

**Utility Vehicle**

**2200**

**2200S**

**2300**



**Bobcat®**

# **Service Manual**



**S/N A59Z11001 & ABOVE (2200 DIESEL)**

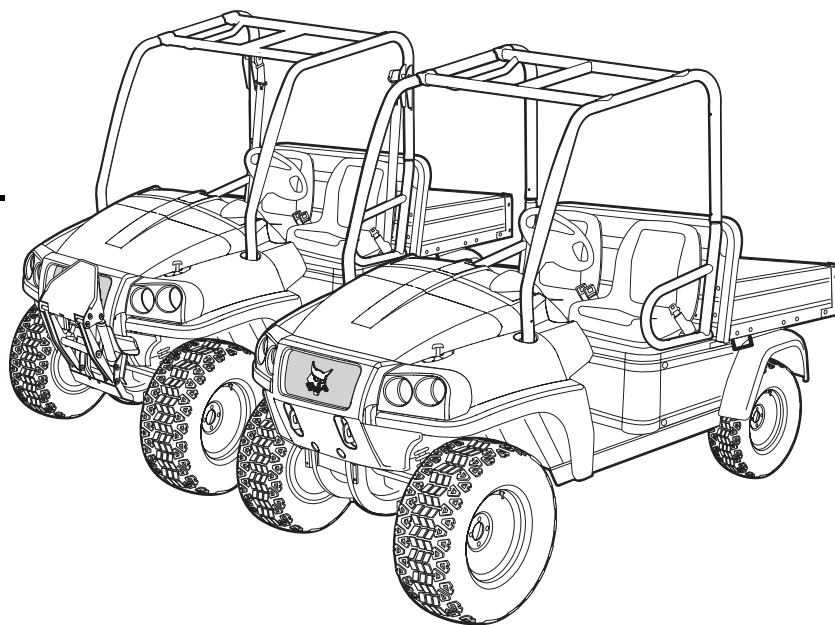
**S/N A5KR11001 & ABOVE (2200 DIESEL) HOM.**

**S/N A59Y11001 & ABOVE (2200 GASOLINE)**

**S/N A5A111001 & ABOVE (2200S DIESEL)**

**S/N A5A011001 & ABOVE (2200S GASOLINE)**

**S/N A59W11001 & ABOVE (2300 DIESEL)**



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## SECTION 12A – ELECTRICAL COMPONENTS: KAWASAKI POWERED GASOLINE VEHICLES

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Starter and Starter Solenoid .....	12a-1
Relays .....	12a-1
Neutral Switch .....	12a-2
Carburetor Solenoid .....	12a-2
Carburetor Heater .....	12a-3
Voltage Regulator .....	12a-4
Warning Lights .....	12a-5
Fuel Gauge/Hour Meter .....	12a-6
Key Switch .....	12a-7
12-Volt Accessory Receptacle .....	12a-8
Bed Lift Switch .....	12a-9
Bed Lift Circuit Breaker .....	12a-9
Light Switch .....	12a-10
Fuse .....	12a-10
Reverse Warning Buzzer (If Equipped) .....	12a-11
Reverse Warning Buzzer Limit Switch (If Equipped) .....	12a-12
Front Differential Switch .....	12a-13
Fuel Level Sending Unit .....	12a-14
Ignition Coil and Charge Coil .....	12a-15
Oil Pressure Sensor .....	12a-15
Headlights .....	12a-15
Wire Harness Diodes .....	12a-16
Battery .....	12a-17
General Information .....	12a-17

## SECTION 12B – ELECTRICAL COMPONENTS: HONDA POWERED GASOLINE VEHICLES

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Starter and Starter Solenoid .....	12b-1
Relays .....	12b-1
Neutral Switch .....	12b-2
Carburetor Solenoid .....	12b-2
Voltage Regulator .....	12b-3
Warning Lights .....	12b-4
Fuel Gauge/Hour Meter .....	12b-5
Key Switch .....	12b-6
12-Volt Accessory Receptacle .....	12b-7
Bed Lift Switch .....	12b-8
Bed Lift Circuit Breaker .....	12b-8

# SECTION 1 – SAFETY

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

## **DANGER**

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

## **WARNING**

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

## **CAUTION**

- A CAUTION with the safety alert symbol indicates a hazard or unsafe practice that could result in minor personal injury.

## **CAUTION**

- A CAUTION without the safety alert symbol indicates a potentially hazardous situation that could result in property damage.

## GENERAL WARNING

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

## **DANGER**

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

## 2200 HOMOLOGATED SPECIFICATIONS

SPECIFICATIONS	DIESEL	
<b>POWER SOURCE</b>		
<b>Engine:</b> Three-cylinder, liquid-cooled, with pressure lubrication system	•	
<b>Fuel system:</b> Mechanical injection, fuel water separator, fuel filters, and electric fuel pump	•	
<b>Governor:</b> internal to engine, mechanical, centrifugal ball	•	
<b>Ignition:</b> Compression	•	
<b>Transmission:</b> Forward and reverse with neutral (4.98:1 forward, 7.79:1 reverse)	•	
<b>Electrical system:</b> 12 volt, 500 cca at 0 °F (-17.8 °C), 650 at 32 °F (0 °C). 105-minute reserve capacity and 35-amp charging capacity	•	
<b>Torque converter:</b> Automatic, variable-speed, dry type	•	
<b>STEERING/SUSPENSION/BRAKES</b>		
<b>Steering:</b> Self-adjusting rack and pinion, Ackerman	•	
<b>Suspension:</b> <b>Front:</b> Independent double A-arms with coil-over shock absorbers <b>Rear:</b> Swing arms with coil-over shock absorbers	•	
<b>Brakes:</b> Hydraulic brake system – brake pads and discs on each wheel with separate foot-operated park brake	•	
<b>BODY/CHASSIS</b>		
<b>Frame/Chassis:</b> Box tube aluminum	•	
<b>Side and rear body:</b> All aluminum	•	
<b>Cargo bed:</b> Powder-coated steel or aluminum	•	
<b>Front body:</b> ABS/DR acrylic cap	•	
<b>Tires:</b> <b>All Terrain:</b> 25 x 10.5 – 12 front, and rear; tubeless, 4-ply rated load range <b>Mud:</b> 25 x 11.0 – 12 front and rear; tubeless, 4-ply rated load range	•	
<b>DIMENSIONS/CAPACITIES</b>		
<b>Overall length</b> (box bed configuration)	124.6 in. (317 cm)	
<b>Overall width</b> without mirror with mirror	58.9 in. (149.7 cm) 66.1 in. (167.8 cm)	
<b>Overall height</b> (with ROPS)	82.2 in. (208.9 cm))	
<b>Wheelbase</b>	81.7 in. (207.5 cm)	
<b>Ground clearance:</b> under differential	8.27 in. (21.0 cm)	
<b>Front wheel tread</b>	48.2 in. (122.5 cm)	
<b>Rear wheel tread</b>	48.2 in. (122.5 cm)	
<b>Forward speed</b>	25 mph (40 km/h)	
<b>Governed RPM</b>	3825	
<b>Maximum payload capacity</b> (level surface only)	<b>Standard option:</b> 706 lb. (320 kg)	<b>High capacity option:</b> 961 lb. (436 kg)
<b>Vehicle rated capacity</b> (payload, driver, and passenger; level surface only)	2756 lb. (1250 kg)	3016 lb (1368 kg)
<b>NOISE AND VIBRATION SPECIFICATIONS</b>		
<b>Drive-by noise level to operator</b>	84.4 dBA	
<b>Drive-by noise level to environment</b>	79.9 dBA	
<b>Specifications continued on next page...</b>		

## SECTION 4 – BODY AND TRIM

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### **⚠ DANGER**

- See General Warning, Section 1, Page 1-1.

### **⚠ WARNING**

- See General Warning, Section 1, Page 1-1.

## CLEANING THE VEHICLE

---

See General Warning, Section 1, Page 1-1.

### **CAUTION**

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

Each vehicle is equipped with a Gelay XTW front body, a polypropylene rear body, and an aluminum frame. The cargo beds are either powder-coated steel or aluminum.

The manufacturer does not recommend any type of pressure washing or steam cleaning. Such a process will expose electrical components to moisture. Moisture entering electrical components can result in water damage and subsequent component failure. Normal residential water pressure is adequate for exterior cleaning.

For regular front body cleaning, use automotive cleaning solutions with a sponge or soft cloth. The Gelay XTW body panel material is the same material used in various automotive applications. Automotive cleaning/polishing products are available at automotive specialty and hardware stores.

To remove oxidation or discoloration from aluminum, use a commercially available aluminum cleaner paste and fine grade (No. 00) steel wool. Battery acid, fertilizers, tars, asphalt, creosote, paint, or chewing gum should be removed immediately to prevent possible stains.

## SEAT CLEANING

Clean seats regularly using the following guidelines: **See following CAUTION.**

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

**NOTE:** *Dispose of waste water properly.*

**Difficult Stains** – Dampen a soft, white cloth with a solution of 10% household bleach (sodium hypochlorite) and 90% water. Rub gently to remove stain, then rinse with a water dampened cloth to remove bleach concentration.

**For More Difficult Stains** – Perform previous procedure using full-strength bleach, or allow bleach to puddle on affected area for approximately 30 minutes. Rinse with a water dampened cloth to remove any remaining bleach concentration. **See following CAUTION.**

4. Remove the safety belt buckle assembly.



Figure 4-2 Coiled Seat Belt Assembly

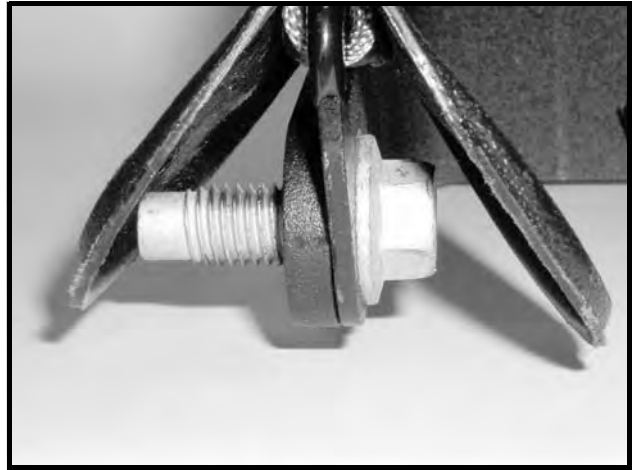


Figure 4-3 Center Seat Belt Fastener

## SAFETY BELT INSTALLATION

1. Install the center safety belt buckle assembly to the seat belt bracket with a new thread-forming bolt. Orient the assembly with the buckle end pointed up slightly, and tighten the hardware to 55 ft-lb (75 N·m).
2. Install the coiled safety belt assembly on the outside of the ROPS seat support with a new thread-forming bolt. Orient the assembly with the tang end pointed up slightly, and tighten the hardware to 55 ft-lb (75 N·m).

## CARGO BED – ELECTRIC LIFT

See General Warning, Section 1, Page 1-1.

### TESTING THE BED LIFT MOTOR

Gasoline Vehicles: See Test Procedure 29, Section 11a, Page 11a-39.

Diesel Vehicles: See Test Procedure 34, Section 11c, Page 11c-51.

### BED LIFT MOTOR REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in the NEUTRAL position. Remove the key. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-2.**
3. With the bed in the down position, working from under the vehicle, disconnect the two wires from the connectors at the electric bed lift motor.
4. Remove the locknut, bolt, sleeve, spacers and washers from the rod end of the bed lift motor and bed frame.
5. Remove the locknut, bolt, sleeve, spacers and washers from the base of the bed lift motor and vehicle frame and remove the bed lift motor.

3. Install the cable end on the pedal bracket stud and secure with washer and E-clip.
4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Adjust the brake cable equalizer. **See Park Brake Cable Adjustment on page 6-25.**



Figure 6-5 Rear Brake Pad and Caliper

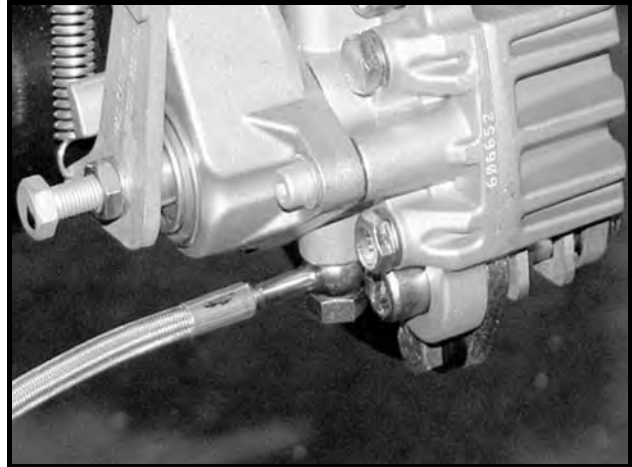


Figure 6-6 Rear Brake Line and Banjo Bolt

## REAR BRAKE PAD AND CALIPER INSTALLATION

### **⚠ WARNING**

- If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See **Bleeding the Hydraulic Brake System** on page 6-22.

### Rear Brake Caliper Installation

1. Secure the caliper body to the axle tube with two new lock-patch bolts tightened to 36 ft-lb (49 N·m).
2. Secure the brake line to the caliper with a new banjo bolt and new copper washers. Tighten the hardware to 13 ft-lb (18 N·m). **See following NOTE and CAUTION.**

**NOTE:** Position the brake line so it is perpendicular to the caliper assembly and pointing directly toward the base bracket on the shock absorber.

### **CAUTION**

- The banjo bolts are metric. Use only metric thread replacements.
3. Bleed the brake line at the bleed port on the caliper body. **See following NOTE.**

**NOTE:** Individual bleeding of the hydraulic ports at the caliper requires an assistant to press the brake pedal.

4. Repeat steps 1 through 3 for the opposite rear wheel if necessary.

### Rear Brake Pad Installation

1. Install the brake pads and install the socket-head slide-pin bolts through the top and bottom holes of the pads. Tighten the hardware to 32 ft-lb (43 N·m). **See following NOTE.**

**NOTE:** It may be necessary to loosen the park brake adjuster arm on the caliper.

2. Install the tire and wheel and finger-tighten the lug nuts.

**NOTE:** Place a plastic bag around the master cylinder to catch brake fluid before the brake line is removed. Wrap the bag around the master cylinder to prevent debris from entering the brake line port.

5. Remove the brake lines, banjo bolts and copper washers from each rear caliper assembly. **See following NOTE.**

**NOTE:** Place a pan under each rear caliper assembly to collect the brake fluid.

*Place a plastic bag around each caliper to prevent debris from entering the brake line ports. Do not allow brake fluid to contact the brake pads and disc.*

6. Remove each brake line from the grommet and clamp locations.
7. Remove the T-bracket from the passenger side on the rear receiver hitch frame.
8. Remove the brake line from the clamp locations under the vehicle frame and floorboard.
9. Remove the brake lines that are toward the rear of the vehicle on the passenger side. **See following NOTE.**

**NOTE:** Tie a heavy nylon string to the flare-nut end of the brake line before removal. Allow the string to travel with the brake line until it clears the rear of the vehicle. During replacement, tie the flare-nut end of the new brake line to the nylon string and use it to pull the new brake line into position and to the master cylinder.

## REAR BRAKE LINE INSTALLATION

1. Feed a new brake line from the rear of the vehicle and position it in line with the frame clamps and up to the master cylinder. **See following NOTE.**

**NOTE:** If a heavy nylon string was used to remove the previous rear brake line, tie the string to the flare-nut end of the new brake line. Use the string to pull the new brake line into position and to the master cylinder.

2. Carefully install the flared end of the brake line into the master cylinder and tighten to 11 in-lb (15 N·m).
3. Secure the brake lines to the clamp and grommet locations.
4. Secure the brake lines, banjo bolts, and new copper washers to each rear wheel caliper. Tighten the hardware to 13 ft-lb (18 N·m). **See following NOTE.**

**NOTE:** Position the brake line perpendicular to the caliper assembly and pointing directly toward the base bracket on the shock absorber. **See following CAUTION.**

## **CAUTION**

- The banjo bolts are metric. Use only metric thread replacements.
5. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6-22.**
  6. Perform all of the brake system inspections. **See Brake System Inspection on page 6-1.**

2. Insert the threaded adjustment rod through the equalizer bracket.
3. Secure the conical nut to the cable with the cone oriented toward the equalizer. Tighten the nut until the cable is drawn snugly through the equalizer bracket.
4. Thread the jam nut onto the threaded portion of the equalizer rod so that it is beyond the spring retaining hole.
5. Secure the extension spring to the end of the threaded end of the cable and the vehicle frame.
6. Adjust the brake cable equalizer. **See Park Brake Cable Adjustment on page 6-25.**

## RACK AND PINION ASSEMBLY

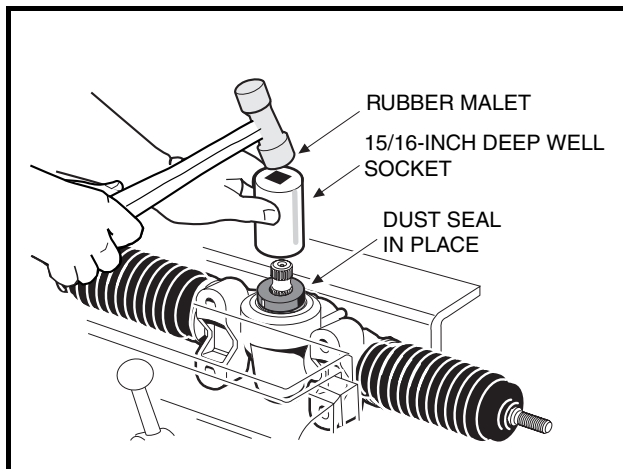
1. Apply a liberal amount of EP grease to the teeth of the rack (2), then slide the rack through the bushing (17) and housing (1) (**Figure 7-16, Page 7-8**).

### **CAUTION**

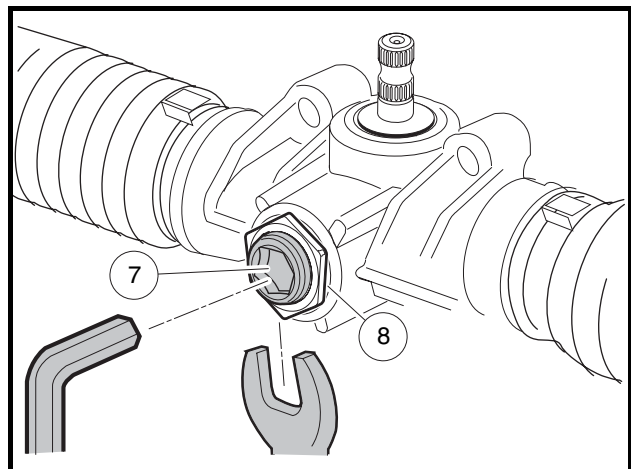
- In step 2, do not press against the outer race of the bearing.
2. If the pinion bearing (15) was removed, grease a new bearing before installation. Press the new bearing onto the pinion shaft, and exert all pressure on the inner race. Then install the C-type stop ring (16). **See preceding CAUTION.**
  3. Install the pinion (3) and bearing (15) assembly into the housing (1). Ensure the gear teeth in the rack (2) will mesh with the gear teeth on the pinion. It may be necessary to rotate the rack slightly and lightly tap the pinion-bearing assembly with a rubber mallet. **See following CAUTION.**

### **CAUTION**

- Do not force the pinion-bearing assembly into the housing. The gear teeth or the small bearing could be damaged.
4. Install the snap ring (4).
  5. Use a socket to apply pressure evenly, and press in a new dust seal (**Figure 7-17, Page 7-9**).



**Figure 7-17 Press In Dust Seal**



**Figure 7-18 Rack and Pinion Adjustment**

6. Apply a small amount of grease to the rack guide (5) where it contacts the rack (2) (**Figure 7-16, Page 7-8**).
7. Install the ball joints (9) onto the rack (2). Secure the rack in a vise with wood blocks between the rack and the jaws of the vise to protect the rack from damage, and tighten the ball joints to 60 ft-lb (81 N·m) (**Figure 7-20, Page 7-10**).
8. Tap a flange into the notch on the rack.
9. Place a few drops of Loctite 222 on the threads of the screw (7) (**Figure 7-18, Page 7-9**).



Figure 7-35 Front Shock Bottom Mount



Figure 7-36 Front Shock Top Mount

## FRONT COIL-OVER SHOCK ABSORBER INSTALLATION

The vehicles are equipped with coil-over shock absorbers. **See following NOTE.**

**NOTE:** When front shock absorbers are installed, ensure both front shock absorbers have identical part numbers.

1. Install the top of the shock mount on the vehicle frame with a bolt and flange-head locknut. Tighten the hardware to 62 ft-lb (84 N·m) (**Figure 7-36, Page 7-19**).
2. Install the bottom of the shock mount on the upper A-arm with a new flange-head bolt. Tighten the hardware to 62 ft-lb (84 N·m) (**Figure 7-35, Page 7-19**).
3. Remove the floor jack.
4. Install the front tire and wheel. Finger-tighten the lug nuts.
5. Raise the vehicle, and remove the jack stands.
6. Tighten the lug nuts to 87 ft-lb (118 N·m).
7. Repeat steps 1 through 6 for the remaining shock absorber.

## STEERING UPRIGHT INSTALLATION

1. Slide the upright and wheel hub assembly onto the splined half shaft spindle. **See following NOTE.**

**NOTE:** Apply a small amount of anti-seize compound to the splined front spindle before it is installed.

2. Loosely secure a large flat washer and new locknut to the spindle.
3. Install the lower ball joint onto the upright lower tab (**Figure 7-27, Page 7-14**).
4. Install a new locknut, and tighten the hardware to 18 ft-lb (24 N·m).
5. Install the upper ball joint on the upright upper tab (**Figure 7-28, Page 7-14**).
6. Install a new locknut, and tighten the hardware to 18 ft-lb (24 N·m).
7. Install the drag link ball joint on the tab (**Figure 7-26, Page 7-14**).
8. Secure the top end of the shock absorber to the frame with a new flanged bolt and a new locknut. Tighten the bolt to 73 ft-lb (99 N·m).
9. Secure the bottom end of the shock absorber to the A-arm with new flanged bolt. Tighten the hardware to 85 ft-lb (115 N·m).

# SECTION 10A – PERIODIC MAINTENANCE: HONDA GASOLINE & KUBOTA DIESEL VEHICLES

---

## **⚠ DANGER**

- See General Warning, Section 1, Page 1-1.

## **⚠ WARNING**

- See General Warning, Section 1, Page 1-1.

## PERIODIC SERVICE SCHEDULE

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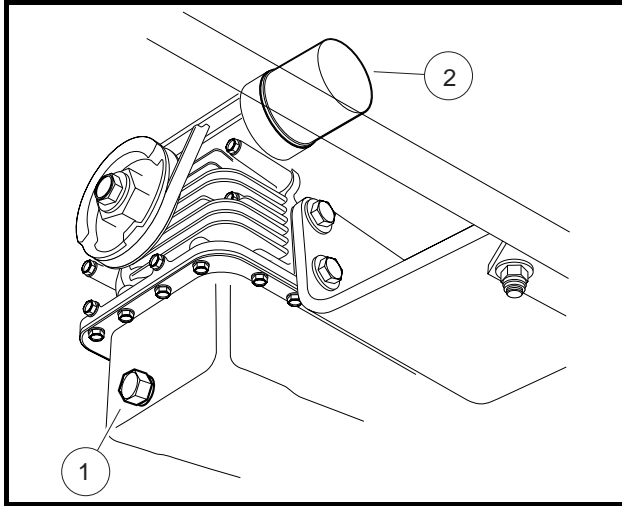
See General Warning, Section 1, Page 1-1.

## **⚠ WARNING**

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

**NOTE:** *If the vehicle is constantly subjected to heavy use or severe operating conditions, the preventive maintenance procedures should be performed more often than recommended in the Periodic Service and Lubrication Schedule.*

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



**Figure 10a-11 Engine Oil Drain Plug and Oil Filter – Diesel Vehicles**

## Engine Oil Filter Change

1. Drain the engine oil. **See Engine Oil Draining on page 10a-10.**
2. Place the oil drain pan under the engine oil filter (2) (**Figure 10a-10, Page 10a-10 or Figure 10a-11, Page 10a-11**).
3. Remove the engine oil filter. Turn it counterclockwise and drain the residual oil in the filter port and filter into the oil drain pan. **See following NOTE.**

**NOTE:** An oil drip guard (1) can be used to prevent excess oil from dripping onto the engine base plate. Use an empty quart (one liter) container and cut the bottom off at an angle, then slide the open area of the container up and under the oil filter (2) before removal. Position the port of the plastic container so oil will be directed into the oil pan (3) (**Figure 10a-12, Page 10a-12**). A drip guard can be made by folding a piece of cardboard, thin metal, or plastic under the oil filter, forming a channel to direct the filter port oil into the drain pan.

Dispose of used oil according to the environmental laws and regulations for your area.

# SECTION 10B – PERIODIC MAINTENANCE: KAWASAKI GASOLINE & KUBOTA DIESEL POWERED VEHICLES

---

## **⚠ DANGER**

- See General Warning, Section 1, Page 1-1.

## **⚠ WARNING**

- See General Warning, Section 1, Page 1-1.

## PERIODIC SERVICE SCHEDULE

---

See General Warning, Section 1, Page 1-1.

## **⚠ WARNING**

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

**NOTE:** *If the vehicle is constantly subjected to heavy use or severe operating conditions, the preventive maintenance procedures should be performed more often than recommended in the Periodic Service and Lubrication Schedule.*

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

5. To help seal the new oil filter to the oil port flange, apply a light coat of white lithium NLGI Number 2 grease (Dow Corning® BR2-Plus or equivalent) or new engine oil to the rubber seal around the outside surface of the filter before attaching it to the oil filter port (**Figure 10b-11, Page 10b-10**). Install the new oil filter (gas Kawasaki: CCI P/N 1016467, diesel: CCI P/N 102703301) onto the engine oil filter port. **See following NOTE.**

**NOTE:** Use only OEM oil filters designed for your engine.

6. Tighten the oil filter by hand 2/3 turn after gasket contact. Do not use a band wrench or channel lock pliers.

## Engine Oil Filling

1. Add engine oil; use a funnel or pour spout to direct the oil into the opening (**Figure 10b-12, Page 10b-10 or Figure 10b-13, Page 10b-10**). With filter change, the engine requires:
  - Kawasaki gasoline engines: 1 qt. and 19 oz. (1.5 L) of oil per change.
  - Kubota diesel engines: 3 qt. (2.8 L) of oil per change.
2. Refer to oil viscosity guidelines for selection of oil grade (**Figure 10b-14, Page 10b-12 or Figure 10b-15, Page 10b-12**). **See following CAUTION.**

### **CAUTION**

- **Do not exceed recommended oil capacity. Doing so will decrease engine performance or result in damage to the engine.**

3. Connect the battery cables, positive (+) cable first, and tighten terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. With the Forward/Reverse handle in the NEUTRAL position, start and run the engine for a few minutes. Observe both the drain plug and the oil filter from under the vehicle and watch for oil leaks. If a leak is detected, check the tightness of the oil filter and drain plug. Tighten, repair, and/or replace components as necessary. **See following NOTE.**

**NOTE:** Wait five minutes after turning off the engine before removing the dipstick.

5. Remove the dipstick and check the engine oil as a final step. Replace the dipstick.

## OIL VISCOSITY

Choose the viscosity according to the temperature as shown in the appropriate oil viscosity chart (**Figure 10b-14, Page 10b-12 or Figure 10b-15, Page 10b-12**). **See following NOTE.**

**NOTE:** Use engine oil with API classification SJ for gasoline engines and CF for diesel engines.

Using multi-grade oils (5W-20, 10W-30, and 10W-40) will increase oil consumption. If multi-grade oil is used, check the oil level more frequently.

<b>TROUBLESHOOTING GUIDE</b>		
<b>SYMPTOM</b>	<b>POSSIBLE CAUSES</b>	<b>REFER TO</b>
<b>Loss of engine power.</b>	Exhaust valve is restricted with carbon deposit	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
	Muffler or exhaust pipe restricted with carbon or other substance	Exhaust System on page 13a-6
	Ignition coil failure	Test Procedure 15 – Ignition Spark on page 11a-26
	Air filter is dirty or clogged	Air Filter Replacement on page 13a-25
	Governor is improperly adjusted	Fuel System on page 13a-9
	Throttle linkage out of adjustment	Engine Control Linkages on page 13a-20
	Low cylinder compression	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
	Spark plug failed	Spark Plugs on page 10b-12
	Restricted fuel flow	Fuel System on page 13a-9
	Clutches are not backshifting properly	Clutches on page 13a-29
<b>Spark plug fouls repeatedly.</b>	Incorrect plug	Spark Plugs on page 10b-12
	Unsuitable fuel, or incorrect (rich) fuel mixture	Fuel System on page 13a-9
	Spark plug wire is damaged	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
	Dirt entering combustion chamber	Fuel System on page 13a-9
	Ignition coil failed	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
	Rings are heavily worn, low cylinder pressure	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
<b>Carburetor floods.</b>	Inlet valve or seat is leaking, dirty, worn, or damaged	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
	Float is damaged and filled with gasoline	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
	Carburetor vent is clogged	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
	Float needle valve not functioning properly	<b>Section 20a – Kawasaki FH680D Gasoline Engine Manual</b>
<b>Starter fails to operate.</b>	Starter control circuit is not operating	Test Procedure 5 – Starter Control Circuit on page 11a-14
	Start relay failure	Test Procedure 6 – Start Relay on page 11a-15
	Fuse is blown	Test Procedure 2 – Fuse on page 11a-12
	Battery is dead	Test Procedure 1 – Battery on page 11a-9
	Charge coil failed	Test Procedure 13 – Charge Coil on page 11a-25
<b>Troubleshooting Guide continued on next page...</b>		

4. Check the negative (–) battery terminal, 6-gauge black wire (w202), and the two 12-gauge black wires (w112 and w132) for damage. Repair or replace as required.
5. Check the engine ground wire (w203), located on the remote oil filter bracket, for corrosion, loose connections, and/or damage (**Figure 11a-7, Page 11a-13**). Repair or replace as required.
6. Set the multimeter to 200 ohms.
7. Check for continuity between the 6-gauge wire (w202) terminal, disconnected from the negative (–) battery terminal, and the frame.
8. Check for continuity between the 6-gauge wire (w203) terminal, disconnected from the frame, and the engine.
9. The readings obtained in the previous steps should indicate continuity. If any of the readings are incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.



Figure 11a-6 Frame Ground



Figure 11a-7 Engine Ground to Frame

## TEST PROCEDURE 4 – KEY SWITCH (STARTER CIRCUIT)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. See **WARNING “To avoid unintentionally starting...”** in **General Warning, Section 1, Page 1-1**.
3. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
4. Remove the key switch. See **Key Switch Removal, Section 12a, Page 12a-7**.
5. Set the multimeter to 200 ohms.
6. Turn the key switch ON. Place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch. The reading should indicate continuity. If the reading does not indicate continuity, replace the key switch (**Figure 11a-8, Page 11a-14**). See **Key Switch Removal, Section 12a, Page 12a-7**.



Figure 11a-17 Neutral Switch Two-Pin Connector

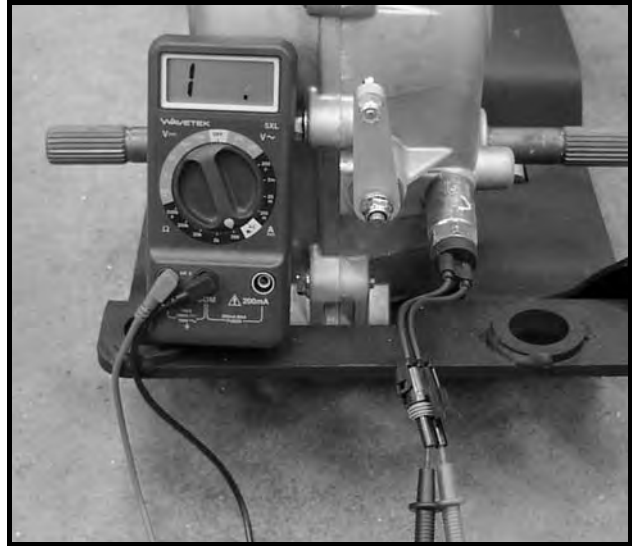


Figure 11a-18 Neutral Switch – Forward Position

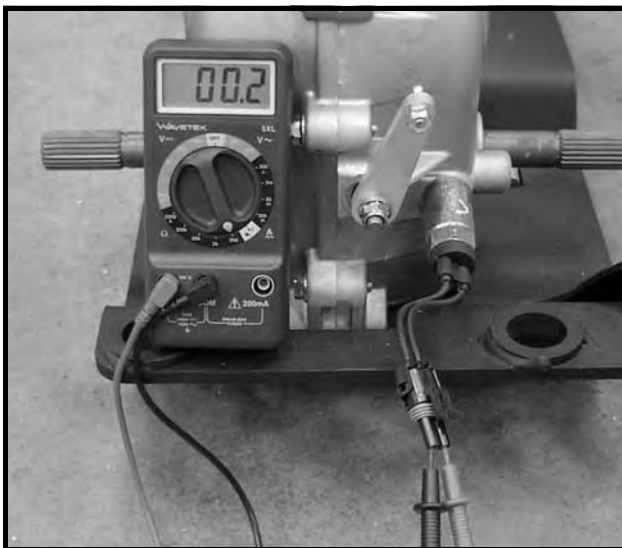


Figure 11a-19 Neutral Switch – Neutral Position

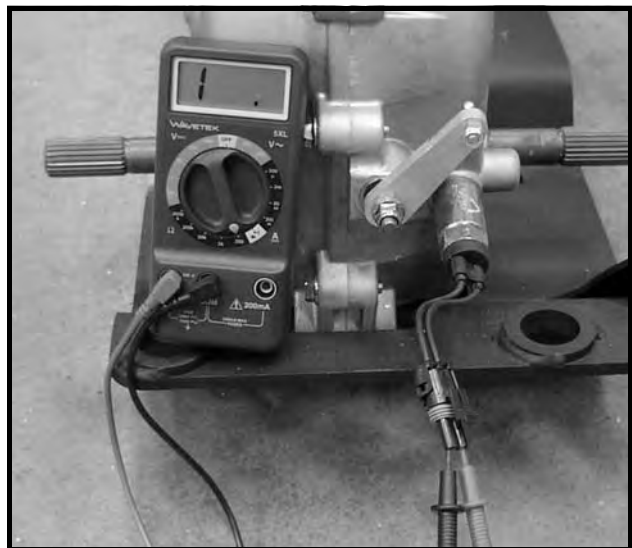
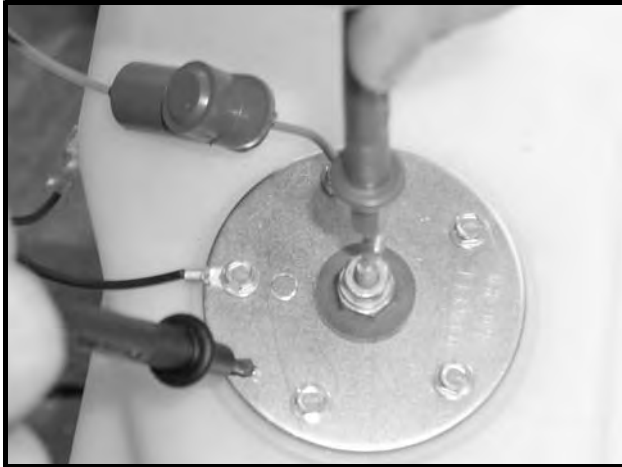


Figure 11a-20 Neutral Switch – Reverse Position

5. Check for continuity on the switch contacts with the Forward/Reverse handle in the NEUTRAL position (**Figure 11a-19, Page 11a-23**). The multimeter should indicate continuity.
6. Check for continuity on the switch contacts with the Forward/Reverse handle in the REVERSE position (**Figure 11a-20, Page 11a-23**). The multimeter should indicate no continuity.
7. If any of the continuity readings are incorrect, replace the neutral switch. **See Neutral Switch Removal on page 12a-2.**



**Figure 11a-28 Fuel Level Sending Unit Test**

5. The following resistance readings (in ohms) should be indicated, depending on the position of the float inside the fuel tank. The resistance reading will vary according to the exact position of the float. The following table may be used as a guideline to determine if the fuel level sending unit is operating correctly. Make sure the float is at the surface of the fuel in the tank.

FLOAT POSITION	RESISTANCE READING	FUEL GAUGE READINGS
Lower position (tank empty)	240 ± 20 ohms	Empty
Center position (tank half full)	120 ± 20 ohms	Half full
Upper position (tank full)	60 ± 20 ohms	Full

6. If the readings are within the specifications listed in the preceding table, the fuel level sending unit is working properly. If the readings are incorrect, the fuel level sending unit has failed and the fuel tank must be replaced. **See Fuel Tank Removal, Section 13a, Page 13a-16.**
7. If the readings are correct and the fuel gauge does not function correctly, leave the battery disconnected and check the continuity of the following:
- Orange wire (w104) from the fuel level sending unit to the fuel gauge/hour meter.
  - Blue wire (w25) and purple wire (w47) from the fuel gauge/hour meter to the key switch.
  - Black ground wires at the fuel level sending unit (w106) and at the fuel gauge/hour meter (w22). **See Fuel Gauge/Hour Meter Removal, Section 12a, Page 12a-6.**
8. If the readings are correct according to the position of the float, but the reading on the fuel gauge/hour meter is incorrect, test the fuel gauge/hour meter. **See Test Procedure 25 – Fuel Gauge on page 11a-34.**

# SECTION 11B – TROUBLESHOOTING AND ELECTRICAL SYSTEM: HONDA POWERED GASOLINE VEHICLES

## **⚠ DANGER**

- See General Warning, Section 1, Page 1-1.

## **⚠ WARNING**

- See General Warning, Section 1, Page 1-1.

## TROUBLESHOOTING GUIDE

The following troubleshooting guide will be helpful in identifying operating difficulties should they occur. The guide includes the symptom, probable cause(s) and suggested checks.

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine does not start easily.	Spark plug is partially fouled or in poor condition	Section 20b – Honda GX 620 Gasoline Engine Manual
	Spark plug wire is damaged or loose	Section 20b – Honda GX 620 Gasoline Engine Manual
	Intermittent ignition coil failure	Section 20b – Honda GX 620 Gasoline Engine Manual
	Low cylinder compression	Section 20b – Honda GX 620 Gasoline Engine Manual
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Fuel System, Section 13b, Page 13b-7
	Carburetor improperly adjusted	Section 20b – Honda GX 620 Gasoline Engine Manual
	Starter failure	Section 20b – Honda GX 620 Gasoline Engine Manual
	Carburetor solenoid failure	Test Procedure 21 – Carburetor Solenoid Circuit on page 11b-31
	Diode 2 failed open	Test Procedure 9B – Diode 2 on wire 40 on page 11b-20
	Diode 3 failed open	Test Procedure 9C – Diode 3 on wire 45 on page 11b-21
Troubleshooting Guide continued on next page...		

## Test Procedure 1B – Voltage Test

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Set the multimeter to the 20 VDC setting.
4. Measure the voltage across the battery terminals. If the reading is less than 12.4 volts, or if the lowest specific gravity reading from the hydrometer test is less than 1.225, recharge the battery. If battery voltage is greater than 12.4 volts and specific gravity is greater than 1.225, the problem is not with the battery. If the battery does not reach 12.4 volts, or if the specific gravity of a cell is still less than 1.225 after charging, replace the battery. **See following NOTE.**

**NOTE:** A fully charged battery that is in good condition should have a specific gravity of at least 1.225 in all cells and the difference in the specific gravity of any two cells should be less than 50 points. Open-circuit voltage, the battery voltage with no electrical load, should be at least 12.4 volts.

## Test Procedure 1C – Load Test

**NOTE:** Ensure that the battery is fully charged before performing the following test procedure.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Connect a 160-ampere load tester to the battery posts. **See following NOTE.**

**NOTE:** If a load tester is not available, a load can be placed on the battery by removing the spark plug wires and activating the starter motor. If this method is used, the voltage must be read when the starter motor is turning. **See following CAUTION.**

## **CAUTION**

- **Activating the starter for more than a few seconds could result in damage to the starter motor, the starter, and/or the flywheel gears.**

4. Turn the load tester switch to the ON position.
5. Read the battery voltage after the load tester has been turned ON for 15 seconds. The minimum acceptable battery voltage for proper engine starting is approximately 9.6 VDC.
6. If the battery voltage is acceptable, or if the electrical problem continues after the battery has been replaced, test the electrical circuits.
7. If the voltage reading exceeds 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the starter. **See Section 20b – Honda GX 620 Gasoline Engine Manual. See also the following NOTE.**

**NOTE:** Record the voltage reading at 70 °F (21 °C). At lower electrolyte temperatures, the voltage reading will be lower.

8. If the reading is less than 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the battery electrolyte in each cell. **See Test Procedure 1A – Hydrometer Test on page 11b-9.**

8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

### Test Procedure 9C – Diode 3 on wire 45

#### See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
3. Raise the hood and disconnect the multi-pin connector from the key switch.
4. Disconnect the 18-gauge purple wire (w42) from the oil light.
5. Disconnect the 18-gauge blue wire (w25) from the fuel gauge/hour meter.
6. Remove the differential relay and the accessory relay from the multi-pin connector located on the electrical component mounting plate.
7. Set the multimeter to the diode test function (→|←).
8. Connect the black (–) probe of the multimeter to the 18-gauge purple wire (w47) at the key switch multi-pin connector.
9. Connect the red (+) probe of the multimeter to the 18-gauge yellow wire (w123) at the bullet connector (wire harness side).
10. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
11. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
12. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

### Test Procedure 9D – Diode 4 on wire 140

#### See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
3. Remove the start relay, differential relay, and accessory relay from the multi-pin connector located on the electrical component mounting plate.

## TEST PROCEDURE 21 – CARBURETOR SOLENOID CIRCUIT

See General Warning, Section 1, Page 1-1.

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

1. Check the carburetor solenoid coil circuit.
  - 1.1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
  - 1.2. Disconnect the 18-gauge yellow wire (w123) from the carburetor solenoid bullet connector (**Figure 11b-16, Page 11b-20**).
  - 1.3. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting (**Figure 11b-10, Page 11b-15**). See following **WARNING**.

### **⚠ WARNING**

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

- 1.4. Set the multimeter to 20 VDC.
  - 1.5. Place the probes to measure the voltage between the 18-gauge yellow wire (w123) terminal (wire harness side) and the frame ground.
  - 1.6. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF position. The reading should indicate approximately 12 VDC when the key is in the ON and START positions; if the multimeter does indicate 12 VDC, proceed to step 2. If the reading does not indicate approximately 12VDC with the key in the ON and START positions, check the following items:
    - Key switch (starter circuit). See **Test Procedure 4 – Key Switch (Starter Circuit) on page 11b-13**.
    - Diode 2. See **Test Procedure 9B – Diode 2 on wire 40 on page 11b-20**.
    - Diode 3. See **Test Procedure 9C – Diode 3 on wire 45 on page 11b-21**.
    - Diode 6. See **Test Procedure 9F – Diode 6 on wire 130 on page 11b-23**.
2. Check the carburetor solenoid coil.
    - 2.1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
    - 2.2. Disconnect the battery as instructed. See **WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1**.
    - 2.3. Set the multimeter to 200 ohms.
    - 2.4. Measure the resistance between the carburetor solenoid coil wire and the frame or engine (ground) (**Figure 11b-26, Page 11b-32**) The resistance should be approximately 37.5 ohms.
    - 2.5. If the resistance reading is incorrect, replace the solenoid coil. See **Section 20b – Honda GX 620 Gasoline Engine Manual**.

# SECTION 11C – TROUBLESHOOTING AND ELECTRICAL SYSTEM: DIESEL VEHICLES

**⚠ DANGER**

- See General Warning, Section 1, Page 1-1.

**⚠ WARNING**

- See General Warning, Section 1, Page 1-1.

## TROUBLESHOOTING GUIDE

The following troubleshooting guide will be helpful in identifying operating difficulties should they occur. The guide includes the symptom, probable cause(s) and suggested checks.

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	REFER TO
<b>Engine does not start (starter motor functions).</b>	Fuel tank is empty	Fuel System on page 13c-8
	Fuel with low cetane number	Use specified fuel. See owner's manual.
	Excessively high viscosity fuel or engine oil	Use specified fuel and engine oil. See owner's manual.
	Water in fuel system	Replace fuel and fuel filter.
	Air in fuel system	Section 19 – Kubota D722 Diesel Engine Manual
	Fuel filter clogged	Replace fuel filter. See Fuel Filter Replacement on page 13c-9.
	Fuel line or pipe(s) clogged	Clean or replace fuel line and/or pipe(s). See Fuel System on page 13c-8.
	Injection nozzle clogged	Section 19 – Kubota D722 Diesel Engine Manual
	Injection pump failed	
	Fuel pump failure	Test Procedure 26 – Fuel Pump Circuit on page 11c-43
	Fuel leak caused by loose injection pipe retaining nut	Tighten nut. Section 19 – Kubota D722 Diesel Engine Manual
	Incorrect injection timing	Section 19 – Kubota D722 Diesel Engine Manual
	Excessive valve clearance	
	Improper valve seat alignment, valve spring broken, or valve seized	
	Improper valve timing	
Piston ring worn		
Cylinder compression leak		
<b>Troubleshooting Guide continued on next page...</b>		

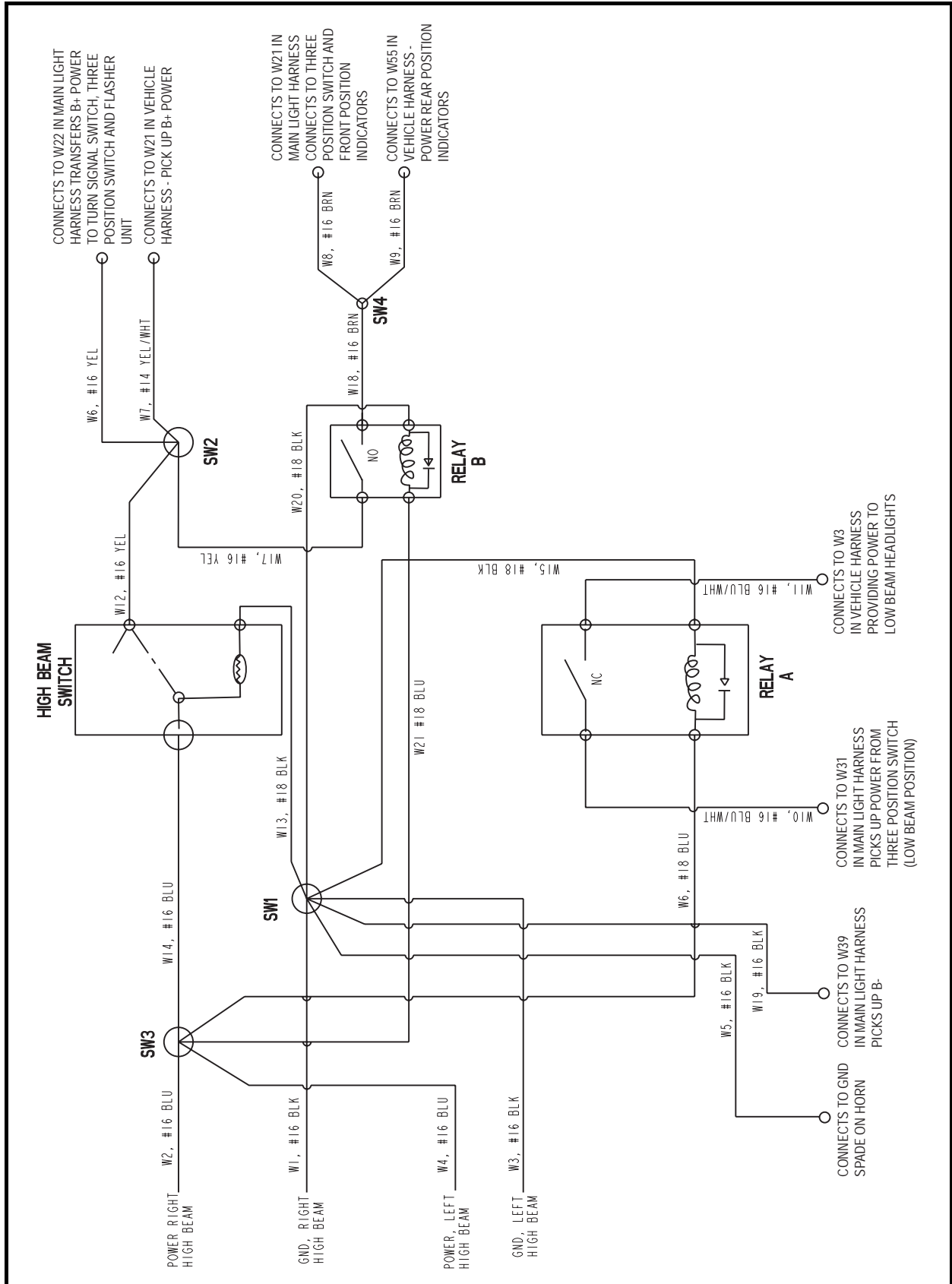


Figure 11c-6 High Beam Wiring Diagram – Bobcat 2200 Homologated Vehicle

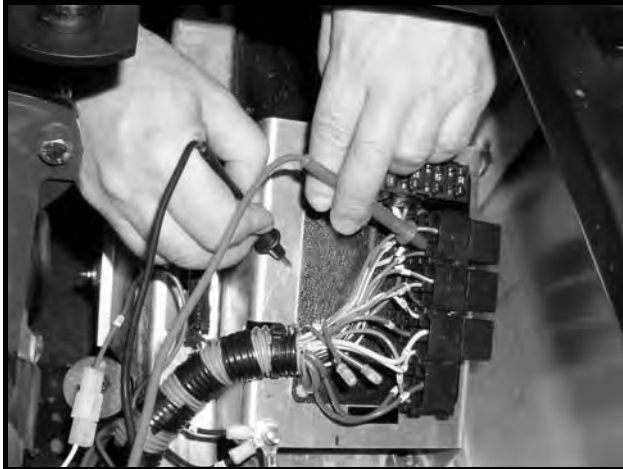


Figure 11c-15 Start Relay Coil Circuit Test



Figure 11c-16 Start Relay Contact Test

## TEST PROCEDURE 8 – START RELAY

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting (**Figure 11c-13, Page 11c-20**). See following **WARNING**.

### **⚠ WARNING**

- Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 16-gauge light green start relay wire (w110) terminal and the frame ground (**Figure 11c-15, Page 11c-21**).
5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF and ON positions. The reading should indicate approximately 12 VDC when the key is in the START position and the relay should click. See following **NOTE**.

**NOTE:** The differential (if equipped), fan, and accessory relays may be removed to isolate the sound of the start relay click.

6. If the reading is 12 VDC and the relay does not click when the key switch is turned to the START position, replace the relay.
7. If the reading is 12 VDC and the relay clicks when the key is in the START position, check the relay contacts.
  - 7.1. Set the multimeter to 200 ohms.
  - 7.2. Check for continuity between the 16-gauge green/white wire (w147) and the 16-gauge green wire (w128) relay terminals (**Figure 11c-16, Page 11c-21**).
  - 7.3. Monitor the multimeter. The multimeter should not indicate continuity with the key in the OFF or ON positions. The multimeter should indicate continuity when the key is in the START position.
  - 7.4. If the multimeter does not indicate continuity while the key is in the START position and the relay

7. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12c, Page 12c-18.**
8. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
9. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12c, Page 12c-18.**

### Test Procedure 13B – Diode 2 on wire 40

#### See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
3. Raise the hood.
4. Disconnect the two-pin connector between the fan and the wire harness (**Figure 11c-23, Page 11c-28**).
5. Set the multimeter to the diode test function (→+).
6. Connect the black (–) probe of the multimeter to the frame (ground).
7. Connect the red (+) probe of the multimeter to the 14-gauge blue wire (w52) on the two-pin connector (wire harness side).
8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12c, Page 12c-18.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12c, Page 12c-18.**

### Test Procedure 13C – Diode 3 on wire 144

Diode 3 is only used on vehicles equipped with the two piece wire harness and a differential relay.

#### See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
3. Remove the start relay, differential relay, fan relay, and accessory relay from the multi-pin connector located on the electrical component mounting plate.
4. Disconnect the two-pin connector between the neutral switch and the wire harness (**Figure 11c-26, Page 11c-32**).
5. Set the multimeter to the diode test function (→+).
6. Connect the black (–) probe of the multimeter to the 18-gauge black/white wire (w142) at the neutral switch two-pin connector.



Figure 11c-37 Glow Plug Circuit Test

## TEST PROCEDURE 22 – REVERSE WARNING BUZZER LIMIT SWITCH (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

**NOTE:** Keep the battery connected during this test procedure.

The reverse warning buzzer limit switch is located on the Forward/Reverse handle under the hood.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for proper wiring and tight connections at the reverse warning buzzer and the reverse warning buzzer limit switch (**Figure 11c-38, Page 11c-42**).
3. Move the Forward/Reverse handle to REVERSE and listen for an audible click from the limit switch. If there is no click, check the switch for proper alignment and switch arm movement.
4. If the switch is being activated but the buzzer does not function, place the red (+) probe of the multimeter on one terminal and the black (-) probe on the other terminal of the limit switch. With the limit switch lever fully released, the reading should be no continuity.
5. Place the Forward/Reverse handle in the REVERSE position to activate the limit switch. The multimeter should indicate continuity when the limit switch lever is activated. If either reading is incorrect, replace the limit switch (**Figure 11c-38, Page 11c-42**).

the red (+) probe into the blue wire terminal of the wire harness. If the multimeter reading is approximately 12 volts, the blue wire has continuity.

7. Check the continuity of the 16-gauge black wire from the headlight to the ground terminal.
  - 7.1. Set the multimeter to 20 VDC.
  - 7.2. Place the black (–) probe of multimeter into the black wire (w13) terminal of the wire harness and use an alligator clip to attach the red (+) probe onto the positive (+) battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.
8. If the readings are correct in all of the previous steps, replace the headlight bulb.

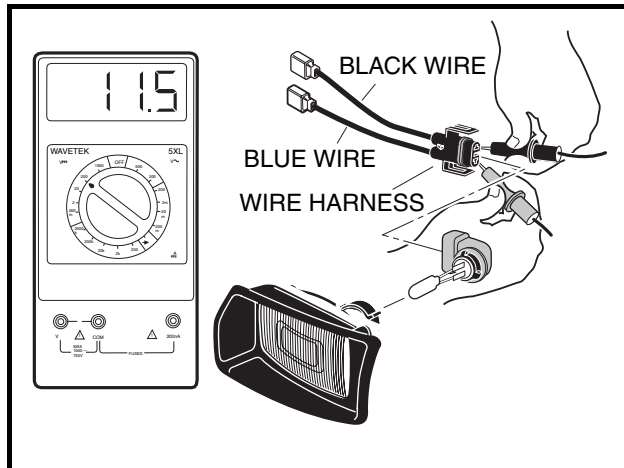


Figure 11c-47 Voltage At Headlight Socket



Figure 11c-48 Bed Lift Motor Wires

## TEST PROCEDURE 34 – BED LIFT MOTOR

**NOTE:** Keep the battery connected during this test procedure.

Ensure that the battery is fully-charged before performing this test procedure.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the red and yellow wires from the bed lift motor (**Figure 11c-48, Page 11c-51**).
3. Set a multimeter for 20 VDC.
4. Place the red probe in the bullet connector on the red wire (wire harness side) and place the black probe in the bullet connector on the black wire (wire harness side) (**Figure 11c-49, Page 11c-52**).
5. Have an assistant press the bed lift switch in the UP position and monitor the multimeter:
  - A reading of approximately + (positive) 12 VDC indicates that the bed lift harness and switch are wired correctly. Proceed to step 6.
  - A reading of approximately – (negative) 12 VDC indicates that the bed lift harness or switch are wired incorrectly. Check the wiring of the bed lift harness and bed lift switch. **See Wiring Diagram on page 11c-6.**
  - A reading of approximately 0 VDC indicates a failed bed lift switch, failed bed lift circuit breaker, a poor connection in the bed lift wire harness, or a broken wire.
6. Place the red probe in the bullet connector on the red wire (wire harness side) and place the black probe in the bullet connector on the black wire (wire harness side) (**Figure 11c-50, Page 11c-52**).

2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the fuel gauge/hour meter (2) (**Figure 12a-6, Page 12a-6**).
5. Remove the fuel gauge/hour meter.
  - 5.1. **Type A Meter:** Remove the two hex nuts (3) and lockwashers (4) from the threaded studs on the back of the gauge. Remove the mounting bracket (5) from the back side of the gauge/meter and remove it from the instrument panel.
  - 5.2. **Type B Meter:** Remove the mounting clip (14) that secures the gauge/meter. Alternate pulling the lower and upper tabs away from the gauge housing to remove clip. Pull gauge/meter from the instrument panel.

### Fuel Gauge/Hour Meter Installation

1. Install a new fuel gauge/hour meter (2) into the hole in the instrument panel until the flange seats against the instrument panel (**Figure 12a-6, Page 12a-6**).
2. Remove the fuel gauge/hour meter.
  - 2.1. **Type A Meter:** Slide the mounting bracket onto the two threaded studs on the fuel gauge/hour meter. Secure the fuel gauge/hour meter with two lockwashers and two hex nuts. Tighten to 2.5 in-lb (.28 N·m). Place one drop of Loctite on each hex nut. Do not allow Loctite to come into contact with the fuel gauge/hour meter casing.
  - 2.2. **Type B Meter:** Force the mounting clip (14) onto the back of the fuel gauge/hour meter until fully seated.
3. Connect the wires to the fuel gauge/hour meter. **See Wiring Diagram, Section 11a, Page 11a-6.**
4. Coat the terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower and secure the hood.
6. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

## KEY SWITCH

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**See General Warning, Section 1, Page 1-1.**

### Testing the Key Switch

**See Test Procedure 4, Section 11a, Page 11a-13. Also see Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11a-28.**

### Key Switch Removal

1. Turn the key switch (6) OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. From under the hood, remove the multi-pin connector from the key switch.

## Wire Harness Diode Installation

1. Slide a piece of heatshrink tubing over one of the wire ends where the diode will be attached.
2. Install the new diode using in-line wire splicing connectors. Make sure to observe polarity and place the end of the diode with the silver stripe on the wire that was marked when the diode was removed.
3. Slide the heatshrink tubing over the diode and ensure that it will, after being activated, adequately cover the uninsulated diode leads.
4. Activate the heatshrink by carefully applying heat to the tubing.
5. Bundle the wires into the plastic wire conduit and replace any wire ties that were removed when the wires were traced.
6. Restore the wire harness routing to the original routing and secure the harness with wire ties as required.
7. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

## BATTERY

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See General Warning, Section 1, Page 1-1.

### **DANGER**

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

## GENERAL INFORMATION

See preceding DANGER statement.

Gasoline vehicles are equipped with 12-volt, low-maintenance batteries. When changing a 12-volt battery in any gasoline-powered vehicle, the same size battery with adequate amperage ratings should be used as a replacement.

The manufacturer recommends a group 70, side-post battery (CCI P/N 1012328), with a 650 cranking amp rating at 32 °F (0 °C), 500 CCA at 0 °F (-17.8 °C) and a reserve capacity of at least 105 minutes. The group 70 classification indicates battery size: 8-1/4 inches W x 6-1/2 inches D x 7-1/4 inches H (21.0 cm W x 16.5cm D x 18.4 cm H). It is important to use the proper size to ensure that the battery clamp will fit correctly.

## Testing the Battery

See Test Procedure 1, Section 11a, Page 11a-9.

## Key Switch Installation

1. Place spacer on key switch and reverse the removal procedure to install switch in the instrument panel. Tighten the key switch nut firmly.
2. From under the hood, connect the multi-pin connector to the key switch.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

## 12-VOLT ACCESSORY RECEPTACLE

---

See General Warning, Section 1, Page 1-1.

### Testing the 12-Volt Accessory Receptacle

See Test Procedure 23, Section 11b, Page 11b-33.

### 12-Volt Accessory Receptacle Removal

1. Turn the key switch (6) OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. From under the hood, disconnect the wires from the accessory receptacle (12) (**Figure 12b-5, Page 12b-5**).
5. Reach under the instrument panel to remove the retainer (13) securing the accessory receptacle. **See following NOTE.**

**NOTE:** The retainer works like a nut but can be removed quickly by turning only enough to align the two small patches of retainer threads with the two smooth sections in the receptacle threads. Once aligned, the retainer can slide off.

6. Pull the accessory receptacle from the front side of the instrument panel.

### 12-Volt Accessory Receptacle Installation

1. Reverse the removal procedure to install receptacle in the instrument panel. Tighten the retainer firmly.
2. From under the hood, connect the the wires to the accessory receptacle.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)
Organic matter	50.0
Nitrates	10.0
Nitrites	5.0
Chloride	5.0

## Battery Removal

See General Warning, Section 1, Page 1-1 and DANGER on page 12b-15.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-2.
3. Remove the driver-side seat.
4. Remove the battery hold-down located on the bottom of the battery.
5. Remove the battery. See following WARNING.

### **⚠ WARNING**

- Keep the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent hole. Do not exceed this 45° angle when lifting, carrying or installing battery. The battery acid could cause severe personal injury when accidentally coming in contact with the skin or eyes and could damage clothing.

## Charging the Battery

See General Warning, Section 1, Page 1-1 and DANGER on page 12b-15.

1. Charge the battery with an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the charger, positive (+) cable to the positive (+) battery post and negative (–) cable to the negative (–) battery post.
3. The battery may be charged with a slow charge (3-10 amps) or a fast charge (20-30 amps). Charge until the specific gravity reaches 1.250. See following WARNING.

### **⚠ WARNING**

- If the battery case feels hot (approximately 125 °F (52 °C) or more), emits gases, or fluid boils from vents, stop charging immediately. Failure to stop charging battery when any of these conditions are present could result in an explosion, personal injury and/or damage to the battery.
- Do not disconnect the charger DC leads from the battery when the charger is on. The resulting arcing between the DC leads and battery post could cause an explosion.
- If the charger must be stopped, disconnect the AC supply cord from the wall outlet before disconnecting the DC leads from the battery. Allow the battery to cool to room temperature and resume charging battery at a lower amp rate.

3. Pull the circuit breaker out of the in-line fuse holder to remove.

### Bed Lift Circuit Breaker Installation

Install the circuit breaker in the reverse order of removal.

## LIGHT SWITCH

---

See General Warning, Section 1, Page 1-1.

### Testing the Light Switch

See Test Procedure 32, Section 11c, Page 11c-49.

### Light Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Press the upper and lower retaining tabs and push the light switch (11) out of the instrument panel (**Figure 12c-6, Page 12c-5**).
5. Disconnect the wire harness from the light switch.

### Light Switch Installation

1. Match the terminal numbers molded onto the connector and switch and reconnect the wire harness.
2. Push the light switch into the instrument panel until fully seated.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

## FUSE

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See General Warning, Section 1, Page 1-1.

### Testing the Fuse

See Test Procedure 2, Section 11c, Page 11c-16.

### Fuse Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-2.**
3. Remove the electrical component cover (located near the battery).
4. Remove the fuse from the fuse block.

## Wire Harness Diode Installation

1. Slide a piece of heatshrink tubing over one of the wire ends where the diode will be attached.
2. Use in-line wire splicing connectors to install the new diode. Make sure to observe polarity and place the end of the diode with the silver stripe on the wire that was marked when the diode was removed.
3. Slide the heatshrink tubing over the diode and ensure that it will, after being activated, adequately cover the uninsulated diode leads.
4. Activate the heatshrink by carefully applying heat to the tubing.
5. Bundle the wires into the plastic wire conduit and replace any wire ties that were removed when the wires were traced.
6. Restore the wire harness routing to the original routing and secure the harness with wire ties as required.
7. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

## BATTERY

---

See General Warning, Section 1, Page 1-1.

### **DANGER**

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

## GENERAL INFORMATION

See preceding DANGER statement.

Gasoline vehicles are equipped with 12-volt, low-maintenance batteries. When changing a 12-volt battery in any gasoline-powered vehicle, the same size battery with adequate amperage ratings should be used as a replacement.

The manufacturer recommends a group 70, side-post battery (CCI P/N 1012328) with a 650 cranking amp rating at 32 °F (0 °C), 500 CCA at 0 °F (-17.8 °C) and a reserve capacity of at least 105 minutes. The group 70 classification indicates battery size: 8-1/4 inches W x 6-1/2 inches D x 7-1/4 inches H (21.0 cm W x 16.5cm D x 18.4 cm H). It is important to use the proper size to ensure that the battery clamp will fit correctly.

## Testing the Battery

See Test Procedure 1, Section 11c, Page 11c-13.



Figure 13a-4 Muffler Bracket and Inlet Pipe

## INTERMEDIATE PIPE REMOVAL

1. Loosen the muffler spring suspension bracket bolts.
2. Remove the springs from the intermediate pipe and muffler inlet. **See following WARNING and NOTE.**

### **⚠ WARNING**

- Always wear eye protection when springs are removed or installed.

**NOTE:** Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.

3. Remove the springs from the intermediate pipe and manifold pipe and remove the pipe.

## INTERMEDIATE PIPE INSTALLATION

1. Secure the intermediate pipe to the manifold pipe with new springs. **See following WARNING and NOTE.**

### **⚠ WARNING**

- Always wear eye protection when springs are removed or installed.

**NOTE:** Shift the end of the muffler inlet and intermediate pipe from side to side to relax and connect the springs.

2. Secure the intermediate pipe to the muffler inlet with new springs. **See previous NOTE and WARNING.**
3. Align the muffler with the intermediate pipe and tighten the muffler spring suspension bracket bolts to 21 ft-lb (29 N·m).

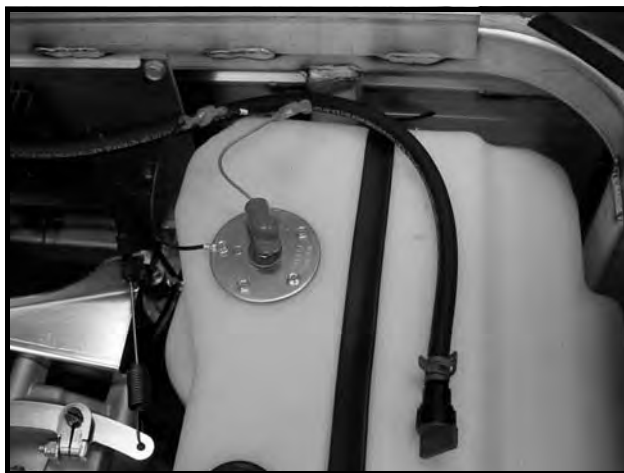
4. Remove the center seat plate.
5. Remove the upper portion of the ROPS. **See ROPS Removal, Section 4, Page 4-7.**
6. Remove the bolts, washers and flanged locknuts from the seat frame, seat side plates, and engine cover plate.
7. Turn the fuel shut-off valve to the closed (OFF) position (**Figure 13a-14, Page 13a-19**).
8. Run the engine until all fuel in the carburetor, fuel pump, and fuel lines is used and the engine stalls.
9. Loosen the clamp and disconnect the fuel line from the fuel tank shut-off valve (**Figure 13a-12, Page 13a-17**).
10. Loosen the clamp and remove the vent tube from the fuel tank.
11. Remove the fuel tank cap.
12. Use a siphon with a built-in suction device to siphon all fuel from the tank and into an approved container. **See following DANGER and WARNING.**

### **⚠ DANGER**

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

### **⚠ WARNING**

- **Never attempt to siphon fuel with a hose that does not have a built-in suction device.**
- **Never attempt to siphon fuel with your mouth.**



**Figure 13a-12 Gasoline Fuel Tank**

13. Disconnect the black wire and orange wire from the fuel level sensor on the tank. Do not remove the lower nut from the center stud of the sensor.
14. Remove the nut from the strap end below the passenger seat area.
15. Lift the strap end and remove the opposite end from the slotted bracket.
16. Remove the passenger side bed latch bracket from the frame.
17. Remove the fuel tank.

## AIR FILTER INTAKE HOSE REMOVAL

The air filter intake hose fits between the driver-side frame and the inlet port on the air filter canister. The frame serves as a duct to carry air from a location at the top of the front of the vehicle.

### **⚠ CAUTION**

- **Do not drill holes or attach anything to the driver side of the frame. A penetrating fastener will create passages that could allow moisture and/or dirt to enter the engine air intake system.**

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
3. Remove the hose from under the filter canister.
4. Remove the hose from under the vehicle body on the frame.
5. Slide the hose through the frame support bracket and remove the hose from the vehicle (**Figure 13a-27, Page 13a-27**).

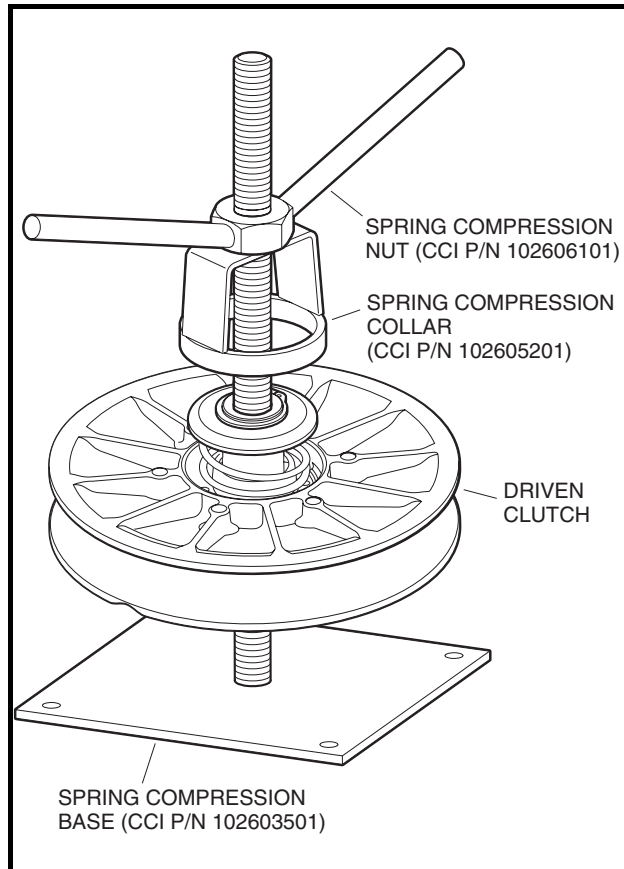


Figure 13a-27 Air Intake Support Bracket

## AIR FILTER INTAKE HOSE INSTALLATION

1. Slide the air intake hose through the frame support bracket (**Figure 13a-27, Page 13a-27**).
2. Secure the air intake hose to the air port under the vehicle body (**Figure 13a-28, Page 13a-28**).
3. Secure the air intake hose under the filter canister (inlet) port (**Figure 13a-29, Page 13a-28**). **See following NOTE.**

**NOTE:** Ensure the hose is positioned against the port surfaces and the clamps are positioned between the port bead and port surface.

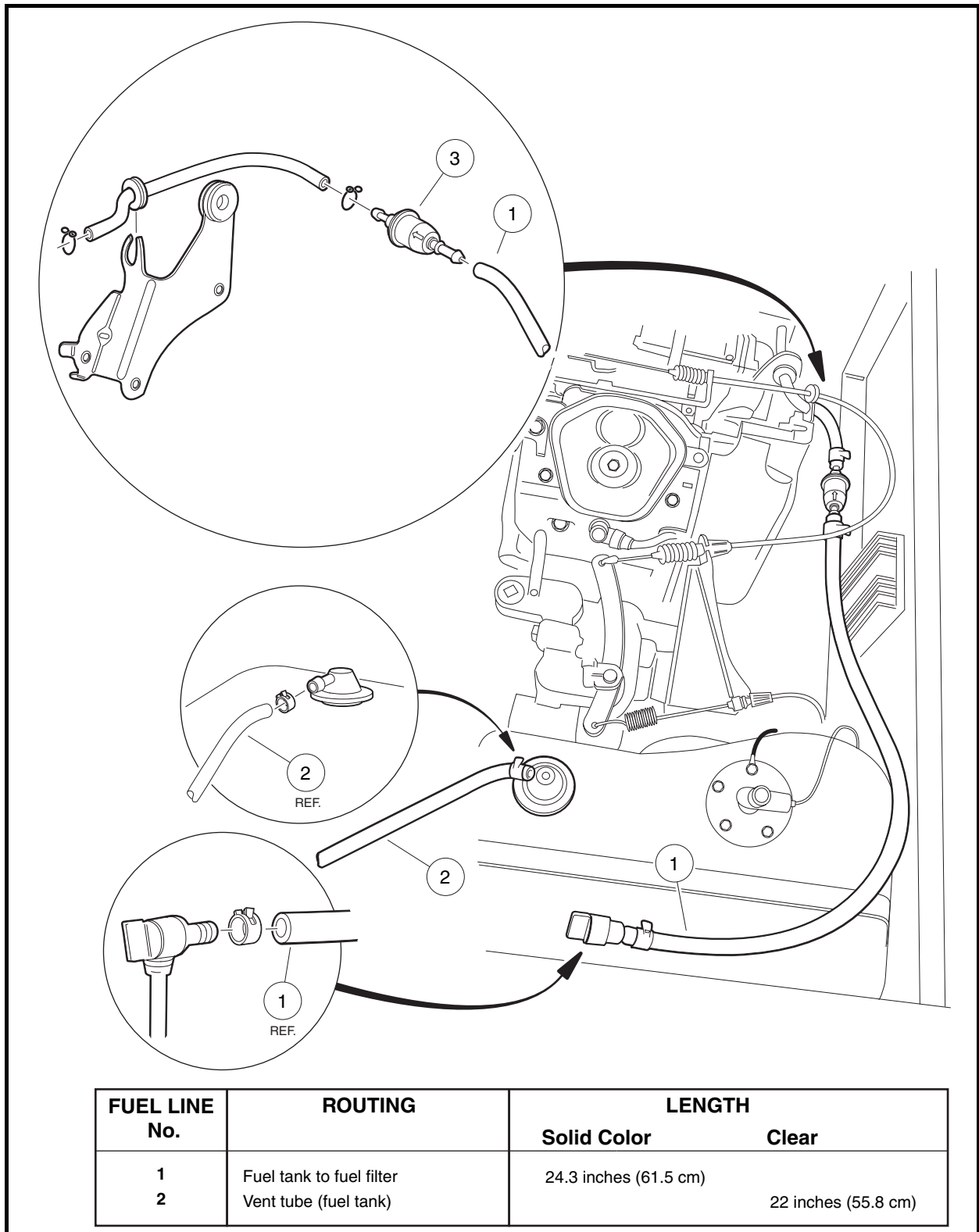


**Figure 13a-34 Driven Clutch Service Tools**

1. Place the driven clutch onto the Spring compression base (CCI P/N 102603501) (**Figure 13a-34, Page 13a-37**).
2. Place the Spring compression collar (CCI P/N 102605201) onto the driven clutch.
3. Thread the Spring compression nut (CCI P/N 102606101) down onto the threaded post enough to release the pressure on the snap ring.
4. Use snap-ring pliers to remove the snap ring (1) (**Figure 13a-35, Page 13a-38**).
5. Slowly remove the spring compression nut. The collar will then rise and release tension on the spring (3).
6. Remove the cup (2) and spring (3).
7. Remove the moveable sheave (4) from the fixed sheave (5). **See following NOTE.**

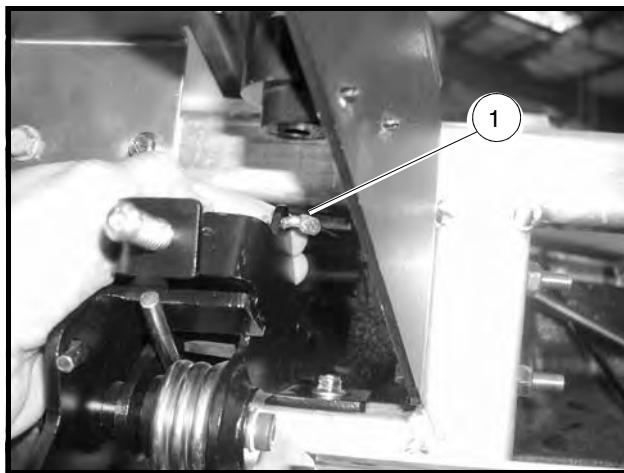
**NOTE:** Both the moveable and fixed sheaves have spacers (6). Be sure to retain the spacers for reassembly of the driven clutch.

**FUEL SYSTEM**

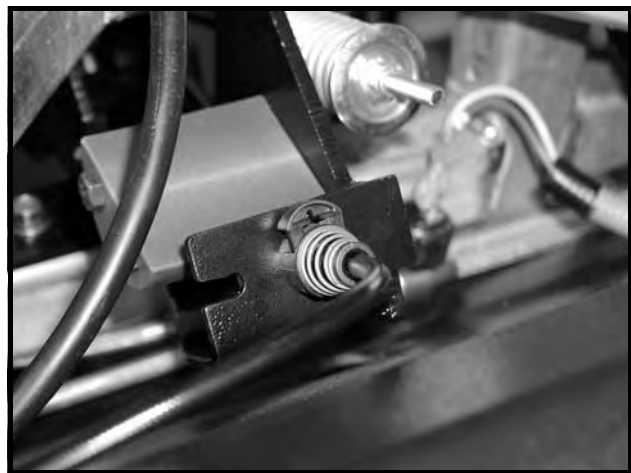


**Figure 13b-3 Fuel System (Honda Powered Gasoline Vehicles)**

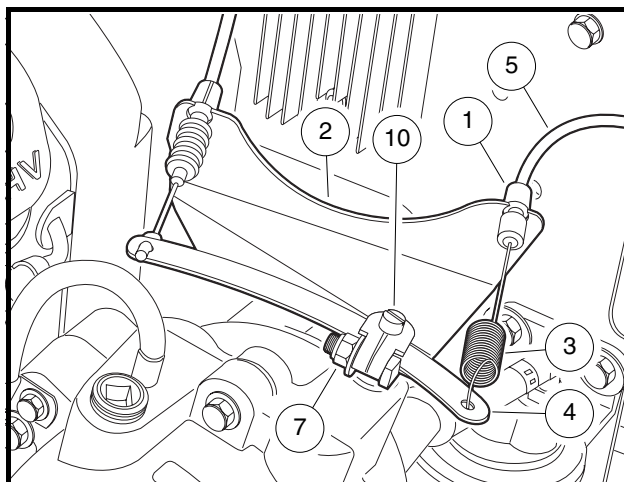
2. Disconnect the battery cables as instructed. See **WARNING “To avoid unintentionally starting...”** in **General Warning, Section 1, Page 1-2**.
3. Raise the hood.
4. Remove the passenger-side seat. See **Seat Removal, Section 4, Page 4-9**.
5. Disconnect the Z-shaped end (1) on the accelerator cable from the pedal (**Figure 13b-12, Page 13b-17**).
6. Release the retention clip at the pedal bracket (**Figure 13b-13, Page 13b-17**).
7. Disconnect the accelerator cable (5) from the engine (**Figure 13b-14, Page 13b-17**).
  - 7.1. Remove the governor guard. See **Governor Guard Removal on page 13b-19**.
  - 7.2. Remove the cable strain relief (1) from the transmission governor bracket (2).
  - 7.3. Disconnect the accelerator cable spring (3) from the transmission governor arm (4).



**Figure 13b-12 Z-Shaped Cable End  
(Gasoline Vehicles)**



**Figure 13b-13 Accelerator Cable Pedal Bracket  
(Gasoline Vehicles)**



**Figure 13b-14 Governor Arm (Gasoline Vehicles)**

6. Remove the two bolts and park brake cable from the canister and remove the canister.



Figure 13b-26 Air Filter Canister

## AIR CANISTER INSTALLATION

1. Position the canister next to the frame bracket with the rubber valve down.
2. Install two bolts to secure the canister base bracket and vehicle frame bracket. Tighten the hardware to 21 ft-lb (28.5 N·m).
3. Secure the bottom (inlet) hose to the canister port.
4. Secure the top (outlet) hose to the canister port.
5. Install a new air filter cartridge. **See Air Filter Installation on page 13b-25.**
6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

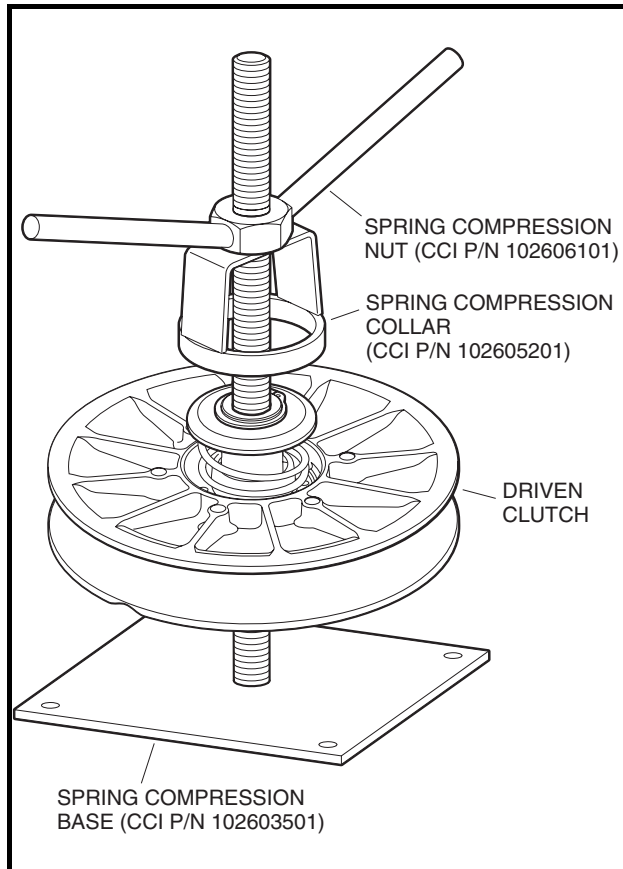
## AIR FILTER INTAKE HOSE REMOVAL

The air filter intake hose fits between the driver-side frame and the inlet port on the air filter canister. The frame serves as a duct to carry air from a location at the top of the front of the vehicle.

### **⚠ CAUTION**

- **Do not drill holes or attach anything to the driver side of the frame. A penetrating fastener will create passages that could allow moisture and/or dirt to enter the engine air intake system.**

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
3. Remove the hose from under the filter canister.
4. Remove the hose from under the vehicle body on the frame.
5. Slide the hose through the frame support bracket and remove the hose from the vehicle (**Figure 13b-27, Page 13b-28**).



**Figure 13b-34 Driven Clutch Service Tools**

1. Place the driven clutch onto the Spring compression base (CCI P/N 102603501) (**Figure 13b-34, Page 13b-37**).
2. Place the Spring compression collar (CCI P/N 102605201) onto the driven clutch.
3. Thread the Spring compression nut (CCI P/N 102606101) down onto the threaded post enough to release the pressure on the snap ring.
4. Use snap-ring pliers to remove the snap ring (1) (**Figure 13b-35, Page 13b-38**).
5. Slowly remove the spring compression nut. The collar will then rise and release tension on the spring (3).
6. Remove the cup (2) and spring (3).
7. Remove the moveable sheave (4) from the fixed sheave (5). **See following NOTE.**

**NOTE:** Both the moveable and fixed sheaves have spacers (6). Be sure to retain the spacers for reassembly of the driven clutch.

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## MUFFLER INSTALLATION

**NOTE:** Replace springs that show signs of brittleness, broken coils, or loss of tension.

1. Loosely secure the muffler and spring suspension bracket to the chassis with two bolts and large flat washers (**Figure 13c-7, Page 13c-7**).
2. Secure the muffler inlet to the intermediate pipe with new springs. **See following WARNING and NOTE.**

### **⚠ WARNING**

- Always wear eye protection when springs are removed or installed.

**NOTE:** Shift the end of the muffler inlet and intermediate pipe from side to side to relax and connect the springs.

3. Align the muffler with the intermediate pipe and tighten the muffler spring bracket hardware to 21 ft-lb (29 N·m). **See previous NOTE and WARNING.**

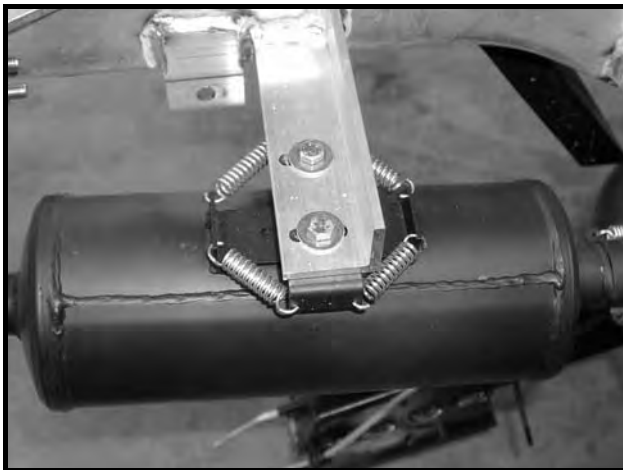


Figure 13c-7 Muffler and Bracket

4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Place the Forward/Reverse handle in NEUTRAL, start the engine and check for exhaust leaks and proper engine operation. **See following DANGER.**

### **⚠ DANGER**

- The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.



**Figure 13c-13 Diesel Fuel Tank**

11. Disconnect the black wire and orange wire from the fuel level sensor on the tank. Do not remove the lower nut on the center stud of the sensor.
12. Remove the nut from the fuel tank strap below the passenger seat area.
13. Lift the strap end and remove the opposite end from the slotted bracket.
14. Remove the passenger-side bed latch bracket from the frame.
15. Remove the fuel tank.

### **Fuel Tank Storage or Disposal**

1. Remove the cap from the tank and thoroughly rinse it with water. The cap may be discarded or kept as a spare.
2. Use a well-ventilated area and flush the fuel tank with water to remove any remaining fuel.
3. Set the tank upside down in a well-ventilated area so that the water can drain. Allow the tank to sit for 24 hours to dry. **See following WARNING.**

#### **WARNING**

- **Dispose of wastewater and fuel tank in accordance with federal, state, and local laws and ordinances.**

4. Store the tank upside down with the cap installed in a well-ventilated area.

### **Fuel Tank Installation**

1. Place the fuel tank in the vehicle.
2. Insert the tab end of the strap into the frame bracket and place the strap in the indentions on the tank.
3. Feed the threaded tab end down into the bottom of the frame. Install a nylon locknut and tighten the nut to 40 in-lb (4.5 N·m).
4. Connect the clear vent tube to the fuel tank vent and secure the tube with a new clamp.
5. Connect the fuel line to the primary fuel filter on the vehicle frame and secure it with a new clamp.

## CLUTCHES

To assemble and disassemble the drive and driven clutches properly, the following tools should be used:

- Drive clutch service tools:
  - Spider removal tool (CCI P/N 102607501)
  - Fixed sheave tool (CCI P/N 102601501)
- Driven clutch service tools:
  - Spring compression base (CCI P/N 102603501)
  - Spring compression collar (CCI P/N 102605201)
  - Spring compression nut (CCI P/N 102606101)

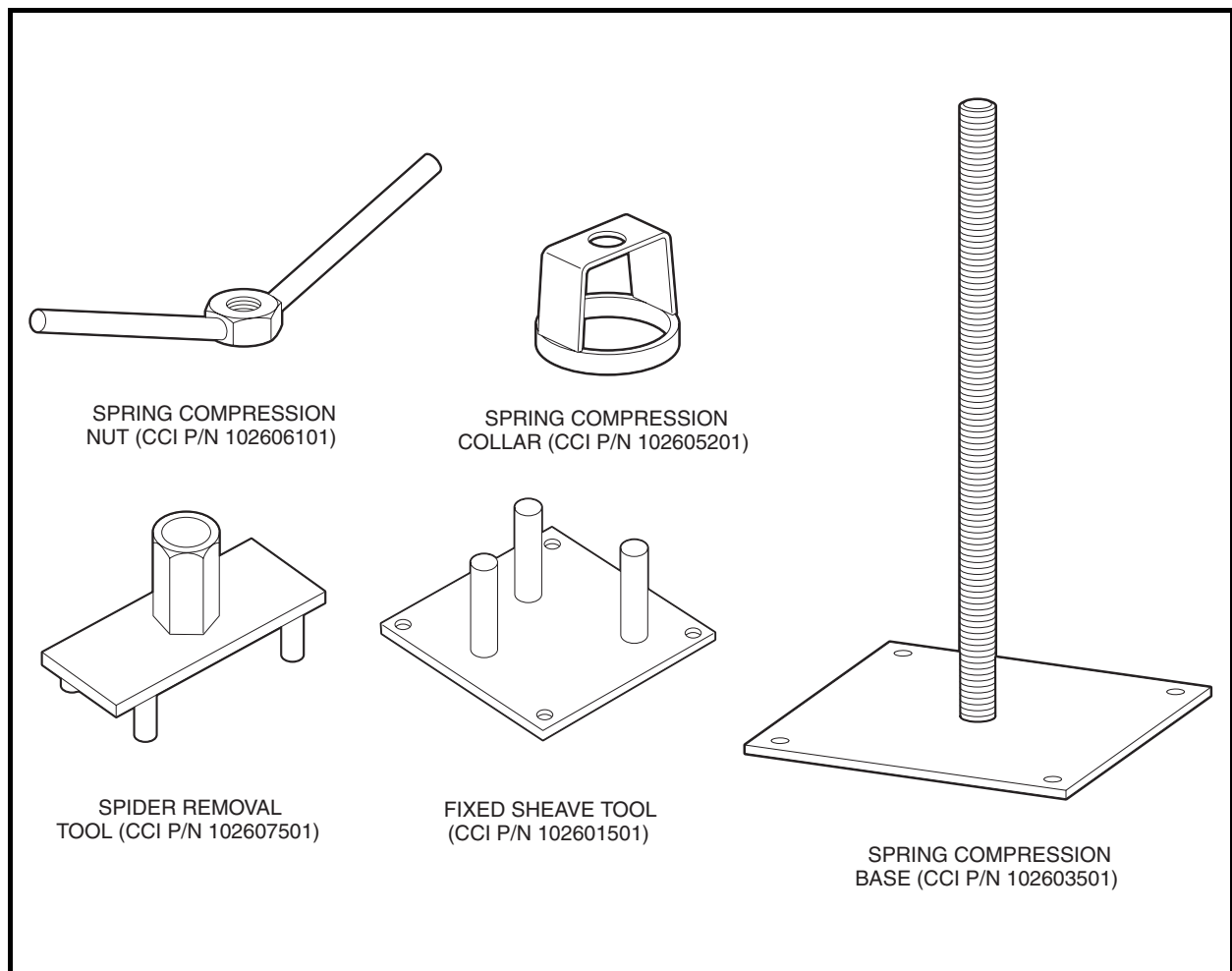


Figure 13c-29 Clutch Service Tools

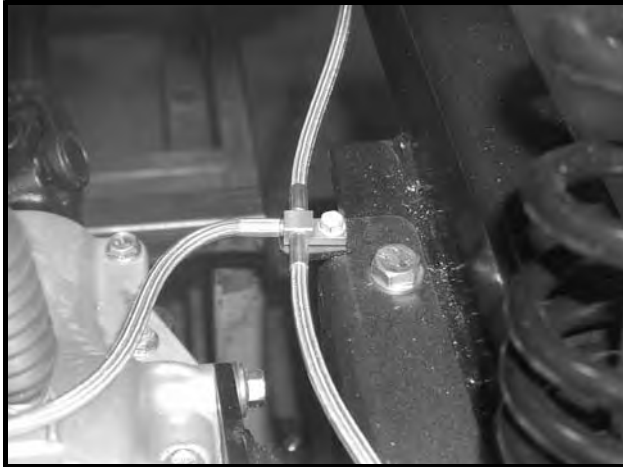
## CLUTCH TROUBLESHOOTING

See General Warning, Section 1, Page 1-1.

Use a tachometer during vehicle operation to determine if the engine begins to lose RPM when the vehicle climbs a steep hill. Check the engine RPM. If engine speed is within manufacturer specifications, there is a clutch problem. See **Engine RPM Adjustment on page 13c-20**.

*Mounting holes in the clutch inner cover have close tolerances. Align the engine and transmission carefully to ensure the mounting holes in the clutch inner cover match the threaded holes in the engine and transmission.*

5. Tighten the engine bolts and washers to 21 ft-lb (28.5 N·m).
6. Tighten the engine stud bolt nuts to 21 ft-lb (28.5 N·m).
7. Tighten the transmission bolts and washers to 21 ft-lb (28.5 N·m).
8. Install the driven clutch. **See Driven Clutch Installation on page 13c-35.**
9. Install the drive belt. **See Drive Belt Installation on page 13c-29.**
10. Install the outer cover. **See Clutch Outer Cover Installation on page 13c-35.**
11. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).



**Figure 14-13 Receiver Hitch Brake Line T-Fitting and Bracket**



**Figure 14-14 Rear Differential Brake Line P-Clamp Bracket**

9. Remove the hydraulic brake lines from all frame-mounted rubber grommets.
10. Remove both park brake cables from the rear brake calipers and park brake levers (**Figure 14-15, Page 14-10**). See **Left Rear Cable Removal, Section 6, Page 6-26**. See **Right Rear Cable Removal, Section 6, Page 6-26**.
11. Remove the hex-head bolts securing the brake caliper to the axle flange. See **Rear Brake Caliper Removal, Section 6, Page 6-8**.
12. Install the brake calipers on the swing arms and fasten them temporarily with wire ties. See following **CAUTION**.

### **⚠ CAUTION**

- Do not kink, twist, or damage the hydraulic brake lines.

13. Position the floor jack under the differential and raise the jack just enough to support the axle (**Figure 14-16, Page 14-10**).
14. Detach rear shock absorbers from axle. See **Rear Shock Absorber Removal, Section 9, Page 9-1**.
15. Remove the rear receiver hitch. See **Rear Receiver Hitch Removal on page 14-7**.
16. Remove the roll pin from the differential pinion shaft and rear driveshaft universal coupling. See following **NOTE**.

**NOTE:** Use a 1/4-inch roll pin punch to drive-out the roll pin.

17. Remove the four bolts, two spacer bars, and flanged locknuts from the axle and swing arm mounting plates. See following **NOTE** and **CAUTION**.

**NOTE:** This procedure is best performed with the help of an assistant.

### **⚠ CAUTION**

- The axle assembly is not balanced at the differential. Once released from the swing arms, the axle is free to tip and could fall from the floor jack. Support the longest end of the axle assembly while lowering it to the floor.

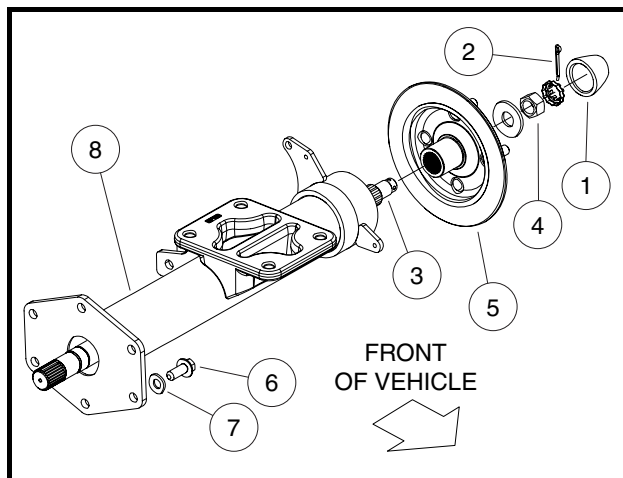
1. Clean debris from drain plug and area around it at the bottom of the differential. Place a large pan under the differential and remove drain plug to empty housng. Install plug after draining.
2. Remove the rubber dust cap (1) and cotter pin (2) from end of axle shaft (3). Discard cotter pin. Loosen the nut (4) on the axle shaft (**Figure 14-25, Page 14-19**). See **Rear Wheel Disc Removal, Section 6, Page 6-15**.
3. Remove the rear axle and clean it in preparation for disassembly. See **Rear Axle Removal on page 14-8**. See following **NOTE**.

**NOTE:** After cleaning, move the rear axle and differential assembly to a clean location before disassembly.

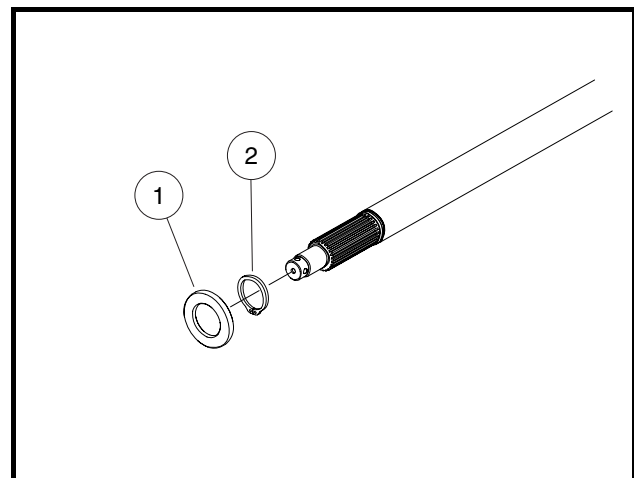
4. Remove rear brake rotors (5) (**Figure 14-25, Page 14-19**). See **Rear Wheel Disc Removal, Section 6, Page 6-15**. See following **CAUTION**.

### **CAUTION**

- The differential and axle tubes have been assembled with Loctite 2760 Threadlocker compound. Use a non-flammable heat source to heat the flange area and bolts during the removal and replacement of each of the six bolts. Once removed, the manufacturer recommends that each thread location be tapped with the same thread (M12 x 1.75 pitch) before new bolts are installed.
5. Remove the six flange-head bolts (6) and flat washers (7) securing each axle tube (8) to the differential (**Figure 14-25, Page 14-19**).
  6. Cover or tape the axle shaft splines to protect the hub seals.
  7. Separate each axle tube from the differential and carefully pull tube straight away until it clears the splined end of the axle shaft.
  8. Avoiding damage caused by dragging splines across lip of seal, carefully pull each axle shaft from the differential.
  9. If replacing shaft, transfer washer (1) and retaining ring (2) from old shaft to new (**Figure 14-26, Page 14-19**).



**Figure 14-25 Axle Shaft and Brake Rotor**



**Figure 14-26 Axle Shaft Retaining Ring and Washer**

2. Verify bar clamp is in position, between the front mounting plate and chassis, before placing hole in mounting plate over bolt in chassis. Install flanged locknut and tighten to 21 ft-lb (28 N·m).
3. Tighten the rear hardware to 21 ft-lb (28 N·m).
4. Attach the six hoses to each end of the corresponding pipes and secure with clamps.
5. Refill the cooling system. **See Engine Coolant Change on page 15-1.**
6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
7. Start and run the engine until it reaches operating temperature and check for leaks.
8. Stop the engine and allow the engine and coolant to cool. **See following WARNING.**

### **WARNING**

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
  - **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**
9. If necessary, remove reservoir cap and fill to the FULL mark. Replace cap. **See preceding WARNING.**
  10. Lower and secure the hood.

## **FAN**

---

**See General Warning, Section 1, Page 1-1.**

### **FAN REMOVAL**

**See Fan Removal, Section 12c, Page 12c-17.**

### **FAN INSTALLATION**

**See Fan Installation, Section 12c, Page 12c-18.**



Figure 16-22 Position Large Helical Gear and Bearing



Figure 16-23 Remove Large Helical Gear Bearing

3. Remove the E-clip and flat washer from the intermediate shaft and the large helical gear and slide the gear from the splined shaft (**Figure 16-24, Page 16-9**).
4. Remove the E-clip and splined-cut washer from the intermediate shaft and small chain sprocket (**Figure 16-25, Page 16-9**). See following NOTE.

**NOTE:** The splined-cut washer is specially designed for this application (**Figure 16-26, Page 16-10**).



Figure 16-24 E-Clip and Washer on Large Helical

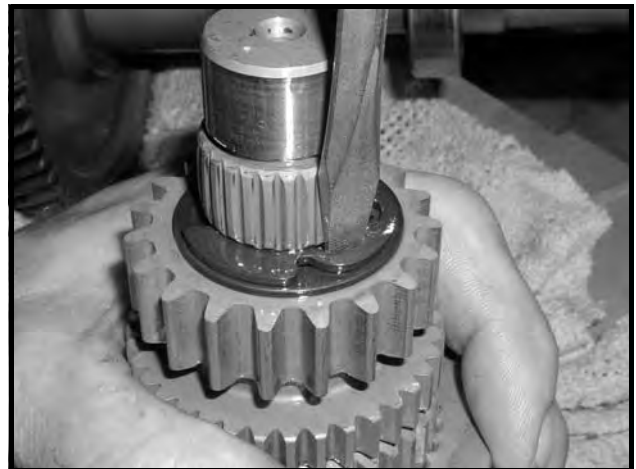


Figure 16-25 E-Clip and Splined-Cut Washer on Small Chain Sprocket

5. Slide the sprocket and engagement gear from the shaft and two needle bearing assemblies (**Figure 16-27, Page 16-10**).
6. Slide the engagement dog gear from the intermediate gear assembly shaft (**Figure 16-27, Page 16-10**).
7. Remove the two needle bearing assemblies from the intermediate shaft. See following NOTE.

## CAUTION

- Slide the bearing assemblies onto the shaft and open just enough to pass the splined and bearing race journals. Do not open them wide enough to clear the diameter of the shaft.
3. Position the intermediate shaft with the small chain sprocket end up and the small helical gear end down through the shaft hole in the service fixture (**Figure 16-62, Page 16-19**).
  4. Install the small chain sprocket onto the shaft and needle bearing assemblies (**Figure 16-63, Page 16-19**).
  5. Install the splined flat washer against the small chain sprocket (**Figure 16-64, Page 16-19**).



Figure 16-61 Bearings For Small Chain Sprocket



Figure 16-62 Position The Intermediate Shaft



Figure 16-63 Small Chain Sprocket Gear



Figure 16-64 Splined Washer on Small Chain Sprocket

6. Install an E-clip onto the shaft and chain sprocket (**Figure 16-65, Page 16-20**).
7. Install large helical gear onto splined intermediate shaft next to the small chain sprocket (**Figure 16-66, Page 16-20**).
8. Install an E-clip onto the intermediate shaft to secure the large helical gear (**Figure 16-67, Page 16-20**).

# SECTION 17 – FRONT DIFFERENTIAL MODELS 6203-01-139-S AND 6203-01-189-S

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## **⚠ DANGER**

- See General Warning, Section 1, Page 1-1.

## **⚠ WARNING**

- See General Warning, Section 1, Page 1-1.

## GENERAL INFORMATION

---

The front differential provides power to the front left and right half shafts which in turn drive the front left and right wheels. It is designed with an electromagnet assembly located in the right front output cover plate. The electromagnet is connected to the vehicle's electrical system and must be electrically energized to work properly. For electrical testing and system diagrams refer to Sections 11a, 11b, and 11c.

Information in this section provides procedures to disassemble, replace parts, and assemble the front differential. It does not include any electrical testing or service information other than the removal and replacement of appropriate electromagnet components.

The front differential has a left output splined hub and a right output splined hub. The left output side has the serial and model number label (**Figure 17-1, Page 17-1**). The right output side is equipped with the electromagnet coil, coil connector plug, and backlash adjustment screw (**Figure 17-2, Page 17-1**).



Figure 17-1 Front Differential – Left Front Output

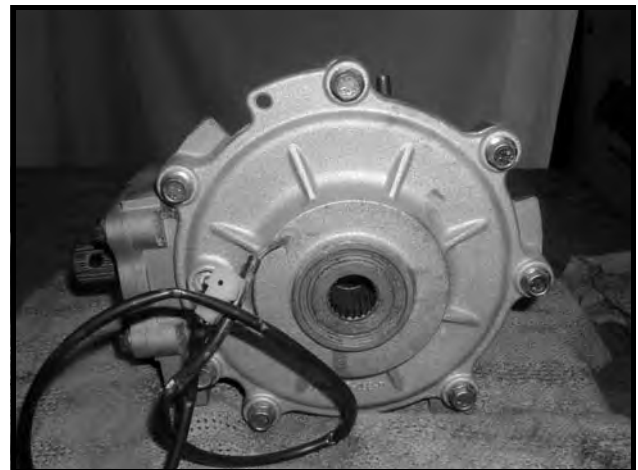


Figure 17-2 Front Differential – Right Front Output

## AXLE HALF SHAFT REMOVAL

---

See Half Shaft Removal, Section 14, Page 14-1.



**Figure 17-30** Install New Input Shaft Seal

3. Inspect the pinion gear and splined portion of the shaft. If the gear is worn, damaged, or the splined portion is worn or damaged, replace the pinion and shaft with a new one. **See following NOTE.**

**NOTE:** If the pinion gear bearing is removed for any reason, it must be replaced with a new bearing.



**Figure 17-31** Inspect Pinion Gear Bearing



**Figure 17-32** Inspect Pinion Gear Shaft Bushing

4. Inspect the pinion gear shaft bushing inside the gearcase (**Figure 17-32, Page 17-11**). **See following NOTE.**

**NOTE:** If the pinion shaft bushing is worn it will require a new gearcase, which is provided with a new bushing. The bushing is not available as a replacement component.

### Clutch and Ring Gear Disassembly

1. Position the ring gear and clutch cage with roller bearings on a clean solid surface (**Figure 17-33, Page 17-12**).
2. Gently raise the clutch cage and the first level of roller bearings to a height where the roller bearings begin to release from the cage (**Figure 17-34, Page 17-12**). **See following NOTE.**

**NOTE:** The clutch cage has two levels of roller bearings, with seven rollers in each layer. They are held in place against the inside of the ring gear hub with spring clips.

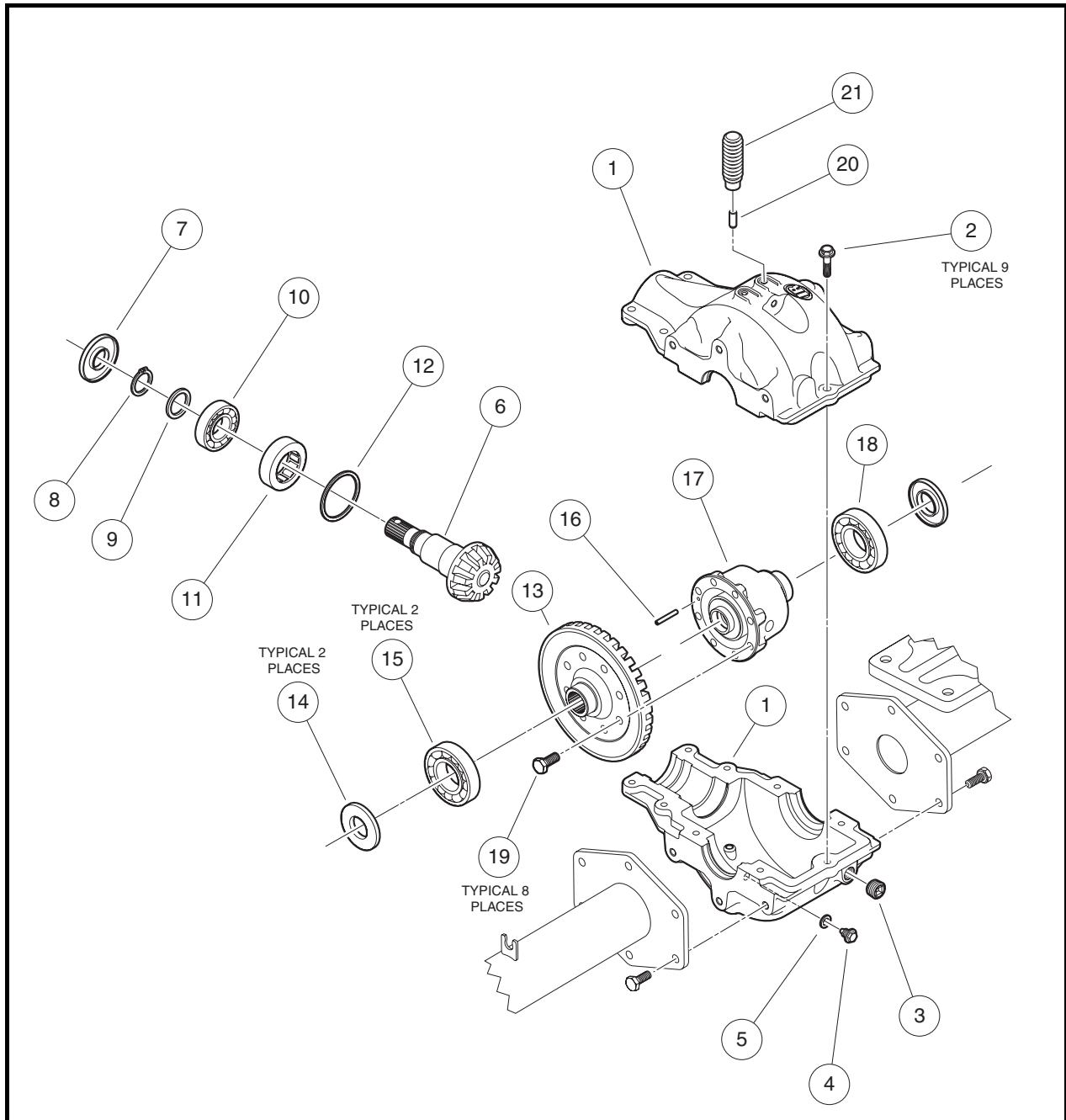


Figure 18-4 Differential Assembly

5. Remove the nine hex flanged-head bolts (2) from the housing (**Figure 18-4, Page 18-3**).
6. Use two flat wrenches or flat metal bars and gently pry the top portion of the housing away from the bottom portion (**Figure 18-5, Page 18-4**). See following **CAUTION**.

### **CAUTION**

- To prevent damage to the mating seal surfaces of the case, use care when separating the halves.

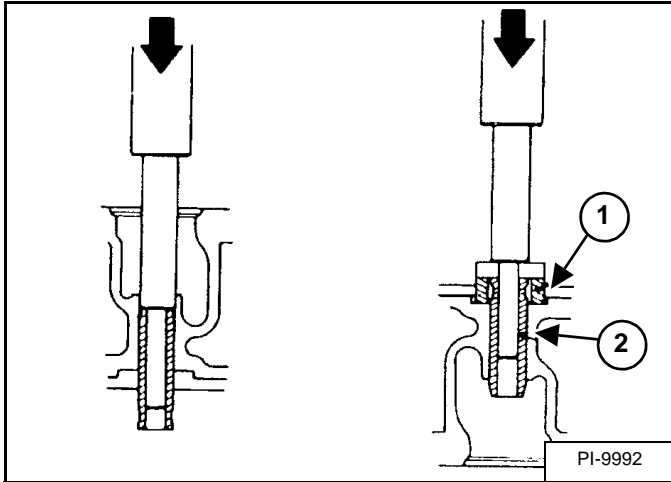
# SECTION 19 – KUBOTA D722 DIESEL ENGINE MANUAL

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## KUBOTA DIESEL ENGINE (CONT'D)

### Valve Guide Checking (Cont'd)

Figure -18



Press the used valve guide out of the cylinder head using the special driver tool [Figure -18]. (See previous page for tool dimensions.)

Put oil on the outside diameter of the new valve guide. Press the new valve guide into the cylinder head from the top side. Use the special driver tools (Item 1 & 2) [Figure -18], press the new guide until the tools contact the cylinder head.

Ream the valve guide to the correct specifications.

## Reconditioning The Valve And Valve Seat

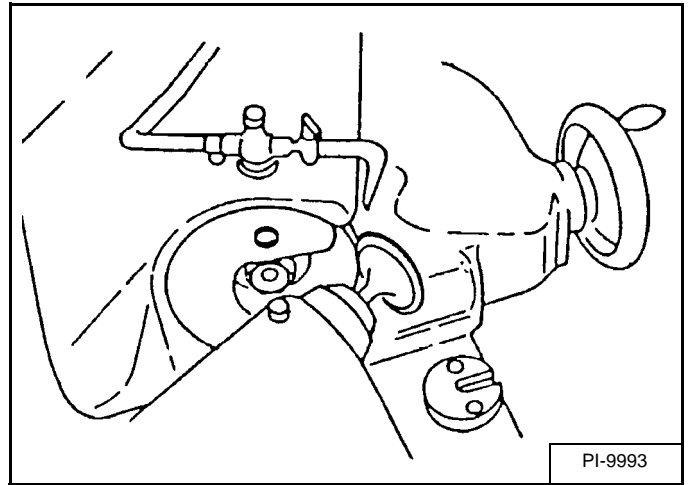


**AVOID INJURY OR DEATH**

**Wear safety goggles to prevent eye injury when drilling or grinding.**

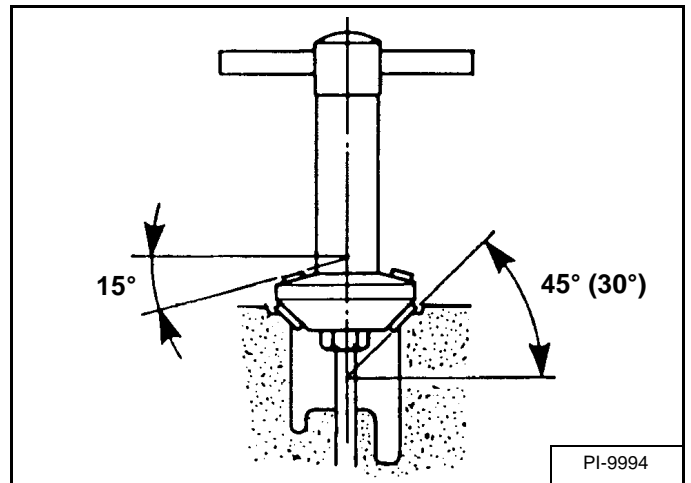
W-2108-1186

Figure -19



Grind the valve face to the correct angle using a valve refacer [Figure -19].

Figure -20

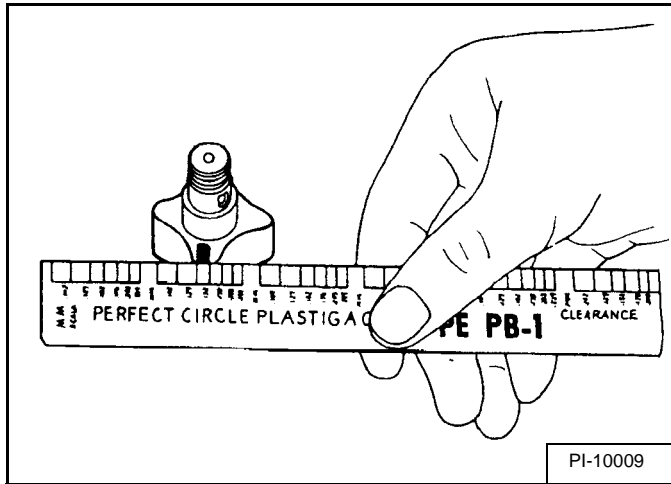


Grind the valve surface in the cylinder head to the correct angle [Figure -20].

## KUBOTA DIESEL ENGINE (CONT'D)

### Oil Pump Service (Cont'd)

Figure -50



Put a piece of press gauge on the rotor face [Figure -50].

Install the cover and tighten the bolts.

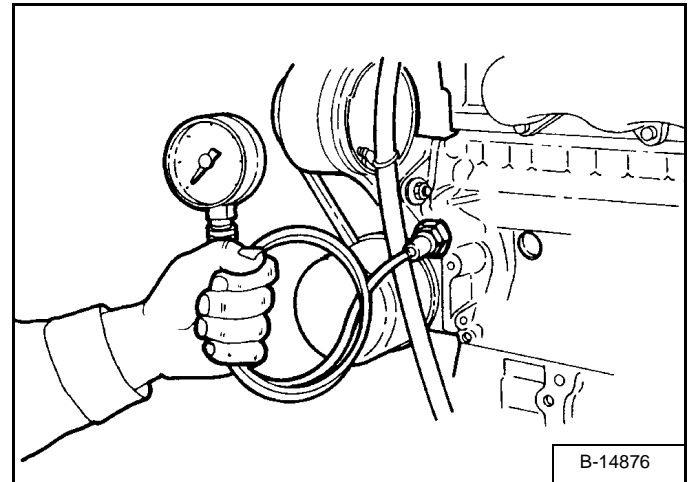
Remove the cover carefully. Measure the width of the press gauge [Figure -50].

If the clearance exceeds the factory limit replace the oil pump.

End Clearance.....0.003-0.005 inch (0,75-0,14 mm)

## Checking Engine Oil Pressure

Figure -51



Remove the oil pressure sensor.

Install a pressure gauge [Figure -51].

Start the engine and run until it is at operating temperature.

If the oil pressure is less than the allowable limit, check the following item:

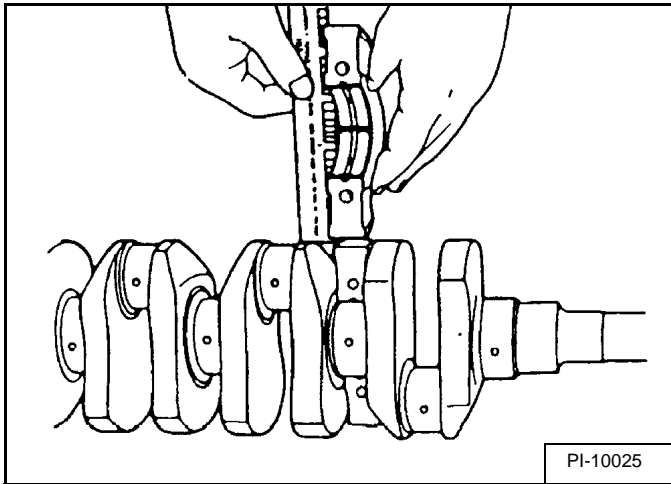
- Engine Oil Level Low
- Oil Pump Defective
- Oil Galley Plugged
- Oil Strainer Plugged
- Excessive Clearance at the Rod & Main Bearings
- Relief Valve Stuck

At Idle Speed Allowable Limit	14 PSI (98 kPa)
At Rated Speed	28-64 PSI (196-441 kPa)
Allowable Limit	14 PSI (98 kPa)

## KUBOTA DIESEL ENGINE (CONT'D)

### Inspection Of Crankshaft And Bearings (Cont'd)

Figure -79



Clean the crankshaft journal and bearing. Put a strip of press gauge on the center journal.

Install the main bearing case halves and tighten the bolts. Remove the bearing case halves.

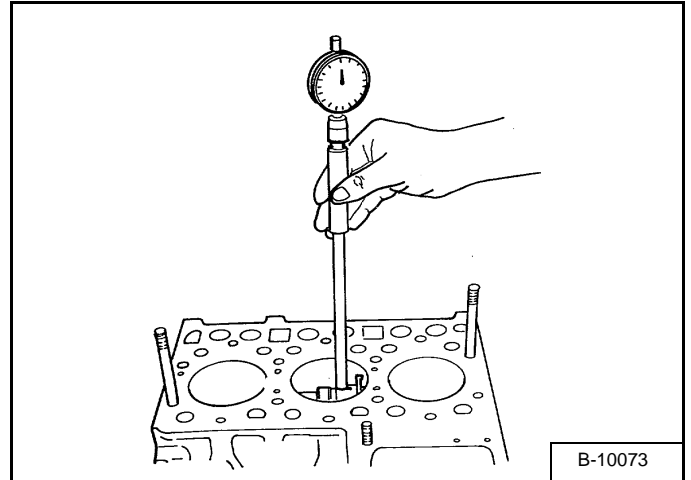
Measure the flattened press gauge [Figure -79].

If the clearance exceeds the allowable limit, replace the crankshaft bearing.

Crankshaft Journal O.D. (Flywheel side)	1.7297-1.7303 inch (43,93-43,95 mm)
Bearing I.D.	1.7317-1.7333 inch (43,90-44,03 mm)
Crankshaft Journal O.D. (Middle)	1.5722-1.5728 inch (39,93-39,95 mm)
Bearing I.D.	1.5742-1.5758 inch (39,98-40,04 mm)
Crankshaft journal O.D. (Front)	1.5722-1.5728 inch (33,98-30,03 mm)
Bearing I.D.	5742-1.5764 inch (33,98-40,04 mm)
Oil Clearance	0.001-0.004 inch (0,4-0,10 mm)
Allowable Limit	0.008 inch (0,2 mm)

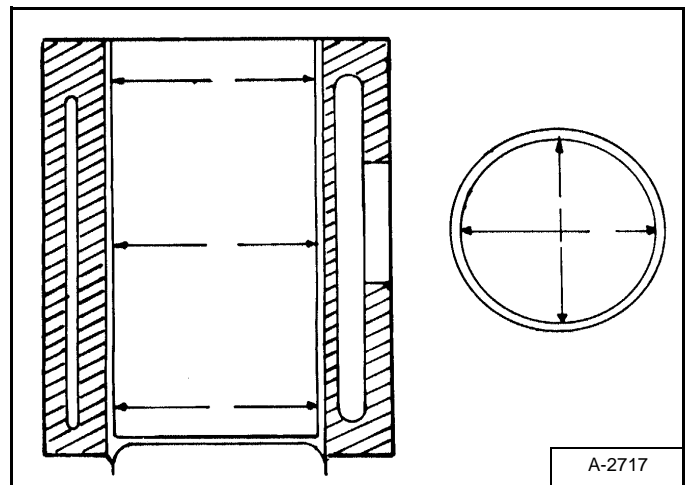
## Cylinder Bore Inspection

Figure -80



Check the inside diameter of the cylinder line [Figure -80].

Figure -81



To find the maximum wear check the inside diameter in six different locations [Figure -81].

When the cylinder bore is not within specifications, bore the cylinder for an oversize piston.

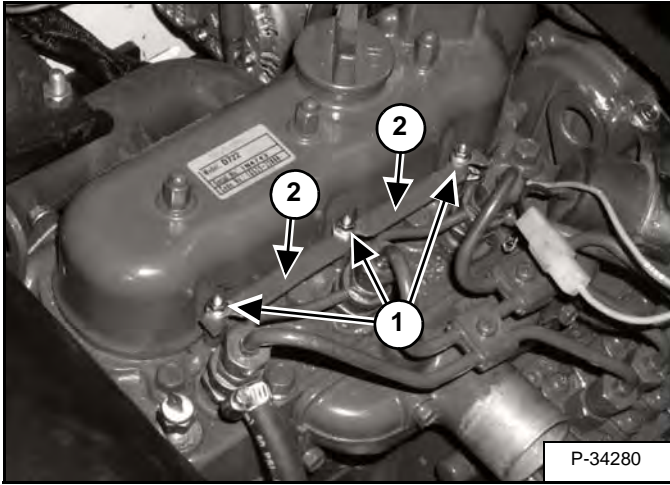
Cylinder Bore I.D	2.638-2.639 inch (67,0-67,02 mm)
Allowable Limit	0.006 inch (0,15 mm)

**NOTE: Make sure you use the correct oversize pistons and rings.**

## KUBOTA DIESEL ENGINE (CONT'D)

### Glow Plugs Checking

Figure -106



Disconnect the three nuts (Item 1) [Figure -106] that hold the glow plug electrical bar to the glow plugs.

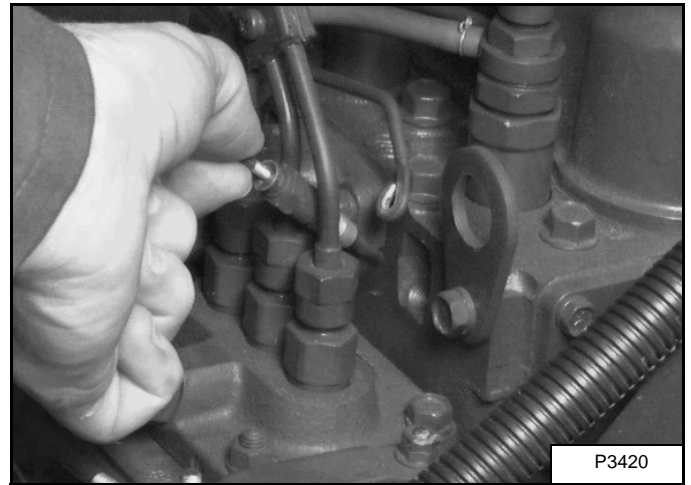
Remove the electrical bar (Item 2) [Figure -106] from the glow plugs.

Test the glow plugs by touching one probe to the end of the glow plug and the other probe to the body of the glow plug.

Glow plug resistance must be approximately 1.6 Ohms. If the resistance is zero ohms the glow plug has a short circuit.

If the resistance is infinite the coil of the glow plug is broken.

Figure -107



Replace the glow plug as needed [Figure -107].

## ENGINE SPECIFICATIONS (DIESEL)(CONT'D)

All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.

### Piston Rings

Ring Gap, Top & Oil	0.0059-0.0118 (0,15-0,30)
Ring Gap, 2nd	0.0118-0.0177 (0,30-0,45)
Limit Permitted	0.0472 (1,2)
Side Clearance of Ring in Groove;	
Top Ring	Beacuse of top ring design, measurement does not apply
2nd Ring	0.0033-0.0045 (0,09-0,12)
Oil Ring	0.0016-0.0031 (0,04-0,08)
Limit Permitted	0.006 (0,15)
Oversize of Piston & Ring	0.0098 (0,25)

### Pistons

I.D. of Piston Bosses	0.7874-0.7879 (20,00-20,013)
Limit Permitted	0.7894 (20,05)
O.D. of Piston Pin	0.7875-0.7878 (20,002-20,011)
I.D. of Connecting Rod Bushing (Small End, Fitted)	0.7884-0.7890 (20,02-20,04)
Clearance between Piston Pin & Bushing	0.0006-0.0015 (0,014-0,038)
Clearance between Piston Pin & Bushing Limit Permitted	0.004 (0,10)
Connecting Rod Alignment Limit Permitted	0.002 (0,05)

### Crankshaft

Crankshaft Alignment Limit Permitted	0.003 (0,02)
O.D. of Crankshaft Journal No. 1 & No. 3	1.5722-1.5728 (39,93-39,95)
O.D. of Crankshaft Journal No. 2	1.7297-1.7303 (43,93-43,95)
I.D. of Crankshaft Bearing No. 1	1.5742-1.5764 (39,98-40,04)
I.D. of Crankshaft Bearing No. 2	1.7317-1.7333 (43,98-44,03)
I.D. of Crankshaft Bearing No. 3	1.5742-1.5758 (39,98-40,03)
Clearance between No. 1 Crankshaft Journal and Bearing	0.0013-0.0042 (0,03-0,11)
Limit Permitted	0.008 (0,20)
Clearance between No. 2 Crankshaft Journal Bearing	0.0013-0.0036 (0,03-0,09)
Limit Permitted	0.008 (0,20)
Clearance between No. 3 Crankshaft Journal and Bearing	0.0013-0.0036 (0,03-0,09)
Limit Permitted	0.008 (0,20)
O.D. of Connecting Rod Journals	1.3370-1.3376 (33,96-33,98)
I.D. of Connecting Rod Bearings`	1.3384-1.3402 (33,99-34,04)
Clearance between Connecting Rod Journals and Bearings	0.0008-0.0032 (0,02-0,08)
Limit Permitted	0.006 (0,15)
Crankshaft End Play	0.006-0.012 (0,15-0,31)
Limit Permitted	0.020 (0,50)

# General Information

## Table of Contents

Before Servicing .....	1-2
Model Identification .....	1-4
General Specifications .....	1-5
Periodic Maintenance Chart.....	1-6
Torque and Locking Agent.....	1-7
Special Tools.....	1-9

# Fuel System

## Table of Contents

Exploded View.....	2-2	Carburetor Removal.....	2-11
Specifications.....	2-4	Carburetor Installation.....	2-12
Governor Link Mechanism.....	2-5	Carburetor Disassembly/Assembly.....	2-13
Control Panel Assembly Removal.....	2-5	Carburetor Cleaning.....	2-14
Control Panel Assembly Installation.....	2-5	Carburetor Inspection.....	2-14
Governor Arm Removal.....	2-5	Fuel Shut-Off Solenoid Valve Test.....	2-15
Governor Arm Installation.....	2-6	Intake Manifold.....	2-16
Governor Assembly Removal.....	2-6	Intake Manifold Removal.....	2-16
Governor Assembly Installation.....	2-6	Intake Manifold Installation.....	2-16
Governor Assembly Inspection.....	2-7	Intake Manifold Inspection.....	2-17
Governor Shaft Removal.....	2-7	Fuel Pump, Fuel Filter.....	2-18
Governor Shaft Installation.....	2-7	Fuel Pump Inspection.....	2-18
Carburetor.....	2-8	Fuel Filter Inspection.....	2-18
Fuel and Air Flow.....	2-8	Air Cleaner.....	2-19
Fuel Shut Off Solenoid Valve (Electric Starter Model).....	2-9	Element Removal.....	2-19
Low Idle Speed Adjustment.....	2-9	Element Installation.....	2-19
High Idle Speed Adjustment.....	2-10	Element Cleaning and Inspection.....	2-19
High Altitude Operation.....	2-11	Cleaner Body Removal.....	2-20
Main Jet Replacement.....	2-11	Cleaner Body Installation.....	2-20
Fuel System Cleanliness Inspection.....	2-11	Housing (Cover and Body) Inspection.....	2-20

## Carburetor

### High Altitude Operation

At high altitude, the standard carburetor air-fuel mixture will be excessively rich. Performance will decrease, and fuel consumption will increase. High altitude performance can be improved by installing a smaller diameter main-jet in the carburetor and correct idle speed.

#### NOTE

- The main jet high altitude kits are available if the equipment is to be used in the high altitudes. The main jet numbers are stamped on ends of the main jets.

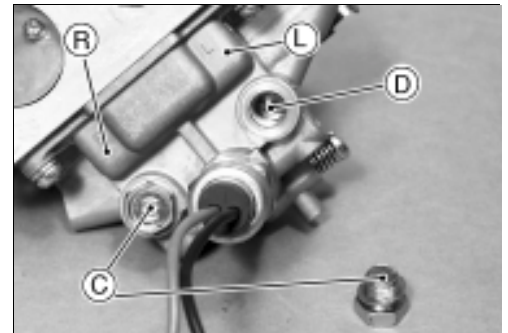
#### High Altitude Main Jet

Altitude	Main Jet No.		
	FH601D, FH641D	FH680D	
0 ~ 1000 m (0 ~ 3000 ft)	L: #92	R: #95	#108: L and R
1000 ~ 2000 m (3000 ~ 6000 ft)	L: #89	R: #92	#105: L and R
2000 m (6000 ft) and higher	L: #86	R: #89	#102: L and R

### Main Jet Replacement

- Place the engine (equipment) on a level surface.
- Close the fuel shut off valve in the equipment.
- Drain the fuel in the carburetor completely by unscrewing the drain screw at the bottom of the float chamber.
- Remove the carburetor (see Carburetor Removal).
- Unscrew the main jet plugs [C] and take off the main jet plugs and gaskets.
- Make sure that "L" [L] or "R" [R] mark on the float chamber is shown the main jet position.
- Using a proper blade screw driver, carefully replace the main jet [D] with a new one for altitude expected.
- Tighten the main jet to the specification (see Carburetor Disassembly/Assembly).
- Install the gasket and the main jet plug.

**Torque - Main Jet Plug: 19 N·m (1.9 kg·m, 14 ft·lb)**



### Fuel System Cleanliness Inspection

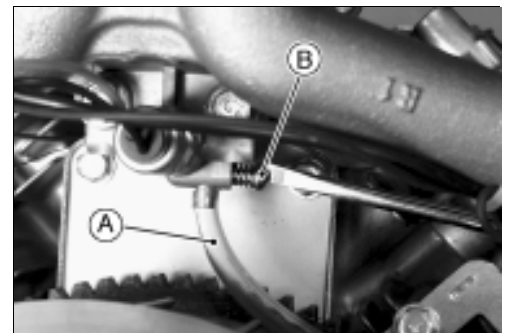
#### ⚠ WARNING

**Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. Do not smoke. Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.**

- Remove the air cleaner. (see Cleaner Body Removal)
- Connect a plastic tube [A] to the carburetor drain hole and place a suitable container under the plastic tube other end.
- Turn out the drain screw [B] a few turns to drain the carburetor and check to see if water or dirt has accumulated in the carburetor.
- Tighten the drain screw.

**Torque - Drain Screw: 2.0 N·m (0.2 kg·m, 18 in·lb)**

- If any water or dirt is found, clean the carburetor (see Carburetor Cleaning), and fuel tank, and check the fuel filter.



### Carburetor Removal

#### ⚠ WARNING

**Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. Do not smoke. Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.**

# Cooling System

## Table of Contents

Exploded View.....	3-2
Cooling Fan.....	3-3
Cooling Fan Removal.....	3-3
Cooling Fan Installation.....	3-3
Cooling Fan Inspection.....	3-3
Screen Clearance Adjustment.....	3-3

## Cylinder Head

- Tighten the cylinder head bolts following the tightening sequence.  
Torque - Cylinder Head Bolts: 25 N·m (2.6 kg·m, 19.0 ft·lb)

### CAUTION

A torque wrench must be used to assure proper torque. Improper tightening of the head bolts can result in warping of the cylinder head.

- Check and adjust the valve clearance (see Valve Clearance Inspection, Valve Clearance Adjustment).
- Install the gasket and rocker cover.  
Torque - Rocker Cover Mounting Bolts: 6.9 N·m (0.70 kg·m, 61 in·lb)
- Install the other removed parts.

### Push Rod Removal

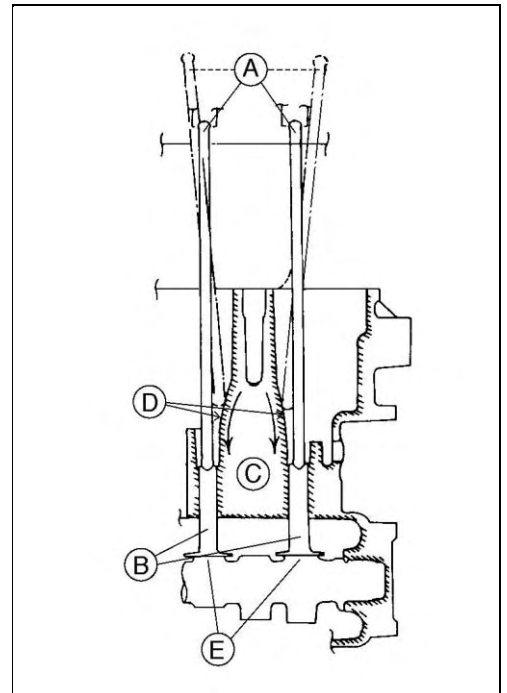
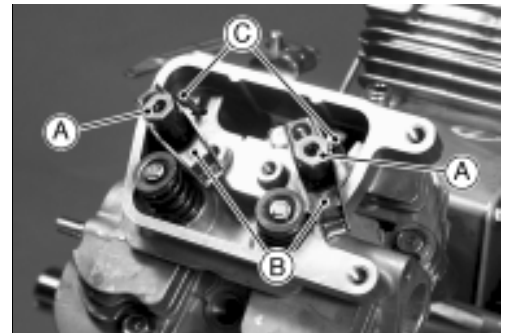
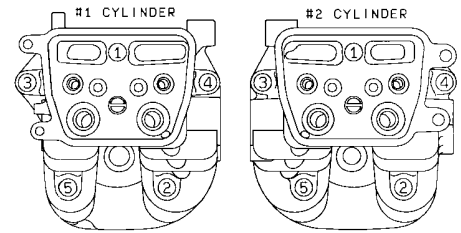
- Set each cylinder at T.D.C of power stroke.
- Remove the rocker covers. (see Cylinder Head Assembly Removal)
- Loosen the valve clearance adjusting nuts [A].
- Move the rocker arms [B] to clear the push rod [C] upper ends.
- Pull out the push rods.

### NOTE

- Mark the push rods so they can be installed in their original position during assembly.

### Push Rod Installation

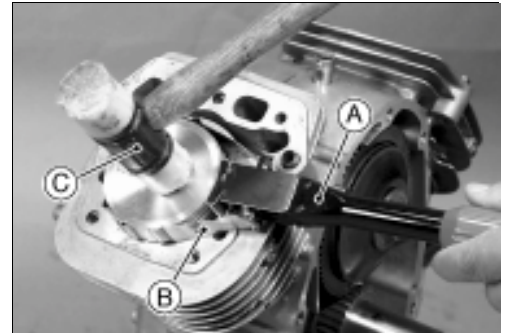
- Set each cylinder at T.D.C of power stroke.
- Install the push rods [A] in their original positions on each cylinder.
- To install the push rod in a correct position on the tappet [B], insert the push rod so end of the push rod is sliding down [C] along inside wall [D] of the crankcase and position the push rod end on to the tappet.
- Check that both intake and exhaust push rods on each cylinder are at lowest position on the cam lobes [E], if not turn the flywheel clockwise one turn (360°) and reset each cylinder at T.D.C of power stroke in.
- Be sure the end of the push rods are correctly seated on the tappets.
- Tighten the valve clearance adjusting nuts.
- Check and adjust the valve clearance.



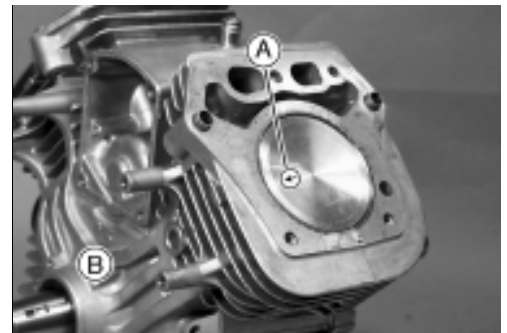
## Cylinder, Piston

- Apply engine oil to the piston skirt and the cylinder bore.
- ★ Using the piston ring compressor grip [A] and the belt [B], lightly tap the top of the piston with a plastic mallet [C] to insert the piston and connecting rod into the cylinder.

**Special Tool -** Piston Ring Compressor Grip: 57001-1095  
Piston Ring Compressor Belt: 57001-1097



- Insert the piston and connecting rod so that the arrow match mark [A] on the top of the piston is facing the flywheel side [B].



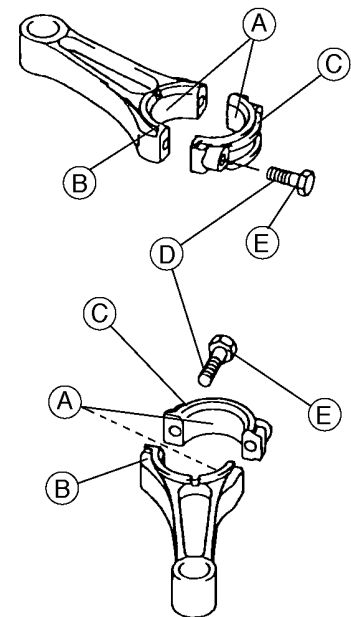
### CAUTION

The connecting rod and the connecting rod big end cap are machined at the factory in the assembled state, so they must be replaced together as a set.

- Apply engine oil to the inner surface [A] of the connecting rod big end [B] and caps [C].
- Install the connecting rod big end caps on their original position on each connecting rod big ends.
- Apply a small amount of engine oil to the thread [D] and seating surface [E] of the cap bolts.
- Tighten the cap bolts.

**Torque -** Connecting Rod Big End Cap Bolts: 9.8 N·m (1.0 kg·m, 87 in·lb)

- Install:
- Camshaft (see Camshaft/Crankshaft chapter)
- Crankcase Cover (see Camshaft/Crankshaft chapter)



### Piston/Cylinder Seizure

- In case of seizure, remove the piston.
- Visually inspect the cylinder and piston damage.
- ★ If there is only light damage, smooth the position with #400 emery cloth. Remove the small aluminum deposits from the cylinder with #400 emery cloth or light honing.
- ★ If the damage is severe, the both cylinders must be bored oversize and oversized pistons installed.

## Engine Oil and Oil Filter

### CAUTION

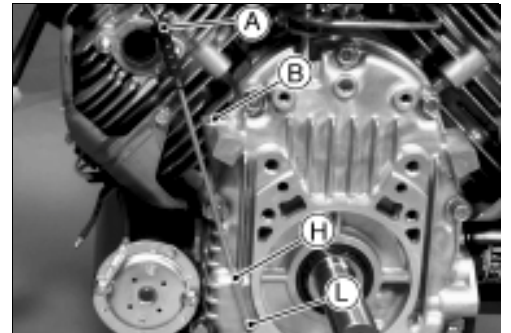
Engine operation with insufficient, deteriorated, or contaminated engine oil will cause accelerated wear and may result in engine seizure and accident.

Before starting the engine for the first time, add oil: The engine is shipped dry. Preoil the engine to force all air from the internal oil passages and the oil filter.

- Fill fresh engine oil to the specified level (see Oil Level Inspection).
- Run the engine at slow speed 2 minutes.
- Stop the engine and check the oil level.

### Oil Level Inspection

- Place the engine on a level surface and check the oil level.
- Clean area around oil gauge [A] before removing it.
- Remove the oil gauge and wipe it with a clean cloth.
- Insert the oil gauge into gauge hole [B] and let its plug firmly fit into the gauge hole, then check the oil level.
- The oil level should be the operating range (between "H" line and "L" line) on the oil gauge.
- ★ If the oil level is near or below the "L" line, remove the oil filler cap [C] and add enough engine oil to bring oil level to the "H" line.



### CAUTION

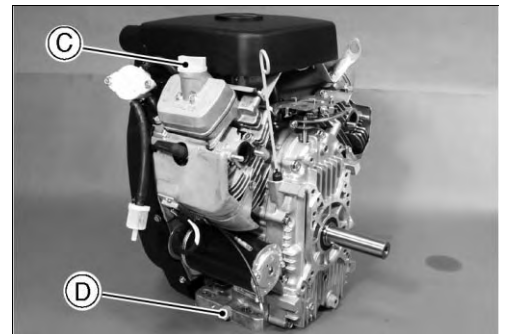
Do not fill above the "H" line. Excess oil will cause a smoking condition.

- Use the same type and make of oil that is already in the engine.

### NOTE

- If the engine oil type and make are unknown, use any brand of the specified oil to top up the level in preference to running the engine with the oil level low. Then at your earliest convenience, change the oil completely.

- ★ If the oil level is too high, remove the excess oil by loosening the drain plug [D].



### Oil Change

- Change the oil after first 8 hours of operation. Thereafter change oil every 100 hours.
- Start and warm up the engine so the oil will drain easily. Stop the engine.
- Place the engine on a level surface.
- Place a suitable container under the engine.
- Remove the drain plug [A] and drain the oil.

### WARNING

Be careful of hot oil when drained. It may be hot enough to burn you severely.

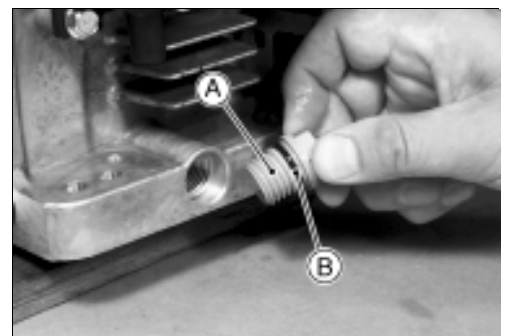
- Check the O-ring [B] at the drain plug for damage. Replace the O-ring with a new one if it is damaged.

- ★ If the oil drain plug joint is removed, tighten it.

Torque - Oil Drain Plug Joint (Plastic) :17 N·m (1.7 kg·m, 12.0 ft·lb)  
Oil Drain Plug Joint (Metal) :39 N·m (4.0 kg·m, 29 ft·lb)

- Install the drain plug with the O-ring and tighten it.

Torque - Oil Drain Plug (Plastic) :6.9 N·m (0.70 kg·m, 61 in·lb)  
Oil Drain Plug (Metal) :20 N·m (2.0 kg·m, 14.5 ft·lb)



## CAMSHAFT/CRANKSHAFT 6-3

### Specifications

Item	Service Limit
<b>Camshaft, Tappet:</b>	
Cam lobe height	Intake 29.621 mm (1.166 in.) Exhaust 29.621 mm (1.166 in.)
Camshaft journal diameter	PTO side 15.985 mm (0.6293 in.) Flywheel side 15.985 mm (0.6293 in.)
Camshaft bearing inside diameter	Crankcase 16.136 mm (0.6352 in.) Crankcase cover 16.136 mm (0.6352 in.)
<b>Crankshaft, Connecting Rod:</b>	
Connecting rod bend	0.15/100 mm (0.006/3.94 in.)
Connecting rod twist	0.15/100 mm (0.006/3.94 in.)
Connecting rod big end width	20.45 mm (0.805 in.)
Crankpin width	43.1 mm (1.697 in.)
Connecting rod big end inside diameter	40.044 mm (1.5765 in.)
Crankpin Outside diameter	39.940 mm (1.5724 in.)
Crankshaft runout	0.05 mm (0.002 in.) TIR
Crankshaft journal diameter	PTO side 39.896 mm (1.571 in.) Flywheel side 39.896 mm (1.571 in.)
<b>Crankcase:</b>	
PTO shaft bearing inside diameter	Crankcase cover 40.15 mm (1.581 in.)
Crankshaft journal bearing inside diameter	Crankcase 40.15 mm (1.581 in.)

Sealant - Kawasaki Bond (Silicone Sealant): 56019-120

## Crankshaft, Connecting Rod

### Connecting Rod Removal

- Remove:
  - Piston (see Engine Top End Chapter)

### Connecting Rod Installation

- Install:
  - Piston (see Engine Top End chapter)

### Crankshaft Removal

- Set the engine on a clean surface while parts are being removed.
- Drain the oil (see Lubrication System chapter).
- Remove:
  - Flywheel (see Electrical System chapter)
  - Camshaft (see Camshaft, Tappet Removal)
  - Connecting Rod and Piston Assembly (see Engine Top End chapter)
- Pull the crankshaft [A] out of the crankcase. Tap gently with a wooden or plastic mallet if necessary to loosen the crankshaft.



### Crankshaft Installation

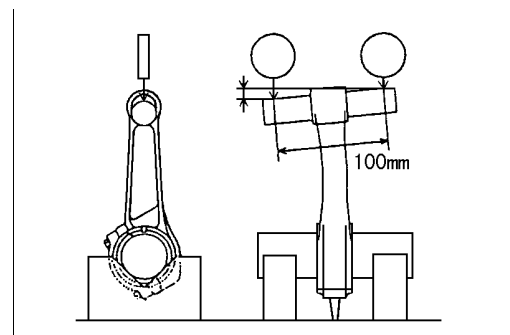
- Clean up the crankshaft and crankcase thoroughly, especially at the bearing contact surfaces.
- Pack some amount of high temperature grease into the oil seal on the crankcase.
- Apply engine oil to the journal and bearing.
- Carefully insert the crankshaft flywheel end into the main bearing and oil seal in the crankcase.

### Cleaning/Inspection

- After removing, clean the crankshaft and connecting rods with a high flash-point solvent and dry them with compressed air.
- Inspect the teeth of the crankshaft gear for pitting, fatigue cracks, burrs and evidence of improper tooth contact.
- ★ Replace the gear if necessary.
- Inspect the crankshaft and connecting rods especially at the bearing surfaces for wear, scratches, evidence of improper contact or other damages.
- ★ Replace them if necessary.

### Connecting Rod Bend/Twist

- Measure connecting rod bend.
- Select an arbor of the same diameter as the connecting rod big end, and insert the arbor through the connecting rod big end.
- Select an arbor of the same diameter as the piston pin and at least 100 mm long, and insert the arbor through the connecting rod small end.
- On a surface plate, set the big-end arbor on V blocks.
- With the connecting rod held vertically, use a height gauge to measure the difference in the height of the small end arbor above the surface plate over a 100 mm length to determine the amount of connecting rod bend.
- ★ If connecting rod bend exceeds the service limit, the connecting rod must be replaced.



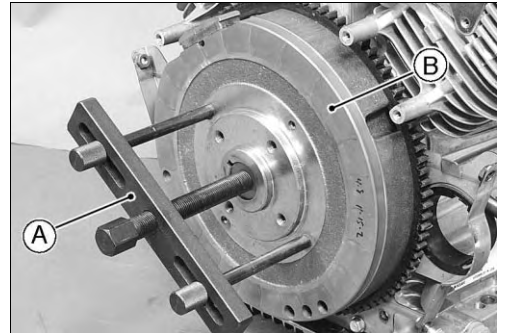
### Connecting Rod Bend

**Service Limit:** 0.15/100 mm (0.006/3.94 in.)

## Charging, Ignition System

- Using a suitable flywheel puller [A], remove the flywheel [B].

<b>CAUTION</b>
<b>Always use flywheel puller.</b>

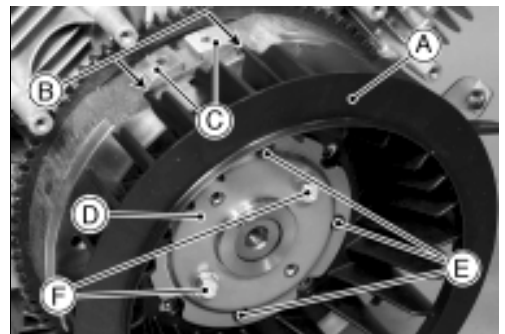
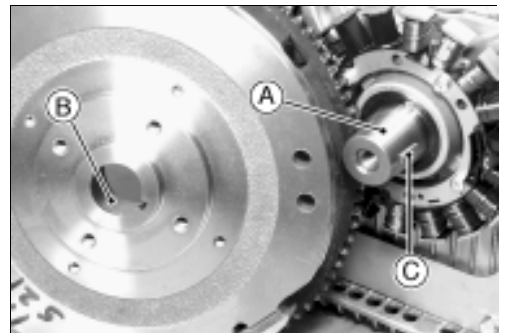


- Remove:  
Woodruff Key [A]  
Screws [B]  
Stator Coil [C]

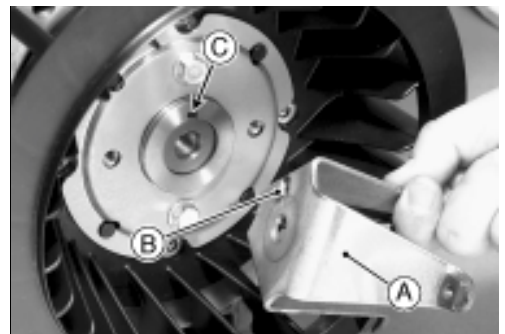


### *Flywheel, Stator Coil Installation*

- Install the stator coil and tighten the screws.  
**Torque - Stator Coil Screws: 3.4 N·m (0.35 kg·m, 30 in·lb)**
- Using a cleaning fluid, clean off any oil or dirt on the following portions and dry them with a clean cloth.  
[A] Crankshaft Tapered Portion  
[B] Flywheel Tapered Portion
- Fit the woodruff key [C] securely in the slot in the crankshaft before installing the flywheel.
- Install the flywheel onto the crankshaft taper so that the woodruff key fits in the key way in the hub of the flywheel.
- Install the fan [A] so that two positioning bosses [B] fit around flywheel ignition magnet [C].
- Install the plate [D] so that the bosses [E] of the fan fit in the holes of the plate with bolts [F].



- Install the bracket [A] so that the notch [B] inserts into the slot [C] in the flywheel.

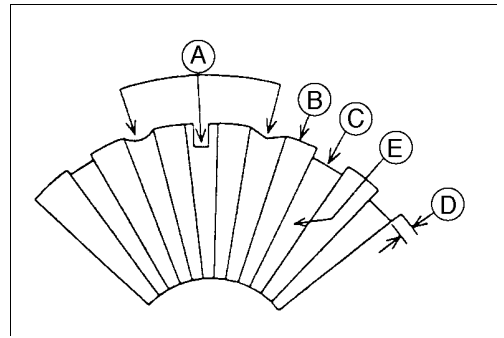


**Starter System**

- Measure the depth of the grooves between the commutator segments.
- ★ If the grooves are shallower than the specified limit, replace the armature with a new one.
- ★ If the grooves are only dirty, clean them carefully.

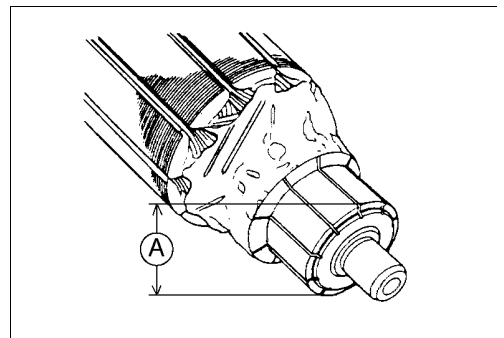
**Commutator Groove Depth Limit**  
 Less than 0.9 mm (0.035 in.)

- [A] Bad
- [B] Segment
- [C] Good
- [D] 0.9 mm (0.035 in.) limit
- [E] Mica



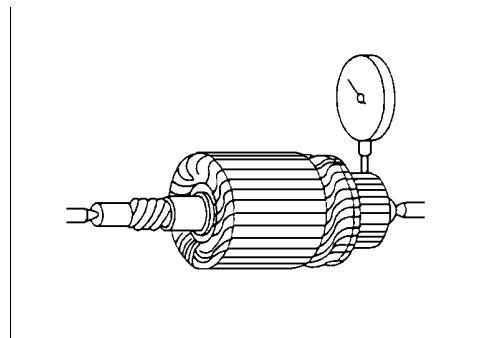
- Measure the commutator outside diameter [A] at several points.
- ★ If the diameter is less than the service limit, replace the armature with a new one.

**Commutator Outside Diameter**  
 Service Limit: 31.1 mm (1.225 in.)



- Support the armature in an alignment jig at each end of the shaft as shown. Position a dial indicator perpendicular to the commutator.
- Rotate the armature slowly and read the commutator runout.
- ★ If runout is more than the service limit, turn down the commutator or replace the armature with a new one.

**Commutator Runout**  
 Service Limit: 0.4 mm (0.016 in.)

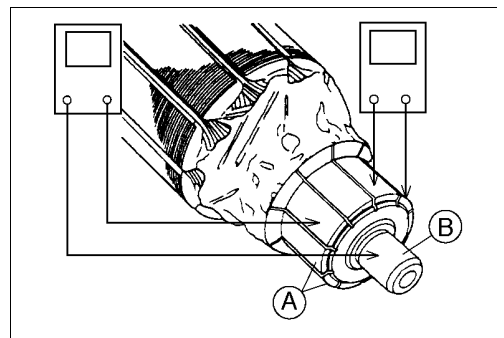


- Measure the armature winding resistance.
- Set the hand tester to the  $R \times 1 \Omega$  range and measure the resistance between each segment [A] and all the others.
- ★ If the resistance is too high or even infinite, the armature winding has an open circuit. Replace the starter motor.

**Armature Winding Resistance**  
 Close to 0  $\Omega$

- Set the hand tester to the  $R \times 1 k\Omega$  range and measure the resistance between the commutator and the armature shaft [B].
- ★ If the resistance is less than infinite, the armature is shorted. Replace the starter motor.

**Commutator to Shaft Resistance**  
 ( $\infty$ )



# A FEW WORDS ABOUT SAFETY

## SERVICE INFORMATION

The service and repair information contained in this manual is intended for use by qualified, professional technicians. Attempting service or repairs without the proper training, tools, and equipment could cause injury to you or others. It could also damage the engine or create an unsafe condition.

This manual describes the proper methods and procedures for performing service, maintenance, and repairs. Some procedures require the use of special tools. Any person who intends to use a replacement part, service procedure, or a tool that is not recommended by Honda, must determine the risks to their personal safety and the safe operation of the engine.

If you need to replace a part, use genuine Honda parts with the correct part number, or an equivalent part. We strongly recommend that you do not use replacement parts of inferior quality.

## For Your Customer's Safety

Proper service and maintenance are essential to the customer's safety and the reliability of the engine. Any error or oversight while servicing an engine can result in faulty operation, damage to the engine, or injury to others.

## For Your Safety

Because this manual is intended for the professional service technician, we do not provide warnings about many basic shop safety practices (eg, Hot parts – wear gloves). If you have not received shop safety training or do not feel confident about your knowledge of safe servicing practices, we recommend that you do not attempt to perform the procedures described in this manual.

Some of the most important general service safety precautions are given below. However, we cannot warn you of every conceivable hazard that can arise in performing service and repair procedures. Only you can decide whether or not you should perform a given task.

## Important Safety Precautions

- Make sure you have a clear understanding of all basic shop safety practices and that you are wearing appropriate clothing and using safety equipment. When performing any service task, be especially careful of the following:
  - Read all of the instructions before you begin, and make sure you have the tools, the replacement or repair parts, and the skills required to perform the tasks safely and completely.
  - Protect your eyes by using proper safety glasses, goggles, or face shields any time you hammer, drill, grind, or work around pressurized air or liquids, and springs or other stored-energy components. If there is any doubt, put on eye protection.
  - Use other protective wear when necessary, for example, gloves or safety shoes. Handling hot or sharp parts can cause severe burns or cuts. Before you grab something that looks like it can hurt you, stop and put on gloves.
- Make sure the engine is off before you begin any servicing procedures, unless the instructions tell you to do otherwise. This will help eliminate several potential hazards:
  - Carbon monoxide poisoning from engine exhaust. Be sure there is adequate ventilation whenever you run the engine.
  - Burns from hot parts. Let the engine and exhaust system cool before working in those areas.
  - Injury from moving parts. If the instruction tells you to run the engine, be sure your hands, fingers, and clothing are out of the way.
- Gasoline vapors are explosive. To reduce the possibility of a fire or explosion, be careful when working around gasoline.
  - Use only a nonflammable solvent, not gasoline, to clean parts.
  - Never drain or store gasoline in an open container.
  - Keep all cigarettes, sparks, and flames away from all fuel-related parts.

### WARNING

Improper service or repairs can create an unsafe condition that can cause your customer or others to be seriously hurt or killed.

Follow the procedures and precautions in this manual and other service materials carefully.

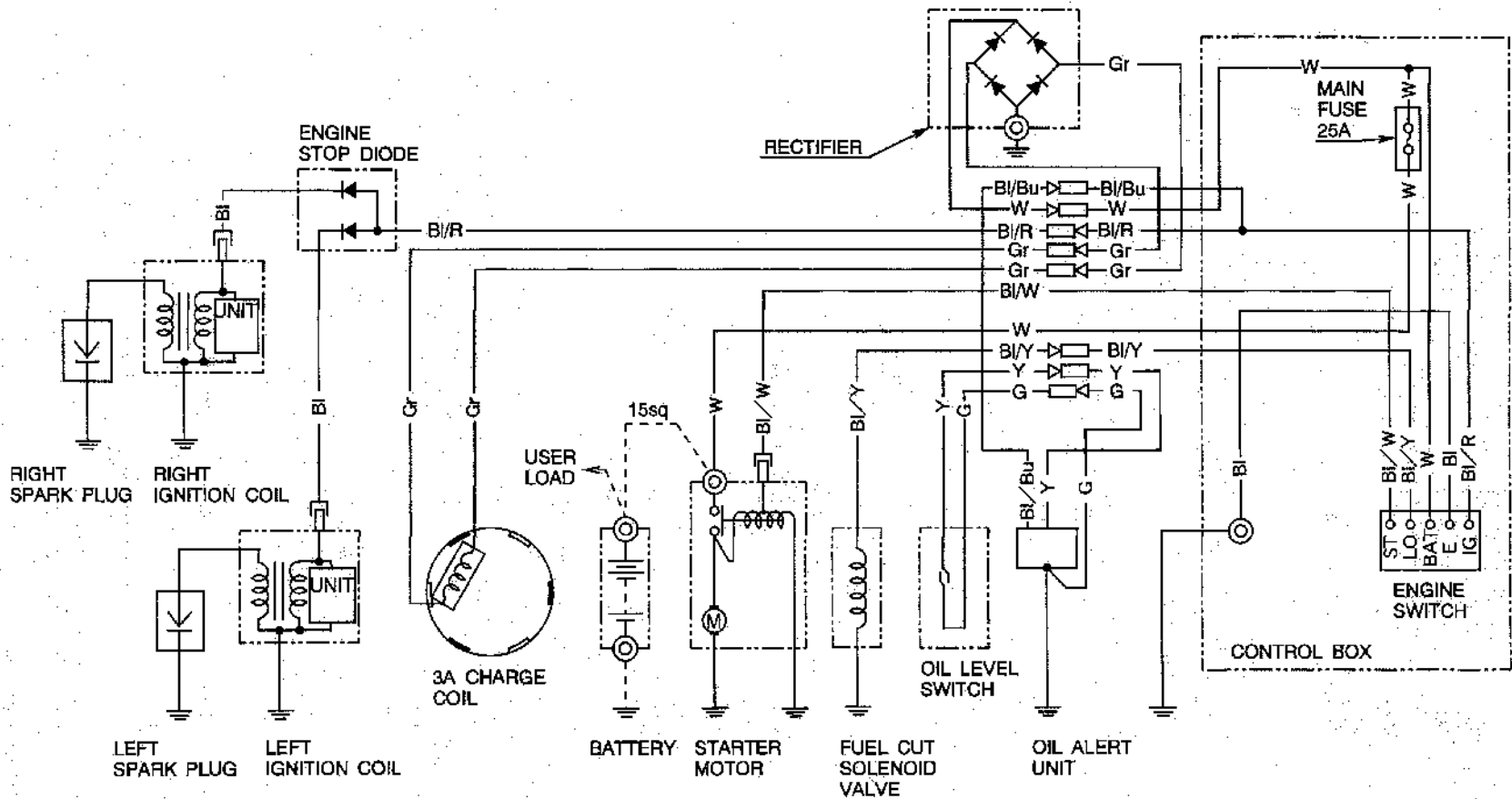
### WARNING

Failure to properly follow instructions and precautions can cause you to be seriously hurt or killed.

Follow the procedures and precautions in this manual carefully.

# WIRING DIAGRAMS

(3A Charge coil type)



ENGINE SWITCH

	IG	E	BAT	LO	ST
OFF	○	○			
ON			○	○	
ST			○	○	○

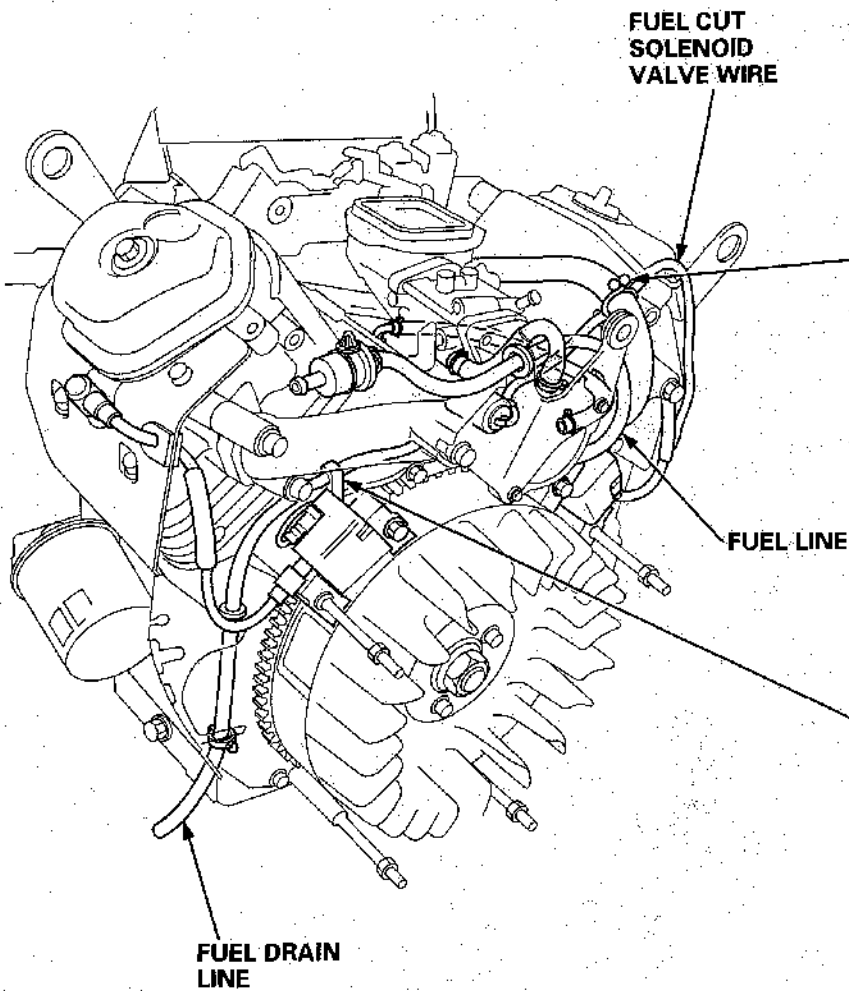
BI	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

# TORQUE VALUES

Item	Thread dia. (mm)	Torque		
		N-m	kgf-m	lbf-ft
Cylinder head bolt	M10 x 1.25	34	3.5	25
Cylinder head cover bolt	M6 x 1.0	9	0.9	6.5
Socket bolt	M8 x 1.25	27	2.7	20
Connecting rod bolt	M6 x 1.0	12	1.2	9
Spark plug	M14 x 1.25	18	1.8	13
Oil filter holder	M20 x 1.5	18	1.8	13
Oil filter cartridge	M20 x 1.5	22	2.2	16
Flywheel nut	M20 x 1.5 (Special nut)	196	20.0	145
Cylinder head stud bolt	M8 x 1.25	18	1.8	13
Pivot bolt	M8 x 1.25	24	2.4	17
Pivot adjusting nut	M6 x 0.5	10	1.0	7
Carburetor bolt	M6 x 1.0	9	0.9	6.5
Oil drain bolt	M14 x 1.5	39	4.0	29
Oil pressure switch	PT 1/8	9	0.9	6.5
Fan cover bolt/nut	M6 x 1.0	9	0.9	6.5
Governor arm nut	M6 x 1.0	11	1.1	8
Oil level switch joint nut	M10 x 1.25	10	1.0	7
Valve lifter assembly bolt	M5 x 0.8	5.5	0.55	4.0
Starter motor terminal nut	M8 x 1.25	9	0.9	6.5
Fuel pump cover screw	M5	4	0.4	2.9
Fuel pump washer-screw	M6 x 1.0	9	0.9	6.5
Oil pump cover assembly bolt	M6 x 1.0	10	1.0	7
Special bolt	M5 x 0.8	5.5	0.55	4.0
Sealing bolt	PT 1/8	9	0.9	6.5
Standard torque values	5 mm screw	4	0.4	2.9
	5 mm bolt/nut	5	0.5	3.6
	6 mm screw	9	0.9	6.5
	8 mm bolt (SH bolt)	9	0.9	6.5
	6 mm bolt/nut	10	1.0	7
	8 mm flange bolt/nut	12	1.2	9
	8 mm bolt/nut	22	2.2	16
	8 mm flange bolt/nut	27	2.7	20
	10 mm bolt/nut	34	3.5	25
	10 mm flange bolt/nut	39	3.9	28
	12 mm bolt/nut	54	5.5	40
6 mm CT flange bolt	12	1.2	9	

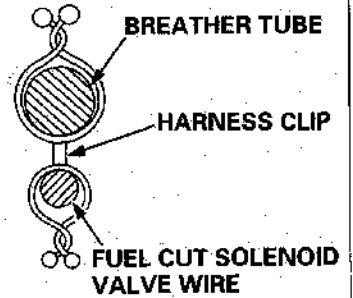
## NOTE:

- (SH) indicates a small head bolt.
- (CT) indicates a self-tapping bolt.
- (PT) indicates a taper-pipe-thread bolt.



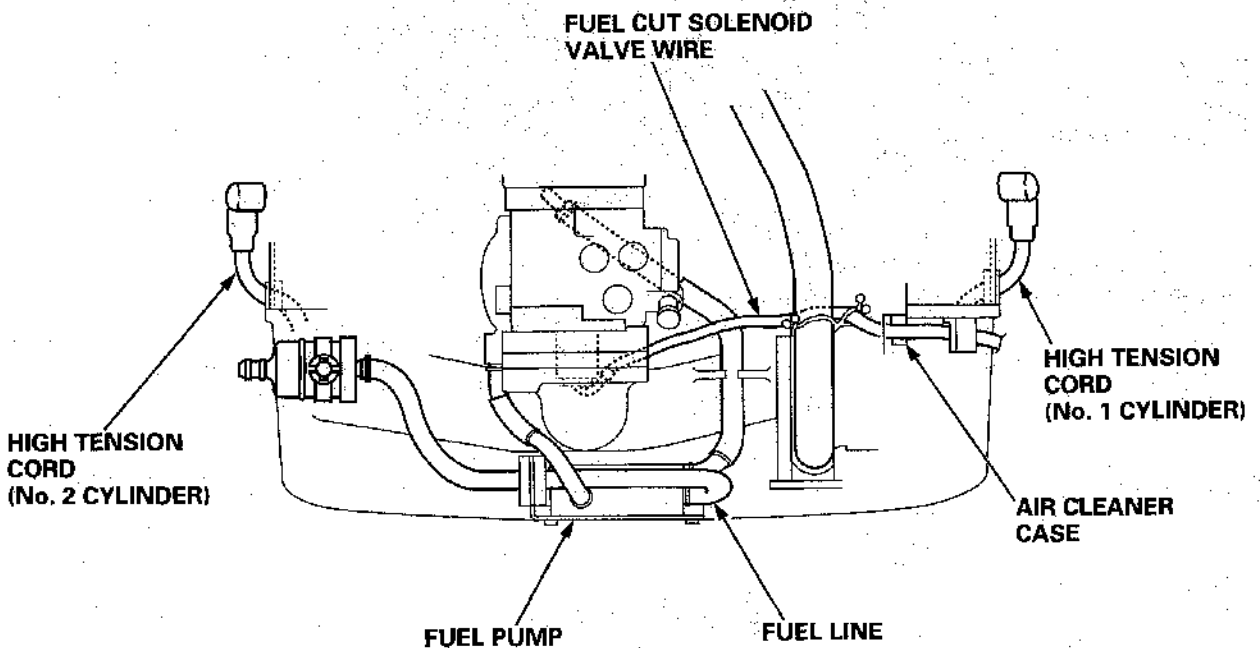
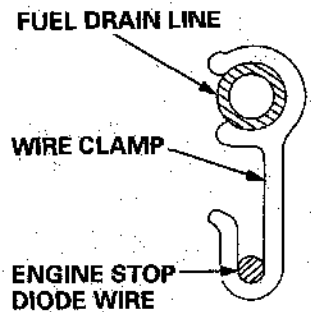
**HARNESS CLIP**

Install as shown.



**WIRE CLAMP**

Install as shown.



# CARBURETOR

## • Adjustment

### Throttle stop screw:

- 1) Remove the two 5 x 20 mm tapping screws and the fuel pump cover.
- 2) Start the engine and allow it to warm up to normal operating temperature.
- 3) With the engine idling, turn the throttle stop screw to obtain the standard idle speed.

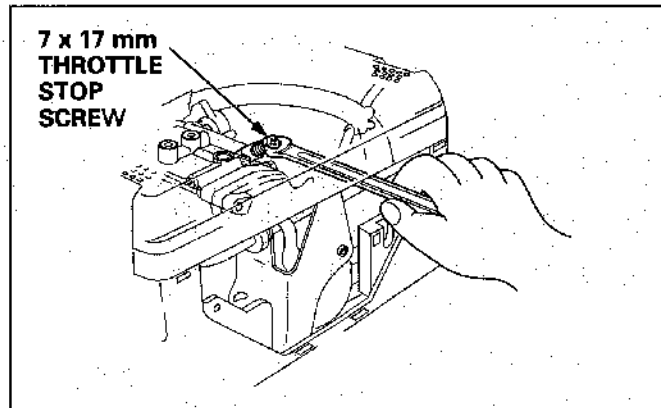
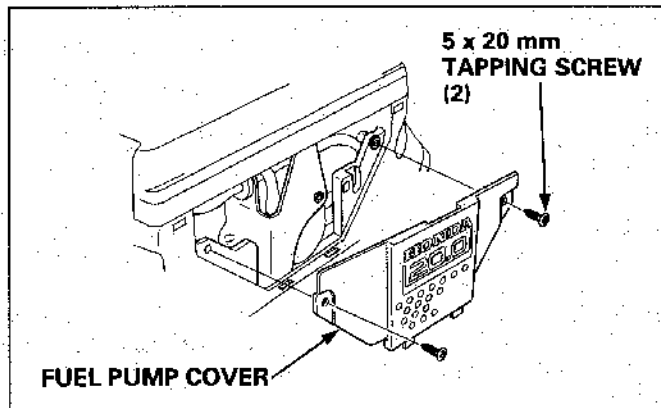
Standard idle speed

### Pilot screw:

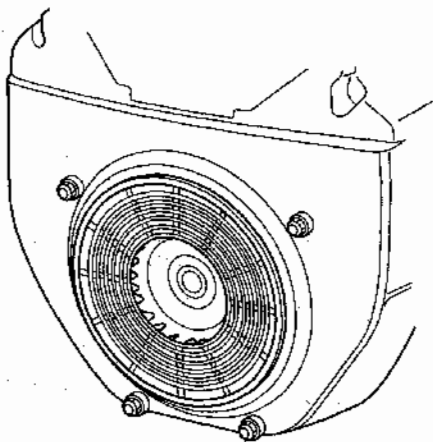
The pilot screw is fitted with a limiter cap that prevents excessive enrichment of the air-fuel mixture in order to comply with emissions regulations.

Do not attempt to remove the limiter cap for pilot screw adjustment. The limiter cap cannot be removed without breaking the pilot screw.

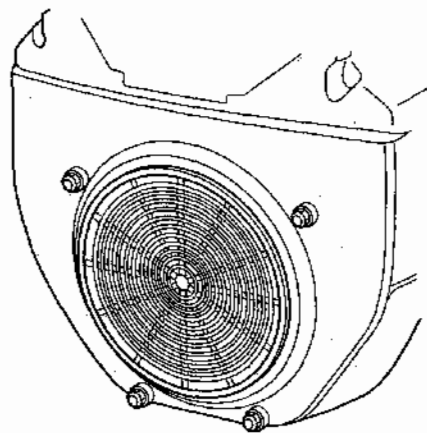
Pilot screw adjustment must be performed only when it is disassembled



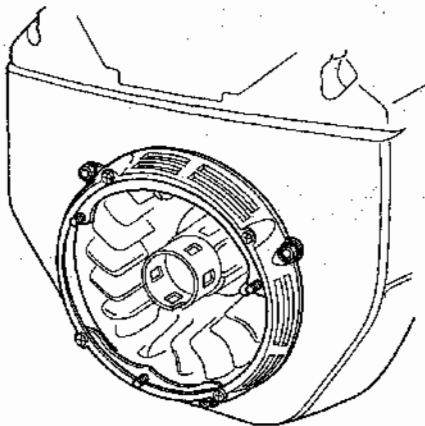
**FLYWHEEL P.T.O. TYPE**



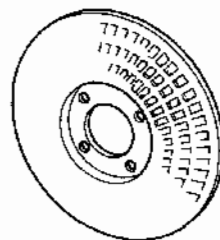
**PROTECTOR TYPE  
(STANDARD)**



**RECOIL STARTER EQUIPPED TYPE**



**SCREEN GRID (OPTIONAL PART)**



**FLYWHEEL P.T.O. TYPE**

## DISASSEMBLY/REASSEMBLY

Before disassembly, loosen the drain screw and drain the carburetor.

### ⚠ WARNING

Gasoline is highly flammable and explosive.

You can be burned or seriously injured when handling fuel.

- Keep heat, sparks, and flame away.
- Handle fuel only outdoors.
- Wipe up spills immediately.

- Clean the outside of the carburetor before disassembly.

### CARBURETOR BODY

#### REASSEMBLY:

Clean thoroughly with compressed air before installation.

### THROTTLE STOP SCREW ADJUSTMENT

### PILOT SCREW

#### REASSEMBLY:

Inspect for wear or damage before installation.

#### ADJUSTMENT

### LIMITER CAP

#### INSTALLATION

The limiter cap is cemented on the pilot screw and should not be removed unless the carburetor is overhauled.

### MAIN NOZZLE

#### REASSEMBLY:

Clean thoroughly with compressed air before installation.



### FLOAT VALVE

#### REASSEMBLY:

Check for worn float valve seat, float valve or weak spring before installation.



REPLACE

#### FLOAT VALVE

OK

OK



### MAIN JET

#### REASSEMBLY:

Clean thoroughly with compressed air before installation.

MAIN JET NUMBER:



### FLOAT

INSPECT

#### REASSEMBLY:

Check for smooth movement after installation.

### FLOAT PIN

### FLOAT CHAMBER GASKET

4 x 14 mm WASHER-SCREW (4)

DRAIN SCREW

O-RING

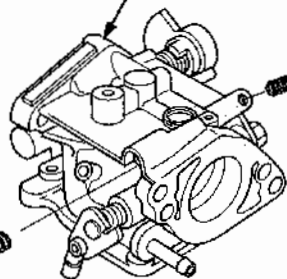
FLOAT CHAMBER

O-RING

FUEL CUT SOLENOID VALVE

INSPECTION

5 x 12 mm WASHER-SCREW (2)



### L. SIDE PLATE

#### REASSEMBLY:

Set the projection on the L. shroud into the hole in the L. side plate.

### CHARGE COIL [12 V - 20 A] INSPECTION

6 x 35 (6)

6 x 35 (2)

### CHARGE COIL [12 V - 3 A] INSPECTION

### R. SIDE PLATE

#### REASSEMBLY:

Set the projection on the R. shroud into the hole in the R. side plate.

6 x 12 (4)

6 x 71 mm  
STUD BOLT (2)

6 x 8 (2)

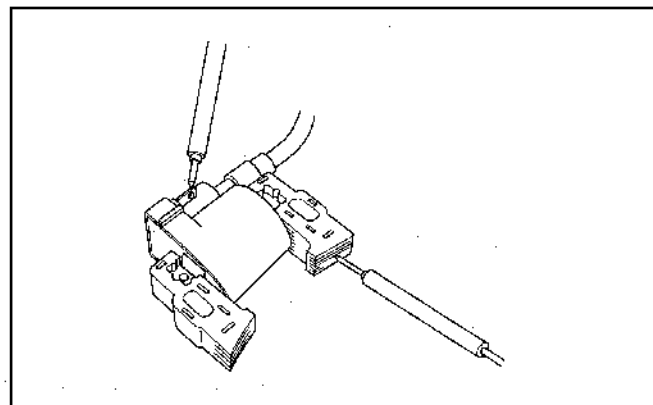
## INSPECTION

### • IGNITION COILS

#### <Primary Side>

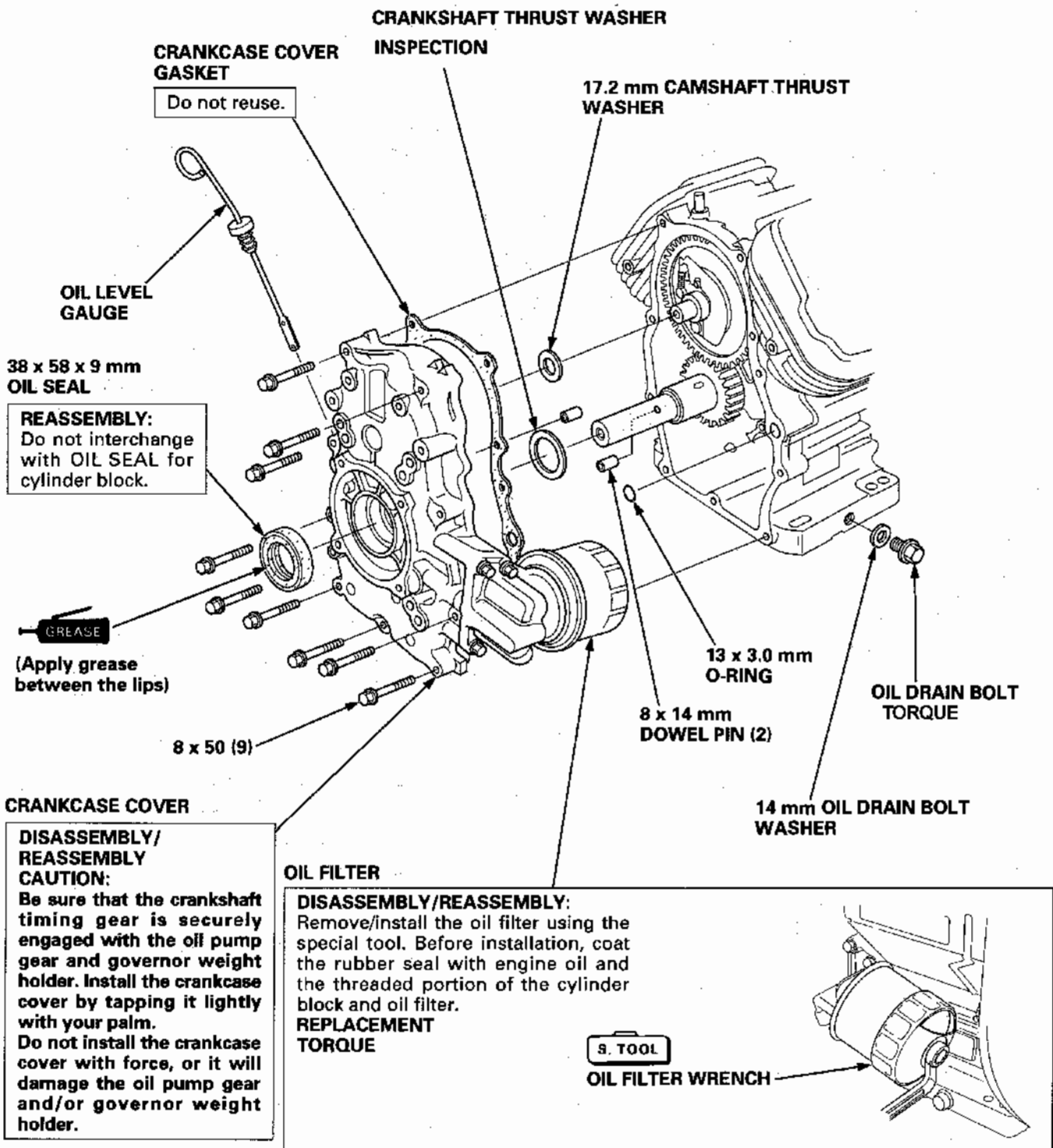
Measure the resistance of the primary coil by attaching one ohmmeter lead to the ignition coil's primary terminal while touching the other test lead to the iron core.

Primary side resistance value



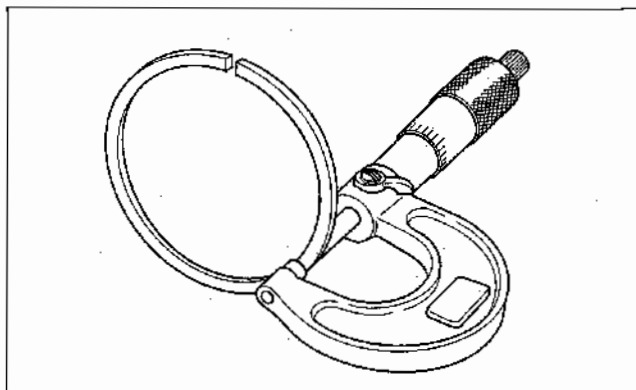
# CRANKCASE COVER

## REMOVAL/INSTALLATION



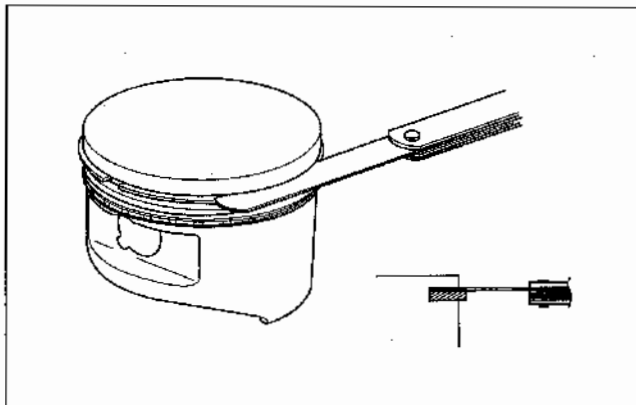
### ● PISTON RING WIDTH

STANDARD	SERVICE LIMIT
----------	---------------



### ● PISTON RING SIDE CLEARANCE

STANDARD	SERVICE LIMIT
----------	---------------



### ● PISTON/CONNECTING ROD

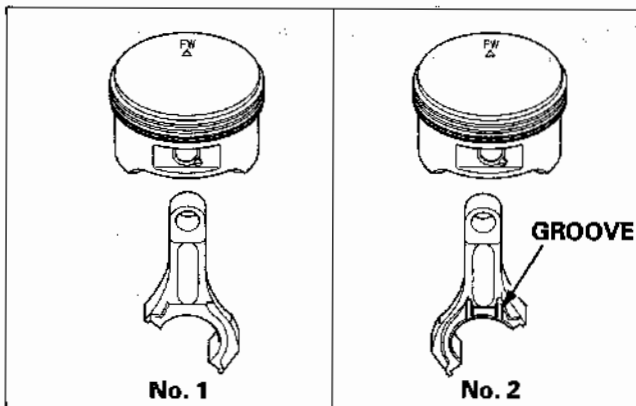
#### REASSEMBLY:

#### <For No. 1 cylinder>

Install the piston/connecting rod so that the groove on the connecting rod and the "FW" mark on the top of the piston are set in the same direction.

#### <For No. 2 cylinder>

Install the piston/connecting rod so that the groove on the connecting rod and the "FW" mark on the top of the piston are set in the opposite direction.



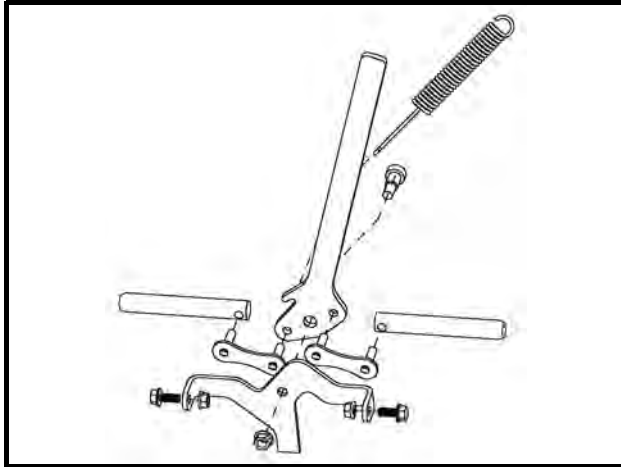


Figure 21-3 Hand Lever Linkages and Pins

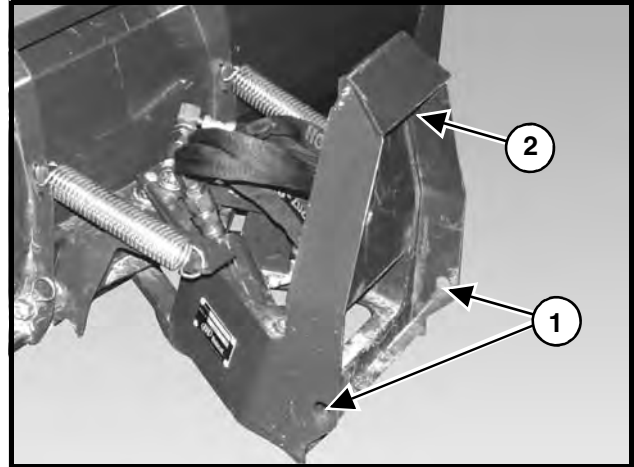


Figure 21-4 Inspect Mount

## Mount

**NOTE:** The following picture may not show your exact attachment but mounting frame inspections are the same.

Inspect the pin mounts (1), mounting flange (2) and all welds for wear, damage and cracks (**Figure 21-4, Page 21-3**). Replace or repair parts as necessary.

## REMOVING AND INSTALLING THE ATTACHMENT ARM MECHANISM

When the attachment arm mechanism is not being used, it can be removed from the vehicle.

**NOTE:** Remove the bucket or the attachment before attempting to remove the attachment arm mechanism from the vehicle.

## Attachment Arm Removal



Figure 21-5 Lower Arm and Tilt Interface Forward

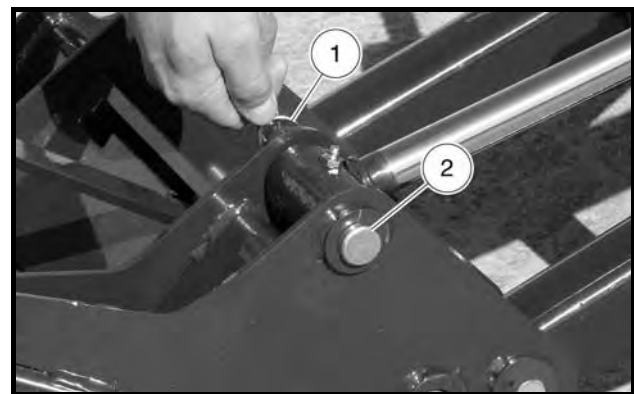


Figure 21-6 Remove Interface Cylinder Retaining Pin

**NOTE:** When removing the cylinders from the attachment arm or the interface, the cylinders may need to be retracted slightly. Do not have hands in the area of the cylinders when extending or retracting the cylinders.

- Check the fuse.
- Check continuity of the 14-gauge red wire (w06) from the “hot” side of the circuit breaker to the fuse.
- Check continuity of the 14-gauge red wire (w52) from the fuse to the Accessory Relay
- Check continuity of the 18-gauge red wire (w40) from the fuse to the ON/OFF switch.
- Check continuity from the 14-gauge red wire (w08) at the Accessory Relay to the 16-gauge orange/black wire (w10) at the ON/OFF switch.
- Check continuity from the 16-gauge orange wire (w81) at the ON/OFF switch to any 18-gauge orange wire at the joystick.

### Joystick ON/OFF Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the joystick ON/OFF switch to OFF and remove both seats.
3. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
4. Cut the wire tie securing joystick harness to chassis (**Figure 21-22, Page 21-11**).
5. Access the joystick ON/OFF switch. **See Joystick Removal on page 21-11.**
6. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
7. Unplug harness from switch (**Figure 21-22, Page 21-11**). Squeeze tabs at each end of switch and push switch out the back of the control box.

### Joystick ON/OFF Switch Installation

1. Insert switch into control box until fully seated.
2. Connect harness plug to switch.
3. Install control box cover/joystick assembly and secure with the four screws.
4. Secure joystick harness to chassis with new wire tie (**Figure 21-22, Page 21-11**).
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

- The supplied voltage.
  - The continuity of the control valve coil.
  - Any debris in the valve cartridge.
    - Check for debris by energizing the valve without starting the motor and listening for the “valve shift” (a definite “Click” is heard when the valve is energized).
    - If it cannot be heard, remove the cartridge from the valve body and blow compressed air through all parts to dislodge dirt. Clean all parts in solvent, blow dry, and lubricate.
2. If the valve does not return to the neutral or unshifted position, check for dirt in the valve cartridge and repair as described above.

## HOSES

### HOSE ROUTING

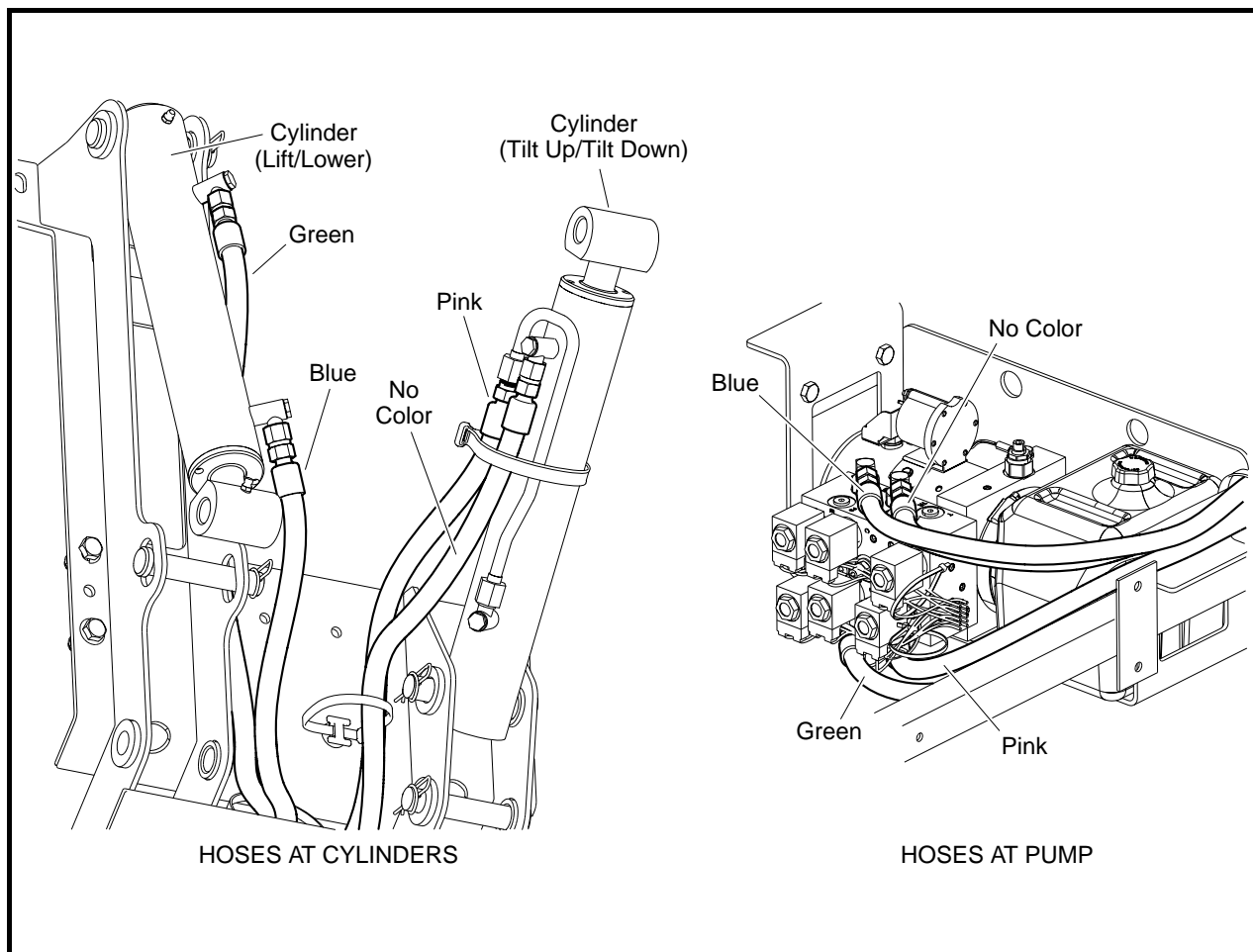


Figure 21-34 Lift And Tilt Circuit Hoses

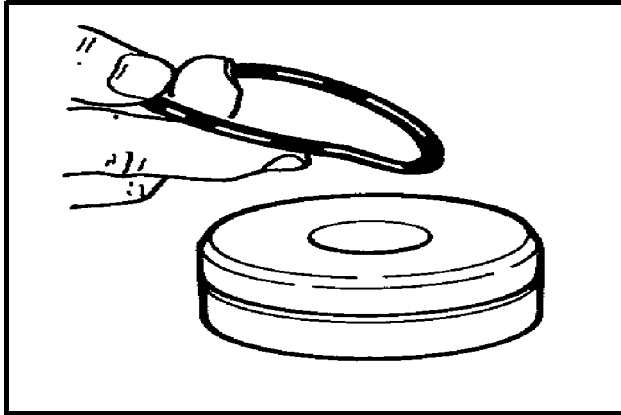


Figure 21-53 Install Piston O-ring

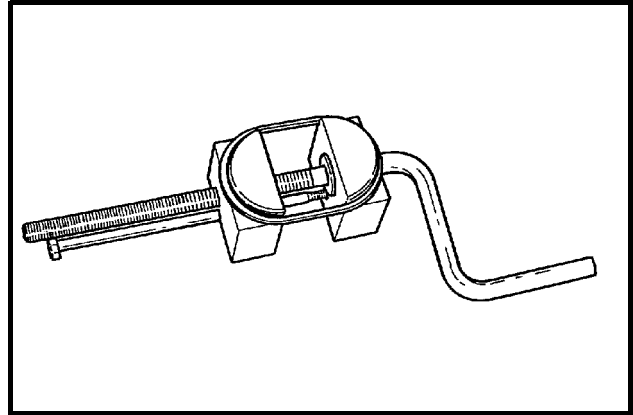


Figure 21-54 Stretch Piston Seal

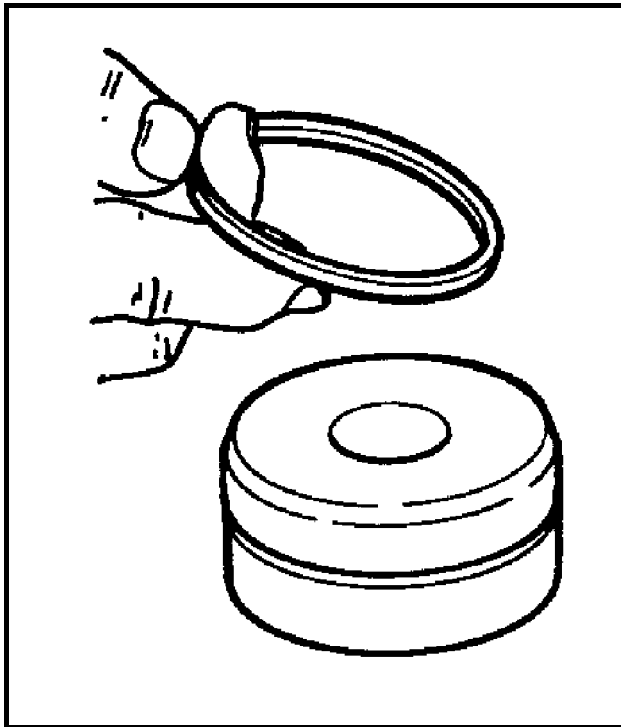


Figure 21-55 Install Piston Seal

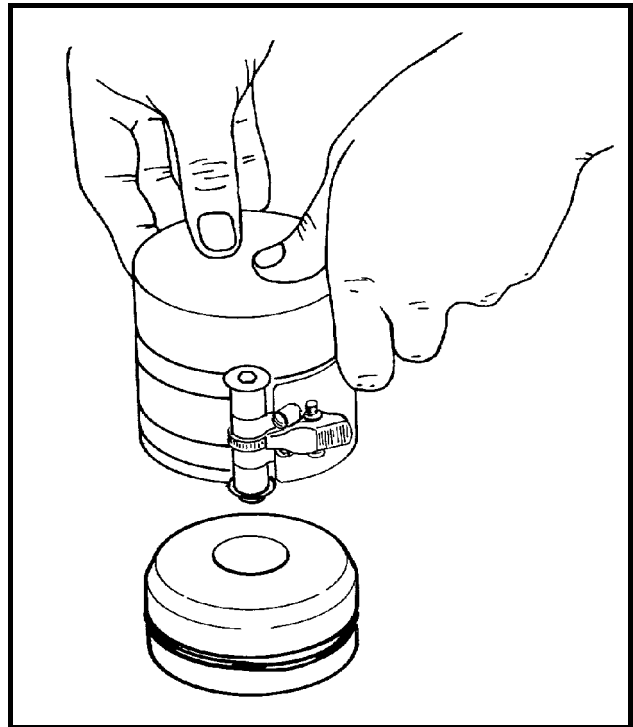


Figure 21-56 Compress Piston Seal

5. Install the oil seal on the rod seal tool (**Figure 21-57, Page 21-34**).

**NOTE:** The O-ring side of the oil seal goes toward the inside of the cylinder.

6. Install the oil seal in the head (**Figure 21-58, Page 21-34**).

## HYDRAULIC PUMP ASSEMBLY

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### **⚠ WARNING**

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - Fluids are under pressure.
  - Flying debris or loose material is present.
  - Engine is running.
  - Tools are being used.

### **CAUTION**

- **When repairing hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.**

*NOTE: Mark hoses for correct installation if factory markings are not found.*

*Contain and dispose of any leaking oil in an environmentally safe manner.*

## FLUID LEVEL INSPECTION

See Hydraulic System – 2300 Vehicle, Section 10a, Page 10a-16.

## FLUID CHANGE

### **If replacing the hydraulic fluid with fresh fluid**

1. Remove attachment if installed. **See Attachment Interface on page 21-2.**
2. Relieve pressure in hydraulic system. **See Relieving Hydraulic System Pressure on page 21-1.**
3. Thoroughly clean the hose fittings and the area around the ends of the hoses being removed.
4. Locate and note the hose factory color marking to ease reassembly. **See following NOTE.**

*NOTE: Mark hoses for correct installation if factory markings are not found.*

5. Place drain pan under cylinders.
6. Slowly loosen and disconnect hoses at cylinders and, if equipped, quick connect fittings. Allow cylinders to drain into pan and then cover cylinder and quick connect fittings to keep out debris. **See Vehicle Mounted Cylinders on page 21-26. See also Quick Connect Fittings (Auxiliary Hydraulic Circuit only) on page 21-25.**
7. Place hose ends into a clean bucket to catch fluid.
8. Reconnect the battery cables, positive (+) cable first, and turn the key switch ON.
9. Switch the joystick ON/OFF switch to ON.
10. Pump fluid out of the hoses by moving the joystick back and forth and side to side several times and press the auxiliary hydraulic switch, if equipped, to the right and left several times until reservoir is nearly empty.
11. Inspect filler cap and replace if necessary.
12. Add fresh hydraulic fluid to reservoir until level is between the Maximum and Minimum Fluid Level lines.

- cargo bed**  
 see bed, cargo
- CAUTION**  
 definition of ..... 1-1
- charge coil (gasoline vehicles)** ..... 12a-15, 12b-12  
 testing ..... 11a-25, 11b-26  
 troubleshooting ..... 11a-25, 11b-26
- choke cable (gasoline vehicles)**  
 installation ..... 13a-23, 13b-26  
 removal ..... 13a-22, 13b-25
- circuit breaker, bed lift (diesel vehicles)**  
 installation ..... 12c-9  
 removal ..... 12c-8
- circuit breaker, bed lift (gasoline vehicles)**  
 installation ..... 12a-9, 12b-8  
 removal ..... 12a-9, 12b-8
- circuit breaker, hydraulic attachment**  
 installation ..... 21-20  
 removal ..... 21-20  
 testing ..... 21-20
- cleaning**  
 seat ..... 4-1  
 vehicle body ..... 4-1
- clutch and ring gear**  
 assembly ..... 17-13  
 disassembly ..... 17-11
- clutch carrier**  
 assembly ..... 18-7  
 bearing installation ..... 18-7  
 bearing removal ..... 18-7  
 installation ..... 18-7  
 removal ..... 18-7
- clutch inner cover (diesel vehicles)**  
 installation ..... 13c-36  
 removal ..... 13c-36
- clutch inner cover (gasoline vehicles)**  
 installation ..... 13a-40, 13b-40  
 removal ..... 13a-39, 13b-39
- clutch outer cover (diesel vehicles)**  
 installation ..... 13c-35  
 removal ..... 13c-35
- clutch outer cover (gasoline vehicles)**  
 installation ..... 13a-39, 13b-39  
 removal ..... 13a-39, 13b-39
- clutch, drive**  
 see drive clutch
- clutch, driven**  
 see driven clutch
- coil and output cover**  
 assembly ..... 17-5  
 disassembly ..... 17-4  
 installation ..... 17-6  
 removal ..... 17-3
- coil, charge (gasoline vehicles)** ..... 12a-15, 12b-12
- coil, ignition (gasoline vehicles)** ..... 12a-15, 12b-12
- column, steering**  
 installation ..... 7-3  
 removal ..... 7-2
- coolant reservoir (diesel vehicles)**  
 installation ..... 15-4  
 removal ..... 15-3
- coolant temperature warning light circuit (diesel vehicles)**  
 testing ..... 11c-39
- coolant, engine (diesel vehicles)**  
 change ..... 15-1  
 level check ..... 10a-17, 10b-16
- cylinder, auxiliary**  
 installation ..... 21-28  
 removal ..... 21-27
- cylinder, hydraulic**  
 assembly ..... 21-32  
 bushings ..... 21-37  
 disassembly ..... 21-29  
 parts identification ..... 21-29
- cylinder, vehicle mounted**  
 installation ..... 21-27  
 removal ..... 21-26
- D**
- DANGER**  
 definition of ..... 1-1
- differential relay (diesel vehicles)**  
 testing ..... 11c-22
- differential relay (gasoline vehicles)**  
 testing ..... 11b-17
- differential, front**  
 installation ..... 14-6  
 lubrication  
 change ..... 10a-14, 10b-13  
 fill ..... 10a-14, 10b-13  
 level check ..... 10a-14, 10b-13  
 removal ..... 14-4  
 see front differential
- differential, rear**  
 installation ..... 14-20  
 lubrication  
 change ..... 10a-14, 10b-13  
 level check ..... 10a-14, 10b-13  
 removal ..... 14-18  
 see rear differential
- diode, wire harness (diesel vehicles)**  
 installation ..... 12c-19  
 removal ..... 12c-18

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