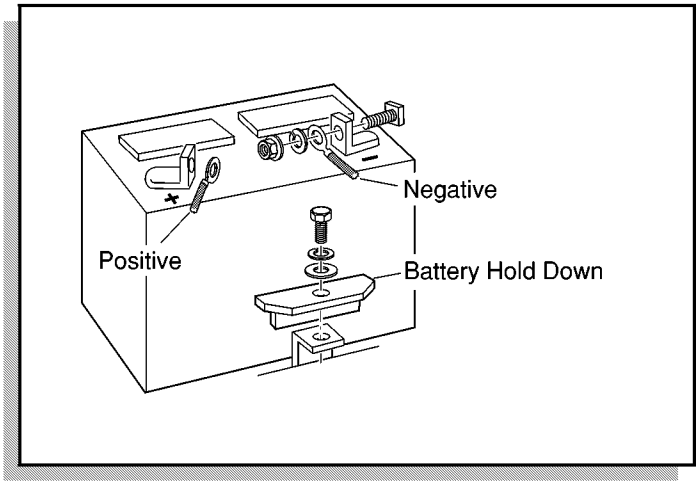


Fig. 1 Battery Removal

Install battery in reverse order or removal. Tighten battery hold down bolt to 14 - 18 ft. lbs. (19 - 24 Nm). Connect the positive (+) battery cable first. **Connect negative (-) battery cable last.** Tighten terminal hardware to 50 - 70 in. lbs. (6 - 8 Nm).

⚠ WARNING ⚠

Aerosol containers of battery protectant must be used with extreme care. Insulate metal container to prevent can from contacting battery terminals which could result in an explosion.

After installing battery, coat terminals with commercially available terminal protectant.

LIFTING THE VEHICLE

Some servicing operations may require the front, rear or the entire vehicle to be raised.

Tool List	Qty. Required
Floor jack	1
Jack stands	4
Chocks	4

⚠ WARNING ⚠

To prevent possible injury or death resulting from a vehicle falling from a jack, be sure the vehicle is on a firm and level surface. Never get under a vehicle while it is supported by a jack. Use jack stands and test the stability of the vehicle on the stands. Always place chocks in front and behind the wheels not being raised. Use extreme care since the vehicle is extremely unstable during the lifting process.

CAUTION **When lifting the vehicle, position jacks and jack stands only on the areas indicated.**

To raise the entire vehicle, install chocks in front and behind each front wheel (Ref Fig. 2 on page B-8). Center the jack under the rear frame crossmember. Raise the vehicle and locate a jack stand under the outer ends of the rear axle.

Lower the jack and test the stability of the vehicle on the two jack stands.

Place the jack at the center of the front axle. Raise the vehicle and position jack stands under the frame crossmember as indicated.

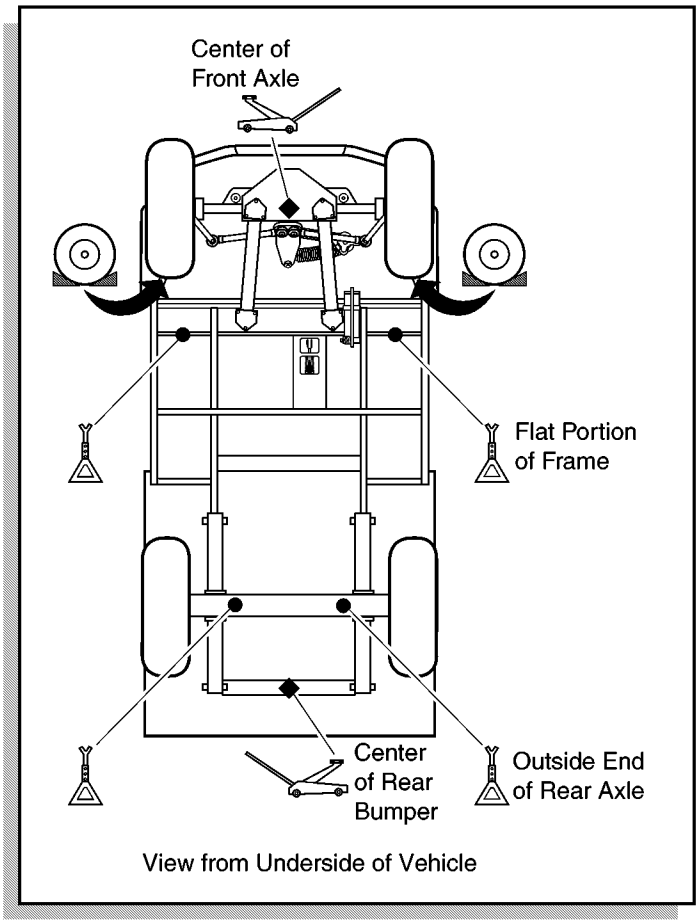


Fig. 2 Lifting the Vehicle

Lower the jack and test the stability of the vehicle on all four jack stands.

If only the front or rear of the vehicle is to be raised, place the chocks in front and behind each wheel not being raised in order to stabilize the vehicle.

Lower the vehicle by reversing the lifting sequence.

BODY AND TRUCKBED

C

TABLE OF CONTENTS FOR SECTION 'C'

SECTION TITLE **PAGE NO.**

LIST OF ILLUSTRATIONS

Notes:

BODY AND TRUCKBED

C

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

GENERAL

NOTE *In the following text, there are references to removing/installing bolts etc. Additional hardware (nuts, washers etc.) that is removed must always be installed in its original position unless otherwise specified. Non-specified torques are as shown in the table in Section A.*

⚠ WARNING ⚠ ***To prevent possible injury or death from battery explosion:***

Batteries should always be removed before any servicing that will generate sparks.

It is important to use a sharp drill bit when removing the rivets on the side of the vehicle. Extreme care must be used when drilling out the rivets located in the front of the body and the bottom side of the body. Excessive pressure could result in the drill bit being forced through the body panel and penetrating an internal component. As extra protection, it is recommended that a protective piece of sheet metal be placed between any component and the rivet. Use of a drill depth stop will provide additional protection.

In general, body component replacement can be accomplished with a minimum of specialized tools. Most body components are held in place with conventional removable hardware (nuts, bolts, washers and screws). Some components are mounted with 'pop' rivets which require the rivet head be removed in order to push out shank of rivet. The rivet head is easily removed by drilling into it with a **sharp** drill bit that is **slightly** larger than the shank of the rivet (Ref Fig. 1 on page C-1). Care must be exercised when drilling to prevent the drill from being forced through body panels where it could damage components located immediately behind the rivet. The best way to prevent this from occurring is to use a sharp drill bit that requires very little pressure to cut successfully and to place a piece of protective sheet metal between the surface being drilled and components directly behind it.

COMPONENT REPLACEMENT

The body and truck bed components can be replaced by removing the securing hardware, replacing the component and securing with hardware in the same orientation as removed. The following illustrations indicate the assembly methods for the various components.

NOTE *If the instrument panel is to be replaced, the serial number plate must be removed and reinstalled on the new instrument panel (Ref Fig. 4 on page C-2).*

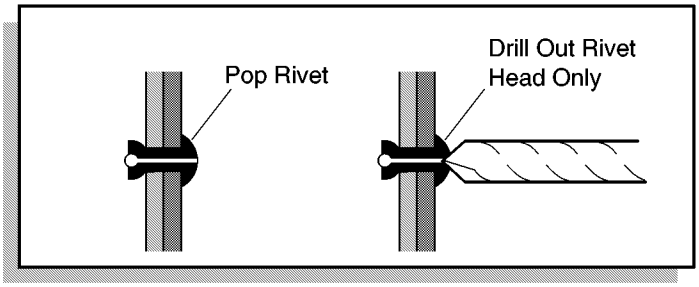


Fig. 1 Drill Out Metal Rivet

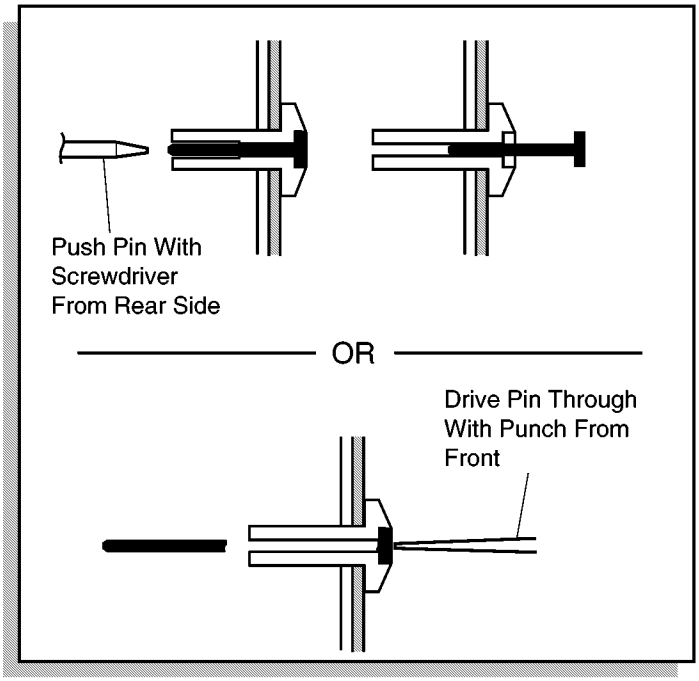


Fig. 2 Drive Rivet Removal

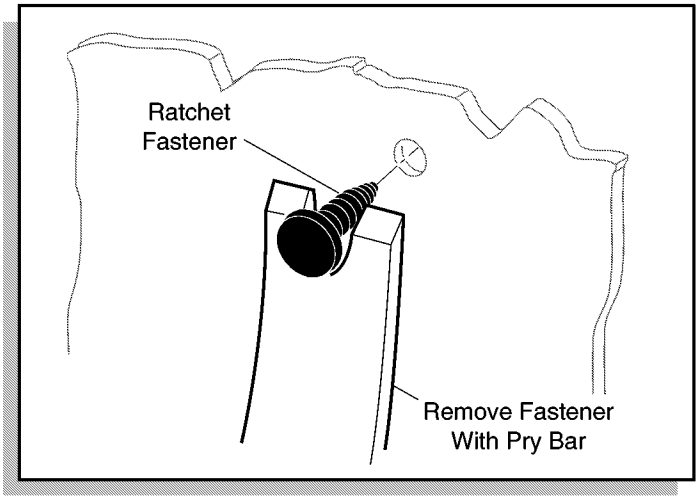


Fig. 3 Removing Ratchet Fasteners

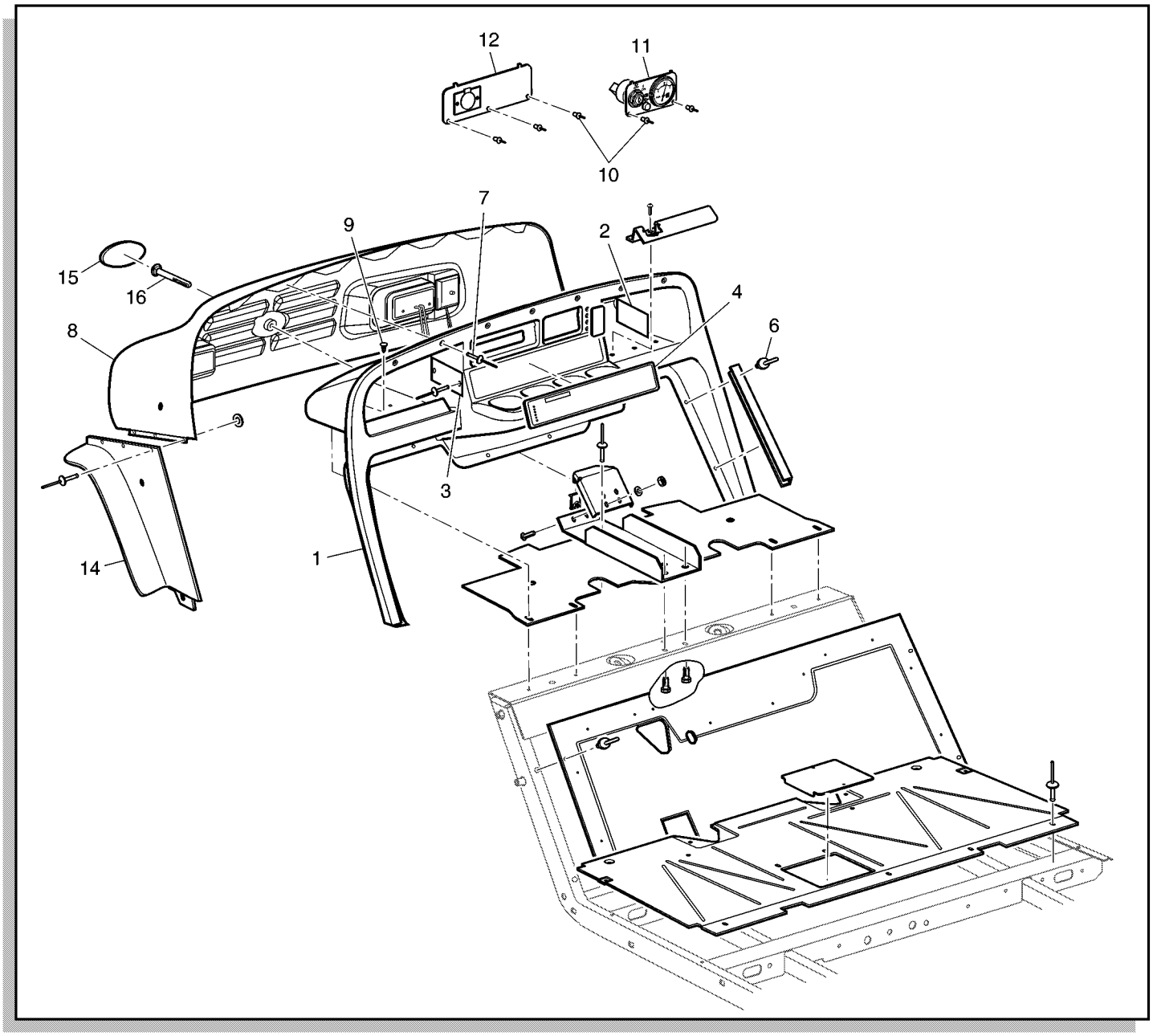


Fig. 4 Body Components (Front)

Instrument Panel Replacement

Tool List	Qty. Required
Insulated wrench, 1/2"	1
Electric/air drill	1
Drill bit, 7/32"	1
Pry bar	1
Punch, small	1
Hammer	1
Rivet gun	1

NOTE *If the instrument panel is to be replaced, the serial number plate must be removed and reinstalled on the new instrument panel (Ref Fig. 4 on page C-2).*

The instrument panel may be removed without removing the cowl or may be removed as part of the cowl.

⚠ WARNING ⚠ ***To prevent the possibility of injury due to lack of vehicle information, the correct safety label must be on the instrument panel at all times.***

To prevent personal injury, disconnect negative (-) battery cables before servicing vehicle.

If instrument panel (1) is to be replaced, the serial number plate (2) and capacity plate (3) must be removed from old instrument panel and reinstalled on replacement panel (Ref Fig. 4 on page C-2). When installing a replacement instrument panel, a new safety label (4) **must** be ordered and placed on new instrument panel. When ordering a replacement instrument panel, provide vehicle serial number to the Service Parts Representative who will provide the correct part number for the safety label.

Using an insulated wrench, disconnect cables at negative (-) battery terminal to prevent electrical shorts that could cause an explosion.

Pull front of floor mat (5) up to expose rivets (6) that secure instrument panel (1) to floor. Drill out rivets (6, 7) attaching bottom of instrument panel to floor and across top of the instrument panel attaching it to cowl (8).

Pry out four ratchet fasteners (9) located within instrument panel storage compartments.

Pull instrument panel away from the cowl.

Remove the drive rivets (10) securing the key switch (11) and power outlet plate (12) to the instrument panel. Rotate key switch and power outlet plate and push them through instrument panel openings, freeing panel for removal.

Assemble in reverse order of disassembly using new rivets.

Cowl Replacement

Tool List	Qty. Required
Insulated wrench, 1/2"	1
Socket, 1/2", 3/8" drive	1
Ratchet, 3/8" drive	1
Electric/air drill	1
Drill bit, 7/32"	1
Phillips screwdriver	1
Rivet gun	1
Torque wrench, 3/8" drive, ft. lbs.	1

⚠ WARNING ⚠ ***To prevent personal injury, disconnect the negative (-) battery cables before servicing vehicle.***

Using an insulated wrench, disconnect negative (-) cables from battery to prevent electrical shorts that could cause an explosion.

Remove front bumper (13). See 'Front Bumper Replacement' on page C-3.

Drill out rivets (7) across top of instrument panel (1) and fender flares (14) attaching them to cowl (8) (Ref Fig. 4 on page C-2).

Remove label (15) and screw (16) securing front of cowl and lift cowl up to unplug lights.

Remove cowl assembly from vehicle and transfer lights to new cowl.

Assemble in reverse order of disassembly using new rivets. Tighten front bumper bolts (17) to 17 ft. lbs. (23 Nm) torque.

Front Bumper Replacement

Tool List	Qty. Required
Socket, 1/2", 3/8" drive	1
Ratchet, 3/8" drive	1
Torque wrench, 3/8" drive, ft. lbs.	1

⚠ WARNING ⚠ ***The front bumper is heavy and awkward to handle. To prevent personal injury, it is strongly recommended that adequate help be used to remove bumper from vehicle.***

Remove the sun top, if equipped, allowing front strut to be removed with bumper. See WEATHER PROTECTION section.

Remove two bolts (17) from one end of bumper (13) and remove spacer tube (or front strut) (19), spacer (20) and washer (21) (Ref Fig. 5 on page C-4). Have an assistant hold this end and repeat at other side to remove bumper.

With the aid of an assistant, position bumper and spacer tubes (or front strut) along side cowl (8). Take care not to scratch the cowl while installing bumper.

On each side of vehicle, align top holes in bumper and spacer tube (or front strut) with upper hole in cowl. Insert bolt (17) with lock washer (18) through top hole in bumper and spacer tube (or front strut) only. Insert spacer (20) and washer (21) between spacer tube (or front strut) and cowl and push bolt through cowl and

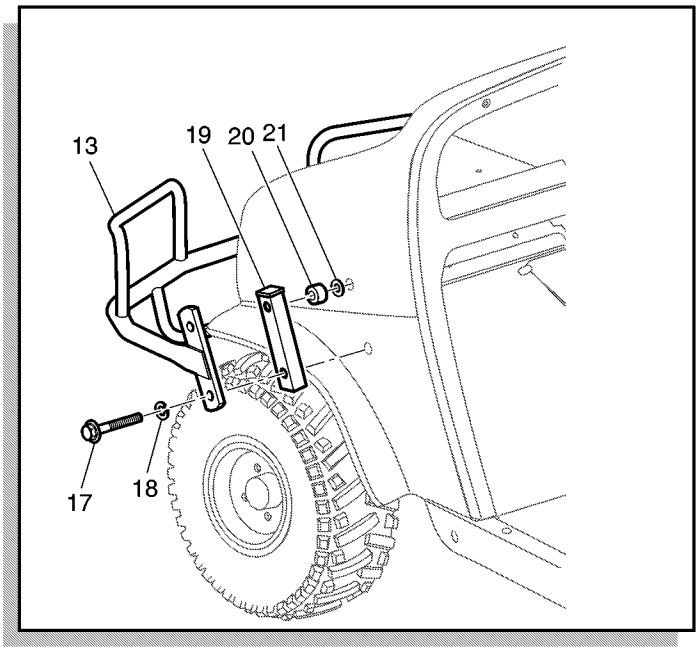


Fig. 5 Front Bumper

threading it into frame. Finger tighten hardware at this time to allow for adjustment.

Align bottom hole in bumper with hole in fender flare (14). Insert bolt with lock washer through bumper, spacer tube (or front strut) and cowl threading bolt into frame. Finger tighten bolts at this time to allow for adjustment.

Once all bolts are in place, tighten to 17 ft. lbs. (23 Nm) torque.

Rocker Panel Replacement

Tool List	Qty. Required
Phillips screwdriver	1
Wrench, 3/8"	1
Wrench, 7/16"	1

Remove screws (22, 23) securing each end and top of rocker panel to vehicle (Ref Fig. 7 on page C-5). Save hardware for reuse and note the location of each spacer (25, 26) to ensure proper placement.

Remove rocker panel.

Replacement is the reverse order of disassembly, making sure hardware and spacers are replaced in the appropriate locations.

Seat Bottom Replacement

Tool List	Qty. Required
Straight blade screwdriver, small	1
Phillips screwdriver, large	1

To remove driver seat bottom (27), loosen setscrew (28) in choke knob (29) and remove knob (Ref Fig. 6 on page C-4). Raise seat high enough to slide it in front of center console and off hinge pins.

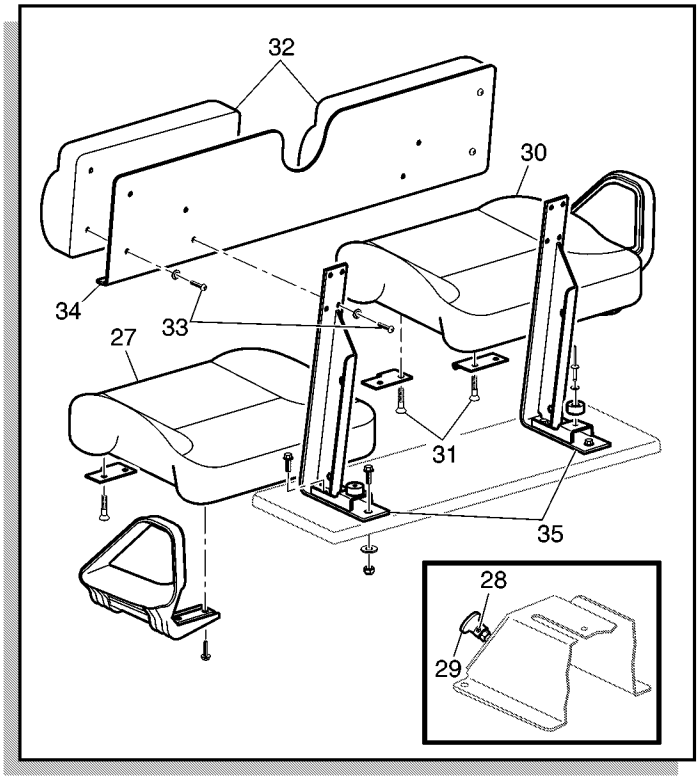


Fig. 6 Seat Components

To remove passenger seat bottom (30), remove four screws (31) securing seat bottom to hinges.

Install replacement in reverse order of disassembly.

Seat Back Replacement

Tool List	Qty. Required
Phillips screwdriver	1

⚠ WARNING ⚠ ***To prevent personal injury caused by the seat back assembly falling, replace only one seat back at a time.***

To remove a seat back (32), remove four screws (33) securing seat back to plate (34) and support bracket (35) (Ref Fig. 6 on page C-4).

Install replacement in the reverse order of disassembly.

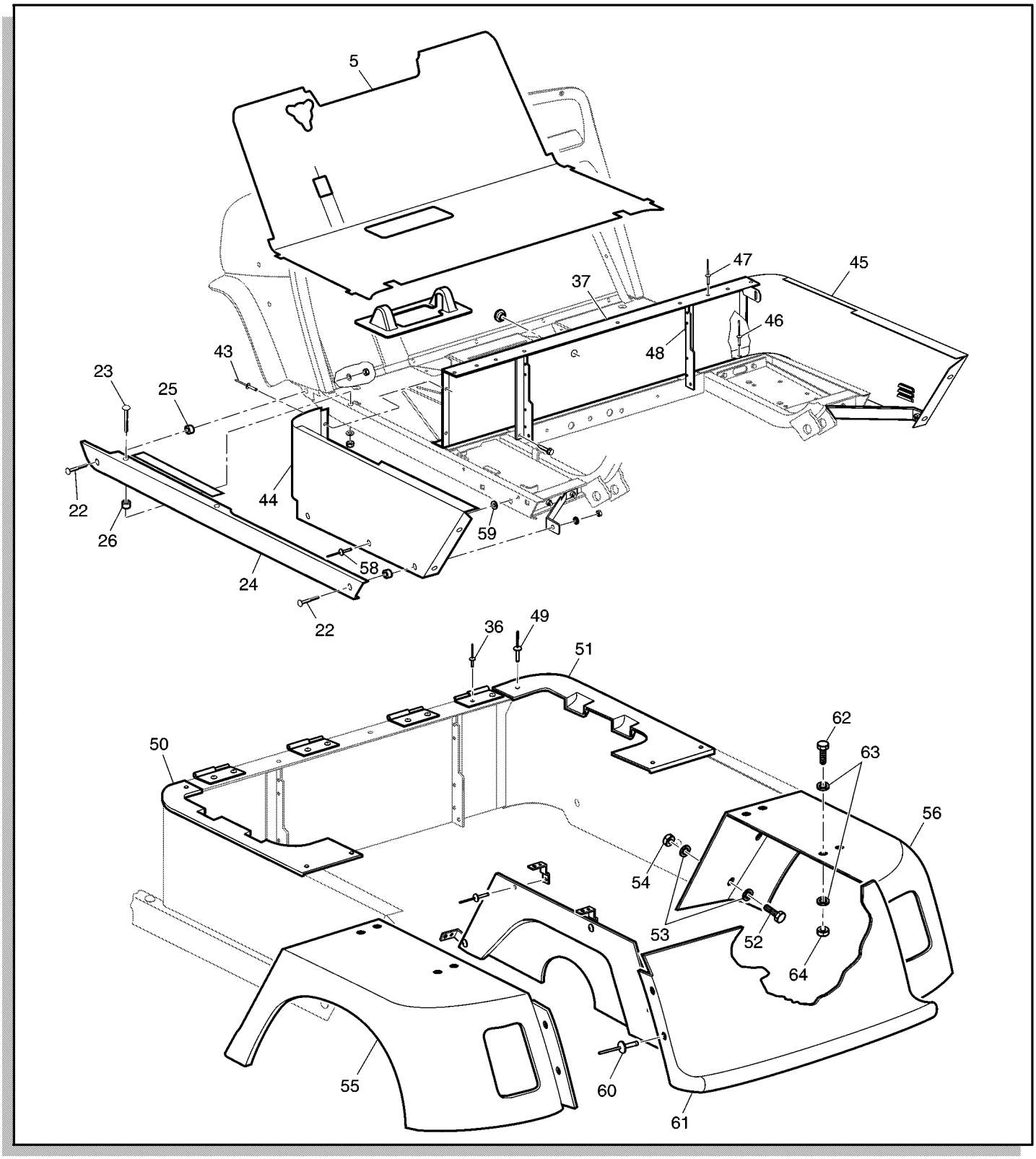


Fig. 7 Body Components (Rear)

Seat Support Panel Replacement

Tool List	Qty. Required
Electric/air drill	1
Drill bit, 7/32"	1
Pliers	1
Phillips screwdriver	1
Wrench, 7/16"	1
Wrench, 3/8"	1
Rivet gun	1

Remove both seat bottoms (27, 30) by drilling out rivets (36) securing hinges to seat support panel (37) (Ref Fig. 7 on page C-5).

Remove toggle switch nut (38) and drill out rivets (39) securing toggle switch guard (40) to seat support panel (Ref Fig. 8 on page C-6). Remove hardware (41) securing winch receptacle (42) to seat support panel.

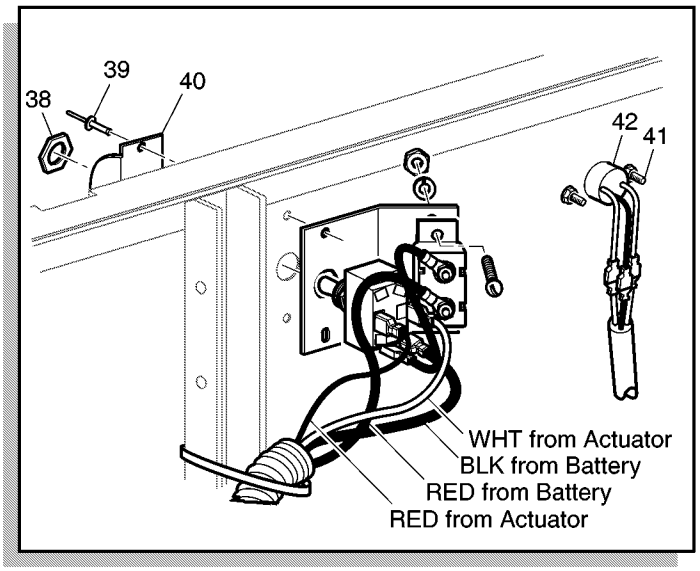


Fig. 8 Electric Lift Toggle Switch and Winch Receptacle

Drill out rivets (43) attaching seat support panel to each side panel (44, 45).

Loosen bolts (23) at top of each rocker panel (24), freeing the floor mat (5). Pull floor mat back to expose rivets (46) that attach seat support panel to floor and drill out rivets.

Drill out rivets (47) across top of seat support panel attaching it to seat frame (48).

Remove seat support panel.

Install in reverse order of disassembly using new rivets.

Seat Filler Panel Replacement

Tool List	Qty. Required
Electric/air drill	1
Drill bit, 7/32"	1
Rivet gun	1

Drill out rivets (49) securing filler panel (50, 51) to side panel (44, 45) (Ref Fig. 7 on page C-5).

Remove seat filler panel.

Install using new rivets.

Side Panel Replacement

Tool List	Qty. Required
Electric/pneumatic drill	1
Drill bit, 7/32"	1
Socket, 7/16", 3/8" drive	1
Ratchet, 3/8" drive	1
Wrench, 7/16"	1
Rivet gun	1

To replace either driver or passenger side panel, first remove rocker panel (24). See 'Rocker Panel Replacement' on page C-4.

Remove two bolts (52) securing side panel (44, 45) to rear fender (55, 56), retaining hardware (53, 54) for reuse during installation.

CAUTION **To prevent piercing the fuel tank when using a drill, place a piece of protective sheet metal between the tank and the panel being removed.**

If replacing passenger side panel (56), drill out rivets (49) securing filler panel (51) and remote air hose adapter (57) to side panel (45) (Ref Fig. 7 on page C-5). Place a piece of sheet metal between fuel tank and seat support panel before drilling out rivets attaching side panel to seat support panel.

Drill out rivets (43) securing side panel to seat support panel (37).

Drill out rivets (58) securing side panel to frame (Ref Fig. 7 on page C-5). Retain the washers (59) behind side panel for reuse during installation.

Remove side panel.

Install in reverse order of disassembly using new rivets.

Rear Fender Replacement

Tool List	Qty. Required
Socket, 7/16", 3/8" drive	1
Ratchet, 3/8" drive	1
Wrench, 7/16"	1
Electric/air drill	1
Drill bit, 7/32"	1
Rivet gun	1

If the vehicle is equipped with tail lights, unplug the tail light leads from the wiring harness. Remove tail lights by pushing on the small tabs around perimeter of tail lights enabling them to be pushed out of rear fenders (55, 56) (Ref Fig. 7 on page C-5). Retain tail lights for use at fender installation.

Drill out two rivets (60) on side of rear panel (61) securing it to rear fender.

Remove four bolts (52, 62) securing rear fender to side panel (44, 45) and frame. Retain the hardware (53, 54, 63, 64) for reuse during installation.

Remove rear fender from vehicle.

Replacement is the reverse order of rear fender removal. Tail light should be replaced in rear fender with wiring at top of tail light.

Rear Panel Replacement

Tool List	Qty. Required
Electric/air drill	1
Drill bit, 7/32"	1
Rivet gun	1

Drill out two rivets (60) on each side of rear panel (61) securing it to rear fenders (55, 56) (Ref Fig. 7 on page C-5).

Remove rear panel.

Install in reverse order of disassembly using new rivets.

Truck Bed Replacement

Tool List	Qty. Required
Back brace	2

⚠ WARNING ⚠ ***The truck bed is heavy and awkward to handle. To prevent possible personal injury, it is strongly recommended that an assistant or adequate lifting device be used to remove truck bed from vehicle.***

Raise bed using electric lift toggle switch.

With a person on each side of bed, remove cotter pin (66), spacers (67) and clevis pin (68) that connect electric lift actuator (65) to bed (69) and swing actuator down to rest on rear axle (Ref Fig. 9 on page C-7).

NOTE *If removing bed to replace engine, remove electric lift actuator for additional clearance. Unplug chassis harness lead and pull out cotter and clevis pin connecting actuator to fame.*

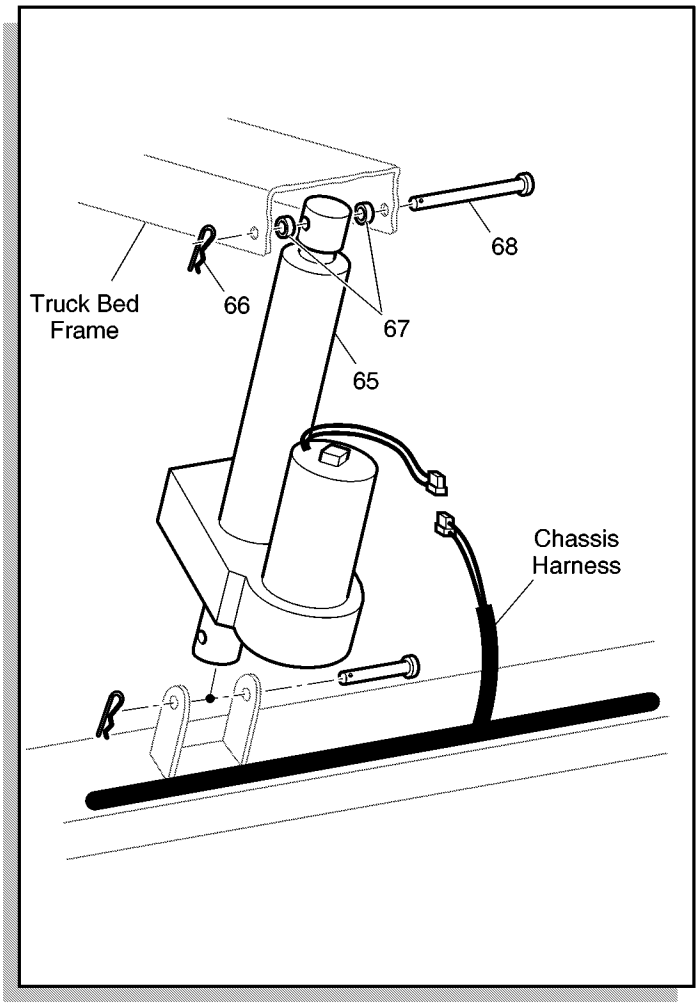


Fig. 9 Electric Lift Actuator

Lower bed.

Remove cotter pins (70) and clevis pins (71) from bed pivots (72) located under tailgate (73) (Ref Fig. 10 on page C-8).

Remove bed from vehicle.

Install truck bed in reverse order of disassembly.

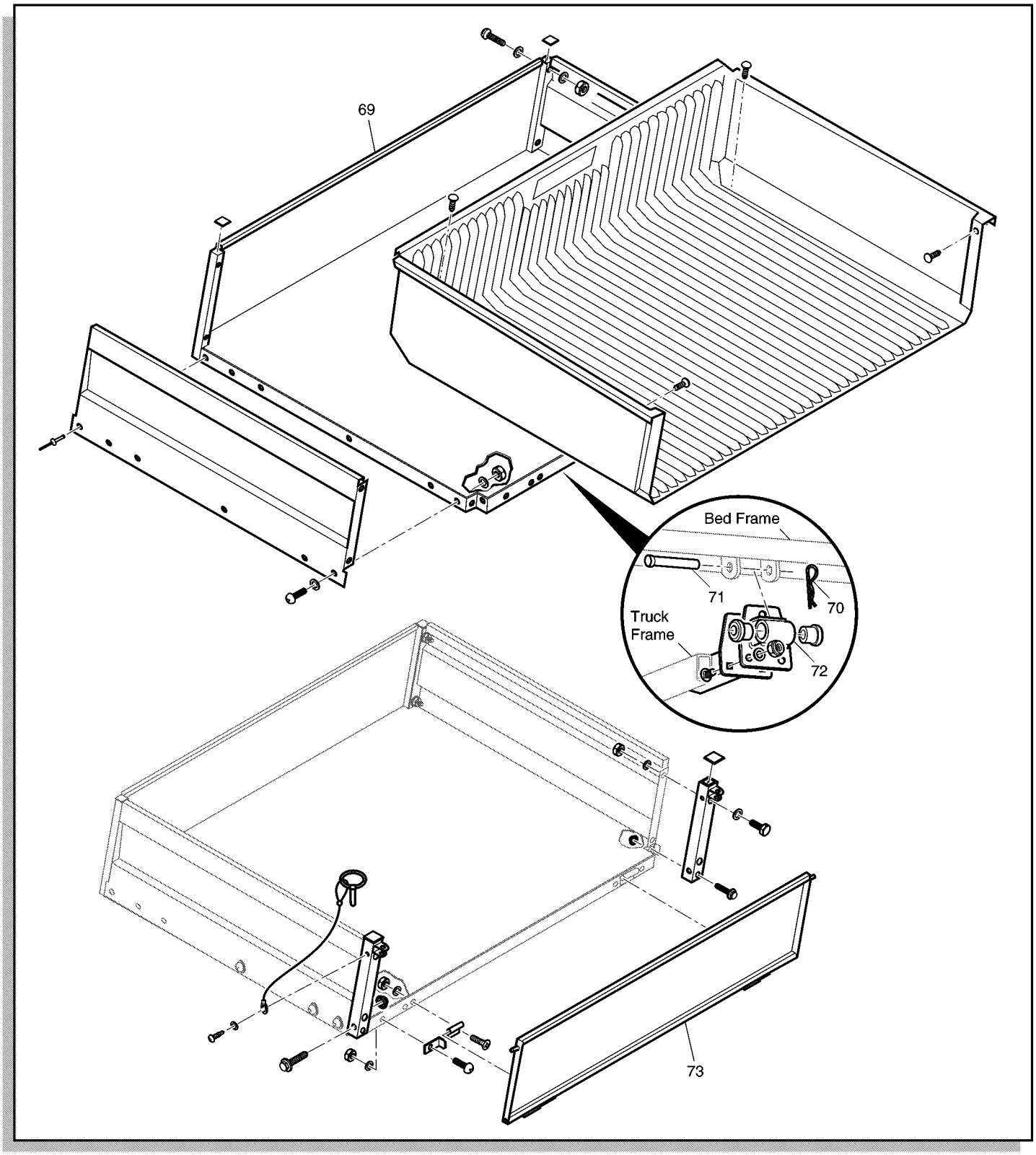


Fig. 10 Truckbed Components

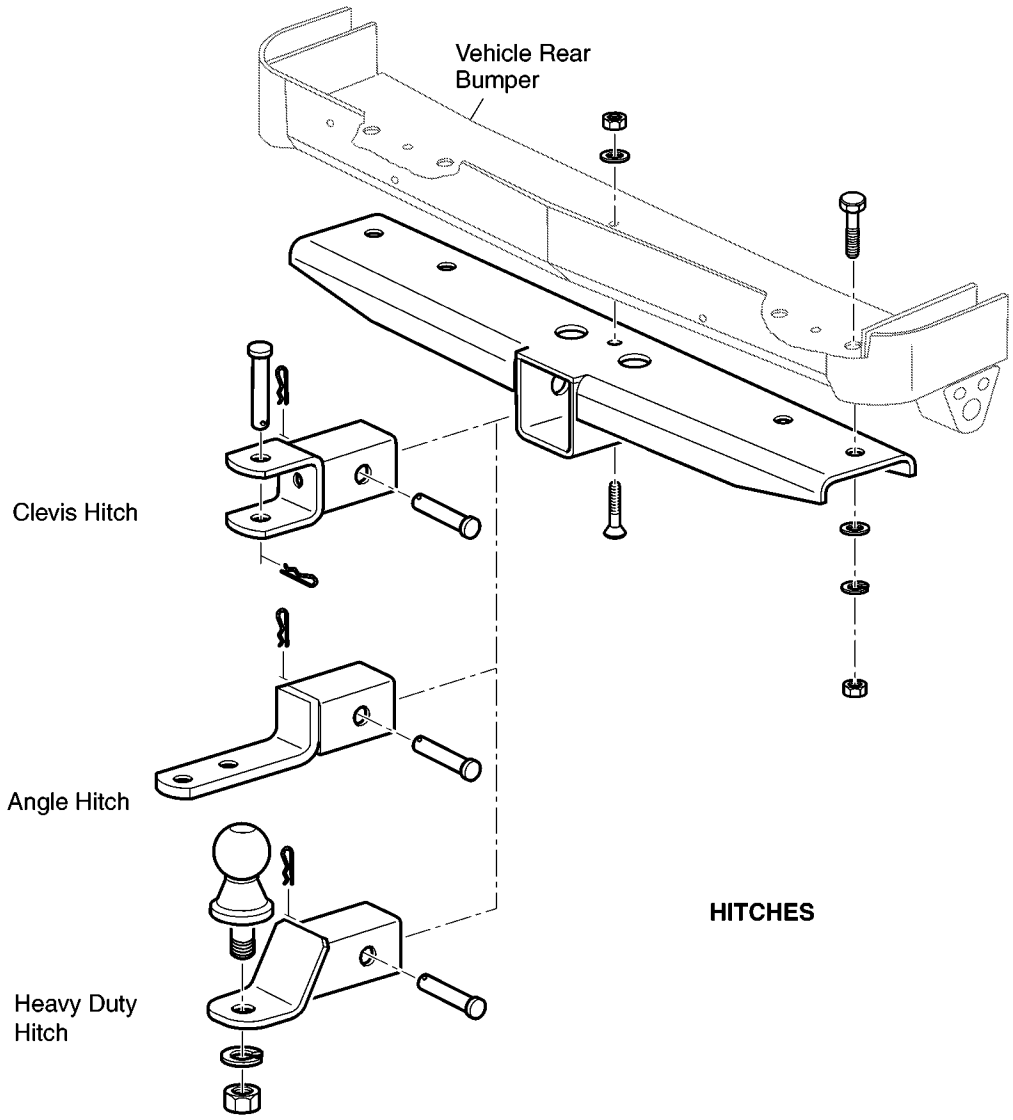


Fig. 11 Hitches

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Notes:

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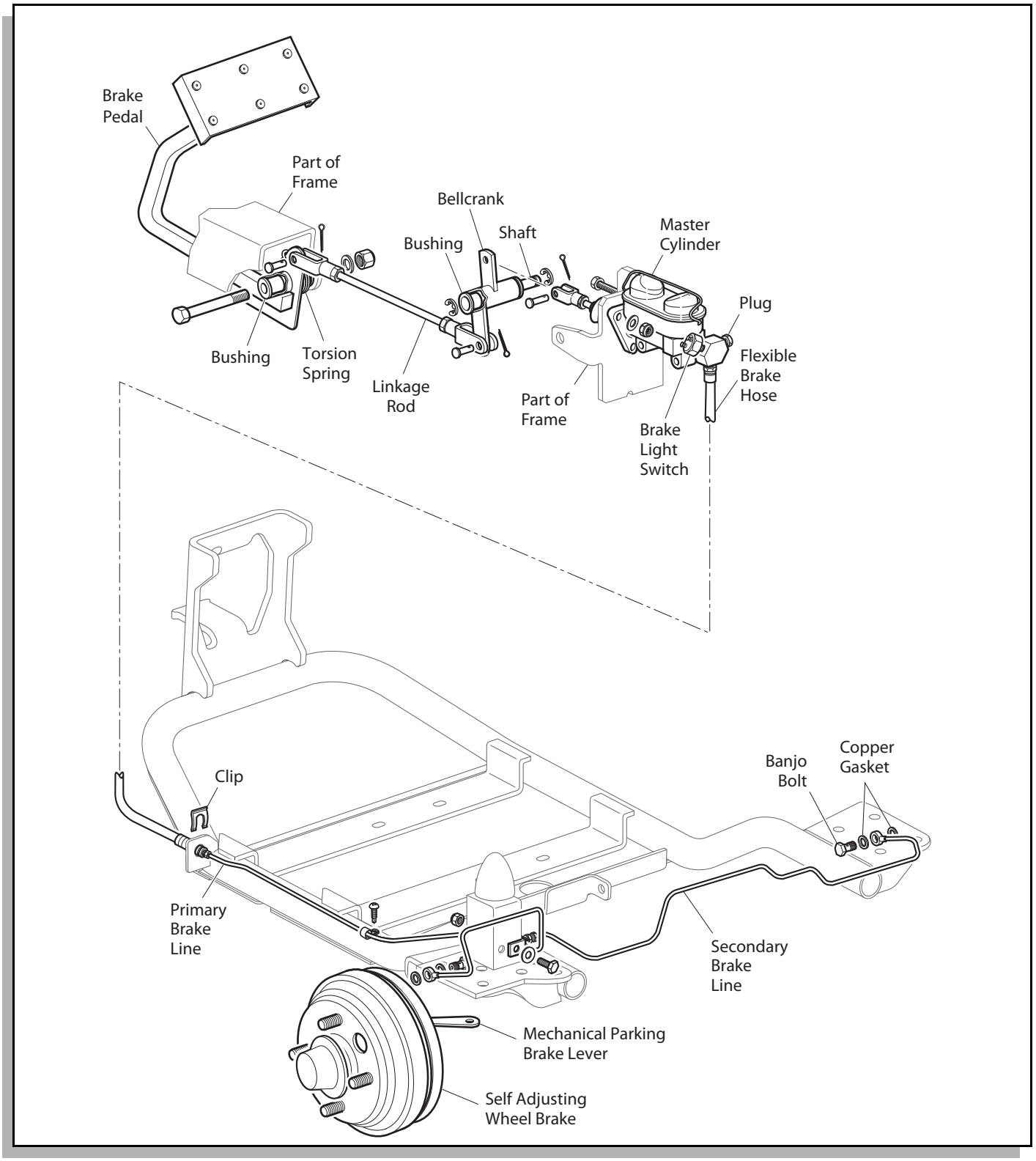

Fig. 1 Hydraulic Brake System Components

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

GENERAL

How The Hydraulic System Works

A hydraulic system actuates the rear brakes. The system transmits the power required to activate the friction surfaces (brake shoes) of the braking system from the pedal to the individual brake units at each wheel.

The hydraulic system operates as follows:

When at rest, the entire system is full of brake fluid. Upon application of the brake pedal, fluid trapped in front of the master cylinder piston is forced through the lines to the wheel cylinders. Here, it forces the pistons outwards against the brake shoes which in turn contact the brake drum. Upon release of the brake pedal, a spring located inside the master cylinder immediately returns the piston to the normal position. The brake shoe return springs retract the brake shoes and wheel cylinders which returns the brake fluid to its original position within the master cylinder.

Wheel Brake

The 160 x 30mm hydraulic brake is a leading-trailing design. The shoes are held to the backing plate by hold-down springs, pins, and spring retainers. The shoes are fitted to the anchor at the bottom and secured by a lower shoe to shoe spring. At the top, the shoe web rests on the wheel cylinder piston. The shoes are held to the wheel cylinder pistons by the upper shoe to shoe spring.

The wheel cylinders are of the double piston design, permitting even distribution of force to each shoe. There are no links. Shoes rest directly on the piston ends. Wheel cylinders incorporate external boots.

Brake adjustment is automatic. Adjustment takes place, if needed, whenever the brakes are applied, whether during a forward or reverse stop or when the vehicle is stationary. Upon any brake application, the shoes move outward contacting the drum. As the shoes move outward, the automatic adjuster levers (attached to each shoe by a pin) follow the shoe movement. The automatic adjuster pin is smaller than the slot in the brake shoe web; therefore, when the brakes are released, the shoes are allowed to return slightly, providing brake shoe to drum running clearance.

The rear brake includes a parking feature consisting of a lever and strut. The lever is applied by a cable attached to the parking brake lever (hand operated). The parking brake is used to retain the vehicle when stationary. It may also be used as an emergency brake in the event of hydraulic system failure.

MAINTENANCE

Daily Brake Performance Test

NOTE *To assure correct braking performance, all periodic maintenance, inspections and procedures must be performed as indicated in the Periodic Service Schedule in Section A of this manual.* ***It is important that a Daily Brake Performance Test be performed and the entire brake system be serviced in accordance with the Periodic Service Schedule****.*

The brake system must be bled whenever ***any part of the brake system*** *has been replaced.*

Depress brake pedal. The pedal should have some free play and then become hard. A brake pedal that has no free travel, excessive free travel or a spongy feel indicates a brake inspection is required. A brake pedal that falls after it is applied indicates a leak in the master or wheel cylinders. Check brake fluid level. Adjust brakes if required and inspect system for fluid leaks.

Brake System Inspection

Brake failure usually occurs as either a gradual decrease in braking effect from the shoe material being worn away, a loss of braking at one wheel or a sudden and complete failure with no brakes working except the parking brake.

Should the brakes at one wheel become ineffective while the brakes at the other wheel functions properly, remove the wheel and drum. See 'BRAKE DRUM REMOVAL AND INSTALLATION' on page D-5. Inspect the brake for evidence of a leaking or inoperative wheel cylinder assembly.

NOTE *Care should be taken to prevent brake fluid from coming into contact with the brake shoes. If the brake shoes should become wet with hydraulic fluid, remove the brake drum and wipe the brake shoes and drum until they are dry.*

Complete brake failure usually indicates a loss of hydraulic fluid pressure.

The hydraulic system may be checked for leaks by applying pressure to the pedal gradually and steadily. If the pedal sinks very slowly to the floor, the system has a leak. This is not to be confused with a springy or spongy feel due to the compression of air within the lines.

Check for leaks along all lines and at brake assembly. If no external leaks are apparent, the problem is inside the master cylinder.

CAUTION Do not allow brake fluid to contact painted surfaces. Wipe off immediately.

After making any repairs to hydraulic lines, wheel cylinders or master cylinder, the brakes must be bled to remove any trapped air. A bleeder valve is located at each wheel cylinder for this purpose. See 'BLEEDING AND FLUSHING' on page D-9.

MASTER CYLINDER

Just like any other brake part, the master cylinder will eventually require replacement. The usual reason for a master cylinder failure is the cylinder seals (cups) deteriorate. Fluid leaks past the cups and shows as an external leak. A common symptom is a 'spongy' brake pedal that goes all the way to the floor when all the other brake components are in good condition. The rubber parts wear with usage or deteriorate with age or fluid contamination. Corrosion or deposits formed in the cylinder bore due to moisture or dirt in the hydraulic system may result in wear of the cylinder bore or related parts. Do not try to remove corrosion or deposits with a cylinder hone. If corrosion or deposits are present, discard master cylinder and replace with new one.

Brake Fluid

NOTE *Hydraulic brake systems must be totally flushed if the fluid becomes contaminated with water, dirt or other corrosive chemicals. To flush, bleed the entire system until all brake fluid has been replaced with fresh DOT 3 standard automotive brake fluid.*

It is important to maintain proper fluid levels in the master cylinder. The fill cap for the cylinder is located under the driver seat. To prevent contamination when checking fluid, wipe off any dirt from fill cap before removing it. Reservoir fluid level should be checked per 'PERIODIC SERVICE SCHEDULE' in Section A. When required, clean brake fluid should be added to maintain fluid level 1/4" (6 mm) from top of reservoir. Use fresh DOT 3 standard automotive brake fluid.

Master Cylinder Replacement

Tool List	Qty. Required
Insulated wrench, 1/2"	1
Shop towels	A/R
Catch pan	1
Wrench, 3/8"	1
Wrench, 5/8"	1
Needle nose pliers	1
Wrench, 9/16"	2
Wrench, 1"	1
Wrench, 7/16"	1
Teflon tape	A/R
Crowfoot wrench, 1", 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1
Socket, 7/16", 3/8" drive	1
Crowfoot wrench, 5/8", 3/8" drive	1
Socket, 9/16", 3/8" drive	1

⚠ WARNING ⚠ ***Wrap wrenches with vinyl tape to prevent the possibility of a dropped wrench 'shorting out' a battery, which could result in an explosion and severe personal injury or death.***

CAUTION **During this process, it is likely that brake fluid will leak from the master cylinder. Avoid allowing brake fluid to contact the painted body components of the vehicle. Wipe off immediately.**

Turn vehicle key to 'OFF' and remove. Insure all optional electrical accessories are turned OFF. At the battery, remove the negative (-) cables. Cover top of battery with a cloth or non-conductive material to prevent the possibility of a dropped wrench or metal object from 'shorting out' the battery.

Clean the area around the master cylinder to prevent dirt and grease from contaminating the hydraulic system.

Disconnect wire terminal block from brake light switch on top of branch tee (Ref Fig. 2 on page D-3).

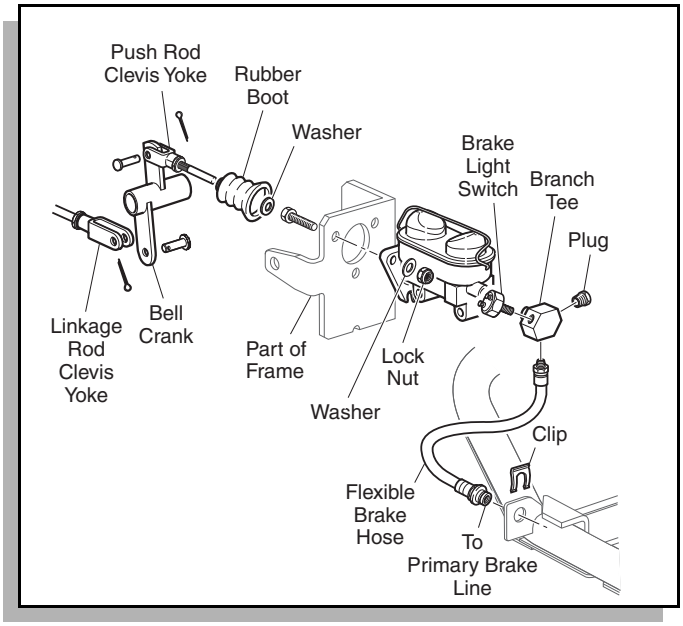

Fig. 2 Replacing Master Cylinder

Disconnect primary brake line where it connects to flexible brake hose. Provide a catch pan for the released brake fluid. Remove clip anchoring flexible brake hose to subframe.

Disconnect clevis yoke from upper arm of bellcrank in front of master cylinder. Disconnect linkage rod clevis yoke from lower arm of bellcrank to allow bellcrank to swing out of the way. Pull clevis yoke and push rod out of master cylinder and remove boot.

Remove three lock nuts, lock washers and bolts and remove master cylinder from vehicle.

Remove flexible brake hose from branch tee.

Remove brake light switch from branch tee.

Remove plug from branch tee.

Do **not** reuse existing branch tee on new master cylinder.

Install **new** branch tee on new master cylinder using teflon tape and tighten so that one of the three threaded holes points straight down toward the ground at 70 - 80 in. lbs. (8 - 9 Nm) torque.

Install plug into branch tee using teflon tape and tighten to 70 - 80 in. lbs. (8 - 9 Nm) torque.

Connect flexible brake hose to branch tee using teflon tape and tighten to 190 - 200 in. lbs. (21.5 - 22.6 Nm) torque. Anchor other end to subframe with clip. Connect primary brake line to flexible brake hose and tighten fitting to 70 - 80 in. lbs. (8 - 9 Nm) torque.

Install brake light switch into branch tee using teflon tape and tighten to 70 - 80 in. lbs. (8 - 9 Nm) torque.

Mount master cylinder to frame bracket using new lock nuts. Do **not** reuse original lock nuts. Tighten lock nuts to 28 - 32 in. lbs. (3 - 4 Nm) torque.

Insert push rod through rubber boot and washer into master cylinder (make sure rod is through washer inside boot). Snap rubber boot back onto master cylinder.

Install both clevis yokes back onto bellcrank using clevis pins and new cotter pins.

⚠ WARNING ⚠ ***To prevent brake failure resulting from contaminated brake fluid, never reuse any excess fluid or return to the original container. Dispose of brake fluid properly.***

Fill reservoir with DOT 3 brake fluid and bleed brake system. See 'BLEEDING AND FLUSHING' on page D-9.

After bleeding brake system, check for leaks along all lines and at master cylinder.

Connect the negative (-) battery cables.

BRAKE LINKAGE

The brake pedal linkage is set at the factory. However, if the master cylinder should have to be replaced, the linkage may require adjustment.

The master cylinder is located under the driver seat and is connected to the brake pedal by clevis yokes, threaded rods and a bellcrank.

Adjustment

Tool List	Qty. Required
Wrench, 1/2"	1
Pliers	1
Crowfoot wrench, 1/2", 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1

NOTE *The master cylinder has built in free travel.*

Distance between rubber bumper and bumper mounting plate should be 7/8" - 1" and the brake pedal arm should be approximately parallel to brake pivot bracket (Ref Fig. 3 on page D-4). If adjustment is needed, loosen lock nut and thread bumper in or out of mounting bracket as required and tighten lock nut to 13 ft. lbs. (18 Nm) torque.

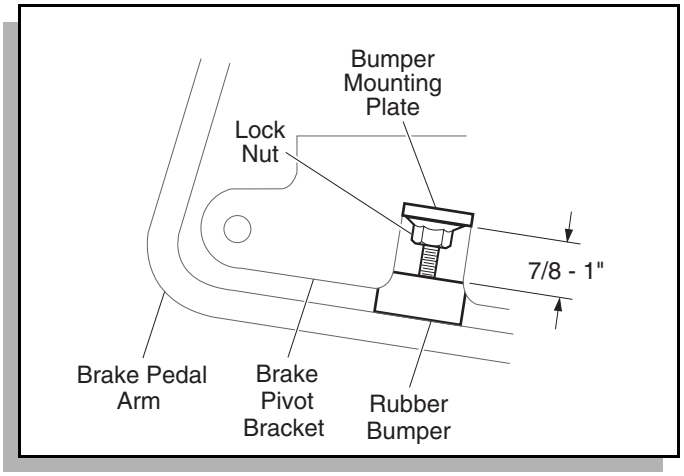

Fig. 3 Brake Pedal Bumper Adjustment

Remove cotter and clevis pins attaching linkage rod to brake pedal arm but maintain alignment of holes (Ref Fig. 4 on page D-5). At this position, the push rod on opposite arm of bellcrank should be against piston in master cylinder but should not be applying any force. If push rod is not against piston or is applying force, loosen jam nut at free end of linkage rod and thread clevis yoke

forward or back as required. Tighten jam nut to 65 - 75 in. lbs. (7 - 8 Nm) torque.

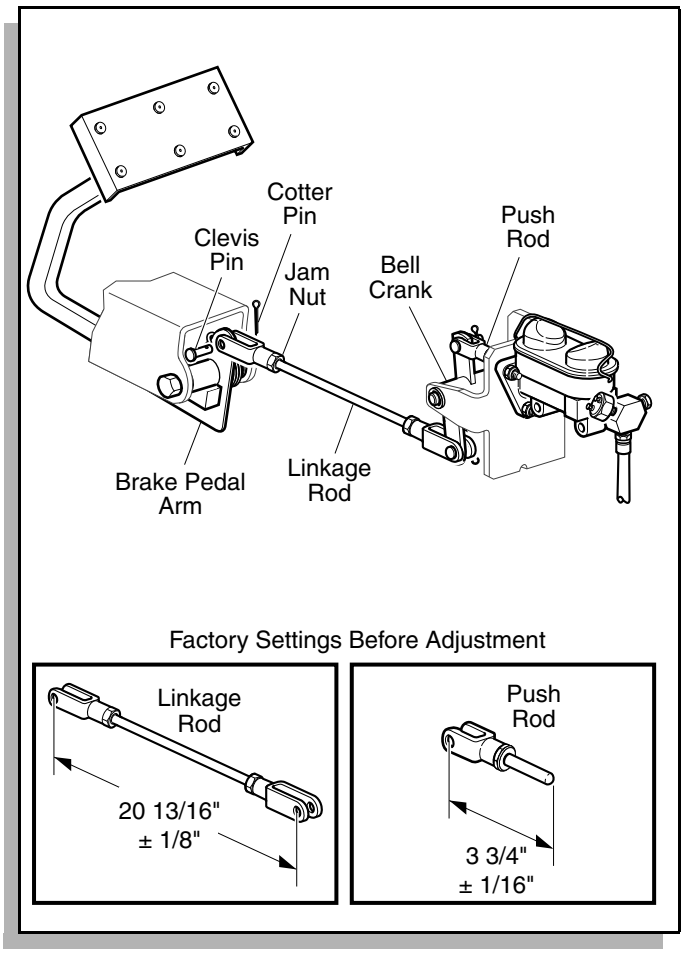

Fig. 4 Linkage Adjustment

Master cylinder piston should begin to move immediately upon any activation of the brake pedal.

BRAKE DRUM REMOVAL AND INSTALLATION

Tool List	Qty. Required
Slip joint pliers	1
Needle nose pliers	1
Socket, 1 1/8", 1/2" drive	1
Ratchet, 1/2" drive	1
Plastic faced hammer	1
Drum puller (P/N 15947-G1)	1
Wrench, 7/16"	1
Anti-seize compound	A/R
Torque wrench, 1/2" drive, ft. lbs.	1

⚠ WARNING ⚠ ***The drum must not be turned to 'true' a worn friction surface. Turning will make the drum too thin causing drum and brake failure which could cause severe injury or death.***

Wear a dust mask and eye protection whenever working on wheel brakes. Do not use pressurized air to blow dust from brake assemblies.

Remove cap to gain access to the castellated nut and the cotter pin (Ref Fig. 5 on page D-6).

Remove the cotter pin and castellated nut as shown.

NOTE *Do not apply the brake when removing the nut as the shoes may not fully retract preventing removal of the brake drum.*

Remove washer.

Slide the brake drum from the axle shaft. If required, tap the drum with a plastic faced hammer to loosen it from the axle shaft or use drum puller (P/N 15947-G1).

If shoes interfere with drum removal, rotate adjuster bolt on back side of backing plate towards the axle to retract shoes and remove brake drum.

NOTE *Pay particular attention to the location of the inner brake drum washer inside the brake drum, which may be on the axle shaft or attached to the rear of the drum hub. This washer must be reinstalled when the brake is reassembled.*

To install the brake drum, clean the axle shaft and the splines on the brake drum to remove dirt, grease and foreign matter. Apply a small amount of anti-seize compound to the axle spline. Install the inner brake drum washer and slide the brake drum into place. Check to insure the nose of drum hub is beyond the end of the axle splines. If not, remove drum and install one additional inner brake drum washer (total of 2) to obtain required spacing. If two inner brake drum washers do not provide the required spacing, the brake drum is incorrect and must be replaced with a new drum

CAUTION **Do not back off nut to install cotter pin.**

Install the remaining hardware and tighten the nut to 70 ft. lbs. (95 Nm) torque. Continue to tighten until a new cotter pin can be installed through the castellated nut and the hole in the axle. Maximum torque is 140 ft. lbs. (190 Nm).

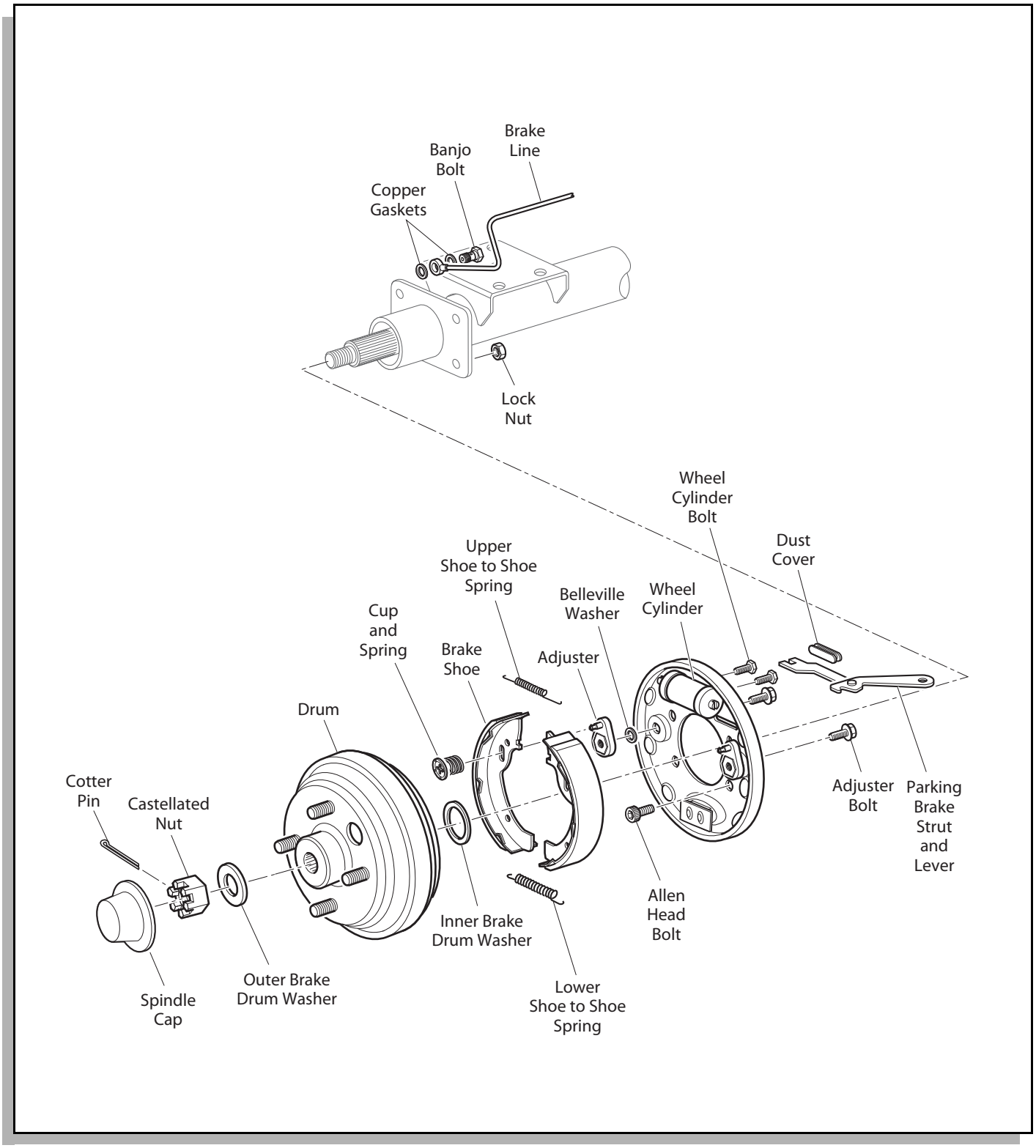

Fig. 5 Wheel Brake Components

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

WHEEL BRAKE SERVICE

Tool List	Qty. Required
Dust mask	1
Safety glasses	1
Socket, 3/4", 1/2" drive	1
Ratchet, 1/2" drive	1
Wheel chocks	4
Hydraulic floor jack	1
Jack stands	2
Brush	1
Wheel cylinder clamp	1
Pliers	1
Wrench, 9/16"	1
Wrench, 10 mm	1
Cleaner	A/R
Shop towels	A/R
Socket, 7/16", 3/8" drive	1
Torque wrench, 3/8" drive, in. lbs.	1
Wire brush	1
Grease	A/R
High temperature lubricant	A/R
Socket, 10 mm, 3/8" drive	1
Socket, 9/16", 3/8" drive	1
Locking pliers	1
Thread locking compound	A/R

Disassembly

⚠ WARNING ⚠ ***Wear a dust mask and eye protection whenever working on wheel brakes. Do not use pressurized air to blow dust from brake assemblies. Replace both brake shoes on both wheels if one or more shoes are worn below .06" (1.5mm) thickness at any point.***

CAUTION Do NOT touch any of the wheel brake mechanism except as instructed.

Do NOT use a commercial brake cleaner unless the entire brake has been disassembled.

Be sure that the parking brake is released.

Loosen rear wheel lug nuts and lift rear of vehicle per Section B.

Remove wheel and drum. See 'BRAKE DRUM REMOVAL AND INSTALLATION' on page D-5. Remove excess dust and dirt from the drum with a brush.

Remove any accumulated brake dust from the wheel brake assembly with a brush.

Install wheel cylinder clamp, then unhook upper and lower shoe to shoe springs.

Remove parking brake strut and lever.

Remove shoe hold-down springs and remove shoes.

If the wheel cylinder must be removed, begin by loosening and removing the brake line from the back of the wheel cylinder. Next remove the wheel cylinder bolts and remove the wheel cylinder from the backing plate.

Cleaning And Inspection

⚠ WARNING ⚠ ***The drum must not be turned to 'true' a worn friction surface. Turning will make the drum too thin causing drum and brake failure which could cause severe injury or death.***

Inspect the brake drum. Look for a blue coloration or blistered paint that would indicate that it has overheated. Check for evidence of scoring. Check for excessive wear indicated by the friction surface being significantly worn and leaving a ledge of unworn drum. Inspect the splines for galling, wear and corrosion. If any of these problems are found, the drum must be replaced.

Visually inspect the axle seal for oil leakage and the condition of the thrust washer. If oil is present, see REAR AXLE section.

Verify the inner brake drum washer is present and check its condition. Replace if damaged or missing.

Clean the backing plate with an approved cleaner for this purpose.

⚠ WARNING ⚠ ***A backing plate assembly that shows any indication of galling or gouging is not repairable and must be replaced with a new wheel brake assembly. Always replace wheel brake assemblies in pairs.***

Inspect the backing plate. Inspect for gouges, galling or other damage, particularly where the backing plate is contacted by the brake shoes. Be sure shoe ledges are smooth and free of rough edges. Replace both wheel brake assemblies if any gouges or galling is found.

Measure the brake shoe thickness. Measure at the most worn area. Brake shoe thickness must never be less than .06" (1.5 mm) at any point on the shoe. It is normal for the shoes to show more wear at the leading and trail-

ing edges. If the brake shoe thickness is approaching .06" (1.5 mm), it is recommended that the shoes be replaced. It is recommended that the brake shoe springs and brake adjusters be replaced when installing new brake shoes

Check springs for loss of tension and damage. Replace weak springs and any damaged or badly worn parts.

Check adjuster operation. Insure that each adjuster will move with approximately 30 - 50 in. lbs. (3.4 - 5.6 Nm) of torque. If adjusters are frozen, badly worn or loose, replace the adjuster assembly. See 'Replacing an Adjuster' on page D-8.

Replace the wheel cylinder if there is any sign of leakage.

Insure that the parking lever and strut assembly can be easily moved by hand. If necessary, this assembly can be serviced as follows:

Disassemble by removing the C-clip. Wire brush contact surfaces to remove any corrosion and contaminants. Lightly grease the pin and contact surfaces before reassembly.

⚠ WARNING ⚠ ***Insure that the C-clip is completely seated in its' groove when finished. Failure to do so could result in a non-functioning parking brake if the clip comes off.***

Reassembly

Apply a light coat of high temperature lubricant to shoe support points on the backing plate, to adjuster pin, and to anchor.

Position the adjusters so that the pins are at the 12 o'clock position.

If the wheel cylinder was removed, install it now into the backing plate. Insert and tighten the wheel cylinder mounting bolts to 120 in. lbs. (14 Nm) torque. Reconnect and tighten the brake fluid line to 124 - 177 in. lbs. (14 - 20 Nm) torque.

Position shoes on backing plate and install hold-down springs.

Install parking brake strut with tab on strut engaged in brake shoe web.

Place upper end of shoe webs against wheel cylinder, and install upper shoe-to-shoe spring. Remove wheel cylinder clamp.

Install lower shoe-to-shoe spring.

Install wheel and drum. See 'BRAKE DRUM REMOVAL AND INSTALLATION' on page D-5.

Pre-adjust shoes by rotating adjuster nut away from the axle until shoes contact drum and then back off just enough to eliminate drag.

Replacing an Adjuster

Replace the adjuster assembly if the adjuster requires more than 50 in. lbs. (5.6 Nm) torque to rotate.

Secure the adjuster arm with locking pliers and remove the bolt on the back side of the backing plate with a wrench or socket. The bolt may shear off which is acceptable. Remove and discard all adjuster components. Clean the backing plate surfaces that contact with the adjuster.

Prepare to install the new adjuster by applying a light coat of grease to the belleville washer. Install the washer onto the adjuster arm with arch up as shown in the illustration (Ref Fig. 6 on page D-8).

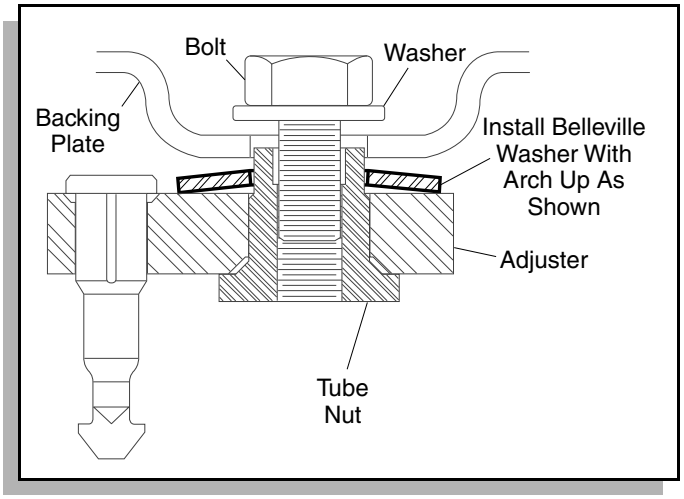

Fig. 6 Belleville Washer Installation

Apply thread locking compound to the bolt.

Insert the nose of the tube nut into the backing plate. Install the bolt into the tube nut and tighten to 110 - 120 in. lbs. (12 - 14 Nm) torque.

Although not strictly necessary, it is recommended to replace both adjusters if one is found to require replacement.

Adjustment

After the brake system has been bled, make 3 to 10 forward and reverse stops by applying firm pressure to the brake pedal on each stop to bring shoes to proper adjustment.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

WHEEL BRAKE ASSEMBLY REPLACEMENT

Tool List	Qty. Required
Socket, 3/4", 1/2" drive	1
Ratchet, 1/2" drive	1
Wheel chocks	4
Hydraulic floor jack	1
Jack stands	2
Socket, 1/4" hex bit, 3/8" drive	1
Ratchet, 3/8" drive	1
Socket, 1/2", 3/8" drive	1
Socket, 9/16", 3/8" drive	1
Needle nose pliers	1
Torque wrench, 3/8" drive, in. lbs.	1
Torque wrench, 3/8" drive, ft. lbs.	1

⚠ WARNING ⚠ ***If one wheel brake assembly requires replacement, the second must also be replaced.***

Wear a dust mask and eye protection whenever working on wheel brakes. Do not use pressurized air to blow dust from brake assemblies.

Be sure that the parking brake is released.

Loosen rear wheel lug nuts and lift rear of vehicle per Section B.

Remove wheel and drum. See 'BRAKE DRUM REMOVAL AND INSTALLATION' on page D-5.

Loosen the four allen head bolts and lock nuts securing the wheel brake backing plate to the flange on the axle tube (Ref Fig. 5 on page D-6). Remove banjo bolt to detach brake line from wheel cylinder. Remove the four allen head bolts and lock nuts and discard.

Remove the clevis pin securing the park brake cable to the wheel brake lever.

Installation is the reverse of removal. Connect the brake cable to the wheel brake lever with the clevis pin installed from the top down and a new cotter pin. Loosely install wheel brake assembly to axle tube flange using new hardware. Attach brake line to wheel cylinder using new copper gaskets and tighten banjo bolt to 124 - 177 in. lbs. (14 - 20 Nm) torque. Tighten allen head bolts and lock nuts to 23 - 27 ft. lbs. (31 - 37 Nm) torque.

BLEEDING AND FLUSHING

Tool List	Qty. Required
Shop towels	A/R
Hose	A/R
Clean container	1
Brake fluid, DOT 3	A/R
Wrench, 1/4" box end	1
Crowfoot wrench, 1/4", 3/8" drive	1
Torque wrench, 3/8" drive, in. lbs.	1

Bleeding

The brake hydraulic system must be free of air to function properly. Any air in the system is compressed when pressure is applied, and the result is a springy, spongy brake pedal.

Air may enter the system if any of the hydraulic parts are disconnected or if the brakes are operated with the master cylinder fluid very low.

The process of removing any air that may be trapped in the hydraulic system is known as bleeding the brakes.

Bleeding requires the use of the brake pedal and master cylinder as a hydraulic pump to expel air and brake fluid from the system when a bleeder screw is opened.

Bleed the complete hydraulic system at both wheels if …

- Primary brake line was disconnected from the flexible brake hose
- Air was introduced into the system through low fluid level in master cylinder reservoir.

If a line or hose was disconnected at any fitting located between the master cylinder and the wheel cylinders, then all wheel cylinders served by the disconnected line or hose must be bled.

Bleeding Sequence

Bleed at each wheel cylinder in succession, beginning with the passenger side wheel, which is farthest from the master cylinder, and then the driver side wheel.

⚠ WARNING ⚠ ***Never reuse any excess fluid or return to the original container. Dispose of brake fluid properly.***

NOTE *An assistant will be necessary to perform this procedure.*

Use a clean cloth to wipe off the master cylinder reservoir and wheel cylinder bleeder valves (Ref Fig. 7 on page D-

10). Clean each fitting before opening to prevent contaminating the system.

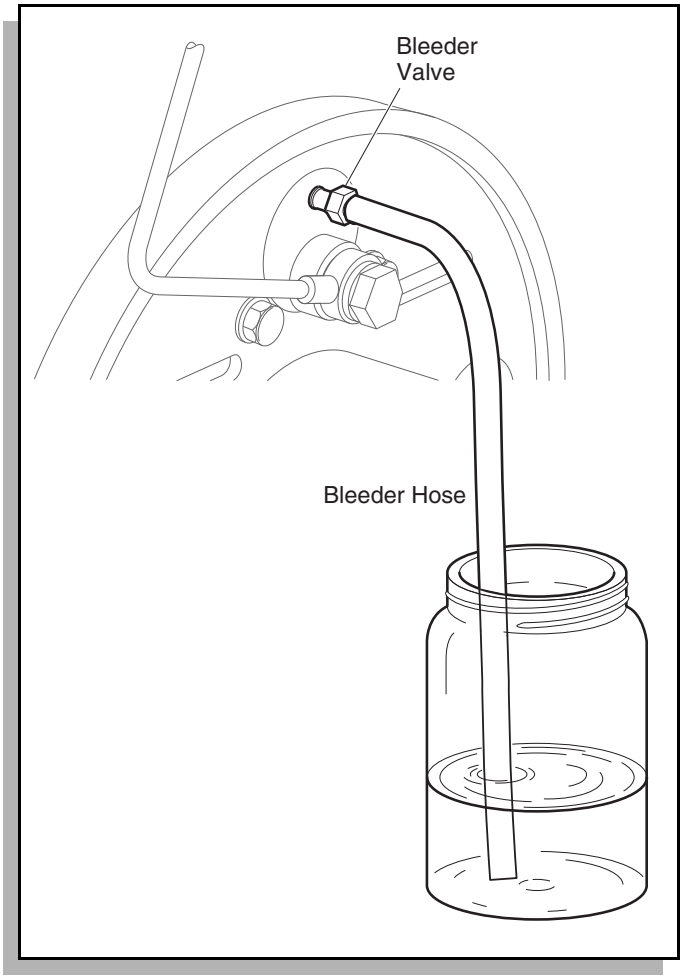

Fig. 7 Bleeder Valve

Fill master cylinder reservoir to within 1/4" (6 mm) of top with new brake fluid before starting and after bleeding is completed.

Check the master cylinder fluid level frequently during bleeding and keep the reservoirs at least one-half full.

The following steps apply to one bleeder screw and should be repeated at both bleeder points.

1. Attach a bleeder hose to the bleeder screw. Place the other end of the hose in a glass jar partially filled with brake fluid.

NOTE *Be sure that the free end of the hose is submerged in brake fluid. This helps to show up air bubbles as they come out of the system, and prevents air from being accidentally sucked into the system through the bleeder screw.*

2. Apply moderate (40 - 50 lbs. [18 - 23 kg]), steady pressure on the brake pedal, and open the bleeder screw.

CAUTION **Do not force brake pedal to floor. The operating rod jam nut could be forced into master cylinder where it could damage internal components.**

3. If the brake pedal goes to the floorboard without removing all of the air bubbles, close the bleeder screw and release the brake pedal slowly. Then repeat Steps 2 and 3.

NOTE *The bleeder valve at the wheel cylinder must be closed at the end of each stroke and before the brake pedal is released to insure that air cannot enter the system. It is also important that the brake pedal be returned to full 'up' position.*

4. When fluid coming from the submerged end of the hose is clear and free of bubbles, close the bleeder screw and release the brake pedal. Tighten bleeder screw to a maximum torque of 38 in. lbs. (4.3 Nm).

Flushing

The process of removing old brake fluid to rid the system of water, mineral oil or other contaminants is called flushing the hydraulic system.

The flushing procedure is the same as bleeding except that a greater quantity of brake fluid is discharged from each bleeder point to be sure that all of the dirty or contaminated fluid is removed.

BRAKE PEDAL REMOVAL AND INSTALLATION

Tool List	**Qty. Required**
Needle nose pliers	1
Straight blade screwdriver	1
Socket, 9/16", 3/8" drive	1
Ratchet, 3/8" drive	1
Wrench, 3/4"	1
Torque wrench, 3/8" drive, ft. lbs.	1

Disconnect the linkage rod from the brake pedal by removing the cotter pin and the clevis pin. Unhook the torsion spring by inserting a thin blade screwdriver between the small hook and the bracket. Move the hook back and to the side to release the torsion spring (Ref Fig. 8 on page D-11).

Remove the lock nut, the shoulder bolt and remove the brake pedal.

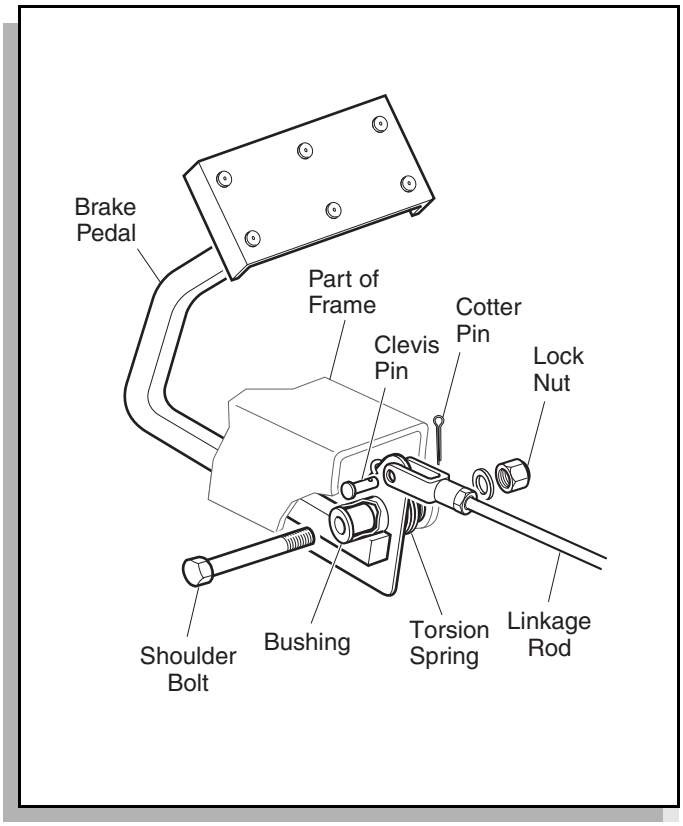

Fig. 8 Brake Pedal Removal and Installation

Inspect the shoulder bolt for corrosion that could cause binding. This bolt and both bushings must be replaced with new ones if corrosion or wear is found.

Brake pedal installation is in the reverse order of disassembly. Tighten the nut to 25 - 29 ft. lbs. (34 - 39 Nm) torque and use a new cotter pin when installing the linkage rod.

PARKING BRAKE

The rear brake includes a parking feature consisting of a wheel brake lever and strut. The wheel brake lever is applied by a cable attached to the parking brake lever (hand or foot operated). The parking brake is used to retain the vehicle when stationary. It may also be used as an emergency brake in the event of hydraulic system failure.

The hand operated parking brake lever is located at the right side of the driver in the console between the front seats (Ref Fig. 9 on page D-12).

Lubrication

CAUTION **When lubricating parking brake, be sure to use the recommended dry spray lubricant. Commercial grease can attract dirt and accelerate wear.**

The hand operated parking brake lever requires periodic lubrication with a dry graphite or molybdenum disulfide lubricant. Raise the lever and spray into the underside to access the pivot arm and ratchet mechanism of the parking brake. See Section A - Periodic Service Schedule for recommended lubrication schedule.

Adjustment

The parking brake adjustment is made at the clevis yoke on the end of the parking brake lever cable located under the front seats (Ref Fig. 9 on page D-12).

Loosen jam nut at clevis yoke.

Remove cotter and clevis pin attaching clevis yoke to equalizer.

Rotate clevis yoke up or down the threaded end of cable and reconnect to equalizer to check tension. Correct tension is when, at the sixth click of the hand operated parking brake lever, vehicle movement is prevented while under a load on a typical area slope. Readjust if necesary.

Tighten jam nut firmly against clevis yoke to secure.

Cable Replacement

Cables should be replaced when they become inoperable. Cable replacement consists of first removing the cotter and clevis pins securing the cable to the equalizer and wheel brake levers. Then remove the retaining rings securing the cable to the frame and subframe. Install new cable in reverse order of removal and adjust parking brake system per instructions above.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

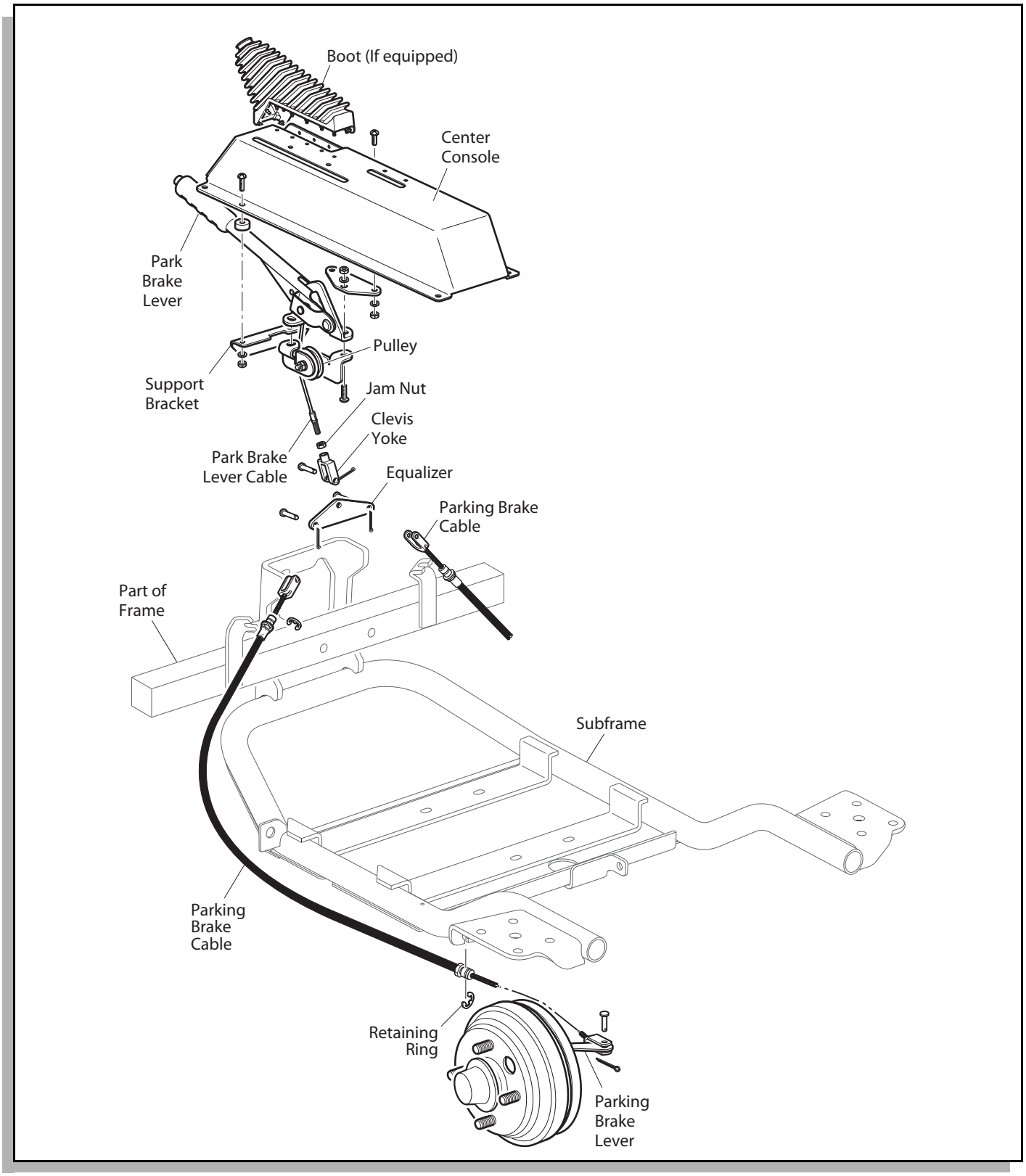

Fig. 9 Parking Brake System Components

CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

E

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Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

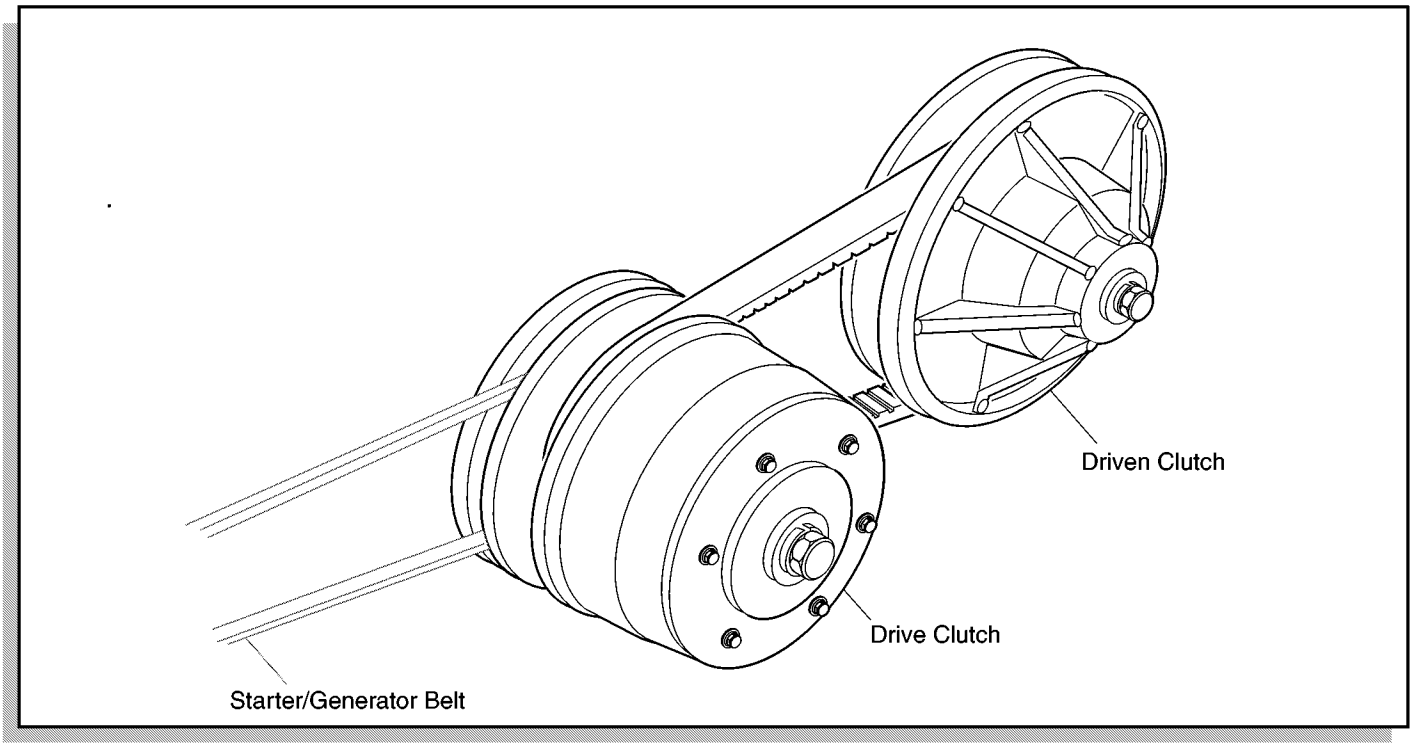

Fig. 1 Continuously Variable Transmission System (CVT)

GENERAL

Power transmission from the engine to the rear axle is by means of a continuously variable transmission (CVT). The CVT consists of two matched clutch units joined by a drive belt (Ref Fig. 1 on page E-1). The engine mounted drive clutch is a centrifugal unit that responds to engine speed and the rear axle mounted driven clutch is a load sensing unit.

CLUTCHES

Drive Clutch

When the accelerator is depressed, the engine speed is increased which causes the cams (weights) within the centrifugal drive clutch to move outwards and force the moveable sheave inwards. The drive belt is engaged by the clutch sheaves and begins to rotate. At this point, the ratio between drive and driven clutch is approximately 3:1.

As the engine speed continues to rise, the drive clutch sheave continues to move inwards forcing the drive belt to the outer diameter of the drive clutch sheaves which increases the speed of the belt. The ratio is greatly decreased and provides maximum speed.

When the accelerator is released, the engine speed is decreased and the cams exert less pressure on the moveable sheave which is forced outwards against the cams by a compression spring. The drive belt disengages from the clutch sheave when engine speed is reduced to the point where the cams exert less force than the spring.

Driven Clutch

The driven clutch sheaves are closed at rest which results in the drive belt being held at the outer diameter of the driven clutch. The driven clutch has no weights but is held closed by a torsion spring which is joined to the moveable sheave and a torque ramp (cam) that is attached to the fixed sheave. The moveable sheave slides against the cam with the three points of contact provided by low friction 'buttons'.

As the drive belt starts to rotate, the driven clutch starts to rotate. As the speed of the drive clutch increases and the belt starts to climb the sheaves, the driven clutch responds by being forced open in order to permit the belt to ride lower in the driven clutches sheaves. The sheaves overcome the pressure exerted by the torsion spring and cam.

As the driven clutch slows, the belt rides lower in the drive clutch sheaves. The driven clutch compensates by closing in response to the torsion spring and cam.

Increased Load

When a vehicle traveling at governed speed begins to climb a grade or is subjected to other increased load conditions, a change in wheel speed is detected by the clutch system and the drive belt seeks a position where it can achieve adequate friction to overcome the load change. The belt moves outwards on the driven clutch which closes due to the torsion spring moving the moveable sheave against the torque ramps. The movement of the drive belt overcomes some of the centrifugal force exerted by the cams in the drive clutch. This forces the belt lower into the drive clutch which increases the drive ratio. This 'downshifting' applies more torque to the rear axle without an appreciable change to the engine speed since the governor opens the carburetor in direct response to the reduction in ground speed.

Equilibrium

The CVT functions because the drive and driven clutches maintain equilibrium. Clutch sets are tuned to the vehicle that they are designed to operate. Changes in vehicle weight or desired performance characteristics require that both clutches be tuned to the needs of the vehicle and remain compatible with each other.

Drive Clutch Removal

Tool List	Qty. Required
Plastic faced hammer	1
Socket, 5/8", 3/8" drive	1
Ratchet, 3/8" drive	1
Clutch puller (P/N 19779-G2)	1
Impact socket, 13/16", 1/2" drive	1
Impact wrench, 1/2" drive (air or electric)	1
Thread locking adhesive	AR
Torque wrench, 1/2" drive, ft. lbs.	1

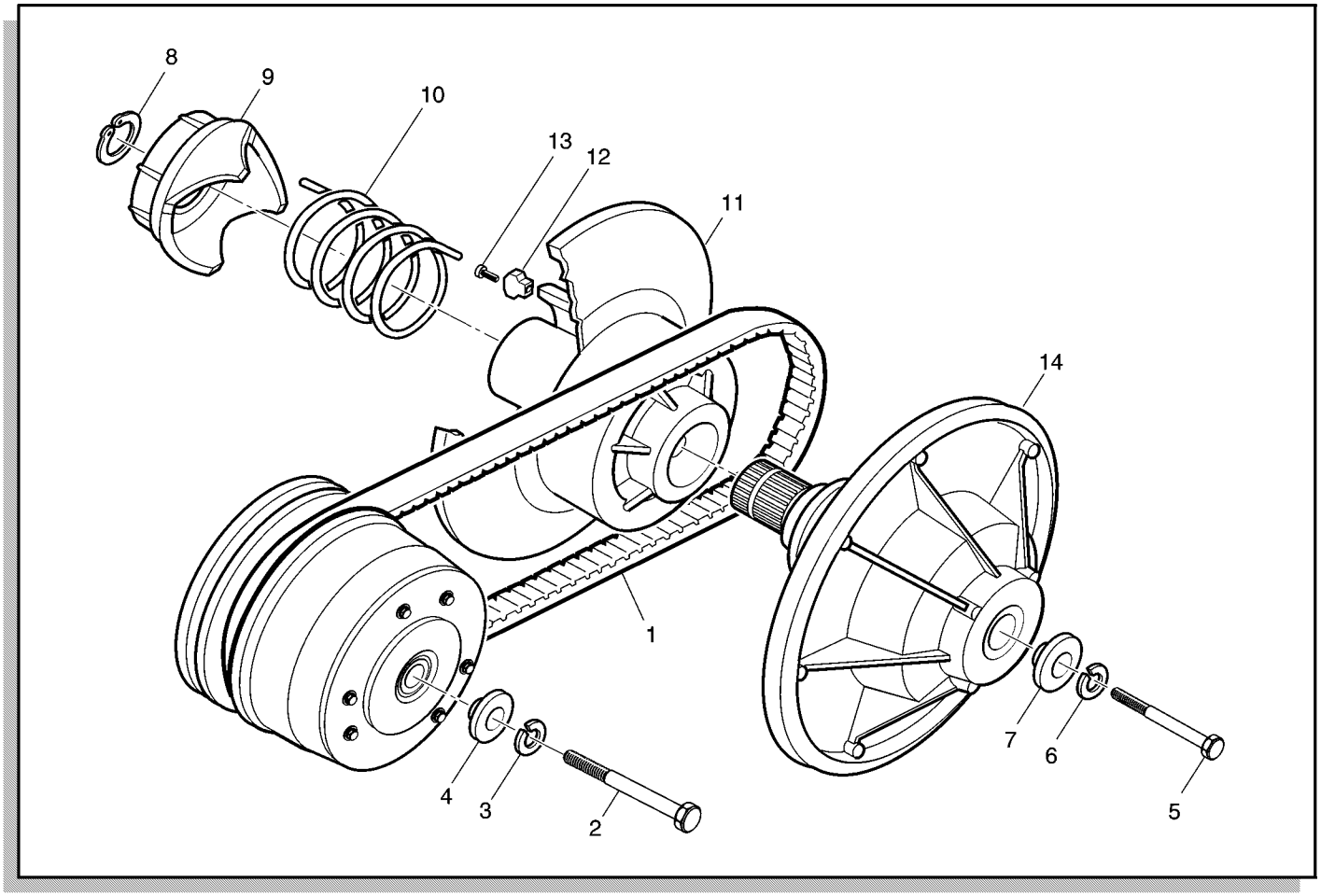

Fig. 2 CVT Components

⚠ WARNING ⚠ ***To prevent burns and other possible injuries:***

Disable the electrical system before attempting to remove the drive belt to prevent the engine from inadvertently starting.

Be sure that the engine and exhaust components have cooled before attempting any service.

Do not allow fingers to become trapped between the belt and clutch sheave.

Use only sockets designed for use with an impact wrench. Never use a socket intended for use with hand tools.

Remove the drive belt (1). See 'Removing the Drive Belt' on page E-4. Remove the starter/generator belt per ENGINE section.

Remove the clutch bolt (2), lock washer (3) and pilot washer (4) (Ref Fig. 2 on page E-2). Insert a greased clutch puller and tighten (clockwise) using an impact wrench which will remove the clutch from the engine crankshaft.

NOTE *In some extreme cases, the clutch may not separate from the crankshaft. Remove the clutch puller and fill the cavity with grease. Replace the clutch puller and tighten it with the impact wrench. The combined mechanical and hydraulic effect will remove the clutch. Remove all excess grease.*

Drive Clutch Installation

CAUTION **To prevent damage to the clutch, be sure to remove all grease from the body of the clutch since grease penetrating the seal may cause premature clutch failure.**

Do not install the bolt with an impact wrench.

Clean both the engine crankshaft and the drive clutch bore. Slide the clutch onto the engine crankshaft and rotate the clutch while lightly pushing the moveable sheave in and out several times to seat the clutch with the tapered crankshaft (Ref Fig. 2 on page E-2).

Install the lock washer (3) and the large pilot washer (4) onto the clutch bolt (2).

Apply thread locking adhesive to the threads of the clutch bolt and install and tighten to 40 ft. lbs. (55 Nm) torque.

Driven Clutch Removal

Tool List	Qty. Required
External snap ring pliers	1
Socket, 5/8", 1/2" drive	1
Ratchet, 1/2" drive	1
Phillips screwdriver	1
Thread locking adhesive	AR
Socket, Phillips screwdriver bit, 3/8" drive	1
Torque wrench, 3/8" drive, in. lbs.	1
Anti-seize compound	AR
Torque wrench, 1/2" drive, ft. lbs.	1

Remove the drive belt (1) (Refer to 'Removing The Drive Belt' procedure elsewhere in this section).

Remove the clutch bolt (5), the lock washer (6) and the pilot washer (7) and slide the clutch from the rear axle input shaft.

Driven Clutch Repair

NOTE *Parts must be reassembled in same position as their original position. Mark all components to facilitate accurate reassembly.*

Some minor field repairs may be made to the driven clutch. Remove the retaining ring (8) and remove the torque ramp (Ref Fig. 2 on page E-2). Remove the spring (10) and the moveable sheave (11).

Inspect the shaft for signs of wear and inspect the bushings for signs of deterioration. If there is wear to the point of causing vibration, the clutch must be replaced.

Torque Ramp Buttons

Remove any fragments and dirt. Remove the ramp buttons (12) by removing the screws (13) (Ref Fig. 2 on page E-2). Using thread locking adhesive on new screws, insert new buttons and tighten screws to 20 - 24 in. lbs. (23 - 28 kg cm) torque. It is good practice to replace all buttons as a set.

Driven Clutch Assembly

Assemble the moveable sheave (11) to the fixed sheave (14) and insert the spring (10) in the pilot hole in the moveable sheave (Ref Fig. 2 on page E-2). Insert the other end of the spring in the torque ramp (9) and rotate the ramp counterclockwise 140° before engaging the splines and inserting the retaining ring (8).

Driven Clutch Installation

Coat the rear axle input shaft with a light coating of anti-seize compound and slide the clutch onto the shaft (Ref Fig. 2 on page E-2). Install the lock washer (6) and pilot washer (7) to the clutch bolt (5) and apply thread locking adhesive to the threads of the clutch bolt. Install the bolt and tighten to 14 - 17 ft. lbs. (19 - 23 Nm) torque.

DRIVE BELT

Removing the Drive Belt

With the vehicle on level ground, remove the drive belt by pulling the belt upwards which will cause the driven clutch sheaves to open and loosen the belt tension (Ref Fig. 3 on page E-4). The belt may then be rolled off the driven clutch.

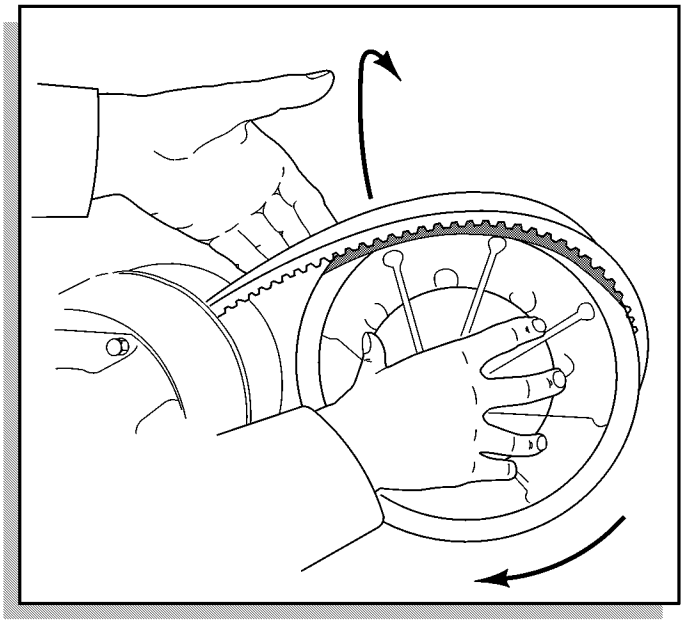

Fig. 3 Removing the Drive Belt

Drive Belt Service

The drive belt will require no service unless the vehicle has been operated in an extremely dusty or muddy location in which case it should be washed with plain water. If the belt becomes frayed or badly worn, it must be replaced.

STORAGE

If the vehicle is to be out of service for an extended period of time, the clutches should **not** be coated with any protecting spray. The drive clutch sheaves may develop some surface rust which will be removed within a few minutes of running time. The driven clutch is aluminum and requires no treatment.

DIRECTION SELECTOR

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DIRECTION SELECTOR

F

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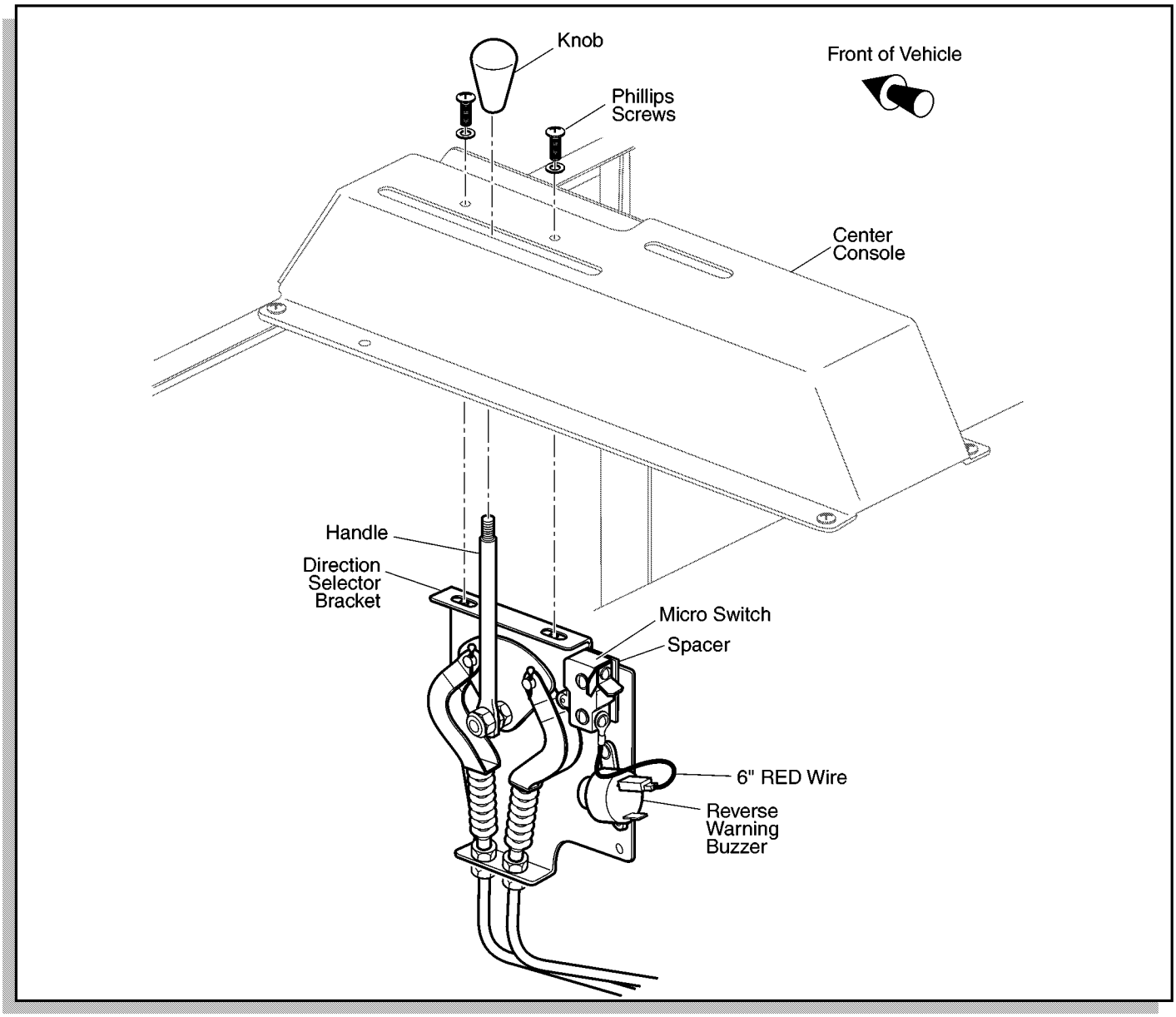


Fig. 1 Direction Selector Components

DIRECTION SELECTOR

Removing Direction Selector

Tools List	Qty. Required
Insulated wrench, 1/2"	1
Phillips screwdriver	1

NOTE *Always observe the following warnings when working on or near batteries:*

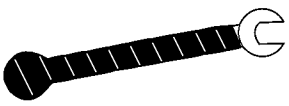
⚠ WARNING ⚠ ***To prevent an electrical arc that could cause an electrical explosion, be sure that the key switch is off and all electrical accessories are turned off before starting work on vehicle.***

Never disconnect a circuit under load at a battery terminal.

The battery negative (-) cable(s) must be removed before starting work on vehicle.

DIRECTION SELECTOR

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings



Wrap wrenches with vinyl tape to prevent the possibility of a dropped wrench from 'shorting out' a battery, which could result in an explosion and severe personal injury or death.

Before replacing a suspect direction selector or replacing the buzzer or micro switch, insure the shift cables are properly adjusted, the electrical wires are firmly attached and the wire is in good condition. Test suspect component to insure it is not in good condition before replacing. It is not necessary to remove the direction selector assembly to replace the reverse buzzer or micro switch.

Prior to removing the direction selector from the body, the battery negative (-) cable(s) must be disconnected to prevent the possibility of electrical spark or 'shorting out' the battery, either of which could result in an explosion and severe personal injury or death.

Unscrew knob from the direction selector handle (Ref Fig. 1 on page F-1). Remove the two screws attaching the direction selector bracket to the center console and remove direction selector from vehicle.

Install in reverse order of removal.

After replacing direction selector, the shift lever must be checked for proper operation of the direction selector and cables must be checked for correct length to insure full engagement of 'Forward' and 'Reverse' at the rear axle when selected by the shift lever. See 'Shift Cable Adjustment' on page F-2.

Replacing the Reverse Warning Buzzer

Tools List	Qty. Required
Test leads	2
Straight blade screwdriver	1
Wrench, 5/16"	1

Before replacing the warning buzzer, test it to insure it is not working properly. To test the reverse warning buzzer, carefully remove the two electrical wires from the buzzer. Using two test leads, attach one lead to each terminal. Touch the loose end of one wire to the positive (+) battery terminal and the other wire to the negative (-) terminal. If the buzzer is in good condition the buzzer will sound. If no sound is heard, the buzzer must be replaced.

Remove the wires from the failed buzzer and attach the wires to the replacement buzzer. Test as above to insure replacement buzzer is in good condition. After restoring power, test the wiring to insure it is operational by connecting wires to replacement buzzer and moving the direction selector to 'REVERSE' position before continuing. Once it is determined that the buzzer and wiring are good, remove the failed buzzer from the direction selector assembly and replace with new buzzer.

Replacing a Micro Switch

Tools List	Qty. Required
Digital Volt Ohm Meter (DVOM)	1
Phillips screwdriver	1
Wrench, 5/16"	1
Socket, 5/16", 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1

To test a micro switch, carefully remove the two electrical wires from the switch terminals. Using a DVOM set to 'continuity', test the switch continuity by operating the switch to insure it is not good before continuing. Once it is determined that the switch is not good, remove the failed switch from the direction selector assembly, keeping the spacer for reuse, and replace with new micro switch. Tighten the brass screw attaching the wires to the switch and the screws attaching the switch to the assembly to 8 - 11 in. lbs. (0.7 - 0.9 Nm) torque.

Shift Cable Adjustment

Tools List	Qty. Required
Wrench, 3/8"	2

NOTE *To assure proper engagement of the transmission, the shift cable length must be maintained.*

The direction selector is a mechanical device that operates cables connected to the rear axle. The cables are sealed and do not require lubrication, but may require occasional adjustment. The factory installed length of 1 3/8" (3.5 cm) must be maintained (Ref Fig. 2 on page F-2). The only other maintenance required is periodic lubrication of the linkage and related moving parts.

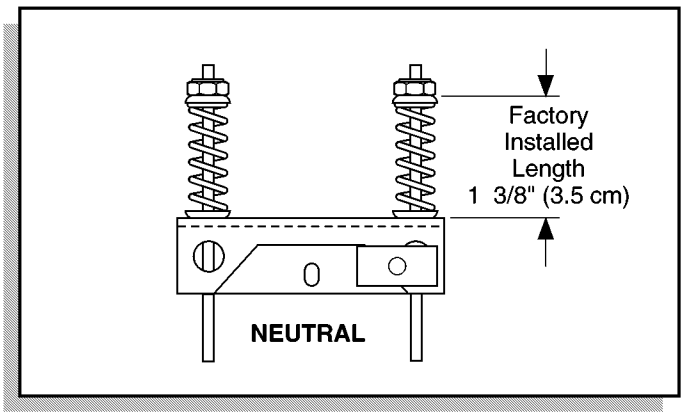


Fig. 2 Shift Cable Adjustment

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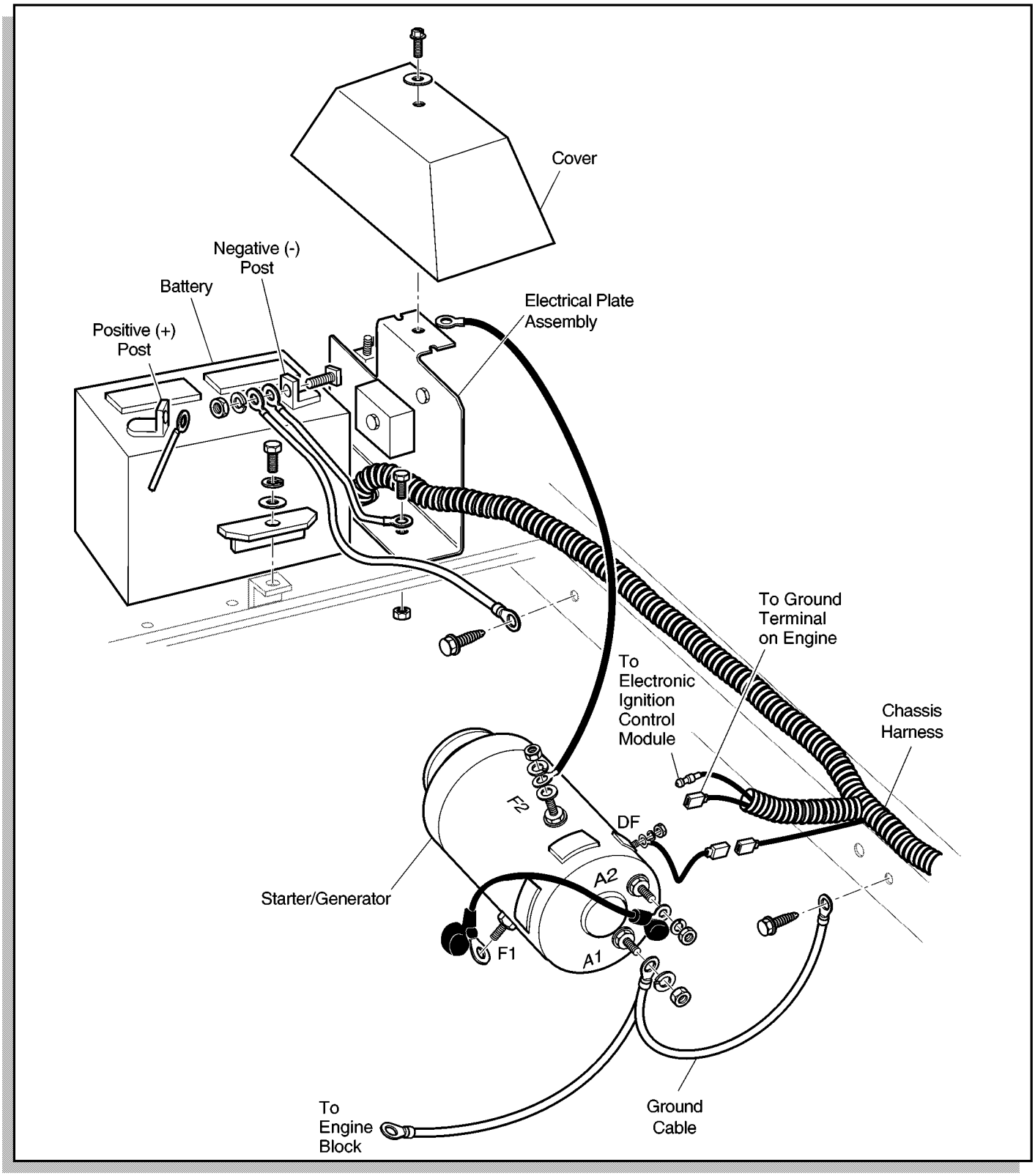

Fig. 1 Electrical System Components

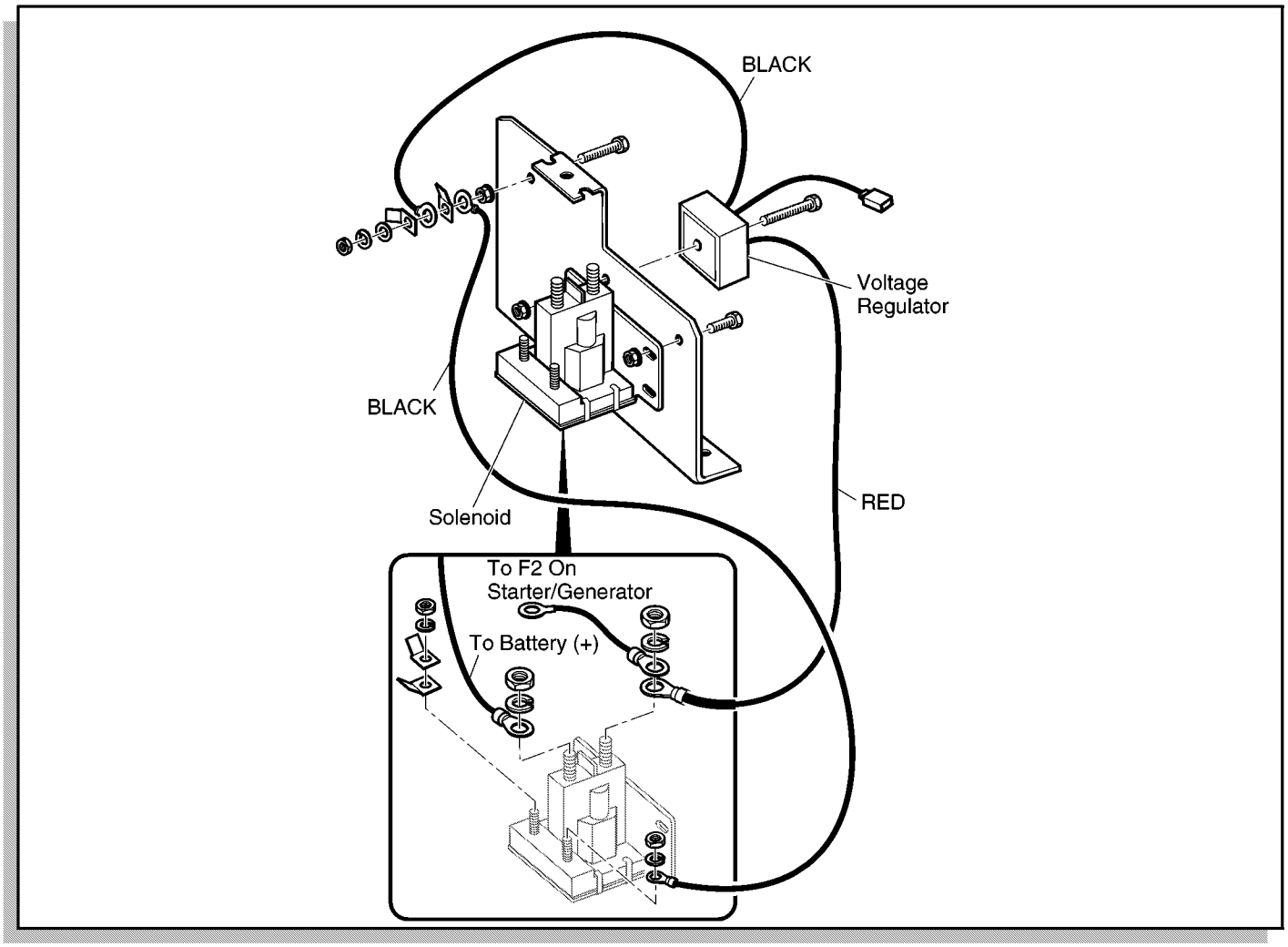

Fig. 2 Electrical Plate Assembly

CIRCUITS AND CONTROLS

The electrical system is a 12 volt negative ground system (Ref Fig. 1 on page G-1) (Ref Fig. 2 on page G-2) consisting of:

- battery
- starter/generator
- voltage regulator
- solenoid
- accelerator limit switch
- fuses
- key switch

These components comprise the Starting and Charging Circuits.

⚠ WARNING ⚠ ***To prevent injury or death from inadvertent movement of vehicle, all tests performed requiring starter/generator or engine to rotate must be performed with the rear wheels raised (see Section B) or the neutral lock engaged (see Section A).***

Follow the lifting procedure in Section B of this manual. Place wheel chocks in front of and behind the front wheels. Check the stability of the vehicle on the jack stands before starting any repair procedure. Never work on a vehicle that is supported by a jack alone.

This section will assist in troubleshooting the vehicle electrical system and accessory wiring. To troubleshoot the ignition electrical system, refer to the Briggs & Stratton engine Operating & Maintenance Instructions (Form

No. 274272) supplied with the vehicle. For more in-depth assistance, refer to the Repair Manual for Vanguard™ V-Twin Overhead Valve engine (Part No. 272144).

STARTER/GENERATOR

Starter Mode

When starting the engine, the field coils are in series with the armature and the starter/generator operates as a motor (Ref Fig. 4 on page G-5). This circuit is controlled by a key switch, fuse, accelerator limit switch and a solenoid. With the key in the 'ON' position, battery current is available to the accelerator limit switch which remains open until the accelerator pedal is pressed. When the pedal is pressed, the plunger on the switch is released, the contacts close and the ignition circuit is energized. Battery current then energizes the solenoid which closes the contacts and energizes the starter circuit. The starter/generator now functions as a starter to start the engine.

Generator Mode

When the engine is running, the starter/generator functions as a generator. This is used for charging the battery and for the ignition system. Generated output is controlled by the voltage regulator at 14.25 - 14.75 V, without regard to engine speed. However, the charging current will vary depending on the condition of the battery. If it is fully charged, current is controlled at 3 to 5 amps.

DIGITAL VOLT OHM METER

⚠ WARNING ⚠ ***Before performing any test of wiring components, disconnect the battery cables from the battery posts to prevent electrical shock or explosion (see procedure in Section B).***

Electrical tests of the wiring for continuity may be made with a DVOM (Digital Volt Ohm Meter) available through the Service Parts Department (P/N 27481-G01). The actual model may vary depending on availability. The DVOM (digital volt ohm meter) shown is representative only (Ref Fig. 3 on page G-3). Any DVOM may be used, however the controls, displays and features may vary depending on the make and model. Always follow the meter manufacturer's recommendations and instructions for the use and care of meter. For the purpose of this section, the red probe (+) and black probe (-) are used. Set the meter selector to the ohms scale and check continuity between each circuit component as indicated. Example: If a switch is open or if there is a break in the wiring, the meter will display a visual signal. If an analog meter is used it will read infinity (∞).

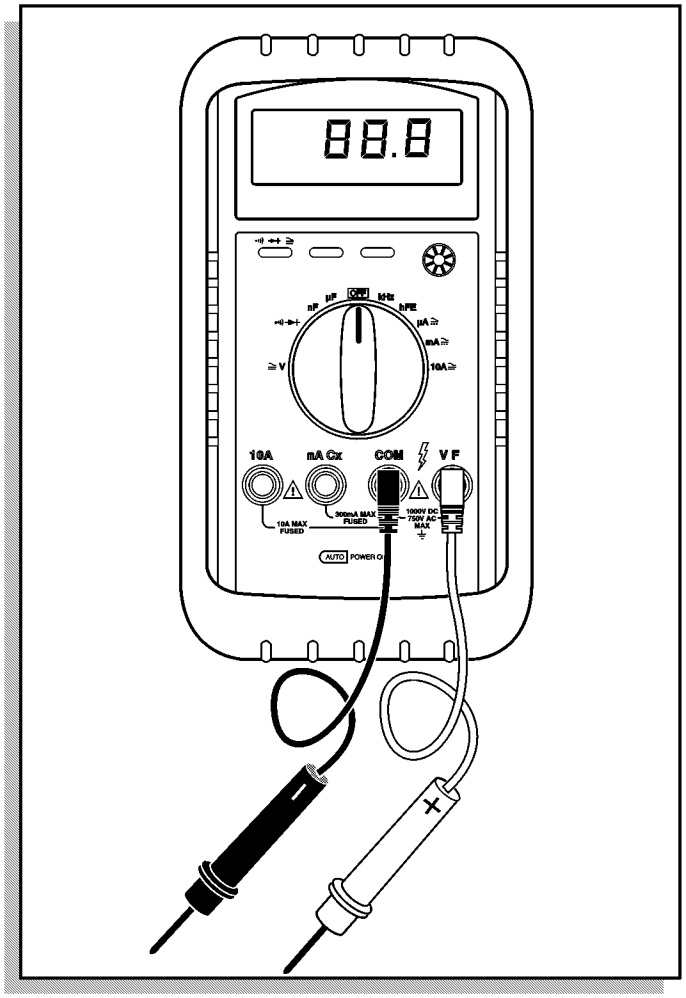

Fig. 3 DVOM

TESTING STARTING CIRCUIT

⚠ WARNING ⚠ ***To prevent the possibility of injury resulting from vehicle inadvertently starting, disconnect battery for steps 1 through 8 (see Section B).***

Tool List	**Qty. Required**
DVOM	1

If the engine will **not** turn over, proceed as follows:

1. Check the battery for a voltage reading which should be between 12.2 and 12.5 volts. Inspect for loose or dirty battery post connections.

2. Check for a blown in line fuse and replace if necessary with a 7.5 amp fuse (Ref Fig. 4 on page G-5).
3. Check for loose wires at all terminal connections.
4. Check the complete electrical system for correct circuitry.
5. Inspect for worn insulation or bare wires touching the frame. Bare wires will cause a short circuit.
6. Check for continuity through the key switch. Set the DVOM to the ohms (Ω) scale. Remove key switch plate from instrument panel. See BODY AND TRUCKBED section. Detach electrical plug from key switch. Place positive (+) probe on terminal of green (GRN) wire and negative (-) probe on terminal of blue (BLU) wire. The reading on the meter should be "0" Ω with the switch key in the '**ON**' position and a visual signal (∞) with the switch in the '**OFF**' position. If the meter does not register, replace the switch. Reconnect the wires.
7. Turn the key switch to '**OFF**'.
   a. Place one probe of the DVOM (set to ohms scale) on the red wire at the solenoid. Place the other probe on the key switch terminal with the blue wire.
   b. Press the accelerator and observe the DVOM. A reading of less than 2 Ω indicates a good limit switch. A reading of greater than 2 Ω indicates that the switch terminals should be checked. A reading of infinity, a visual signal (∞), indicates that the switch must be replaced. Connect the battery.
8. Check the starting solenoid operation. Turn the key switch to the '**ON**' position.
   a. Place the DVOM (set to appropriate DC volts scale) negative (-) probe on terminal A of the solenoid. Place positive (+) probe on terminal B. The DVOM should indicate approximately 12 V.
   b. Press the accelerator pedal. The DVOM will indicate "0" voltage if the solenoid contacts are closed.
   c. If "0" voltage is not indicated while the accelerator pedal is pressed, replace the solenoid.

TESTING CHARGING CIRCUIT

Tool List	**Qty. Required**
DVOM	1

⚠ WARNING ⚠ ***To prevent the possibility of injury resulting from vehicle inadvertently starting, the drive belt must be removed or both rear wheels raised (see procedure in Section B).***

The charging circuit consists of a starter/generator, voltage regulator and battery (Ref Fig. 4 on page G-5). The solenoid must be functional in order to start the vehicle, but is not considered part of the charging circuit.

1. If the battery charge is inadequate (less than 11 VDC), proceed as follows:
   a. Check the battery voltage and inspect for loose or corroded terminal posts and connections. Check electrolyte level.
   b. Check charging circuit component terminals for proper, clean, tight connections.
   c. Check for charging voltage as follows:
      1) Raise the vehicle (see procedure in Section B) so that both rear wheels are free to rotate.
      2) With the engine off, measure the voltage at the battery's terminals by placing the negative (-) probe on the negative (-) post and the positive (+) probe on the positive (+) post of the battery. Note the reading.
      3) Attach the DC voltmeter across the regulator's red and black leads.
      4) Start the engine and accelerate to governed speed.
      5) The meter should read higher than before starting the engine. In a reasonable amount of time, the reading should settle between 14 and 15 volts, indicating the regulator is functioning properly.
      6) If no increase over battery voltage is observed, there is a malfunction in the charging circuit.
      7) If the reading is **above** 15 volts, check to assure the wiring harness and generator field winding (green lead) is not grounded. If it is not, replace the regulator.
      8) If the reading is **below** 14 volts, disconnect the regulator's green field wire from the system harness. Temporarily connect the green field wire to ground. If the voltage rises above its prior reading, replace the regulator.
      9) If the above procedures do not correct the problem, check for faults in the vehicles wiring harness and/or generator.

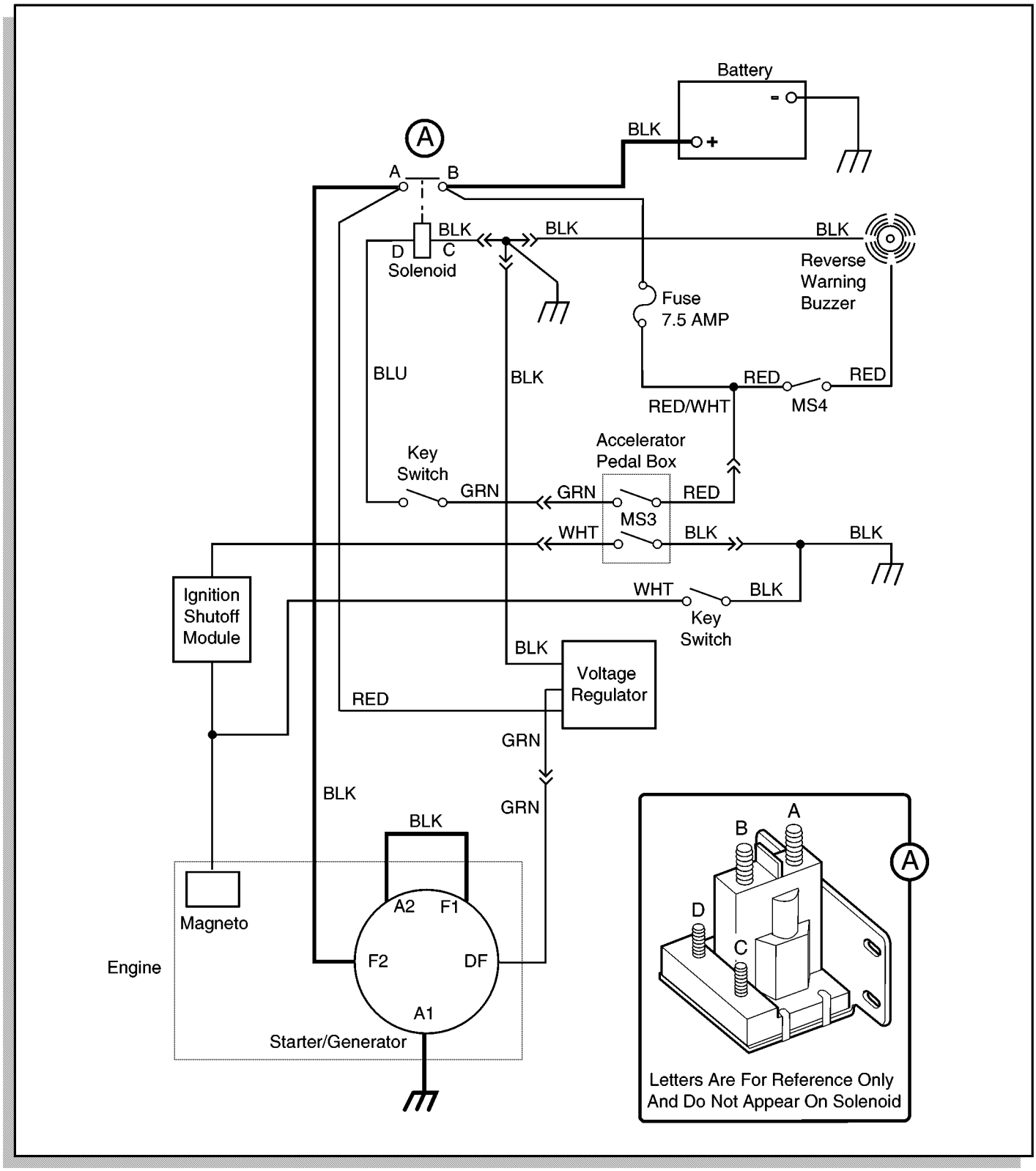

Fig. 4 Starting and Charging System Wiring Diagram

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

STARTER/GENERATOR

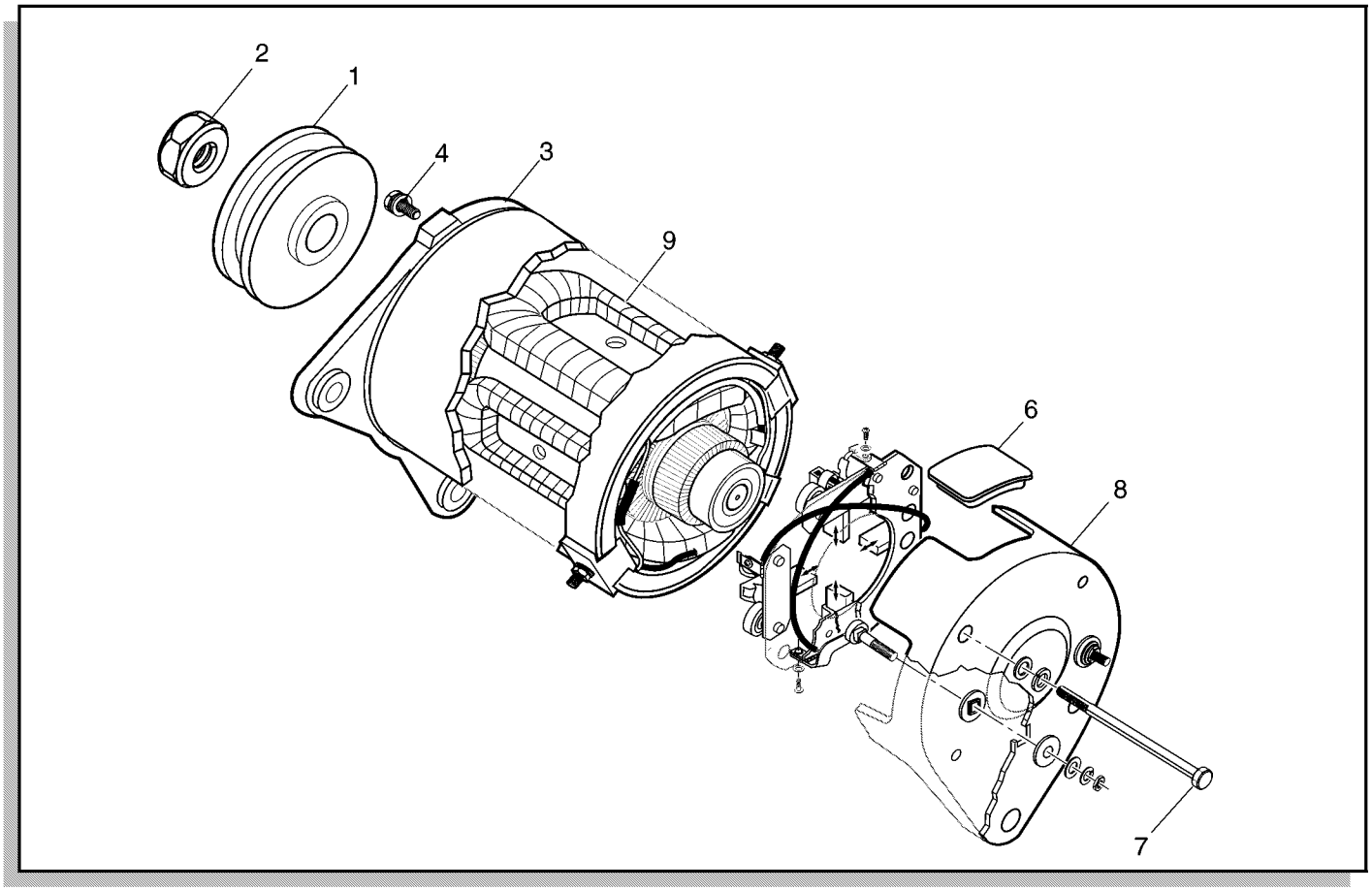

Fig. 5 Starter/Generator

Starter/Generator Removal

See ENGINE section.

Starter/Generator Disassembly

Tool List	Qty. Required
DVOM	1
Wrench, 24 mm	1
Wrench, 10 mm	1
Wrench, 6 mm	1
Wrench, 5 mm	1
Socket, 10 mm, 3/8" drive	1
Phillips screwdriver, 3/8" drive	1
Two jaw puller	1
Straight blade screwdriver	1
Ratchet, 3/8" drive	1

NOTE *In general, starter/generator service is best performed by trained motor technicians who have the knowledge and equipment to overhaul the unit. Some checks and repairs however, can be accomplished by a skilled mechanic. Make your own evaluation of the equipment and skills available before starting disassembly.*

Hold the pulley (1) and remove the pulley nut (2). Remove the pulley, screws (4) and front cover (3) (Ref Fig. 5 on page G-6).

Remove the brush covers (6) by prying out with a screwdriver. Pull up on the brush springs and move to the side of brushes, slide the brushes out approximately 1/4" (6 mm) (Ref Fig. 6 on page G-7). Remove the through bolts (7) and the rear cover (8). Remove the frame and field coils (9). Remove the 5 mm screws from the brush holder and 6 mm nuts from A1 and A2 terminals. Remove the brush holder. If the bearing needs to be replaced, use an automotive style two jaw puller to remove the bearing from armature (Ref Fig. 7 on page G-7).

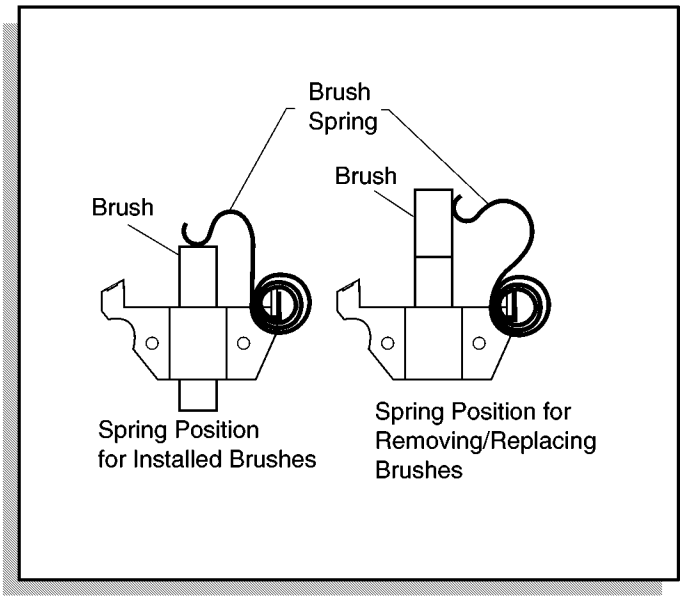

Fig. 6 Starter/Generator Brush Removal

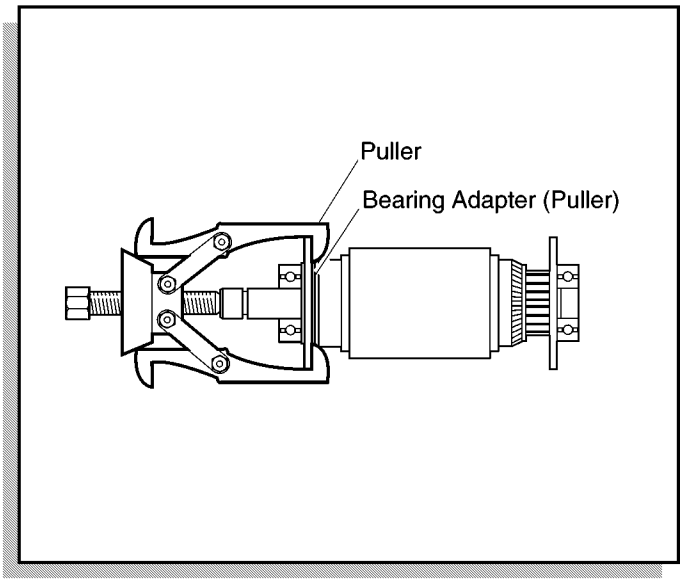

Fig. 7 Bearing Removal

Starter/Generator Inspection

1. Inspect the commutator for wear or damage.
2. Inspect the brush assembly for wear and damage to the brush holder insulators. Check the brushes for length, approximately 11/16" (17 mm) or to the line marked on the brush and signs of carbonization.
3. Inspect the armature for distortion or broken wires.
4. Inspect the field coil insulators and lead wire.
5. Check the bearings for free rotation and lack of end play on shaft. Replace if necessary.

Starter/Generator Repair and Replacement

Tool List	Qty. Required
DVOM	1
Torque wrench, 1/2" drive, ft. lbs.	1
Torque wrench, 3/8" drive, in. lbs.	1
Clean cloth	1
Socket, 5 mm, 3/8" drive	1
Socket, 6 mm, 3/8" drive	1
Socket, 10 mm, 3/8" drive	1
Socket, 24 mm, 1/2" drive	1

1. Commutator - Clean with a soft, clean cloth.
2. Replace any damaged or cracked brush holders or brushes worn to less than 11/16" (17 mm) in length or to the line marked on the brush.
3. Test the insulation between the core and the commutator segments and shaft with a circuit tester. If continuity is indicated, the insulation is defective and the armature must be replaced.
4. With the brushes removed, using a DVOM, check the field coils for continuity between 'F1' and 'F2' and 'DF' and 'F1'. If an open circuit exists, replace the field coils. Check for continuity between all four terminals and the frame (outer shell). If continuity is indicated, the field coils are grounded against the frame and the field coils must be replaced.
5. Clean all parts to be reinstalled and reassemble in the reverse order of disassembly. Tighten bolts and nuts to the following values:
   - 5 mm - torque to 15 - 21 in. lbs. (17 - 24 kg cm)
   - 6 mm - torque to 30 - 43 in. lbs. (35 - 50 kg cm)
   - 10 mm - torque to 52 - 74 in. lbs. (60 - 85 kg cm)
   - 24 mm - torque to 33 - 40 ft. lbs. (45 - 54 Nm)

Tighten **terminal nuts** to the following torques:
- F1 - F2 - torque to 43 - 52 in. lbs. (50 - 60 kg cm)
- DF - torque to 26 - 35 in. lbs. (30 - 40 kg cm)

BATTERY VOLTAGE TEST

⚠ WARNING ⚠ ***Hydrogen gas formed during battery charging is explosive and can cause personal injury or death. Avoid any electrical spark or open flame near battery.***

NOTE *If the temperature of the battery or the ambient temperature is below 60° F (15° C), the capacity of the battery will be less. It will require more time to charge.*

A cold battery will build up voltage and more rapidly reduce the charging rate.

Batteries that are new or have been stored must be fully charged before being tested or placed in vehicle.

CAUTION **Do not overcharge battery.**

Battery voltage can be checked using a voltmeter. Attach the negative (-) lead of the DVOM to the ground terminal of the battery. The positive (+) lead is then attached to the positive battery terminal. The voltage reading obtained should be 12 volts or above. If the reading is below 12 volts, the battery requires either charging or replacement.

STORAGE OF BATTERY

A battery that is removed from service for storage must be cared for as follows:

For battery removal see 'Battery Removal' in Section B. Charge fully. Cover terminals with petroleum jelly to prevent oxidation (use commercially available battery protectant when installed in vehicle). Store in a cool place not below 32° F (0° C) or above 80° F (27° C) Battery should be charged every 30 days using a 2 amp trickle charger.

TROUBLESHOOTING

In order to effectively troubleshoot the circuits that include the horn, lighting, brake/turn signals and gauges, the technician must be able to use the wiring diagram and a DVOM.

The wiring diagram shows the path followed by a voltage or signal from its origination point to its destination. Each wire is indicated by color. (Ref Fig. 8 on page G-9)

The technician should use simple logic troubleshooting in order to reduce the number of steps required to isolate the problem.

Example 1: If the vehicle will not start and none of the lights function (or burn dimly) the battery should be tested before trying to troubleshoot the lighting circuit.

Example 2: If a problem occurs in the lighting circuit that results in only one of the headlights not working, there is no reason to check battery wiring or the fuse since it is obvious that voltage is present. Since bulbs will burn out over time, the obvious place to start is at the headlight that is not functioning. If power is present at the connector and the ground wiring is satisfactory, the only possibilities that exist are a burned out bulb or a poor contact between the connectors and the headlight.

If power is not present but the other headlight functions, a wiring problem is indicated between the two headlights.

In some cases where battery voltage is expected, the easiest way to test the circuit is to set the DVOM to DC volts and place the negative (-) probe of the DVOM on the negative battery terminal. Move the positive (+) probe to each wire termination starting at the battery and working out to the device that is not working. Be sure to check both sides of all switches and fuses.

When no battery voltage is found, the problem lies between the point where no voltage is detected and the last place that voltage was detected. In circuits where no voltage is expected, the same procedure may be used except that the DVOM is set to continuity. Place the negative (-) probe on a wire terminal at the beginning of the circuit and work towards the device that is not working with the positive (+) probe. When continuity is no longer indicated, a failed conductor or device is indicated.

POWER SUPPLY

Tool List	**Qty. Required**
DVOM	1

1. Check for Loose or Bare Wires

Check for loose wires at each terminal connection and for worn insulation or bare wires touching the frame. BARE WIRES MAY CAUSE A SHORT CIRCUIT.

NOTE *If any DVOM readings indicate a faulty wire, it is recommended that the condition of the terminals and wire junction be examined. A faulty wire must be replaced. See 'FAULTY WIRE REPLACEMENT'.*

2. Check Battery Condition

Check for adequate battery volts (nominal 12 VDC) by setting DVOM to 30 VDC range and place the red probe (+) on the battery post with the white (WHT) wire attached. Place the black probe (-) on the battery post with the black (BLK) wire attached. A reading of 11 VDC or greater indicates adequate battery condition. No reading indicates (a) a poor connection between the probes and the battery terminals; (b) a faulty DVOM. A voltage reading below 11 volts indicates poor battery condition and the vehicle should be recharged before proceeding with the test.

NOTE *Due to the resistance of the wires involved*

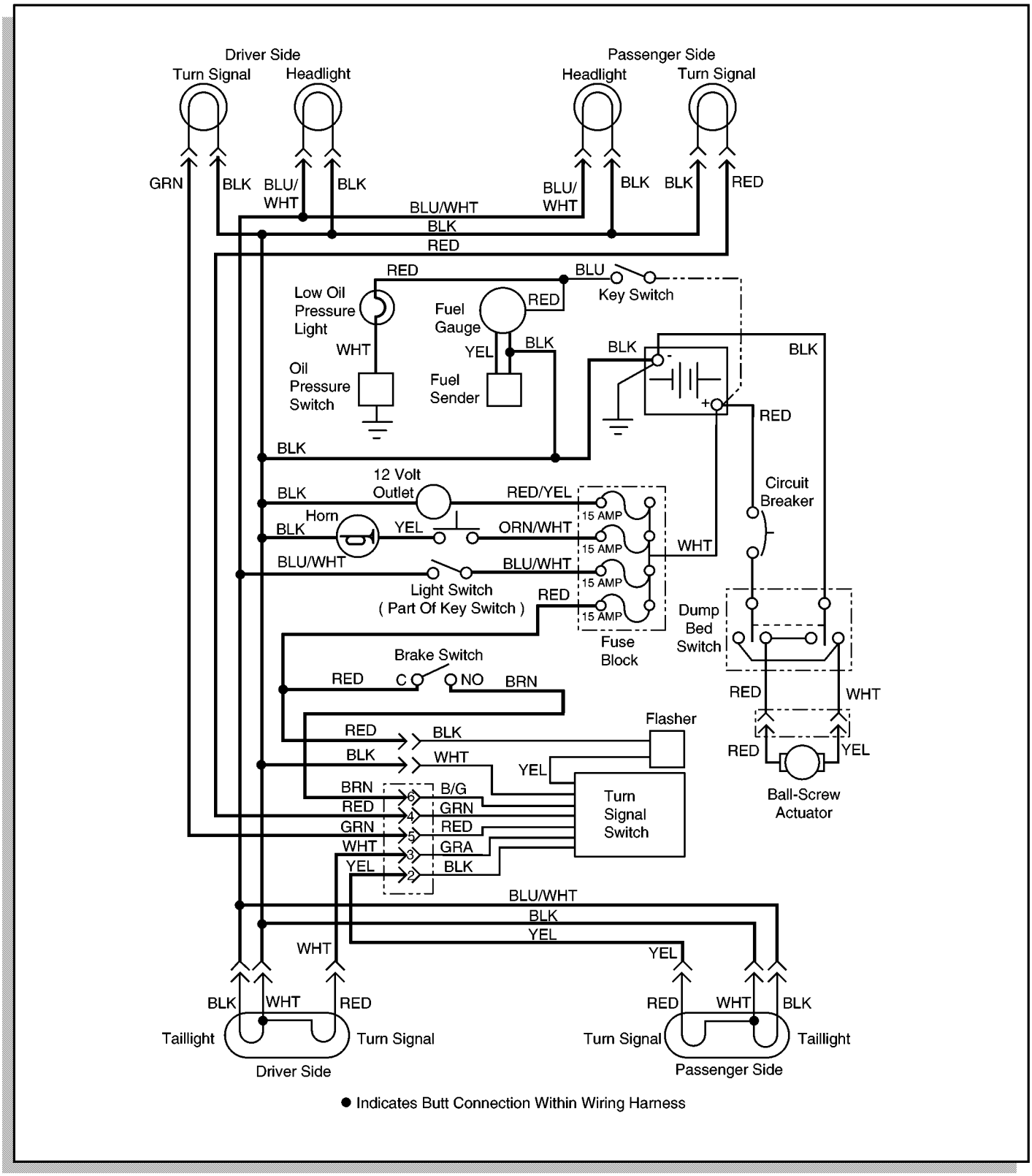

Fig. 8 Accessory Wiring Diagram

within the harness, voltage readings may be somewhat lower than battery voltage. A reading of 1 volt below battery voltage is acceptable.

3. Check Power Wire

Firmly attach the black probe (-) to the battery post with the black wire attached and the red probe (+) to the power (white) wire terminal at the fuse block. A reading of battery voltage indicates that the power wire is in good condition.

NOTE *The power wire supplies power to the entire fuse block.*

4. Check Fuse

Place the red probe (+) to each wire terminal on the fuse block. A reading of battery voltage indicates that the fuse is in good condition. No reading indicates a faulty fuse; replace with a good fuse of the same amperage rating.

CAUTION **Use of incorrect fuse rating can damage electrical components.**

ACCESSORY WIRING

After determining that there is power to the fuse panel, and the fuse is good, continue checking the circuit using the procedures previously used to check the power supply, i.e. loose or rusted connections, bare wires, continuity of the wiring from terminal to terminal, operating condition of switch, etc.

Use the wiring schematic (Ref Fig. 8 on page G-9) to check correct wiring and wire routing. If there is power at the fuse end of the wire, there must also be power at the other end of the wire at the switch or electrical accessory, and eventually at the ground connection. Electricity must flow from the fuse panel through the full length of the circuit to the ground connection. Any interruption of electricity flow must be corrected, whether by repairing or replacing the wire, the switch or accessory.

FAULTY WIRE REPLACEMENT

A faulty wire should be replaced with one of the same gauge and color, wired between the correct components, and secured to the harness bundle with a wire tie. The faulty wire should be cut back close to the harness and the ends protected with vinyl electrical tape.

LIGHT BULB REPLACEMENT

To replace the headlight bulb, locate the two screws in back of the headlight underneath the cowl that secure the front part of the light (bulb) to the rear housing. Remove the screws allowing the bulb to be removed from the outside of the cowl. Disconnect the two wires from the bulb. Connect the wires to the new bulb and put new light bulb in place. Secure with screws previously removed.

NOTE *It will be necessary to push or pull the splash panel as necessary to remove the headlight.*

To replace the taillight bulb, roll the rubber bezel from around the edge of the taillight and remove the lens. Replace with new bulb. Replace lens.

Headlight and taillight bulbs and fuses are available from a local Distributor, an authorized Branch or the Service Parts Department.

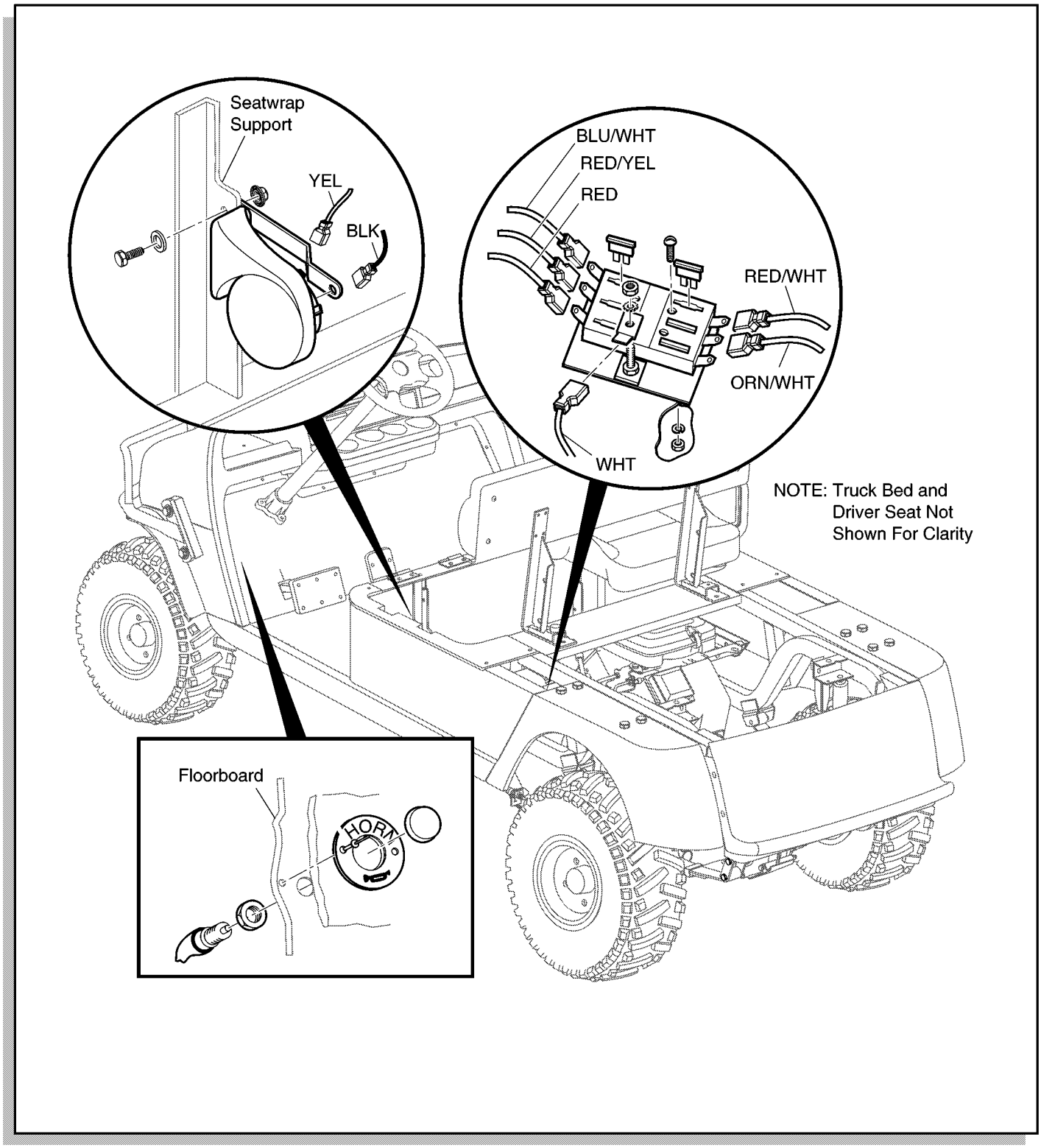

Fig. 9 Horn and Fuse Block

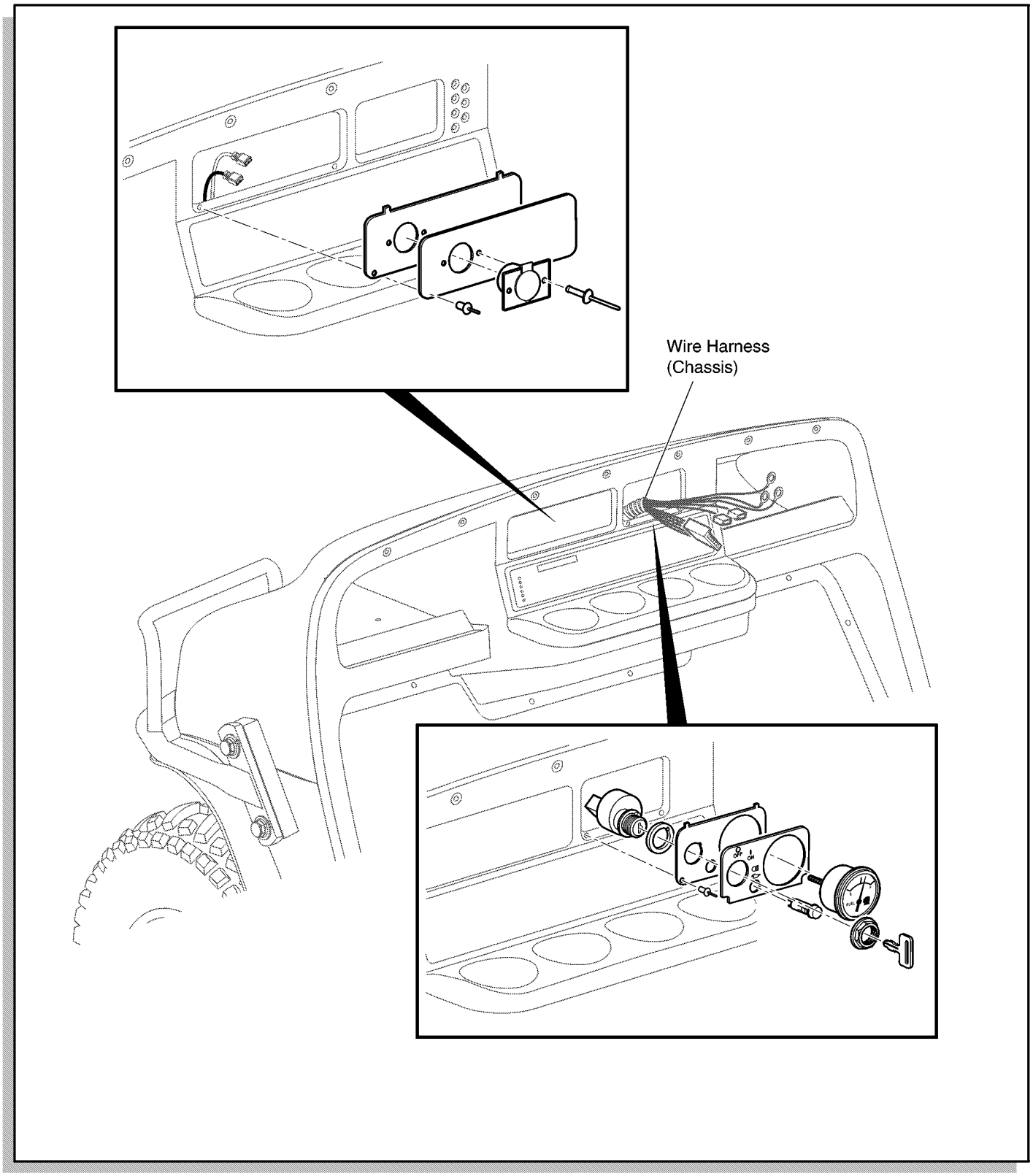

Fig. 10 Ignition Switch and 12 Volt Power Outlet

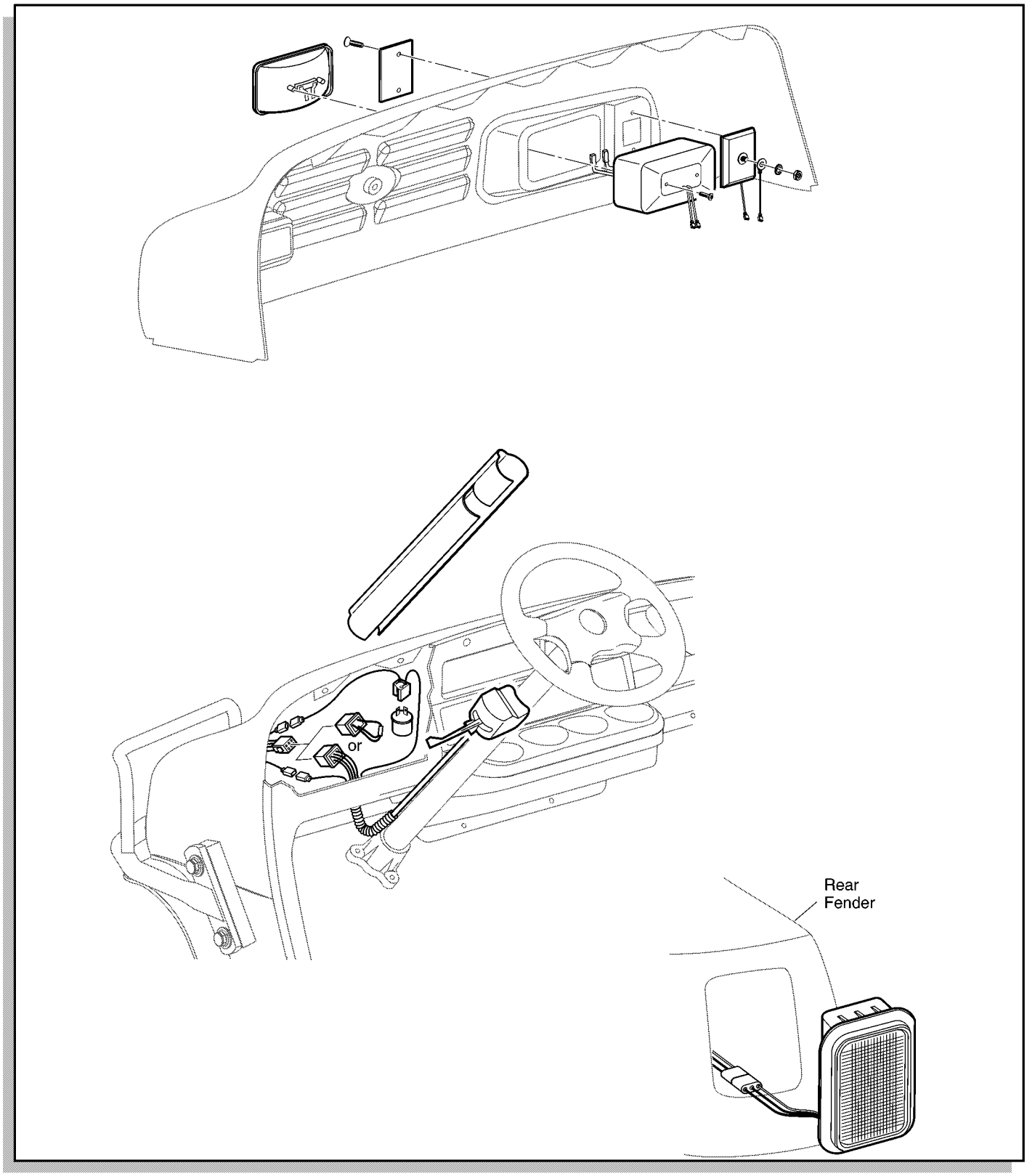

Fig. 11 Headlight, Turn Signal and Taillight

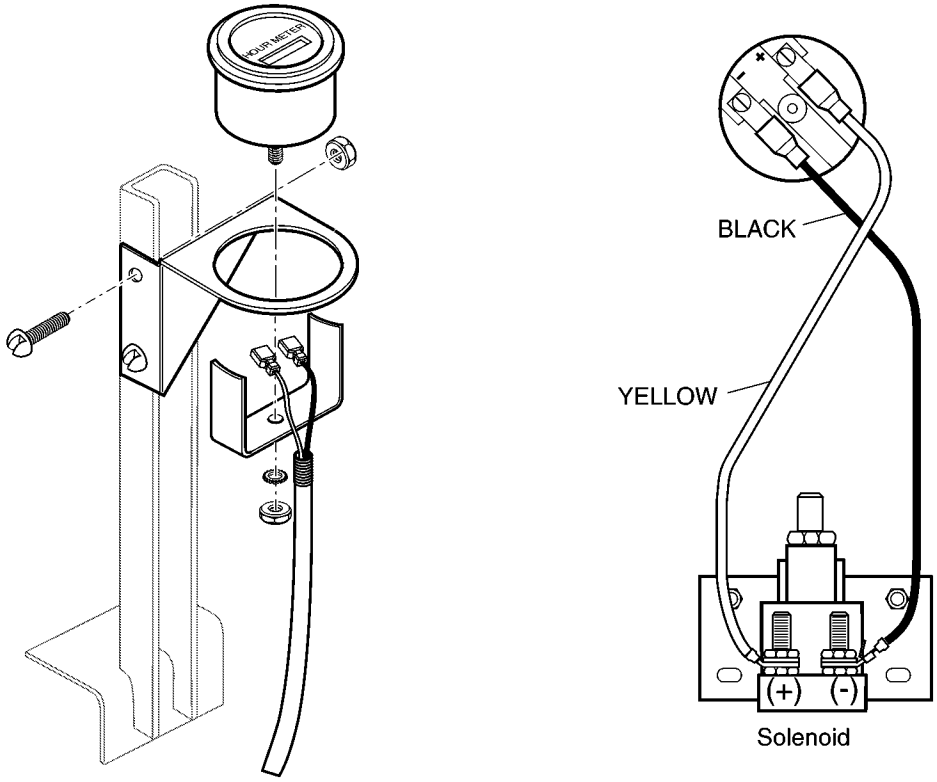

Fig. 12 Hour Meter

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LIST OF ILLUSTRATIONS

Notes:

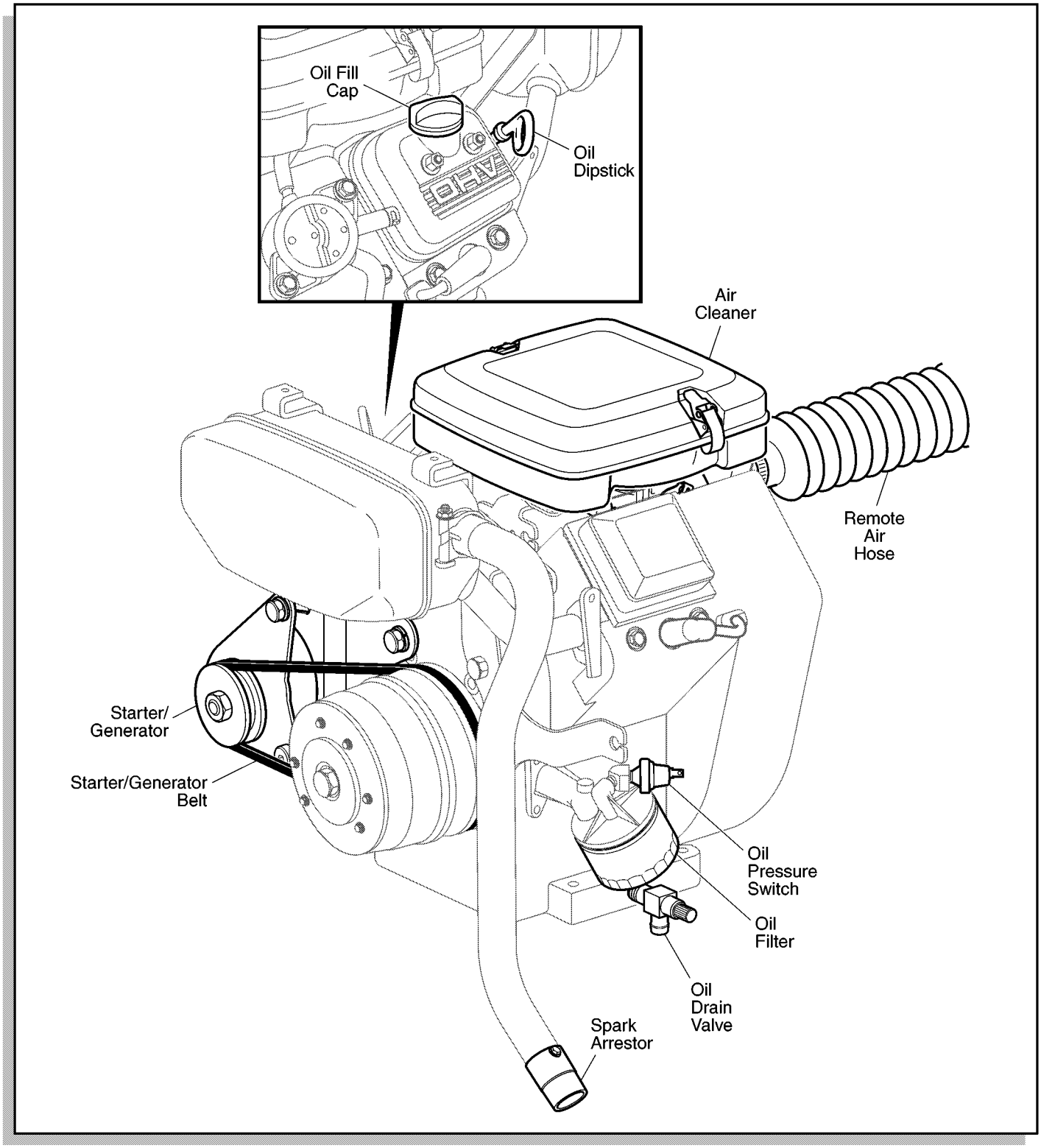
Oil Fill Cap
Oil Dipstick
Air Cleaner
Remote Air Hose
Starter/ Generator
Starter/Generator Belt
Oil Pressure Switch
Oil Filter
Oil Drain Valve
Spark Arrestor

Fig. 1 Engine

ENGINE

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

This section describes procedures for performing regular maintenance, preparing vehicle to test engine condition and replacing engine. For engine condition testing and repair procedures, Briggs & Stratton Repair Manual (P/N 272144) for Vanguard™ V-Twin Overhead Valve engine is available.

POWERTRAIN MAINTENANCE

Access the powertrain by raising or removing seat. Full access to powertrain may be obtained by raising the load bed. Some service procedures may require the vehicle be lifted. Refer to LIFTING THE VEHICLE in section B for proper lifting procedure and safety information.

Removing Debris

⚠ WARNING ⚠ ***Engine parts should be kept clean to reduce risk of overheating and ignition of accumulated debris which could result in severe injury.***

After every off road use, allow to cool and then check for a build up of dirt and debris in the air intake and cooling fins. Dirt and debris may clog the engine's air cooling system. Clean areas shown to prevent engine damage (Ref Fig. 2 on page H-2). Keep linkages, springs and controls clean. To prevent fire, keep area around muffler free of any combustible material.

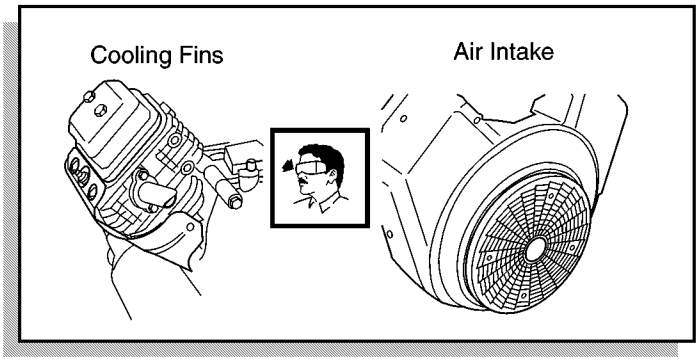

Fig. 2 Cleaning Air Intake

Oil Capacity

Engine oil capacity is approximately 1 1/2 quarts (1.4 liters) when changing oil **and filter**.

Oil Recommendations

The oil must be high quality detergent oil classified "For Service SF, SG, SH, SJ" or higher. Do not use special additives and do not mix oil with gasoline. The selection of oil viscosity is dependent upon the climate in which the vehicle will be used. Most vehicles require SAE 30 oil; however, vehicles used in cold climates will require a multi-viscosity oil (Ref Fig. 3 on page H-2).

Synthetic oil meeting ILSAC GF-2, API certification mark and API service symbol with "SJ/CF ENERGY CONSERVING" or higher, is an acceptable oil at all temperatures. **Use of synthetic oil does not alter required oil change intervals.**

NOTE *Do not use special additives in recommended oil.*

Do not mix oil with gasoline.

CAUTION **Air cooled engines run hotter than automotive engines. The use of non-synthetic multi-viscosity oils (5W-30, 10W-30, etc.) in temperatures above 40° F (4° C) will result in higher than normal oil consumption. When using a multi-viscosity oil, check oil level more frequently.**

SAE 30 oil, if used below 40° F (4° C) will result in hard starting and possible engine bore damage due to inadequate lubrication.

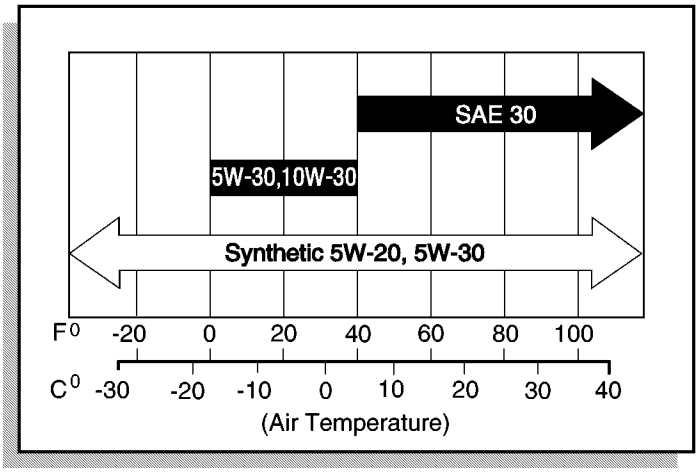

Fig. 3 Oil Viscosity Chart

Checking the Oil Level

Tool List **Qty. Required**

Clean cloth.....2

Check oil level daily before starting the engine. The vehicle must be on a level surface with the parking brake engaged. Use a cloth to wipe clean the oil dipstick handle and oil fill cap (Ref Fig. 4 on page H-3). This is necessary to prevent debris from falling into the engine.

Remove the dipstick and wipe off the entire area indicated with a clean cloth (Ref Fig. 5 on page H-3).

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

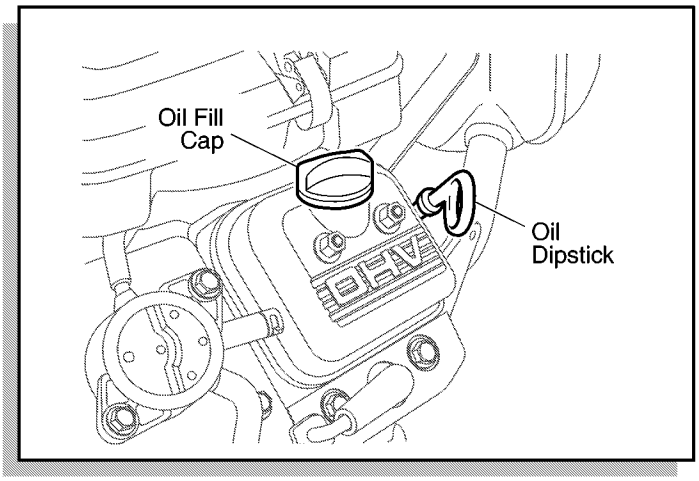

Fig. 4 Cleaning the Top of the Engine

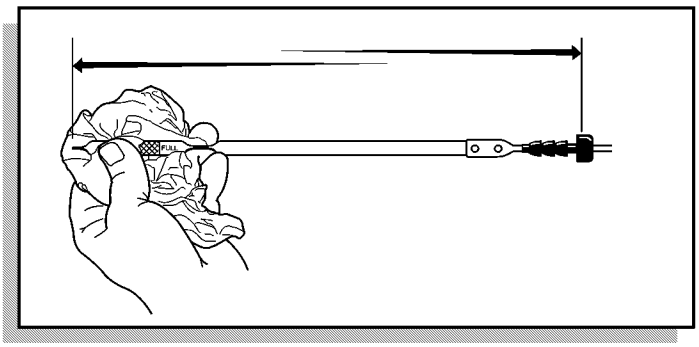

Fig. 5 Clean Entire Dipstick

Insert the dipstick **fully** into the dipstick tube and remove. Examine the level of oil on the dipstick. Oil should be at the FULL mark (Ref Fig. 6 on page H-3).

If oil is required, remove oil fill cap and add oil slowly to bring level to the FULL mark. **Do not overfill.**

Replace dipstick **fully** into the dipstick tube and firmly replace the oil fill cap.

NOTE *When adding oil between oil changes, do not mix brands and viscosity grades of oil.*

Both the oil dipstick and fill cap must be in place before operating the engine. Failure to install the dipstick and fill cap will result in oil becoming contaminated and/or oil being discharged into the engine compartment.

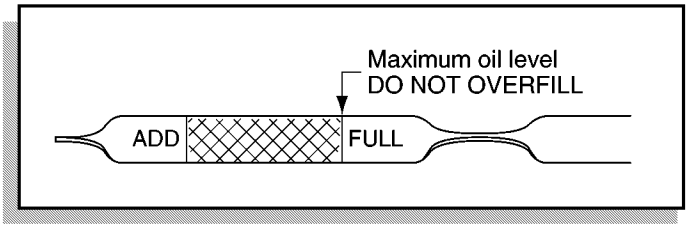

Fig. 6 Check Oil Level on Dipstick

Changing the Oil

Tool List	Qty. Required
Pliers	1
Oil drain pan	1
Clean cloth	2

For maximum performance and longevity, the engine oil should be replaced after the first five (5) to eight (8) hours of operation. After the initial oil change, it should be changed per the Periodic Service Schedule in Section A.

⚠ WARNING ⚠ ***Be aware that engine fluids may be hot and contact to the skin may cause severe burns. Wear rubber gloves to protect skin from exposure to the old oil and degreaser.***

The oil should be changed with the engine warm. Park the vehicle on a level surface, engage the parking brake and remove the key. Place a drain pan under the engine. Wipe the oil fill cap clean with a cloth and remove the cap (Ref Fig. 4 on page H-3).

Clean the area around the oil drain valve (Ref Fig. 7 on page H-3). Open the valve and allow the oil to drain through the hole in the engine mounting plate. Close valve once oil has drained.

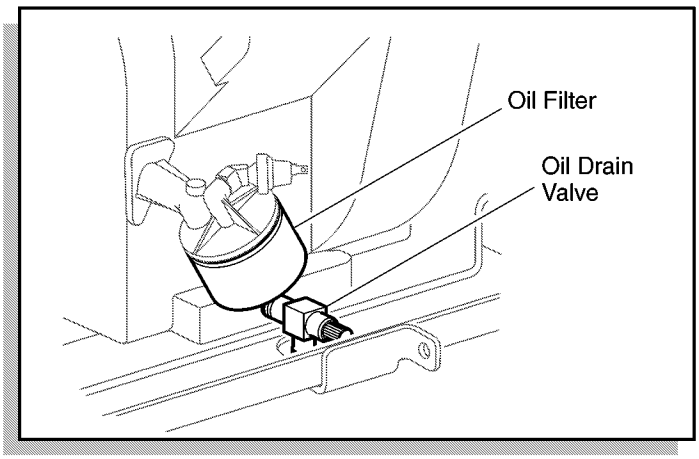

Fig. 7 Remove Oil Filter

Add 1 quart (1 liter) of oil. Start and drive vehicle at a slow speed long enough to warm the oil. Stop and turn off vehicle on a level surface and wait 30 seconds for the oil to settle to the bottom of the engine. Check for leaks. Slowly add more oil to bring level to the FULL mark on dipstick. **Do not overfill.**

Replace dipstick **fully** into the dipstick tube and firmly replace the oil fill cap.

Changing the Oil Filter

Tool List	Qty. Required
Oil filter wrench, to fit 3" (76 mm) oil filter	1
Oil drain pan	1
Clean cloth	2

Clean the area around the oil filter and oil drain. Drain engine oil per "Changing the Oil" and remove oil filter (Ref Fig. 7 on page H-3). Make sure the seal came off with filter and is not stuck to the engine.

Wipe around the sealing surface of filter mount with a clean, lint free cloth. Lightly oil the seal on the new filter with fresh, clean oil. Screw filter on by hand until the seal contacts the filter mount. Tighten 1/2 to 3/4 turn more. Refill engine with new oil per "Changing the Oil".

AIR CLEANER MAINTENANCE

The air cleaner is a dual filter cleaner, equipped with a foam pre-cleaner over a conventional paper cartridge. The filters must be serviced per the Periodic Service Schedule in Section A for optimum engine life and performance.

CAUTION **To prevent engine damage, be careful not to let debris fall into the carburetor when servicing the air cleaner.**

To prevent water entering air cleaner and causing starting or engine problems, replace air cleaner cover making sure the entire flange around the bottom of the cover fits over the top edge of the air cleaner base. Secure with the spring clips.

Access the filters by unsnapping the spring clip on each side of the air cleaner and removing the air cleaner cover (Ref Fig. 8 on page H-4). If necessary, vacuum or wipe out any loose dirt or trash from the air cleaner base.

Pre-Cleaner Service

Carefully remove pre-cleaner from cartridge and wash it in liquid detergent and water. Rinse. Dry by squeezing pre-cleaner in a clean cloth. Saturate with engine oil and squeeze with a clean absorbent cloth to remove all **excess** oil. Install pre-cleaner over cartridge. Replace air cleaner cover making sure that the entire flange around the bottom of the cover fits over the top edge of the air cleaner base. Secure with the spring clips

Cartridge Service

Unscrew the knob securing the cartridge to the air cleaner base and remove plate. Remove cartridge and inspect. Replace if too dirty to clean or at the first sign of filter paper deterioration. Clean cartridge by gently tapping on a flat surface.

CAUTION **Do not use petroleum solvents, pressurized water, or compressed air to clean cartridge. Doing so will damage the cartridge and will damage the engine.**

NOTE *The paper cartridge is a dry unit.* ***Do not*** *use oil on the cartridge.*

Install cartridge, plate, knob, and pre-cleaner.

Replace air cleaner cover making sure that the entire flange around the bottom of the cover fits over the top edge of the air cleaner base. Secure with the spring clips.

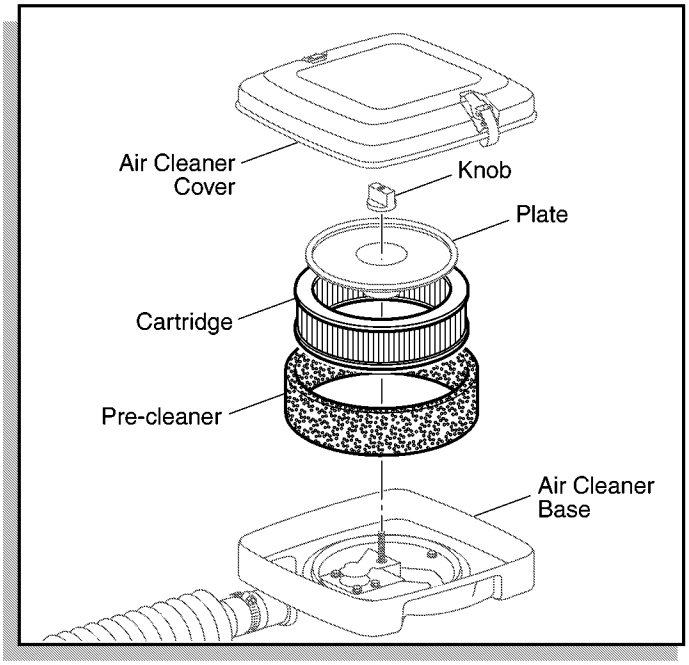

Fig. 8 Air Cleaner

STARTER/GENERATOR BELT TENSION

Tool List	Qty. Required
Belt tension gauge	1
Wrench, 3/4"	1
Wrench, 1/2"	2
Ratchet, 3/8" drive	1
Socket, 3/4", 3/8" drive	1
Socket, 1/2", 3/8" drive	1
Pry bar	1

The starter/generator belt tension should be checked after the first 15-20 hours of operation and set to 75-80 lbs (34-36 kg).

NOTE *A loose belt can cause audible vibration and squeal.*

Tighten a **new** starter/generator belt to 90-110 lbs. (41-50 kg) tension when a gauge is applied half way between the two pulleys (Ref Fig. 9 on page H-5).

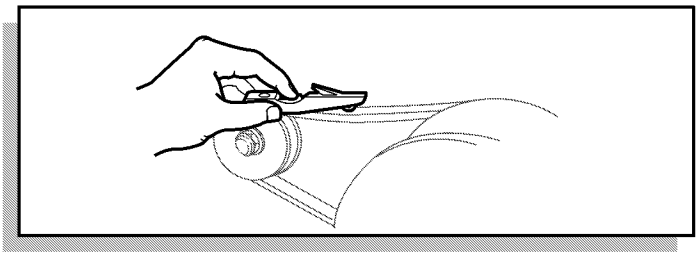

Fig. 9 Checking Belt Tension with Gauge

Although not as accurate, the belt may be depressed with a finger. A maximum deflection of 3/8" (1 cm) is acceptable for a **new** belt (Ref Fig. 10 on page H-5).

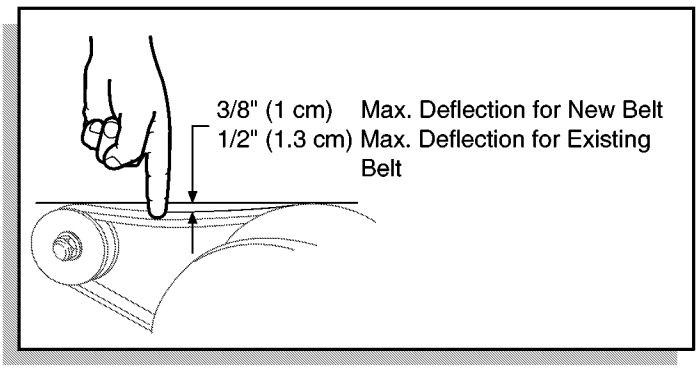

Fig. 10 Checking Belt Tension with Finger

Re-tighten an **existing** belt to 75-80 lbs. (34-36 kg) tension using the same technique. A maximum deflection of 1/2" (1.3 cm) is acceptable.

Adjusting Belt Tension

Loosen front and back pivot bolts of starter/generator (Ref Fig. 11 on page H-5).

Loosen adjusting bolt. Use pry bar to force starter/generator towards front of vehicle until proper belt tension is achieved. Hold starter/generator in place and tighten adjusting bolt.

Tighten pivot bolts to 25 ft. lbs. (35 Nm) torque.

SPARK PLUGS

Tool List	Qty. Required
Spark plug socket, 5/8", 1/2" drive	1
Ratchet, 1/2" drive	1
Plug gauge, wire type	1

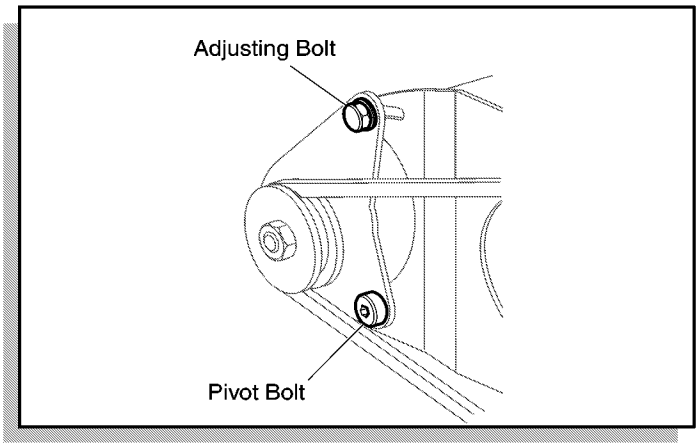

Fig. 11 Adjusting the Belt Tension

Anti-seize compound	AR
Torque wrench, 1/2" drive, ft. lbs	1

Remove and inspect the spark plugs per the Periodic Service Schedule located in Section A. Fouled spark plugs are indicated by a wet, black appearance. This could be caused by a dirty air filter element or other restrictions in the air intake system. Incorrectly adjusted valves, spark plug wires which are in poor condition or poor quality fuel could also contribute to the problem. Clean and gap to .030" (.76 mm). If a plug has been burned beyond .035" (.89 mm) or the porcelain is cracked, it should be replaced (Ref Fig. 12 on page H-5).

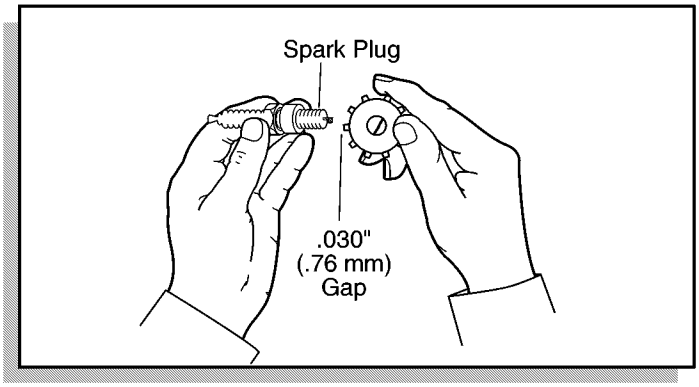

Fig. 12 Gapping the Spark Plug

NOTE *Do not sand blast spark plugs. They should be cleaned by scraping or wire brushing by hand and washing in a commercial solvent.*

Spark plugs should be properly gapped to .030" (.76 mm) (CHAMPION RC12YC), given a light coat of anti-seize compound and tightened to 15 ft. lbs. (20 Nm) torque.

CAUTION **Use care not to overtighten the plug. Overtightening can damage the aluminum cylinder head threads.**

ENGINE

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

ENGINE DESCRIPTION

The engine is a four cycle air cooled, V block, twin cylinder, overhead valve unit. It incorporates pressure lubrication, and a replaceable oil filter.

The OHV V-Twin engine uses a Magnetron® ignition consisting of an ignition armature with a self-contained transistor module. Two armatures are used with a flywheel containing a permanent magnet.

Engine Specifications

Engine model 303440
Type..... Four cycle, overhead valve
Number of cylinders ..... 2 (V block)
Displacement..... 480 cc
Rated horsepower..... 16 hp (11.9 kw)
Spark plug type ..... Champion RC12YC
Spark plug gap ..... .030" (.76 mm)
Cooling ..... Fan
Oil Filter..... Replaceable, Spin-off

Engine Operation

To understand the operation of a four cycle engine, it is easiest to consider a single cylinder.

The first cycle (stroke) takes place with the piston moving down and the intake valve open. Fuel is drawn into the combustion chamber from the carburetor and through the intake valve and is known as the **intake stroke**. As the piston reaches the bottom (BDC) of its travel and starts to move upwards, the second cycle begins. The intake valve closes which seals the combustion chamber since the exhaust valve is already closed and causes the fuel air mixture to be compressed as the piston rises. This is known as the **compression stroke.** Just before the piston reaches TDC (Top Dead Center) the spark plug fires which causes a rapid burning of the air fuel mixture. The temperature rises rapidly which causes the air fuel mixture to expand. The piston has been carried through TDC by centrifugal force and is now forced downwards into the third, or **power stroke** by the expanding gases. As the piston reaches BDC it enters the fourth cycle. The exhaust valve opens and the piston rises forcing burned gases from the combustion chamber in what is known as the **exhaust stroke.** As the piston moves through TDC and starts down, the first cycle is repeated.

The camshaft is gear driven from the crankshaft. The ignition timing is controlled by an electrical pulse received from a magnet mounted on the crankshaft flywheel. The ignition timing is not adjustable.

VEHICLE PREPARATION TO TEST ENGINE CONDITION

Tool List	Qty. Required
Heat resistant gloves	1
Pliers	1
Compression gauge	1
Spark plug socket, 5/8", 3/8" drive	1
Ratchet, 3/8" drive	1

⚠ WARNING ⚠ ***To prevent inadvertent movement of vehicle from causing severe injury, engage neutral lock per Section B.***

To properly prepare for a compression test:

a) If possible, drive vehicle long enough to bring the engine to normal operating temperature.
b) Engage neutral lock per Section B.
c) Disconnect fuel line from fuel tank and plug line to prevent contamination. Run engine until it stops from lack of fuel.
d) Remove the air filter to eliminate the possibility of a restricted air passage.
e) A good, well charged battery should be used. Weak batteries may not provide the correct cranking speed.
f) Starter belts that drag or slip will affect the compression reading. Adjust belt as necessary.

⚠ WARNING ⚠ ***To prevent possibility of personal injury, never operate without magneto being grounded. Any fuel drawn into the cylinders will be expelled through the spark plug opening and could be ignited by the ignition system or another source, resulting in a fire.***

g) Ground magneto by attaching a wire lead, with alligator clips, from the terminal with the white wire (located on fan cover at side of engine) to the ground cable bolted to the frame.
h) Follow procedure to check compression as outlined in the Briggs & Stratton® Repair Manual (P/N 272144) for Vanguard™ V-Twin Overhead Valve engine.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

ENGINE REMOVAL

Tool List	Qty. Required
Masking tape	AR
Back brace	2
Insulated wrench, 1/2"	1
Oil drain pan	1
Socket, 1/2", 3/8" drive	1
Ratchet, 3/8" drive	1
Clutch puller (P/N 19779-G2)	1
Pliers	1
Wrench, 1/2"	2
Utility knife	1
Needle nose pliers	1
Straight blade screwdriver	1
Socket, 12mm, 3/8" drive	1
Wrench, 1/4"	1
Socket, deep well, 10mm, 3/8" drive	1
Shop towel, clean	AR
Plug, for fuel line	1
Cap, for fuel pump	1
Wrench, 10mm	1
Wrench, 3/4"	1
Socket, 1/4" hex bit, 3/8" drive	1
Impact wrench, 1/2" drive	1
Impact socket, 5/8", 1/2" drive	1
Impact socket, 13/16", 1/2" drive	1
Socket, 6mm hex bit, 3/8" drive	1
Socket, 5/8", 3/8" drive	1

NOTE *In the following text, there are references to removing/installing bolts, etc. Additional hardware (nuts, washers, etc.) that is removed must always be installed in its original position unless otherwise specified. Non specified torque figures are as shown in the table contained in Section A.*

Note the location of wires, wire ties and clamps before removal and always install them in their original location. Use of masking tape to label wires is recommended.

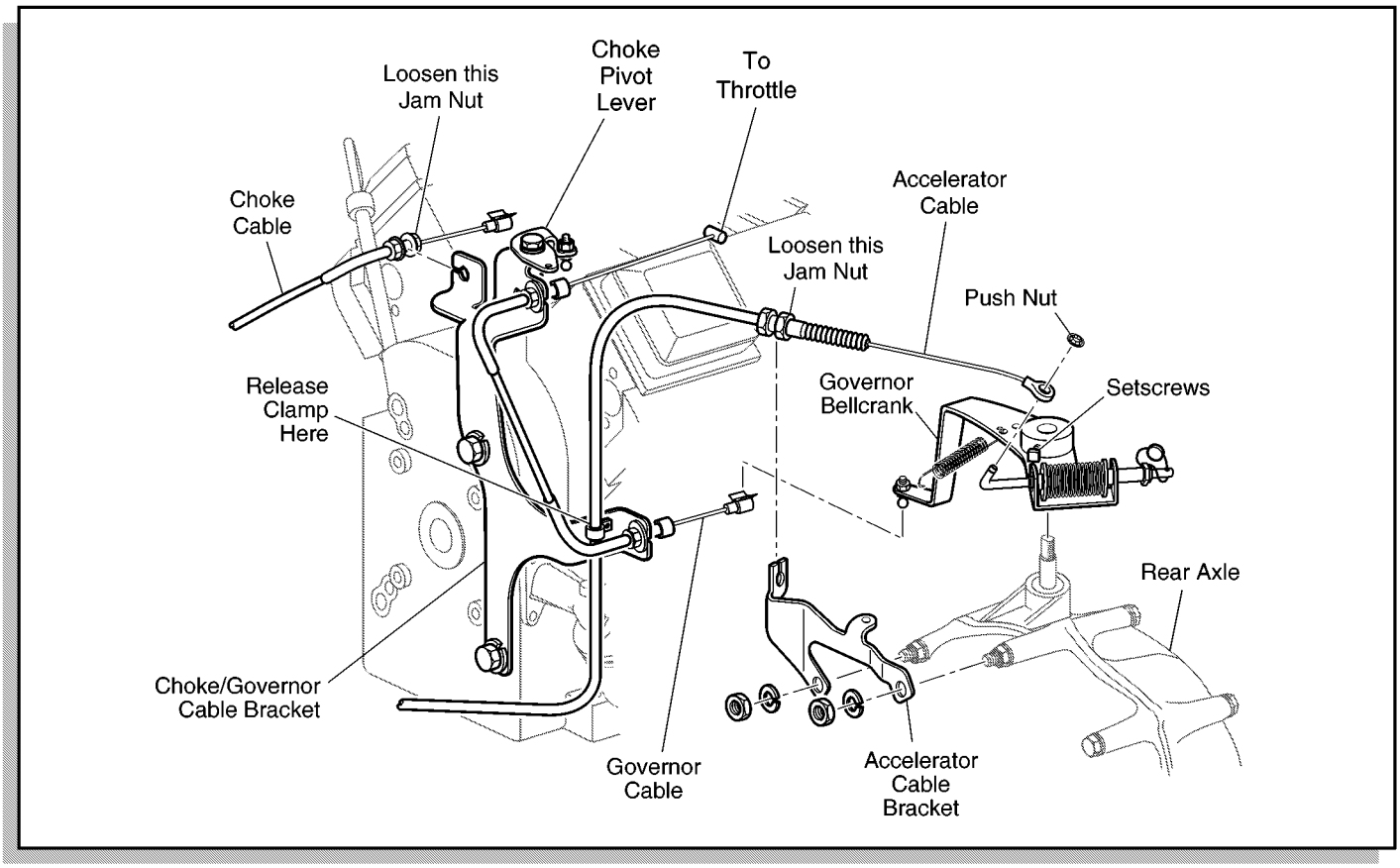

Fig. 13 Disconnect Accelerator, Governor, and Choke Cables

Remove bed per BODY AND TRUCKBED section.

If engine is to be repaired, **not** replaced, wash engine and chassis to remove dirt build-up.

⚠ WARNING ⚠ ***To prevent the possibility of personal injury, disconnect the negative (-) battery cables before starting engine removal.***

Disconnect negative (-) cables from battery to prevent electrical shorts that could cause an explosion (Ref Fig. 16 on page H-9).

Drain oil from engine.

Loosen clamp and remove exhaust pipe from muffler.

Remove drive belt and driven clutch. See CONTINUOUSLY VARIABLE TRANSMISSION section.

Remove push nut securing end of accelerator cable to governor. To maintain cable adjustment, loosen only the back jam nut anchoring accelerator cable to accelerator cable bracket and remove cable (Ref Fig. 13 on page H-7). Release clamp securing cable to choke/governor cable bracket and pull accelerator cable down from between bracket and governor cable to clear engine.

Pry governor cable off ball stud on lower end of governor bellcrank located between engine and differential (Ref Fig. 13 on page H-7). Remove two nuts mounting accelerator cable bracket to differential. Loosen two setscrews and pull governor bellcrank assembly and accelerator cable bracket from differential.

Pry choke cable off ball stud of choke pivot lever. To maintain cable adjustment, loosen only the back nut anchoring choke cable to choke/governor cable bracket, remove cable and moor between seat back supports (Ref Fig. 13 on page H-7).

Disconnect remote air hose from air cleaner. Remove air cleaner cover and filter. Remove five bolts that mount air cleaner base to engine, disconnect crankcase breather hose and remove base. Secure a clean towel over carburetor with a rubber band to prevent any debris falling into engine.

At rear axle, remove cotter and clevis pin connecting differential lock cable to differential lock arm. To maintain cable adjustment, loosen only the back nut anchoring differential lock cable to bracket and remove cable (Ref Fig. 14 on page H-8).

Disconnect wire from oil pressure switch, located above oil filter, and free from any wire ties or clamps anchoring it to engine.

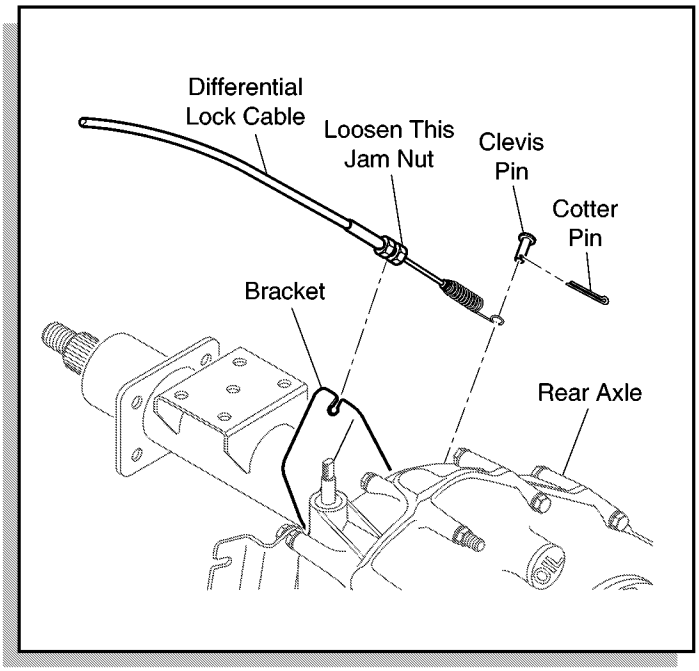

Fig. 14 Disconnect Differential Lock Cable

⚠ WARNING ⚠ ***To prevent a possible explosion, do not smoke near the fuel tank or in an area where gasoline is being handled. Do not perform procedures involving the fuel system near open fire or electrical items which could produce a spark.***

Do not handle gasoline in an area that is not adequately ventilated.

Always wear safety glasses to prevent possible eye injury from gasoline or gasoline vapor.

Do not smoke and wear eye protection before opening the fuel system. Provided ventilation is adequate, remove and plug fuel line from fuel pump and cap fuel pump nipple (Ref Fig. 15 on page H-9).

Detach ground cable from starter/generator and engine block (Ref Fig. 16 on page H-9). Discard lock nut but retain bolt and washers for engine installation.

At starter/generator terminal F2, disconnect black power cable running from solenoid to starter (Ref Fig. 16 on page H-9).

Disconnect green wire of chassis harness from starter/generator lead (Ref Fig. 16 on page H-9).

Disconnect the two white wires, located at side of fan cover, from the engine stop terminal and ignition control module (Ref Fig. 15 on page H-9).

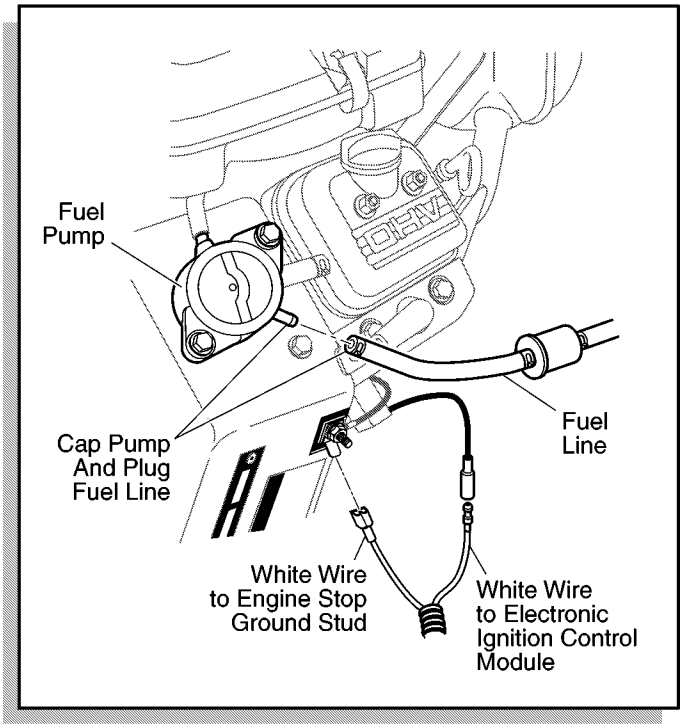

Fig. 15 Disconnect White Engine Stop Wire, Ignition Control Module and Fuel Line

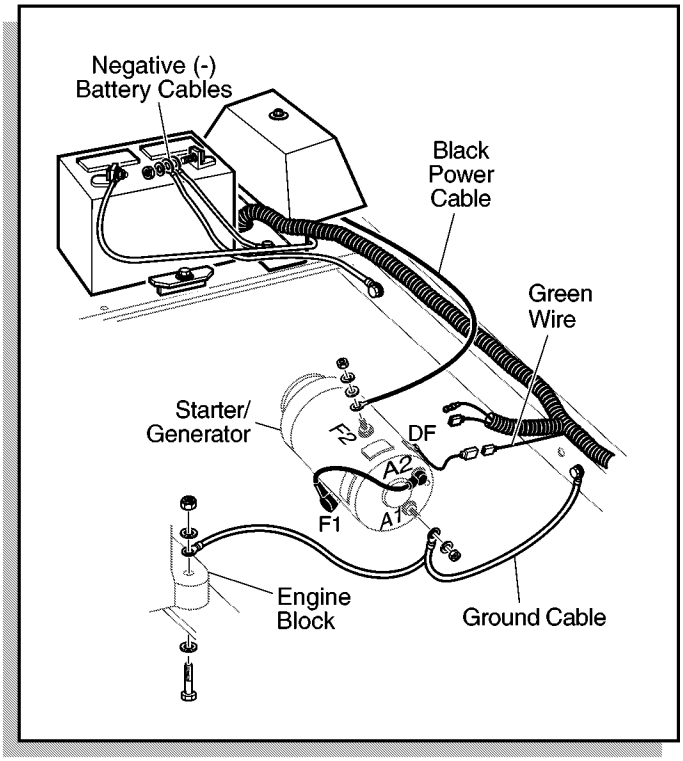

Fig. 16 Disconnect Starter and Ground Cables

Loosen and remove starter/generator belt. See 'Adjusting Belt Tension' on page H-5.

Remove drive clutch. See CONTINUOUSLY VARIABLE TRANSMISSION section.

Remove three remaining bolts securing engine to subframe. Discard lock nuts but retain bolts and washers for engine installation.

NOTE *The engine will be lifted out between differential and wide crossmember of frame.*

⚠ WARNING ⚠ ***The following step involves lifting substantial weight. Two people are recommended. Use of a personal back support brace and proper lifting technique is required to prevent personal injury.***

Wear a personal back support brace and use proper lifting technique before lifting engine. With a person on each side of vehicle, rotate and lean engine back to position the muffler down, where the driven clutch was, and carefully maneuver engine out of vehicle.

If replacing engine:

- Remove starter/generator and its mounting brackets from old engine.
- Remove choke/governor cable bracket from old engine. Detach governor cable and choke link from carburetor.
- Remove oil drain valve and clamp from fan cover of old engine. Retain for use on new engine.

ENGINE INSTALLATION

Tool List	Qty. Required
Socket, 5/8", 3/8" drive	1
Socket, 6mm hex bit, 3/8" drive	1
Ratchet, 3/8" drive	1
Teflon tape	AR
Crowfoot wrench, 1/4", 3/8" drive	1
Torque wrench, 3/8" drive, ft. lbs	1
Torque wrench, 3/8" drive, in. lbs	1
Socket, 1/2", 3/8" drive	1
Wrench, 1/2"	2

If installing a replacement engine:

- Attach starter/generator. See 'Starter/Generator Installation' on page H-10.
- Attach governor cable and choke link to carburetor and secure choke/governor cable bracket to

new engine using existing hardware. Tighten bolts to 260 - 280 in. lbs. (29 - 32 Nm).

- Apply teflon tape to threads of oil drain valve and install so that nipple is pointed away from oil filter at approximately the 4 to 5 o'clock position. Attach clamp to fan cover using existing bolt.

⚠ WARNING ⚠ ***The following step involves lifting substantial weight. Two people are recommended. Use of a personal back support brace and proper lifting technique is required to prevent personal injury.***

Wear a personal back support brace and use proper lifting technique before lowering engine into vehicle. With a person on each side of vehicle, install engine in reverse order of removal replacing all lock nuts with new lock nuts.

Tighten engine to subframe mounting hardware to 20 ft. lbs. (30 Nm) torque.

Tighten drive clutch bolt to torque specified in CONTINUOUSLY VARIABLE TRANSMISSION section.

Tighten starter/generator belt. See 'STARTER/GENERATOR BELT TENSION' on page H-4.

Tighten starter terminal nuts to specified torque. See 'Starter/Generator Installation' on page H-10.

If differential lock cable adjustment is required, adjust per REAR AXLE section.

If choke cable adjustment is required, adjust per FUEL SYSTEM section.

Tighten two governor bellcrank assembly setscrews to 70 - 84 in. lbs. (8 - 9 Nm).

CAUTION **A new push nut must be used when installing the accelerator cable to the governor.**

Secure end of accelerator cable to governor with new push nut. If accelerator cable adjustment was lost, adjust per SPEED CONTROL section.

Tighten driven clutch bolt to torque specified in CONTINUOUSLY VARIABLE TRANSMISSION section.

Center end of exhaust pipe between driven clutch and subframe and tighten clamp till no loose play is present.

Check oil level in engine and adjust as needed. See 'POWERTRAIN MAINTENANCE' on page H-2.

Reconnect negative (-) battery cables and tighten hardware to 60 in. lbs. (7 Nm).

STARTER/GENERATOR REPLACEMENT

Starter/Generator Removal

Tool List	Qty. Required
Insulated wrench, 1/2"	1
Socket, 10mm, 3/8" drive	1
Socket, 1/2", 3/8" drive	1
Socket, 1/4" hex bit, 3/8" drive	1
Socket, 3/4", 3/8" drive	1
Ratchet, 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1
Pry bar	1
Belt tension gauge	1
Torque wrench, ft. lbs., 3/8" drive	1

⚠ WARNING ⚠ ***To prevent the possibility of personal injury, disconnect the negative (-) battery cable before starter/generator removal.***

Disconnect negative (-) cables from battery to prevent electrical shorts that could cause an explosion (Ref Fig. 16 on page H-9).

Disconnect wires from starter/generator (Ref Fig. 17 on page H-11). Loosen adjusting bolt and pivot bolts securing starter/generator and remove starter/generator belt. Remove adjusting bolt and pivot bolts and remove starter/generator from vehicle.

Starter/Generator Installation

Align starter/generator between mounting brackets on engine and loosely install pivot hardware. Attach wires to their original locations (Ref Fig. 18 on page H-11). Tighten terminal nuts to the following torques:

- A1, A2, F1, F2 - torque to 43 - 52 in. lbs. (50 - 60 kg/cm)
- DF - torque to 26 - 35 in. lbs. (30 - 40 kg/cm)

Install belt and adjusting hardware. Adjust belt tension. See 'STARTER/GENERATOR BELT TENSION' on page H-4.

Reconnect negative (-) battery cables and tighten hardware to 60 in. lbs. (7 Nm).

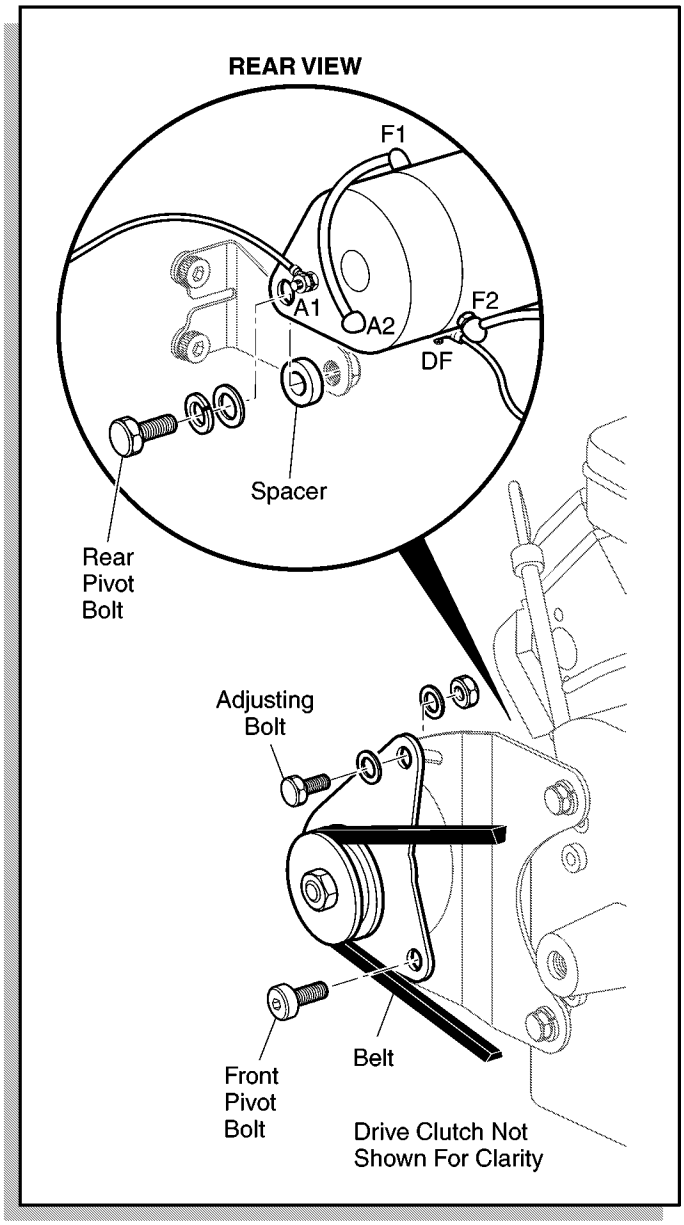

Fig. 17 Starter/Generator Mounting

FROM	TO
A1	Ground
A2	F1 (On Starter/Generator)
F1	A2 (On Starter/Generator)
F2	A on Solenoid
DF	Green from Voltage Regulator

Fig. 18 Starter/Generator Wiring

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Notes:

FRONT SUSPENSION AND STEERING

J

TABLE OF CONTENTS FOR SECTION 'J'

SECTION TITLE **PAGE NO.**

LIST OF ILLUSTRATIONS

Notes:

FRONT SUSPENSION AND STEERING

J

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

FRONT SUSPENSION

NOTE *In the following text, there are references to removing/installing bolts, etc. Additional hardware (nuts, washers, etc.) that is removed must always be installed in its original positions unless otherwise specified. Non-specified torque specifications are as shown in the table contained in Section A.*

⚠ WARNING ⚠ ***To reduce the possibility of personal injury, follow the lifting procedure in Section B of this manual. Place wheel chocks in front and behind the rear wheels. Check the stability of the vehicle on the jack stands before starting any repair procedure. Never work on a vehicle that is supported by a jack alone.***

Front Shock Absorber Replacement

Tool List **Qty. Required**

Wrench, 9/16" 1

Remove the nut (4) from the bottom of the shock absorber (1) at the front axle (2) (Ref Fig. 1 on page J-2). Compress the shock absorber to clear the mounting bracket.

Loosen the nut (4) securing the top of the shock absorber to the vehicle frame and then rotate the shock absorber while holding the nut in place with a wrench.

Remove the shock absorber.

The installation of the shock absorber is the reverse of disassembly, except that the mounting nuts should be tightened until the rubber bushings (5) expand to the diameter of the shock absorber washers (6).

Shock Boot Removal and Replacement

Tool List **Qty. Required**

Wrench, 9/16" 1

Remove the nut (4) from the bottom of the shock absorber (1) at the front axle (2) (Ref Fig. 1 on page J-2). Compress the shock absorber to clear the mounting bracket.

Remove clamps securing the boot to the shock absorber and slide boot down and off the shock absorber.

Replace shock boot and reattach shock absorber as instructed above.

Front Axle Replacement

Tool List **Qty. Required**

Wheel chocks 4
Floor jack 1
Jack stands 2
Impact wrench, 1/2" drive 1
Impact socket, 3/4", 1/2" drive 1
Pliers 1
Wrench, 3/4" 1
Plastic faced hammer 1
Socket, 9/16", 1/2" drive 1
Wrench, 9/16" 1
Torque wrench, 1/2" drive, ft. lbs. 1

Lift and support front of vehicle per SAFETY section.

Remove the front wheels. Remove the bottom shock absorber mounting hardware (Ref Fig. 1 on page J-2).

Loosen the nut (9) until the threaded end of king pin (8) is protected. Tap the nut with a plastic faced hammer to loosen the king pin.

Remove the nut (9) and washer (23) from the king pin. Remove the king pin (8), washer (21), thrust washer (10) and spindle sleeve (22) from the spindle and swing it to the side. Remove the hardware (12) that secures the front of the leaf spring to the front axle.

Front axle installation is in the reverse order of disassembly.

NOTE *The thrust washer is located on top of the spindle bushing.*

Tighten the king pin nut (9) to 40 - 50 ft. lbs. (55 - 70 Nm) torque.

NOTE *After replacing the front axle, the axle must be aligned with the frame. This is **not** a wheel alignment. Replacing the axle will also require that the front wheels be aligned.*

When the front axle is replaced, it must be aligned to the frame. The distance from the center bolt at rear of left spring to the center bolt at front of right spring must be the same as the distance from the center bolt at rear of right spring to the center bolt at front of left spring (Ref Fig. 2 on page J-2).

Tighten leaf spring hardware (12) to 35 - 50 ft. lbs (50 - 70 Nm) torque.

Tighten the shock absorber mounting hardware until the rubber bushings expand to the diameter of the shock absorber washer.

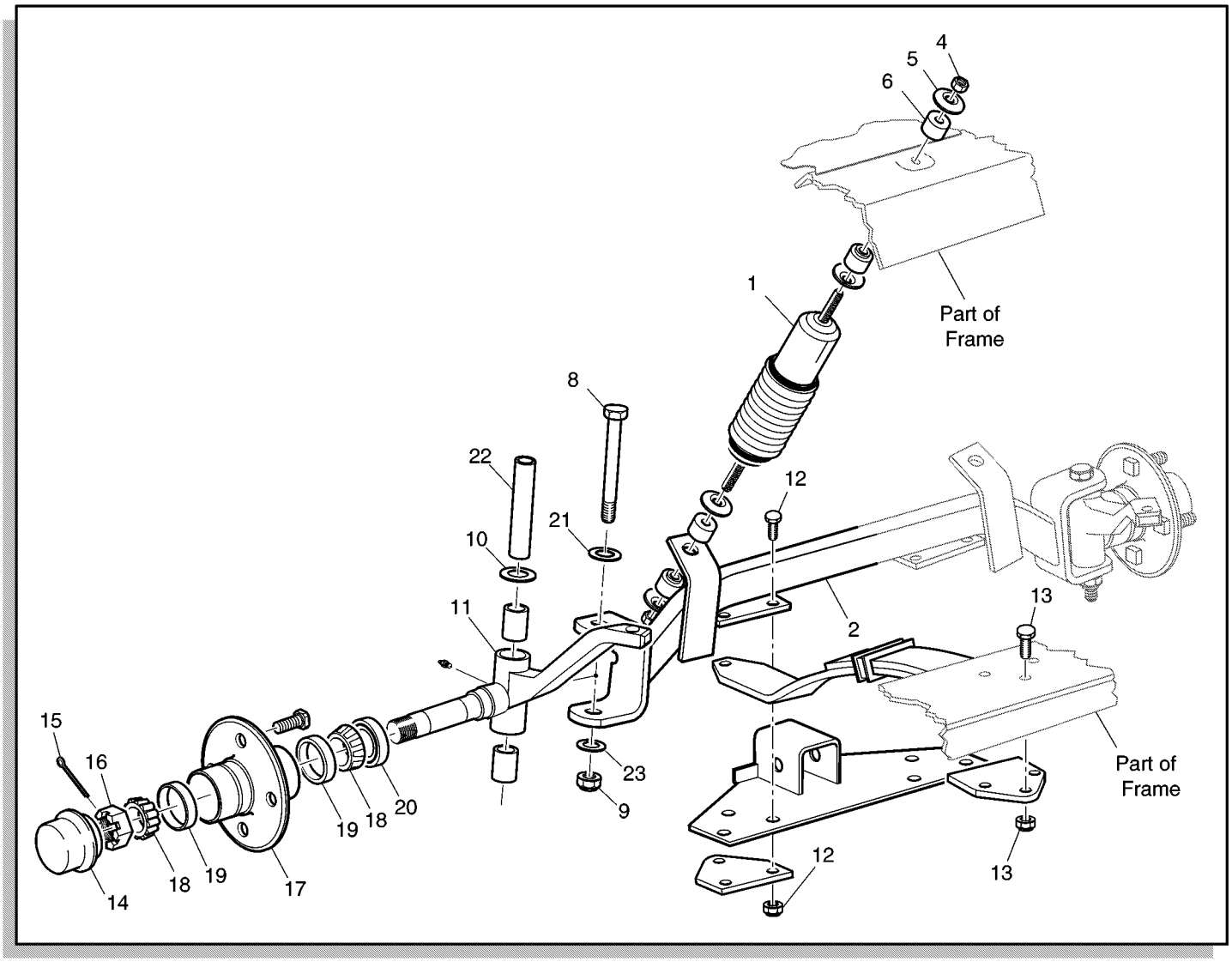

Fig. 1 Suspension Components

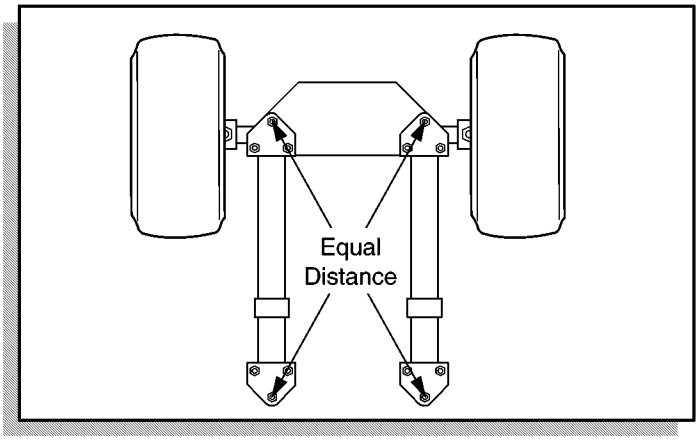

Fig. 2 Front Axle Alignment

Replace front wheels per WHEELS AND TIRES section and lower vehicle.

Front Spring Replacement

Tool List	Qty. Required
Wheel chocks	4
Floor jack	1
Jack stands	4
Impact wrench, 1/2" drive	1
Impact socket, 3/4", 1/2" drive	1
Torque wrench, 1/2" drive, ft. lbs.	1
Pliers	1
Wrench, 3/4"	1

Socket, 9/16", 1/2" drive 1
Wrench, 9/16" 1

NOTE *Failure of a single spring will result in overstressing the other spring, therefore it is good practice to replace front springs as a set.*

Lift and support front of vehicle. (See SAFETY section.) Support front axle with jack stands.

Remove the front wheels.

Remove the hardware (12) securing the front of the damaged leaf spring to the axle (2) (Ref Fig. 1 on page J-2).

Pull the top of the floor mat down. Locate and remove the hardware (13) securing the rear of the spring to the vehicle frame.

Install a new spring by first attaching the rear of the spring to the vehicle frame with hardware (13) and then installing the front of the leaf spring to the axle with hardware (12).

Repeat at opposite side.

NOTE *If a spring is replaced, the axle will need to be aligned to the frame. Unless the axle has been replaced, this will not affect the wheel alignment. It is always good practice to check the wheel alignment any time the front-end components are replaced or adjusted.*

When springs are replaced, the front axle must be aligned to the frame. The distance from the center bolt at rear of left spring to the center bolt at front of right spring must be the same as the distance from the center bolt at rear of right spring to the center bolt at front of left spring (Ref Fig. 2 on page J-2). Tighten the spring hardware to 35 - 50 ft. lbs. (50 - 70 Nm) torque.

Replace front wheels per WHEELS AND TIRES section and lower vehicle.

Tie Rod, Wheel Bearing and King Pin Inspection

Grasp the tie rod and check for any vertical motion which would indicate a worn condition and require replacement. Grasp the top and bottom of the wheel and use a rocking motion to check for excessive king pin or wheel bearing movement which indicates a worn or loose condition.

Tie Rod Replacement

Tool List	Qty. Required
Wheel chocks	4
Floor jack	1
Jack stands	2
Pliers	1
Impact wrench, 1/2" drive	1
Impact socket, 3/4", 1/2" drive	1
Impact socket, 11/16", 1/2" drive	1
Torque wrench, 1/2" drive, ft. lbs.	1
Ball joint separator	1
Wrench, 3/4"	1

Lift and support front of vehicle per SAFETY section.

Remove front wheels.

Remove the cotter pin (1) from the ball joint (2) and remove the castellated nut (3). (Ref Fig. 3 on page J-3) Insert a ball joint separator between the ball joint and the linkage and separate the ball joint from the linkage at both ends.

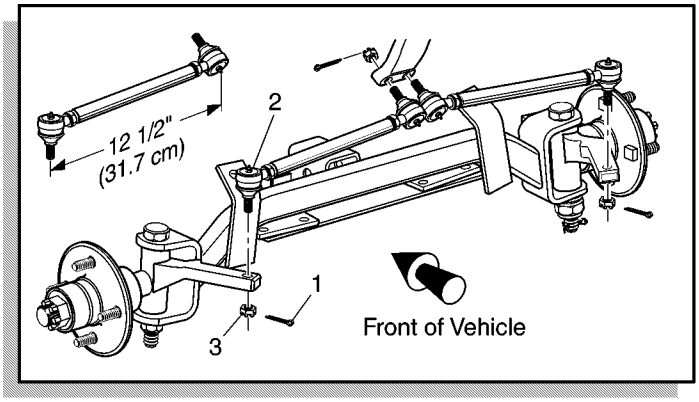

Fig. 3 Tie Rod Replacement

NOTE *A worn tie rod is likely to be out of adjustment. The vehicle will require a wheel alignment before being returned to service (Ref Fig. 12 on page J-10).*

Adjust tie rod to 12 1/2" (31.7 cm) between center of tie rod ends and install in reverse order of disassembly (Ref Fig. 3 on page J-3). The castellated nut (3) should be tightened to a **minimum** of 35 ft. lbs. (50 Nm) torque and continue tightening as required in order to insert a new cotter pin. Maximum torque is 50 ft. lbs. (70 Nm).

Once the tie rod has been replaced, the front wheel toe-in will need to be checked and adjusted as necessary. See 'Wheel Alignment' later in this section.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

STEERING

Steering Wheel Replacement

Tool List	Qty. Required
Phillips screwdriver	1
Socket, 15/16", 1/2" drive	1
Ratchet, 1/2" drive	1
Plastic faced hammer	1
Ball peen hammer	1
Torque wrench, 1/2" drive	1

NOTE *To maintain correct orientation when replacing steering wheel, first turn wheels straight ahead.*

CAUTION **To prevent damage to the hub cover, perform the following removal procedure. Do not use a screwdriver to push or pry the retaining tabs.**

From the front side of the steering wheel (1), remove the hub cover (2) by first pulling straight up on the bottom of the hub cover to release the two bottom retaining tabs. Then first pull down, and then push up to release the two top retaining tabs (Ref Fig. 4 on page J-4).

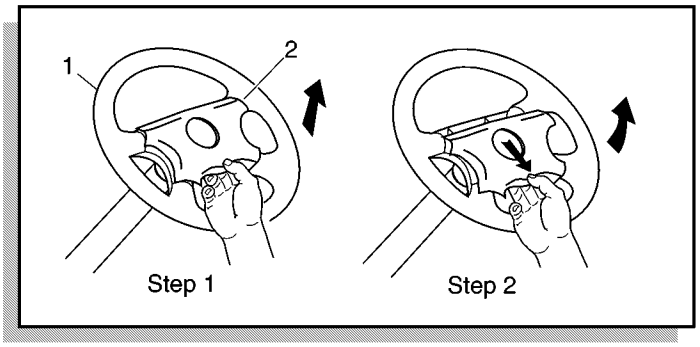

Fig. 4 Hub Cover Removal

Loosen the steering wheel retaining nut (3) two to three turns. DO NOT REMOVE NUT AT THIS TIME. Apply upward pressure to the steering wheel. Place a plastic faced hammer against the steering wheel nut and strike plastic faced hammer sharply with a ball peen hammer (Ref Fig. 5 on page J-4).

CAUTION **Do not strike the steering nut or the end of the steering shaft directly with the ball peen hammer.**

When steering wheel is loosened, remove retaining nut and remove steering wheel.

If installing new steering wheel, assemble the steering wheel and rear collar hub (4) by aligning the retaining tabs on the hub with slots in back of steering wheel. Squeeze tabs to allow insertion of hub. **Do not force**. Squeeze hub on top and bottom to fully seat.

Replace steering wheel by first lightly coating the splines of the steering shaft with a commercially available anti-seize compound. With the vehicle wheels in the straight ahead position, align the steering wheel on the steering shaft and slide wheel on shaft. Tighten the steering wheel nut (3) to 10 - 15 ft. lbs. (15 - 20 Nm) torque.

Inspect the four retaining tabs on the hub cover (5) for white stress lines. If stress lines are present, replace hub cover. Install by carefully pressing, first the top two, then the bottom two retaining tabs into the matching slots in steering wheel (Ref Fig. 5 on page J-4).

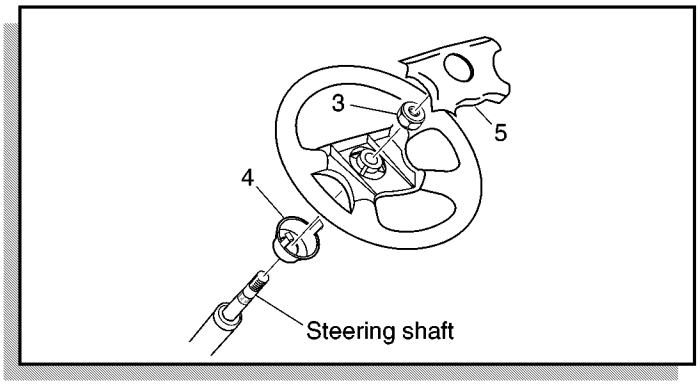

Fig. 5 Steering Wheel Removal

Steering Shaft Replacement

Tool List	Qty. Required
Ratchet, 1/2" drive	1
Socket, 9/16", 1/2" drive	1
Torque wrench, 1/2" drive	1
Allen wrench 3/16"	1
Socket, 7/16", 3/8" drive	1
Ratchet, 3/8" drive	1

Remove the steering wheel (as previously described). Remove the three epoxy patch bolts (6) and washers (7) that secure the steering column (5) to the steering housing (13) (Ref Fig. 6 on page J-5). Remove the column and gasket (8) from the steering housing. Remove the bolts (9) and nuts (10) from the coupling (11) and remove shaft (12) from the steering assembly.

Replace steering shaft in reverse order of removal. Gasket (8) should be replaced with a new gasket.

Bolts (9) should be tightened to a light drag between shaft (12) and coupling (11). **Do not over tighten**.

Bolts (6) must be replaced with new bolts. Tighten bolts to 18 - 22 ft. lbs. (25 - 30 Nm) torque.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

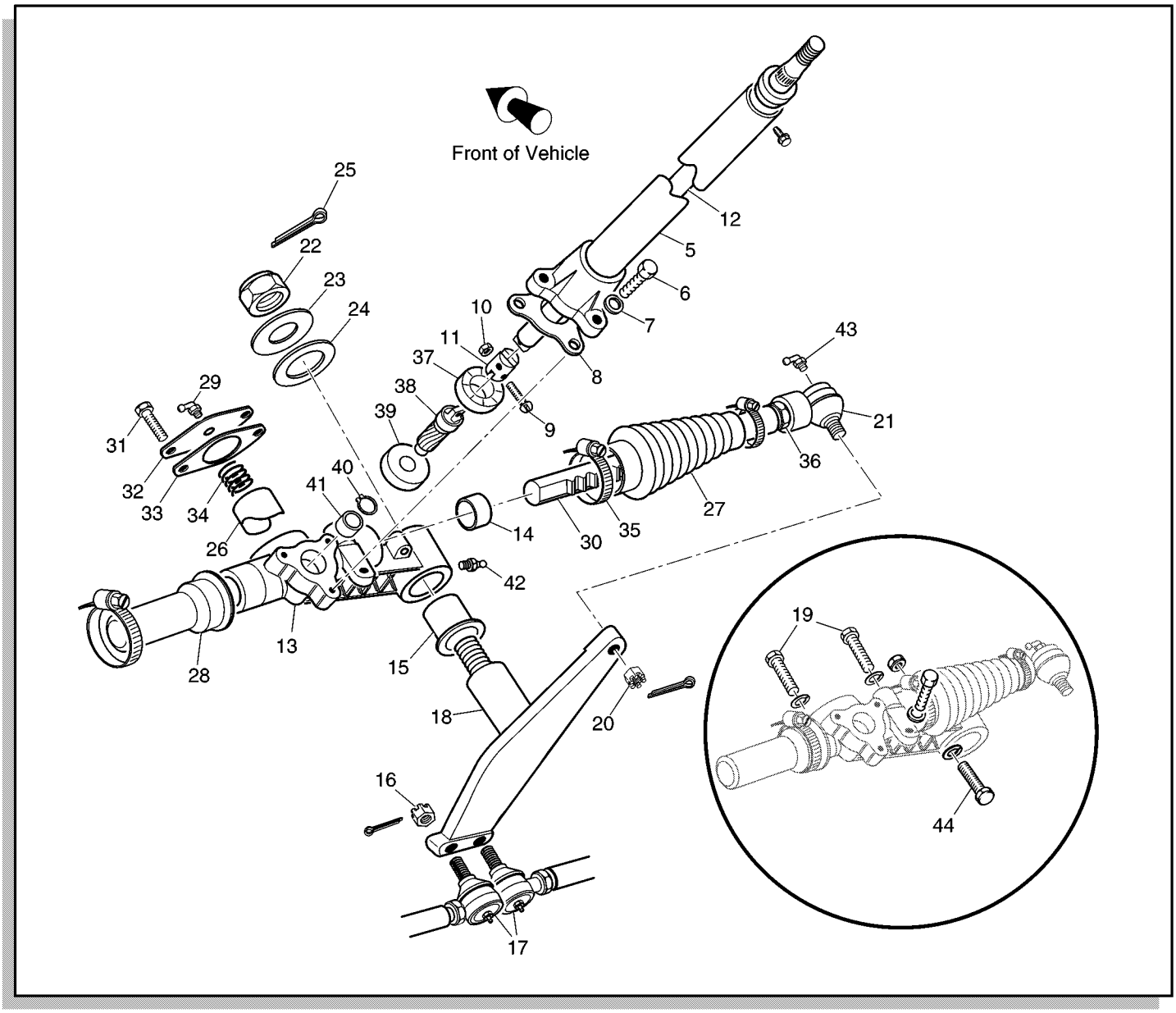

Fig. 6 Steering Components

Steering Housing Assembly Replacement

Tool List	Qty. Required
Needle nose pliers	1
Wrench, 11/16"	1
Ball joint separator	1
Plastic faced hammer	1
Wrench, 5/8"	2

Except for major damage to the steering assembly housing, there is no need to remove the housing (13) from the vehicle. The only components requiring replacement due to wear that would require removing the housing from the vehicle would be the replacement of the bearing (14) and bushing (15) (Ref Fig. 6 on page J-5). The bearing and bushing must be pressed out.

To remove the steering housing assembly, remove the driver side front wheel, remove the steering wheel (3), and remove the steering shaft (12) as instructed above. Remove the cotter pins and loosen the two nuts (16) until ball joint (17) end threads are protected. Using a ball joint

separator as a lever, apply pressure to ball joint and tap nut with plastic faced hammer to release ball joint from idler arm (18). Remove tie rods, and lastly, remove the two epoxy patch bolts (19) and longer bolt (44) attaching the steering housing to the frame mount and remove the housing from the underside of the vehicle.

Replace steering housing in reverse order of removal.

Bolts (19) must be replaced with new bolts. Tighten mounting bolts to 35 - 50 ft. lbs. (50 - 70 Nm) torque.

Tighten tie rod nuts (16) to 35 ft. lbs. (50 Nm) torque and continue to tighten as needed to insert new cotter pin. Maximum torque 50 ft. lbs. (70 Nm).

Idler Arm Replacement

Tool List	Qty. Required
Needle nose pliers	1
Wrench, 11/16"	1
Wrench, 1 1/4"	1

To remove the idler arm (18) from the steering housing assembly (13), remove the steering housing assembly from the vehicle (as described above) (Ref Fig. 6 on page J-5). Remove the cotter pin and nut (20) attaching the steering rack ball joint (21) to the upper idler arm, remove the lock nut (22) and the two washers (23, 24) from the idler and remove the idler arm from the steering housing.

Replace idler arm in reverse order of removal.

Tighten nut (22) to 70 - 80 ft. lbs. (95 - 110 Nm) torque. Insert new cotter pin (25).

Tighten nut (20) to 35 ft. lbs. (50 Nm) torque and continue to tighten as needed to insert new cotter pin. Maximum torque 50 ft. lbs. (70 Nm).

Lubricate through grease fitting (42).

Rack Tensioner Replacement

Tool List	Qty. Required
Wrench, 9/16"	1

In general, there is no need to remove the rack tensioner (26) unless the rack bellows (27) and or the rack cover (28) have been torn or damaged and there is reason to believe that water or dirt has entered the housing (Ref Fig. 6 on page J-5). The tensioner can be greased through a right angle grease fitting (29) located on the steering housing directly behind the front shield. The tensioner does need to be removed in order to replace the rack (30).

To remove the tensioner, remove the bolts (31), the cover plate (32) and gasket (33) that secures the rack tensioner in the steering housing. Remove the spring (34) and tensioner.

Replace rack tensioner in the reverse order of removal, replacing gasket (33) with a new one.

Tighten bolts (31) to 18 - 22 ft. lbs. (25 - 30 Nm) torque.

Lubricate through grease fitting (29).

Rack Replacement

Tool List	Qty. Required
Wrench, 9/16"	1
Needle nose pliers	1
Wrench 11/16"	1
Ball joint separator	1
Plastic faced hammer	1
Straight blade screwdriver	1

The rack can be removed by loosening the tensioner bolts (31), removing cotter pin and backing off nut (20) on rack ball joint (21) until end threads of ball joint are protected (Ref Fig. 6 on page J-5). Using a ball joint separator as a lever, apply pressure to ball joint and tap nut with plastic faced hammer to release ball joint from idler arm. Remove nut from ball joint and ball joint from idler arm. Remove the large clamp (35) that secures rack bellows (27) to the steering housing. The rack and the bellows may now be pulled from housing.

To test for straightness, lay smooth side of rack on the edge of a metal straight edge in good condition. If a .015" (.381 mm) feeler gauge passes between the rack and the straight edge, the rack is excessively bent and must be replaced. **The rack and steering pinion must be replaced as a set**.

Rack replacement is the reverse order of removal. Pull rack into steering assembly by turning steering wheel.

Rack Ball Joint Removal

For rack ball joint replacement, the rack must be removed from the steering assembly in order to properly adjust the rack/ball joint length. (See above for rack removal). The rack end ball joint (21) can be removed from the steering rack (30) once the rack is removed from the steering housing by loosening the jam nut (36) and removing the ball joint (21) from the rack (Ref Fig. 6 on page J-5).

Rack Ball Joint Installation

Clean threads. Apply primer (LOCTITE LOCQUIC PRIMER T, #7471) and thread locking adhesive (LOCTITE RED #271) to rack ball end before attachment to steering rack. The ball joint (21) and jam nut (36) should be threaded into the rack until the dimension between the end of the rack and the center of the ball joint stud is 14 27/32" (37.7 cm). Tighten the jam nut (36) to 25 - 30 ft. lbs. (35 - 40 Nm) torque (Ref Fig. 7 on page J-7).

See 'Rack Replacement' above for installation of rack into steering housing

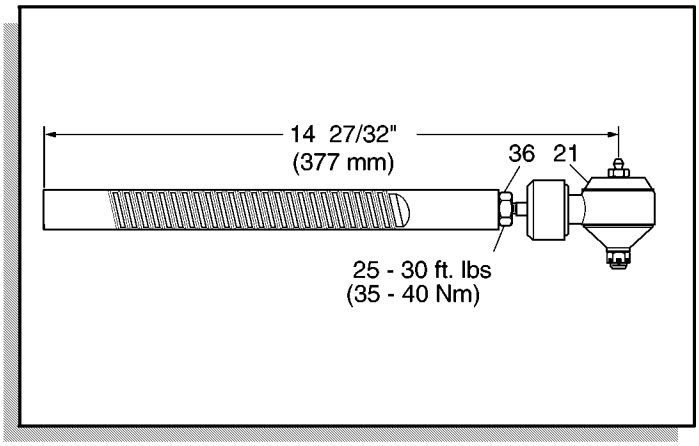

Fig. 7 Rack Ball Joint Installation

Steering Pinion and Bearing Replacement

Tool List	Qty. Required
Retaining ring pliers	1

To remove the steering pinion bearing, refer to 'Steering Shaft Replacement' above. Once the steering shaft is removed, remove the pinion retainer (37) from the steering housing and pull the pinion (38) and bearing (39) as an assembly from the housing (Ref Fig. 6 on page J-5).

The steering pinion bearing (39) can be removed from the pinion gear (38) by removing the external snap ring (40) and pressing the bearing from the pinion shaft.

The steering pinion gear bushing (41) is designed to last the life of the vehicle. If in the unlikely event that it should require replacement, a competent machine shop must remove the bushing without damage to the bore. A new pinion bushing can then be inserted. The rack and steering pinion must be replaced as a set.

MAINTENANCE

Good routine maintenance of the front suspension and steering consists of routine lubrication (See Lubrication Chart and the Periodic Service Schedule in Section A). Be sure to use only the recommended lubricants. Maintain the correct adjustment of the front bearings and repack them in accordance with the periodic service schedule or if a bearing replacement is required. Routine examination of the tires will provide indications that an alignment is required.

Lubrication

Tool List	Qty. Required
Grease gun	1

Grease the rack tensioner (26) at fitting (29), the idler bushing (15) at (42), rack ball joint (21) at (43), tie rod ends (17) and spindle (11) (Ref Fig. 8 on page J-8) per Periodic Service Schedule.

CAUTION **Do not use more than three (3) pumps of grease in each grease fitting at any one time. Excess grease may cause grease seals to fail or grease migration into areas that could damage components.**

NOTE *Some maintenance items must be serviced more frequently on vehicles used under severe driving conditions.*

Wheel Bearing Inspection/Packing

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Wrench, 1 1/2"	1
Needle nose pliers	1
Non-ferrous punch	1
Ball peen hammer	1
Ratchet, 1/2" drive	1
Socket, 3/4", 1/2" drive	1
Extension, 6", 1/2" drive	1
Grease gun	1
Bearing packer	1

Lift the front of the vehicle and support on jack stands as per Section B. Rotate the front wheel and feel for any roughness. Grasp the outside of the tire and rock it. If any movement is detected the wheel bearing may require replacement/adjustment. If the wheel bearing is satisfactory, a worn king pin/bearing is indicated. See 'King Pin Bushing Replacement'.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

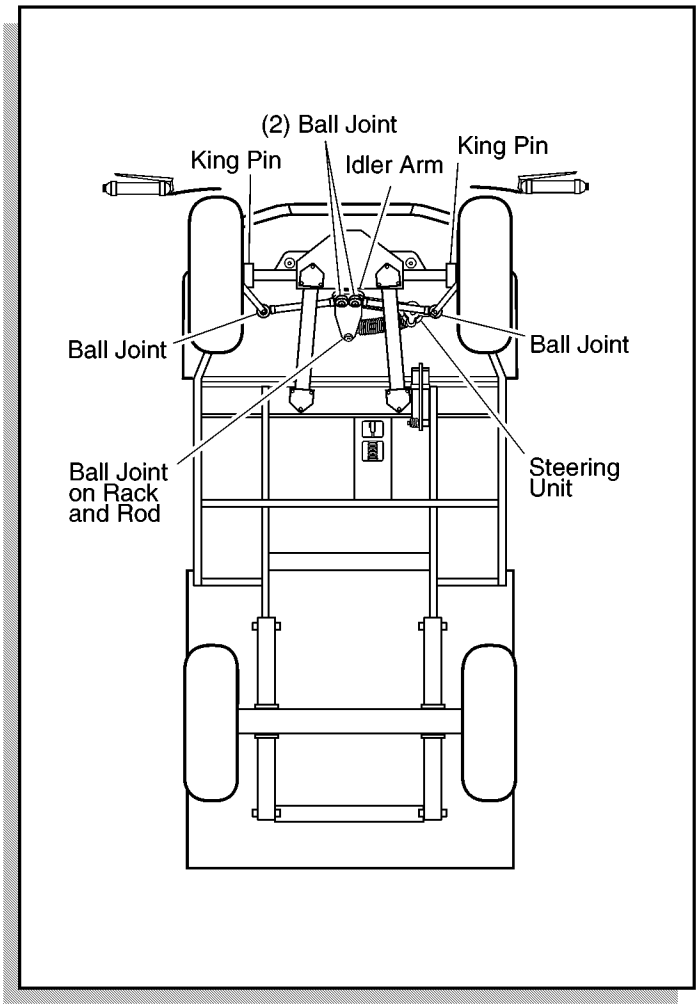

Fig. 8 Lubrication Points

Remove the wheel.

Remove the dust cap (14), cotter pin (15), castellated nut and washer (16), outer roller bearing (18) and hub assembly (17) from the spindle (Ref Fig. 9 on page J-8). Remove the inner bearing seal (20), inner roller bearing (18) and bearing races (19) by tapping lightly around the bearing race through the hub using a soft non ferrous punch. Tap the punch in a circular pattern to avoid damaging the bore of the hub. Clean all bearings, seal, hub and dust cap in solvent and dry thoroughly. Inspect for signs of damage. Pitting or a blue coloration of the rollers will require replacement of the bearing. If the roller portion of the bearing is to be replaced, the race must also be replaced. Install new bearing only after packing with grease.

The front wheel bearings are tapered roller type and must be packed with grease at installation, or any time that the bearing is removed for inspection. It is recommended that a bearing packer attached to a grease gun be used; however, manual packing is acceptable if done correctly. To pack a bearing manually requires that a dab of grease be placed in the palm of the hand and the bearing be dipped in the grease. Force the grease up through and around all of the rollers until the entire bearing is coated in grease. Fill the area between the rollers with grease and apply a light coating to the bearing race. Install bearing in race.

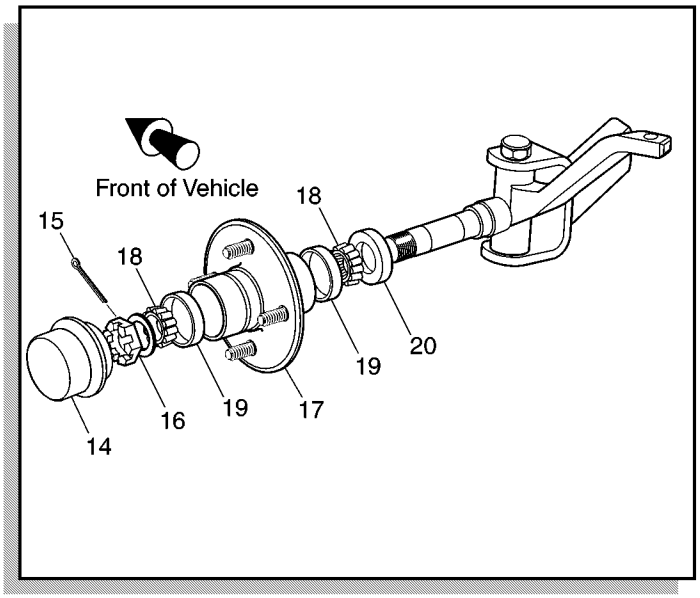

Fig. 9 Wheel Bearing Replacement

Seal Installation

Clean the hub seal surface to remove grease and press the inner bearing seal into place with the flange side of the seal facing into the bore. Tap gently into place with a seal installation tool until it is flush with the outside of the hub assembly. Lubricate the seal surface with a light oil. (Ref Fig. 10 on page J-9)

Bearing Adjustment

Assemble hub with bearings on spindle. Reinstall wheel on hub. Rotate the wheel while tightening the castellated nut (1) (Ref Fig. 11 on page J-9). Tighten the castellated nut until slight resistance to rotation is noticed.

Rotate the wheel 2 - 3 more turns to displace excess grease. If required, tighten castellated nut again until slight resistance is felt. If the cotter pin hole in the spindle (2) aligns with a slot in the castellated nut (1), insert a new cotter pin (3). If the hole does not align, the castellated nut must be **loosened** to align with the **closest available** slot in the nut.

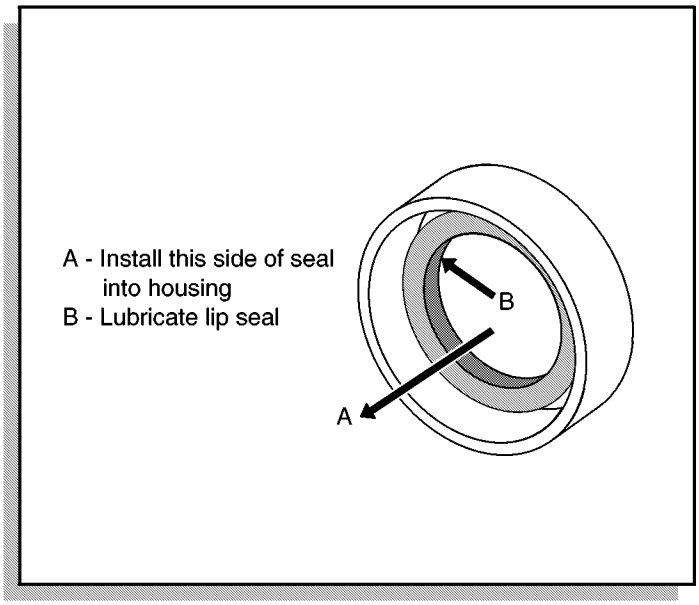

Fig. 10 Seal Installation

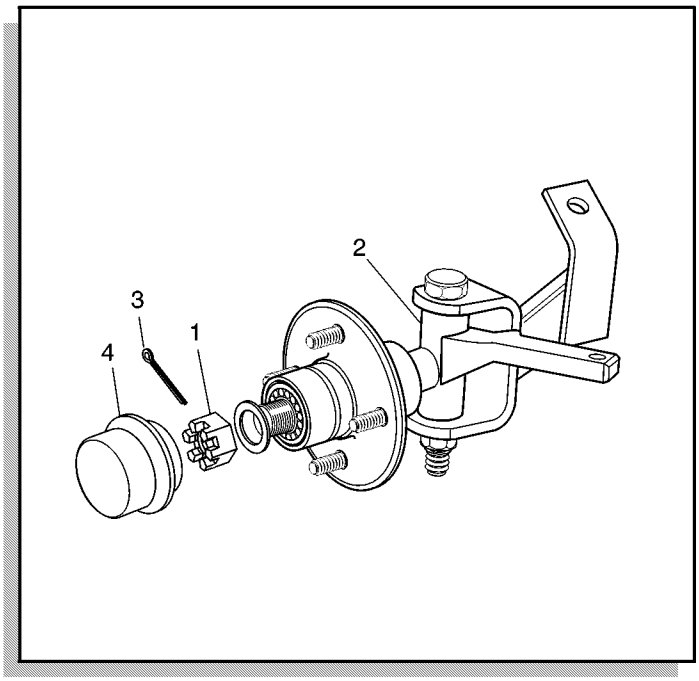

Fig. 11 Front Spindle and Bearing

Check for smooth and free rotation of the wheel and an absence of play when the wheel is grasped by the outside of the tire. Bend the cotter pin (3) against the flats of the castellated nut (1) and cut off any excess.

Replace the dust cap (4).

King Pin Bushing Replacement

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Pliers	1
Box end wrench, 15/16"	1
Sizing reamer, .875"	1
Socket, 15/16", 1/2" drive	1
Torque wrench, ft. lbs., 1/2" drive	1
Inside micrometer, 1"	1

Grasp top and bottom of tire and rock. If excessive motion is present, check wheel bearing adjustment. If adjustment is satisfactory, a worn king pin/bearing is indicated.

Remove the spindle assembly and clean the king pin bushings with solvent. (Ref Fig. 1 on page J-2) If the inside diameter of the bushings are worn to .880" (22 mm) or greater, the bushings should be replaced. Press out the old bushings and press new ones into the spindle until flush with the spindle housing.

NOTE *As a result of the press operation, the bushing inside diameter will close slightly. Use an .875" diameter sizing reamer to correctly size the new bushings.*

Reinstall the spindle and tighten the king pin nut to 40 - 50 ft. lbs. (55 - 70 Nm) torque.

Wheel Alignment

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Box end wrench, 1 1/4"	1
Tape measure	1
Chalk	1

Lift the front of the vehicle and support on jack stands as per Section B. Confirm the alignment of the springs as described in 'Front Spring Replacement'.

Rotate each wheel and scribe or chalk a line around the circumference of the tire at the center of the tread pattern. Lower the vehicle and roll it forward approximately five feet in order to allow the tires to take their normal running position.

Measure the distance between the chalk lines at both the front and rear of the tires (Ref Fig. 12 on page J-10). The measurement taken at the front of the tire should be 1/4" ± 1/8" (6 mm ± 3 mm) less than the rear. Manufacturing tolerances may cause some variance, however typical dimensions would be 33 1/2" (85 cm) front and 33 3/4" (86 cm) rear.

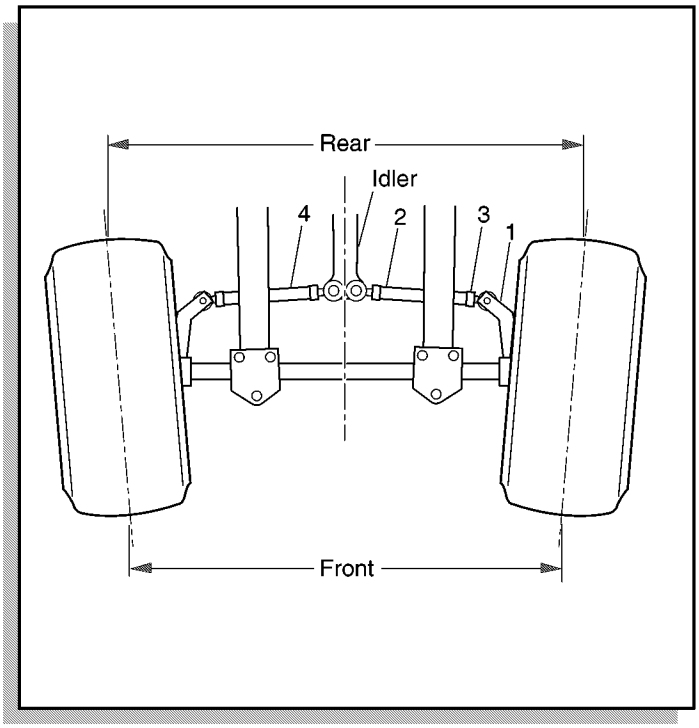

Fig. 12 Front End Alignment

To adjust the wheel alignment, first turn the steering wheel to the left until it stops. Look at the driver side spindle arm (1) (Ref Fig. 12 on page J-10) and see if it is touching the 'U' shaped bracket at the front axle. If not, adjust the driver side tie rod (2). Loosen the tie rod jam nuts (3) and adjust the driver's side tie rod (2) until the spindle arm contacts the 'U' bracket with the steering wheel turned fully to the left. Lock the tie rod jam nuts 25 - 30 ft. lbs. (35 - 40 Nm) torque. Center the steering wheel and adjust the passenger side tie rod (4) until the correct alignment is achieved. Lock the tie rod jam nuts 25 - 30 ft. lbs. (35 - 40 Nm) torque.

Check that the idler is centered ± 1/2" (±13 mm). Adjustment may be made at one tie rod providing the dimension difference does not exceed 3/4" (19 mm).

Test drive the vehicle and confirm that the steering wheel is correctly centered. If not, remove steering wheel and rotate it to the correct position.

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LIST OF ILLUSTRATIONS

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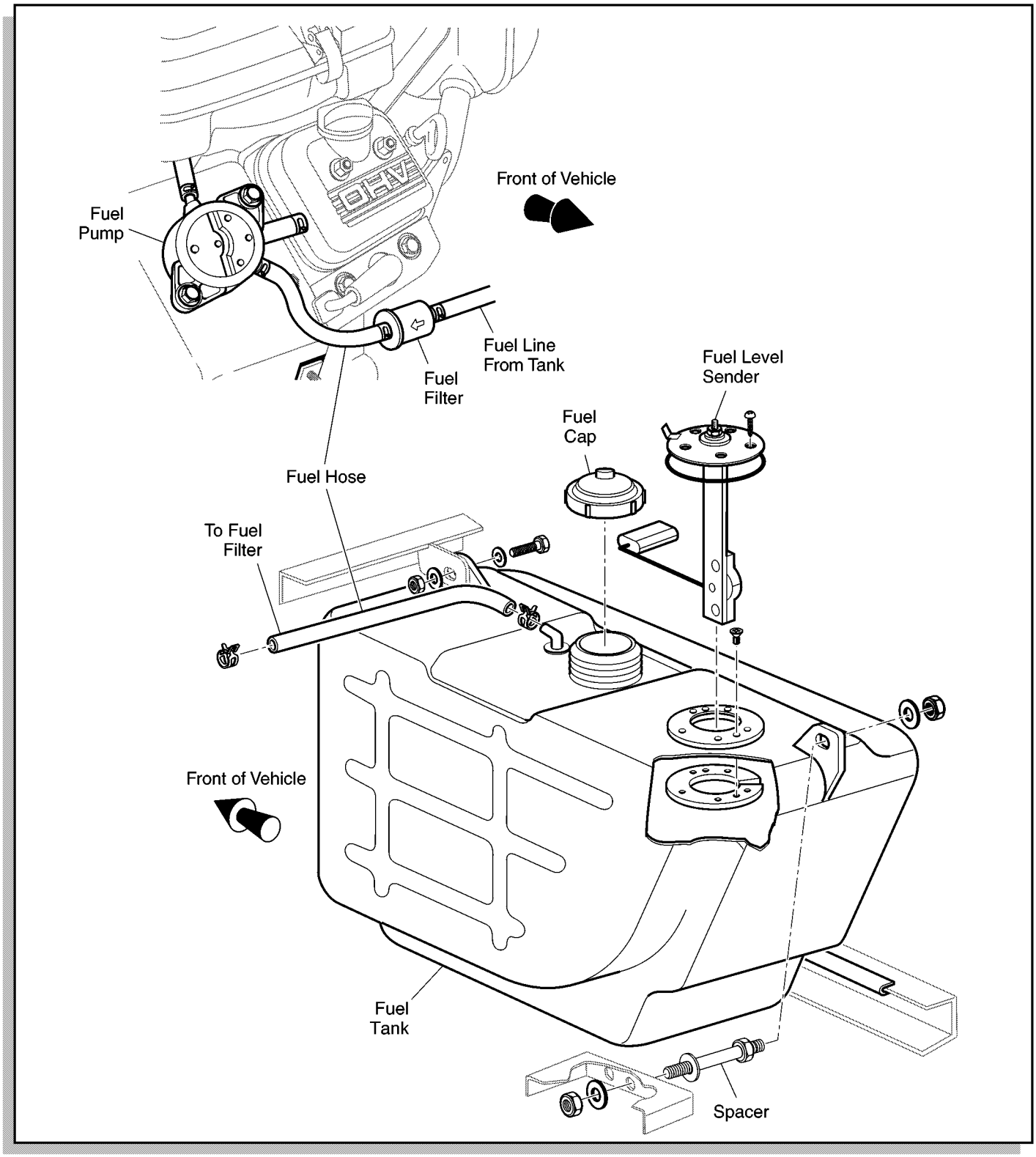

Fig. 1 Fuel System Components

FUEL SYSTEM

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

GENERAL

NOTE *In the following text, there are references to removing/installing bolts, etc. Additional hardware (nuts, washers, etc.) that is removed must always be installed in its original position unless otherwise specified. Non-specified torque specifications are as shown in the table contained in Section A.*

The fuel system consists of a fuel tank, fuel lines, fuel filter, fuel pump, and carburetor (Ref Fig. 1 on page K-1). For fuel pump or carburetor service, refer to the Briggs & Stratton Engine Manual (P/N 272144) for Vanguard™ V-Twin Overhead Valve engines.

FUEL

⚠ WARNING ⚠ ***To prevent serious injury or death resulting from a possible explosion, do not smoke near the fuel tank or refuel near open flame or electrical items which could produce a spark.***

Always wear safety glasses while refueling to prevent possible eye injury from gasoline or gasoline vapor.

When refueling, inspect the fuel cap for leaks or breaks that could result in fuel spillage.

Do not handle fuel in an area that is not adequately ventilated. Do not permit anyone to smoke in an area where vehicles are being fueled.

The fuel tank cap is located under the passenger seat (Ref Fig. 2 on page K-2). Fill tank with fresh, clean, automotive grade, unleaded, 87 octane (minimum) gasoline. Leaded gasoline may be used if it is commercially available and if unleaded is unavailable.

Do not use gasoline which contains Methanol.

Do not mix oil with gasoline.

CAUTION **Some fuels, called oxygenated or reformulated gasoline, are gasoline blended with alcohols or ethers. Excessive amounts of these blends can damage the fuel system or cause performance problems. If any undesirable operating symptoms occur, use gasoline with a lower percentage of alcohol or ether.**

Do not over fill the fuel tank. Allow adequate space for the expansion of gasoline. Leave at least 1" (2.5 cm) space below bottom of filler neck.

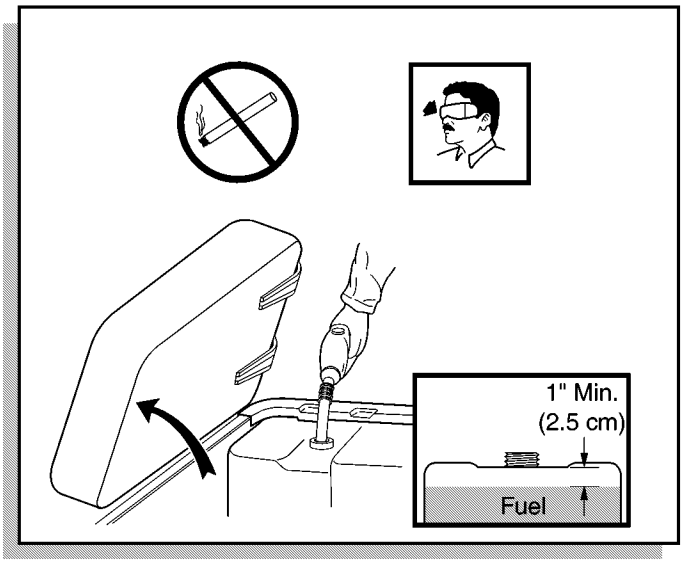

Fig. 2 Fuel Tank Location

FUEL SYSTEM COMPONENT SERVICE AND REPLACEMENT

⚠ WARNING ⚠ ***To prevent personal injury resulting from explosion or fire:***

Check for clogged or kinked hoses. Clogged or kinked carburetor hoses are not only detrimental to the proper operation and performance of the vehicle, but can also be a safety hazard in the case of fuel leaking on a hot engine.

Tests that involve fuel flow should be avoided if at all possible. If a test to determine fuel/vapor presence or flow is required, the ignition system must be disabled. Ground the magneto in order to prevent an ignition spark that could ignite the fuel/vapor. Never permit smoking or an open flame in an area that contains fuel/vapor. Clean up all fuel spills immediately.

Never attempt to repair a damaged or leaking fuel tank. It must be replaced.

Disconnect the negative (-) battery cables before servicing fuel system.

The fuel filter, tank, hoses and cap should be checked frequently for leaks or signs that the cap vent or filter has become clogged. The filter should be replaced periodically. See 'Periodic Service Schedule' in Section A.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Fuel Lines and Filters

Tool List	Qty. Required
Pliers	1
Hose plug	1

Fuel is supplied to the fuel pump and carburetor through flexible fuel hoses. An in-line filter is installed in the hose between the fuel tank and fuel pump.

CAUTION **The filters are marked with a flow direction arrow. Be sure that the arrow points towards the fuel pump.**

To replace fuel filter, move clamps off ends of filter and pull filter up higher than the fuel pump to reduce the amount of gas that will spill (Ref Fig. 1 on page K-1). Remove hose coming from fuel tank first and plug. Remove filter from hose going to fuel pump and discard.

NOTE *Orient direction of new fuel filter according to FLOW arrow on side of filter.*

Install new fuel filter in reverse order of removal.

Fuel Pump

Tool List	Qty. Required
Pliers	1
Wrench, 10mm	1

Raise passenger seat.

Disconnect fuel hose coming from fuel filter.

Remove pump mounting hardware and disconnect pump from hoses going to carburetor and valve cover.

Remove pump from vehicle.

Install new fuel pump in reverse order of removal.

Fuel Tank

Tool List	Qty. Required
Phillips screwdriver	1
Pliers	1
Wrench, 3/8"	2
Wrench, 1/2"	2

Raise passenger seat.

Remove seat filler panel. See BODY AND TRUCKBED section.

Disconnect fuel hose and gauge wires from tank.

Remove tank mounting hardware and tank from vehicle.

Install new fuel tank in reverse order of removal.

Choke System

The choke functions to make initial starting of the engine easier in cold weather conditions. The choke plate restricts the air flow into the carburetor which richens the air/fuel ratio.

Choke Operation

Pull choke knob out to operate choke. Check that cable operates smoothly and that cable returns when the knob is released. The motion should be smooth throughout the entire operating range. If there is any binding or sharp bends, the choke cable assembly and linkage must be inspected and parts replaced as necessary.

NOTE *Do not attempt to lubricate the choke cable. Lubricant tends to retain dirt on the moving parts which will cause premature deterioration of the cable.*

Choke Cable Removal

Tool List	Qty. Required
Wrench, 1/2"	1
Wrench, 5/8"	1
Straight screwdriver, small	1

Pry choke cable off ball stud of choke pivot lever (Ref Fig. 3 on page K-3). Loosen jam nuts securing choke cable to bracket and remove. At the center console, loosen setscrew securing knob to end of cable and remove knob. Remove nut securing end of cable to console and remove choke cable from vehicle.

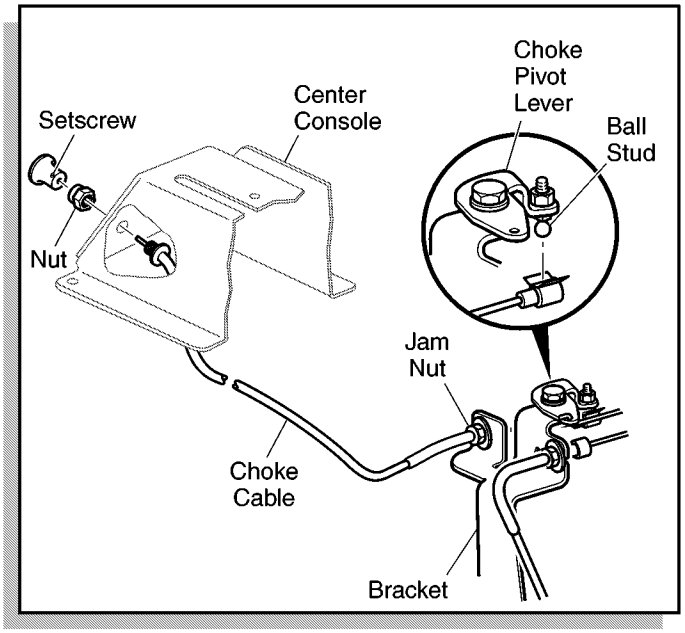

Fig. 3 Choke Cable

Choke Cable Installation and Adjustment

From below the console, feed the choke cable through the hole in the console and secure end of cable with nut (Ref Fig. 3 on page K-3). Place knob on end of cable and firmly tighten setscrew to retain knob. At other end of cable, place cable in slot of bracket with a jam nut and washer on each side of bracket. Snap ball stud into socket on end of choke cable.

Remove air cleaner cover and filter cartridge to see choke plate in carburetor. Adjust the position of the cable in the bracket using the jam nuts until the choke plate fully opens and closes using the knob. Check the cable to be sure that there are no sharp bends or kinks in the cable before firmly tightening the jam nuts.

Carburetor

Tool List	**Qty. Required**
Pliers	1
Insulated wrench, 1/2"	1
Wire lead with alligator clips	1

To properly prepare for carburetor service:

a) Disconnect fuel hose at fuel filter and plug ends to prevent contamination. Empty carburetor by running engine until it stops from lack of fuel.

b) Disconnect negative (-) cables from battery to prevent electrical shorts that could ignite fuel vapors.

c) Wash engine and chassis to remove dirt build-up, especially the underside of the wide frame cross-member directly above the air cleaner.

d) Ground magneto by attaching a wire lead, with alligator clips, from the terminal with the white wire (located on fan cover at side of engine) to the ground cable bolted to the frame.

e) Follow carburetor removal and service procedures outlined in the CARBURETION section of the Briggs & Stratton® Repair Manual (P/N 272144) for Vanguard™ V-Twin Overhead Valve engine.

PROLONGED STORAGE

For information on preparing vehicle for prolonged storage, refer to the GENERAL INFORMATION AND ROUTINE MAINTENANCE section.

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PAINT

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

PAINTING

Follow the paint manufacturer's recommendations for specific painting procedures and information.

⚠ WARNING ⚠ ***All painting must be done in an area with adequate ventilation to safely disperse harmful vapors.***

Wear eye protection and respirator, following manufacturer's instructions, to protect from overspray and airborne mist.

CAUTION **Provide protection from overspray to vehicle and surrounding area.**

Minor Scratches

For minor scratches, the manufacturer suggests the following steps be taken to repair the Durashield™ body:

I. Thoroughly clean the surface to be repaired with alcohol and dry.

II. Touch up damaged area with sequential coats (two coats minimum recommended, allowing 30 - 45 minutes between coats, increasing to 45 - 60 minutes in higher humidity) using brush on touch-up paint, until coating layer is visible, slightly above the surface of the part.

III. Use 400 grit "wet" sand paper to blend touch up area level with the rest of the part being repaired. Use a polishing compound (3M Finesse or automotive grade) to renew gloss and to further blend and transition newly painted surface.

IV. Clean with alcohol and dry.

V. (Optional but recommended) Follow this process with clear coat to renew and protect depth of finish.

VI. Wax or polish with Carnauba base product, available at any automotive parts distributor.

Larger Scratches

For larger scratches, the manufacturer suggests the following steps be taken to repair the Durashield™ body:

I. Thoroughly clean the surface to be repaired with alcohol and dry.

II. Mask area to be painted (common masking tape is adequate) prior to repair and use aerosol type touch-up paint.

III. Apply spray touch up paint in light even overlapping strokes. Multiple coats may be applied to provide adequate coverage and finish. Always remember to shake the can for a minimum of one minute to mix the paint and achieve the best color match.

IV. After painting, allow to dry overnight. Smooth the mask lines using 400 grit "wet" sand paper to blend touch up area level with the rest of the part being repaired. Use a polishing compound (3M Finesse or automotive grade) to renew gloss and to further blend and transition newly painted surface.

V. Clean with alcohol and dry.

VI. (Optional but recommended) Follow this process with clear coat to renew and protect depth of finish.

VII. Wax or polish with Carnauba base product, available at any automotive parts distributor.

Complete Panel Repair

In situations where large panels or areas must be painted, touch up paint is not recommended. In such cases professional painting or panel replacement is called for. The manufacturer suggests body panel replacement be considered as a cost effective alternative to painting. If the decision to repaint is taken, the task can be accomplished by any paint and body shop with experience in painting 'TPE' panels. TPE is a common material in modern automobile bodies and all body shops should be familiar with the materials and processes required.

The finish will include an application of a primer coat, a base color coat and a clear coat. The manufacturer does not supply these materials due to the variety of paint manufacturers and the preferences of the individual painter.

Most paint manufacturers can perform a computer paint match to assure accurate color matching.

PAINT

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Notes:

REAR AXLE AND SUSPENSION

M

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REAR AXLE AND SUSPENSION

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

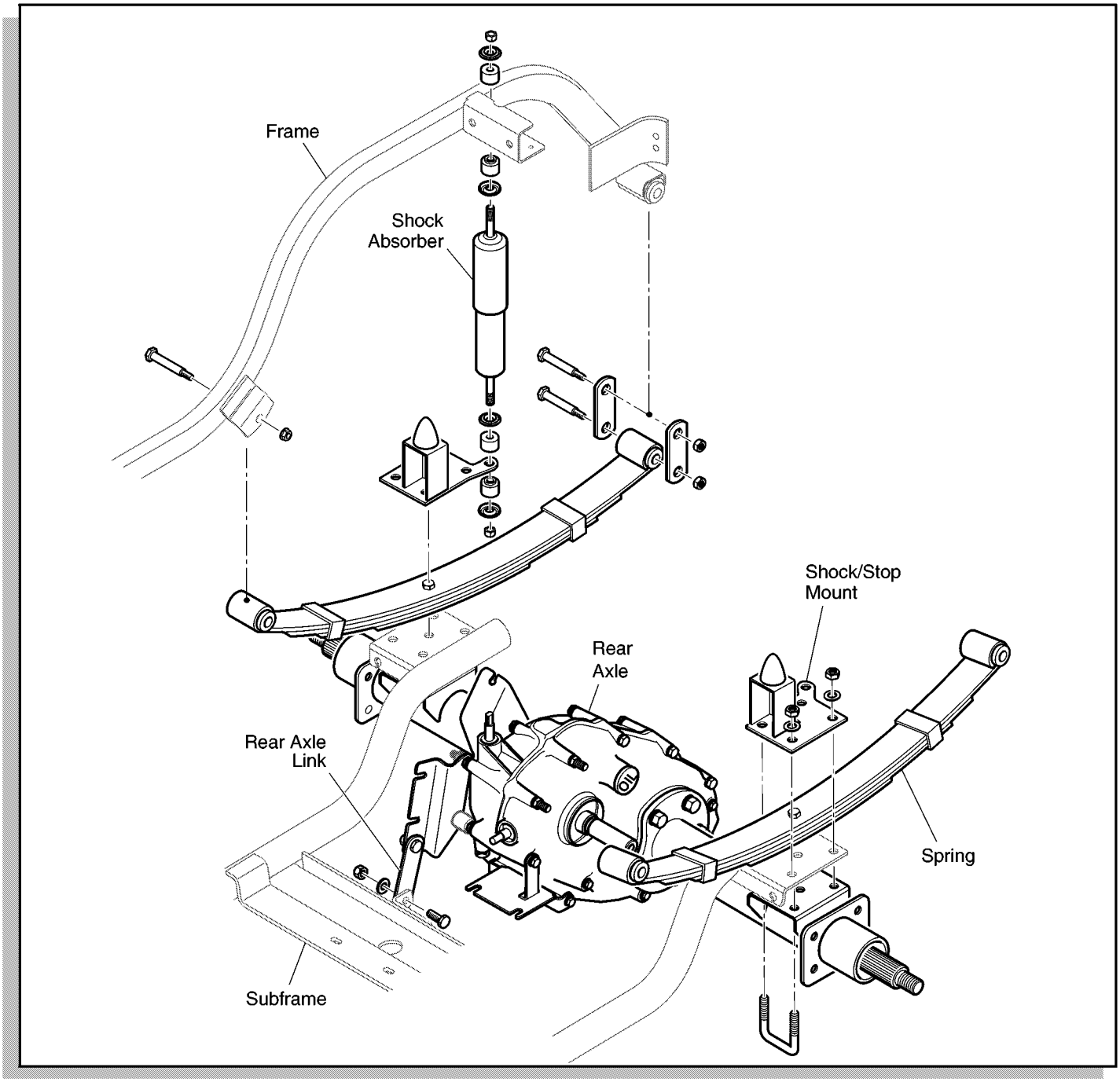

Fig. 1 Rear Axle and Suspension Components

REAR AXLE

Maintenance

The rear axle is provided with a lubricant level check plug located on the driver side at rear of housing. Unless leakage is evident, an annual lubricant check is sufficient.

Checking the Lubricant Level

Tool List	Qty. Required
Wrench, 13 mm	1
Funnel	1

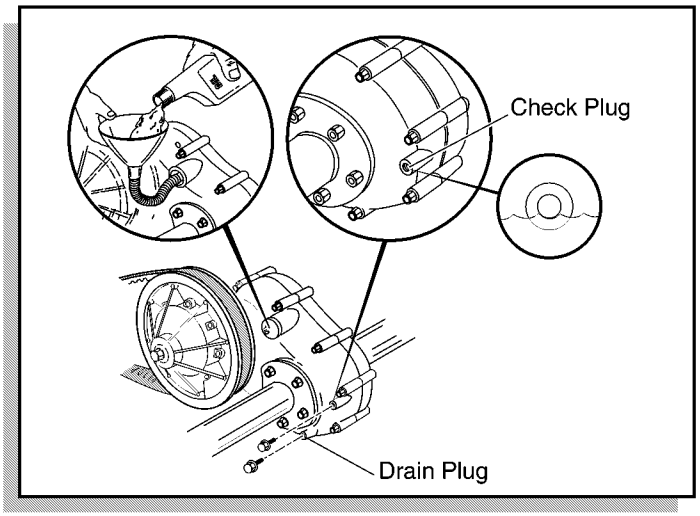

Fig. 2 Check, Add or Drain Rear Axle Lubricant

Clean area around check and fill plugs. Remove check plug (Ref Fig. 2 on page M-2).

The correct lubricant level is **just** below the bottom of the threaded hole. If lubricant is to be added, remove the fill plug and add lubricant (SAE 30 oil) using a funnel. Add lubricant slowly until lubricant starts to seep from the check plug. Install the check plug and the fill plug. In the event that the lubricant is to be replaced, a drain plug is provided at the bottom of the differential housing. Capacity of axle is 48 oz. (1.4 liters).

Differential Lock Cable Adjustment

Tool List **Qty. Required**

Wrench, 1/2" 2

With lever in the unlocked position, loosen jam nuts at bracket (Ref Fig. 3 on page M-2).

Tighten front jam nut until arm on differential lock unit begins to pivot.

Back off front jam nut one turn and hold while tightening rear jam nut.

Rear Axle Removal

Tools List **Qty. Required**

Lug wrench, 3/4" 1
Wheel chocks 4
Jack stands 2
Floor jack 1
Socket, 1 1/8", 1/2" drive 1
Ratchet, 1/2" drive 1
Needle nose pliers 1
Socket, 1/4" hex bit, 1/2" drive 1

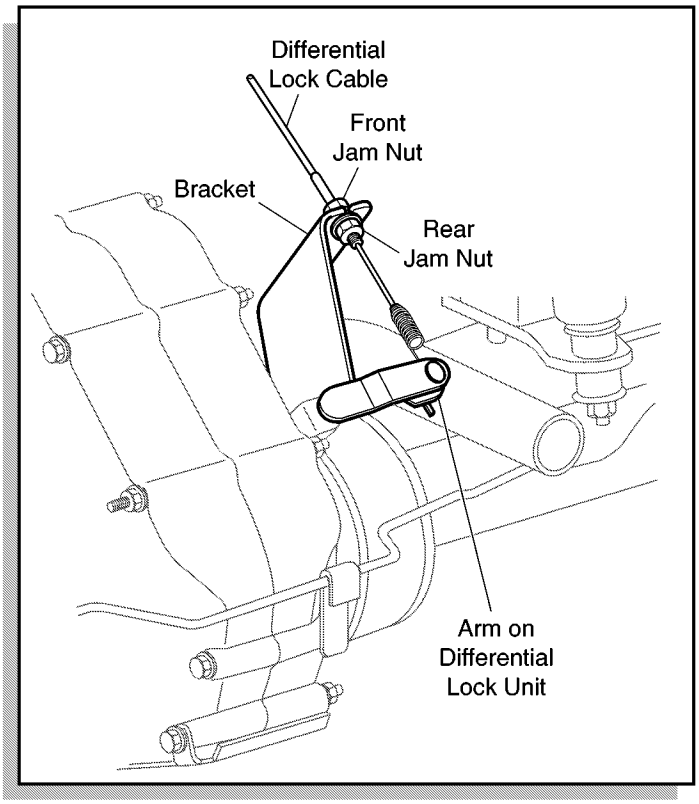

Fig. 3 Differential Lock Cable Adjustment

Socket, 1/2", 1/2" drive 1
Wrench, 9/16" 1
Wrench, 1/2" 1
Straight blade screwdriver 1
Socket, 12 mm, 1/2" drive 1
Wrench, 1/4" 1
Socket, 9/16", 1/2" drive 1
Wrench, 3/4" 1
Torque wrench, 1/2" drive, ft. lbs. 1
Anti-seize compound ..... AR
Crowfoot wrench, 9/16", 3/8" drive 1
Torque wrench, in. lbs., 3/8" drive 1
Thread locking sealant ..... AR

Remove load bed per BODY AND LOAD BED section.

⚠ WARNING ⚠ ***To reduce the possibility of personal injury, follow the lifting procedure in Section B of this manual. Place wheel chocks in front and behind each wheel not being raised and check the stability of the vehicle on the jack stands before starting any repair procedure. Never work on a vehicle that is supported by a jack alone.***

Loosen lug nuts at rear wheels and lift rear of vehicle according to lifting procedure in SAFETY section.

Remove rear wheels and brake drums.

Disconnect parking brake cables by first removing cotter and clevis pins from actuating levers and then retaining rings from subframe brackets (Ref Fig. 4 on page M-3).

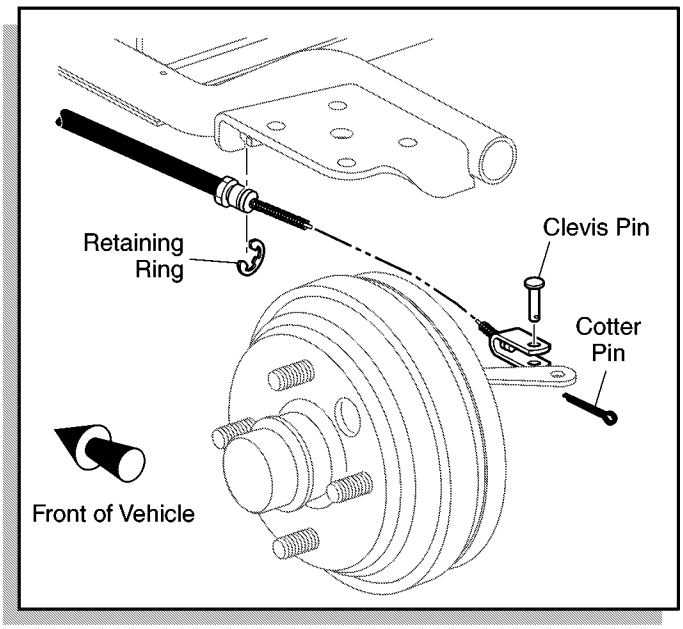

Fig. 4 Disconnect Parking Brake Cables

To gain clearance for banjo bolts, loosen backing plate hardware until lock nuts are at end of bolts.

Disconnect hydraulic brake lines at backing plates by removing banjo bolts and copper gaskets (Ref Fig. 5 on page M-3). Remove brake line, running across rear axle, from clamp on rear axle. Bleeding the hydraulic brakes is required after any hydraulic part is removed or replaced.

Loosen clamp and remove exhaust pipe from muffler.

Remove drive belt and driven clutch. See CONTINUOUSLY VARIABLE TRANSMISSION section.

Remove push nut securing end of accelerator cable to governor. To maintain cable adjustment, loosen only the rear jam nut anchoring accelerator cable to accelerator cable bracket and remove cable (Ref Fig. 6 on page M-4).

Remove governor cable from ball stud on lower end of governor bellcrank located between engine and differential (Ref Fig. 6 on page M-4). Remove two nuts mounting accelerator cable bracket to differential. Loosen two setscrews and pull governor bellcrank assembly and accelerator cable bracket from differential.

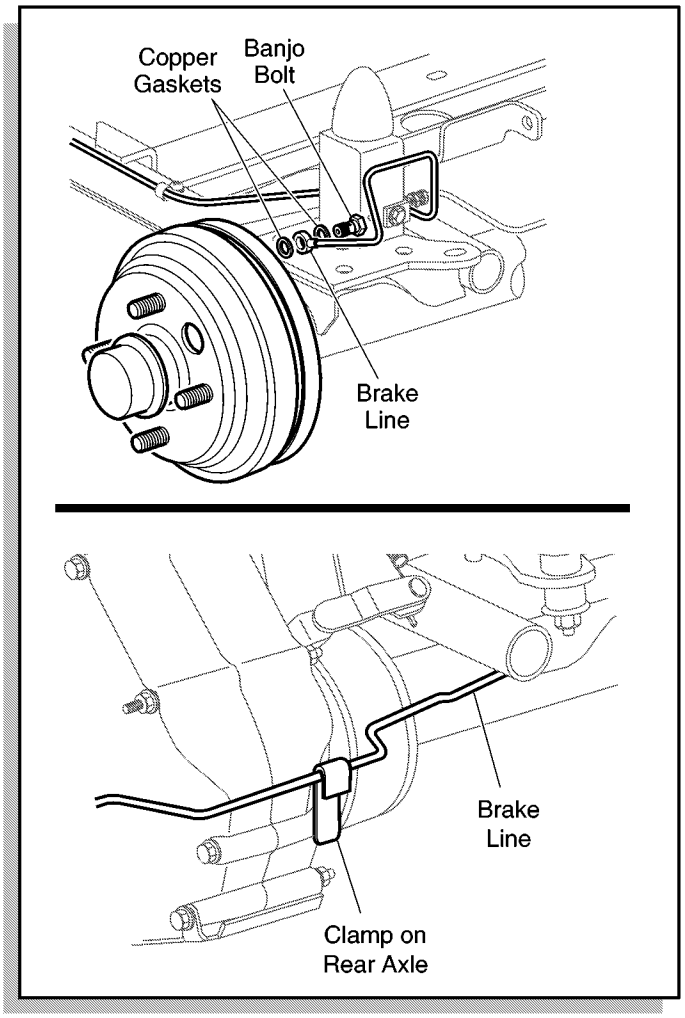

Fig. 5 Disconnect Brake Lines

At differential, remove cotter and clevis pin connecting differential lock cable to differential lock arm (Ref Fig. 7 on page M-4). To maintain cable adjustment, loosen only the rear jam nut anchoring differential lock cable to bracket and remove cable.

Loosen nuts anchoring direction selector cables to differential bracket (Ref Fig. 8 on page M-4). Remove nut attaching pivot to differential and slide pivot from shaft.

Remove hardware securing rear axle link to subframe (Ref Fig. 9 on page M-4).

⚠ WARNING ⚠ ***The differential makes the rear axle assembly top heavy and may tend to rotate when separated from springs. To reduce possibility of personal injury while removing rear axle, be sure to support differential when removing the 'U' bolts.***

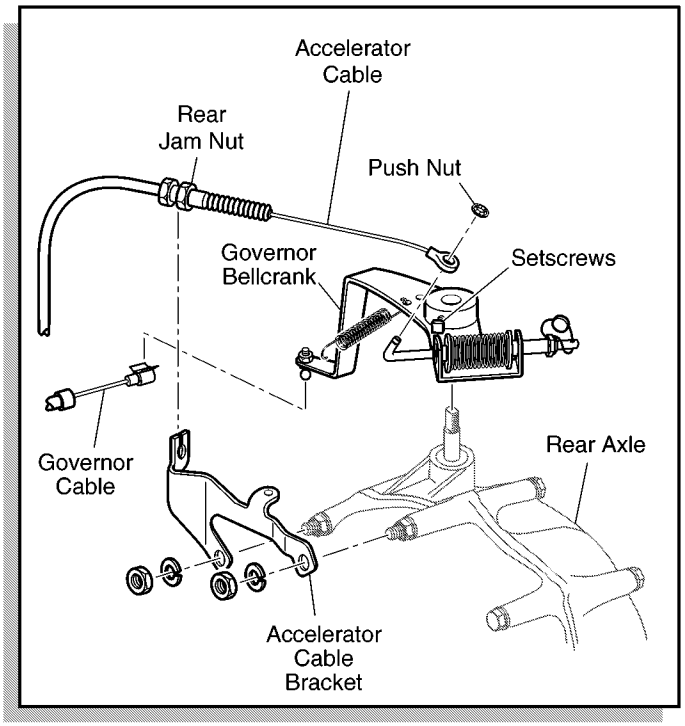

Fig. 6 Disconnect Accelerator Cable and Governor

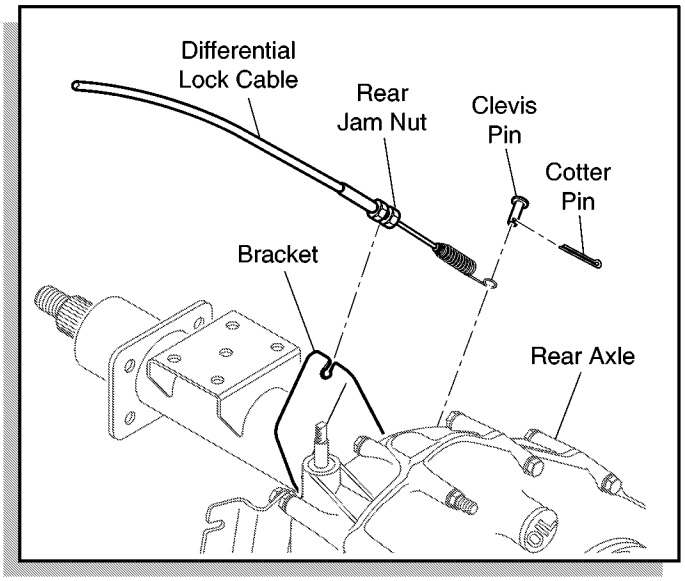

Fig. 7 Disconnect Differential Lock Cable

If no lifting device is available, a second person should hold the rear axle in the correct position until the 'U' bolts are removed. Both persons should remove the rear axle assembly.

Place floor jack under center section of rear axle and raise it just enough to take weight off springs. With both

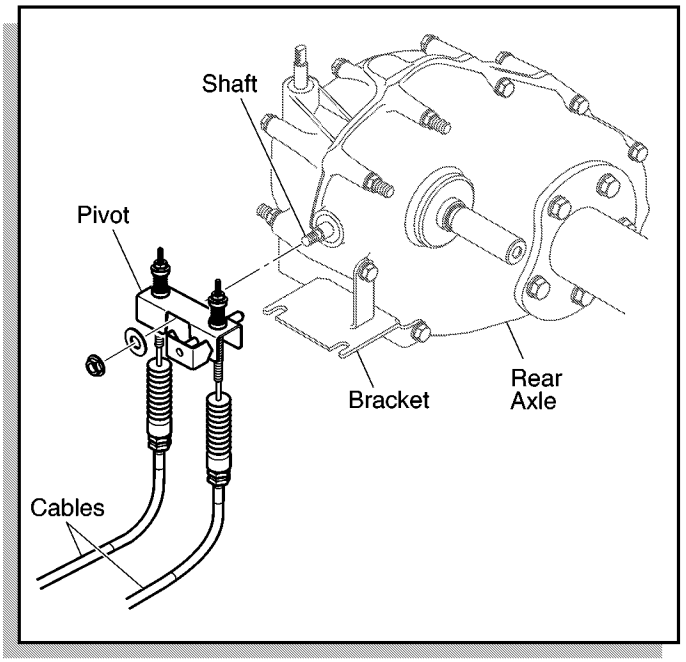

Fig. 8 Disconnect Direction Selector Cables

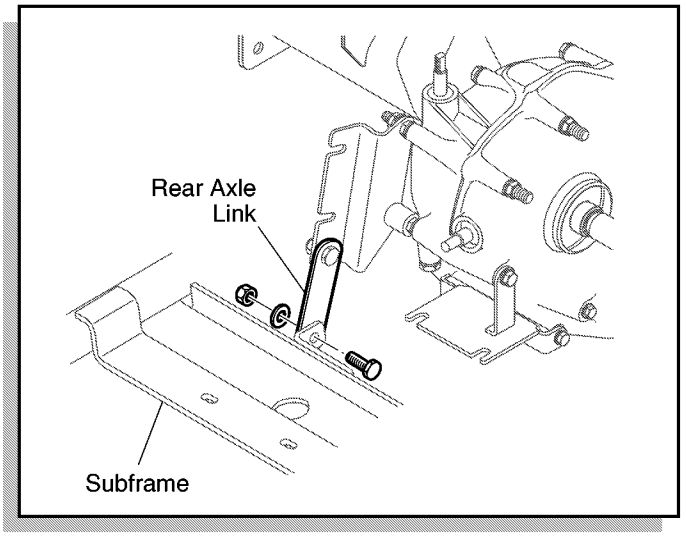

Fig. 9 Detach Differential Link

rear axle and frame properly supported, remove 'U' bolts mounting axle to subframe (Ref Fig. 10 on page M-6).

Lower rear axle and pull it out from under side of vehicle.

Rear Axle Installation

Rear axle installation is in the reverse order of disassembly using new lock nuts.

Tighten 'U' bolt lock nuts to 18 ft. lbs. (25 Nm) torque.

Tighten two governor bellcrank assembly setscrews to 70 - 84 in. lbs. (8 - 9 Nm).

Tighten driven clutch bolt to torque specified in CONTINUOUSLY VARIABLE TRANSMISSION section.

Center end of exhaust pipe between driven clutch and subframe and tighten clamp till no loose play is present.

Tighten banjo bolts to 124 - 177 in. lbs. (14 - 20 Nm) torque.

Tighten backing plate lock nuts and castellated nuts securing brake drums to torque specified in HYDRAULIC BRAKES section.

Install rear wheels and tighten lug nuts. See WHEELS AND TIRES section.

Bleed brake system before installing load bed. See HYDRAULIC BRAKES section.

REAR SUSPENSION

NOTE *In the following text, there are references to removing/installing bolts, etc. Additional hardware (nuts, washers, etc.) that is removed must always be installed in its original position unless otherwise specified. Non specified torque specifications are as shown in the table contained in Section A.*

General

Tool List	Qty. Required
Wheel chocks	4
Jack stands	4
Floor jack	1
Wrench, 9/16"	1
Socket, 9/16", 3/8" drive	1
Socket, 9/16", deepwell, 3/8" drive	1
Extension, 3", 3/8" drive	1
Ratchet, 3/8" drive	1
Wrench, 3/4"	1
Torque wrench, 3/8" drive, ft. lbs.	1

The rear suspension consists of the rear axle and attachments that secure it to the subframe, springs and shock absorbers (Ref Fig. 10 on page M-6). This section is confined to the removal and replacement of the springs and shock absorbers.

Shock Absorber Removal

Raise load bed.

Raise the rear of the vehicle in accordance with the instructions provided in Section B of this manual and support the rear of the vehicle on the outer ends of the rear bumper.

Remove the bottom shock absorber nut (Ref Fig. 10 on page M-6).

Compress the shock absorber and remove the top shock absorber nut.

Remove the shock absorber.

Shock Absorber Installation

Shock absorber installation is in the reverse order of disassembly except that the shock absorber nuts must be tightened until the shock absorber bushings expand to the diameter of the shock absorber washer.

Rear Spring Removal

⚠ WARNING ⚠ ***To reduce the possibility of personal injury, follow the lifting procedure in section B of this manual. Place wheel chocks in front and behind the front wheels and check the stability of the vehicle on the jack stands before starting any repair procedure. Never work on a vehicle that is supported by a jack alone.***

NOTE *If both springs are to be replaced and the rear axle is not to be removed, it is important to remove and replace one spring at a time. Springs must be replaced in sets. Never replace just one.*

Remove the bottom shock absorber nut (Ref Fig. 10 on page M-6).

Place a floor jack under the center section of the rear axle and raise just enough to place a second set of jack stands under the axle tubes. With both the rear axle and the frame supported, the 'U' bolts and shock/stop mount can be removed.

Remove the rear spring shackle assembly and the front spring mounting hardware.

Remove the spring.

Rear Spring Installation

Spring installation is in the reverse order of disassembly.

The shock absorber nuts must be tightened until the shock absorber bushings expand to the diameter of the shock absorber washer (Ref Fig. 10 on page M-6).

Tighten the front spring hardware to 20 ft. lbs. (30 Nm) torque.

Tighten the rear spring shackle hardware to 12 ft. lbs. (20 Nm) torque.

Tighten 'U' bolt lock nuts to 18 ft. lbs. (25 Nm) torque.

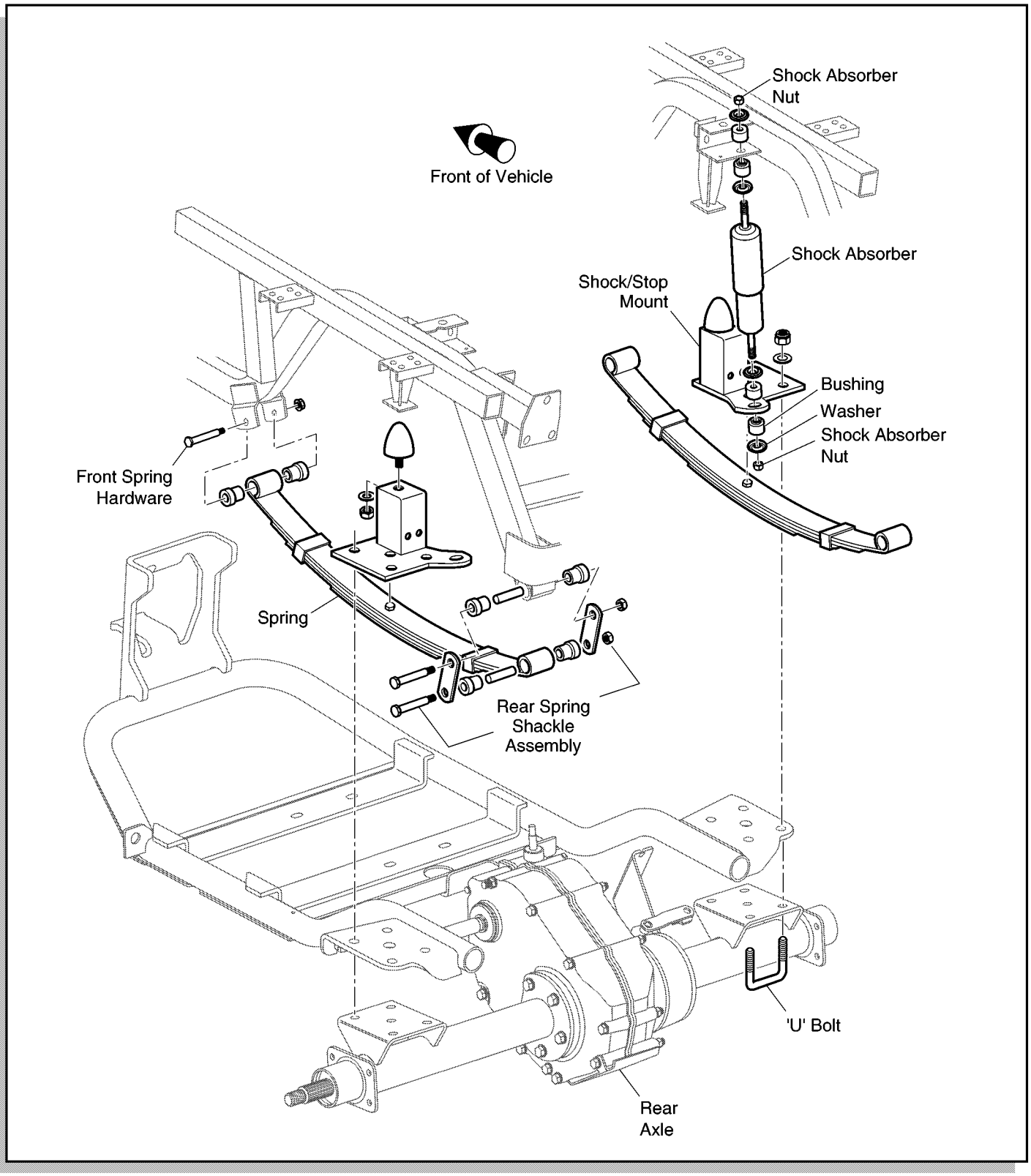

Fig. 10 Rear Suspension

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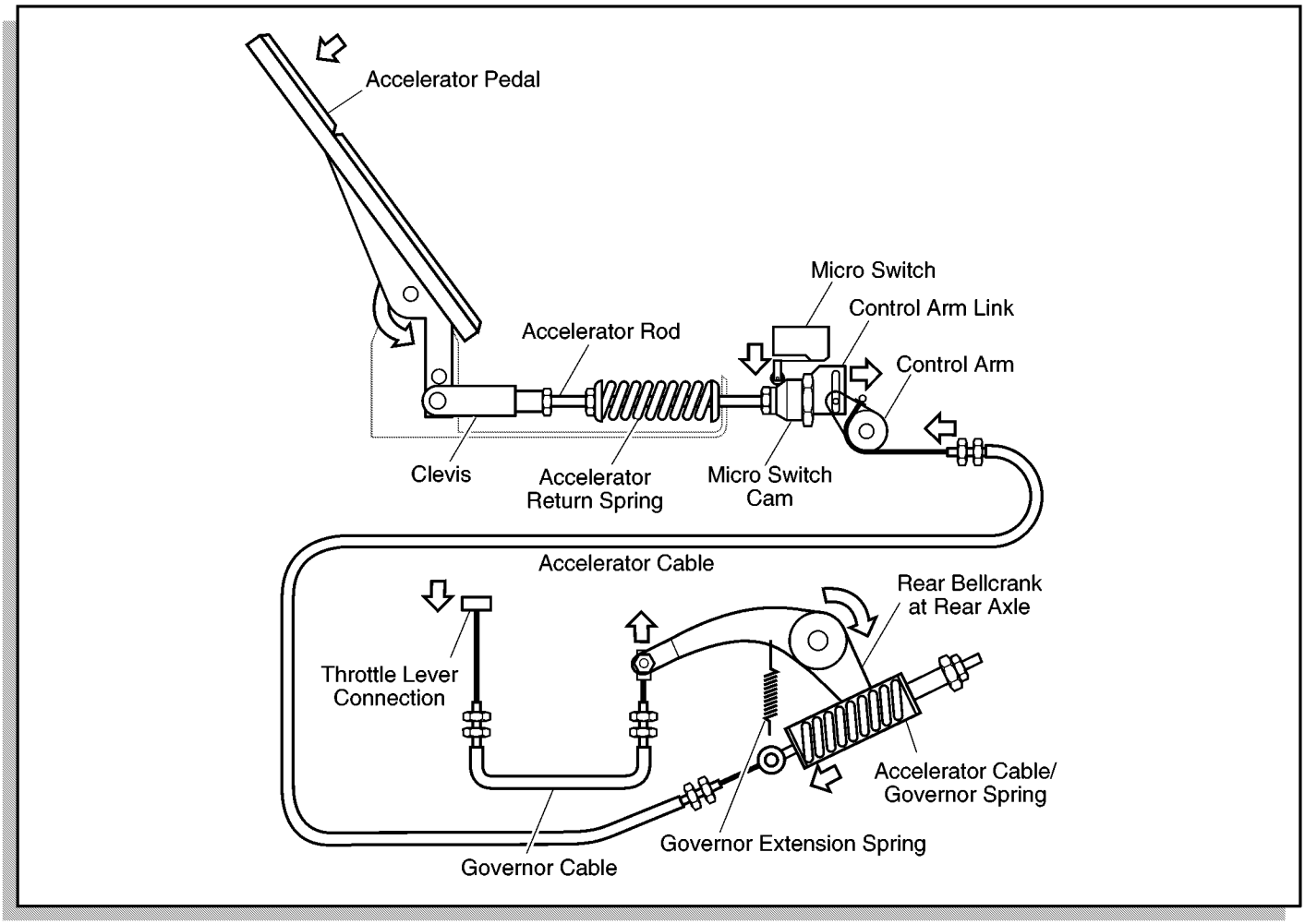

Fig. 1 Accelerator and Governor System

ACCELERATOR, GOVERNOR AND CARBURETOR LINKAGE

System Operation

NOTE *The linkages that control the accelerator mechanism, governor and carburetor are designed to operate as an integrated assembly. Any adjustment to one portion of the system will have an effect on the other components within the system.*

When the accelerator pedal is depressed, the accelerator rod moves towards the rear of the vehicle by overcoming the resistance of the accelerator return spring (Ref Fig. 1 on page N-1).

As the accelerator pedal moves, the micro switch closes and activates the ignition circuit.

The rear end of the accelerator rod is joined to the control arm link, which in turn is attached to the control arm with a pin which slides within a slot in the control arm link.

As the accelerator rod moves to the rear of the vehicle, the control arm rotates and pulls the accelerator cable.

When the accelerator cable pulls against the accelerator cable/governor spring, the spring compresses until it overcomes the resistance exerted by the governor mechanism and its extension spring. As the accelerator cable/governor spring overcomes these forces, the governor bellcrank moves and the motion is transferred through the governor cable to the throttle lever on the carburetor.

Governor Operation

Until the vehicle reaches its governed speed, the vehicle will continue to accelerate in relation to the accelerator pedal position. When the governed speed is reached, the

ground speed governor in the rear axle assembly operates against the accelerator cable/governor spring and closes the carburetor until the correct governed speed is achieved (Ref Fig. 1 on page N-1).

It is the force of the accelerator cable/governor compression spring in response to accelerator pedal and governor bellcrank position which controls the position of the carburetor throttle plate. The compression spring provides cushioning of sudden changes in throttle linkage position to provide smooth power transmission.

⚠ WARNING ⚠ ***Tampering with or adjusting the speed control system to go beyond factory specified speed will void the warranty, is dangerous, could cause a loss of vehicle control and possible injury or death.***

CAUTION **If the governor requires service, the service must be performed by an authorized service branch or distributor who will reseal the governor after calibration.**

TROUBLESHOOTING

Erratic acceleration and performance that does **not** include a notable increase in governed speed, may indicate the need for a linkage adjustment.

Symptoms that include an increase in governed speed indicate:

- a possible governor failure within the rear axle
- worn components in the governor system
- improper adjustment of linkage system

NOTE *Other factors may effect the performance characteristics of the vehicle but they should be investigated only after confirming the linkage adjustment.*

GENERAL CABLE ADJUSTMENT PROCEDURE

Properly adjusted, the cable should be short enough to be slightly loose but not too short to be pulling on the lever when at rest (Ref Fig. 2 on page N-2).

To permit proper cable adjustment, the cable length may be increased/decreased at its mounting bracket. This is accomplished by moving the cable housing forward/backward at the bracket attachment to increase/decrease the amount of available cable.

To decrease amount of available cable, loosen the nuts on either side of the bracket and move the cable away from the lever. Once correct length is achieved, tighten the nuts.

To increase amount of available cable, loosen the nuts on either side of the bracket and allow the cable to move closer to the lever. Once correct length is achieved, tighten the nuts.

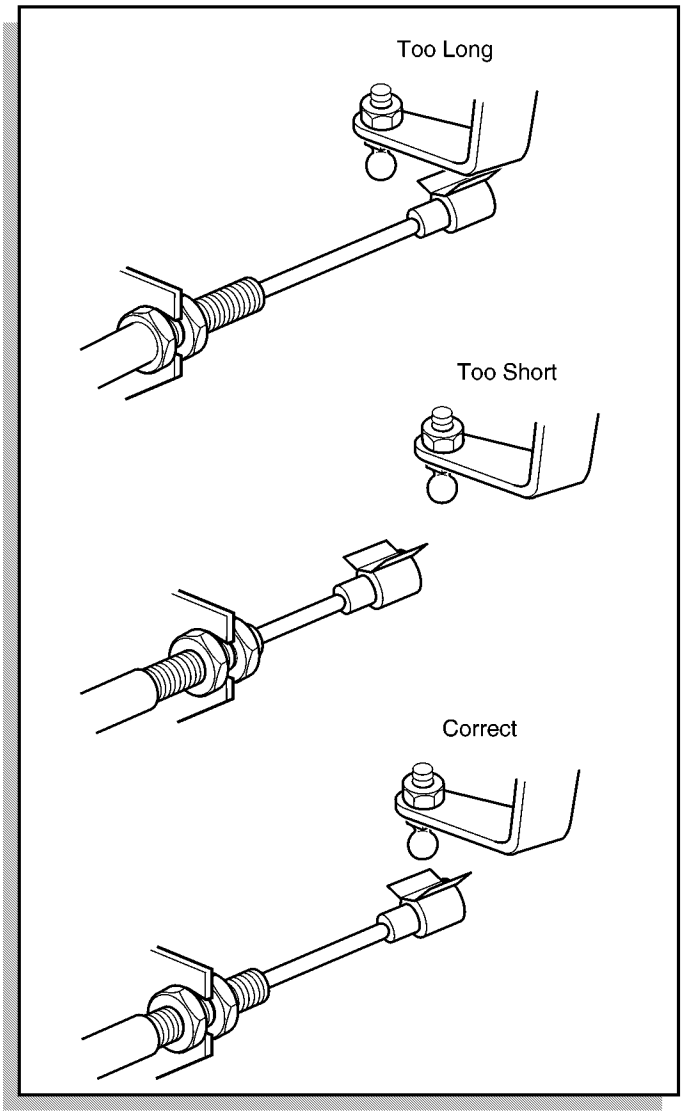

Fig. 2 Cable Adjustment

ACCELERATOR/GOVERNOR CABLE ADJUSTMENT

Tool List	**Qty. Required**
Insulated wrench, 1/2"	2

⚠ WARNING ⚠ ***Remove the negative (-) battery cables at the battery to prevent the vehicle moving and the possible personal injury that may result. Refer to section 'B' of this manual for additional cautions and warnings.***

Loosen the adjustment nuts on the accelerator cable bracket. Tighten front adjustment nut till governor bellcrank begins to pivot. Back off adjustment nut 1 turn and tighten rear adjustment nut. As a final check, with the gas pedal up, the accelerator cable must be slightly loose between the accelerator cable bracket and the governor spring assembly.

CAUTION **The function of the carburetor and governor system may be impaired if no movement is evident.**

If, after adjusting accelerator cable, the vehicle backfires (indicating carburetor is not closing fully) or shows a lack of performance (indicating carburetor is not opening fully), an adjustment to the governor cable is required.

Loosen the adjustment nuts on each end of the governor cable. With governor bellcrank at rest, tighten the outside upper adjustment nut till the throttle lever begins to lift off the carburetor throttle stop. Back off adjustment nut 1 1/2 turns and tighten the inside upper adjustment nut. Tighten the nuts at the lower end of cable. Pull cable to check that throttle lever has full travel (i.e. contacts throttle stop in both full open and full closed throttle plate position).

Check choke function and adjust choke cable if required. See 'Choke Cable Installation and Adjustment' in the FUEL SYSTEM section.

If, after performing the cable adjustments, the vehicle performance is still not satisfactory, proceed to the pedal box and accelerator pedal area for adjustments.

PEDAL BOX ADJUSTMENTS

Tool List	Qty. Required
Wrench, 1/2"	1
Phillips screwdriver	1
Wrench, 7/16"	1
Wrench, 3/8"	1
Socket, 1/8" hex bit, 3/8" drive	1
Ratchet, 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1
Crowfoot wrench, 1/2", 3/8" drive	1
White lithium grease	AR
Socket, 3/8", 3/8" drive	1
Socket, 9/16", 3/8" drive	1

NOTE *If any adjustments are made in the pedal box or accelerator area, it is necessary to go back and perform the accelerator/governor cable adjustment again. This **must** be done because any adjustment made in the pedal box or accelerator area will effect the cable adjustment.*

Accelerator Pedal Arm Adjustment

Lift vehicle using procedures and safety information in section 'B'.

Confirm the accelerator pedal arm (1) contacts the accelerator pedal bracket (2) when in the released position (Ref Fig. 4 on page N-4). If there is no contact, loosen jam nut (3) and rotate the rod (4) until contact is made.

NOTE *Note that the factory applies a thread sealant to the accelerator rod threads before threading the rod into the clevis.*

Tighten the jam nut (3) firmly.

Micro Switch Adjustment

When system is correctly adjusted, the micro switch (5) in the accelerator pedal box (6) will click when the **top** of the accelerator pedal moves approximately 1/2" - 5/8" (13 - 16 mm). The accelerator cable (7) (as seen at the rear axle) should have some slack present and not show any movement until after the micro switch clicks.

To access micro switch, loosen rocker panel, lift floor mat and remove access cover (Ref Fig. 3 on page N-3).

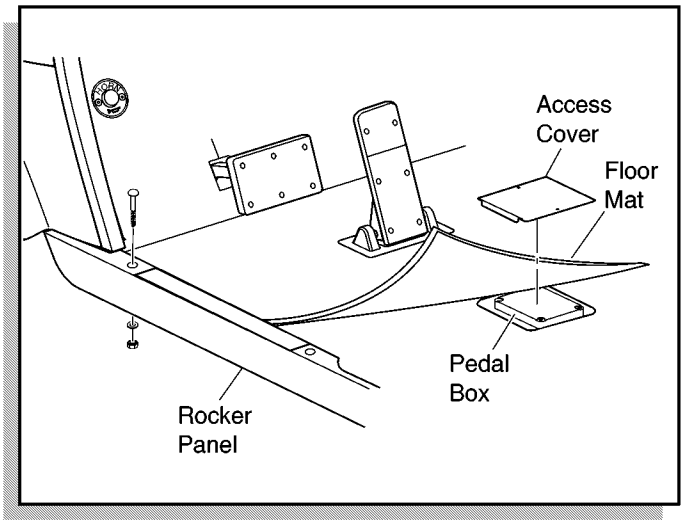

Fig. 3 Access to Pedal Box

The micro switch can be accessed by removing the screws (8) securing the cover (9) on the pedal box (Ref Fig. 4 on page N-4). Loosen the setscrew (10) and rotate the cam (11) to adjust it. Adjust to permit 1/2" - 5/8" (13 - 16 mm) of travel at **top** of accelerator pedal before the micro switch clicks. Make sure the setscrew in the cam does not contact the micro switch actuator and tighten setscrew to 45 - 55 in. lbs. (5 - 6 Nm) torque.

Control Arm Link

Be sure that the control arm link (12) is parallel with the bottom of the pedal box and tighten nuts (13) to 120 - 132 in. lbs. (14 - 15 Nm) torque (Ref Fig. 4 on page N-4). Apply a thin coating of white lithium grease to the slot in the control arm link.

If control arm (14) has been removed from control arm link (12), tighten nut (15) to 25 - 43 in. lbs. (3 - 5 Nm) torque and be sure that arm rotates smoothly on its shaft.

If shaft (16) has been removed from pedal box, tighten nut (17) to 120 - 144 in. lbs. (14 - 16 Nm) torque.

Be sure accelerator pedal moves smoothly and accelerator cable (7) pulls smoothly on governor arm (18) (Ref Fig. 4 on page N-4).

Replace the cover on the pedal box. Tap lightly to set the cover before installing screws. Replace the access cover on the floor. Replace floormat and rocker panel.

Check wide open throttle adjustment. See 'ACCELERATOR/GOVERNOR CABLE ADJUSTMENT' on page N-2.

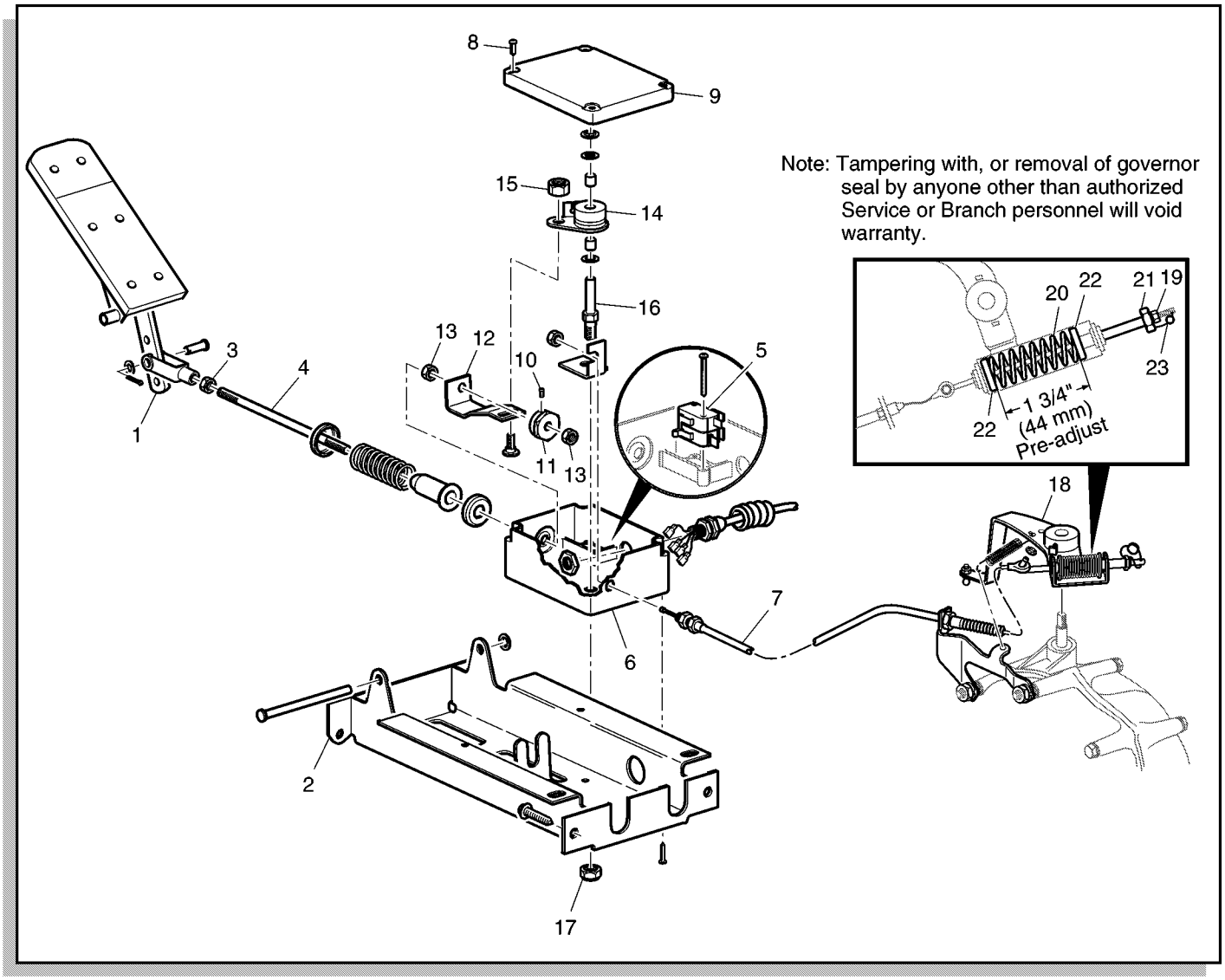

Fig. 4 Accelerator Linkage

GOVERNOR COMPRESSION SPRING ADJUSTMENT

Tool List	Qty. Required
Wire cutter	1
Pliers	1
Wrench, 3/8"	1
Wrench, 9/16"	1

⚠ WARNING ⚠ ***Tampering with or adjusting the speed control system to go beyond factory specified speed will void the warranty, is dangerous, could cause a loss of vehicle control and possible injury or death.***

CAUTION **If the governor requires service, the service must be performed by an authorized service branch or distributor who will reseal the governor after calibration.**

Hold the governor compression spring adjuster rod when turning the governor adjuster (21). Failure to hold the rod will cause the accelerator cable to twist which may cause premature failure.

Cut and remove safety seal (23). Hold governor adjuster (21) and loosen the jam nut (19) (Ref Fig. 4 on page N-4).

Pre-adjust governor compression spring (20) by holding governor rod and rotating governor adjuster until a dimension of 1 3/4" (44 mm) is achieved between the inside of the cup washers (22). This dimension is a starting point and may be further adjusted after a road test.

Tighten the jam nut (19) and perform road test. See 'Road Test' on page N-5.

Road Test

Install the negative (-) battery cable.

Test drive the vehicle and confirm that the compression spring adjustment results in the maximum governed speed specified in the GENERAL SPECIFICATIONS section. Determine speed by measuring the time it takes to travel a known set distance with vehicle at maximum speed. Enter time and distance into this formula to calculate speed:

Rate (in MPH) = (Distance in feet ÷ 5280) ÷ (Time in seconds ÷ 3600)

or

Rate (in KPH) = (Distance in meters ÷ 1000) ÷ (Time in seconds ÷ 3600)

For example:

(300 ft. ÷ 5280) ÷ (13.6 sec. ÷ 3600) = 15 MPH

or

(100 m ÷ 1000) ÷ (15 sec. ÷ 3600) = 24 KPH

If the speed is not within the specified speed range, stop the vehicle and adjust the governor compression spring. Tightening the spring results in a speed increase while loosening it will result in a speed decrease. Repeat road test and adjustment procedure until the factory recommended governed speed is achieved

Install new safety seal on governor after calibrating the vehicle.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Notes:

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TROUBLESHOOTING

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

ENGINE

For engine troubleshooting, diagnostic and repair procedures, refer to Briggs & Stratton® Repair Manual (P/N 272144) for Vanguard™ V-Twin Overhead Valve Engine.

GASOLINE VEHICLE PERFORMANCE

Condition	Possible Cause	Correction
STARTER DOES NOT TURN	Weak or bad battery	Recharge or replace as necessary
	Terminals are loose or corroded	Clean and retighten
	Poor wiring connections	Repair or replace wire and/or connections
	Faulty Ignition Switch	Repair or replace wire and/or connections
	Blown fuse	Investigate cause and replace fuse
	Solenoid faulty	If no audible 'click' is heard, check power and ground. Replace solenoid if power and ground is good
	Accelerator micro switch	Check and adjust if no 'click' is heard. Replace if adjustment does not work
	Starter/generator terminals are loose or corroded	Tighten or clean
	Leads are broken or faulty ground	Check for breaks at bend or joint. Replace or repair leads
	Field coils are open	Repair or replace
	Armature coil is open	Repair or replace
STARTER TURNS SLOWLY	Terminals are loose or corroded	Retighten or clean
	Weak battery	Charge battery
	Leads are nearly broken or connections are faulty	Check for any defect of leads at bend or joint. Replace leads or repair connections
	Mechanical problem inside starter/generator	Check
	Internal engine damage	Inspect and repair
	Crankcase over filled with oil	Drain and fill to recommended level with approved oil

TROUBLESHOOTING

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Condition	Possible Cause	Correction
STARTER ROTATES BUT VEHICLE WILL NOT START OR HARD TO START	Weak Battery	Recharge or replace as necessary
	Corroded or loose battery connections	Clean and tighten battery connections. Apply a coat of battery protectorate to terminals
	Check for adequate fuel level	Fill with correct grade gasoline to 1" (2.5 cm) below bottom of filler neck
	No spark at spark plugs. Broken or disconnected spark plug wiring	Check and replace if required
	Spark plugs fouled	Clean or replace
	Incorrect spark plug gap/type	Set gap correctly
	Fuel pump faulty	Repair or replace
	Fuel line clogged or clamp loose	Clean or replace if required
	Cracked or broken fuel line	Replace with new hose
	Main jet blocked	Clean or replace jet
	Throttle lever motion restricted	Check all linkages and repair
	Dirt or water in fuel line or carburetor	Clean lines and carburetor. Replace filter
	Clogged fuel filter	Check and replace if required
	Engine flooded	Push choke in. Clean/or replace spark plugs
	Engine fuel starved	Use choke and push in as soon as engine runs smoothly
	Air intake tube is blocked	Repair or clean
	Clogged air filter	Wash or replace as required
	Plugged muffler or pipe	Repair or replace
POOR LOW SPEED PERFORMANCE	Plugged gas tank vent	Clean or repair
	Choke on	Push choke in
	Fuel pump faulty	Repair or replace
	Insufficient fuel level	Add fuel
	Spark plug fouled	Clean or replace
POOR MIDRANGE OR HIGH SPEED PERFORMANCE	Spark plug fouled	Clean or replace
	Dirty air filter	Clean or replace
	Brake(s) dragging	Perform brake maintenance
	Governor misadjusted	Adjust

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Condition	Possible Cause	Correction
ENGINE OVERHEATING	Foreign matter in cylinder fins and blower housing	Clean
	Damaged blower housing or fins	Repair or replace
	Damaged or plugged muffler	Repair or replace
	Inadequate oil supply	Check oil system, inspect oil pump, change oil, fill to correct level
REPEATED SPARK PLUG FOULING	Wrong spark plug type	Replace with correct spark plug
	Wrong spark plug gap	Check and adjust if required
	Faulty ignition system	Check and repair if required
	Poor quality gasoline	Use correct fuel, check bulk storage tank for proper storage and handling
	Air leak allowing dirt to enter system	Repair
	Choke sticking closed	Repair
	Wrong main jet for conditions (high altitude operations)	Replace with correct altitude jet for conditions
CARBURETOR FLOODS ENGINE	Inlet valve/seat dirty	Clean or replace
	Fuel contamination	Clean fuel system/carburetor
	Incorrect float level	Adjust
	Clogged air filter element	Clean or replace
EXCESSIVE SMOKING	Wrong oil weight	Replace with recommended oil
	Dirty oil	Change
	Crankcase overfilled with oil	Drain and fill to recommended level
	Piston rings worn or broken	Replace
	Valves worn	Replace
	Valve seals or valve guides worn	Replace

TROUBLESHOOTING

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Condition	Possible Cause	Correction
BACKFIRING	Accelerator limit switch out of adjustment	Adjust
	Loose muffler or leaking gasket	Repair
	Carburetor throttle lever motion restricted	Repair
	Carburetor throttle lever not closing fully	Adjust
	Throttle stop preventing throttle from closing fully	Adjust
	Carburetor throttle valve spring weak or broken	Replace
	Incorrect adjustment of accelerator, governor and carburetor linkages	Adjust
	Carburetor throttle lever shaft bent	Replace or rebuild carburetor
	Governor torsion spring weak or broken	Replace
	Faulty plug wires	Replace
	Faulty ignition system	Check and repair if required
ERRATIC, SURGING, OR SUDDEN CHANGE IN GOVERNED SPEED	Governor bracket spring dragging	Clean and/or oil
	Problem with adjustment of accelerator, governor and carburetor linkage	Adjust
	Bent governor arm	Repair or replace
	Bent governor shaft	Replace
	Governor failure within the rear axle	Repair

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

STARTER / GENERATOR

Condition	Possible Cause	Correction
STARTER IS NOISY	Bolts are loose	Tighten to correct torque
	Starter/generator has foreign matter inside	Clean starter/generator interior
	Bearings are faulty	Replace
	Bearings contain foreign matter	Replace
	Bearing needs grease	Replace
BATTERY HAS TO BE RECHARGED REGULARLY	Load (i.e. number of accessories operating at one time) exceeds generator output	Reduce load to meet generator output
	Armature bent	Repair or replace if necessary
	Brushes are worn beyond limits	Replace
	Commutator is excessively rough	Smooth with emery cloth
	Incorrect voltage output	Check and replace any components if required
	Commutator is dirty with oil or dust	Clean with a cleaner and dry cloth
GENERATOR DOES NOT CHARGE	Corroded or loose battery connections	Clean and tighten battery connections
	Incorrect voltage regulator output	Replace
	Poor voltage regulator ground connection	Repair
	Open or short circuit	Repair or replace
	Faulty starter/generator	Repair starter/generator
	Field coil is shorted or broken	Repair or replace

SUSPENSION AND STEERING

Condition	Possible Cause	Correction
UNEVEN TIRE WEAR	Incorrect tire pressure	Inflate to recommended pressure
	Improper alignment (Incorrect toe in)	Align front tires
STIFF STEERING	Water has entered steering box and may freeze in cold conditions	Remove steering column, pinion and bearing and remove water before adding grease; Inspect gasket for good seal
	Excessive grease in steering box has migrated into steering rack bellows	Raise the vehicle and observe the rack bellows while moving the steering from lock to lock Any distortion of the bellows may indicate that an excess of grease has built up in the bellows Remove the bellows and remove excess grease
	Insufficient lubricant in king pins, tie rod ends, idler bushing, rack tensioner or steering box	Add one shot of lubricant to each grease fitting and operate steering from lock to lock. **Do not overgrease** If steering does not return to acceptable condition proceed to next step
	Bent rack	Remove rack and place on flat surface with rack teeth up; If a .015" (.381 mm) feeler gauge will pass under the rack, the rack must be replaced
PLAY IN STEERING	Steering wheel loose	Inspect splines - replace steering wheel if required; Tighten steering wheel nut
	Steering components worn	Replace
	Loose wheel bearings	Adjust or replace
VIBRATION	Steering components worn	Replace
	Loose wheel bearings	Adjust or replace
	Out of round tires, wheels, or brake drums	Inspect and replace if out of round
STEERING PULLS TO ONE SIDE	Incorrect tire pressure	Inflate to recommended pressure
	Dragging wheel brakes	Service brake system
	Suspension component failure	Repair
	Alignment incorrect	Align

WEATHER PROTECTION

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WEATHER PROTECTION

Notes:

WEATHER PROTECTION

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

TOP AND WINDSHIELD

⚠ WARNING ⚠ ***The top does not provide protection from roll over or falling objects.***

The windshield does not provide protection from tree limbs or flying objects.

The top and windshield are designed for weather protection only.

Clean with lots of water and a clean cloth. Minor scratches may be removed using a commercial plastic polish or Plexus plastic cleaner available from the service parts department.

Trailering

⚠ WARNING ⚠ ***To prevent personal injury to occupants of other highway vehicles, be sure that the vehicle and contents are adequately secured to trailer.***

Do not ride on vehicle being trailered.

Remove windshield before trailering.

Maximum speed with top is 50 mph (80 kph).

If the vehicle is to be transported on a trailer at highway speeds, the windshield and top must be removed and the seat bottoms secured. Always check that the vehicle and contents are adequately secured before trailering the vehicle. The rated capacity of the trailer must exceed the weight of the vehicle (see GENERAL SPECIFICATIONS for vehicle weight) and load. Lock the parking brake and secure the vehicle to the trailer using ratchet tie downs.

SUN TOP

Rear Strut Installation

Tap end caps (item 7) into top of the rear support (items 1 and 2) with rubber mallet. See Detail D (Ref Fig. 1 on page Q-2).

At driver side, align holes in the rear support (item 1) with holes in seat back support bracket, making sure that the open end of support faces the opposite side of vehicle as shown.

Place washer (item 4) onto bolt (item 3) and insert bolt just through seat back support (2 - 3 threads). Place the white teflon washer (item 5) onto the bolt between the strut and seat back support.

Insert the bolt with the two washers in place through the rear strut. Secure hardware with washer (item 4) and lock nut (item 6). **Do not tighten hardware.** See Detail A.

Repeat steps 2 and 3 for the other hole.

Repeat procedure with rear strut (item 2) at opposite side of vehicle.

Front Strut Installation

Remove the two bolts (8) on each side and remove bumper. Retain bolts, lock washers (9), spacers (10) and washers (11) for later use but discard spacer tubes (12).

At the top hole, install the front strut (item 13) between bumper and cowl with previously removed bolt (8) and lock washer (9) on the outside of strut, and a spacer (item 10) and washer (item 11) between the cowl and strut. **Do not tighten hardware.** See Detail B.

At the lower hole, install previously removed bolt (8) and lock washer (9). **Do not tighten hardware.** See Detail B.

Sun Top Installation

Place sun top (item 14) onto struts.

Secure sun top loosely with screws (item 15 at front and item 16 at rear), plastic spacers (item 17), washers (item 18), and lock nuts (item 19). See Details C and D for installation sequence.

Tighten all sun top hardware to 36 - 60 in. lbs. (4 - 7 Nm) torque.

Tighten all rear strut hardware to 13 - 15 ft. lbs. (18 - 20 Nm) torque.

Tighten all front strut hardware to 17 - 19 ft. lbs. (23 - 26 Nm) torque.

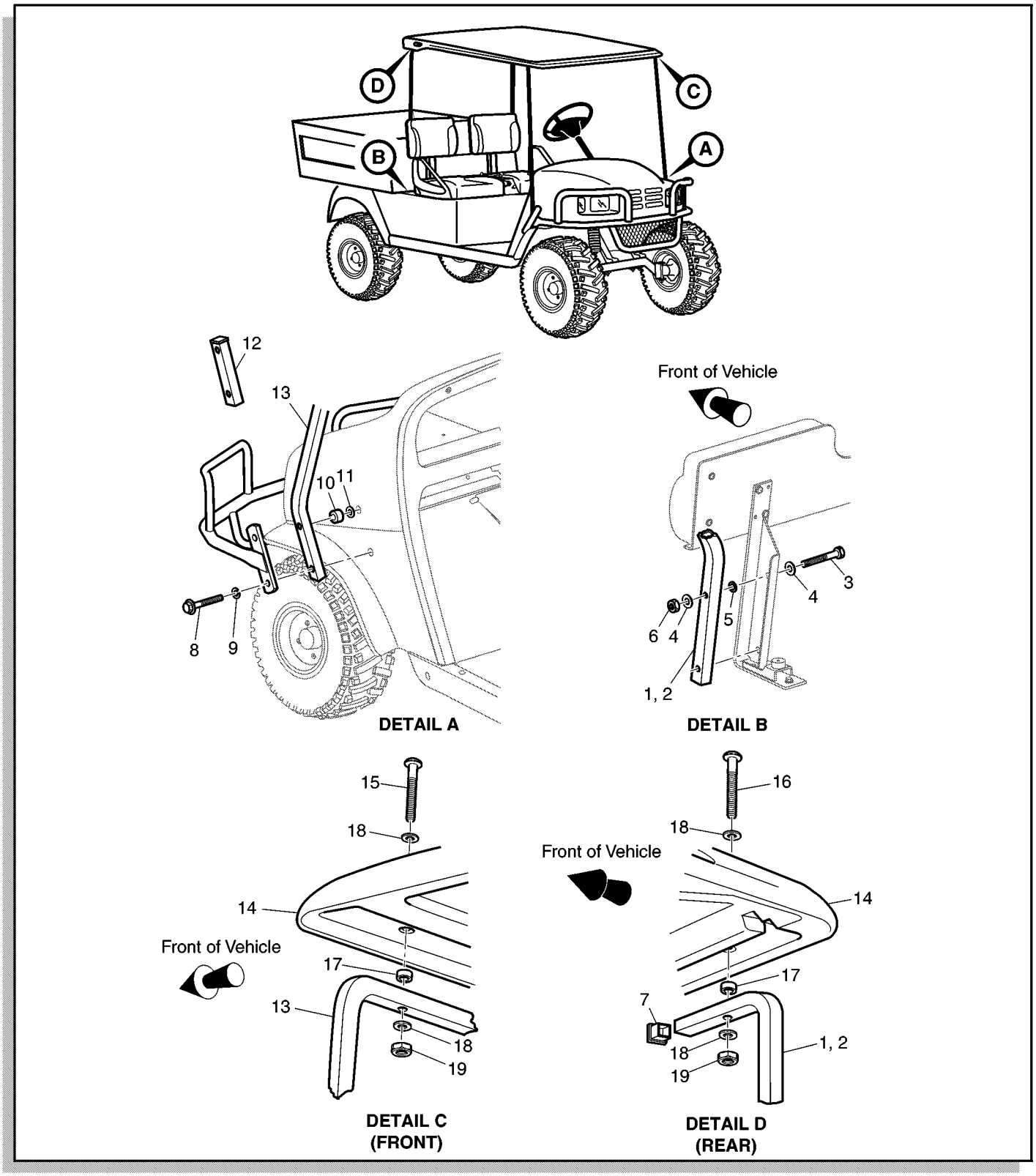
D
C
B
A
12
13
10
11
8
9
DETAIL A
Front of Vehicle
3
4
5
6
4
1, 2
DETAIL B
15
18
14
Front of Vehicle
17
13
18
19
DETAIL C
(FRONT)
16
18
Front of Vehicle
14
17
7
18
19
1, 2
DETAIL D
(REAR)

Fig. 1 Sun Top

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

FOLD DOWN WINDSHIELD

Remove protective covering from the windshield (item 1) (Ref Fig. 2 on page Q-3).

Install sash (item 2) on each side of the lower section of windshield. Using a rubber mallet, gently tap sash to insure windshield seats properly. See Detail A.

Insert bolt (item 3) through washer (item 4), rubber grommet (item 5) and existing hole in front strut. Secure with washer (item 4) and lock nut (item 6). See Detail B. **Do not over-tighten or squeeze grommet**.

Place bottom section of windshield on rubber grommets and press the sash, starting at the bottom, onto the front strut so that it snaps into place. See Details B and C. Repeat for opposite side of windshield.

Position top grips (item 7) at top hole on each side of front strut. See Detail D. Secure with top grip fasteners (item 8).

Swing the top section of windshield up and secure by hooking the top grip on each side of strut around the windshield.

To secure windshield when lowered, press edge of windshield firmly into windshield retainers. See Detail B.

CAUTION **Take care not to warp windshield when raising and lowering the top section of windshield.**

Apply safety label (9) centered at bottom of windshield.

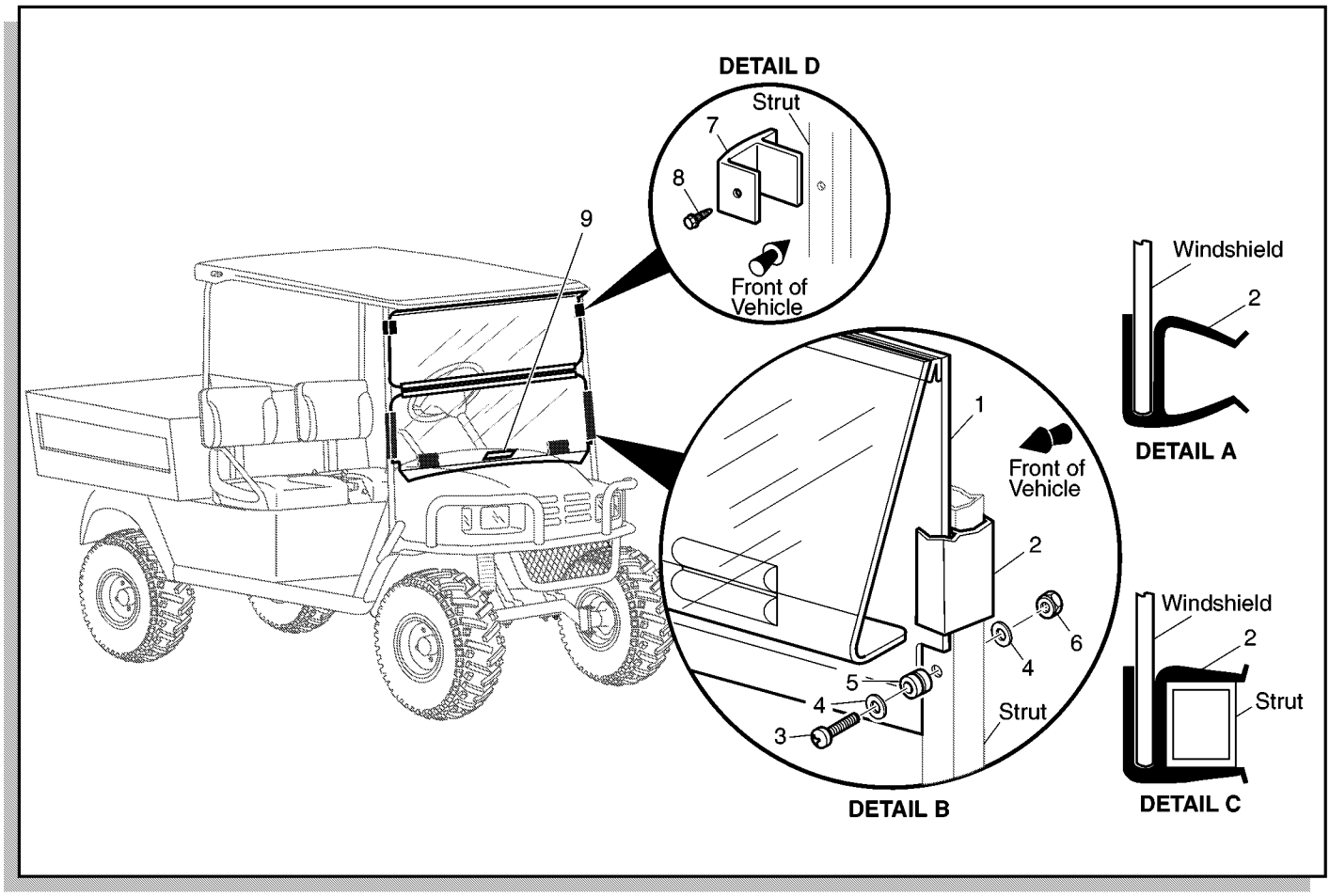

Fig. 2 Fold Down Windshield

ONE-PIECE WINDSHIELD

Remove protective covering from the windshield (item 1) (Ref Fig. 3 on page Q-4).

Install sash (item 2) on each side of the windshield. Using a rubber mallet, gently tap sash to ensure windshield seats properly. See Detail A.

Insert screw (item 3) through washer (item 4), rubber grommet (item 5) and existing hole in front strut. Secure with washer (item 4) and lock nut (item 6). See Detail B. **Do not over-tighten or squeeze grommet.**

Place bottom section of windshield on rubber grommets and press the sash, starting at the bottom, onto the front strut so that it snaps into place. See Details B and C. Repeat for opposite side of windshield.

Apply safety label (7) centered at bottom of windshield.

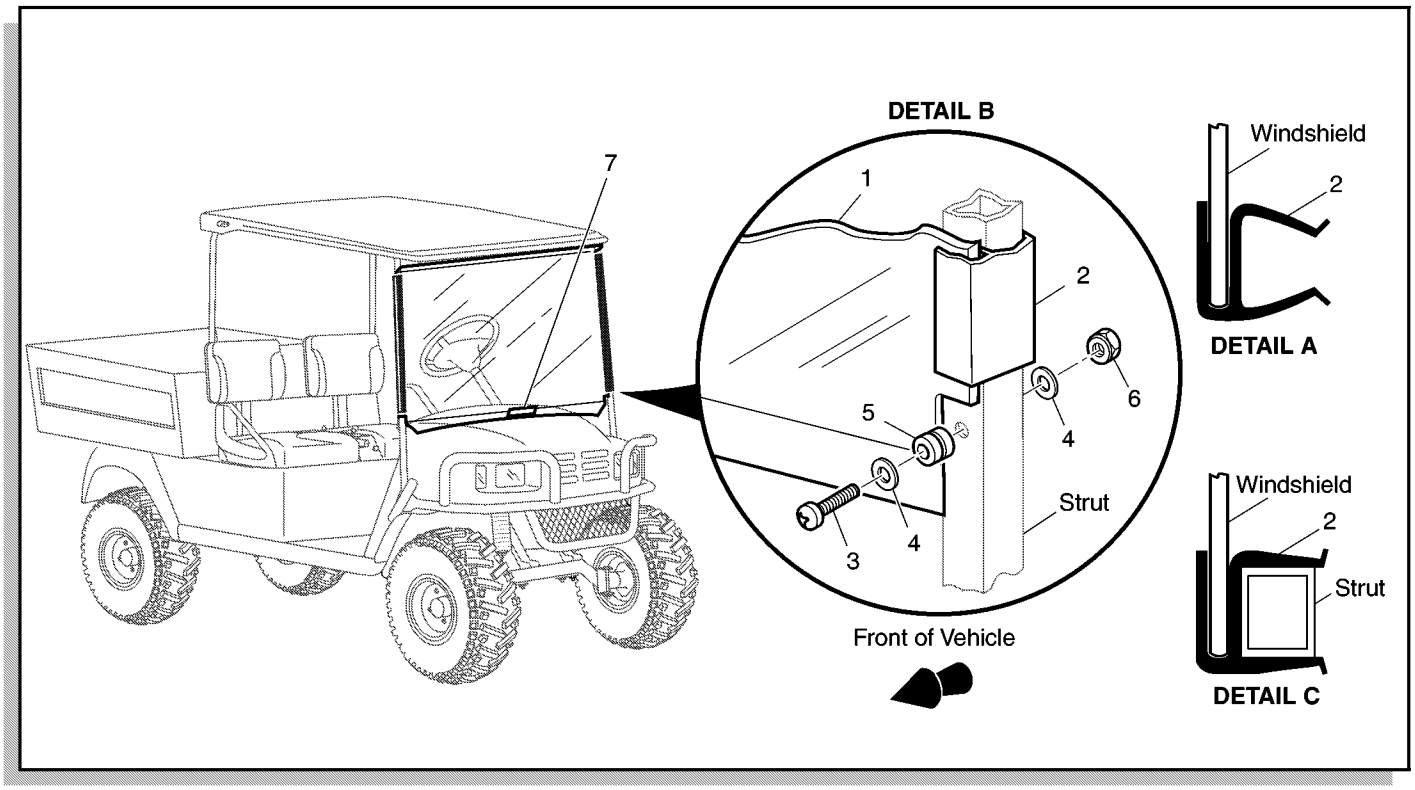

Fig. 3 One-Piece Windshield

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WHEELS AND TIRES

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

WHEEL AND TIRE SERVICE

NOTE *Standard tires for this vehicle are uni-directional and should never be moved from one side of vehicle to the other. Left side tires should always remain on the left side of the vehicle. Right side tires should always remain on the right side of the vehicle. Uni-directional tires have an arrow on the sidewall indicating direction of rotation when moving forward.*

Tools List	Qty. Required
Lug wrench, 3/4"	1
Impact wrench, 1/2" drive	1
Impact socket, 3/4", 1/2" drive	1
Torque wrench, 1/2" drive, ft. lbs.	1

⚠ WARNING ⚠ ***To prevent injury caused by a broken socket, use only sockets designed for impact wrench use. Never use a conventional socket.***

This vehicle comes standard with uni-directional tires. Tire condition should be inspected and inflation pressures checked per the Periodic Service Schedule when the tires are cool. Be sure to install the valve dust cap after checking or inflating. When removing wheels with an impact wrench, use only impact sockets. Regular sockets are not designed for impact pressures exerted by power tools.

⚠ WARNING ⚠ ***A tire explosion can cause severe injury or death. Never exceed inflation pressure rating on tire sidewall.***

To prevent tire explosion, pressurize tire with small amount of air applied intermittently to seat beads. Never exceed the tire manufacturer's recommendation when seating a bead. Protect face and eyes from escaping air when removing valve core.

Use caution when inflating tires. Due to the low volume of these small tires, overinflation can occur in a matter of seconds. Overinflation could cause the tire to separate from the wheel or cause the tire to explode, either of which could cause personal injury.

Tire inflation will depend on the type of tires fitted but under no condition should inflation pressure be higher than recommended on the tire sidewall. Standard and optional tires should be inflated to pressure designated in GENERAL SPECIFICATIONS section. If pressure is not designated in GENERAL SPECIFICATIONS, inflate to pressure designated on tire sidewall. **All four tires** should have the same pressure for optimum handling characteristics. **Do not** overinflate. Due to the low volume of these small tires, overinflation can occur in a matter of seconds. Be sure to install the valve dust cap after checking or inflating.

Tire Repair

The vehicle is fitted with low pressure tubeless tires mounted on one piece rims.

Generally, the most cost effective way to repair a flat tire resulting from a puncture in the tread portion of the tire is to use a commercial tire plug.

NOTE *Tire plug tools and plugs are available at most automotive parts outlets and have the advantage of not requiring the tire be removed from the wheel.*

If the tire is flat, raise vehicle and remove wheel. Refer to 'Lifting the Vehicle' in Section B for proper lifting procedure and safety information. Inflate tire to maximum recommended pressure. Immerse tire in water to locate the leak and mark with chalk. Insert tire plug in accordance with manufacturer's specifications.

If the tire is to be removed or mounted, the tire changing machine manufacturer's recommendations must be followed in order to minimize the possibility of personal injury. Be sure to position tire on wheel correctly. Arrow on tire indicates rotation when moving forward.

⚠ WARNING ⚠ ***To prevent injury, be sure mounting/demounting machine is anchored to floor. Wear OSHA approved safety equipment when mounting/demounting tires.***

Follow all instructions and safety warnings provided by the mounting/demounting machine manufacturer.

Wheel Installation

CAUTION **Do not tighten lug nuts to more than 85 ft. lbs. (115 Nm) torque.**

NOTE *It is important to follow the 'cross sequence' pattern when installing lug nuts. This will assure even seating of the wheel against the hub.*

With the valve stem to the outside, mount the wheel onto the hub with lug nuts. Be sure to position the wheel on hub correctly with arrow indicating direction of rotation when moving forward. Finger tighten lug nuts in a 'cross sequence' pattern (Ref Fig. 1 on page R-2). Then, tighten lug nuts to 50 - 85 ft. lbs. (70 - 115 Nm) torque in 20 ft. lbs. (30 Nm) increments following the same 'cross sequence' pattern.

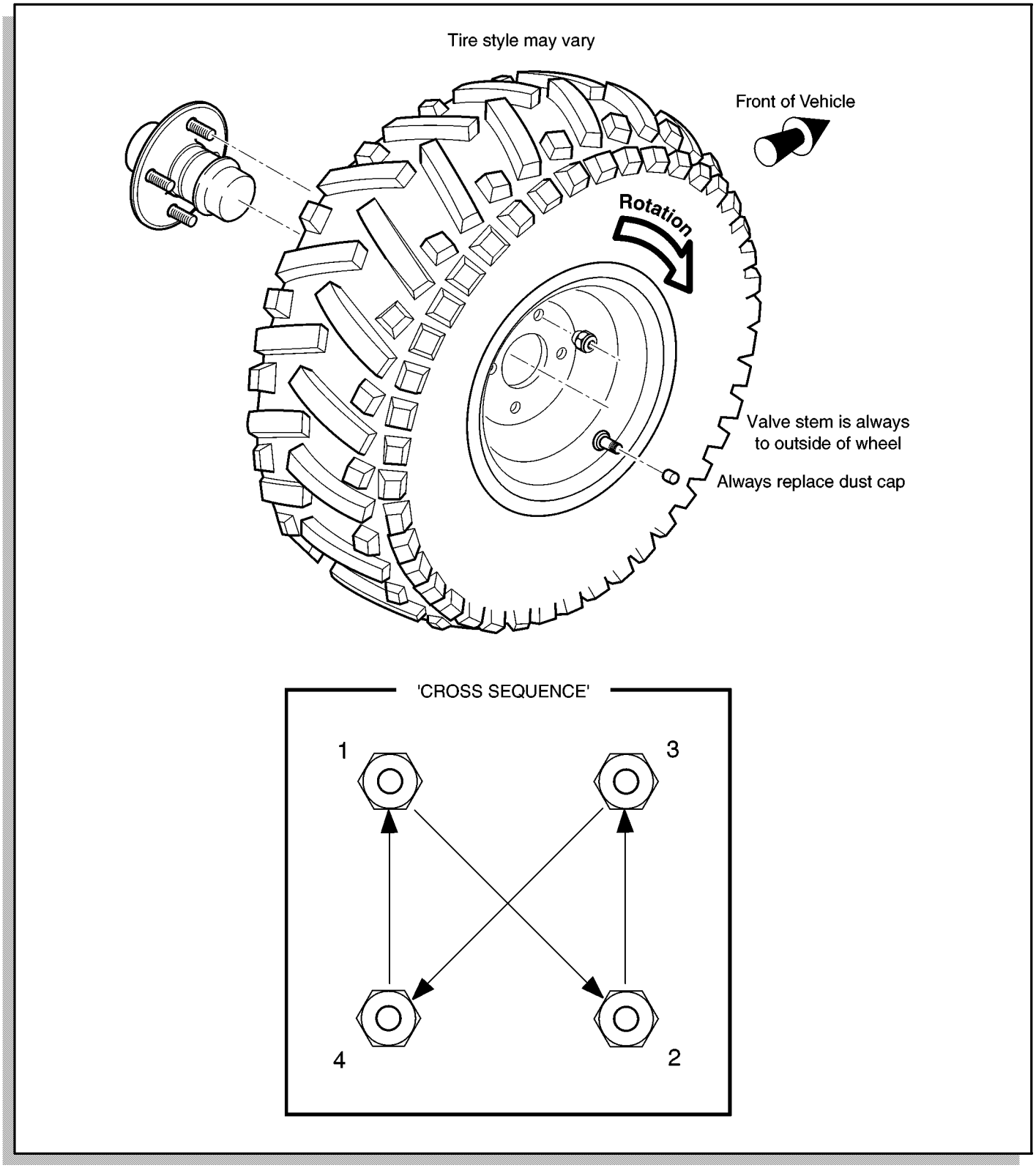

Fig. 1 Wheels and Tires

GENERAL SPECIFICATIONS

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GENERAL SPECIFICATIONS

Gasoline Powered WorkHorse® ST 480 Utility Truck

STANDARD EQUIPMENT:

BATTERY	One 12 Volt Maintenance Free (515 CCA, 82 Minute Reserve)
ENGINE	16 H.P. (11.9 kW) 29.2 ci (480 cc) Twin Cylinder, Overhead Valve Pressurized Lubrication with Spin Off Filter Magnetron™ Ignition with Transistor Module Replaceable Dry Cartridge Air Filter with Pre-Filter & Remote Intake Fixed Jet Bowl Carburetor, Pulse Fuel Pump
TRANSAXLE	13.32:1 Helical geared with Differential Lock and Ground Speed Governor
TRANSMISSION	Automatic Continuously Variable Transmission (CVT)
FUEL TANK	6 Gallon (23 Liters) Tank. 36 lbs. (16 kg) Fuel Weight
BRAKES	Dual Rear Wheel, Self-Adjusting Hydraulic Drum Brakes
PARKING BRAKE	Hand Operated Mechanical Parking Brake
FRONT SUSPENSION	Leaf Springs with Hydraulic Shock Absorbers
REAR SUSPENSION	Leaf Springs with Hydraulic Shock Absorbers
STEERING	Single Reduction Rack & Pinion
STEERING WHEEL	Dual Handgrips
SEATING	Cushion Foam/Vinyl Cover Bucket Seats, Hip Restraint/Hand Hold
SEATING CAPACITY	Operator & 1 Passenger
TOTAL LOAD CAPACITY	800 lbs. (365 kg) Including Operator, Passenger, Accessories & Cargo 500 lbs. (230 kg) Maximum Bed Load
SPEED	16.5 mph (26.5 kph) Max
CHASSIS	Powder Coated (DuraShield™), Welded Tubular Steel
VEHICLE PROTECTION	Tubular Steel Front Bumper with Brush Guards
BODY	Flexible Impact Resistant DuraShield™ Injection Molded TPE (Thermoplastic Elastomer) with Base Coat/Clear Coat Front Cowl. DuraShield™ Powder Coated Steel Rear Body
STANDARD COLOR(S)	ST Series: Hunter Green; ST ADVANTAGE Series: RealTree® Advantage Camo Body and Load Bed
DASH PANEL	Scuff Resistant Glass Fiber Reinforced Plastic (Thermoplastic Olefin) with 4 Drink Holders
LOAD BED	48" (122 cm) W x 40" (102 cm) L x 12" (30 cm) D; 13.3 Cubic feet (.38 m^3); with Full Bed & Tailgate Liner & Electric Dump
LOAD BED FEATURES	Hinged Removable Tailgate, Removable Bed Sides
LIGHTING/HORN (Standard)	Dual Halogen Headlights, Horn
TIRES (Standard)	22 x 9 - 10 Stryker I® (Uni-directional)
TIRE PRESSURE	12 - 16 psi (85 - 110 kPa)
WEIGHT (Without Fuel)	1050 lbs (480 kg)
OPERATING CONTROLS & INSTRUMENTATION	Removable Key, 'Deadman' Accelerator Control, Direction Selector, Audible Reverse Warning, Analog Fuel Gauge, Low Oil Pressure Indicator and 12 Volt Power Outlet

OPTIONS/ACCESSORIES:

Ash Tray
Black Hubcaps
Brake Lights & Taillights
Glove Box Locking (Driver & Passenger Side)
Hour Meter
Paint Color (Custom)
Rear View Mirror (Requires Top)
Receiver, Front & Rear
Tires 21 x 9 - 10 Work Mate® (Uni-directional) @ 12 psi (85 kPa)
Tires 20 x 10 - 10 Turf Saver®
Tool Box
Top (Sun Canopy)
Trailer Hitch
Turn Signals
Weather Protection Enclosure
Winch, Electric
Windshield One-Piece (Top Required) Lexan
Windshield Fold Down (Top Required) Lexan

Specifications subject to change without notice

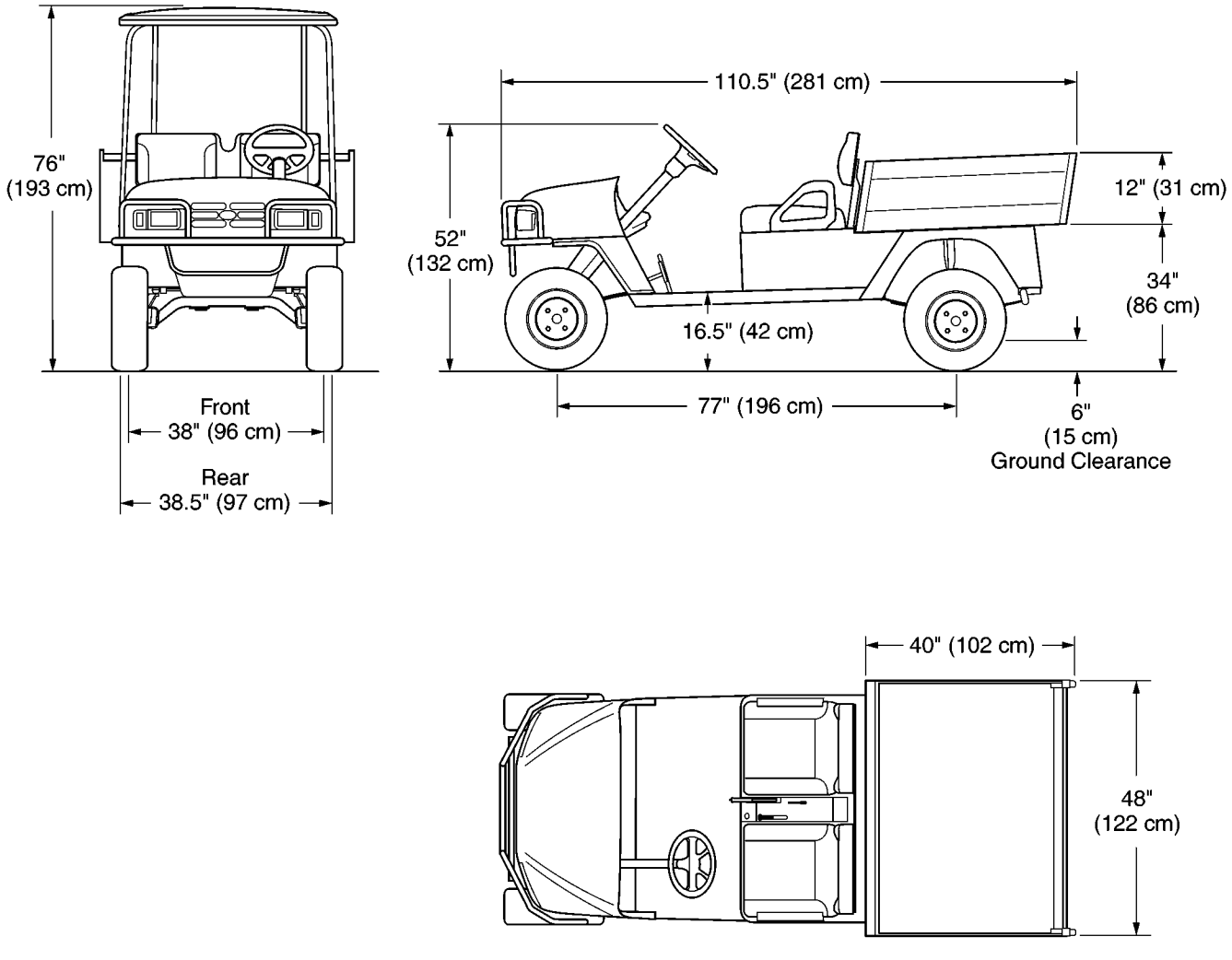
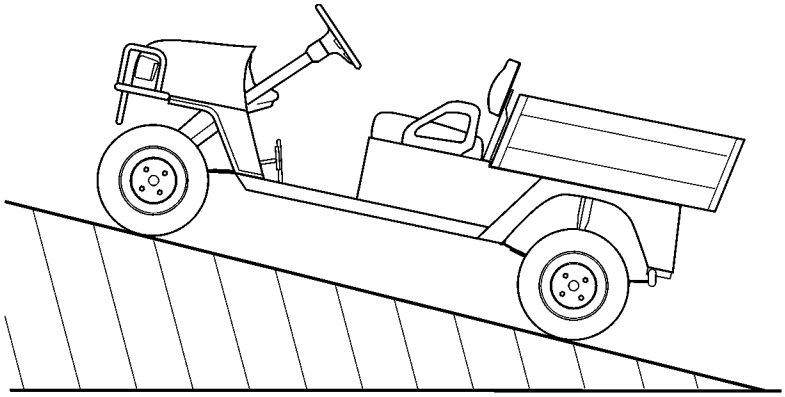
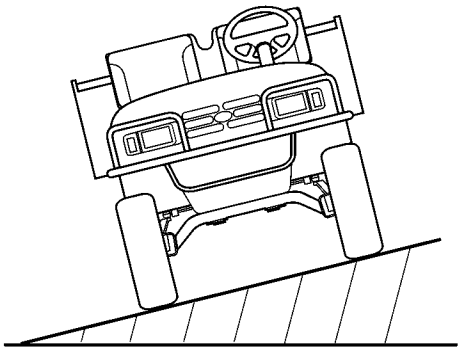


Fig. 1 Vehicle Dimensions



Recommended Ramp Grade
25% or 14˚ Max.



Recommended Side Tilt
25% or 14˚ Max.

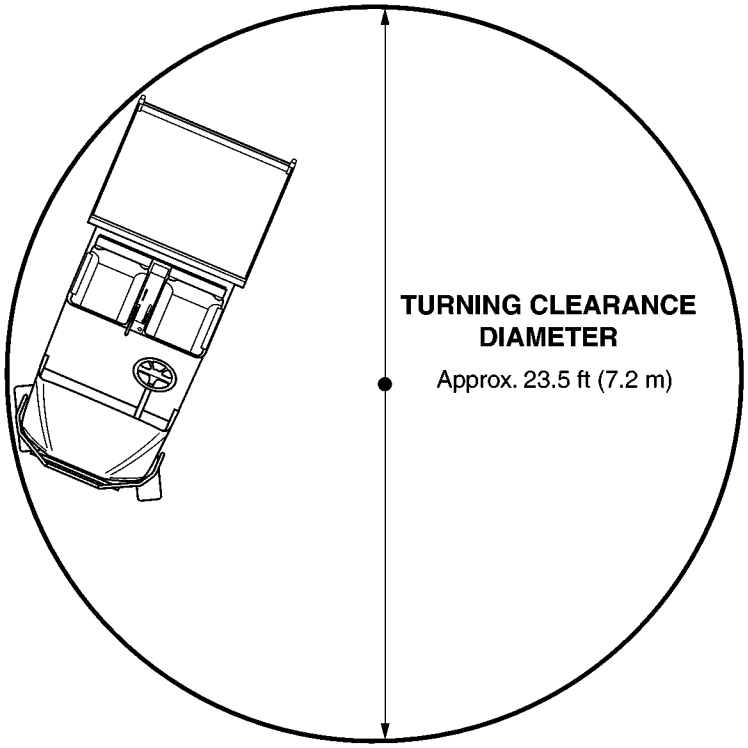


Fig. 2 Vehicle Incline Specifications and Turning Clearance Diameter

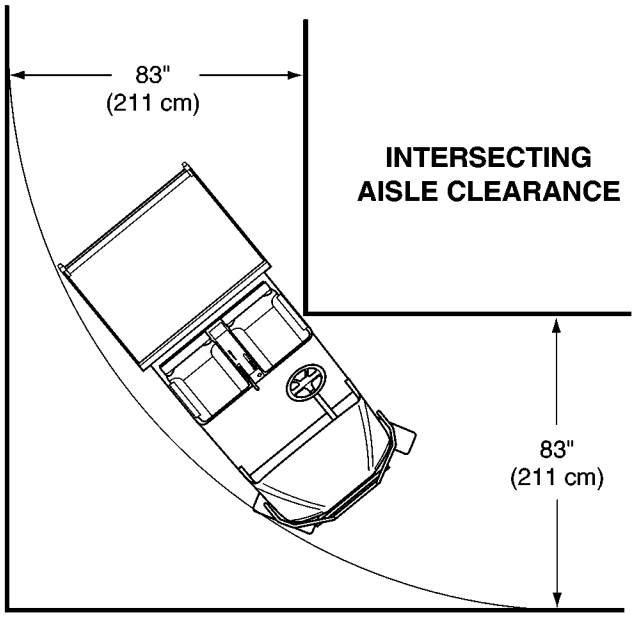


Fig. 3 Intersecting Aisle Clearance

LIMITED WARRANTY

T

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LIMITED WARRANTY

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LIMITED WARRANTY

EMISSION CONTROL SYSTEM WARRANTY STATEMENT

(Owner's Defect Warranty Rights and Oblications)

Refer to the Briggs & Stratton® Operating & Maintenance Instructions, provided with vehicle, for Emission Control System Warranty information.

ENGINE OWNER WARRANTY POLICY

Refer to the Briggs & Stratton® Operating & Maintenance Instructions, provided with vehicle, for Engine Warranty information.

LIMITED WARRANTY

Notes:

NOTE *Read and understand the following warnings before attempting to operate the vehicle:*

⚠ WARNING ⚠ ***To prevent personal injury or death, observe the following:***

When vehicle is to be left unattended, engage parking brake, move direction selector to 'F' (forward) position, turn key to 'OFF' position and remove key.

Drive vehicle only as fast as terrain and safety considerations allow. Consider the terrain and traffic conditions. Consider environmental factors which effect the terrain and the ability to control the vehicle.

Avoid driving fast down hill. Sudden stops or change of direction may result in a loss of control. Use service brake to control speed when traveling down an incline.

Use extra care and reduced speed when driving on poor surfaces, such as loose dirt, wet grass, gravel, etc.

All travel should be directly up or down hills.

Use extra care when driving the vehicle across an incline.

Stay in designated areas and avoid steep slopes. Use the parking brake whenever the vehicle is parked.

Keep feet, legs, hands and arms inside vehicle at all times.

Avoid extremely rough terrain.

Check area behind the vehicle before operating in reverse.

Make sure the direction selector is in correct position before attempting to start the vehicle.

Slow down before and during turns. All turns should be executed at reduced speed.

Always bring vehicle to a complete stop before shifting the direction selector.

See GENERAL SPECIFICATIONS for vehicle load and seating capacity.

NOTE *Read and understand the following text and warnings before attempting to service vehicle:*

In any product, components will eventually fail to perform properly as the result of normal use, age, wear or abuse.

It is virtually impossible to anticipate all possible component failures or the manner in which each component may fail.

Be aware that a vehicle requiring repair indicates that the vehicle is no longer functioning as designed and therefore should be considered potentially hazardous. Use extreme care when working on any vehicle. When diagnosing, removing or replacing any components that are not operating correctly, take time to consider the safety of yourself and others around you should the component move unexpectedly.

Some components are heavy, spring loaded, highly corrosive, explosive or may produce high amperage or reach high temperatures. Battery acid and hydrogen gas could result in serious bodily injury to the technician/mechanic and bystanders if not treated with the utmost caution. Be careful not to place hands, face, feet or body in a location that could expose them to injury should an unforeseen situation occur.

Always use the appropriate tools listed in the tool list and wear approved safety equipment.

⚠ WARNING ⚠ ***To prevent personal injury or death, observe the following:***

Before working on the vehicle, remove all jewelry (rings, watches, necklaces, etc.)

Be sure that no loose clothing or hair can contact moving parts.

Use care not to touch hot objects.

Raise rear of vehicle and support on jack stands before attempting to run or adjust powertrain.

Wear eye protection when working on or around vehicle. In particular, use care when working around batteries, using solvents or compressed air.

Hydrogen gas is formed when charging batteries. Do not charge batteries without adequate ventilation.

Do not permit open flame or anyone to smoke in an area that is being used for charging batteries. A concentration of 4% hydrogen gas or more is explosive.

Engine exhaust gas (carbon monoxide) is deadly. Carbon monoxide is an odorless, colorless gas that is formed as a natural part of incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal.

The following are symptoms of carbon monoxide inhalation:

Dizziness

Vomiting

Intense Headache

Muscular Twitching

Weakness and Sleepiness

Throbbing in Temples

If any of these symptoms are experienced, get fresh air immediately. Never work around or operate a vehicle in an environment that does not ventilate exhaust gases from the area.

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