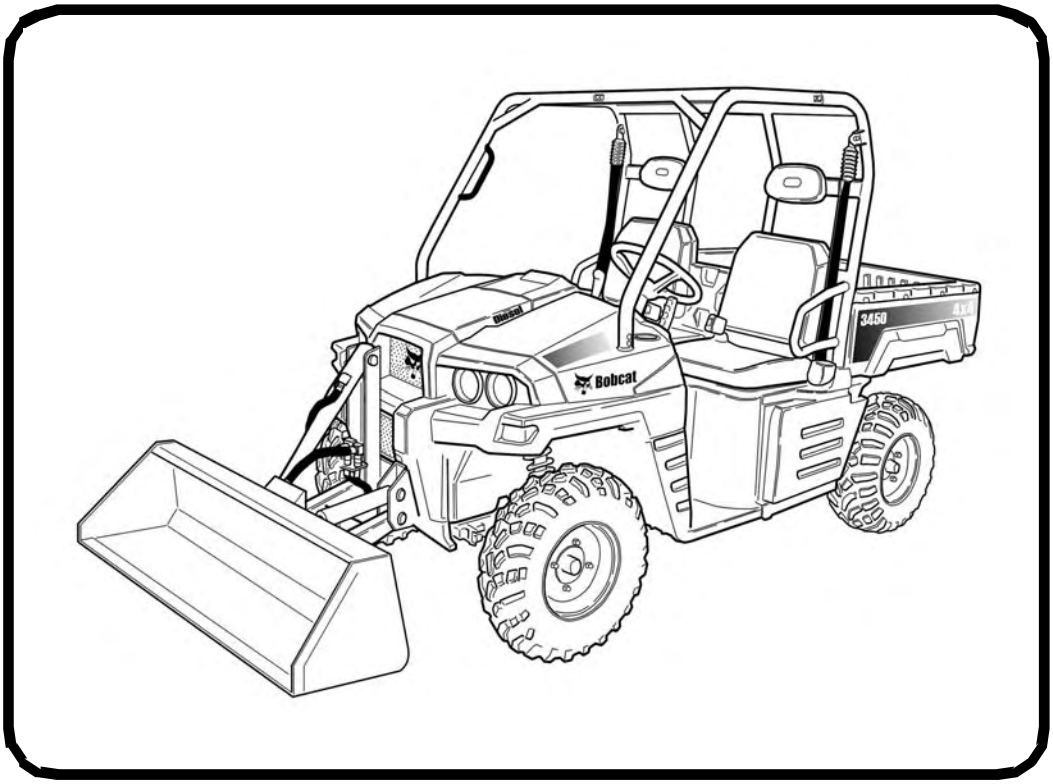
Bobcat®

Service Manual
3450 Utility Vehicle

S/N AJNY11001 & Above



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Printed in U.S.A.

SAFETY INSTRUCTIONS

Safety Alert Symbol

This symbol with a warning statement means: "Warning, be alert! Your safety is involved!" Carefully read the message that follows.

WARNING

Operator must have instructions before operating the utility vehicle. Untrained operators can cause injury or death.

W-2855-0510

IMPORTANT

This notice identifies procedures which must be followed to avoid damage to the utility vehicle.

I-2317-0510

DANGER

The signal word DANGER on the utility vehicle and in the manuals indicates a hazardous situation which, if not avoided, will result in death or serious injury.

D-1022-0510

WARNING

The signal word WARNING on the utility vehicle and in the manuals indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

W-2856-0510

The following publications provide information on the safe use and maintenance of the Bobcat utility vehicle and attachments:

- The Delivery Report is used to assure that complete instructions have been given to the new owner and that the vehicle is in safe operating condition.
- The Operation & Maintenance Manual delivered with the vehicle or attachment contains operating information as well as routine maintenance and service procedures. It is a part of the vehicle and can be stored in a container provided on the vehicle. Replacement Operation & Maintenance Manuals can be ordered from your Bobcat dealer.
- Safety signs (decals) instruct on the safe operation and care of your Bobcat utility vehicle or attachment. The signs and their locations are shown in the Operation & Maintenance Manual. Replacement signs are available from your Bobcat dealer.
- An Operator's Handbook fastened to the operator cab. It's brief instructions are convenient to the operator. The handbook is available from your dealer in an English edition or one of many other languages. See your Bobcat dealer for more information on translated versions.
- The Service Manual and Parts Manual are available from your dealer for use by mechanics to do shop-type service and repair work.
- The Utility Vehicle Operator Training Course is available through your local dealer or at **www.training.bobcat.com** or **www.bobcat.com**. This course is intended to provide rules and practices of correct operation of the utility vehicle. The course is available in English and Spanish versions.
- The Utility Vehicle Safety Video is available from your Bobcat dealer or at **www.training.bobcat.com** or **www.bobcat.com**.

SI UV-0511 SM

LIFTING AND BLOCKING THE UTILITY VEHICLE

Procedure

For service work under the utility vehicle, or to remove the wheels, always support the utility vehicle with jackstands or blocks of adequate capacity for weight of utility vehicle (See Performance on Page SPEC-10-2.)

Always park the utility vehicle on a flat level surface.

Engage the park brake. Stop the engine and put the gear selector in gear.

If removing wheel(s), loosen the wheel nuts slightly before lifting the vehicle.

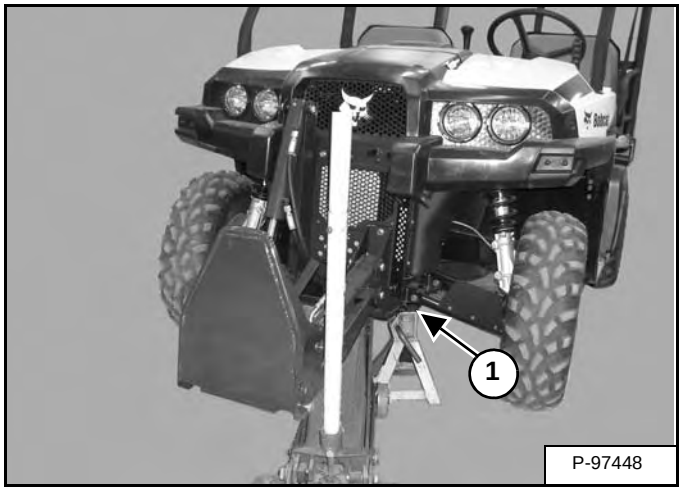
⚠ WARNING

AVOID INJURY OR DEATH

Instructions are necessary before operating or servicing machine. Read and understand the Operation & Maintenance Manual, Operator's Handbook and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments, repairs or service. Untrained operators and failure to follow instructions can cause injury or death.

W-2003-0807

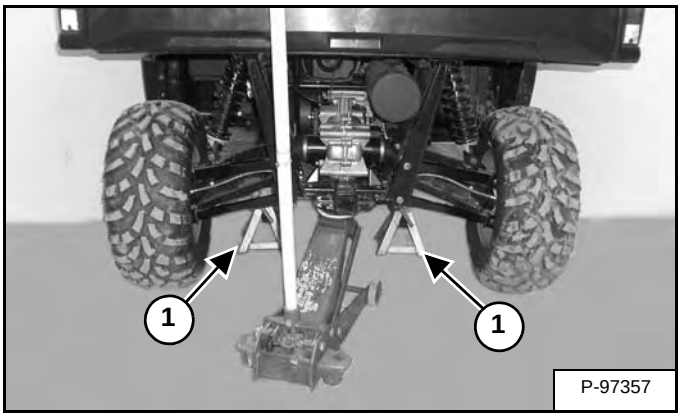
Figure 10-10-1



Place the jackstands (Item 1) **[Figure 10-10-1]** under the frame at the front of the utility vehicle (both sides).

NOTE: When lifting the utility vehicle, place the jack under front frame [Figure 10-10-1].

Figure 10-10-2



Place the jackstands (Item 1) **[Figure 10-10-2]** under the rear frame of the utility vehicle.

NOTE: When lifting the utility vehicle, place the jack under the rear frame [Figure 10-10-2].

AIR CLEANER SERVICE

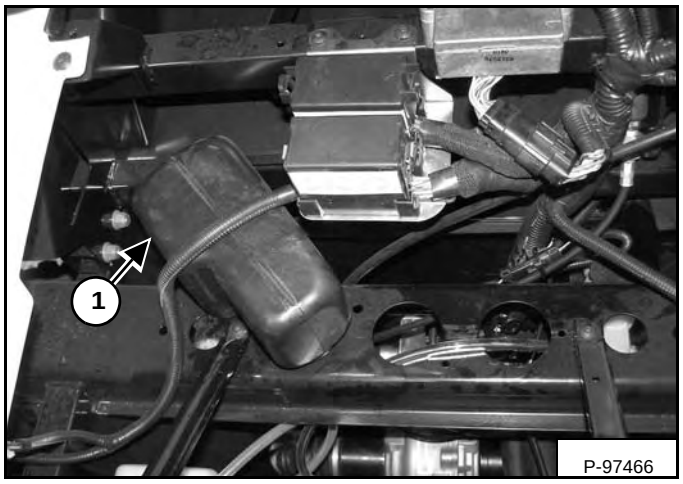
Pre-Filter Element

For the correct service interval of the pre-filter element (See SERVICE SCHEDULE on Page 10-50-1.)

The intake air pre-filter is located under the front cover. The pre-filter traps larger particles before the air reaches the main engine air filter.

Removal

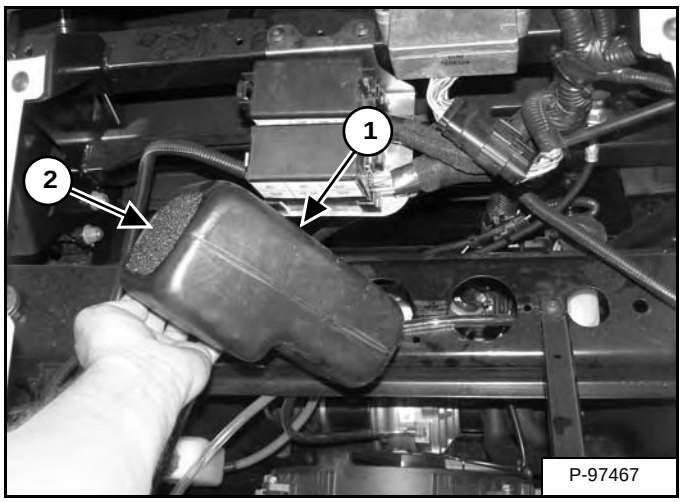
Figure 10-60-1



Remove the front cover.

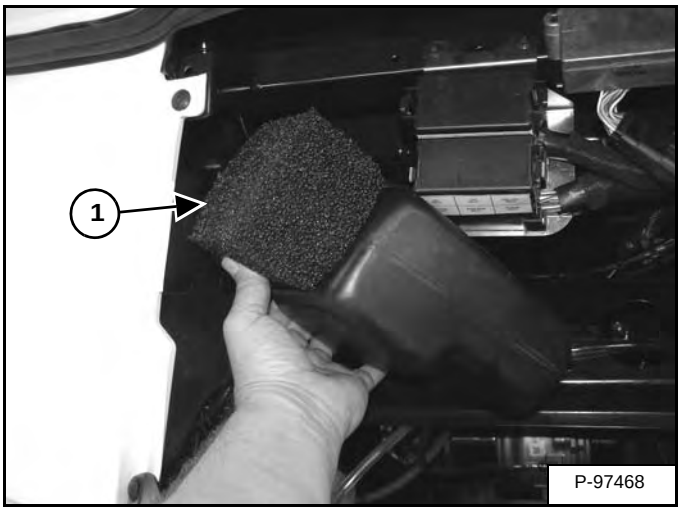
The pre-filter box (Item 1) **[Figure 10-60-1]** is connected to a rubber hose so the box can be relocated to access the element.

Figure 10-60-2



Rotate the pre-filter box (Item 1) back to access the pre-filter element (Item 2) **[Figure 10-60-2]** for removal.

Figure 10-60-3



NOTE: The fiber pre-filter element must be gently removed from the box to avoid tearing or damaging the element. Inspect the element for damage. If any damage is found, replace the element.

Reach into the pre-filter box and squeeze the pre-filter element (Item 1) **[Figure 10-60-3]** to collapse it to aid in removal.

DO NOT used compressed air to clean the pre-filter box. Use a clean damp cloth and wipe out the inside of the box.

Cleaning Element

If the element is dirty, clean it with a high flash point solvent, followed by hot soapy water. Rinse and dry the filter element thoroughly. Inspect element for tears or damage. Replace if necessary.

Installation

Squeeze the pre-filter element (Item 1) **[Figure 10-60-3]** and insert into the box. Make sure the element is properly installed so that it fits snugly back into the box.

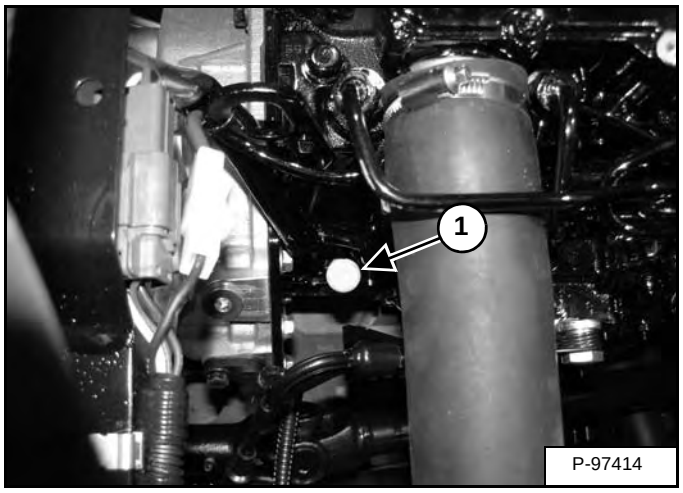
Reposition the pre-filter box (Item 1) **[Figure 10-60-1]** back to its original location.

Reinstall the front cover.

ENGINE LUBRICATION SYSTEM

Checking And Adding Engine Oil

Figure 10-90-1



Check the engine oil level every day.

Park the utility vehicle on a flat and level surface and stop the engine.

The engine oil dipstick is located under the seat on the left front corner of the engine. Remove the seat. (See Seat Base Removal And Installation on Page 30-20-1.)

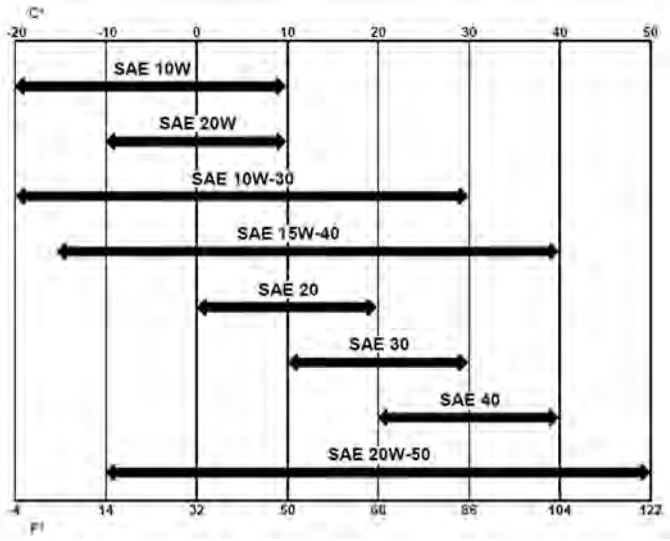
Remove the dipstick (Item 1) **[Figure 10-90-1]** and wipe dry with a clean cloth. Reinstall the dipstick. Remove the dipstick and check the oil level. Keep the oil level between the marks on the dipstick.

NOTE: Rising oil levels between checks in cool weather driving can indicate moisture collecting in the oil pan. If the oil level is over the full mark, change the oil.

Engine Oil Chart

Figure 10-90-2

ENGINE OIL
RECOMMENDED SAE VISCOSITY NUMBER
(LUBRICATION OILS FOR DIESEL ENGINE CRANKCASE)



TEMPERATURE RANGE ANTICIPATED BEFORE NEXT OIL CHANGE (DIESEL ENGINES MUST USE API CLASSIFICATION CI-4 OR BETTER)

Use good quality engine oil that meets API Service Classification of CI-4 or better **[Figure 10-90-2]**.

⚠ WARNING

AVOID INJURY OR DEATH

Always clean up spilled fuel or oil. Keep heat, flames, sparks or lighted tobacco away from fuel and oil. Failure to use care around combustibles can cause explosion or fire.

W-2103-0508

TIRE MAINTENANCE

Tires

WARNING

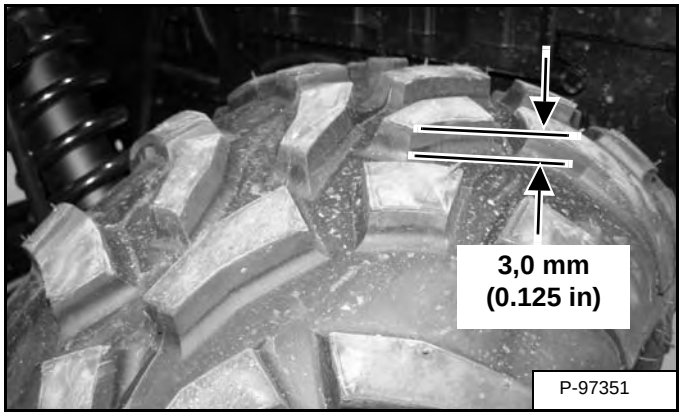
AVOID INJURY OR DEATH

Operating this vehicle with worn tires, improperly inflated tires, non-standard tires or improperly installed tires will affect vehicle handling and could cause an accident resulting in serious injury or death. Always follow all tire maintenance procedures outlined in this manual and on the safety signs (decals). Always use the original equipment size and type when replacing tires.

W-2829-0510

Tire Tread Depth

Figure 10-120-1



Always replace tires when tread depth is worn to 3 mm (0.125 in) **[Figure 10-120-1]** or less.

Axle And Wheel Nut Torque

NOTE: The wheel nuts must be checked and torqued after the first eight hours of operation of a new machine and after the first eight hours of operation when wheel(s) have been removed for service.

Check the wheel nut torque at the correct service interval (See SERVICE SCHEDULE on Page 10-50-1.)

Do not lubricate the studs or lug nuts.

Tighten the wheel nuts to the correct torque. (See Tires on Page SPEC-10-5.)

Wheel Removal And Installation

Check the tires regularly for wear, damage and pressure.

WARNING

AVOID INJURY OR DEATH

Improperly installed wheels can adversely affect tire wear and vehicle handling, which can result in serious injury or death. Always ensure all nuts are torqued to specification. Do not service axle nuts that have a cotter pin installed. See your Bobcat dealer.

W-2830-0510

Removal

1. Apply the brakes and engage the parking brake.
2. Stop the engine and place the gear selector in gear.
3. Loosen the wheel nuts slightly.
4. Raise the utility vehicle and install jackstands or blocks. (See LIFTING AND BLOCKING THE UTILITY VEHICLE on Page 10-10-1.)
5. Remove the wheel nuts. Remove the wheel.

Recommended tire pressure must be maintained to avoid excessive tire wear and loss of stability and handling capability. Check for correct pressure before operating.

NOTE: Install the wheel with the valve stem facing to the outside and the rotation arrow on the tire pointing to the front of the vehicle.

Installation

1. Apply the brakes and engage the parking brake.
2. Place the gear selector in gear.
3. Place the wheel in the correct position on the wheel hub. Be sure the valve stem is towards the outside and the rotation arrows on the tire point towards the forward rotation.
4. Install the wheel nuts and tighten slightly.
5. Lower the utility vehicle to the ground. (See LIFTING AND BLOCKING THE UTILITY VEHICLE on Page 10-10-1.)
6. Tighten the wheel nuts to the correct torque.

IMPORTANT

Do not mix tire sizes. The front and rear tires used on this model are different sizes. Do not intermix front and rear tires.

I-2332-0510

HYDRAULIC SYSTEM

Description

The 3450 utility vehicle has a hydraulic system that is powered by a 12 volt motor. The hydraulic system is powered as soon as the key switch is in the ON position. The hydraulic system is located below the cargo box.

Battery drain is increased when using the hydraulic system. Always allow the utility vehicle additional run time (with hydraulic system turned OFF) to charge the battery when the hydraulic system has been used for extended periods of time.

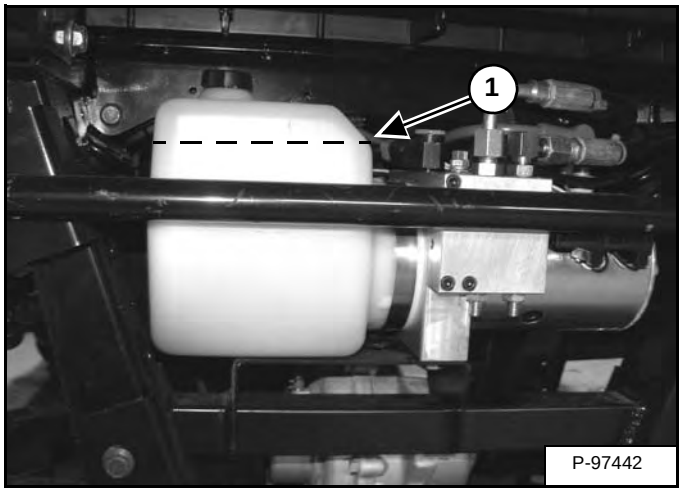
Checking Fluid

Use only recommended fluid in the hydraulic system. (See chart on this page.)

Remove the attachment.

Park the utility vehicle on a flat level surface, fully raise the attachment arm (with attachment removed) and tilt the attachment interface fully back. (Cylinders must be fully retracted for proper checking and filling of the hydraulic fluid.)

Figure 10-170-1



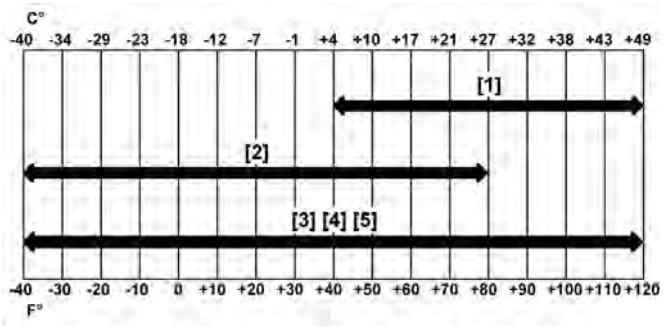
The hydraulic tank (Item 1) **[Figure 10-170-1]** can be viewed from the rear of the utility vehicle to check the fluid level.

The MAXIMUM level needs to be at the beveled surface on the hydraulic tank (with the lift and tilt cylinders fully retracted).

Hydraulic Fluid

Figure 10-170-2

HYDRAULIC FLUID
RECOMMENDED ISO VISCOSITY GRADE (VG)
AND VISCOSITY INDEX (VI)



TEMPERATURE RANGE ANTICIPATED
DURING MACHINE USE

[1] VG 100; Minimum VI 130
[2] VG 46; Minimum VI 150
[3] BOBCAT All-Season Fluid
[4] BOBCAT Synthetic Fluid
[5] BOBCAT Biodegradable Hydraulic / Hydrostatic Fluid (Unlike biodegradable fluids that are vegetable based, Bobcat biodegradable fluid is formulated to prevent oxidation and thermal breakdown at operating temperatures.)

Use only recommended fluid in the hydraulic system **[Figure 10-170-2]**.

Hydraulic Brake System Operation

The brake system consists of the following components or assemblies: brake pedal, master cylinder, hydraulic brake lines, brake calipers, brake pads, and brake discs, which are secured to the drive line.

When the foot activated brake lever is applied it applies pressure on the piston within the master cylinder. As the master cylinder piston moves inward it closes a small opening (compensating port) within the cylinder and starts to build pressure within the brake system. As the pressure within the system is increased, the pistons located in the brake calipers move outward and apply pressure to the moveable brake pads. These pads contact the brake discs and move the calipers in their floating bracket, pulling the stationary side pads into the brake discs. The resulting friction reduces brake disc and vehicle speed.

The friction applied to the brake pads will cause the pads to wear. As these pads wear, the piston within the caliper moves further outward and becomes self adjusting. Fluid from the reservoir fills the additional area created when the caliper piston moves outward.

Brake fluid level is critical to proper system operation. Too little fluid will allow air to enter the system and cause the brakes to feel spongy. Too much fluid could cause brakes to drag due to fluid expansion.

Located within the master cylinder is the compensating port which is opened and closed by the master cylinder piston assembly. As the temperature within the hydraulic system changes, this port compensates for fluid expansion or contraction. Due to the high temperatures created within the system during heavy braking, it is very important that the master cylinder reservoir have adequate space to allow for fluid expansion. **Never overfill the reservoir! Do not fill the reservoir beyond the MAX LEVEL line!**

When servicing the brake system use only **Bobcat DOT 4 Brake Fluid**.

WARNING

AVOID INJURY OR DEATH

After opening a bottle of brake fluid, always discard any unused portion. Never store or use a partial bottle. Brake fluid is hygroscopic, meaning it rapidly absorbs moisture from the air. The moisture causes the boiling temperature of the brake fluid to drop, which can lead to early brake fade and the possibility of accident or severe injury.

W-2872-0510

Caliper Removal

Lift and block the machine. (See Procedure on Page 10-10-1.)

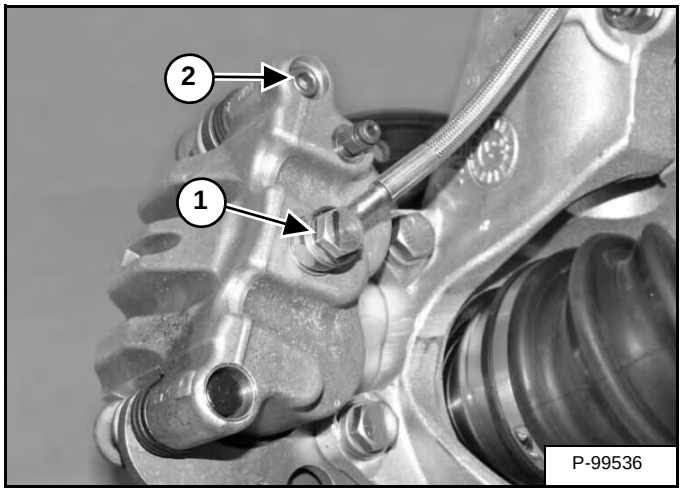
⚠ WARNING

Use care when supporting vehicle so that it does not tip or fall. Severe injury may occur if machine tips or falls.

W-2848-0510

Remove the tire assembly. (See TIRE MAINTENANCE on Page 10-120-1.)

Figure 20-11-7

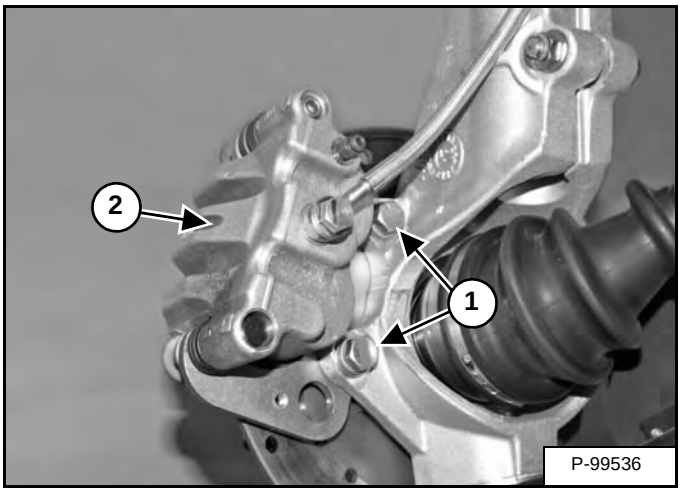


Clean caliper area before removal.

Place a container below the caliper to catch brake fluid when removing the line. Remove brake line from caliper (Item 1) **[Figure 20-11-7]**.

Loosen the pad adjuster screw (Item 2) **[Figure 20-11-7]** 2 - 3 turns to allow brake pad removal after the caliper is removed.

Figure 20-11-8



Remove the two caliper mounting bolts, lock washers and washers (Item 1) and remove the caliper assembly (Item 2) **[Figure 20-11-8]** from the front strut.

Caliper Removal

Lift and block the machine. (See Procedure on Page 10-10-1.)

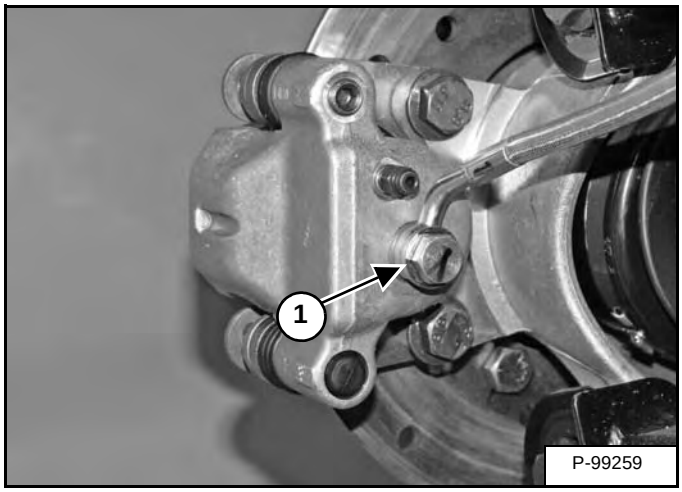
⚠ WARNING

Use care when supporting vehicle so that it does not tip or fall. Severe injury may occur if machine tips or falls.

W-2848-0510

Remove the tire assembly. (See TIRE MAINTENANCE on Page 10-120-1.)

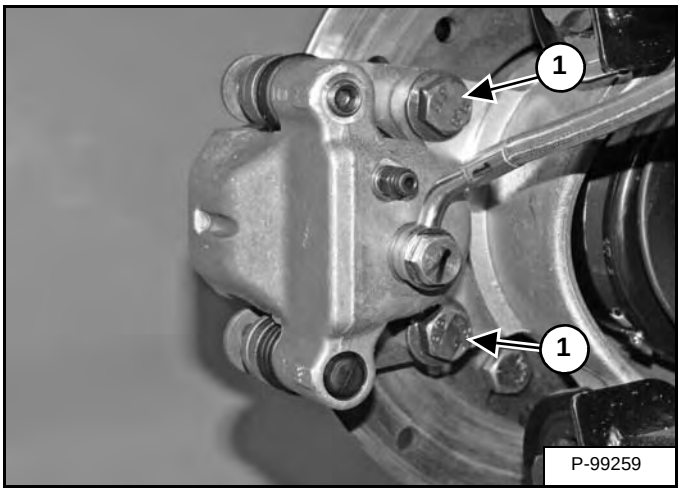
Figure 20-12-6



Clean caliper area before removal.

Place a container below the caliper to catch brake fluid when removing the line. Remove brake line from caliper (Item 1) **[Figure 20-12-6]**.

Figure 20-12-7

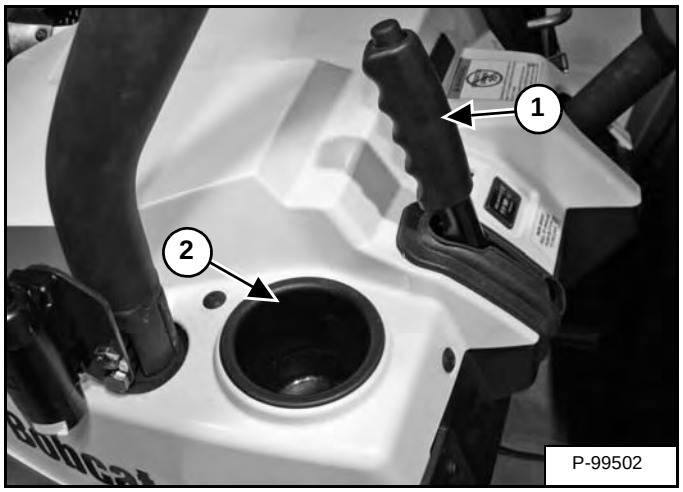


After the fluid has drained into the container, remove the two caliper mounting bolts (Item 1) **[Figure 20-12-7]** and remove caliper.

Clean the disc, caliper body and pistons with brake cleaner or alcohol.

Lever Removal And Installation

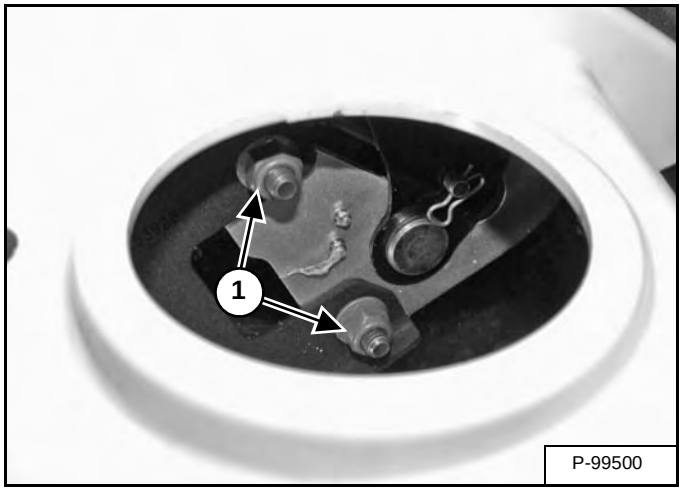
Figure 20-20-2



Make sure the parking brake lever (Item 1) **[Figure 20-20-2]** is not engaged.

Remove the cup holder (Item 2) **[Figure 20-20-2]** from the vehicle.

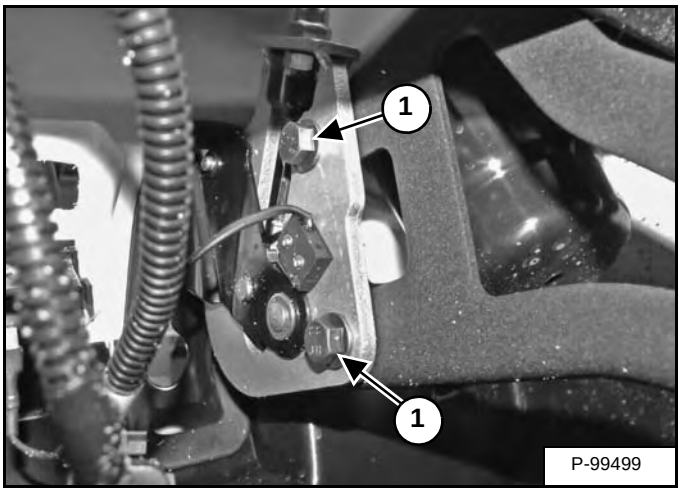
Figure 20-20-3



Remove the nuts (Item 1) **[Figure 20-20-3]** from the parking brake lever assembly.

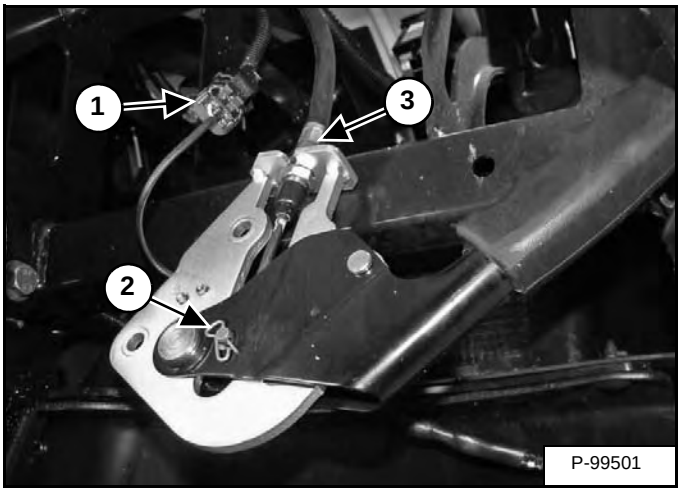
Installation: Tighten the nuts to 18 N•m (13 ft-lb) torque.

Figure 20-20-4



Remove the two bolts (Item 1) **[Figure 20-20-4]** and lower the lever assembly into the wheel well.

Figure 20-20-5



Disconnect the micro switch connector (Item 1) **[Figure 20-20-5]** from the harness.

Remove the clip and clevis pin (Item 2) **[Figure 20-20-5]** which secure the cable to the lever assembly.

Loosen the jam nut (Item 3) **[Figure 20-20-5]** and remove the lever assembly from the vehicle.

Installation: Tighten the jam nut to 19 N•m (14 ft-lb) torque.

GEARCASE (TRANSMISSION)

System Troubleshooting

Check the following items when shifting difficulty is encountered.

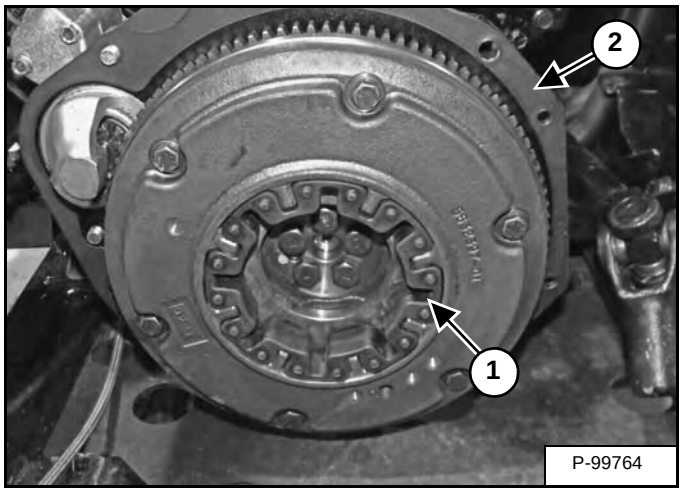
- Shift cable adjustment / condition
- Idle speed (throttle cable routing)
- CVT clutch alignment
- Transmission Lubricant type / quality
- Drive belt deflection (where applicable)
- Loose fasteners on sector gear cover
- Worn rod ends, clevis pins or pivot arm bushings
- Shift selector rail travel
- Worn, broken or damaged internal transmission components

NOTE: To determine if shifting difficulty or problem is caused by an internal transmission problem, isolate the transmission by disconnecting the shift cable end from the transmission bellcrank. Manually select each gear range at the transmission bellcrank, and test ride vehicle. If it functions properly, the problem is outside the transmission.

If transmission problem remains, disassemble transmission and inspect all gear dogs for wear (rounding) or damage. Inspect all bearings, circlips, thrust washers and shafts for wear.

Removal And Installation (Cont'd)

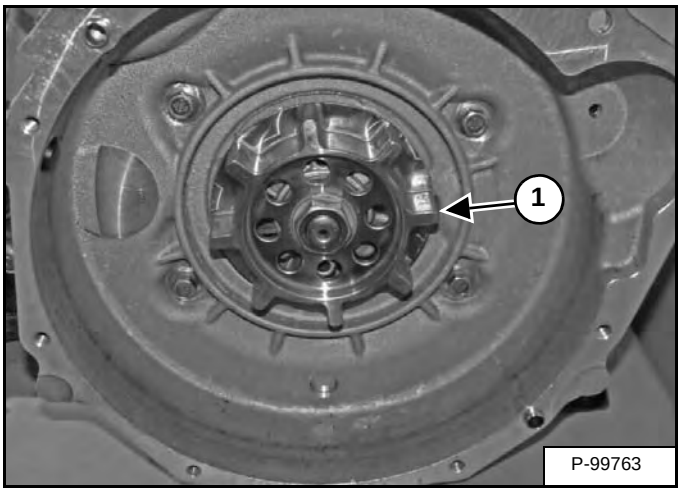
Figure 20-30-33



Inspect the rubber coupler (Item 1) **[Figure 20-30-33]** for damage and replace as needed.

Install a new gasket (Item 2) **[Figure 20-30-33]** on the engine mounting surface.

Figure 20-30-34



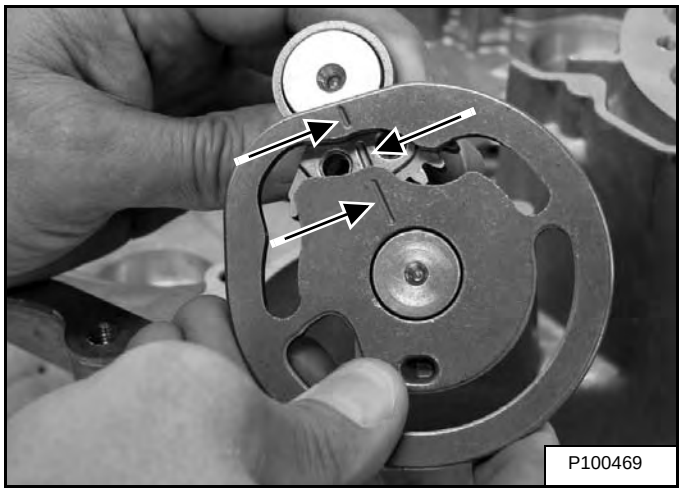
Installation: Align the splines of the coupler (Item 1) **[Figure 20-30-34]** with the slots in the rubber coupler (Item 1) **[Figure 20-30-33]**.

NOTE: The drive clutch may need to be moved slightly while joining the transmission and engine together. Rotating the drive clutch will move the coupler to aid in aligning the splines with the rubber coupler.

Installation: If transmission lubricant was drained, fill the transmission with the specified amount of Bobcat Utility Vehicle synthetic gearcase lubricant prior to installation. (See Fluid And Capacities on Page SPEC-10-4.)

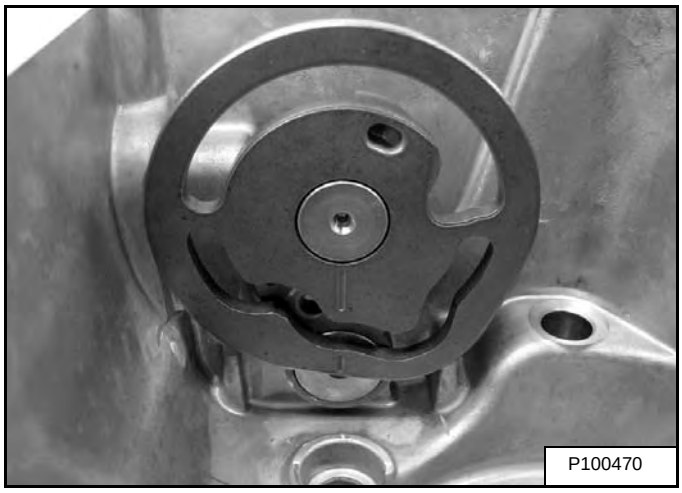
Assembly (Cont'd)

Figure 20-30-61



Align the timing marks on the cam shift shaft and bellcrank shift shaft **[Figure 20-30-61]**.

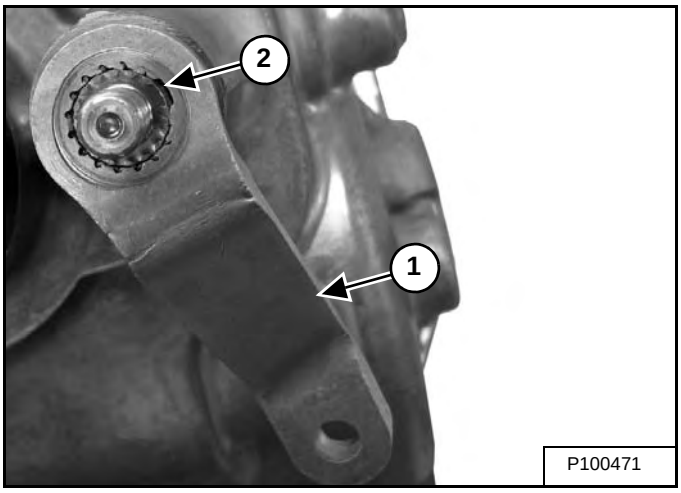
Figure 20-30-62



Place the two shafts into the transmission as an assembly **[Figure 20-30-62]**.

NOTE: Gently rock or twist the shift shafts upon installation to prevent from damaging the new O-rings. Forcing the shift shafts straight into the transmission housing may cut the O-rings.

Figure 20-30-63

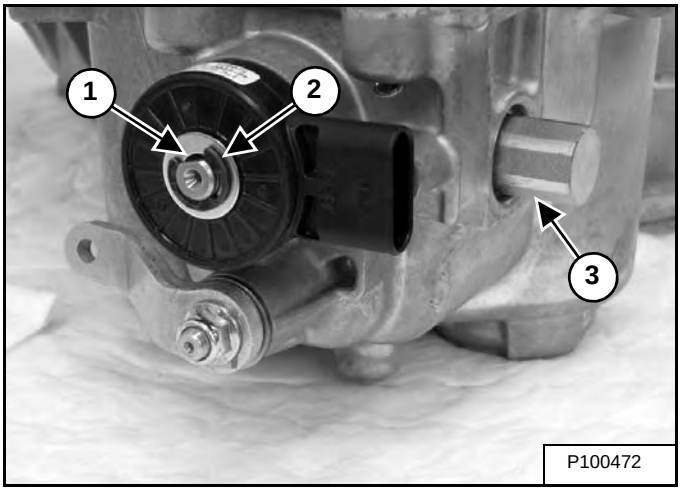


Install the washer over the bellcrank shift shaft and install the bellcrank (Item 1) by aligning the skip-tooth splines (Item 2) **[Figure 20-30-63]**.

Install the retaining nut and torque to specification.

Bellcrank Retaining Nut:	20 N•m (15 ft-lb)

Figure 20-30-64



Install the washer and a new retaining ring onto the cam shift shaft. The retaining ring should be tight on the shaft.

Install the transmission switch, washer (Item 1) and snap ring (Item 2) **[Figure 20-30-64]**.

Install the detent plug (Item 3) **[Figure 20-30-64]** and tighten to 23 - 31 N•m (17 - 23 ft-lb) torque.

CONTINUOUS VARIABLE TRANSMISSION (CVT)

CVT System Overview

WARNING

All CVT maintenance or repairs should be performed by a certified Bobcat technician who has received the proper training and understands the procedures outlined in this manual. Because of the critical nature and precision balance incorporated into the CVT components, it is absolutely essential that no disassembly or repair be made without factory authorized special tools and service procedures.

W-2860-0510

The Continuous Variable Transmission (CVT) consists of three major assemblies:

1) The Drive Clutch

2) The Driven Clutch

3) The Drive Belt

The internal components of the drive clutch and driven clutch control engagement (initial vehicle movement), clutch upshift and backshift. During vehicle development, the CVT system is matched first to the engine power curve; then to average riding conditions and the vehicle's intended usage. Therefore, modifications or variations of components at random are never recommended. Proper clutch setup and careful inspection of existing components must be the primary objective when troubleshooting and tuning.

Drive Clutch Operation

Drive clutches primarily sense engine rpm. The two major components which control its shifting function are the shift weights and the coil spring. Whenever engine rpm is increased, centrifugal force is created, causing the shift weights to push against rollers on the moveable sheave, which is held open by coil spring preload. When this force becomes higher than the preload in the spring, the outer sheave moves inward and contacts the drive belt. This motion pinches the drive belt between the spinning sheaves and causes it to rotate, which in turn rotates the driven clutch.

At lower rpm, the drive belt rotates low in the drive clutch sheaves. As engine rpm increases, centrifugal force causes the drive belt to be forced upward on drive clutch sheaves.

Driven Clutch Operation

Driven clutches primarily sense torque, opening and closing according to the forces applied to it from the drive belt and the transmission input shaft. If the torque resistance at the transmission input shaft is greater than the load from the drive belt, the drive belt is kept at the outer diameter of the driven clutch sheaves.

As engine rpm and horsepower increase, the load from the drive belt increases, resulting in the belt rotating up toward the outer diameter of the drive clutch sheaves and downward into the sheaves of the driven clutch. This action, which increases the driven clutch speed, is called upshifting.

Should the throttle setting remain the same, and the vehicle is subjected to a heavier load, the drive belt rotates back up toward the outer diameter of the driven clutch and downward into the sheaves of the drive clutch. This action, which decreases the driven clutch speed, is called backshifting.

In situations where loads vary (such as uphill and downhill), and throttle settings are constant, the drive and driven clutches are continually shifting to maintain optimum engine rpm. At full throttle a perfectly matched CVT system should hold engine rpm at the peak of the power curve. This rpm should be maintained during clutch upshift and backshift. In this respect, the CVT system is similar to a power governor. Rather than vary throttle position, as a conventional governor does, the CVT system changes engine load requirements by either upshifting or backshifting.

CVT Break-In (Drive Belt / Clutches)

A proper break-in of the clutches and drive belt will ensure a longer life and better performance. Break in the clutches and drive belt by operating at slower speeds during the 10 hour break-in period as recommended. Pull only light loads. Avoid aggressive acceleration and high speed operation during the break-in period.

CONTINUOUS VARIABLE TRANSMISSION (CVT) (DRIVE CLUTCH)

Removal And Installation

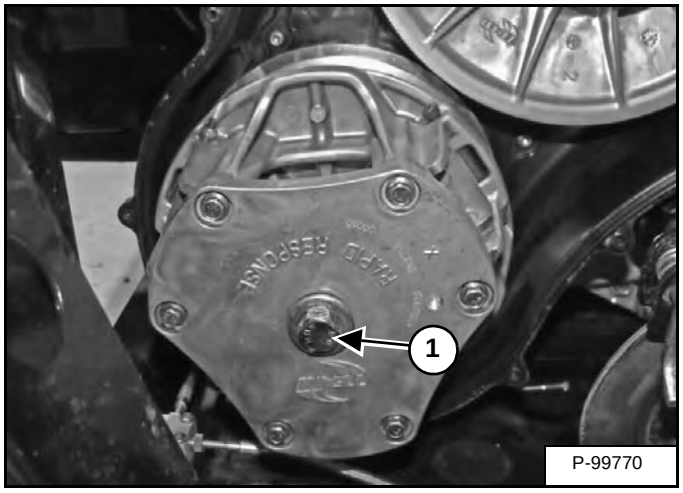
Raise the rear cargo box.

Remove the outer CVT cover. (See CVT (Outer) Cover Removal And Installation on Page 20-50-7.)

Remove the drive belt. (See Removal And Installation (S/N AJNY19999 & Below) on Page 20-40-1.) or (See Removal And Installation (S/N AJNY20001 & Above) on Page 20-40-3.)

Order drive clutch puller (PN PA-48595).

Figure 20-51-1

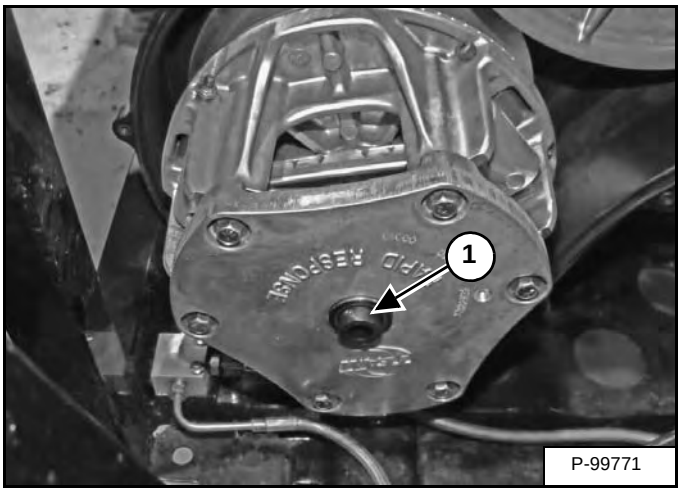


Remove the drive clutch retaining bolt (Item 1) **[Figure 20-51-1]** by turning it clockwise.

Installation: Tighten the retaining bolt to 64 N•m (47 ft-lb) torque.

NOTE: The bolt (Item 1) [Figure 20-51-1] has reverse threads. Remove the bolt by turning in a clockwise direction.

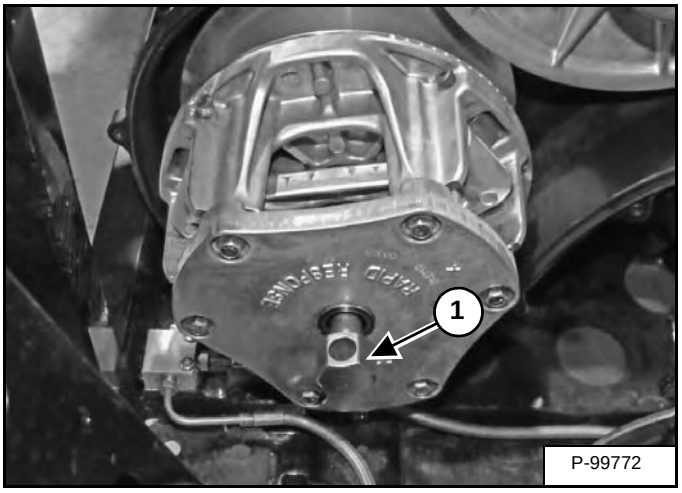
Figure 20-51-2



Remove the plastic bushing (Item 1) **[Figure 20-51-2]** from the drive clutch.

Installation: Inspect the plastic bushing for wear or damage and replace if needed.

Figure 20-51-3

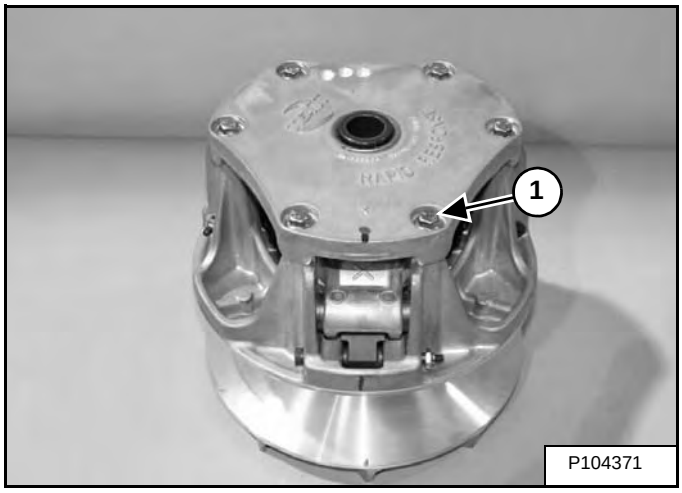


Remove the drive clutch using the drive clutch puller (Item 1) **[Figure 20-51-3]**.

Installation: Clean the crankshaft taper and taper bore inside the drive clutch.

Disassembly (S/N AJNY20001 & Above)

Figure 20-51-22

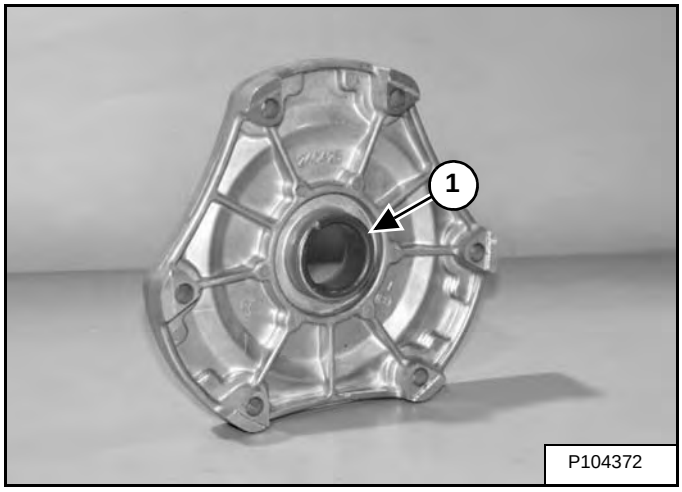


Using a permanent marker, mark the cover, spider, moveable and stationary sheaves, and steel post to the stationary sheave for reference **[Figure 20-51-22]**.

Mark the stationary sheave and clutch shaft to verify the shaft has not turned in the sheave after tightening the spider during clutch assembly.

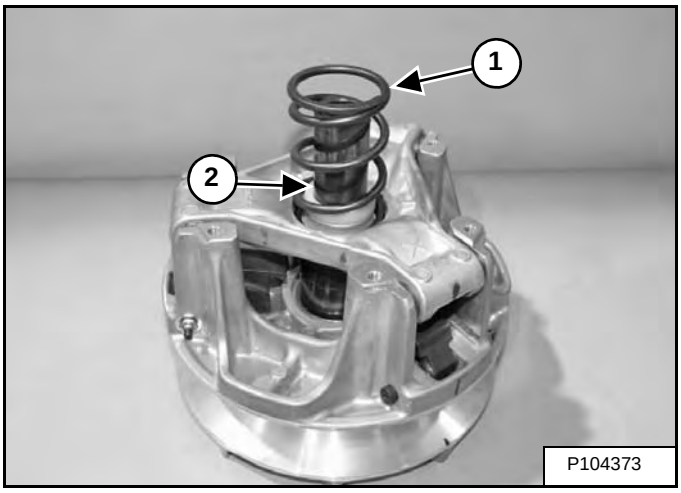
Remove cover bolts (Item 1) **[Figure 20-51-22]** evenly in a cross pattern, and remove cover plate.

Figure 20-51-23



Inspect cover bushing (Item 1) **[Figure 20-51-23]**. The outer cover bushing is manufactured with a Teflon™ coating. Bushing wear is determined by the amount of Teflon™ remaining on the bushing. The bushing is not serviceable.

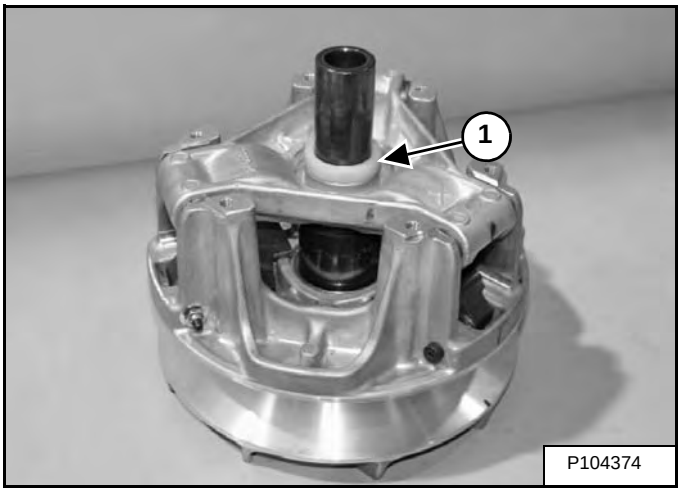
Figure 20-51-24



Remove the clutch spring (Item 1) **[Figure 20-51-24]**.

Inspect the area on shaft (Item 2) **[Figure 20-51-24]** where bushing rides for wear, galling, nicks or scratches. Replace clutch assembly if worn or damaged.

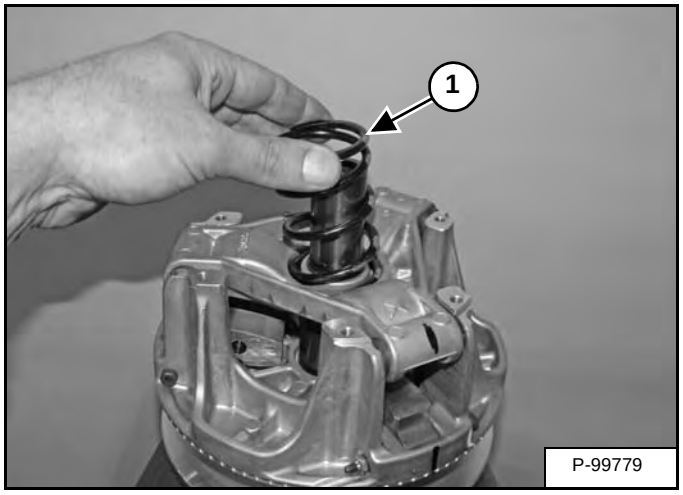
Figure 20-51-25



Remove the plastic collar (Item 1) **[Figure 20-51-25]**.

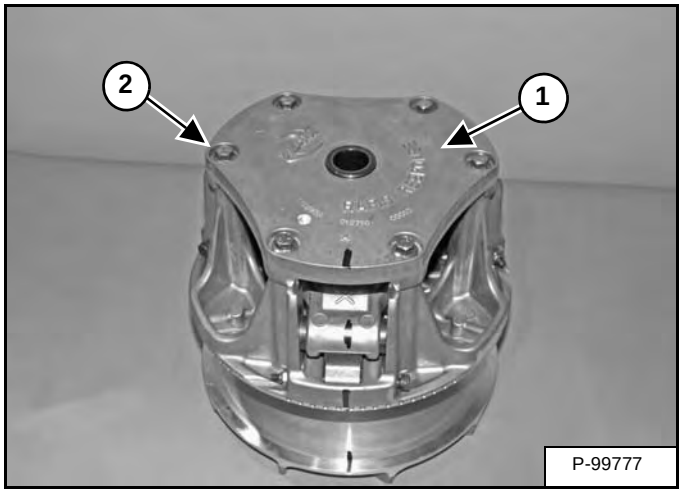
Assembly (S/N AJNY19999 & Below) (Cont'd)

Figure 20-51-53



Reinstall the clutch spring (Item 1) **[Figure 20-51-53]**.

Figure 20-51-54



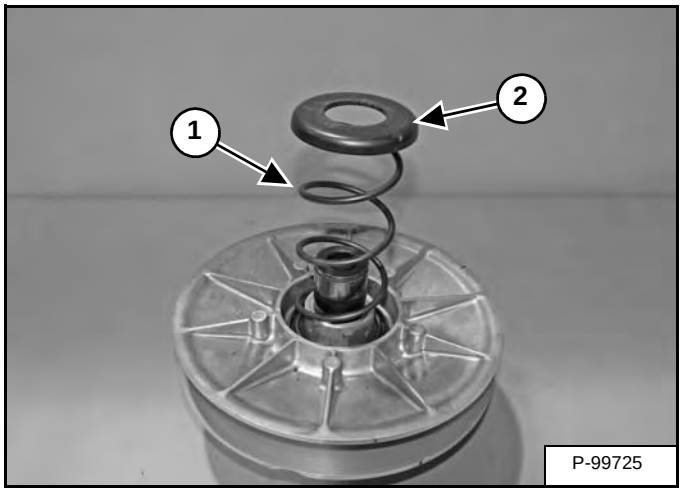
Reinstall cover (Item 1) **[Figure 20-51-54]** aligning the mark with the other marks.

Install the bolts (Item 2) **[Figure 20-51-54]** and tighten evenly in a cross pattern to 11 N•m (100 in-lb) torque.

NOTE: An assistant may be needed to hold down on the cover while the bolts are installed.

Assembly (Cont'd)

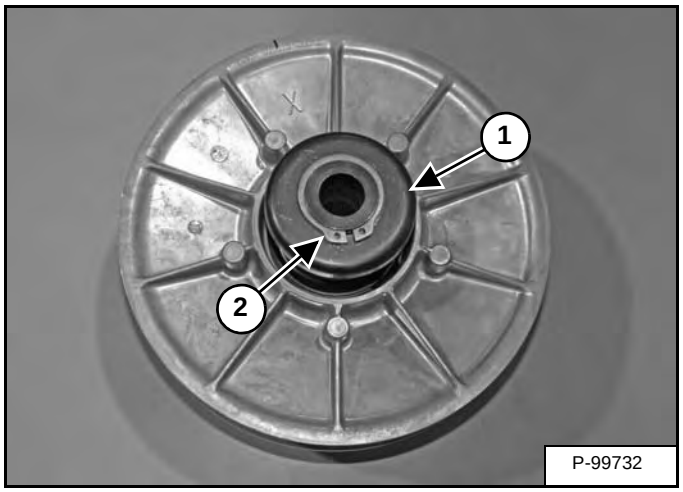
Figure 20-52-16



Install the spring (Item 1) **[Figure 20-52-16]** into the inner retainer.

Install the outer retainer (Item 2) **[Figure 20-52-16]** on top of the spring.

Figure 20-52-17



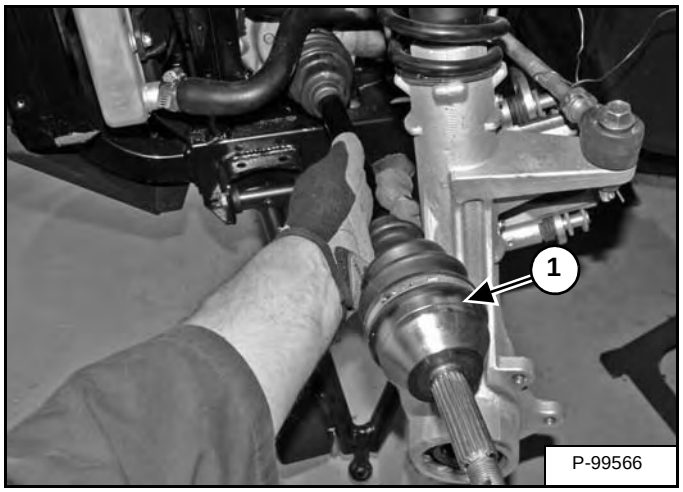
Place the clutch into the clutch compression tool (PN 8700220). Using the compression extensions (PN PS-45909), apply and hold downward pressure on the outer spring retainer (Item 1) **[Figure 20-52-17]**.

Carefully compress the outer spring retainer (Item 1) and install the snap ring (Item 2) **[Figure 20-52-17]**.

NOTE: Remember the spring contains strong spring pressure.

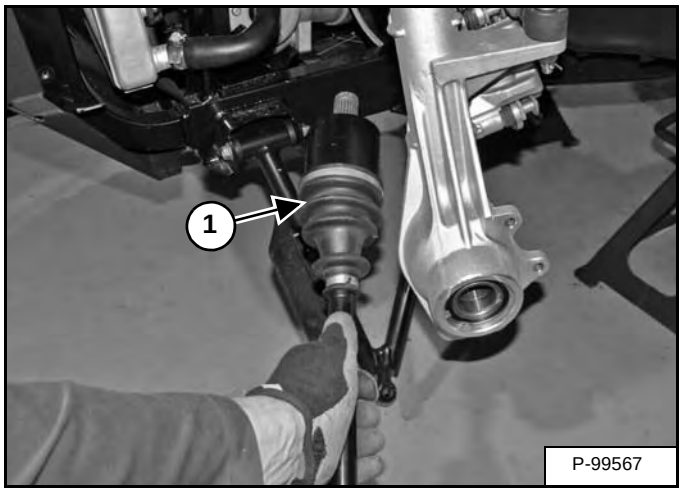
Front Drive Shaft Removal And Installation (Cont'd)

Figure 20-60-22



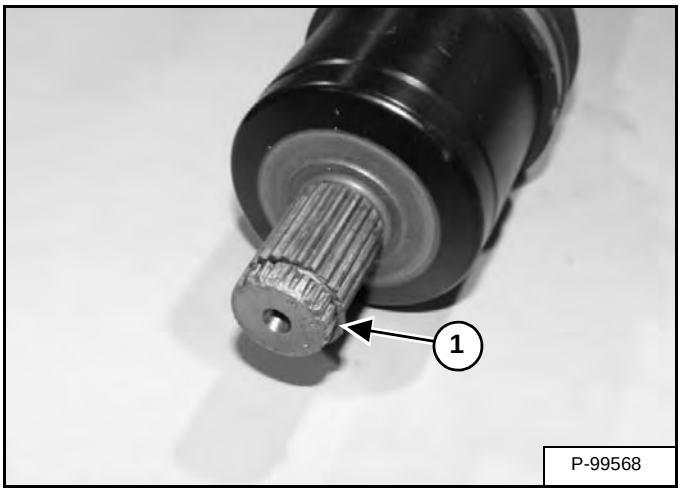
Remove the drive shaft (Item 1) **[Figure 20-60-22]** using short, sharp jerks to free the circlip from the differential.

Figure 20-60-23



Remove the drive shaft (Item 1) **[Figure 20-60-23]** from the vehicle.

Figure 20-60-24

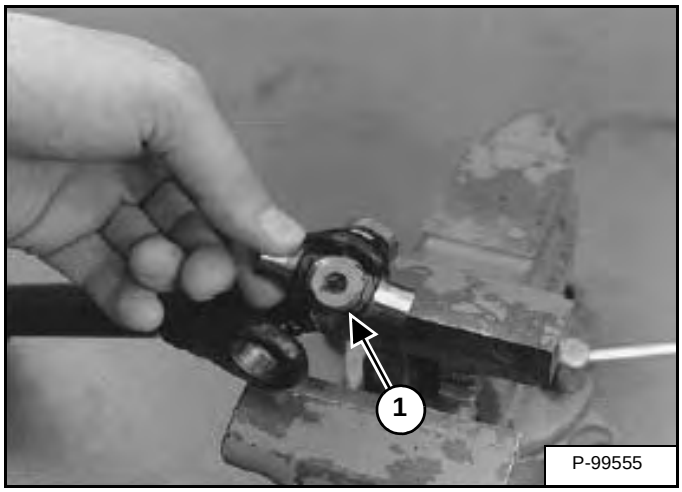


Installation: Install a new circlip (Item 1) **[Figure 20-60-24]** on the end of the drive shaft and apply an anti-seize compound to the splines.

Installation: Align the splines of the drive shaft with the front gearcase and reinstall the drive shaft Use a rubber mallet to tap on the outboard end of the drive shaft if necessary.

Propshaft U-Joint Disassembly (Cont'd)

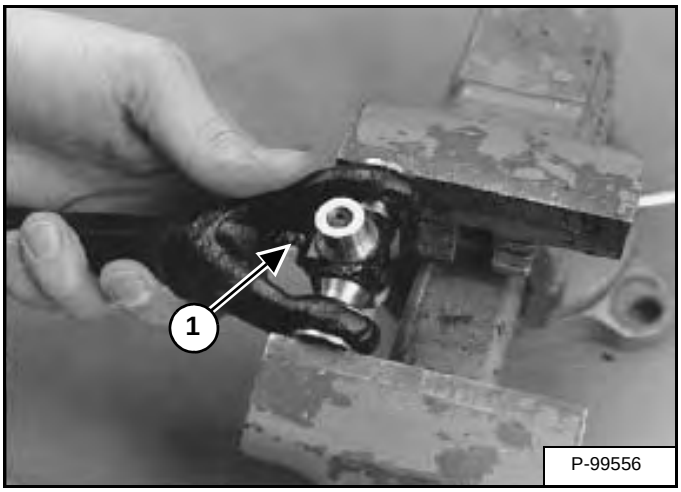
Figure 20-60-45



Force U-joint cross (Item 1) **[Figure 20-60-45]** to one side and lift out of inner yoke.

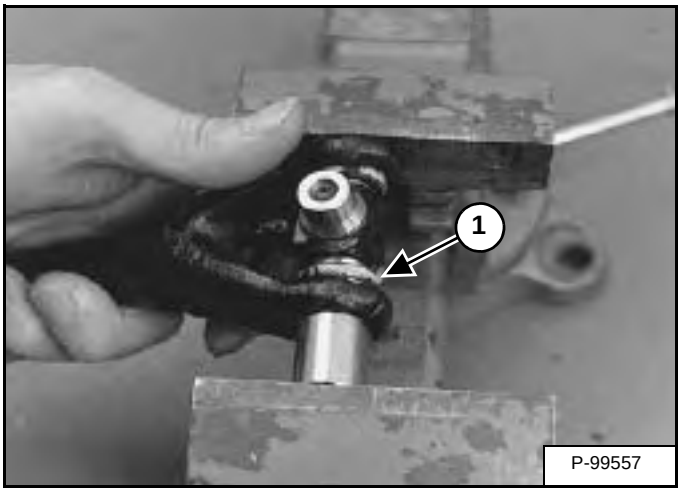
Propshaft U-Joint Assembly

Figure 20-60-46



Install new bearing caps in yoke by hand. Carefully install U-joint cross with grease fitting (Item 1) **[Figure 20-60-46]** properly positioned toward center of shaft. Take care not to dislodge needle bearings upon installation of cross joint. Tighten vise to force bearing caps in.

Figure 20-60-47

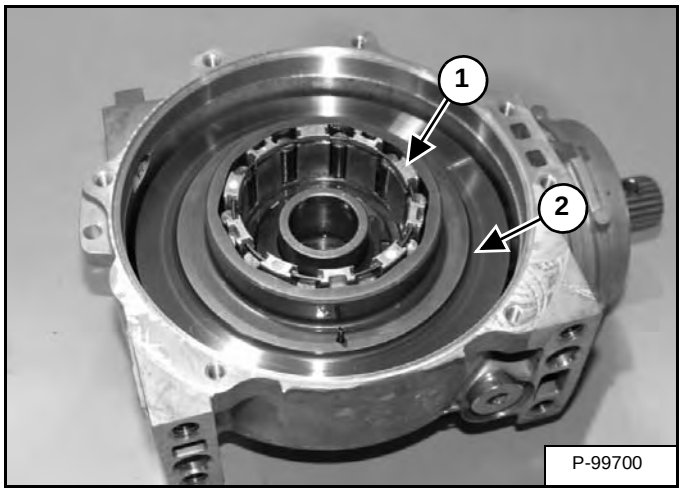


Using a suitable arbor, fully seat bearing cap (Item 1) **[Figure 20-60-47]** in one side. Continually check for free movement of bearing cross as bearing caps are assembled.

Install snap ring to contain bearing cap just installed. Repeat procedure for other side.

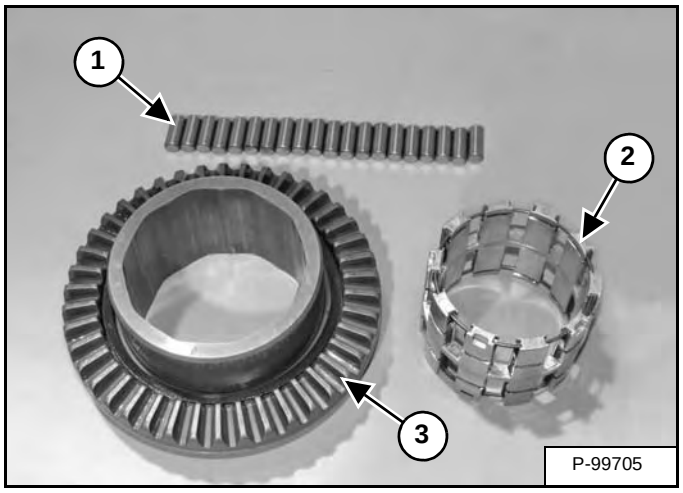
Front Gearcase Disassembly / Inspection (Cont'd)

Figure 20-60-69



Remove the roll cage assembly (Item 1) and ring gear (Item 2) **[Figure 20-60-69]**.

Figure 20-60-70

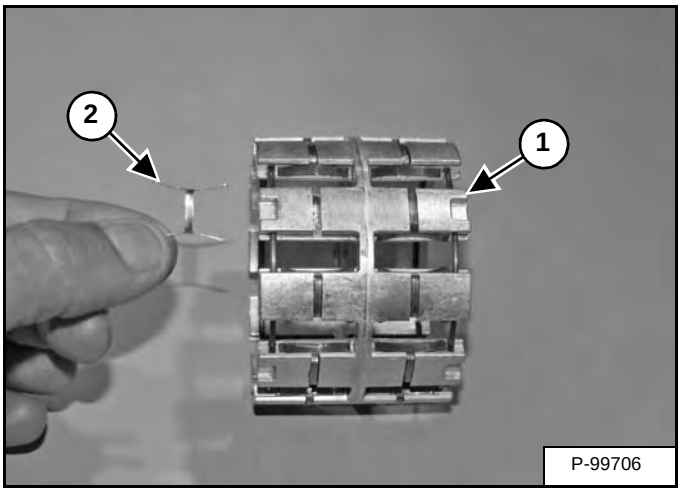


Thoroughly clean all parts. Inspect bearing surfaces of the output hub. Inspect the rollers (Item 1) for nicks, scratches and flat spots. Inspect the roll cage (Item 2) **[Figure 20-60-70]** for damage or cracks.

The rollers must slide up and down freely within the roller cage surfaces.

Inspect the ring gear (Item 3) **[Figure 20-60-70]** for consistent wear patterns. The surfaces should be free of nicks or burrs.

Figure 20-60-71

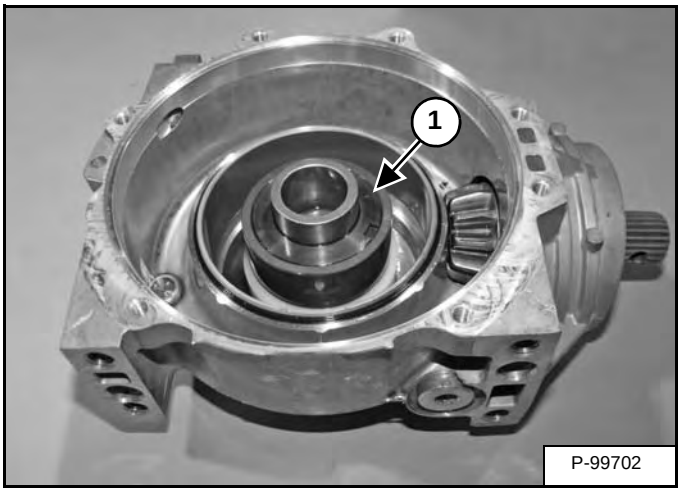


Inspect roll cage (Item 1) **[Figure 20-60-71]** sliding surface. This surface must be clean and free of nicks, burrs or scratches.

Remove and inspect the H-springs (Item 2) **[Figure 20-60-71]**. If the spring legs appear to be flattened or damaged, replace the roll cage and H-springs as an assembly.

NOTE: Most parts are replaced as an assembly or as a complete kit.

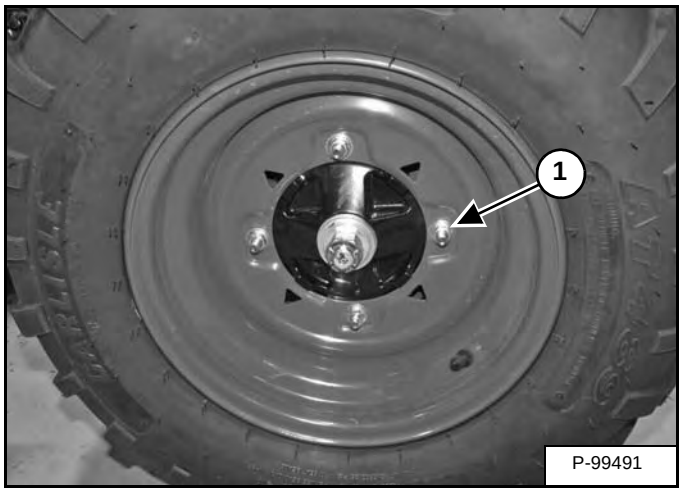
Figure 20-60-72



Remove RH output hub (Item 1) **[Figure 20-60-72]**. Inspect the bearing and contact surfaces of the output hub for signs of wear or damage. Replace component if found to be worn or damaged.

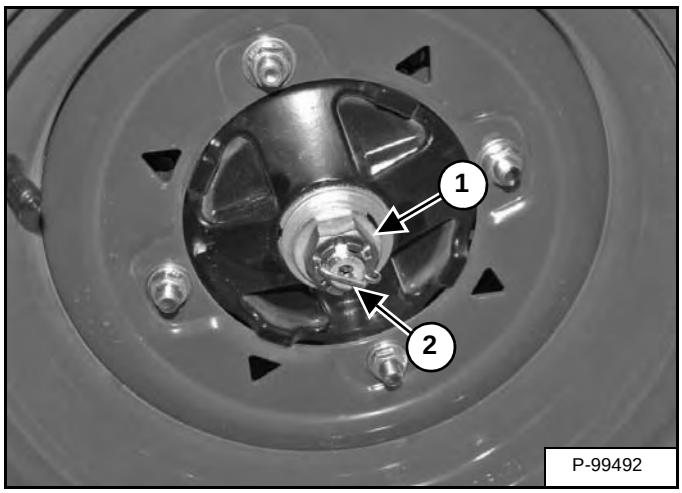
Rear Bearing Carrier Installation (Cont'd)

Figure 20-60-101



Install the wheel, washers and wheel nuts (Item 1) **[Figure 20-60-101]**. Tighten the nuts evenly in a criss-cross pattern to the correct torque. (See Tires on Page SPEC-10-5.)

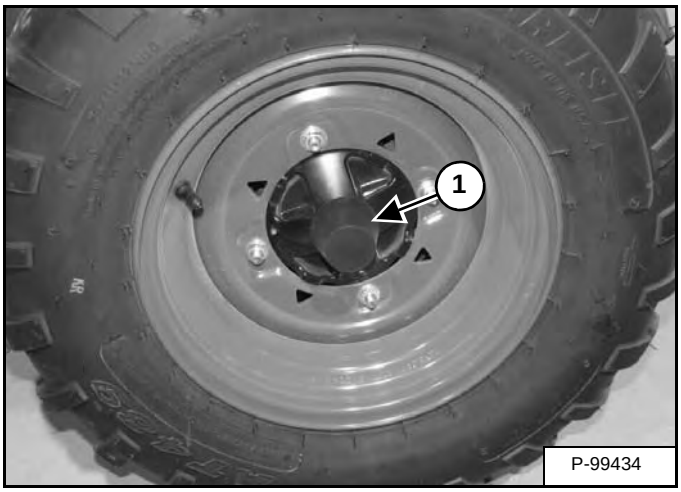
Figure 20-60-102



Lower the vehicle and tighten the rear castle nut (Item 1) **[Figure 20-60-102]** to 150 N•m (110 ft-lb) torque.

Install a new cotter pin (Item 2) **[Figure 20-60-102]**.

Figure 20-60-103



Raise the vehicle.

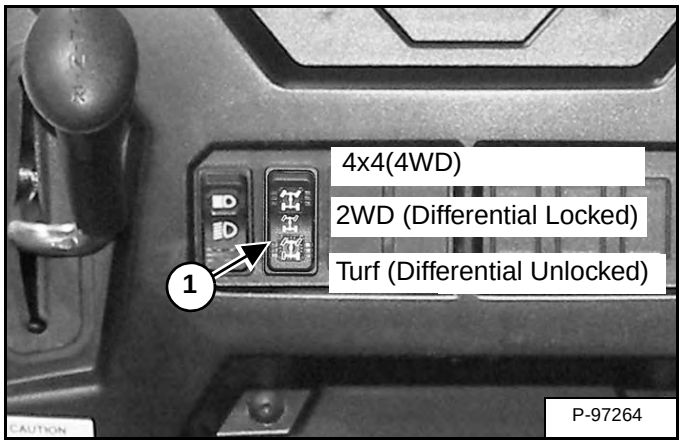
Rotate wheel and check for smooth operation. There should not be any binding, rough spots or side play.

Install the hub dust cap (Item 1) **[Figure 20-60-103]**.

Rear Gearcase Operation

The rear gearcase three traction operational modes: 4WD (4x4), 2WD (Differential Locked) and Turf (Differential Unlocked). Locking the rear differential is beneficial in low traction and rough terrain conditions. Unlocking the rear differential makes maneuvering easier and minimizes damage to turf and sensitive terrains.

Figure 20-60-131



When "Differential-Unlocked" is selected on the switch, the rear differential becomes unlocked for tighter turns. An electrical solenoid mounted in the rear gearcase housing actuates the shift yoke. The solenoid plunger extends out to move the shift yoke and slides the clutch gear away from the engagement dogs that are attached to the differential gear assembly. This unlocks the rear differential.

Figure 20-60-132

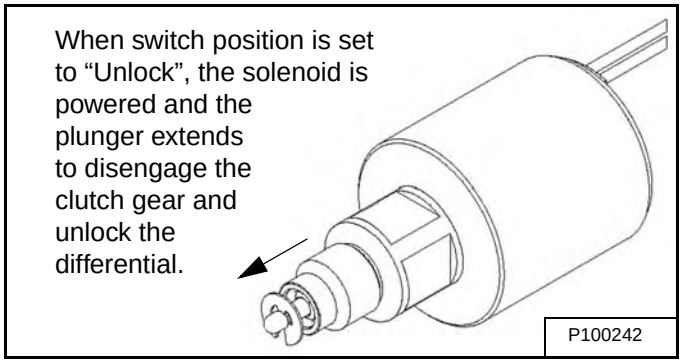
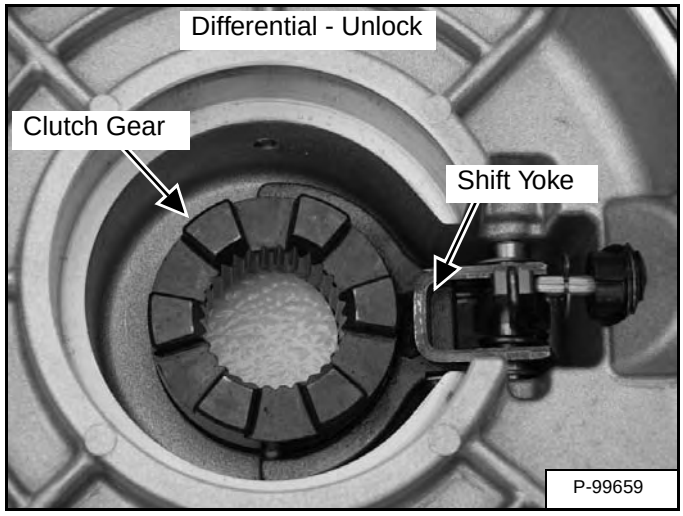


Figure 20-60-133



When "Differential-Locked" is selected on the switch, power is removed from the electrical solenoid allowing the solenoid plunger to retract. Spring tension moves the shift fork back into place and engages the clutch gear into the engagement dogs that are attached to the differential rear assembly, locking the rear differential as a solid rear axle.

Figure 20-60-134

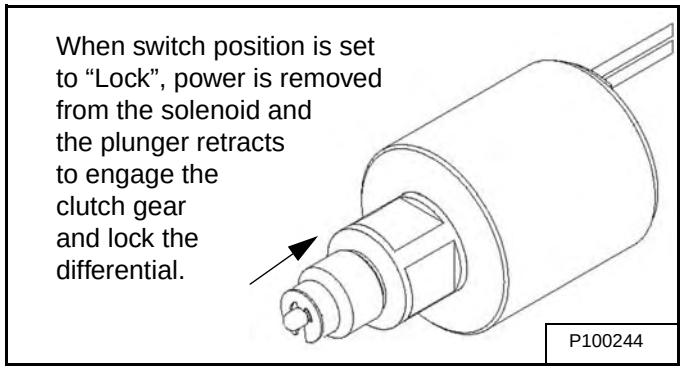
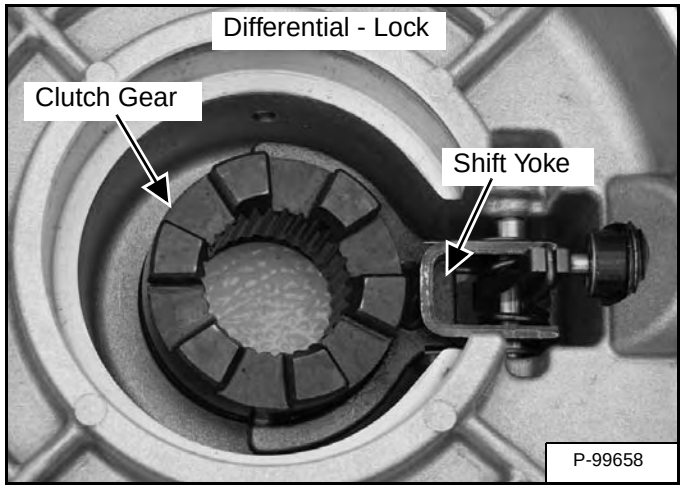


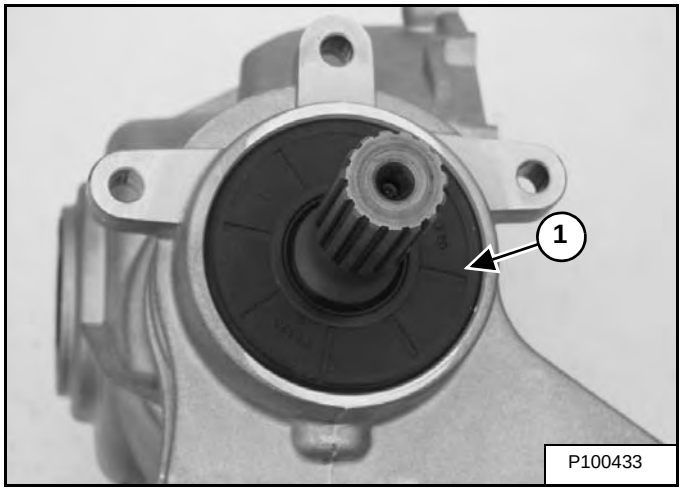
Figure 20-60-135



Rear Gearcase Assembly

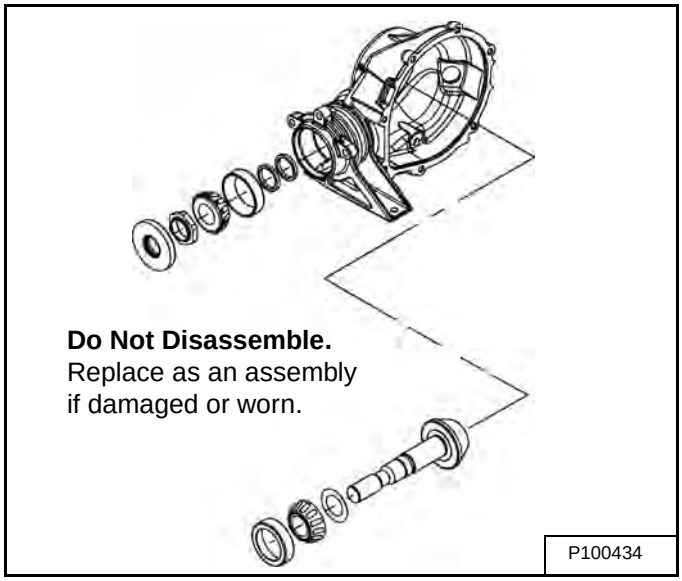
Note: Grease all seals and O-rings with a good quality lithium grease upon assembly.

Figure 20-60-162



Remove the pinion shaft oil seal using a seal puller and replace with a new seal (Item 1) **[Figure 20-60-162]**.

Figure 20-60-163



Note: The pinion gear assembly is NOT intended to be disassembled from the case, as it requires special OEM tooling in order to properly reassemble. If there is any damage to the pinion gear, bearings or case, the assembly must be replaced [Figure 20-60-163].

Figure 20-60-164

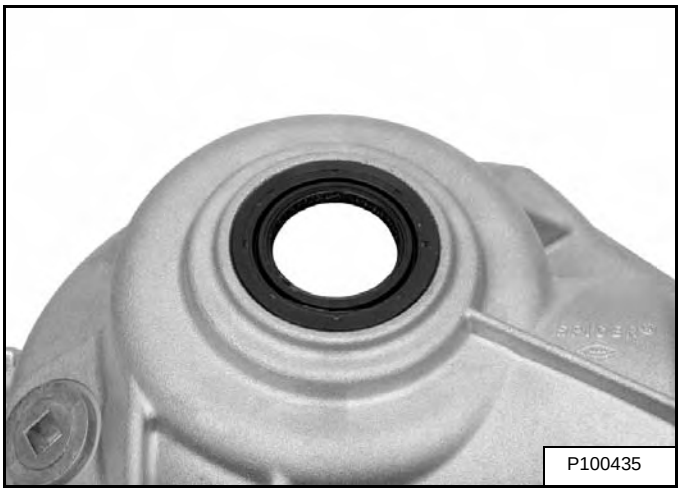
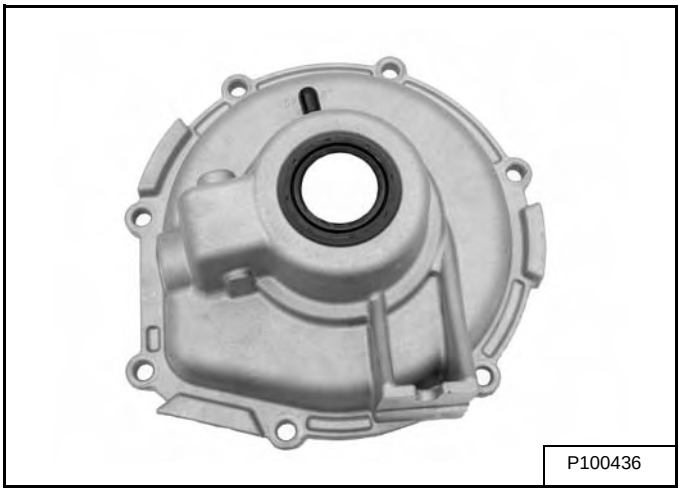


Figure 20-60-165



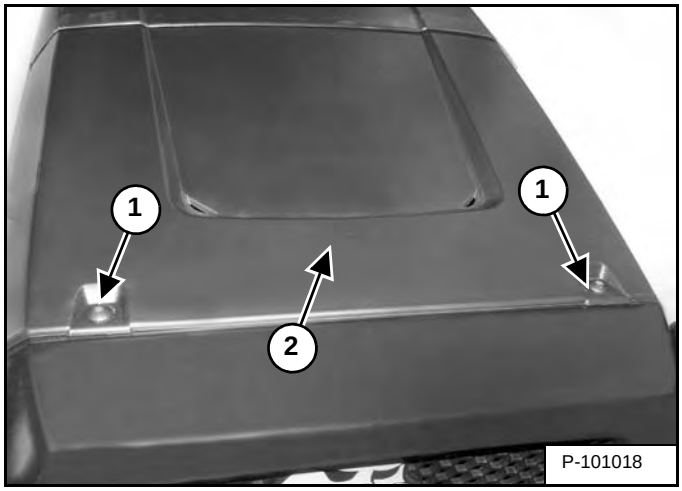
Replace the drive shaft oil seals located in the main gearcase and gearcase cover **[Figure 20-60-164]** and **[Figure 20-60-165]**.

Replace all worn components.

DASH

Front Access Cover Removal And Installation

Figure 30-30-1



Remove the two screws (Item 1) and cover (Item 2) **[Figure 30-30-1]**.

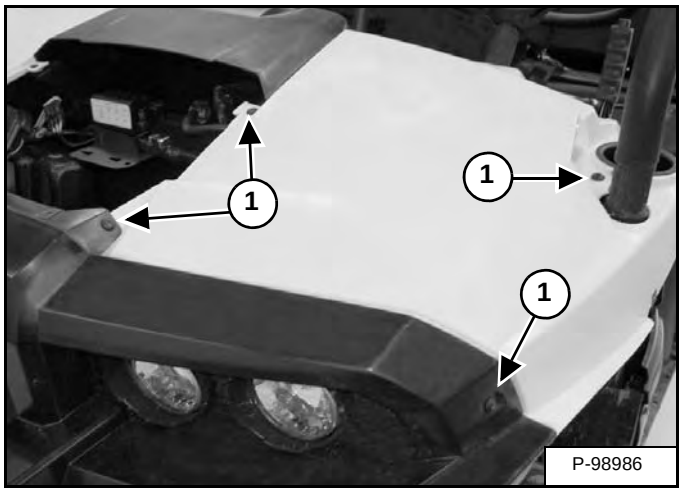
Left Dash Removal And Installation

NOTE: If the left dash is being replaced, the ROPS must be removed. (See Removal And Installation on Page 30-10-1.)

Remove the front access cover. (See Front Access Cover Removal And Installation on Page 30-30-1.)

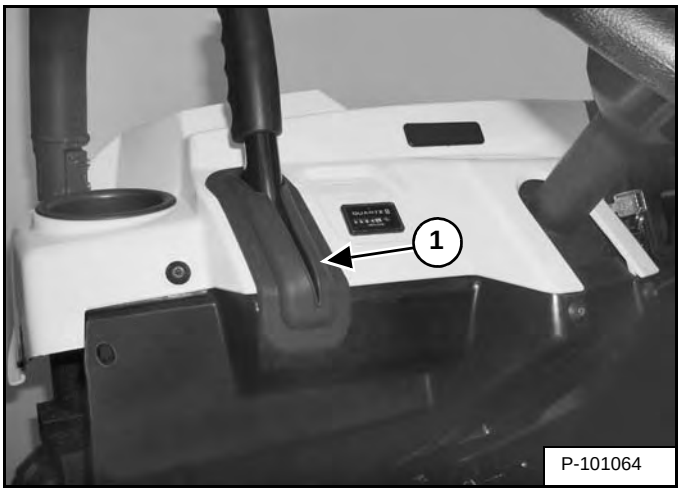
Remove the left fender flare. (See Flare Removal And Installation on Page 30-140-3.)

Figure 30-30-2



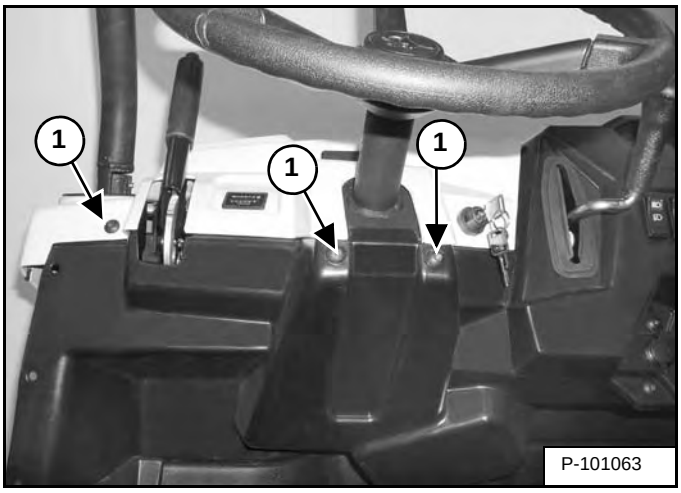
Remove the screws (Item 1) **[Figure 30-30-2]**.

Figure 30-30-3



Remove the rubber grommet (Item 1) **[Figure 30-30-3]**.

Figure 30-30-4



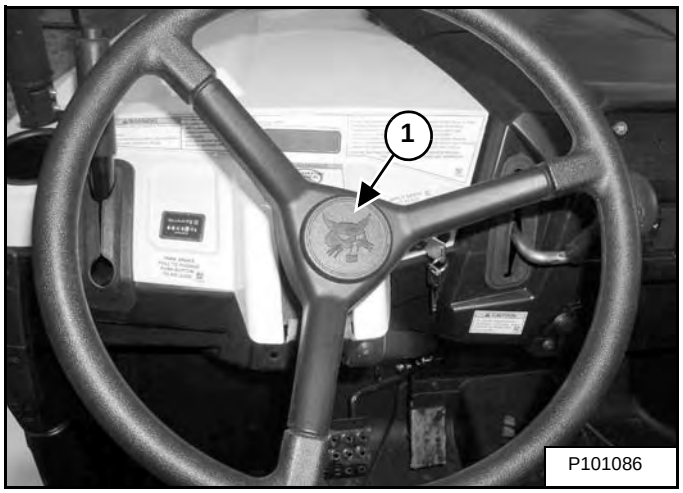
Remove the three screws (Item 1) **[Figure 30-30-4]**.

STEERING COLUMN (S/N AJNY19999 & BELOW) (CONT'D)

Steering Shaft Removal And Installation

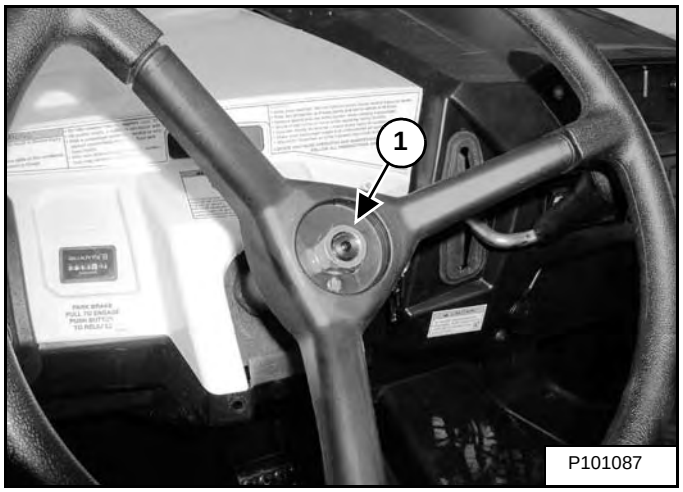
Remove the front access cover. (See Front Access Cover Removal And Installation on Page 30-30-1.)

Figure 30-60-3



Remove the cap (Item 1) **[Figure 30-60-3]** from the steering wheel.

Figure 30-60-4



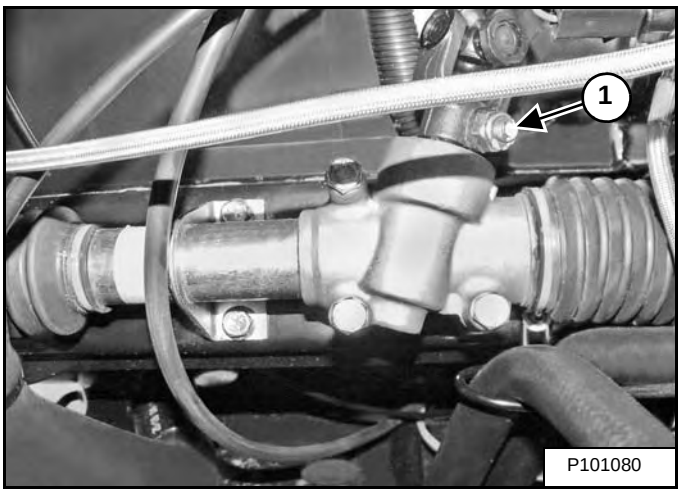
Loosen the nut (Item 2) **[Figure 30-60-4]** and back it half way off the steering shaft.

With a glove on your hand, place it under the steering wheel. Lift upward on the inner portion of the steering wheel while using a hammer to strike the steering shaft nut.

Once the steering wheel pops loose, completely remove the nut (Item 1) **[Figure 30-60-4]** and lift the steering wheel off the shaft.

Installation: Apply Loctite® and tighten the nut to 38 N•m (28 ft-lb) torque.

Figure 30-60-5



Remove the nut and bolt (Item 1) **[Figure 30-60-5]** from the coupler.

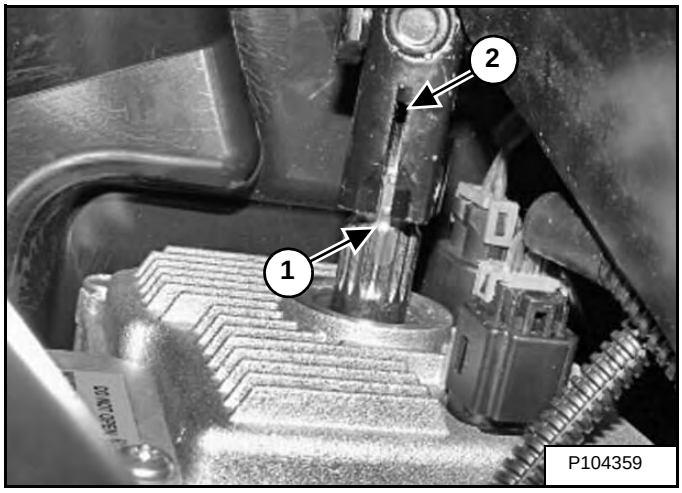
Installation: Apply Loctite® 242 or equivalent thread locker to the threads of the bolt when installing.

Installation: Install the bolt and tighten the nut to 41 N•m (30 ft-lb) torque.

Slide the steering shaft towards the floor to remove from the dash.

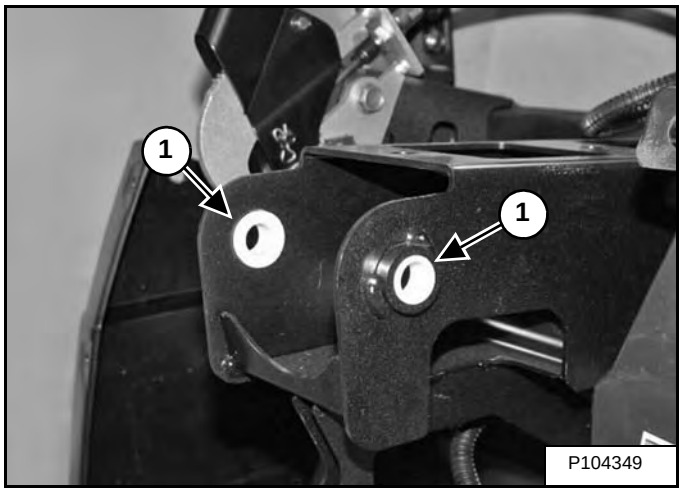
Steering Shaft Removal And Installation (Power Steering Equipped Models) (Cont'd)

Figure 30-61-22



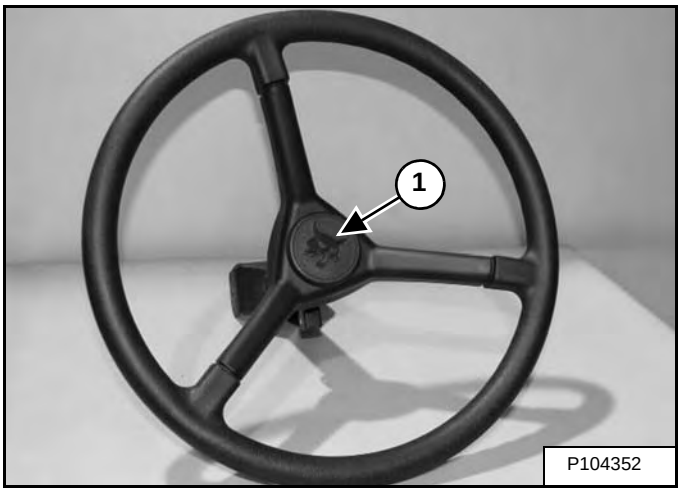
Installation: Align the skip-tooth (Item 1) of the power steering stub shaft with the opening in the steering shaft (Item 2) **[Figure 30-61-22]** then slide steering shaft onto power steering unit.

Figure 30-61-23



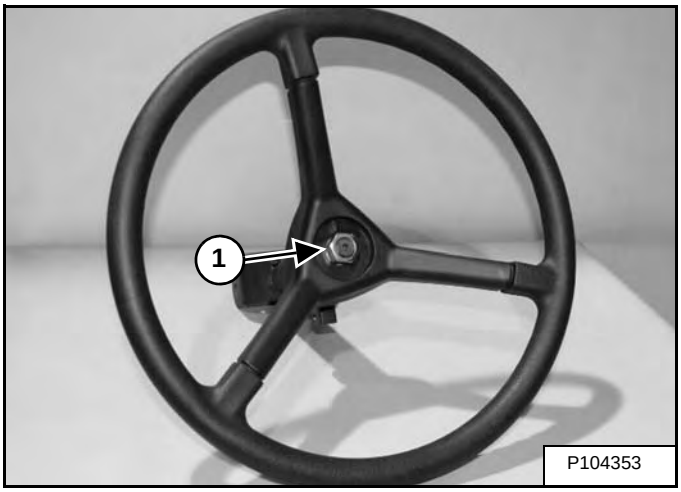
Check the plastic bushings (Item 1) **[Figure 30-61-23]** for wear or damage and replace as needed.

Figure 30-61-24



Remove the steering wheel cap (Item 1) **[Figure 30-61-24]**.

Figure 30-61-25



Loosen the nut (Item 1) **[Figure 30-61-25]** and back it half way off the steering shaft.

SHOCKS

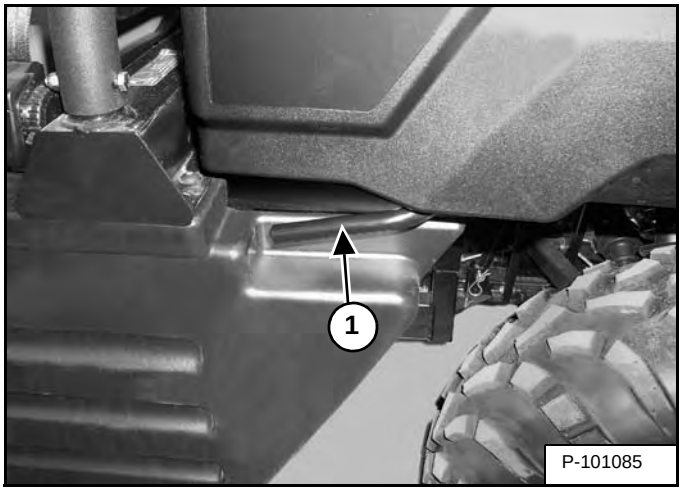
Removal And Installation

Lift and block the machine. (See Procedure on Page 10-10-1.)

Remove the tire assembly. (See TIRE MAINTENANCE on Page 10-120-1.)

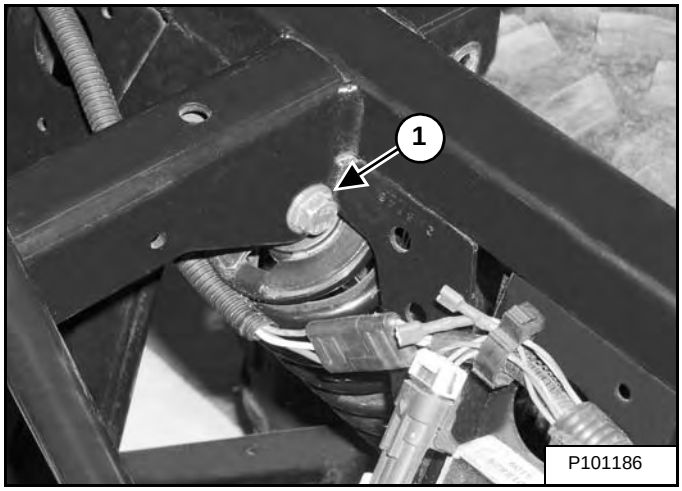
NOTE: The removal procedure for all shocks is the same.

Figure 30-90-1



Lift up on the handle (Item 1) **[Figure 30-90-1]** and tilt the cargo box.

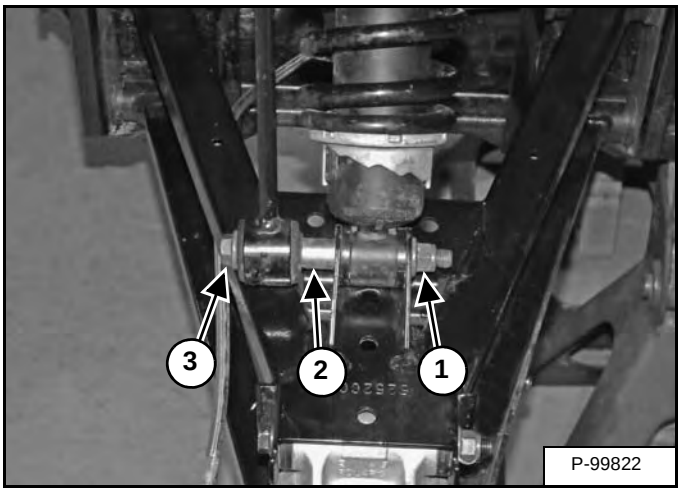
Figure 30-90-2



Remove the top shock mount bolt (Item 1) **[Figure 30-90-2]** and nut.

Installation: Tighten the bolt to 41 N•m (30 ft-lb) torque.

Figure 30-90-3



Remove the bottom shock mount nut (Item 1), spacer (Item 2) and bolt (Item 3) **[Figure 30-90-3]**.

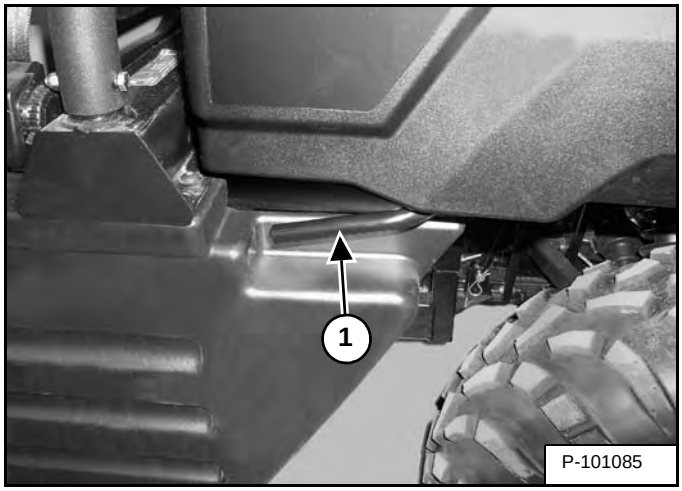
Installation: Tighten the bolt to 41 N•m (30 ft-lb) torque.

Remove the shock.

CARGO BOX

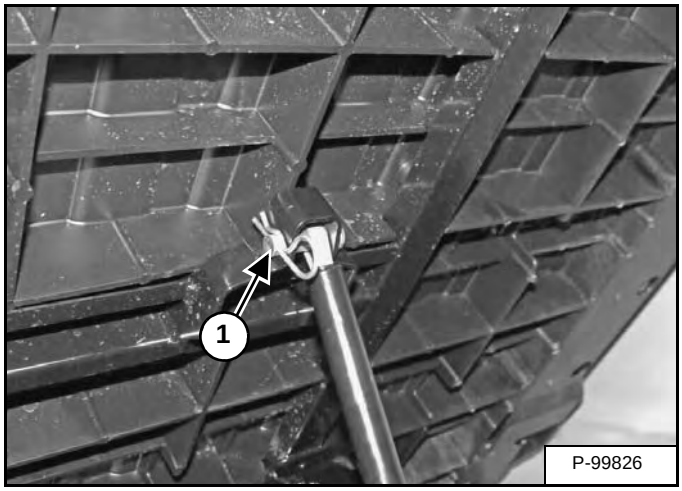
Removal And Installation

Figure 30-130-1



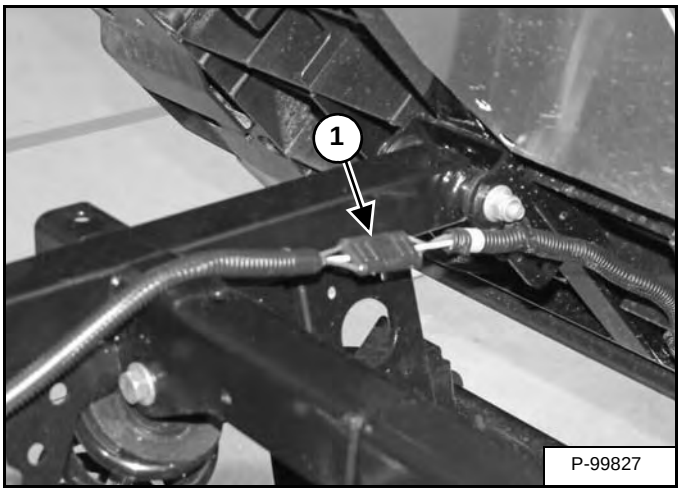
Lift the handle (Item 1) **[Figure 30-130-1]** and tilt the cargo box into the dump position.

Figure 30-130-2



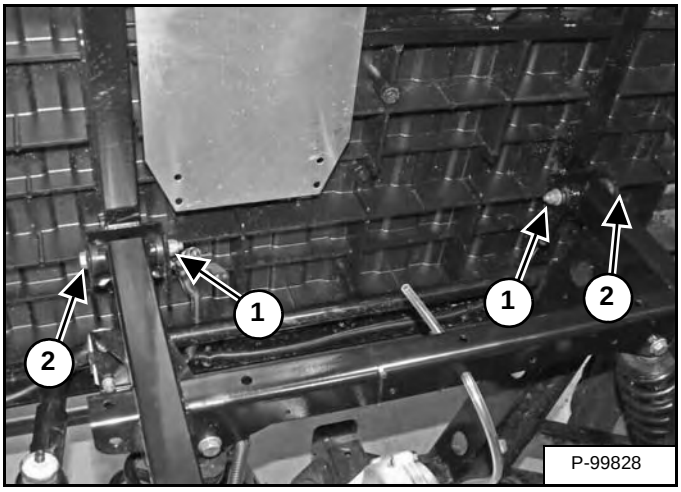
Remove the shock clip (Item 1) **[Figure 30-130-2]** and pin.

Figure 30-130-3



Disconnect the tail light harness (Item 1) **[Figure 30-130-3]**.

Figure 30-130-4



Support the cargo box and remove the nuts (Item 1) and bolts (Item 2) **[Figure 30-130-4]**.

Remove the cargo box.

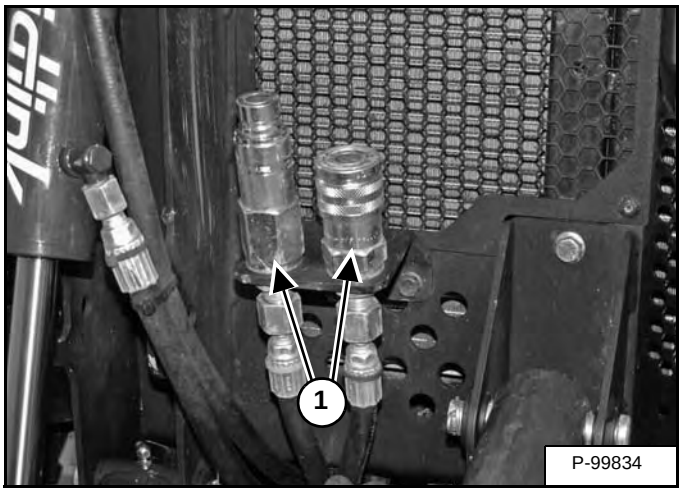
FRONT MOUNT

Removal And Installation

Remove the bucket or attachment.

Remove the attachment arm. (See Removal And Installation on Page 30-160-1.)

Figure 30-170-1

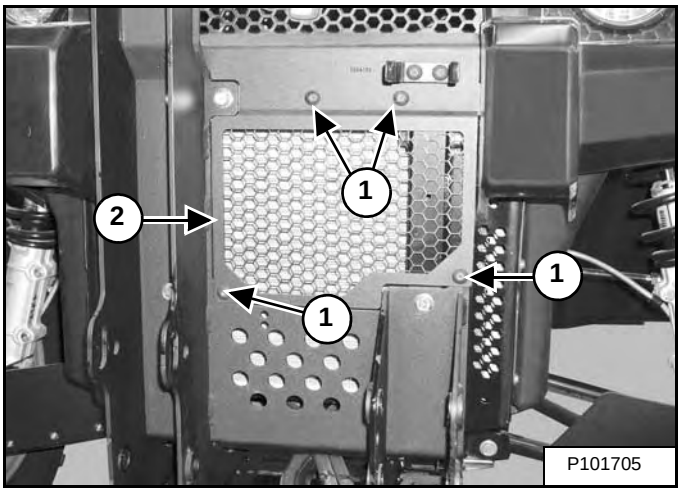


Remove the auxiliary couplers (Item 1) **[Figure 30-170-1]**.

Remove the lift cylinder. (See Removal And Installation on Page 60-10-2.)

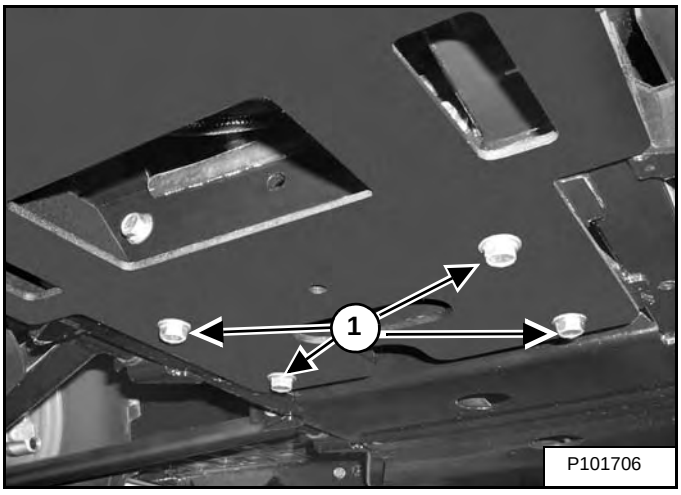
Remove the tilt cylinder. (See Removal And Installation on Page 60-11-2.)

Figure 30-170-2



Remove the four bolts (Item 1) and radiator guard (Item 2) **[Figure 30-170-2]**.

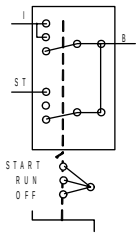
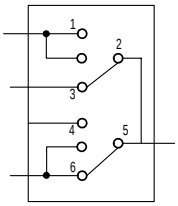
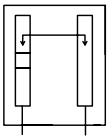
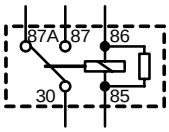
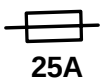
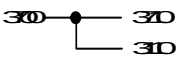
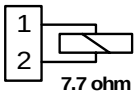
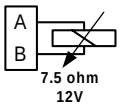
Figure 30-170-3

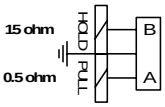
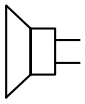
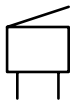
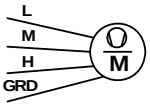
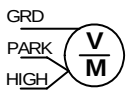
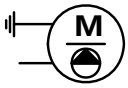
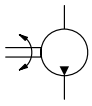
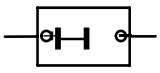


Remove the four bolts (Item 1) **[Figure 30-170-3]** from the underside of the mount.

Installation: Tighten the bolts to 50 N•m (37 ft-lb) torque.

Glossary Of Electrical Symbols (Cont'd)

SYMBOL	DESCRIPTION
	COMPONENTS
	SWITCH - Ignition - Multi position switch to activate various start functions at different positions.
	SWITCH - Light - Multi position switch to activate various lights at different positions.
	ROTARY CONTROL - Provides variable voltage proportional to position.
	RELAY - Uses a low amp switch to control a high amp component.
	FUSE - Used to protect the wire harness from an overloaded circuit. (The fuse rating is listed next to the fuse.)
	SPLICE (•) - Used to show when multiple wires are connected together on the schematic.
	SOLENOID - ON / OFF - Electrically activated coil that controls movement magnetically. (The ohm rating of the solenoid coil is listed next to the component [if available]).
	SOLENOID - VARIABLE - Electrically activated coil that controls movement magnetically. (The ohm rating and voltage of the solenoid coil is listed next to the component [if available]).

SYMBOL	DESCRIPTION
	SOLENOID - Fuel and Traction Lock - Dual solenoids. (The ohm rating of the solenoid coils are listed next to the component [if available]). The pull solenoid is energized for a short time.
	HORN - Audible alarm. Sound is activated manually by a switch to warn personnel.
	BUZZER - Audible alarm. Sounds at a predetermined setting to warn the operator of a component condition.
	RESISTOR - Limits current flow.
	DIODE - Allows electrical current to flow in 1 direction only.
	MOTOR - HVAC - Multi speed motor.
	MOTOR - Wiper - Single or multi speed motor.
	MOTOR - Washer - Single speed.
	PUMP - FUEL
	HOURMETER - Records the time the engine is running.
	POWER PLUG - Supplies 12 volt power for customer supplied accessories.
	GAUGE - Instrument - Indicates certain engine or other component conditions. (The different types of gauge are marked with a icon that represents what function the gauge is monitoring. Example: the gauge shown is for fuel.)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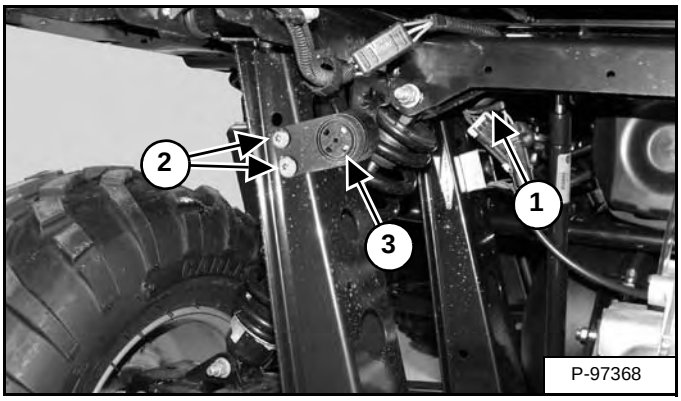
Removal And Installation

Figure 40-140-4



Disconnect the back-up alarm electrical connector (Item 1) **[Figure 40-140-4]** from the main harness.

Remove the two bolts and nuts (Item 2) and remove the back-up alarm (Item 3) **[Figure 40-140-4]** from the vehicle.

Power Steering Troubleshooting (Using Digital Wrench™)

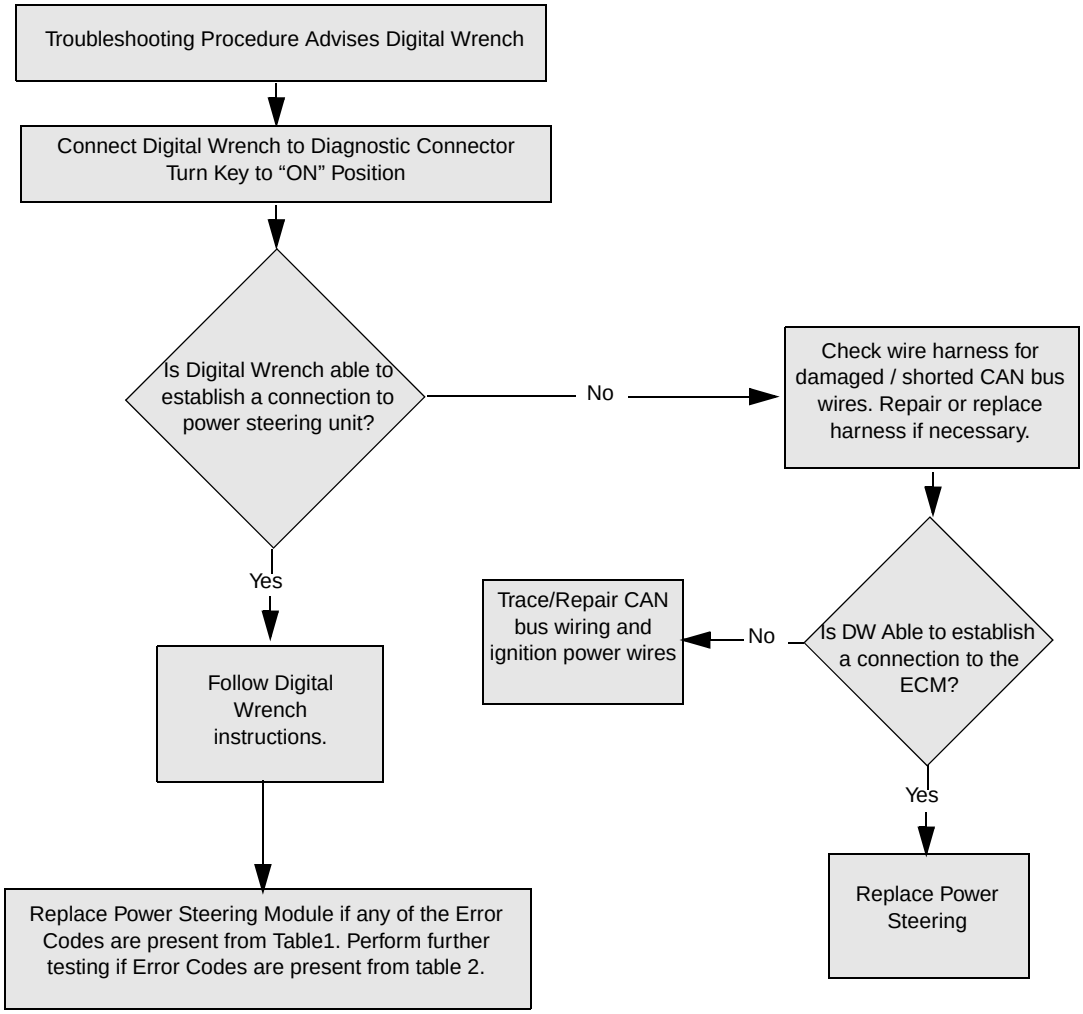


Table 1: Error Codes requiring Power Steering Replacement

1. Position Encoder Error
2. Power Steering Error
3. Steering Torque Sensor Full Failure
4.Steering Excessive Current Error
5.Steering Over Current Shutdown

Table 2: Error Codes requiring Additional Troubleshooting

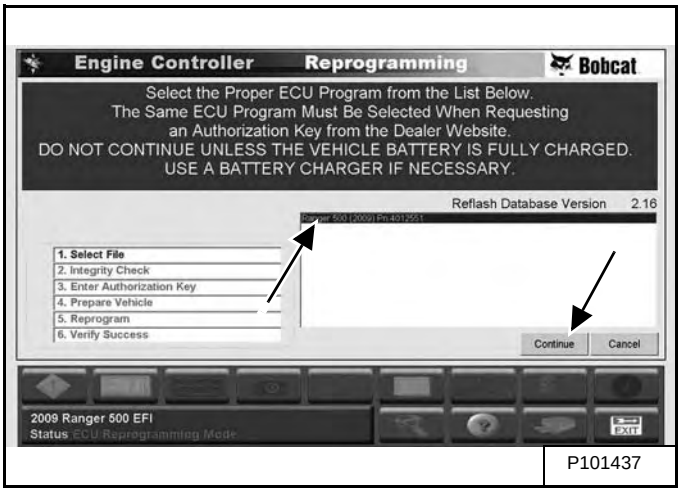
1. Power Steering Inverter Temperature - check for mud/debris on power steering
2. Battery Voltage Over / Under - check machines charging system and battery
3. Calibration Error - Reflash power steering unit

DIAGNOSTIC TESTING (POWER STEERING) (CONT'D)

Engine Controller Reprograming (Reflash) (Cont'd)

Reprogramming (Reflash) (Cont'd)

Figure 40-170-18

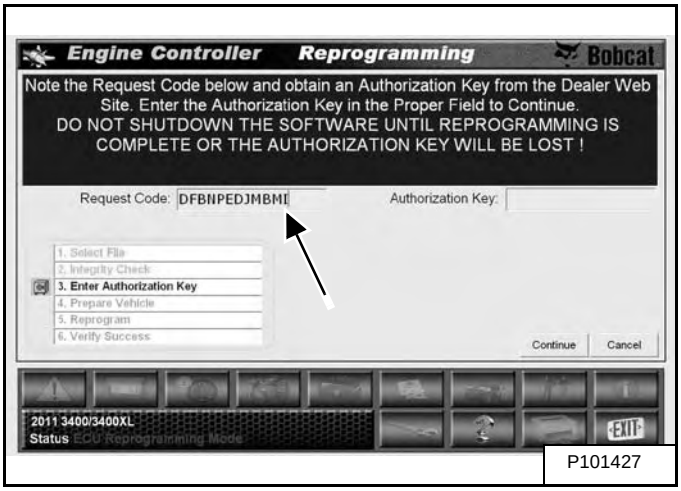


P101437

Select the file you want to load into the ECU then click the "Continue" icon to proceed to the Integrity Check and obtain a Request Code **[Figure 40-170-18]**.

The Request Code is available on Doosan Passport.

Figure 40-170-19



P101427

Copy (CTRL +C) the Request Code that will be required on the dealer website in the next step. DO NOT CLOSE Digital Wrench™ or the Request Code will be invalid **[Figure 40-170-19]**.

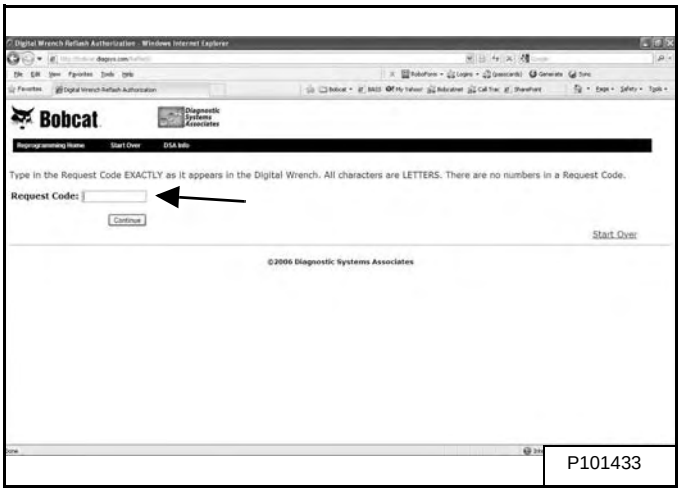
NOTE: All characters are letters; there are no numbers in a request code.

Figure 40-170-20

P-99885

Go to the Doosan Passport main screen and choose the application called "Utility Vehicle ECU Reflash Authorization" **[Figure 40-170-20]**.

Figure 40-170-21



P101433

Enter or paste (CTRL+v) the Request Code into the box **[Figure 40-170-21]**.

Specifications (Cont'd)

Idler Gear Shaft And Bushing

Item	Factory Specification	Limit
Shaft Outside Diameter	29,959 - 29,980 mm (1.1795 -1.1803 in)	29,919 mm (1.1779 in)
Bushing Inside Diameter	30,000 - 30,025 mm (1.1811 - 1.1821 in)	30,066 mm (1.1837 in)
Oil Clearance	0,020 - 0,066 mm (0.0008 - 0.0026 in)	0,147 mm (0.0059 in)

Connecting Rod

Item	Factory Specification	Allowable Limit
Connecting Rod Small End I.D.	22,025 - 22,042 mm (0.8671 - 0.8678 in)	20,072 mm (0.7902 in)
Connecting Rod Small End Radial Clearance	0,0025 - 0,047 mm (0.0010 - 0.0019 in)	0,105 mm (0.0041 in)
Connecting Rod Big End Side Clearance	0,20 - 0,40 mm (0.0079 - 0.0157 in)	
Connecting Rod Big End Radial Clearance	0,020 - 0,058 mm (0.0008 - 0.0023 in)	0,110 mm (0.0043 in)

Crankshaft

Item		Factory Specification	Allowable Limit
Bend		-	0,02 mm (0.0008 in)
Roundness		0,01 mm (0.0004 in) or less	0,02 mm (0.0008 in)
Connecting Rod Journals	Journal Outside Diameter	37,952 - 37,962 mm (1.4942 - 1.4946 in)	37,402 mm (1.4725 in)
	Bearing Inside Diameter	37,982 - 38,010 mm (1.4954 - 1.4965 in)	
	Bearing Insert thickness	1,503 - 1,509 mm (0.592 - 0.0594 in)	
	Oil Clearance	0,020 - 0,058 mm (0.0008 - 0.0023 in)	0,110 mm (0.0043 in)

Engine Removal And Installation

Clean the work area.

Thoroughly clean the engine and chassis.

Remove the seat base. (See Seat Base Removal And Installation on Page 30-20-1.)

Disconnect the negative (-) battery cable.

Drain the engine coolant from the cooling system. (See Removing And Replacing Coolant on Page 10-70-3.)

Drain the oil from the engine. (See Removing And Replacing Oil And Filter on Page 10-90-2.)

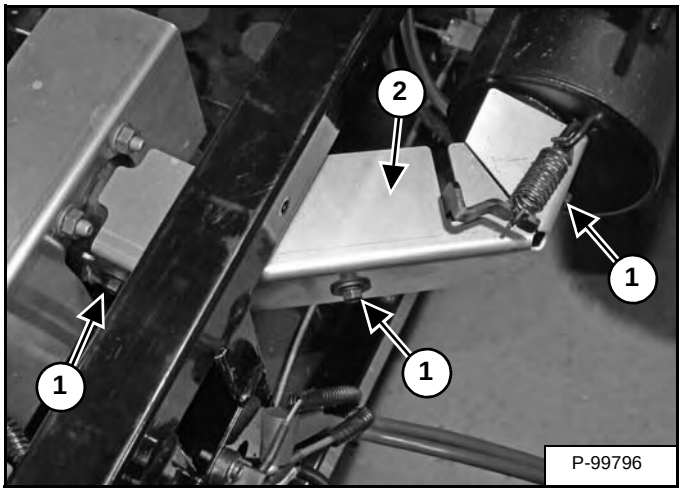
Remove the transmission. (See Removal And Installation on Page 20-30-4.)

⚠ WARNING

Always wear safety glasses and proper shop clothing when performing the procedures in the manual. Failing to do so may lead to possible injury or death.

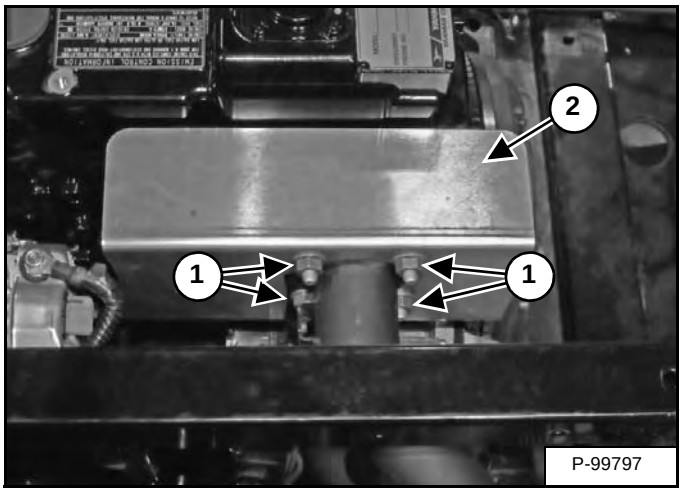
W-2847-0710

Figure 50-10-2



Remove the three bolts (Item 1) and remove the exhaust shield (Item 2) **[Figure 50-10-2]**.

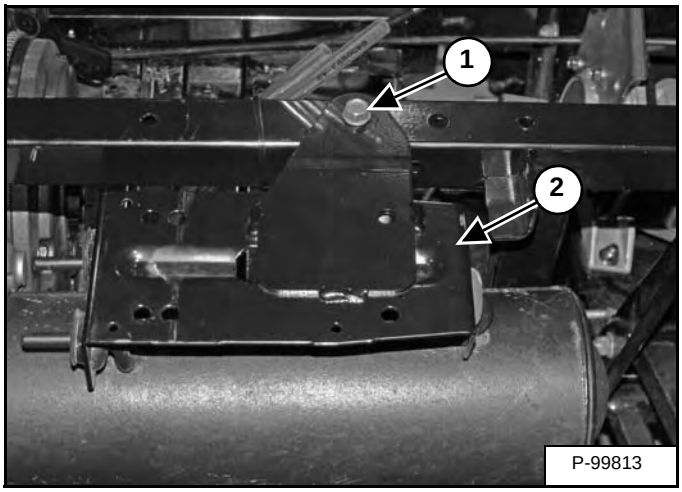
Figure 50-10-3



Remove the four nuts (Item 1) securing the exhaust pipe and remove the shield (Item 2) **[Figure 50-10-3]**.

Installation: Inspect the exhaust gasket for damage and replace if needed.

Figure 50-10-4



Remove the bolt (Item 1) and remove the muffler and bracket assembly (Item 2) **[Figure 50-10-4]**.

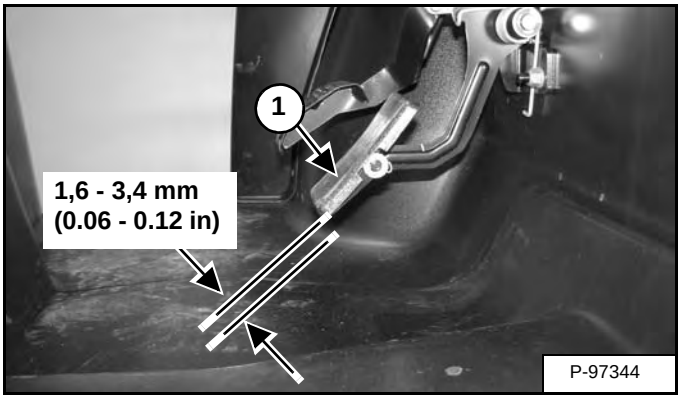
Throttle Freeplay

If the throttle pedal has excessive play due to cable stretch or mis-adjustment, it will cause a delay in the throttle response, especially at low engine speed. The throttle may also not open fully. If the throttle pedal has no freeplay, the throttle may be hard to control, and idle speed may be erratic.

Adjust freeplay as necessary.

Inspection And Maintenance

Figure 50-20-12



Position the utility vehicle on a flat level surface. Engage the park brake, place the gear selector lever in neutral. Start the engine and allow to warm to operating temperature.

Measure the distance the throttle pedal (Item 1) **[Figure 50-20-12]** moves before the engine picks up speed.

The correct throttle pedal freeplay is 1,6 - 3,2 mm (0.06 - 0.12 in).

Remove the seat. (See Seat Base Removal And Installation on Page 30-20-1.)

Throttle Freeplay Adjustment

Figure 50-20-13

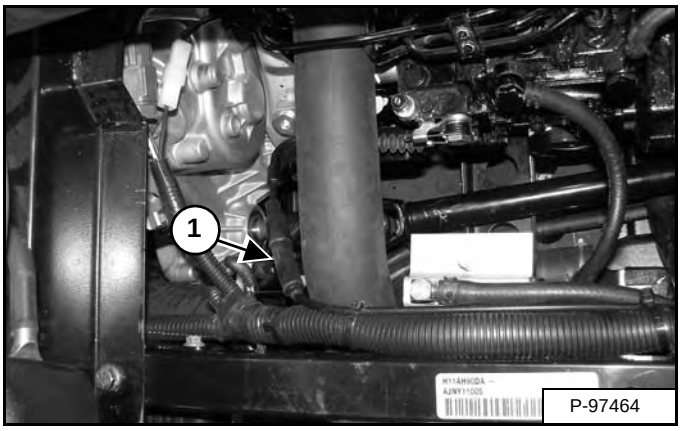
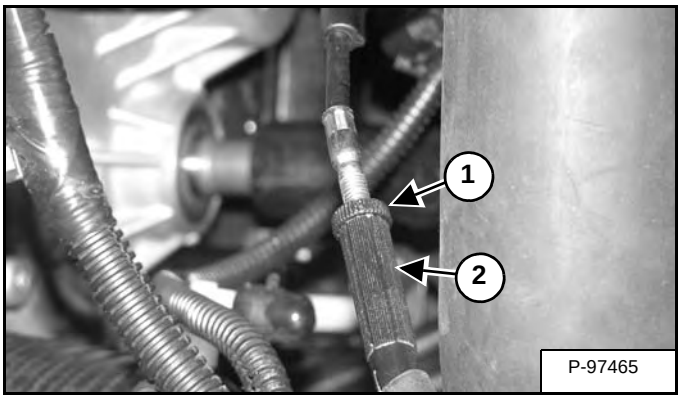


Figure 50-20-14



Position the utility vehicle on a flat level surface. Engage the park brake and stop the engine. Exit the utility vehicle.

The adjustment for the throttle cable is located under the boot (Item 1) **[Figure 50-20-13]**. Squeeze the end of the rubber boot and slide it far enough to expose the end of the in line cable adjuster.

Loosen the adjuster lock nut (Item 1) **[Figure 50-20-14]**.

Rotate the adjuster (Item 2) **[Figure 50-20-14]** until the correct amount of throttle pedal freeplay is achieved.

NOTE: While adjusting, lightly flip the throttle pedal up and down.

Tighten the lock nut (Item 1) **[Figure 50-20-14]** and slide the rubber boot (Item 1) **[Figure 50-20-13]** back to its original location.

Water Pump Disassembly And Assembly

Disassembly

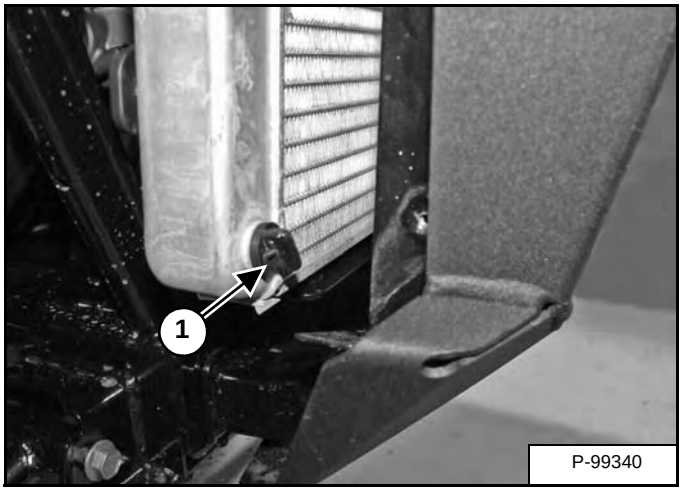
Verify the condition of the engine coolant pump before disassembling it from the engine. Check the engine coolant pump shaft bearing for abnormal noise, sticking, excessive play and water leakage. Replace the coolant pump if any of these conditions are present.

NOTE: If the engine coolant pump must be replaced, replace the engine coolant pump as an assembly only. Do not attempt to repair the engine coolant pump or replace individual components.

Make sure the engine and engine coolant are not hot.

Before removing the engine coolant pump or thermostat, it will be necessary to drain the engine coolant. Drain the coolant into a clean container if the coolant is to be reused. Otherwise, properly dispose of the coolant.

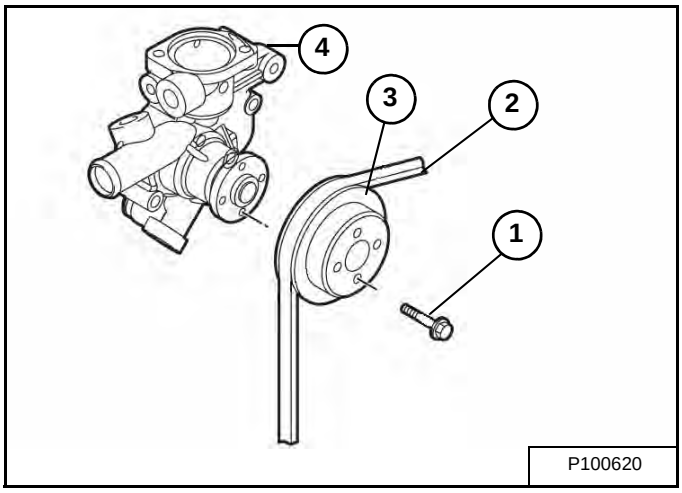
Figure 50-50-14



Open the drain valve (Item 1) **[Figure 50-50-14]** on the front side of the radiator and allow the coolant to completely drain into a suitable container. Properly dispose of the used coolant.

Loosen the alternator mounting bolts. Loosen and remove the V-belt and rotate the alternator away from the engine and out of the way.

Figure 50-50-15

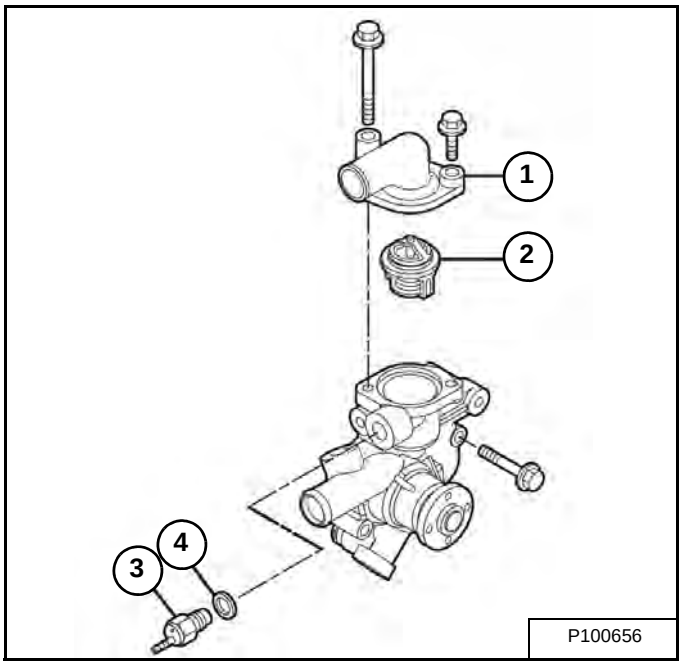


Remove the engine coolant pulley guard (if equipped), Pulley bolts (Item 1), belt (Item 2) and engine coolant pump V-pulley (Item 3) **[Figure 50-50-15]**.

Disconnect the coolant hoses and the temperature switch lead wire from the engine coolant pump.

Remove the engine coolant pump (Item 4) **[Figure 50-50-15]**. Discard the gasket.

Figure 50-50-16



Remove the thermostat cover (Item 1) **[Figure 50-50-16]**.

Remove the thermostat (Item 2) **[Figure 50-50-16]**. Remove the temperature sensor and adaptor (Item 3) and gasket (Item 4) **[Figure 50-50-16]**. Discard the gasket.

High-Pressure Fuel Injection Lines Removal And Installation

Removal

⚠ WARNING

AVOID INJURY OR DEATH

Diesel fuel or hydraulic fluid under pressure can penetrate skin or eyes, causing serious injury or death. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use your bare hand. Wear safety goggles. If fluid enters skin or eyes, get immediate medical attention from a physician familiar with this injury.

W-2072-0807

IMPORTANT

Do not bend the high pressure fuel injection tubes when removing or installing them.

I-2029-0289

IMPORTANT

Do not attempt to maintain or adjust unless you are trained and have the correct equipment.

I-2028-0289

NOTE: To prevent "rounding" the fuel line nuts, always use a "line" or "flare nut" wrench.

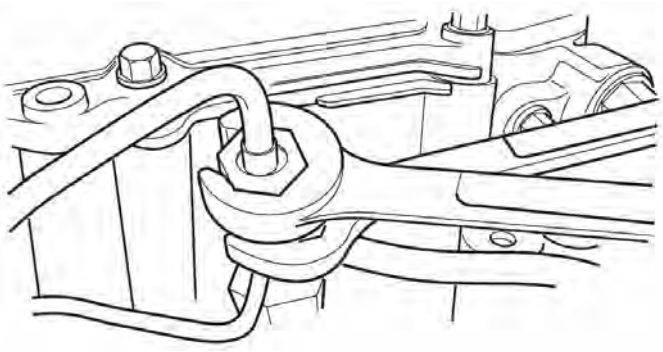
Close any fuel valves in the fuel supply line.

Clean the area to keep contaminants from entering the fuel system.

Place a drain pan under the fuel injection pump to catch any spillage.

Loosen the fuel line nuts at the fuel injection pump.

Figure 50-70-3



P100648

Next, loosen the fuel line nuts at the fuel injectors. Use one wrench to hold the fuel return line nut and fuel return line from rotating. Use a second wrench to loosen the fuel line nut **[Figure 50-70-3]**. Repeat with the remaining fuel injectors.

Finish loosening all the fuel line nuts and remove the high-pressure fuel lines as an assembly, being careful not to bend any of the fuel lines. Be sure to protect the fuel system from contamination by plugging or covering all open connections.

Plug or cap all openings to minimize leakage and prevent contamination.

Installation

NOTE: Remove and install the high-pressure fuel injection lines as an assembly whenever possible. Disassembling the high-pressure fuel injection lines from the retainers or bending any of the fuel lines will make it difficult to install the fuel lines.Note: To prevent "rounding" the fuel line nuts, always use a "line" or "flare nut" wrench.

Start all the fuel line nuts by hand. Then use a wrench to "snug" all the fuel line nuts.

Tighten the fuel line nuts on the fuel injection pump to 29 - 34 N•m (22 - 25 ft-lb) torque.

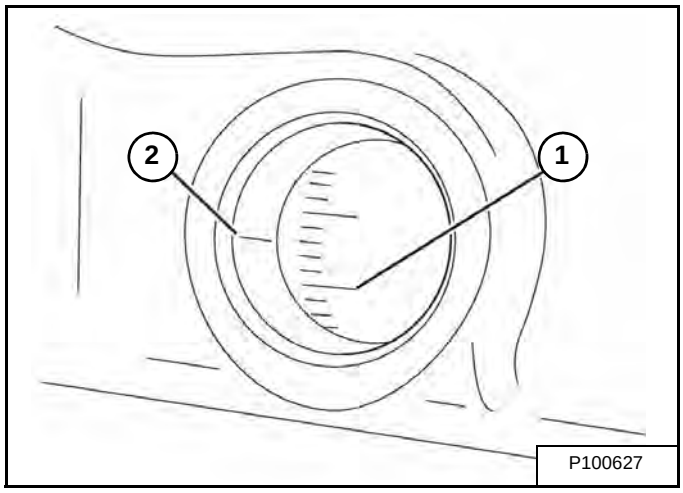
When tightening the fuel line nuts on the fuel injectors, use one wrench to hold the fuel return line nut and fuel return line from rotating. Use a second wrench to tighten the fuel line nuts **[Figure 50-70-3]**.

Injection Pump - Timing (Cont'd)

Adjusting

If the timing marks did not align when performing the (Injection Pump Timing on page 50-70-9), the following steps must be performed to properly time the engine.

Figure 50-70-23

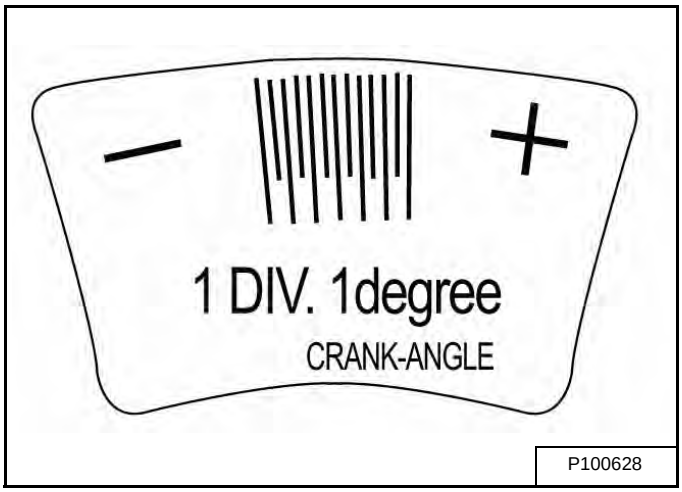


The fuel injection pump of TNM engines is fixed with four bolts. Adjust the injection timing by rotating the pump drive gear on the pump flange.

Leave the "spill-timing" tool installed in the fuel injection pump.

Determine if the timing is "advanced" or "retarded" by comparing the position of the target timing mark on the flywheel grid (Item 1) with the timing mark on the flywheel housing or back plate (Item 2) **[Figure 50-70-23]**.

Figure 50-70-24



The new injection pump will come with a timing grid sticker **[Figure 50-70-24]**. Each line on the timing grid sticker is 1°. Each line on the flywheel grid is also 1°.

CYLINDER HEAD (CONT'D)

Intake And Exhaust Valves (Cont'd)

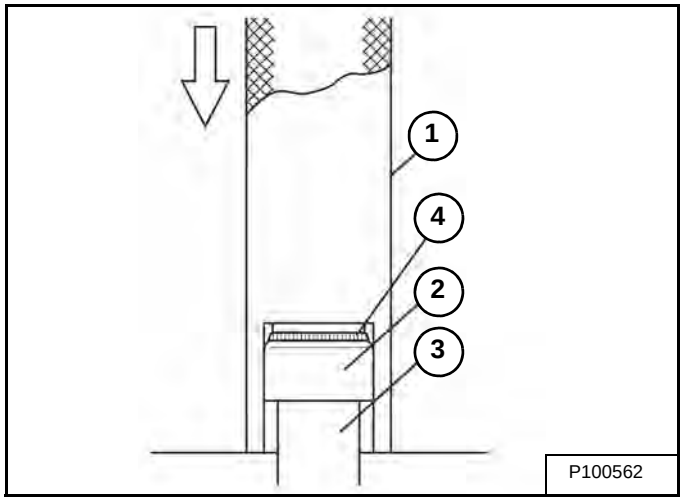
Installation

NOTE: Always install new valve stem seals.

NOTE: For 3TNM72 engines, the exhaust valve stem seals are different than the intake valve stem seals and can be identified by the color of the seal spring (Item 4) [Figure 50-80-8].

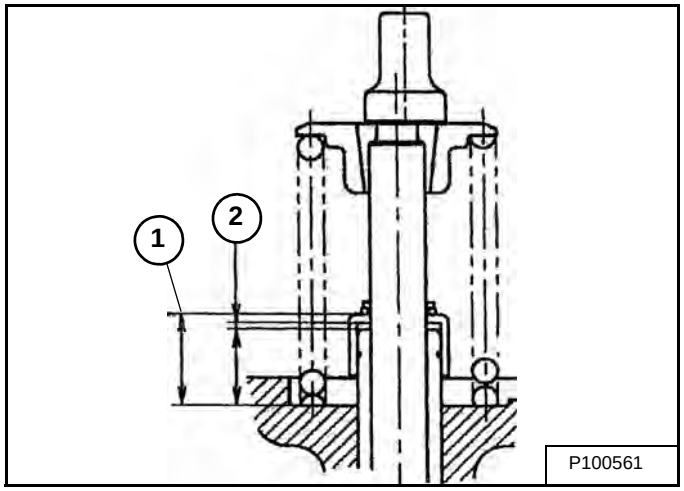
Engine Model	Marking	
	Intake	Exhaust
3TNM72	White (Seal Spring)	White mark (on the Body)

Figure 50-80-8



Oil the lip of the valve stem seal (Item 2). Using the valve stem seal installation tool (Item 1), install a new valve stem seal on each of the valve guides (Item 3) **[Figure 50-80-8]**.

Figure 50-80-9

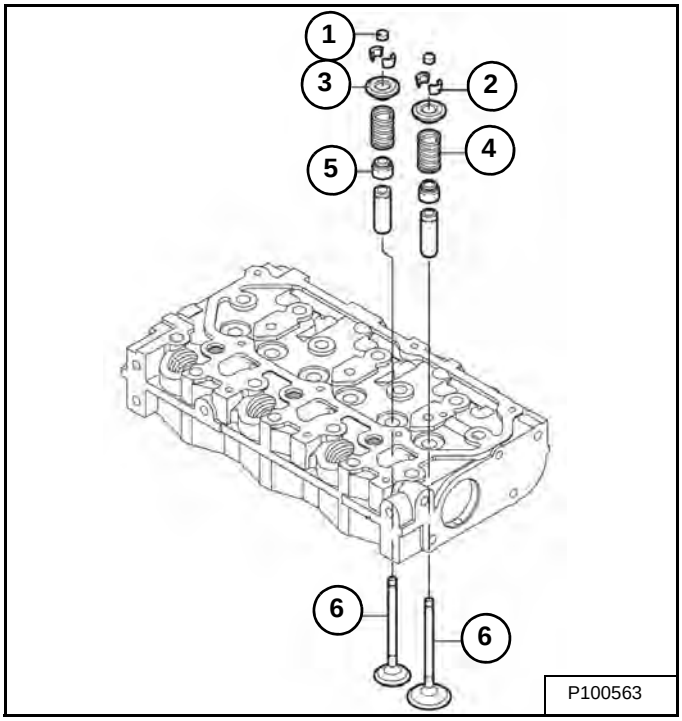


Measure the distance (Item 1) from the cylinder head to valve stem seal to ensure proper clearance (Item 2) **[Figure 50-80-9]** between the valve guide and seal.

Valve Stem Seal (Protrusion Above Head)	13,8 mm (0.543 in)

Put the cylinder head assembly on its exhaust port side.

Figure 50-80-10



Install all the valves (Item 6) **[Figure 50-80-10]** in their proper location in the cylinder head.

Put the cylinder head on the work bench with the combustion side down to install the valve springs. Reinstall the valve spring (Item 4) and spring retainer (Item 5) **[Figure 50-80-10]**.

Using a valve spring compressor tool, compress the valve spring.

Insert the valve keeper (Item 2) and slowly release the tension in the valve spring. Reinstall the valve cap (Item 1) **[Figure 50-80-10]**. Repeat steps on all remaining valves.

Cylinder Head - Servicing

Thoroughly clean all components using a non-metallic brush and an appropriate solvent. Each part must be free of carbon, metal filings and other debris.

Visually inspect the parts. Replace any parts that are obviously discolored, heavily pitted or otherwise damaged. Discard any parts that do not meet its specified limits.

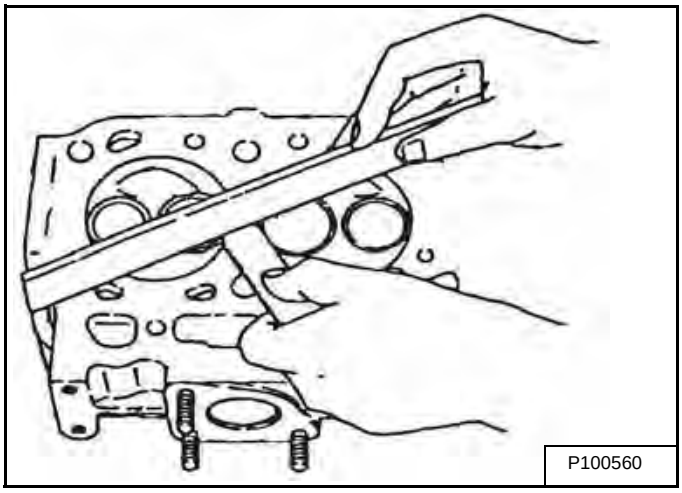
NOTE: Any part which is found defective as a result of inspection or any part whose measured value does not satisfy the standard or limit must be replaced.

NOTE: Any part determined to not meet the service standard or limit before the next service, as determined from the state of current rate of wear, should be replaced even though the part currently meets the service standard limit.

NOTE: Mark all valve train components so they can be installed in their original locations

Cylinder Head Distortion

Figure 50-80-29



Put the cylinder head flat and inverted (combustion side up) on the bench. Use a straightedge and feeler gauge to measure cylinder head distortion **[Figure 50-80-29]**. Measure diagonally and along each side. Record the measurements.

If distortion exceeds the service limit, resurface or replace the cylinder head. Remove only enough material to make the cylinder head flat, but do not remove more than 0,20 mm (0.008 in).

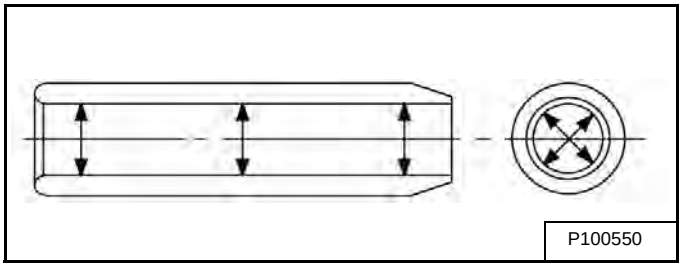
Cylinder Head Distortion	0,05 mm (0.0020 in) or less
Allowable Limit	0,15 mm (0.0059 in)

Valve Guide - Checking

Visually inspect the valve guides for distortions, scoring or other damage.

NOTE: Measure valve guides while they are installed in cylinder head.

Figure 50-80-30



Use a telescoping gauge and micrometer to measure the inside diameter of the valve guide. Measure in three places and 90° apart **[Figure 50-80-30]**. Record the measurements. Replace valve guides if not within specification.

Valve Guide I.D.	6,0 - 6,012 mm (0.2362 - 0.2367 in)

Piston And Connecting Rod Removal And Installation (Cont'd)

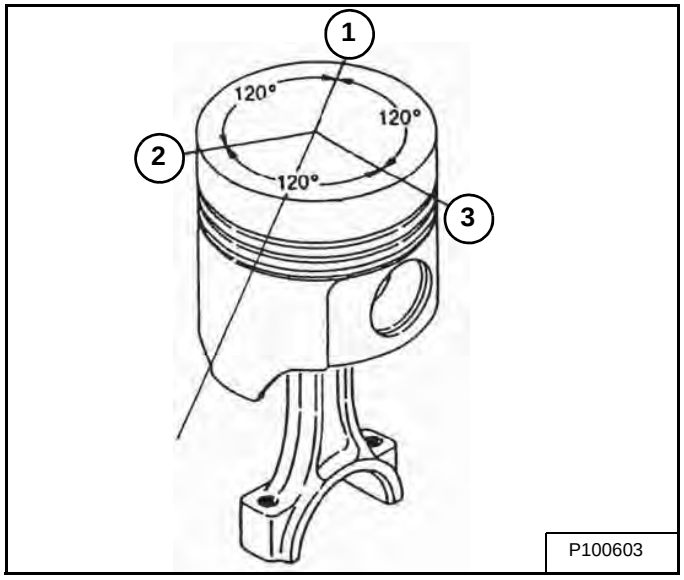
Installation Of Pistons

NOTE: Do not allow the connecting rod to contact the crankshaft journal during piston installation. Damage to the crankshaft bearing journal may result.

Lubricate piston, piston rings and cylinder with clean engine oil or assembly lubricant.

Rotate the crankshaft so the crankpin for the piston being installed is near bottom dead center.

Figure 50-90-13

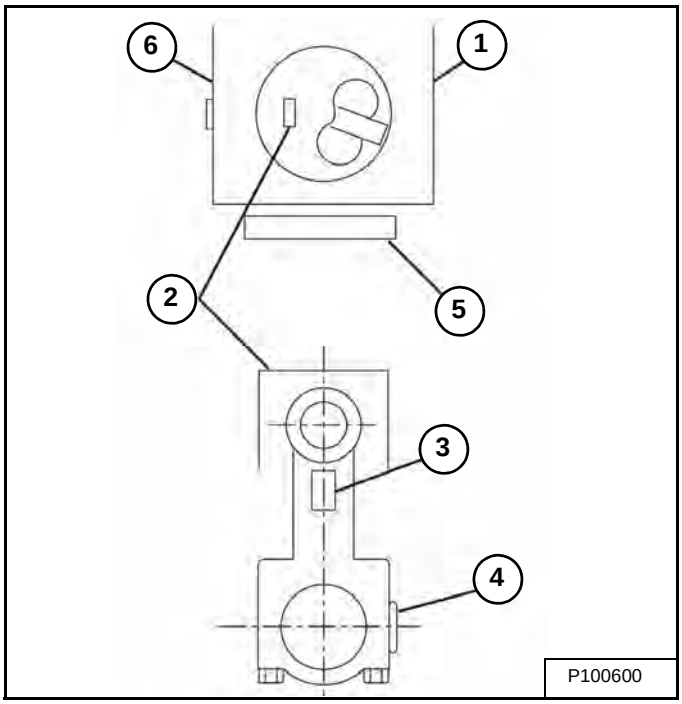


[Figure 50-90-13]
1–Top Compression Ring End Gap
2–Second Compression Ring End Gap
3–Oil Ring End Gap

NOTE: Ensure piston ring gaps are located correctly [Figure 50-90-13].

Using a piston ring compressor, compress the piston rings.

Figure 50-90-14



[Figure 50-90-14]
1–Fuel Injection Pump Side of Engine
2–Piston Identification Mark
3–Embossed Mark on Connecting Rod
4–Rod and Cap Match Marks
5–Flywheel End of Engine
6–Camshaft Side of Engine

Carefully reinstall the piston and rod assembly. Be sure the match marks (Item 4) stamped into the connecting rod and cap are facing the fuel injection pump side of the cylinder block, and the piston identification mark (Item 2) stamped into the piston top is facing the camshaft side (Item 6) **[Figure 50-90-14]**. The embossed mark cast into the connecting rod beam (Item 3) will be facing the flywheel end of the engine (Item 5) **[Figure 50-90-14]**.

NOTE: The piston and connecting rod must be reinstalled with the correct orientation. When installed correctly, the identification mark (Item 2) stamped into the top of the piston will be on the same side of the engine as the fuel injection pump (Item 1) and the embossed mark (Item 3) cast into the connecting rod beam will face the flywheel end of the engine (Item 5) [Figure 50-90-14].

Crankshaft And Bearings - Servicing

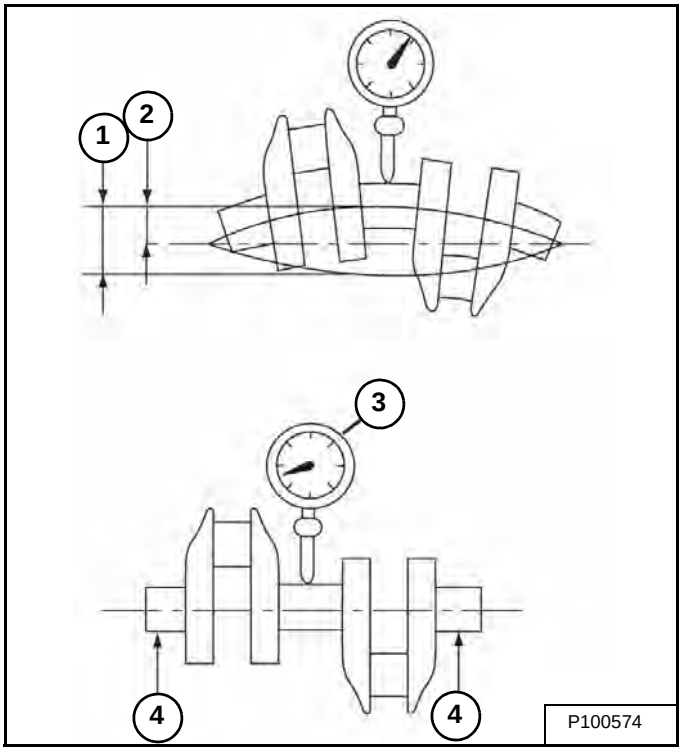
NOTE: Any part which is found defective as a result of inspection or any part whose measured value does not satisfy the standard or limit must be replaced.

NOTE: Any part determined to not meet the service standard or limit before the next service, as determined from the state of current rate of wear, should be replaced even though the part currently meets the service standard limit.

Thoroughly clean all components using a brush and appropriate solvent. Each part must be free of carbon, gasket material, metal filings and other debris.

NOTE: Record all measurements taken during inspection.

Figure 50-90-39



Put the crankshaft end journals (Item 4) **[Figure 50-90-39]** on V-blocks.

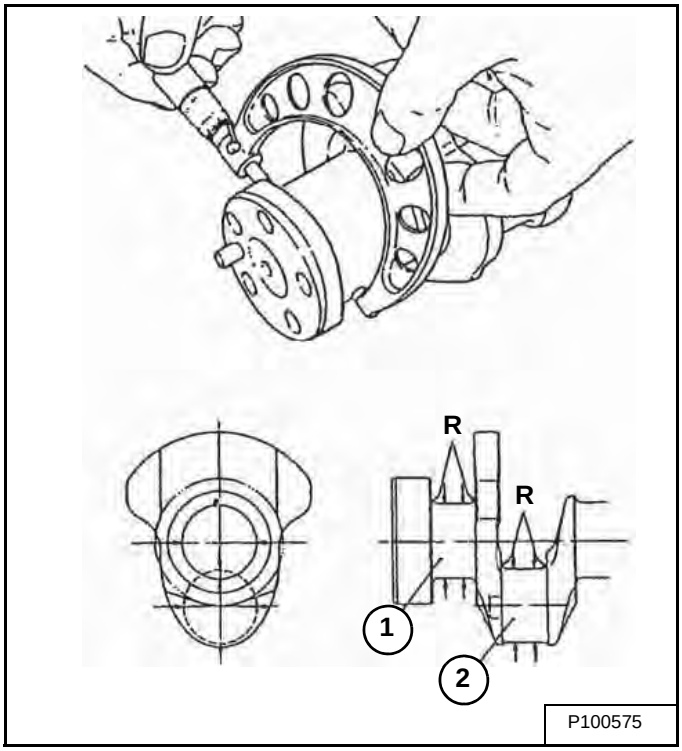
Place a dial indicator (Item 3) **[Figure 50-90-39]** on a center main bearing surface.

Rotate the crankshaft and observe runout. Record the measurements.

Runout	0,01mm(0.0004in) or less
Allowable Limit	0,02 mm (0.0008 in)

Use the color check method or MAGNAFLUX to inspect the crankshaft for cracks. Replace the crankshaft if evidence of fractures is found.

Figure 50-90-40

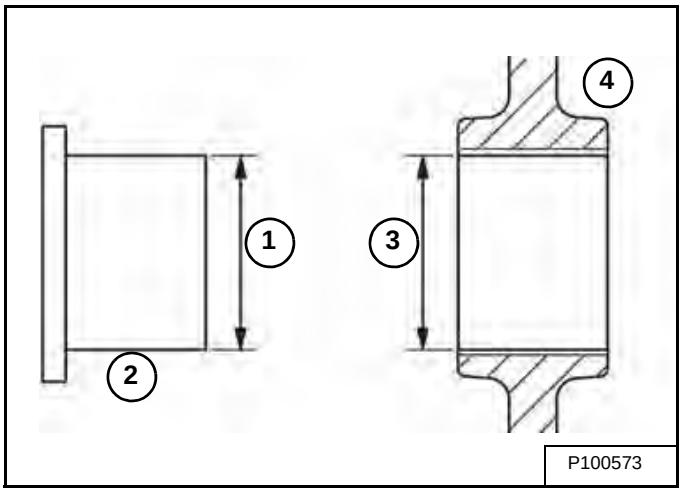


Measure the outside diameter of each crankpin (Item 2) and main bearing journal (Item 1) **[Figure 50-90-39]** and **[Figure 50-90-40]**. (See Crankshaft on Page 50-10-6.) Take measurements at several places around each bearing surface. If not within specification, grind the journals and install undersize bearings, or replace the crankshaft. Record the measurements.

Connecting Rod Journals (Outside Diameter)	37,952 - 37,962 mm (1.4942 - 1.4946 in)
Allowable Limit	37,402 mm (1.4725 in)

Idler Gear And Shaft - Servicing

Figure 50-100-15



Measure the outside diameter (Item 1) of the idler gear shaft (Item 2) **[Figure 50-100-15]**. Record the measurements. (See Idler Gear Shaft And Bushing on Page 50-10-6.)

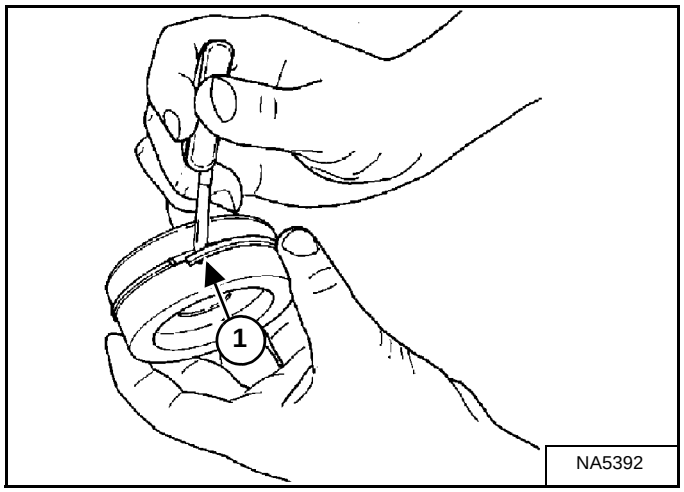
Shaft Outside Diameter	29,959 - 29,980 mm (1.1795 -1.1803 in)
Allowable Limit	29,919 mm (1.1779 in)

Measure the inside diameter (Item 3) of the idler gear bushing (Item 4) **[Figure 50-100-15]**. Record the measurements. (See Idler Gear Shaft And Bushing on Page 50-10-6.)

Bushing Inside Diameter	30,000 - 30,025 mm (1.1811 - 1.1821 in)
Allowable Limit	30,066 mm (1.1837 in)

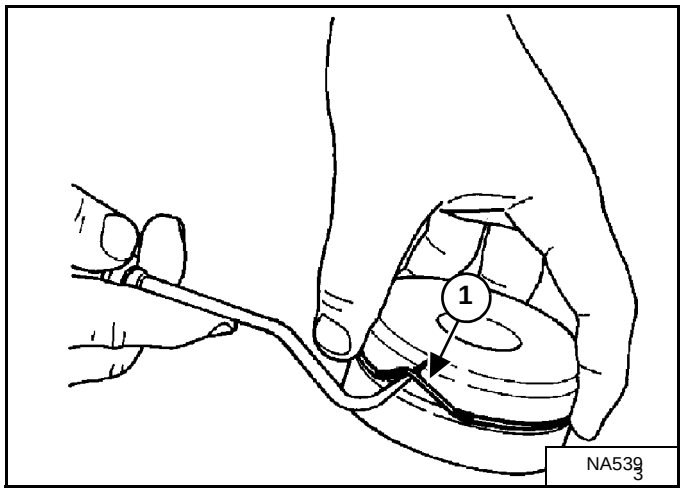
Disassembly (Cont'd)

Figure 60-10-15



Remove the seal (Item 1) **[Figure 60-10-15]** from the piston.

Figure 60-10-16



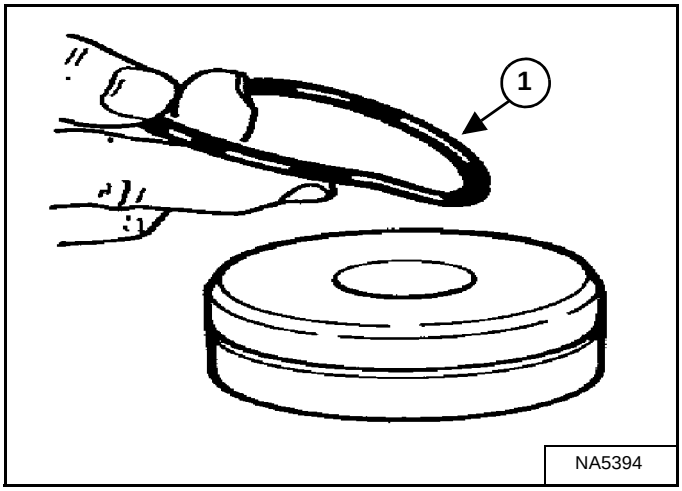
Remove the O-ring (Item 1) **[Figure 60-10-15]**.

Assembly

Clean parts in clean solvent and dry with compressed air.

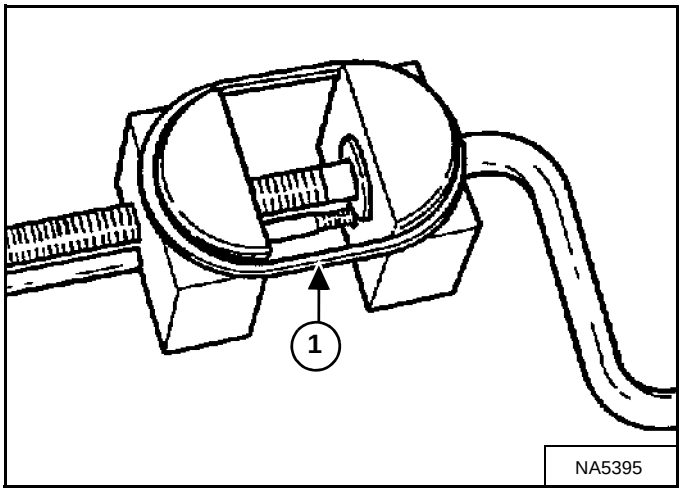
Always use new O-rings and seals during assembly.

Figure 60-10-17



Install the O-ring (Item 1) **[Figure 60-10-17]** on the piston.

Figure 60-10-18

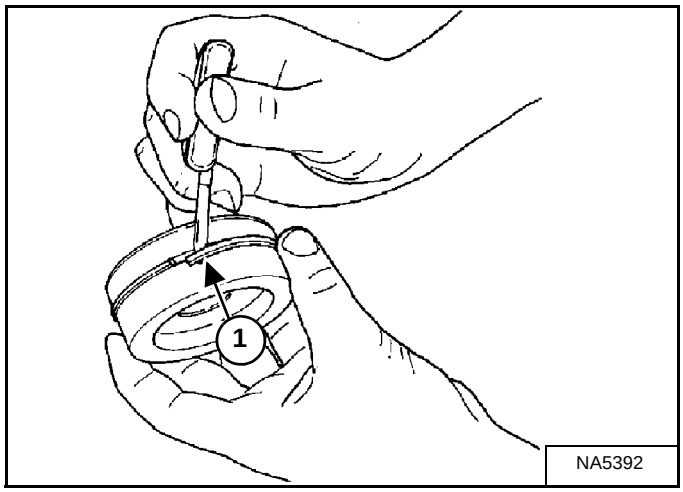


Install the seal (Item 1) **[Figure 60-10-18]** on the tool.

Allow the seal to stretch for 30 seconds before removing.

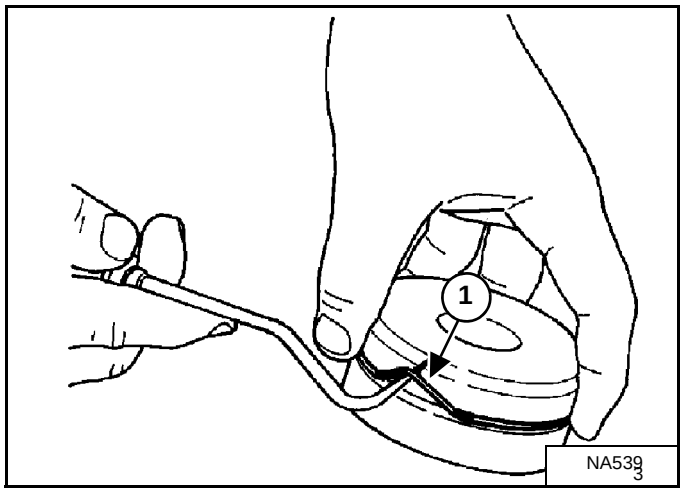
Disassembly (Cont'd)

Figure 60-11-15



Remove the seal (Item 1) **[Figure 60-11-15]** from the piston.

Figure 60-11-16



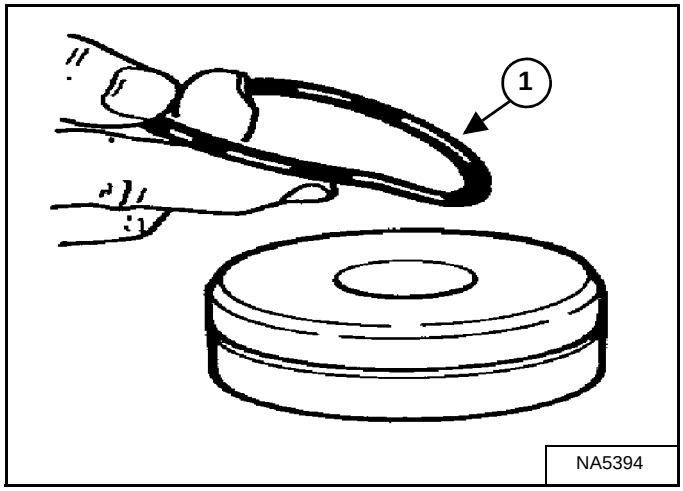
Remove the O-ring (Item 1) **[Figure 60-11-16]**.

Assembly

Clean parts in clean solvent and dry with compressed air.

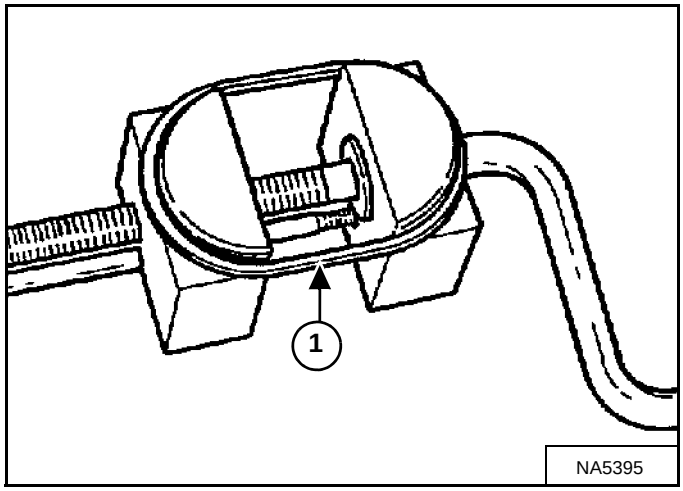
Always use new O-rings and seals during assembly.

Figure 60-11-17



Install the O-ring (Item 1) **[Figure 60-11-17]** on the piston.

Figure 60-11-18

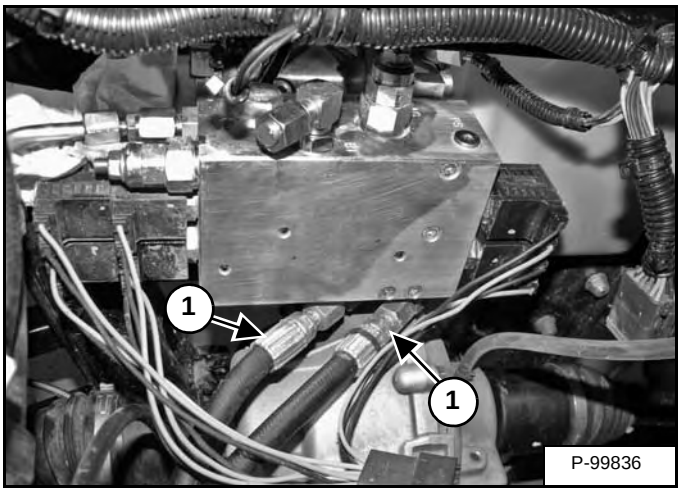


Install the seal (Item 1) **[Figure 60-11-18]** on the tool.

Allow the seal to stretch for 30 seconds before removing.

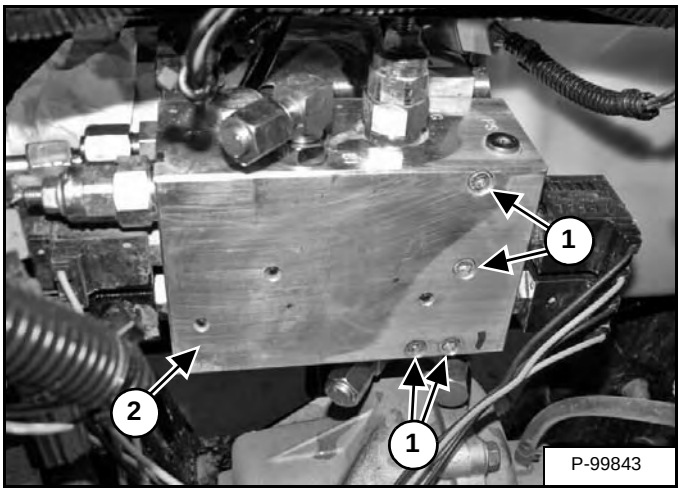
Removal And Installation (Cont'd)

Figure 60-30-3



Disconnect the hoses (Item 1) **[Figure 60-30-3]** from the bottom of the control valve.

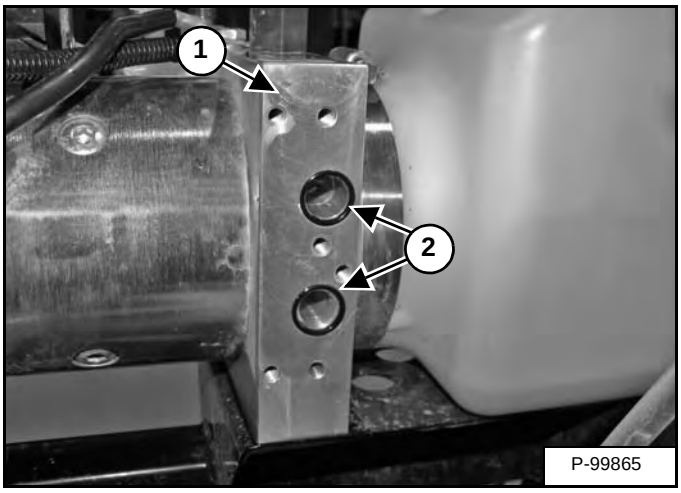
Figure 60-30-4



Remove the four screws (Item 1) and remove the control valve (Item 2) **[Figure 60-30-4]** from the hydraulic power unit.

Installation: Tighten the screws to 16,4 - 17 N•m (145 - 150 in-lb) torque.

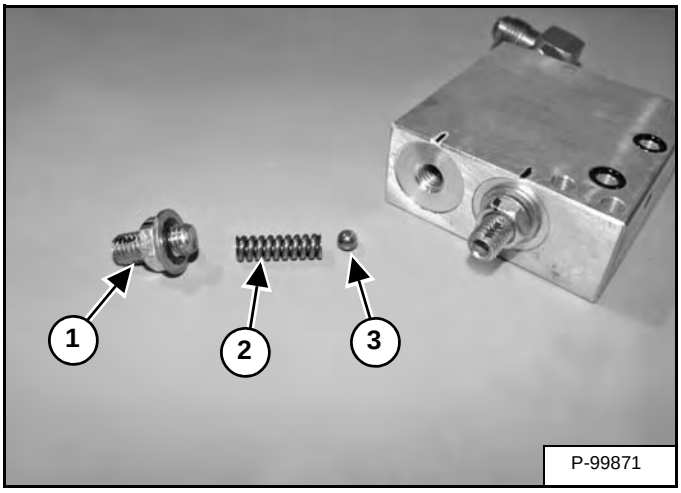
Figure 60-30-5



Installation: Clean the surface (Item 1) and install new O-rings (Item 2) **[Figure 60-30-5]** onto the hydraulic power unit before installing the control valve.

Disassembly And Assembly (Cont'd)

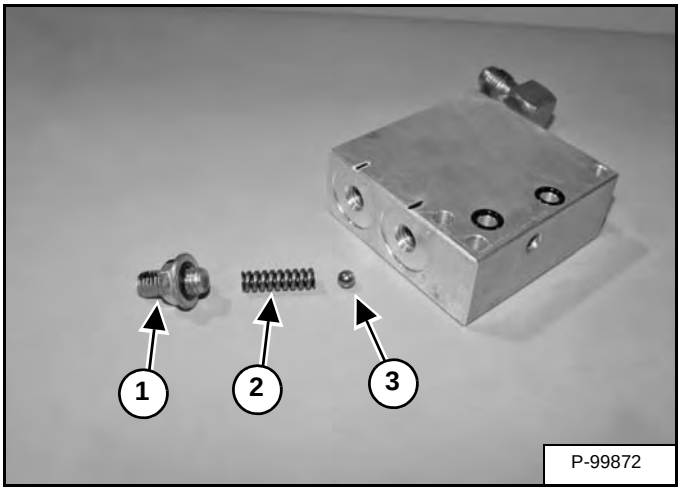
Figure 60-40-9



Remove the set screw (Item 1) **[Figure 60-40-9]** from the control valve.

Remove the spring (Item 2) and ball (Item 3) **[Figure 60-40-9]** from the auxiliary valve. Check for wear or damage and replace as needed.

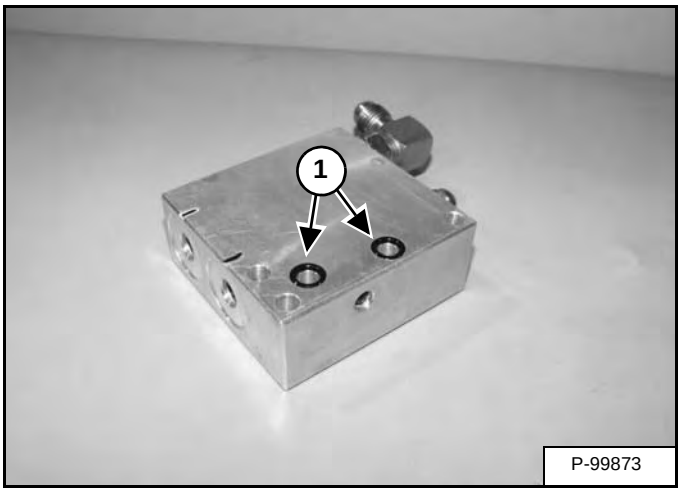
Figure 60-40-10



Remove the set screw (Item 1) **[Figure 60-40-10]** from the control valve.

Remove the spring (Item 2) and ball (Item 3) **[Figure 60-40-10]** from the auxiliary valve. Check for wear or damage and replace as needed.

Figure 60-40-11



Remove the O-rings (Item 1) **[Figure 60-40-11]** from the auxiliary valve.

Installation: Install new O-rings

(3450) UTILITY VEHICLE SPECIFICATIONS (CONT'D)

Drive System

	S/N AJNU19999 & Below and S/N AJNW19999 & Below		S/N AJNU20001 & Above and S/N AJNW20001 & Above	
	FRONT SHAFT	**REAR SHAFT**	**FRONT SHAFT**	**REAR SHAFT**
Gearbox Ratio FWD - Low Gear	-	-	7.31:1	5.77:1
Gearbox Ratio FWD - High Gear	-	-	3.44:1	2.72:1
Gearbox Ratio Reverse	-	-	6.55:1	5.17:1
Final Drive ratio - Front	3.818		3.818	
Final Drive ratio - Rear	3.7		3.7	
Suspension - Front	Macpherson Strut 152,4 mm (6.0 in) Travel			
Suspension - Rear	Dual Control Arm, IRS 152,4 mm (6.0 in) Travel			
Suspension - Rear Adjustment	Spring Preload Adjust			
Rear Differential Type	Lockable			
Rear Differential Selection	Lock / Unlock Switch			
Steering	Rack and Pinion			
Brakes - Front and Rear	Hydraulic Disc			
Brakes - Parking	Mechanical Disc			

Fluid And Capacities

	Capacity	Fluid
Engine Cooling System	5,0 L (5.3 qt)	ETHYLENE GLYCOL ANTI-FREEZE
Fuel Tank	34,1 L (9 U.S. gal)	DIESEL FUEL (See FUEL SYSTEM on Page 10-80-1.)
Engine Lubrication & Filter	1,7 L (1.8 qt)	BOBCAT PREMIUM ENGINE OIL
Main Gear Case (Transmission) Lubricating Oil	0,9 L (32.0 oz)	SYNTHETIC GEARCASE FLUID
Differential - Front	200 ml (6.8 oz)	FRONT DIFFERENTIAL FLUID
Differential - Rear	592 ml (20.0 oz)	PREMIUM GEAR LUBRICANT (80W90)
Hydraulic Reservoir	5,0 L (1.3 U.S. gal)	Bobcat Hydraulic Fluid