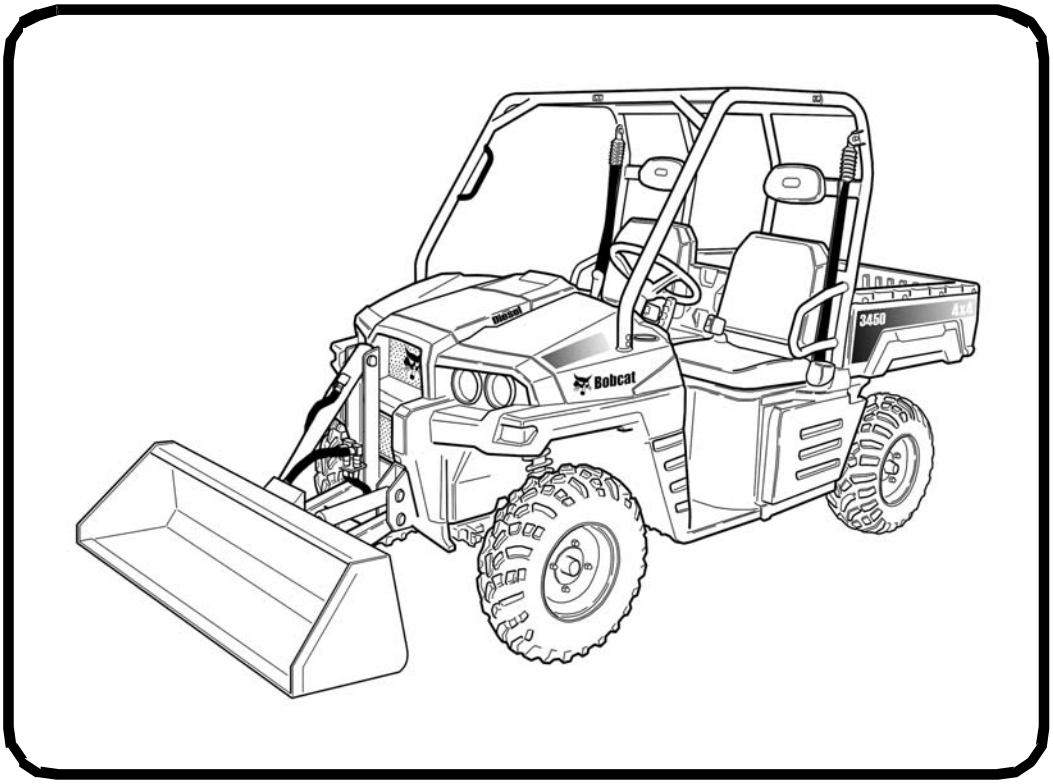
Bobcat®

Service Manual
3450 Utility Vehicle

S/N AJNY11001 & Above



6989610 (4-11)

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-0510 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.

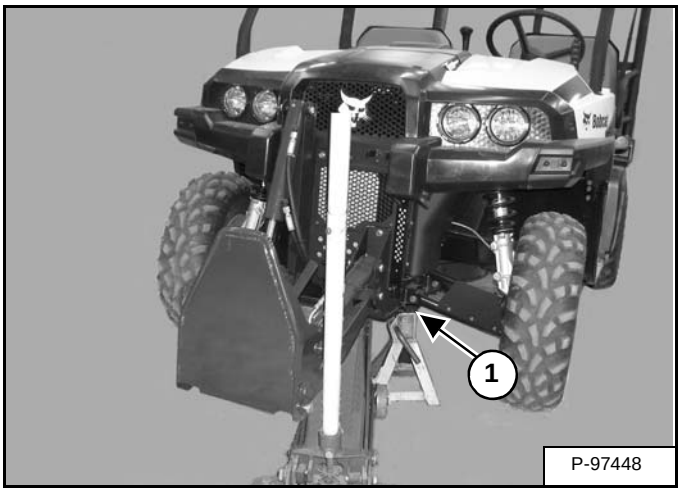
⚠ WARNING

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

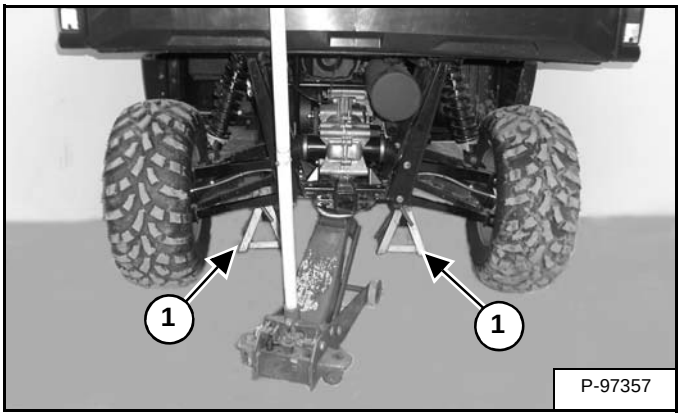
Figure 10-10-1



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

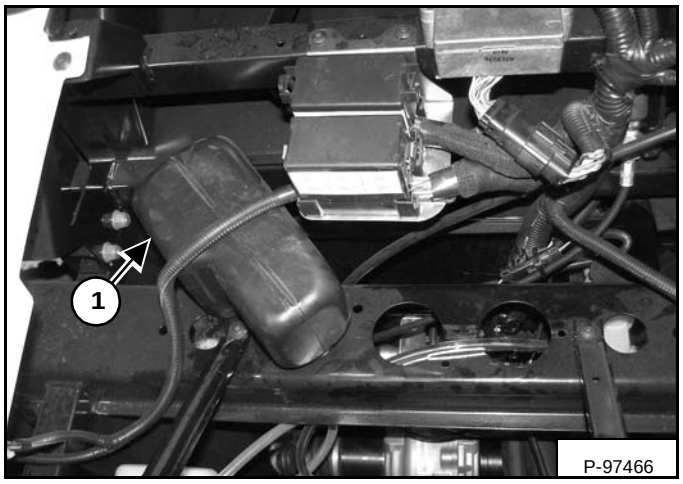
Pre-Filter Element

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

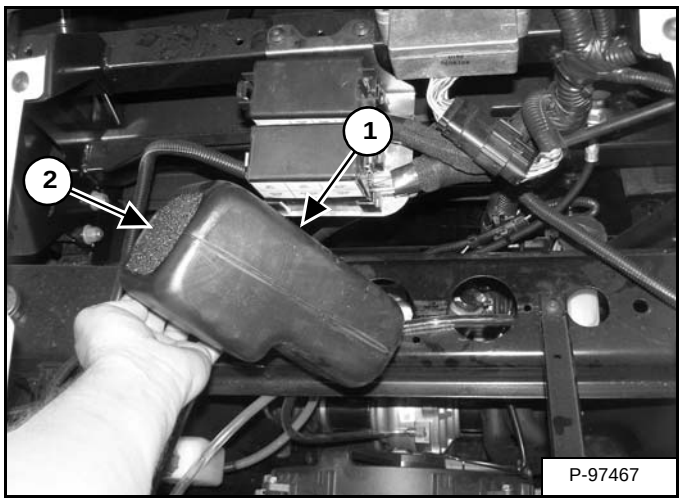
Figure 10-60-1



Remove the front cover.

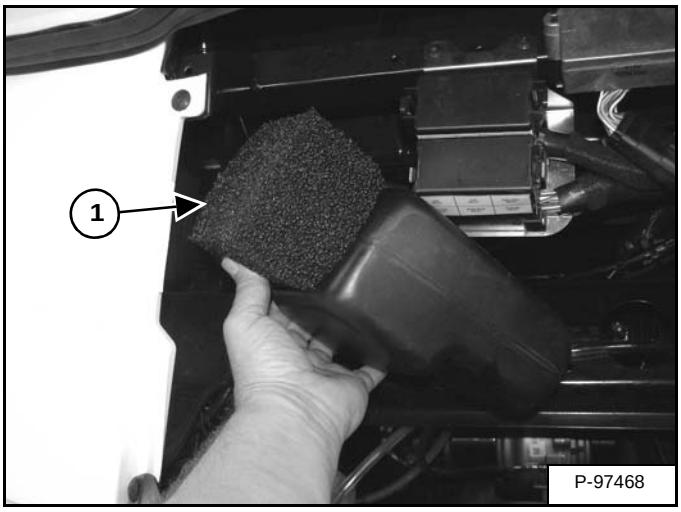
The pre-filter box (Item 1) **[Figure 10-60-1]** is connected to a rubber hose so the box can be relocated to access the element.

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.

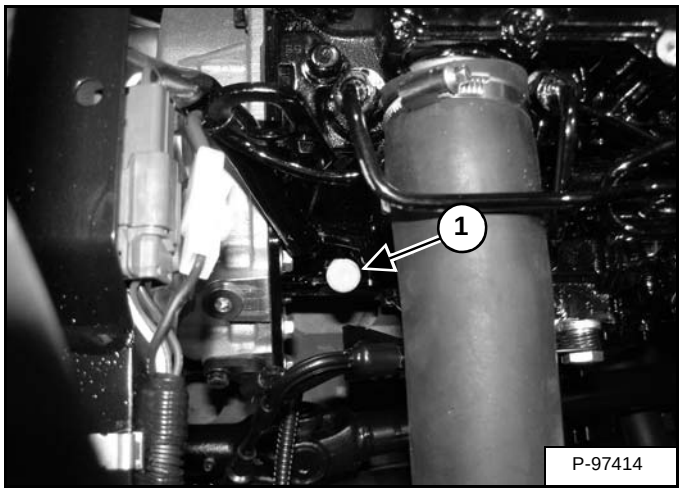
Reposition the pre-filter box (Item 1) **[Figure 10-60-1]** back to its original location.

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.)

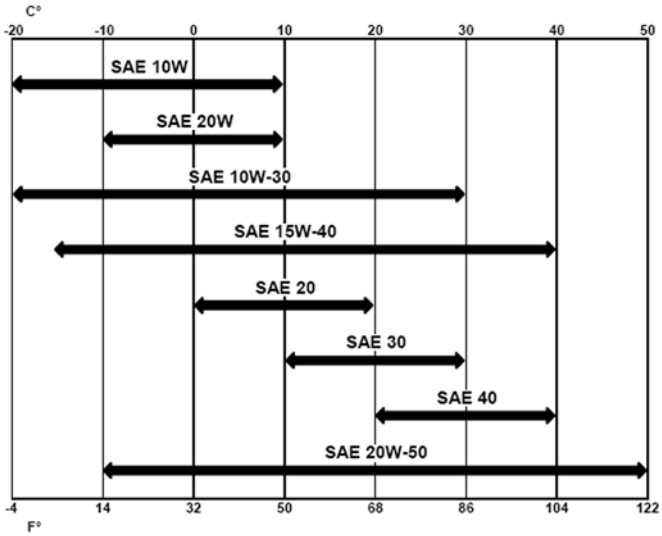
Remove the dipstick (Item 1) **[Figure 10-90-1]** and wipe dry with a clean cloth. Reinstall the dipstick. Remove the dipstick and check the oil level. Keep the oil level between the marks on the dipstick.

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

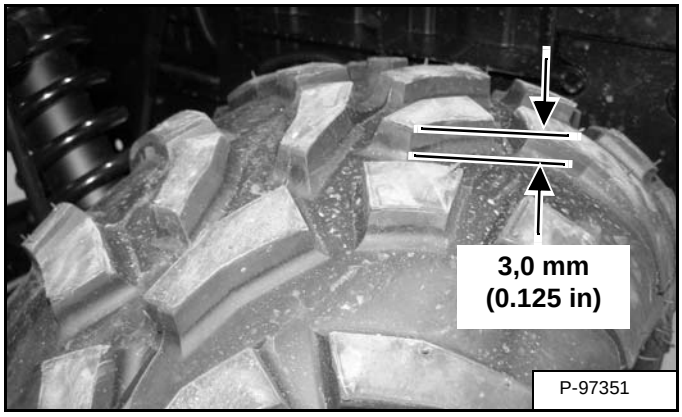
AVOID INJURY OR DEATH

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

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-10-4.)

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.

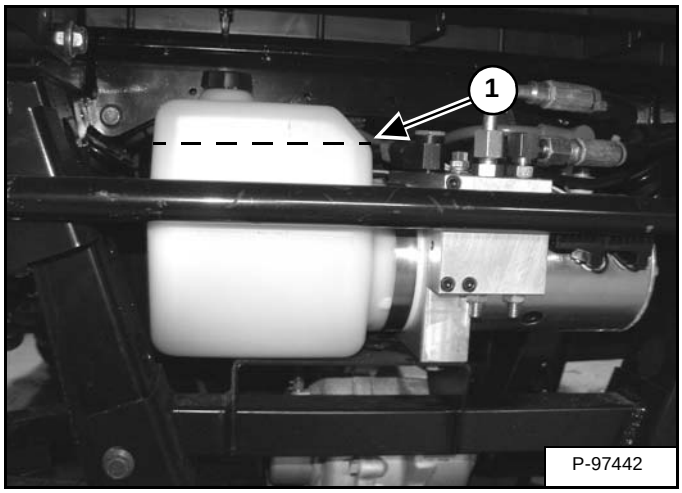
Checking Fluid

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



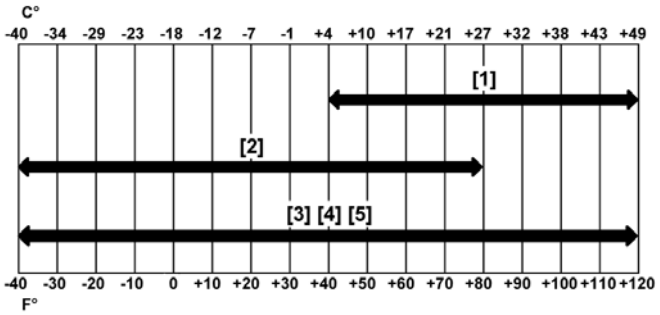
The hydraulic tank (Item 1) **[Figure 10-170-1]** can be viewed from the rear of the utility vehicle to check the fluid level.

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.)

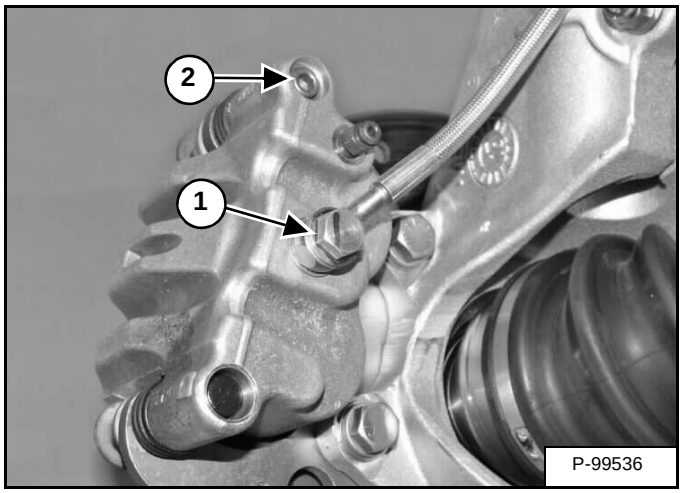
⚠ WARNING

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

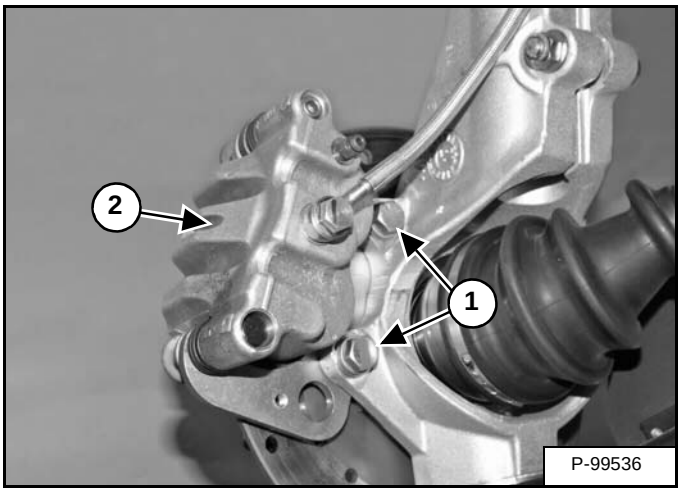


Clean caliper area before removal.

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.)

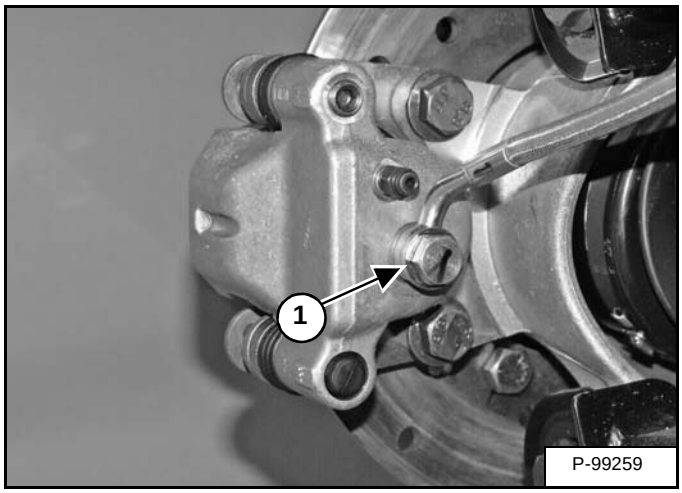
⚠ WARNING

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.)

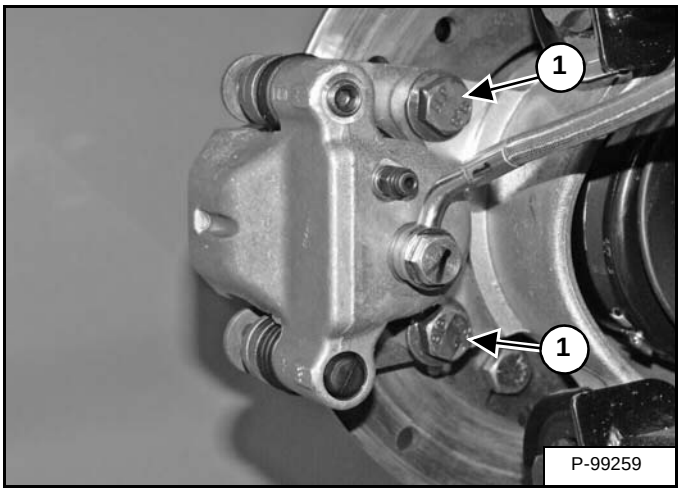
Figure 20-12-6



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

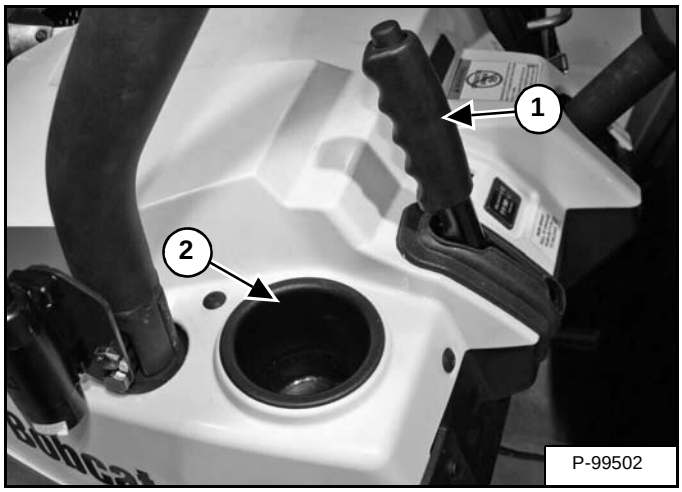


After the fluid has drained into the container, remove the two caliper mounting bolts (Item 1) **[Figure 20-12-7]** and remove caliper.

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

Lever Removal And Installation

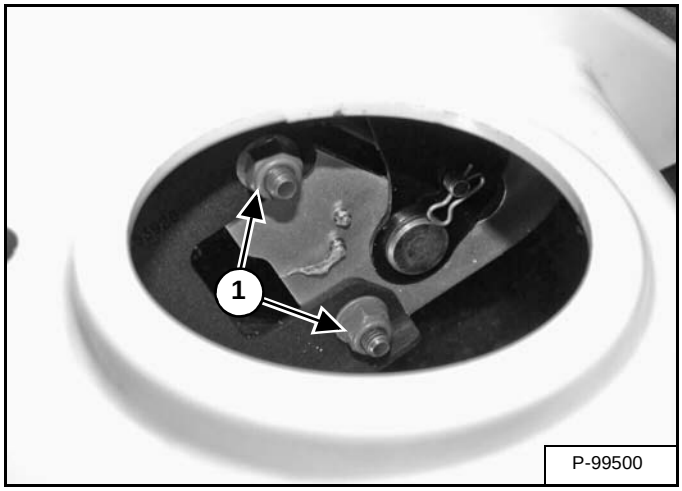
Figure 20-20-2



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.

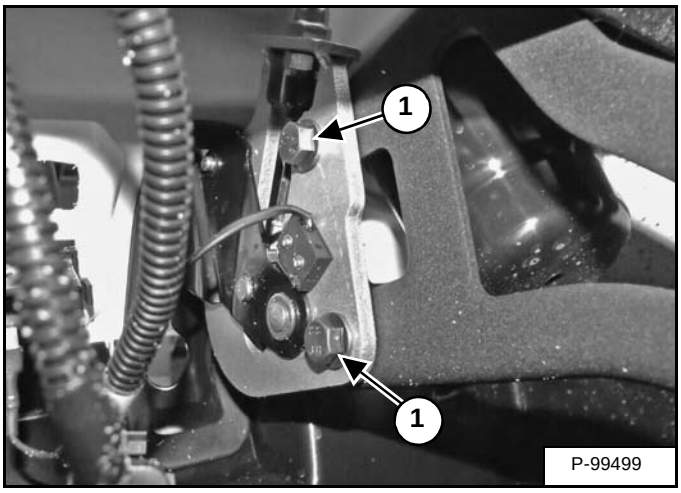
Figure 20-20-3



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

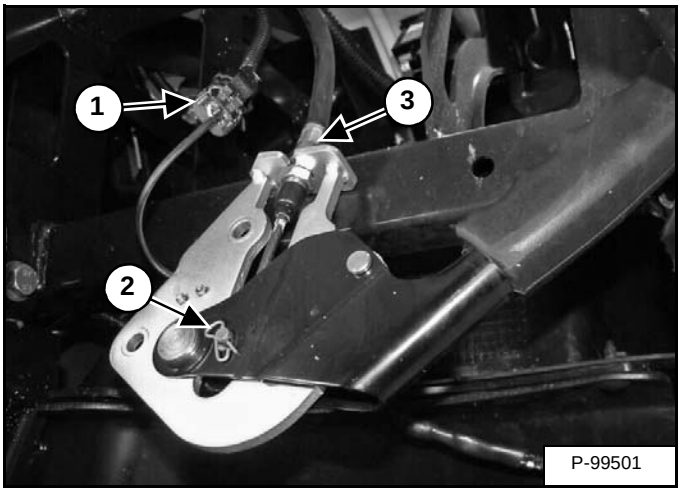
Installation: Tighten the nuts to 18 N•m (13 ft-lb) torque.

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.

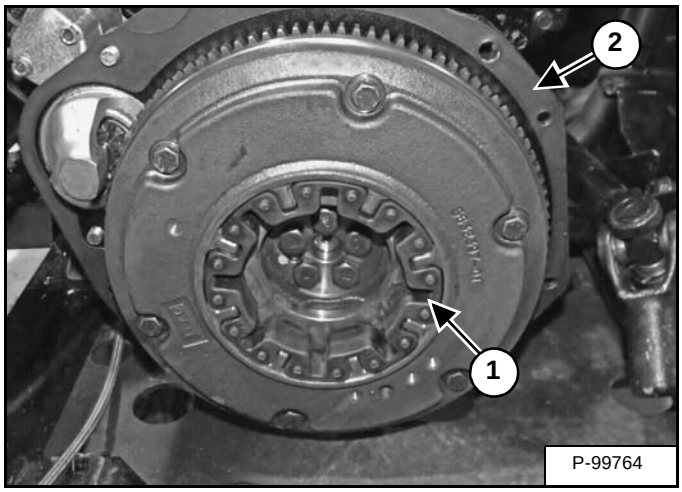
- Shift cable adjustment / condition
- Idle speed (throttle cable routing)
- CVT clutch alignment
- Transmission Lubricant type / quality
- Drive belt deflection (where applicable)
- Loose fasteners on sector gear cover
- Worn rod ends, clevis pins or pivot arm bushings
- Shift selector rail travel
-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

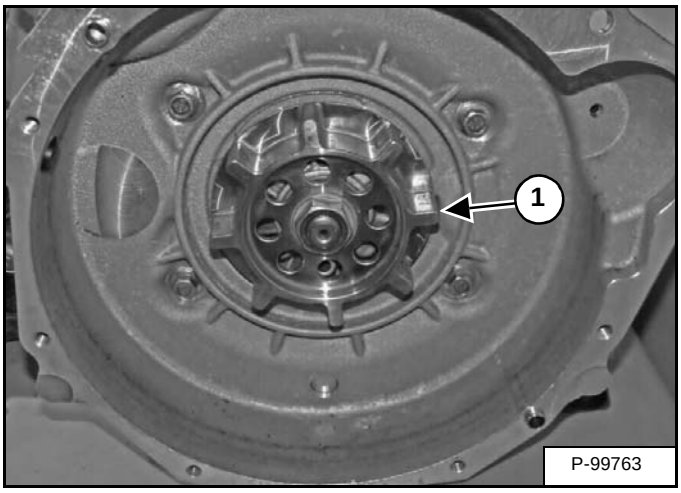
Figure 20-30-33



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



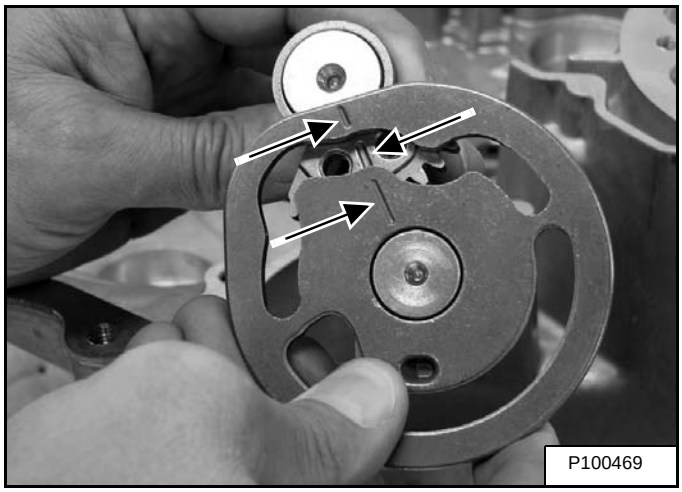
Installation: Align the splines of the coupler (Item 1) **[Figure 20-30-34]** with the slots in the rubber coupler (Item 1) **[Figure 20-30-33]**.

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-10-3.)

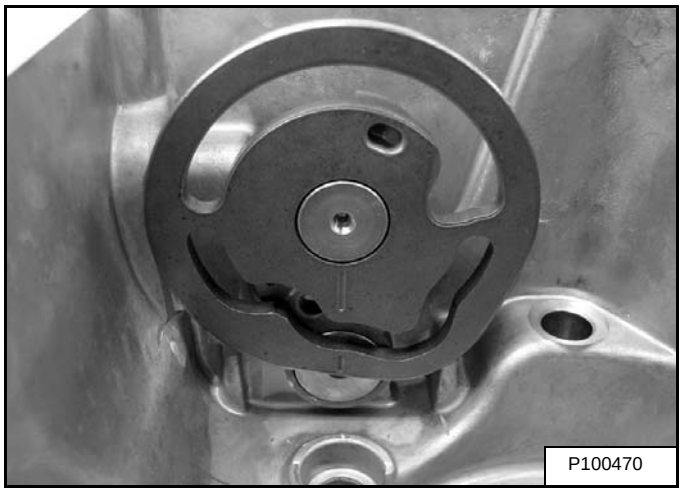
Assembly (Cont'd)

Figure 20-30-61



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

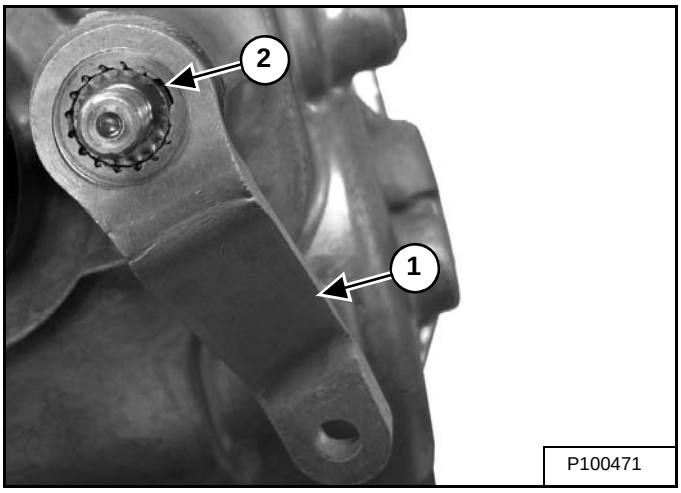
Figure 20-30-62



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

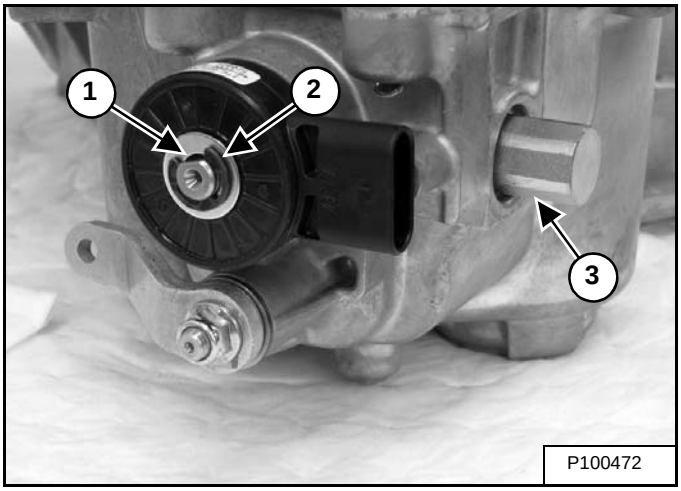


Install the washer over the bellcrank shift shaft and install the bellcrank (Item 1) by aligning the skip-tooth splines (Item 2) **[Figure 20-30-63]**.

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]**.

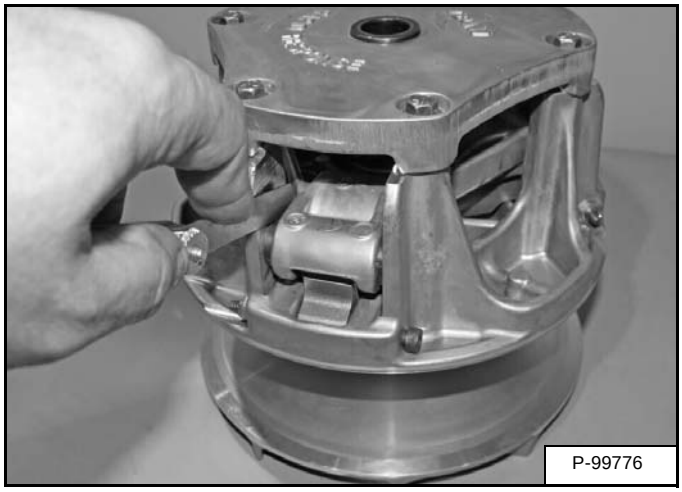
Install the detent plug (Item 3) **[Figure 20-30-64]** and tighten to 23 - 31 N•m (17 - 23 ft-lb) torque.

System Troubleshooting (Cont'd)

ENGINE		
PROBLEM	CAUSE	SOLUTION
Water ingestion	Cover seals or ducts leaking.	Find leak and repair as necessary.
	Operator error.	Instruct operator on guidelines for operation in wet terrain as outlined in the Operation & Maintenance Manual.
Belt slippage	Belt worn out.	Replace belt.
	Water ingestion.	Inspect and seal CVT system.
	Belt contaminated with oil or grease.	Inspect and clean.
CVT noise	Belt worn or separated, thin spots, loose belt.	Replace belt.
	Broken or worn clutch components, cover hitting clutches.	Inspect and repair as necessary.
Engagement erratic or stabby	Thin spots on belt, worn belt.	Replace belt. Refer to belt burnout troubleshooting and instruct operator.
	Drive clutch bushings stick.	Inspect and repair clutches.

Button To Tower Clearance Inspection

Figure 20-51-8



Inspect for any clearance between spider button to tower. If clearance exists, replace all buttons and inspect surface of towers **[Figure 20-51-8]**.

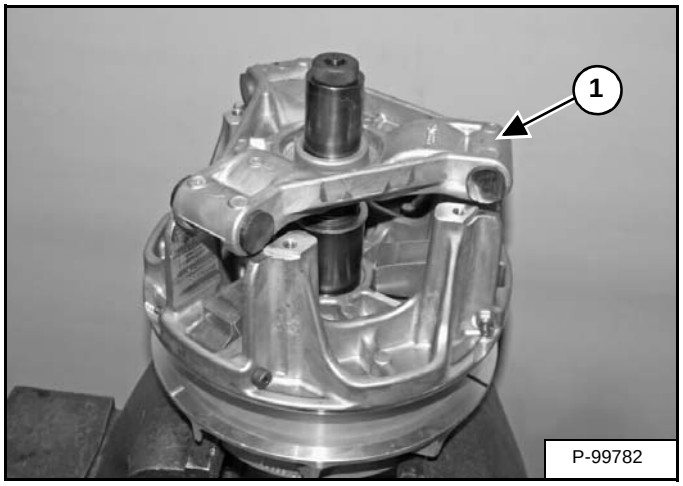
Button To Tower Clearance:

Service Limit	0 - 0,0254 mm (000 - 0.001 in)

Inspect the sheave surfaces. Replace the entire drive clutch if worn, damaged or cracked.

Assembly (Cont'd)

Figure 20-51-35



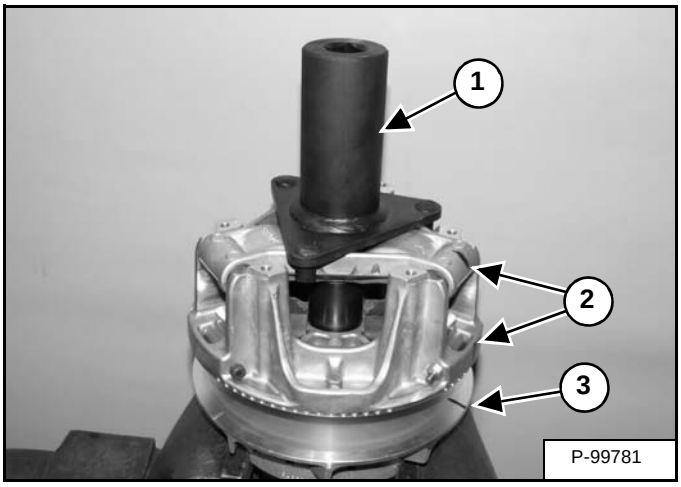
Place the spider (Item 1) **[Figure 20-51-35]** onto the fixed sheave shaft. Compress spider buttons for each tower and install spider, making sure that the marks that were made earlier on spider align with the marks that were made earlier in the moveable sheave.

IMPORTANT

Be sure the spider spacer washers are fully seated in the recessed area in the spider. Any misalignment will alter clutch balance. Inverting the clutch while initially tightening the spider will help position the washers.

I-2324-0510

Figure 20-51-36



Using the spider tool (PN 2870341) (Item 1) tighten the spider to 271 N•m (200 ft-lb) torque. Torque with smooth motion to avoid damage to the stationary sheave. Make sure that the marks (Item 2) made earlier on spider and moveable sheave align with the mark that was made earlier in the stationary sheave (Item 3) **[Figure 20-51-36]**.

FINAL DRIVE

Description

Care should be exercised during drive shaft removal or when servicing CV joints. Drive shaft components are precision parts.

Cleanliness and following these instructions is very important to ensure proper shaft function and a normal service life.

- The complete drive shaft and joint should be handled by getting hold of the interconnecting shaft to avoid disassembly or potential damage to the drive shaft joints.
- Over-angling of joints beyond their capacity could result in boot or joint damage.
- Make sure surface-ground areas and splines of shaft are protected during handling to avoid damage.
- Do not allow boots to come in contact with sharp edges or hot engine and exhaust components.
- Drive shaft is not to be used as a lever arm to position other suspension components.
- Never use a hammer or sharp tools to remove or to install boot clamps.
- Be sure joints are thoroughly clean and that the proper amount and type of grease is used to refill when joint boots are replaced and when joints are cleaned.

Outer CV Joint And Boot (Front Drive Shaft) Removal And Installation (Cont'd)

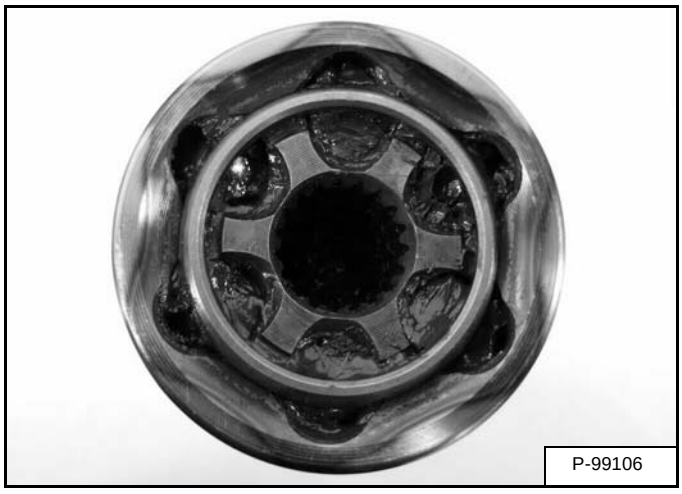
IMPORTANT

Complete disassembly of the CV joint is NOT recommended. The internal components are a precision fit and develop their own characteristic wear patterns. Intermixing the internal components could result in looseness, binding, and/or premature failure of the joint.

I-2329-0510

NOTE: If the grease in the joint is obviously contaminated with water and / or dirt, the joint should be replaced.

Figure 20-60-28



P-99106

Thoroughly clean the joint with an appropriate solvent and dry the joint to prevent any residual solvent from being left in the joint upon reassembly **[Figure 20-60-28]**.

Visually inspect the joint by tilting the inner race to one side to expose each ball. Severe pitting, galling, play between the ball and its cage window, any cracking or damage to the cage, pitting or galling or chips in raceways call for joint replacement.

NOTE: Shiny areas in ball tracks and on the cage spheres are normal. Do not replace CV joints because parts have polished surfaces. Replace CV joint only if components are cracked, broken, worn or otherwise unserviceable.

Clean the splines on the end of the shaft and apply a light coat of grease prior to reassembly.

Slide the small boot clamp and boot (small end first) onto the drive shaft and position the boot in it's groove machined in the shaft.

Install a NEW circlip on the end of the shaft.

Grease the joint with the special CV joint grease provided in the boot replacement kit. Fill the cavity behind the balls and the splined hole in the joint's inner race. Pack the ball tracks and outer face flush with grease. Place any remaining grease into the boot.

IMPORTANT

The grease provided in the replacement kit is specially formulated for wear resistance and durability. DO NOT use substitues or mix with other lubricants.

I-2328-0510

NOTE: The amount of grease that's provided is pre-measured, so use all the grease.

Boot Replacement Grease Requirements:

Outer CV Joint Capacity	150 g

Front Gearcase Operation

The AWD switch may be turned on or off while the vehicle is moving, however, AWD will not enable until the engine rpm drops below 3100. Once the AWD is enabled, it remains enabled until the switch is turned off.

Engage the AWD switch before getting into conditions where the front wheel drive may be needed. If the rear wheels are spinning, release the throttle before switching to AWD.

IMPORTANT

Switching to AWD while the rear wheels are spinning may cause severe drive shaft and gearcase damage. Always switch to AWD while the rear wheels have traction or are at rest.

I-2321-0710

With the AWD switch off, the vehicle drives through the rear wheels only (2 wheel drive). When the AWD is enabled, the front drive acts as an on-demand AWD system. This means, the front drive will engage once the rear wheels have lost traction, and will remain engaged until the torque requirement goes away (i.e. rear wheels regain traction).

Figure 20-60-50

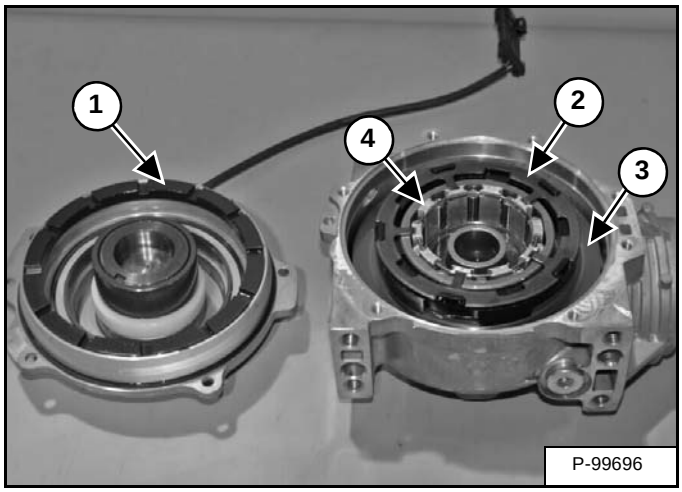
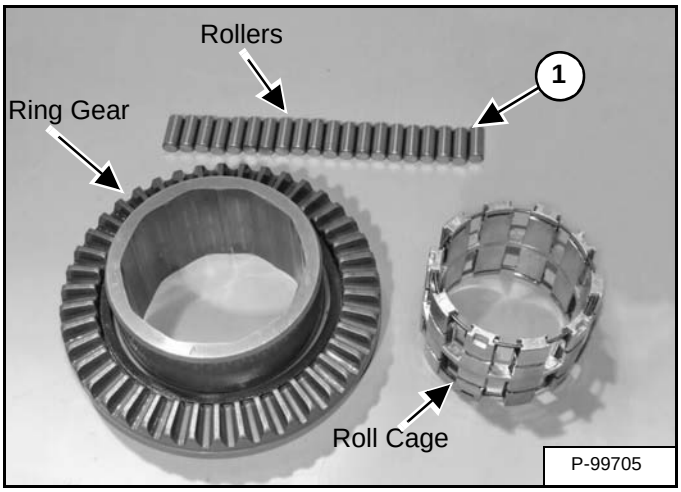


Figure 20-60-51



AWD Engagement: When the AWD switch is activated, the AWD coil (Item 1) **[Figure 20-60-50]** is powered by a 12 Vdc input which creates a magnetic field. This magnetic field attracts an armature plate (Item 2) **[Figure 20-60-50]** that is keyed to the roll cage. When the ring gear (Item 3) and roll cage (Item 4) **[Figure 20-60-50]** are spinning (vehicle is moving), the energized coil and armature plate will apply drag to the roll cage that indexes the rollers inside the ring gear to an engagement position. While in the engagement position, the front drive will be in an "over-running" condition (not engaged), until the rear wheels lose traction. Once the rear wheels begin to lose traction, the front drive will engage by coupling the output hubs to the ring gear via the rollers. The front drive will remain engaged until the torque requirement goes away (i.e. rear wheels regain traction).

NOTE: Rollers (Item 1) [Figure 20-60-51] are non - directional.

IMPORTANT

If the rear wheels are spinning, release the throttle before turning the AWD switch on.
If AWD is engaged while the wheels are spinning, severe drive shaft and clutch damage could result.

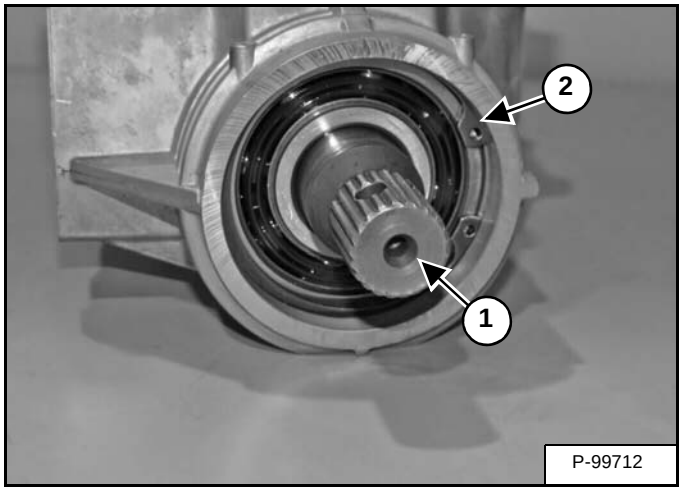
I-2330-0710

AWD Disengagement: Once the rear wheels regain traction, the front wheels will return to the "over-running" condition. The vehicle is now back to rear wheel drive until the next loss of rear wheel traction occurs.

Front Gearcase Assembly

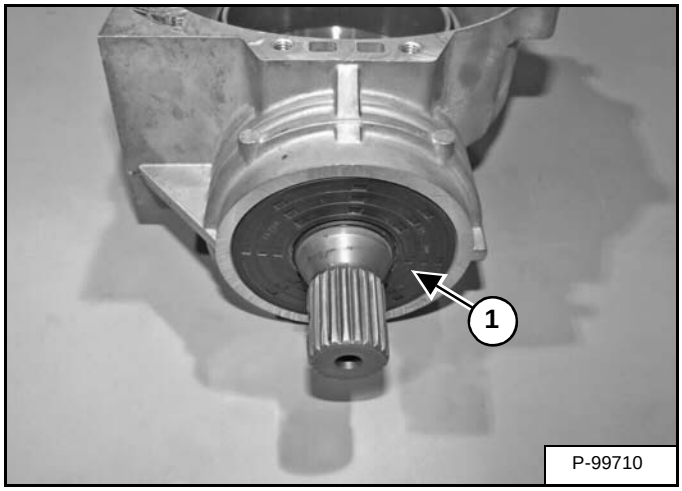
Thoroughly clean the gearcase components before beginning reassembly.

Figure 20-60-76



Install the pinion shaft assembly (Item 1) and install the snap ring (Item 2) **[Figure 20-60-76]**.

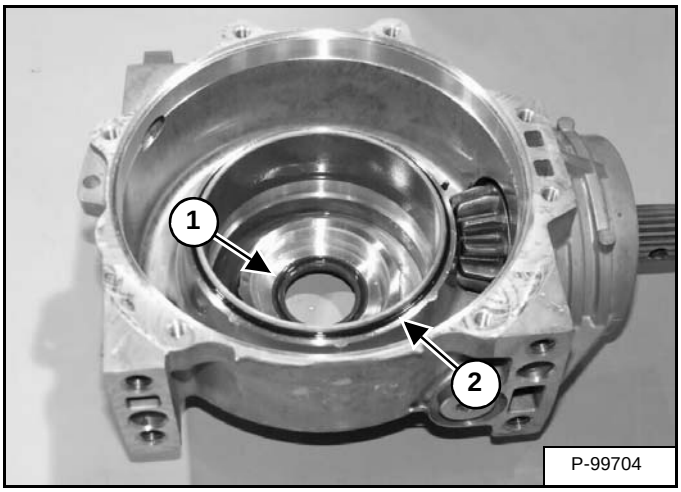
Figure 20-60-77



Install a new input shaft seal (Item 1) **[Figure 20-60-77]**.

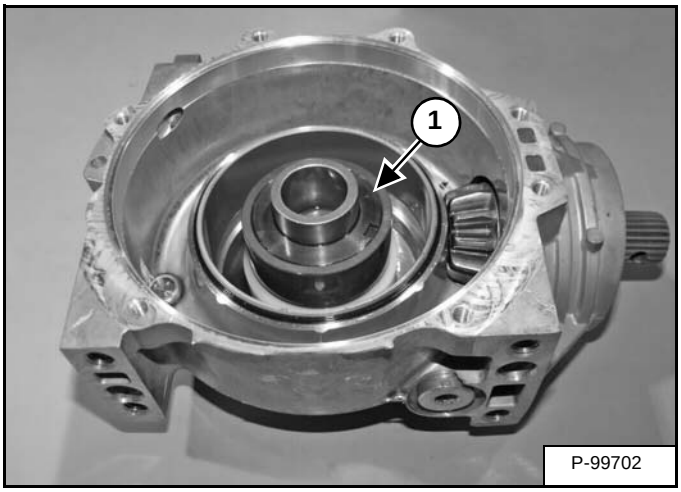
Press the pinion shaft seal into the pinion cover, until the seal is flush with the sealing surface.

Figure 20-60-78



Install a new seal (Item 1) and O-ring (Item 2) **[Figure 20-60-78]** into the gearcase housing.

Figure 20-60-79

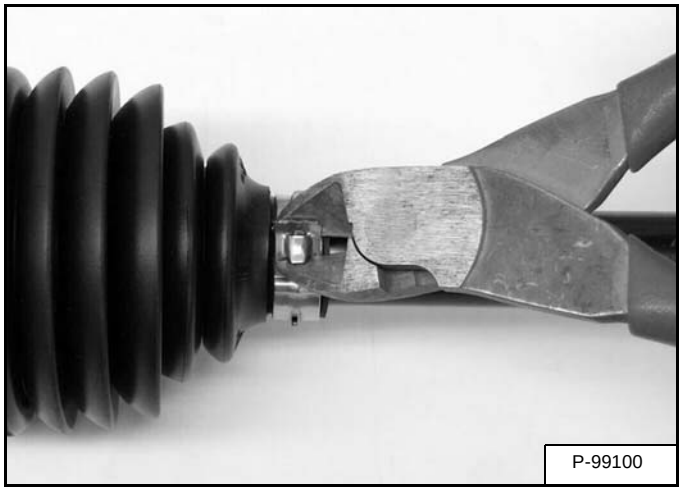


Install the RH output hub (Item 1) **[Figure 20-60-79]** into the gearcase housing. The output hub should spin freely.

Outer CV Joint And Boot (Rear Drive Shaft) Removal And Installation

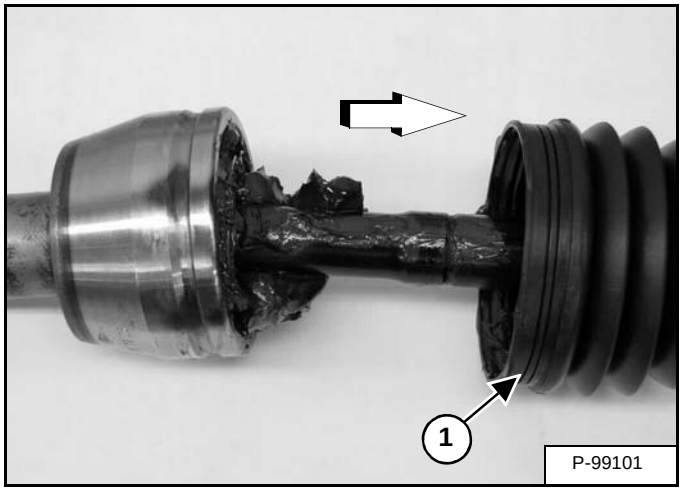
Order Axle Boot Clamp Tool (Mel 1644).

Figure 20-60-108



Using a side cutters, cut away and discard the boot clamps **[Figure 20-60-108]**.

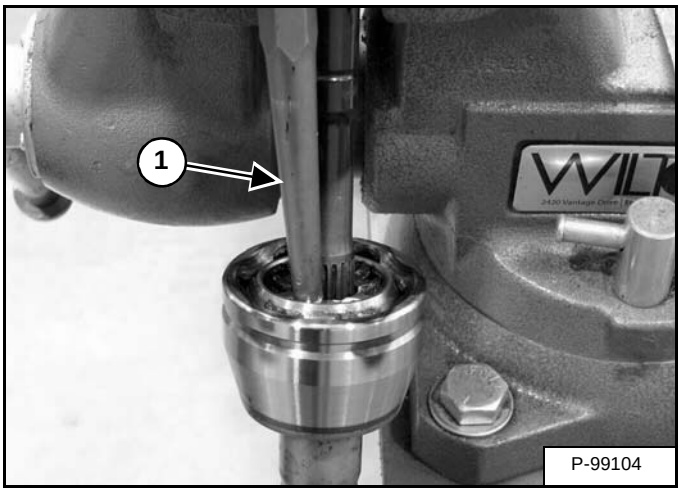
Figure 20-60-109



Remove the large end of the boot (Item 1) **[Figure 20-60-109]** from the CV joint and slide the boot down the shaft.

Clean the grease from the face of the joint.

Figure 20-60-110

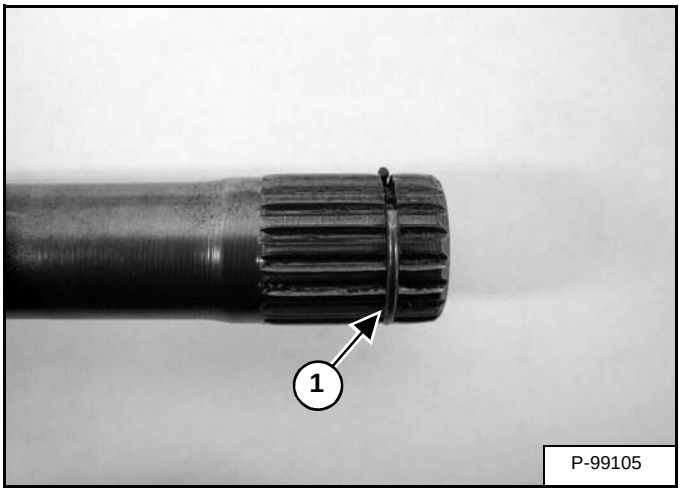


Place the drive shaft in a soft-jawed vise.

Using a soft-faced hammer, or brass drift (Item 1) **[Figure 20-60-110]**, strike the inner race of the joint to drive the joint off the drive shaft. Be sure to tap evenly around the joint to prevent binding.

NOTE: Tap on inner race only!

Figure 20-60-111



Make sure the circlip (Item 1) **[Figure 20-60-111]** is on the shaft and not left in the joint.

Remove the CV boot from the shaft.

Rear Gearcase Removal And Installation

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

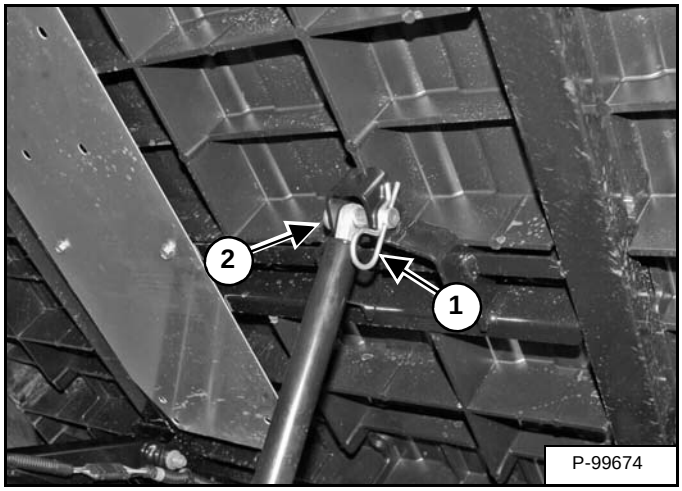
Remove the rear tire assemblies. (See TIRE MAINTENANCE on Page 10-120-1.)

⚠ WARNING

Support the cargo box while the shock is removed to prevent injury or damage.

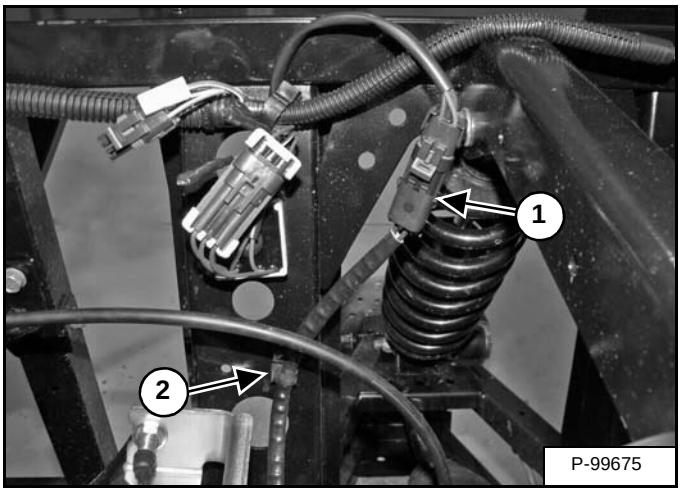
W-2890-0810

Figure 20-60-137



Remove the clip (Item 1) and pin (Item 2) **[Figure 20-60-137]** from the shock and carefully allow the cargo box to rest in the dump position.

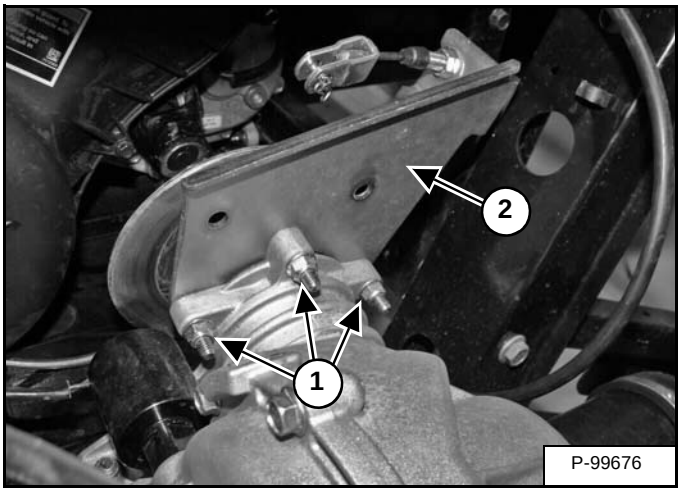
Figure 20-60-138



Disconnect the solenoid harness (Item 1) **[Figure 20-60-138]** from the main harness.

Remove the solenoid harness from the retainer (Item 2) **[Figure 20-60-138]** and move the harness out of the way.

Figure 20-60-139

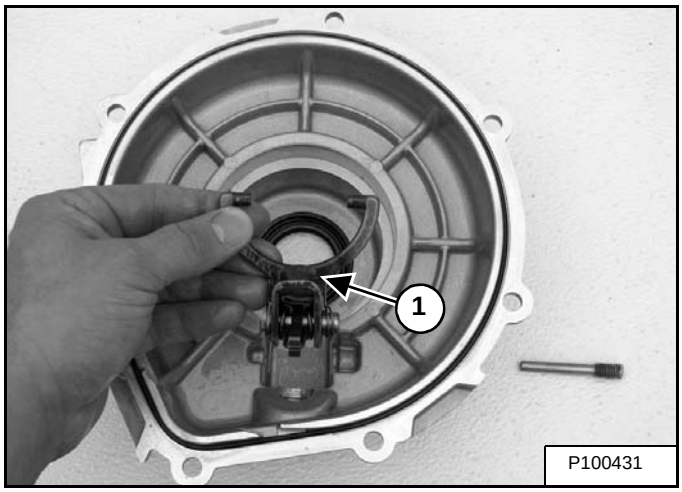


Remove the three nuts and bolts (Item 1) retaining the caliper bracket (Item 2) **[Figure 20-60-139]** to the gearcase and move the bracket out of the way.

Installation: Tighten the bolts to 23 N•m (17 ft-lb) torque.

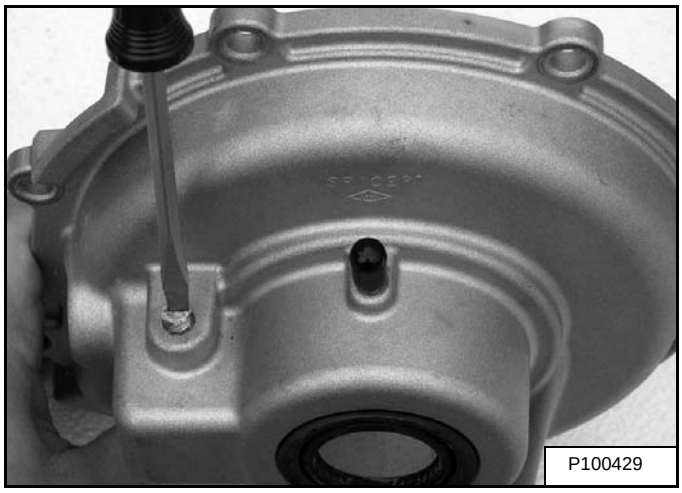
Rear Gearcase Assembly (Cont'd)

Figure 20-60-170



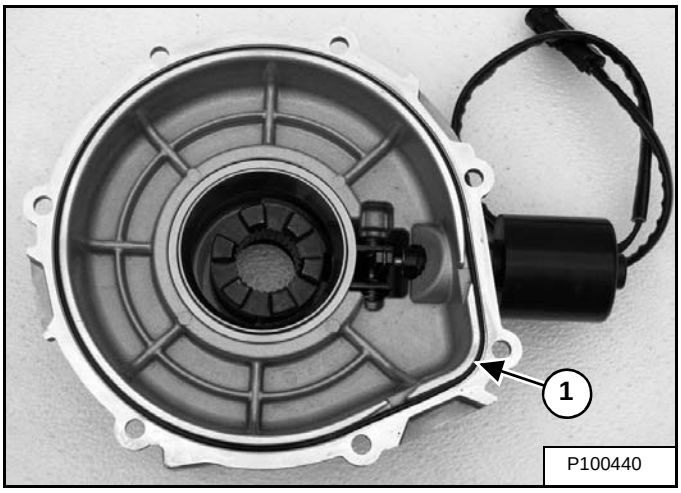
Carefully install the shift yoke assembly (Item 1) **[Figure 20-60-170]** into the gearcase cover.

Figure 20-60-171



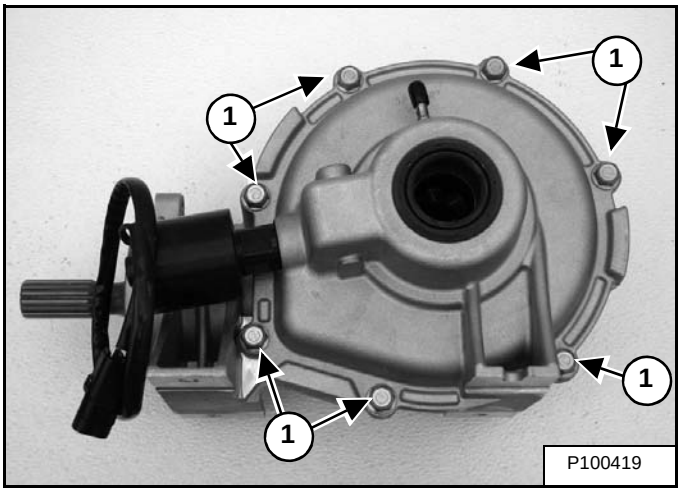
Install the lock assembly pin and tighten **[Figure 20-60-171]**.

Figure 20-60-172



Install the new lightly greased O-ring (Item 1) **[Figure 20-60-172]** onto the carrier cover.

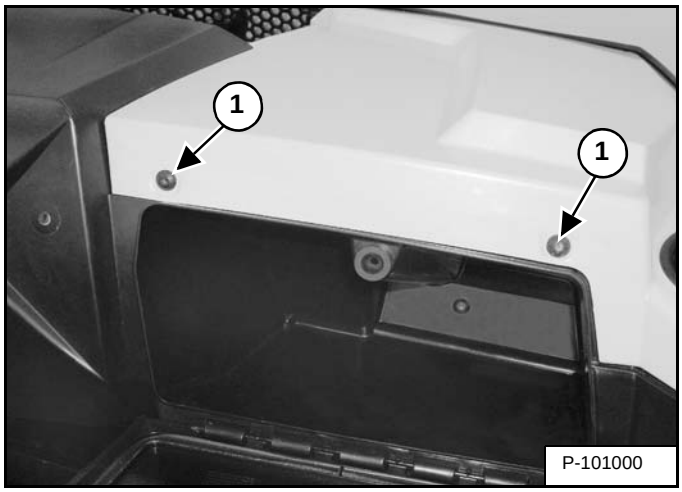
Figure 20-60-173



Assemble the gearcase halves and install the bolts (Item 1) **[Figure 20-60-173]** that secure the cover to the housing. Tighten the bolts in a criss cross pattern to 34 - 48 N•m (25 - 35 ft-lb) torque.

Right Dash Removal And Installation (Cont'd)

Figure 30-30-9



Remove the two screws (Item 1) **[Figure 30-30-9]**.

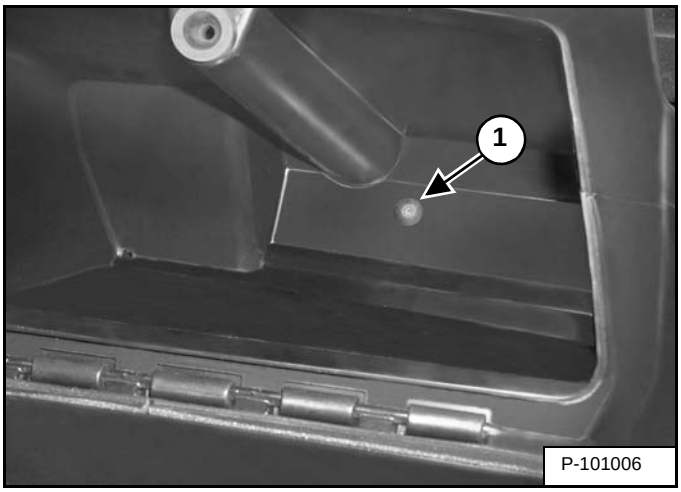
Remove the right dash.

Center Dash Removal And Installation

Remove the left dash. (See Left Dash Removal And Installation on Page 30-30-1.)

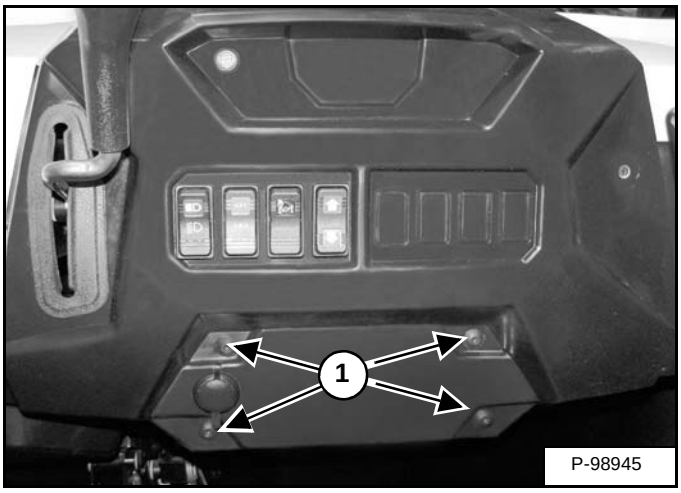
Remove the right dash. (See Right Dash Removal And Installation on Page 30-30-2.)

Figure 30-30-10



Remove the screw (Item 1) **[Figure 30-30-10]**.

Figure 30-30-11



Remove the four screws (Item 1) **[Figure 30-30-11]**.

FUEL TANK

Removal And Installation

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

Remove the right rear fender. (See Removal And Installation (Rear) on Page 30-140-1.)

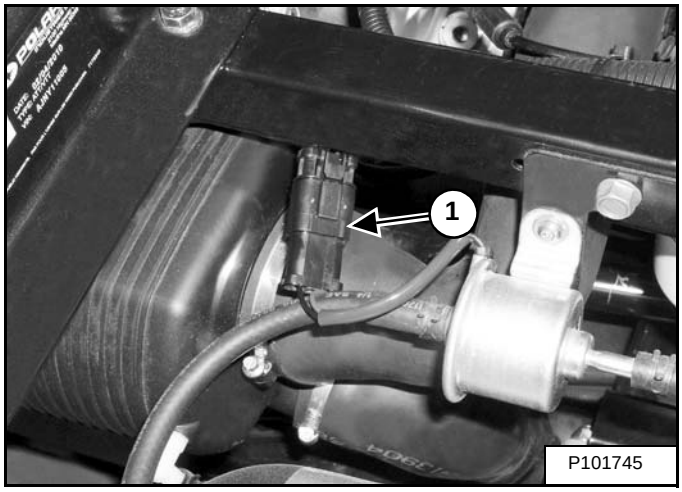
WARNING

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

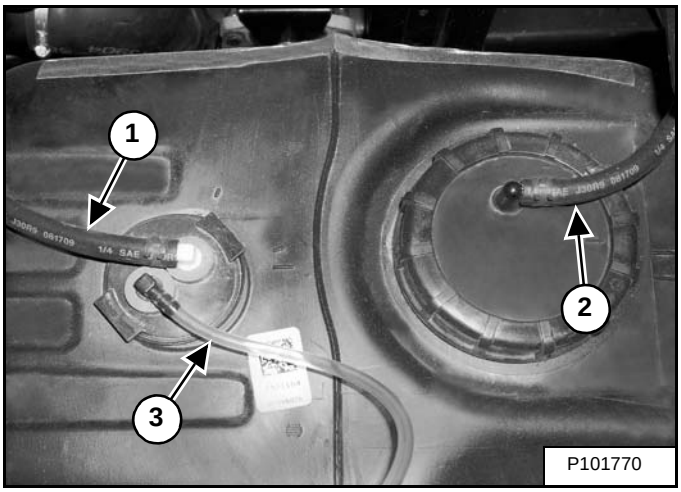
Figure 30-80-1



Disconnect the fuel pump electrical connector (Item 1) **[Figure 30-80-1]** from the main harness.

NOTE: If there is fuel in the tank, the fuel may be siphoned from the tank using an approved method.

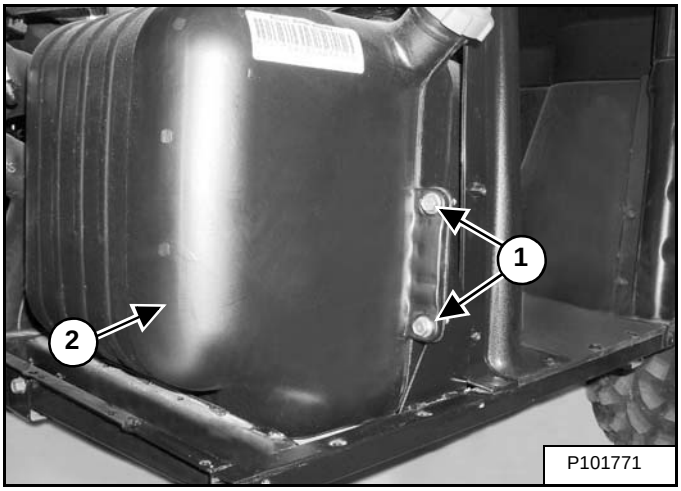
Figure 30-80-2



Remove the fuel return hose (Item 1) and supply hose (Item 2) **[Figure 30-80-3]**.

Remove the fuel vent hose (Item 3) **[Figure 30-80-3]**.

Figure 30-80-3

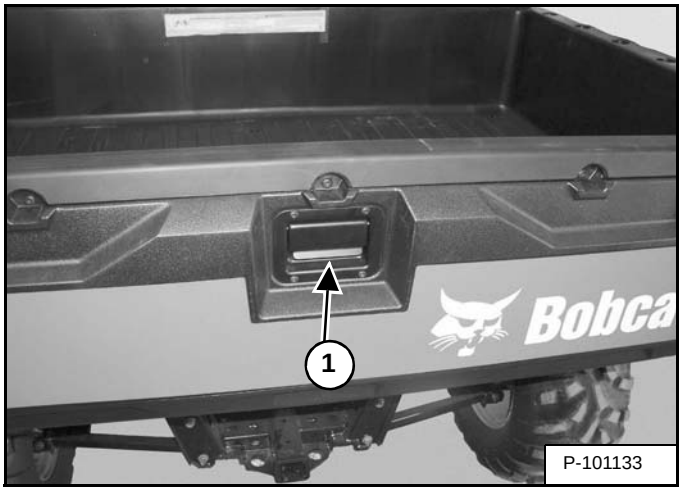


Remove the bolts (Item 1) (both sides) and remove the fuel tank (Item 2) **[Figure 30-80-3]**.

TAILGATE

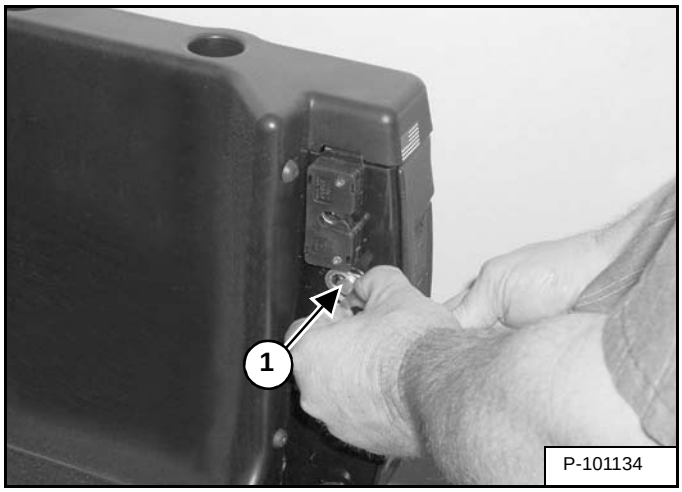
Removal And Installation

Figure 30-120-1



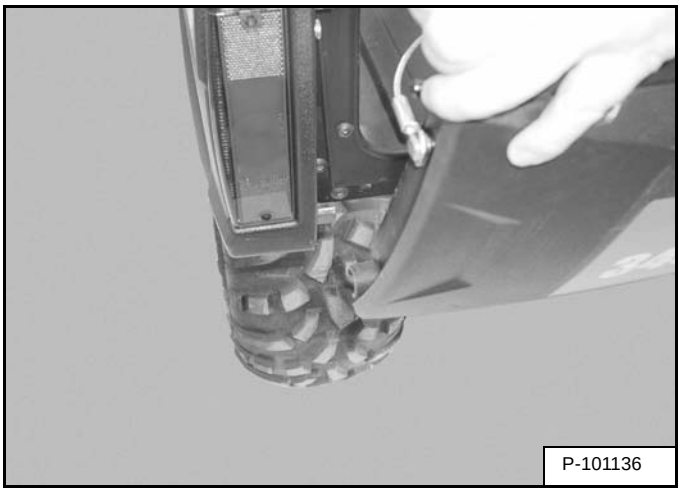
Raise the latch (Item 1) **[Figure 30-120-1]** and lower the tailgate.

Figure 30-120-2



Pull out on the retaining clip (Item 1) **[Figure 30-120-2]** and remove the tailgate cable from the cargo box.

Figure 30-120-3



Lift up and out on the left side of the tailgate first (Item 1) **[Figure 30-120-3]**.

ATTACHMENT ARM

Removal And Installation

Remove the bucket or attachment.

Park the vehicle on a flat level surface.

Figure 30-160-1

Lower the attachment arm fully and tilt the rapidlink fully forward **[Figure 30-160-1]**.

Stop the engine and engage the parking brake.

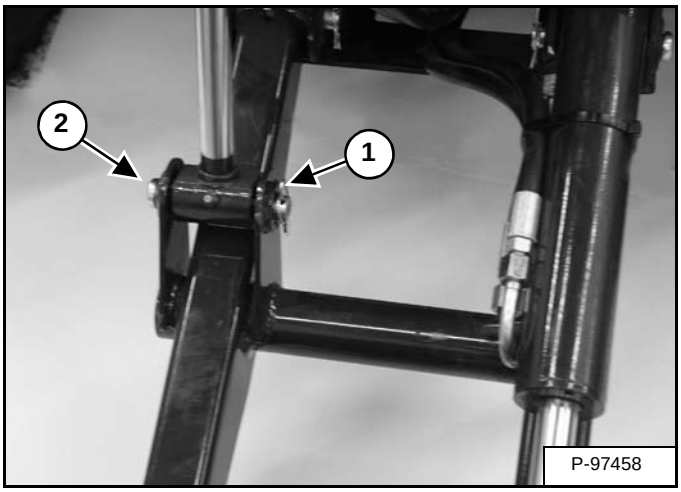
⚠ WARNING

AVOID INJURY

Keep fingers and hands out of pinch points when removing and installing the attachment arm.

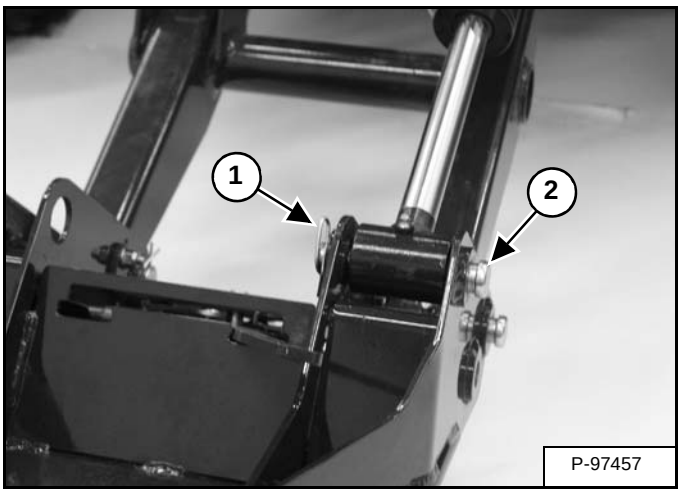
W-2882-0610

Figure 30-160-2



Remove the retaining pin (Item 1) and pin (Item 2) **[Figure 30-160-2]** from the rod end of the lift cylinder.

Figure 30-160-3



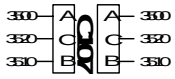
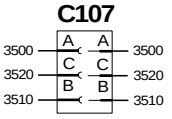
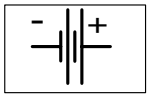
Remove the retaining pin (Item 1) and pin (Item 2) **[Figure 30-160-3]** from the rod end of the tilt cylinder.

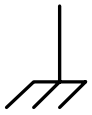
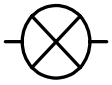
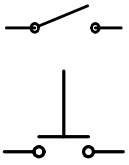
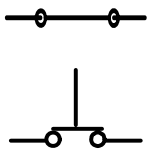
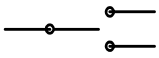
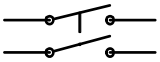
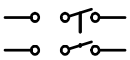
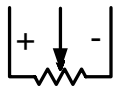
Turn the key switch to the ON position but do not start the engine. Move the attachment arm lock switch to the ON position.

Fully retract the lift and tilt cylinders.

Move the attachment arm lock switch to the OFF position. Turn the key switch to the OFF position.

Glossary Of Electrical Symbols

SYMBOL	DESCRIPTION
	CONNECTIONS
	CONNECTOR - Harness - Used for connecting 2 harnesses together or a harness to a component. The connector can vary from a single pin to any number of pins (Example: 3 pin connectors shown). The connector pins can be numbered alphabetical (shown) or numerical (1, 2, 3 etc.). The harness wires numbers are called out next to the connector (Example: 3500).
	The connector number is called out next to the connector (Example: C107). These connector numbers are used for schematic identification only and do not appear on the harness or connector.
	COMPONENTS
	BATTERY - Used for supplying and storing electrical power for the machine.
+	POSITIVE ELECTRICAL CIRCUIT - Indicates positive battery circuit.
-	NEGATIVE ELECTRICAL CIRCUIT - Indicates battery ground circuit.
	ALTERNATOR - Used to create the electrical current to supply voltage to the battery and components.
	STARTER - Uses battery current to start the machine engine.
	GROUND - Used to represent an external ground connection.

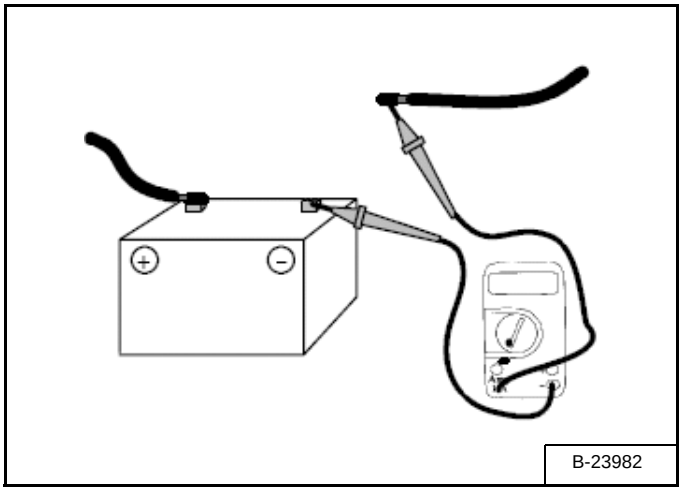
SYMBOL	DESCRIPTION
	COMPONENTS
	GROUND - Frame - Used to represent an component that is internally grounded.
	LIGHT -
	SWITCH - Single Pole - Single Throw (ON-OFF) Normally Open
	SWITCH - Single Pole - Single Throw (ON-OFF) Normally Closed.
	SWITCH - Single Pole - Double Throw (ON-OFF-ON) - This switch can be in any of three positions. (Some switches are spring activated to return them to a certain position when released.)
	SWITCH - Double Pole - Single Throw (ON-OFF) Open and Closed positions will be specified depending on switch application.)
	SWITCH - Double Pole - Double Throw (ON-OFF) Open and Closed positions will be specified depending on switch application.
	POTENTIOMETER - Variable resistance - Provides variable resistance.

CHARGING SYSTEM

Current Draw - Key OFF

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

Figure 40-30-1



If the charging system malfunctions check the following:

Check the electrolyte level in the battery. Add distilled water as needed. (Does not apply to maintenance free batteries.)

Verify the charge of the battery. Make sure battery is fully charged.

Disconnect the battery cables (negative first, then positive). Inspect the cable clamps and battery posts for corrosion. Remove acid or corrosion from the battery and cables with a sodium bicarbonate and water solution. Put grease on the cable ends and battery terminals to prevent corrosion. Reconnect the cable to the positive terminal.

With the key off, connect an ammeter between the negative battery post and the disconnected negative cable clamp **[Figure 40-30-1]**.

1. With the key OFF, current draw should not be more than 0.01 DCA (10 MA).

2. If the draw is excessive, there is a short (drain) in the electrical system of the utility work machine. The short must be repaired before the charging system can be checked

3. Disconnect loads one by one until the draw is isolated. Check component wiring as well as components for shorts to ground.

WARNING

AVOID INJURY OR DEATH

Batteries contain acid which burns eyes and skin on contact. Wear goggles, protective clothing and rubber gloves to keep acid off body.

In case of acid contact, wash immediately with water. In case of eye contact get prompt medical attention and wash eye with clean, cool water for at least 15 minutes.

If electrolyte is taken internally drink large quantities of water or milk! DO NOT induce vomiting. Get prompt medical attention.

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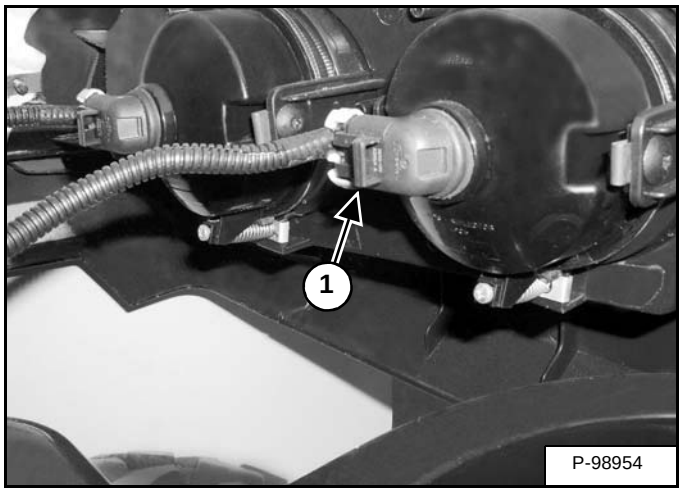
LIGHTS

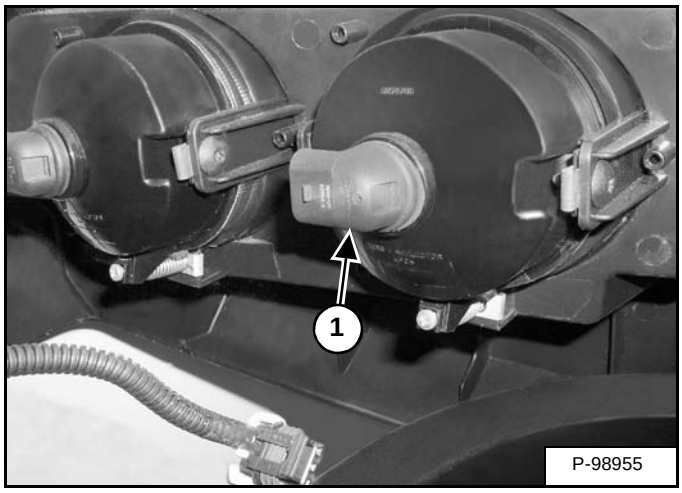
Headlight Removal And Installation

Figure 40-60-1



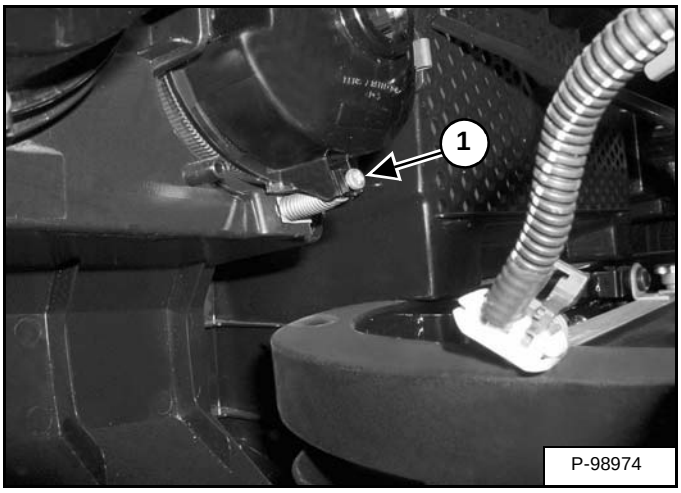
Disconnect the wiring harness (Item 1) **[Figure 40-60-1]**.

Figure 40-60-2



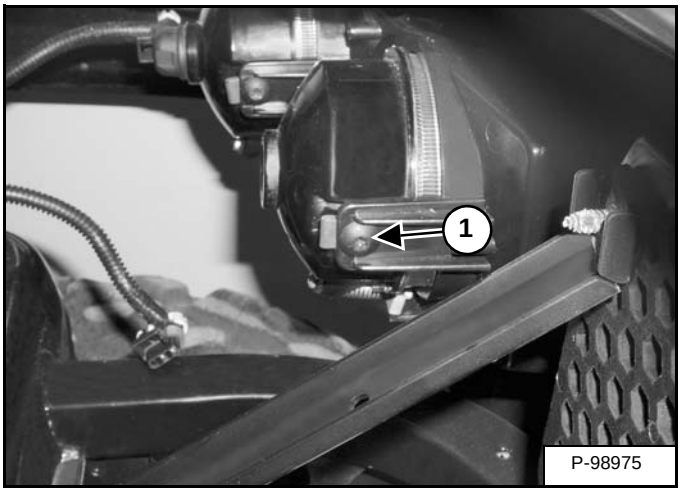
Rotate the bulb (Item 1) **[Figure 40-60-2]** counter clockwise and remove from the light housing.

Figure 40-60-3



Remove the alignment screw (Item 1) **[Figure 40-60-3]**.

Figure 40-60-4



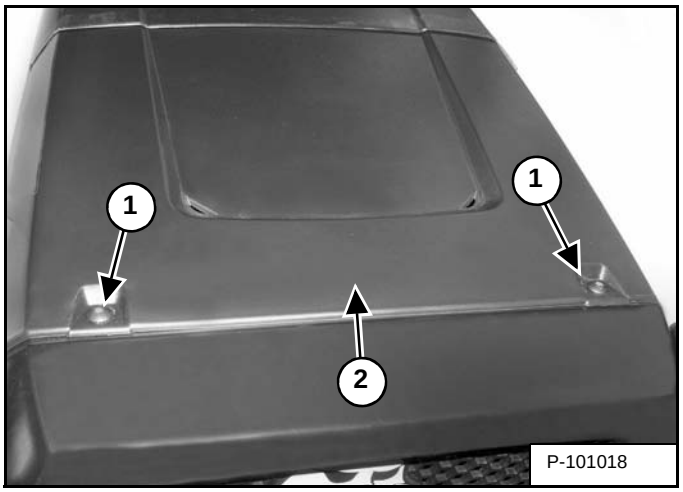
Remove the screw (Item 1) **[Figure 40-60-4]**.

Remove the housing.

SWITCH (HEADLIGHT)

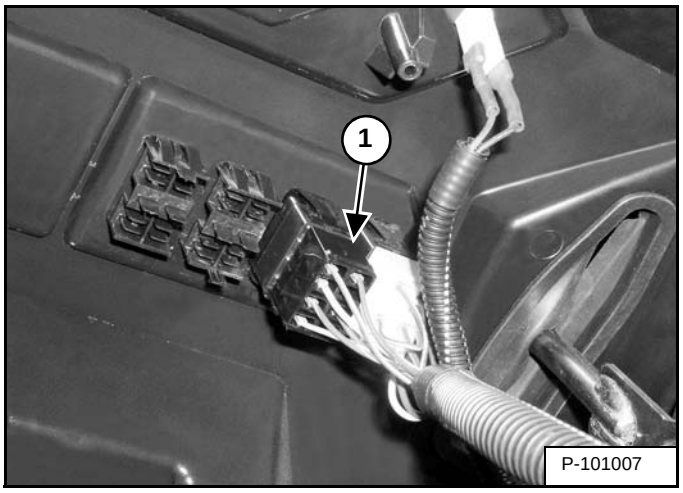
Removal And Installation

Figure 40-90-1



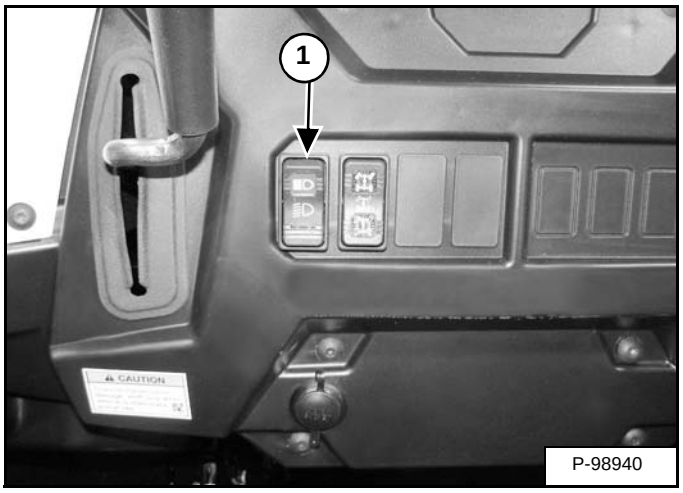
Remove the two screws (Item 1) and the front access cover (Item 2) **[Figure 40-90-1]**.

Figure 40-90-2



Disconnect the switch harness (Item 1) **[Figure 40-90-2]**.

Figure 40-90-3



Remove the switch (Item 1) **[Figure 40-90-3]** from the dash.

Testing

Put the switch to the low beam (center) position. Check for continuity between terminals 2 and 3.

Put the switch in the high beam (up) position.

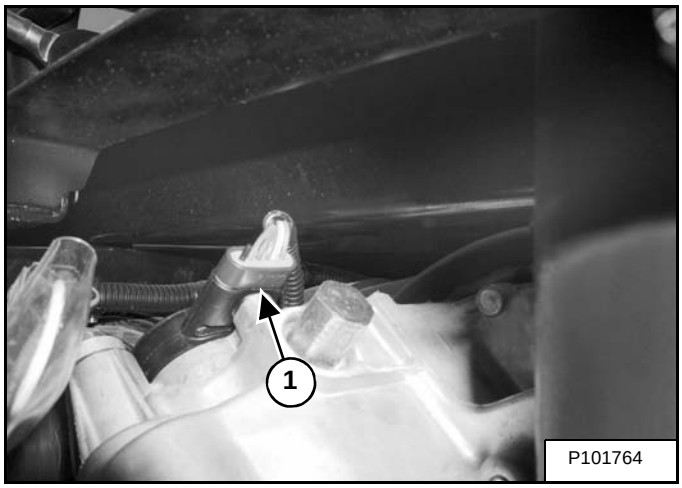
Check for continuity between terminals 5 and 6.

If continuity is not found in both steps, replace the switch.

SWITCH (GEAR SELECTOR)

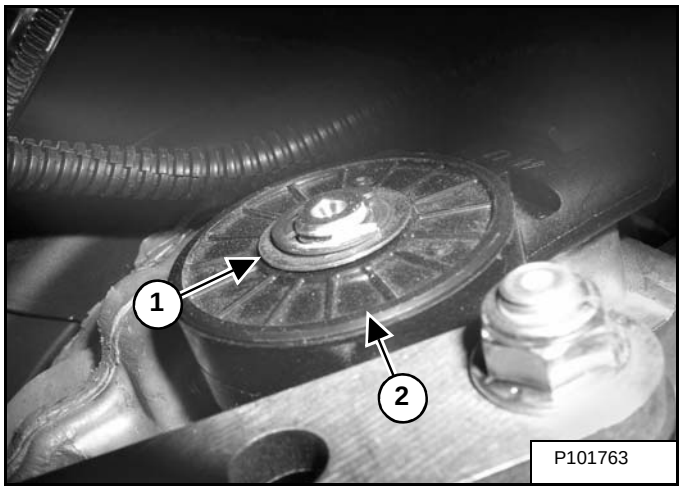
Removal And Installation

Figure 40-95-1



Disconnect the harness (Item 1) **[Figure 40-95-1]**.

Figure 40-95-2



Remove the retaining clip (Item 1) and switch (Item 2) **[Figure 40-95-2]**.

NOTE: The gear selector switch is not adjustable. If the indicator lights do not match the gear selected adjust the shift cable.

Verify shift cable is adjusted correctly. (See Shift Cable Inspecting on Page 20-30-3.)

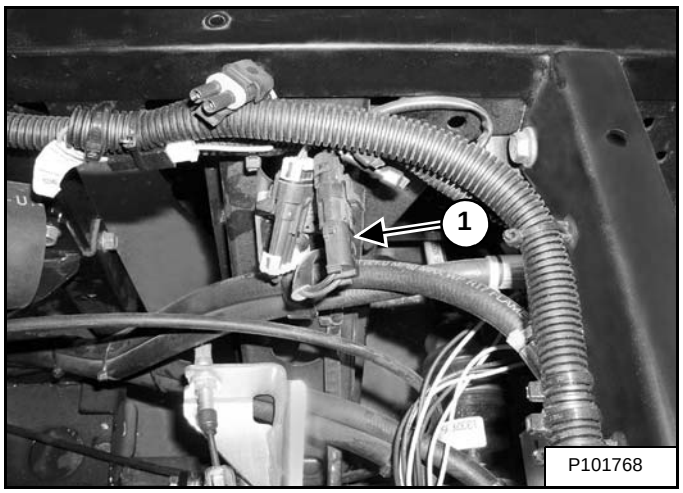
DIFFERENTIAL SOLENOID

Description

The differential solenoid is located on the right side of the transmission. The solenoid actuates an engagement dog, which locks and unlocks the rear differential.

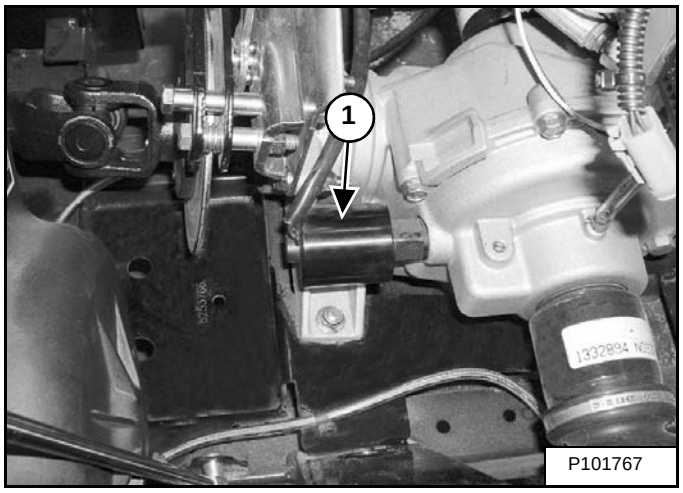
Removal And Installation

Figure 40-110-1



Disconnect the harness (Item 1) **[Figure 40-110-1]**.

Figure 40-110-2



Remove the solenoid (Item 1) **[Figure 40-110-2]**.

JOYSTICK

Removal And Installation

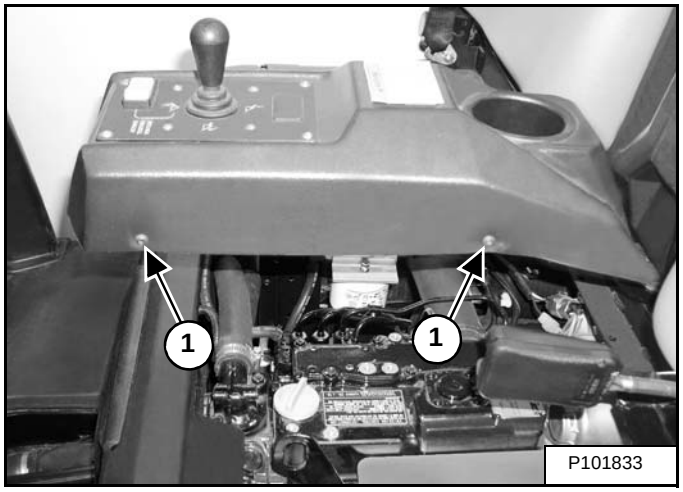
Turn the key switch to the OFF position.

Press the top of the attachment arm lock switch to disengage the joystick.

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

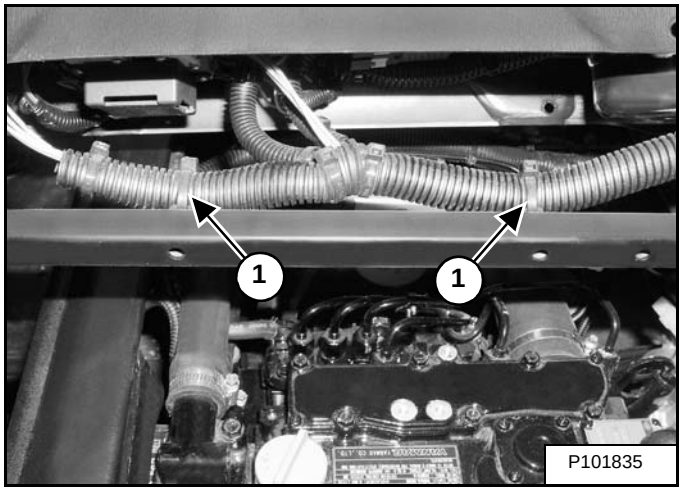
Disconnect the (-) negative terminal from the battery.

Figure 40-150-1



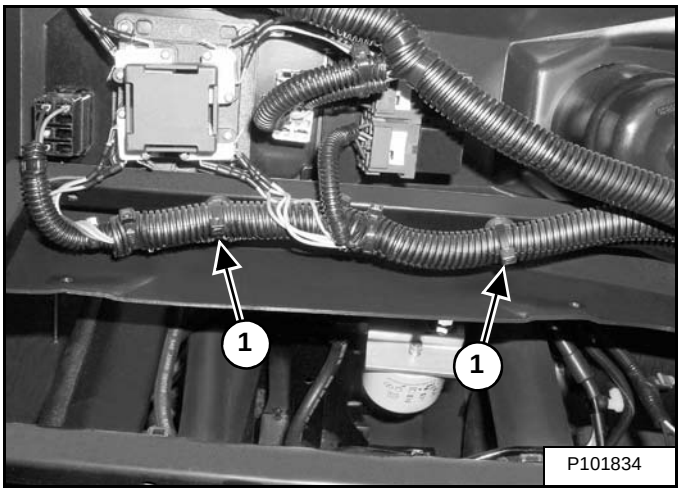
Remove the bolts (Item 1) **[Figure 40-150-1]** and nuts (both sides).

Figure 40-150-2



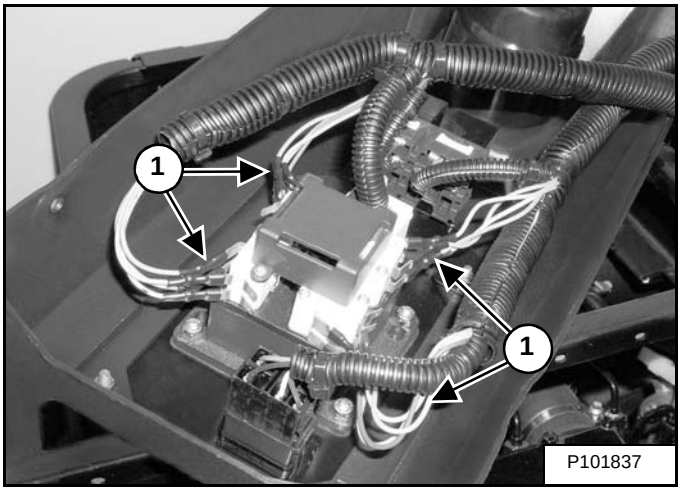
Cut and remove the cable ties (Item 1) **[Figure 40-150-2]**.

Figure 40-150-3



Cut and remove the cable ties (Item 1) **[Figure 40-150-3]**.

Figure 40-150-4



Mark and remove the contact switch wires (Item 1) **[Figure 40-150-4]**.

Installation: Use **[Figure 40-150-5 on Page 40-150-2]** to assist in wire installation

Specifications (Cont'd)

Valve Springs

Item	Factory Specification	Allowable Limit
Valve Spring (Overall Length)	37,8 mm (1.4882 in)	
Valve Spring (Squareness)		1,3 mm (0.512 in)

Cylinder

Item	Factory Specification	Allowable Limit
Cylinder Surface Warpage Limit (Mating With Cylinder Head)	-	0,05 mm (0.0020 in)
Cylinder Bore	72,00 - 72,03 mm (2.8346 - 2.8358 in)	-
Cylinder Taper Limit	-	0,03 mm (0.0012 in)
Cylinder Out Of Round Limit	-	0,03 mm (0.0012 in)
Cylinder (Piston Clearance)	0,015 - 0,050 mm (0.0006 - 0.0020 in)	0,060 mm (0.0024 in)
Cylinder Boring Limit	72,200 mm (2,8425 in)	

Rocker Arms

Item	Factory Specification	Allowable Limit
Rocker Arm I.D.	12,000 - 12,020 mm (0.4724 - 0.4732 in)	12,07 mm (0.4752 in)
Rocker Shaft O.D.	11,966 - 11,984 mm (0.4711 - 0.4718 in)	11,94 mm (0.4701 in)
Rocker Shaft Oil Clearance	0,016 - 0,054 mm (0.0006 - 0.0021 in)	0,13 mm (0.0051 in)

Tappet

Item	Factory Specification	Limit
Tappet Bore (Block) Inside Diameter	21,000 - 21,021 mm (0.8268 - 0-8276 in)	21,041 mm (0.8284 in)
Tappet Stem Outside Diameter	20,927 - 20,960 mm (0.8239 - 0.8252 in)	20,907 mm (0.8231 in)
Oil Clearance	0,040 - 0,094 mm (0.0016 - 0.0037 in)	0,134 mm (0.0053 in)

Push Rod

Item	Factory Specification	Limit
Push Rod Bend	Less than 0,03 mm (0.0012 in)	0,03 mm (0.0012 in)

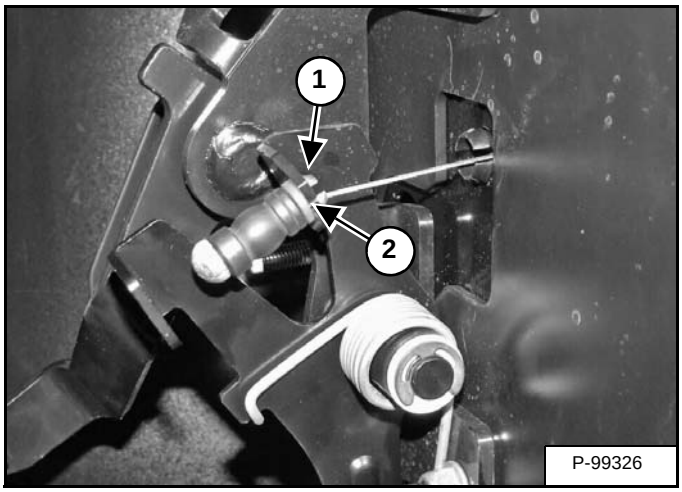
Troubleshooting (Cont'd)

TROUBLE SYMPTOM				CAUSE				
				Fuel System				
				Too Early Timing of Fuel Injection Pump	Too Late Timing of Fuel Injection Pump	Incorrect Diesel Fuel	Water in Fuel System	Clogged Fuel Filter
Starting Problem	Engine Does Not Start						■	■
	Engine Starts But Stops Soon	Exhaust Smoke	None					■
			Little					
			Much				■	
Insufficient Engine Output	Exhaust Color		Ordinary			■		■
			White		■	■	■	
			Black			■		
Poor Exhaust Color	During Work		White		■	■	■	
			Black	■		■		
High Knocking Sound During Combustion				■				
Abnormal Engine Sound								
Uneven Combustion Sound						■	■	
Engine Surging	During Idling						■	
	During Work Operation						■	
Excessive Engine Vibration								
Difficulty In Returning To Low Speed								
Excessive Fuel Consumption					■			
Engine Oil	Excessive Oil Consumption							
	Dilution By Diesel Fuel							
	Oil With Water							
	Low Oil Pressure							
Excessive Blow-by Gas								
Engine Coolant	Overheat							
	Low Coolant Temperature							
Air Intake	Pressure Drop							
	Pressure Rise							
Exhaust Temperature Rise					■			
Corrective Action				Check and Adjust.	Check and Adjust.	Use Correct Fuel Oil.	Drain the Fuel Filter.	Clean or Replace.

THROTTLE SYSTEM

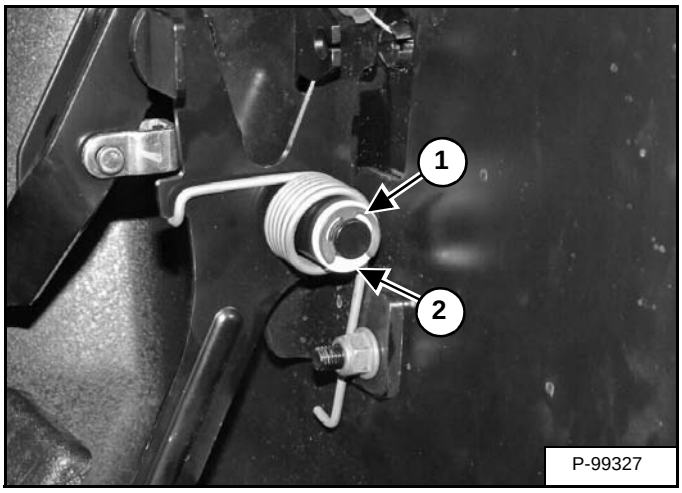
Throttle Pedal Removal And Installation

Figure 50-20-1



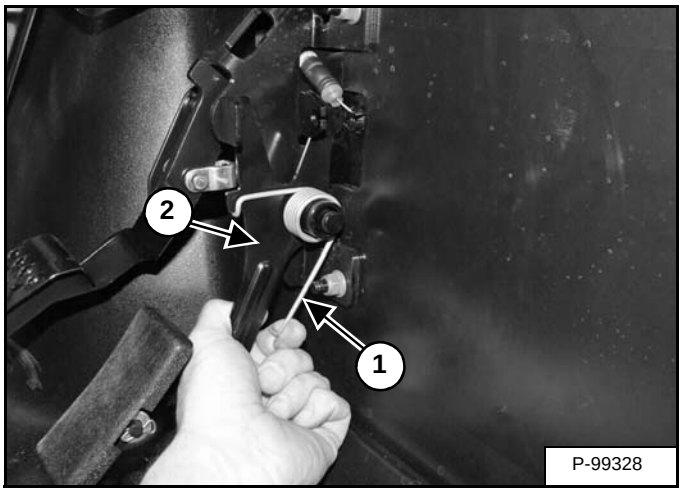
Compress the tabs (Item 1) and remove the cable from the slot (Item 2) **[Figure 50-20-1]**.

Figure 50-20-2



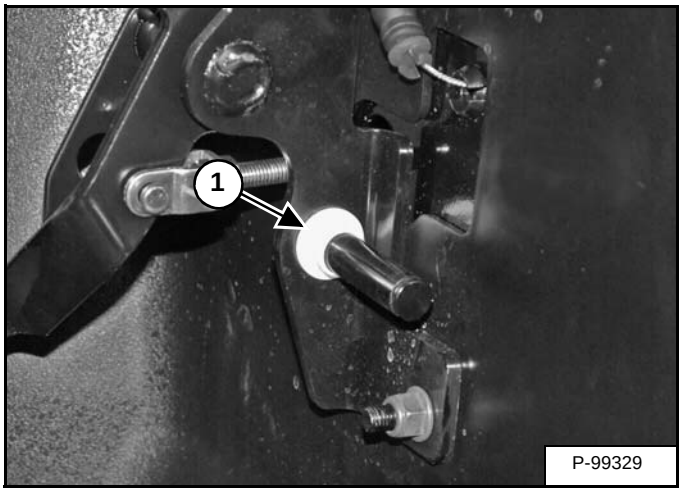
Remove the clip (Item 1) and remove the plastic bushing (Item 2) **[Figure 50-20-2]**.

Figure 50-20-3



Lift the spring (Item 1) and remove the pedal assembly (Item 2) **[Figure 50-20-3]** from the machine.

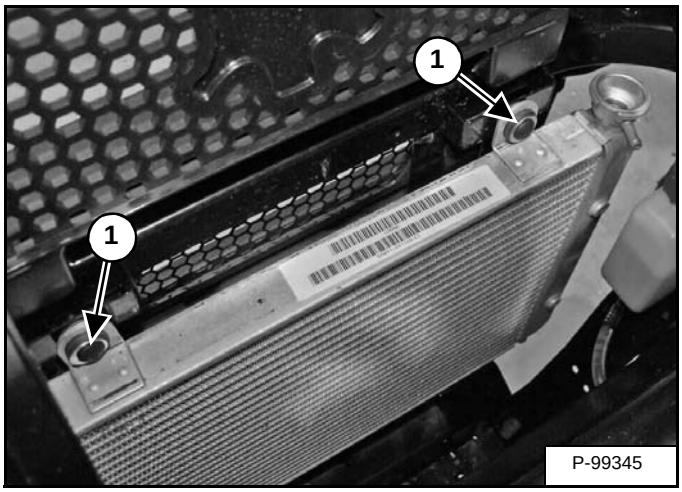
Figure 50-20-4



Remove the plastic bushing (Item 1) **[Figure 50-20-4]** from the shaft.

Radiator Removal And Installation (Cont'd)

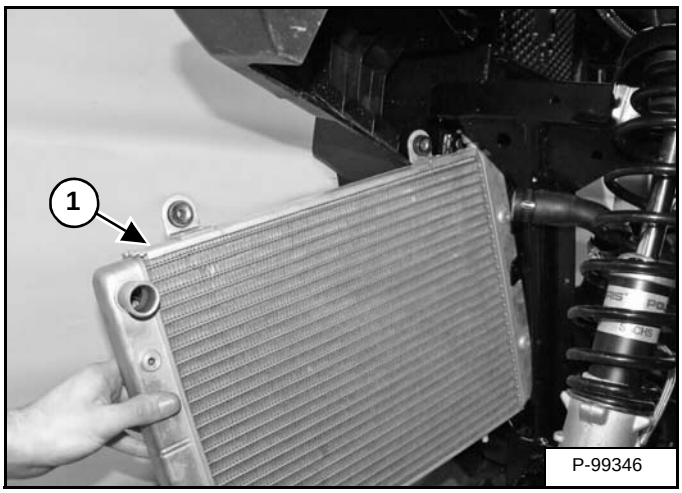
Figure 50-50-4



Remove the two bolts (Item 1) **[Figure 50-50-4]** securing the radiator to the frame.

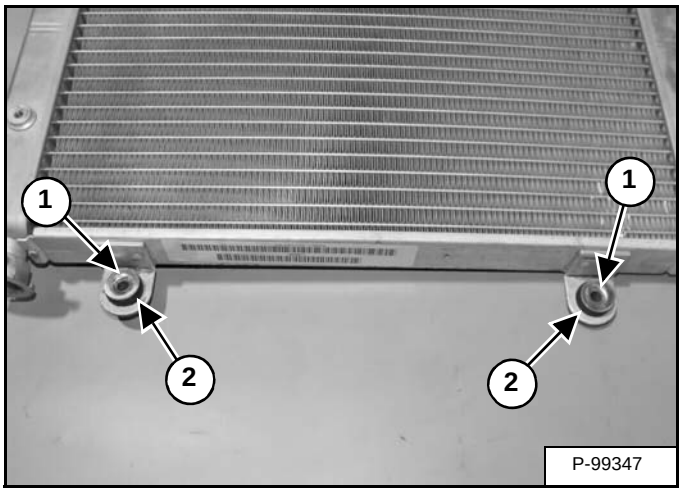
Lift the radiator slightly and shift to the left wheel well.

Figure 50-50-5



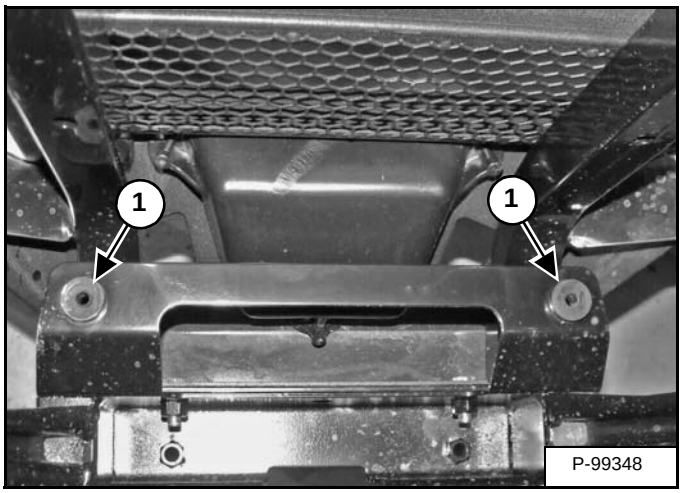
Remove the radiator (Item 1) **[Figure 50-50-5]** through the left wheel well.

Figure 50-50-6



Check the bushings (Item 1) and rubber grommets (Item 2) **[Figure 50-50-6]** on the radiator for damage or wear and replace if needed.

Figure 50-50-7

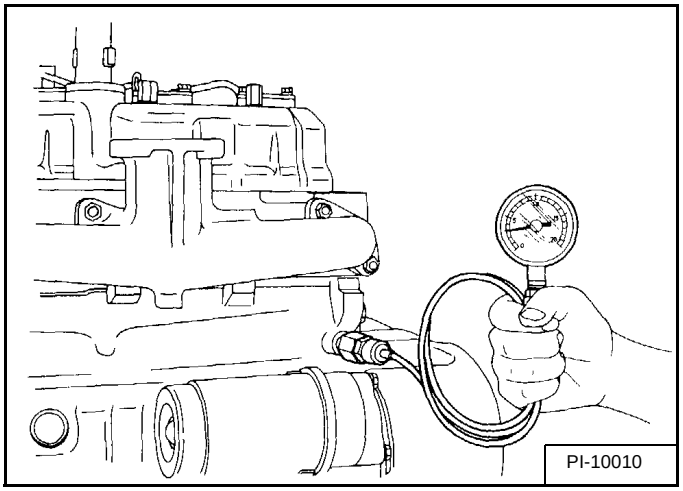


Check the rubber bushings (Item 1) **[Figure 50-50-7]** on the frame for damage or wear and replace if needed.

Engine Oil Pressure - Testing

Remove the oil pressure sender.

Figure 50-60-11



Install a pressure gauge **[Figure 50-60-11]**.

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

If the oil pressure is less than the allowable limit, check the following items.

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

At idle Speed Allowable Limit 60,7 kPa (0,50 bar) (8.8 psi)

At Rated Speed 289,6 - 441,3 kPa (2,94 - 4,41 bar) (42 - 64 psi)

Injection Pump - Timing

⚠ 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.

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NOTE: The following procedure is performed on the No. 1 cylinder. While checking and adjusting the timing on only No. 1 cylinder is usually sufficient, the same procedure can be performed on any or all cylinders.

Checking

Some fuel may drain from the fuel injection pump during this process. Make provisions to contain any such spillage.

Ensure the fuel injection pump is primed with fuel.

Clean the area around the fuel injection pump.

NOTE: Clean the area around the fuel injection pump to prevent any contamination when the fuel injection pump plunger plug is removed.

Remove the Stop Solenoid. (See Stop Solenoid on Page 50-70-1.)

Set the throttle to the HIGH-IDLE position.

Using a wrench on the crankshaft pulley bolt, rotate the crankshaft in a clockwise direction while looking through the flywheel inspection port. Rotate the crankshaft until the injection timing marks on the flywheel are visible for No. 1 cylinder.

Typical flywheel markings are as shown in **[Figure 50-70-18]**.

Note: A typical flywheel will have multiple timing grids depending on the number of cylinders. Any grid and its corresponding cylinder can be used to check the fuel injection timing.

Figure 50-70-17

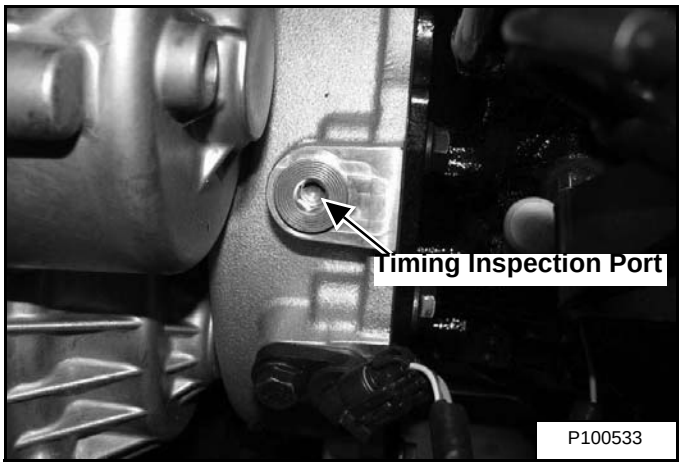
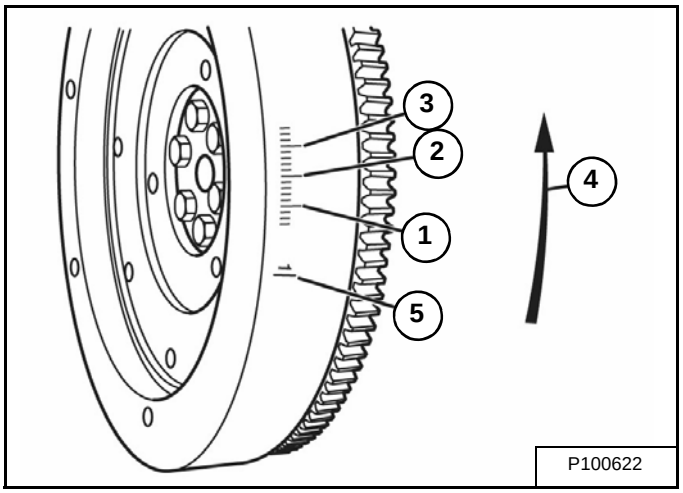


Figure 50-70-18



1 – 15° BTDC (Before Top Dead Center)
2 – 20° BTDC
3 – 25° BTDC
4 – Direction of Rotation
5 – TDC (Top Dead Center)

Set the throttle to the HIGH-IDLE position.

Using a wrench on the crankshaft pulley bolt, rotate the crankshaft in a clockwise direction while looking through the flywheel inspection port. Rotate the crankshaft until the injection timing marks on the flywheel are visible for No. 1 cylinder.

Typical flywheel markings are as shown in **[Figure 50-70-18]**.

NOTE: A typical flywheel will have multiple timing grids depending on the number of cylinders. Any grid and its corresponding cylinder can be used to check the fuel injection timing.

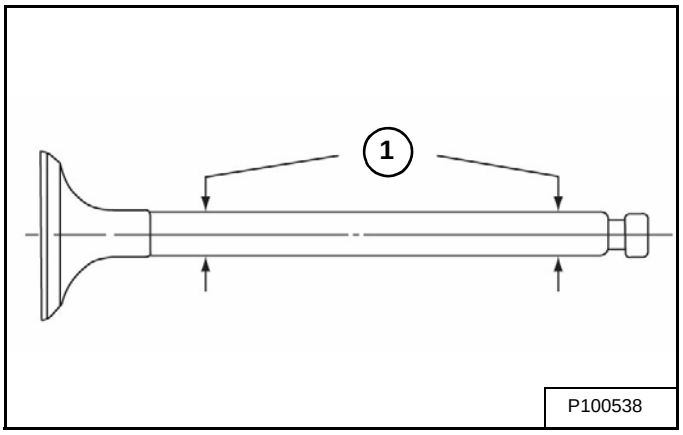
CYLINDER HEAD

Intake And Exhaust Valves

Visually inspect the intake and exhaust valves. Replace any valves that are obviously discolored, heavily pitted or otherwise damaged.

Valve Stem Diameter

Figure 50-80-1

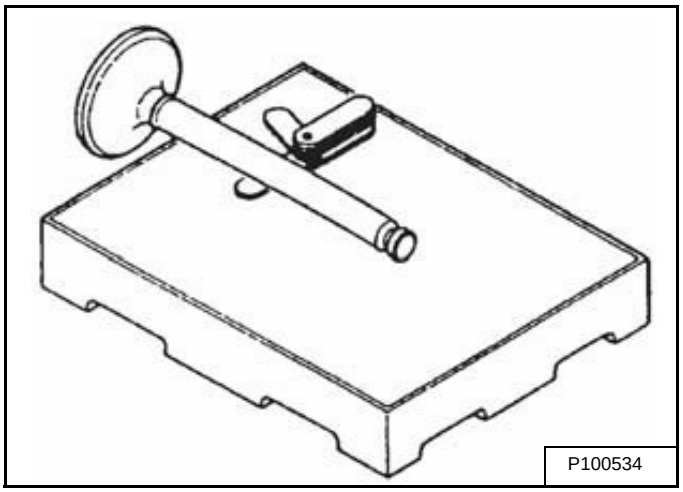


Use a micrometer to measure the valve stem diameter. Measure the valve stem near the combustion end and near the opposite end (Item 1) **[Figure 50-80-1]**.

Valve Stem O.D.	Intake	5,960 - 5,985 mm (0.2346 - 0.2356 in)
	Exhaust	5,945 - 5,970 mm (0.2341 - 0.2350 in)
Allowable Limit	5,900 mm (0.2323 in)	

Valve Stem Bend

Figure 50-80-2



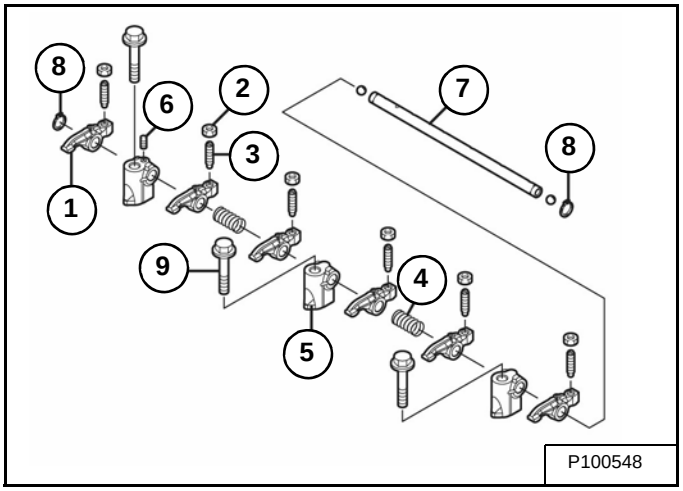
Place the valve stem on a flat inspection block or layout bed. Roll the valve until a gap can be observed between a portion of the valve stem and the surface of the block or bed. Use a feeler gauge to measure the gap **[Figure 50-80-2]**.

Valve Stem Bend - Allowable Limit	Intake	0,010 mm (0.0004 in)
	Exhaust	0,010 mm (0.0004 in)

Cylinder Head Disassembly And Assembly (Cont'd)

Disassembly Of Rocker Arm Assembly

Figure 50-80-24



Remove the rocker arm shaft alignment set screw (Item 6) from support (Item 5) **[Figure 50-80-24]**.

NOTE: The set screw is located in the center support.

Remove two snap rings (Item 8) **[Figure 50-80-24]**.

NOTE: The rocker arm shaft fits tightly in the rocker arm supports. Clamp the support in a padded vise. Twist and pull out on the rocker arm shaft to remove. Reverse this process when installing the rocker arm shaft into the supports.

Slide the rocker arm shaft (Item 7) out of the rocker arm supports (Item 5), springs (Item 4) and rocker arms (Item 1) **[Figure 50-80-24]**.

NOTE: Mark the rocker arms so they can be reinstalled with the original matching valve and push rod.

Remove the valve adjusting screw (Item 3) and lock nut (Item 2) **[Figure 50-80-24]** from the rocker arms. Mark parts so they can be reinstalled on the same rocker arm.

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

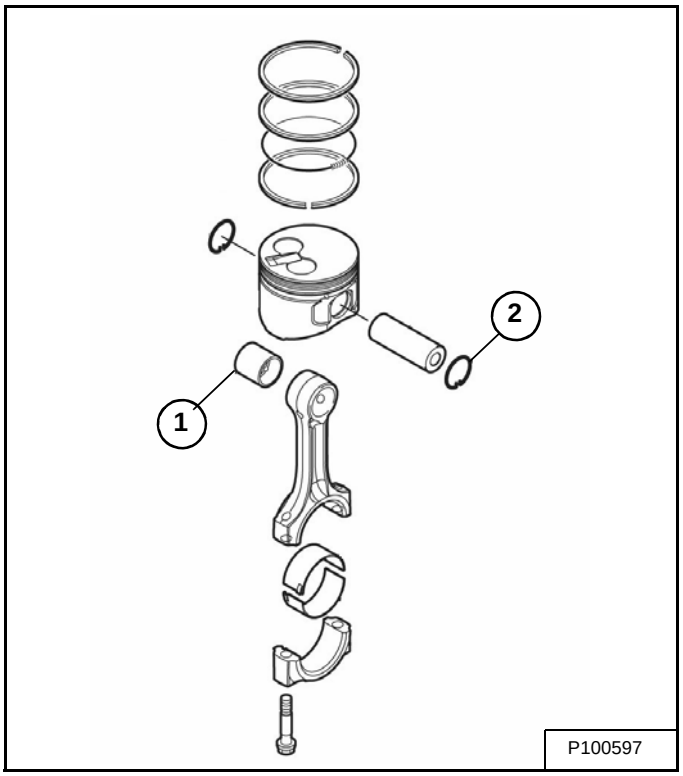
Reassembly Of Pistons

Proceed slowly. Make no forced assemblies unless a pressing operation is called for. All parts must be perfectly clean and lightly lubricated when assembled.

NOTE: Use new gaskets, seals and O-rings during assembly.

NOTE: Liberally apply clean engine oil to all internal parts during assembly.

Figure 50-90-5



Select the parts needed to assemble the piston and connecting rod for one cylinder.

If removed, install a new wrist pin bushing (Item 1) **[Figure 50-90-5]** using a press and the appropriate service tool. Be sure to align the oil holes.

Reinstall one snap ring (Item 2) **[Figure 50-90-5]** into the piston. Ensure the snap ring is securely seated in the groove.

Figure 50-90-6

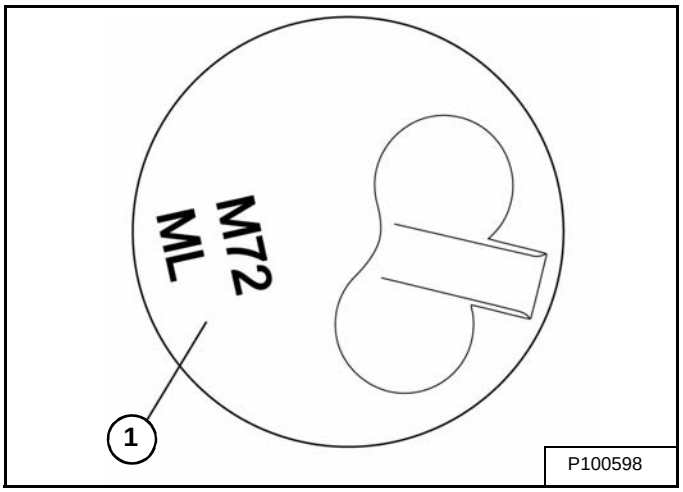
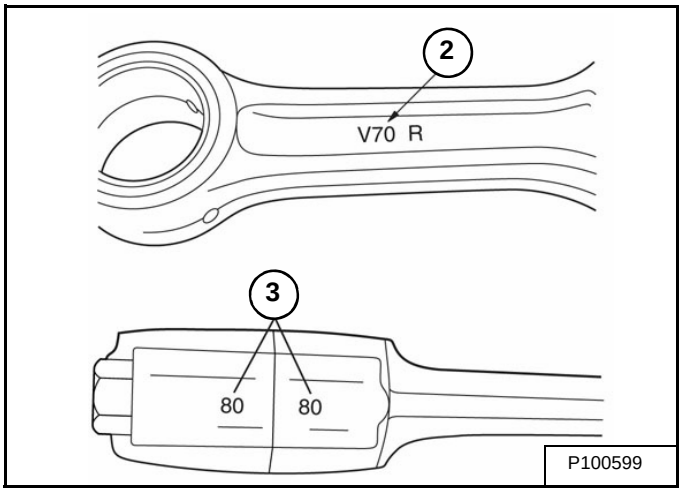


Figure 50-90-7

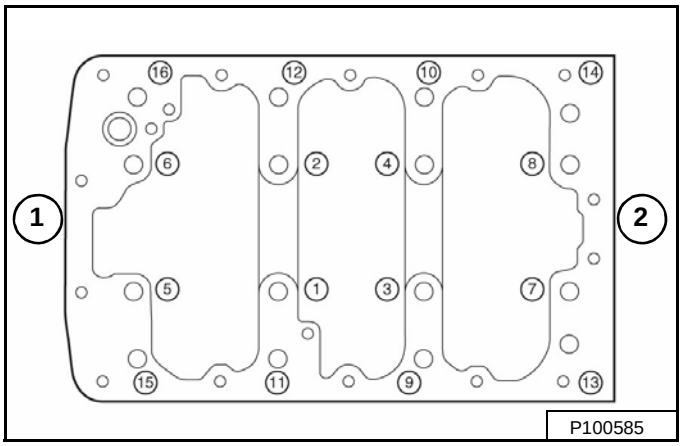


NOTE: The piston and connecting rod must be assembled with the correct orientation. When correctly assembled, the piston identification mark (Item 1) [Figure 50-90-6] stamped into the top of the piston will be on the opposite side of the connecting rod as the match marks (Item 3) [Figure 50-90-7] stamped into the connecting rod and connecting rod cap. When reinstalled in the cylinder, the embossed mark (Item 2) [Figure 50-90-7] cast into the beam of connecting rod will face the flywheel end of the engine.

NOTE: The actual appearance of the match marks will vary but they will always be in the same locations.

Crankshaft And Bearings Removal (Cont'd)

Figure 50-90-29

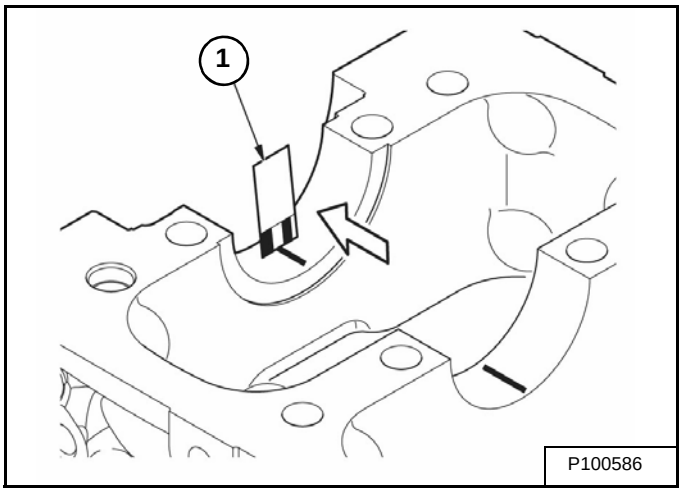


Reinstall the ladder frame **[Figure 50-90-29]**. Tighten the bolts to 45 ± 2 N•m (33 ± 1.5 ft-lb) torque.

[Figure 50-90-29]
1 – Gear Case Side
2 – Flywheel Side

Remove the ladder frame **[Figure 50-90-29]**.

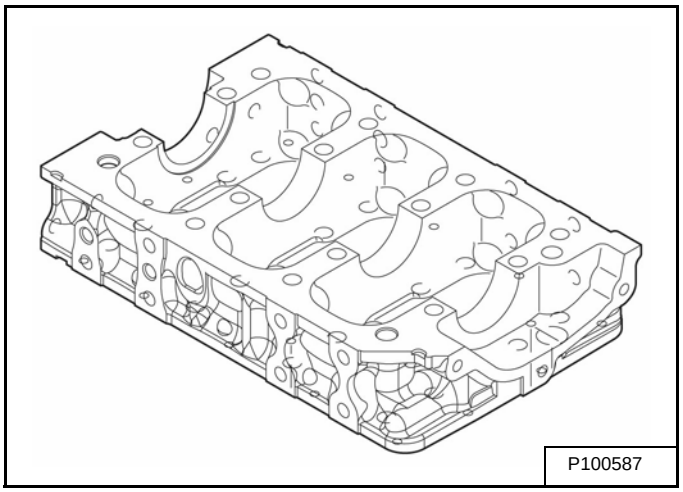
Figure 50-90-30



Compare the width of the flattened PLASTIGAGE (Item 1 to the graduation marks on the package **[Figure 50-90-30]**. The mark that most closely matches the width of the flattened PLASTIGAGE will indicate the bearing oil clearance. Record the measurement.

Oil Clearance	0,020 - 0,058 mm (0.0008 - 0.0023 in)
Allowable Limit	0,110 mm (0.0043 in)

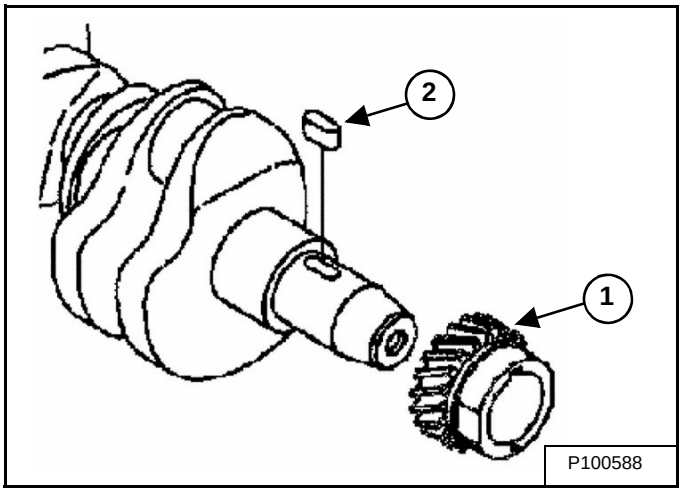
Figure 50-90-31



Repeat with the remaining main bearings **[Figure 50-90-31]**.

NOTE: Be sure to note the markings on the main bearing, or make marks so they can be reinstalled in the same order as they were removed.

Figure 50-90-32



Remove the crankshaft from the engine.

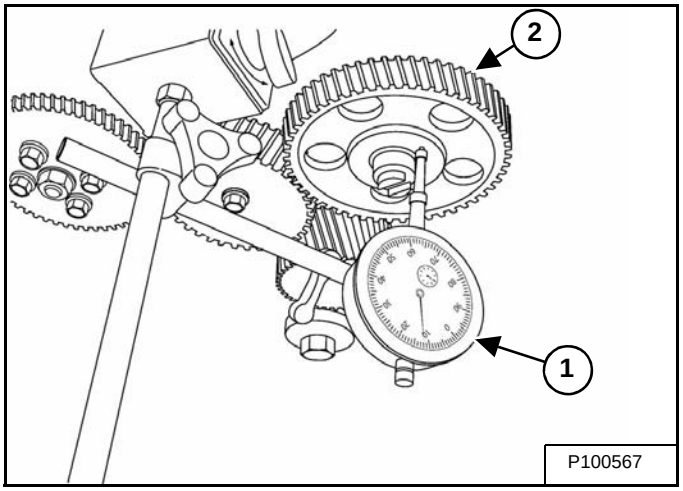
NOTE: Do not remove the crankshaft gear unless the gear or crankshaft are damaged and require replacement.

If necessary, remove the crankshaft gear (Item 1) and key (Item 2) **[Figure 50-90-32]**. If using a gear puller, be careful not to damage the threads in the end of the crankshaft.

Idler Gear And Camshaft Removal And Installation

Removal Of Camshaft

Figure 50-100-8

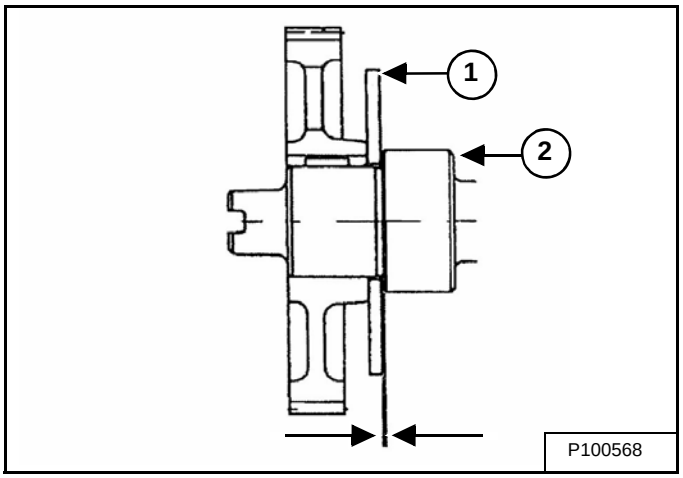


Before removing the camshaft, check the camshaft end play.

Method A: Install a dial indicator (Item 1) on the cylinder block. Move the camshaft and gear (Item 2) **[Figure 50-100-8]** in and out to measure the end play. Record the measurement.

Camshaft End Play	0,05 - 0,15 mm (0.0020 - 0.0059 in)
Allowable Limit	0,25 mm (0.0098 in)

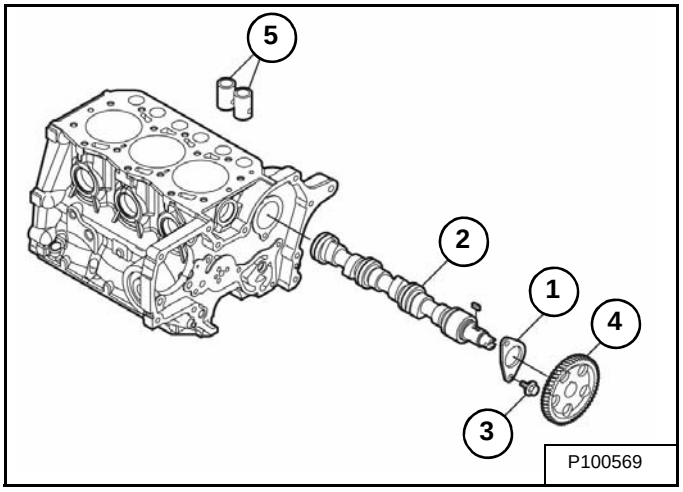
Figure 50-100-9



Method B: Use a feeler gauge to measure the clearance between the thrust plate (Item 1) and front camshaft bearing (Item 2) **[Figure 50-100-9]**. Record the measurement.

Camshaft End Play	0,111 - 0,250 mm (0.0044 - 0.0098 in)
Allowable Limit	0,28 mm (0.0110 in)

Figure 50-100-10



Remove two bolts (Item 3) retaining the camshaft thrust plate (Item 1) **[Figure 50-100-10]**.

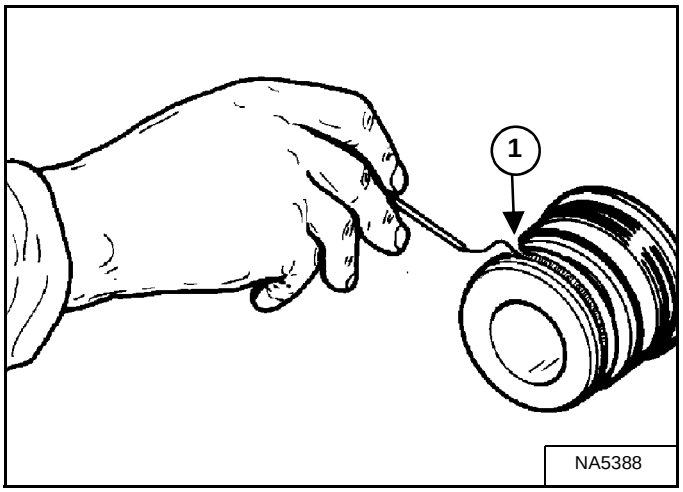
Extract the tappets (Item 5) **[Figure 50-100-10]** through the top of the cylinder block. Mark the tappets so they can be reinstalled in the same location.

Slowly pull the camshaft (Item 2) **[Figure 50-100-10]** assembly out of the engine being careful not to damage the front camshaft bushing.

Remove the camshaft gear (Item 4) **[Figure 50-100-10]** only if the gear or camshaft require replacement. Use a knife-edge puller and a press to remove the gear. The gear is a shrink-fit and will need to be heated to 180 - 200°C (356 - 392°F) to remove.

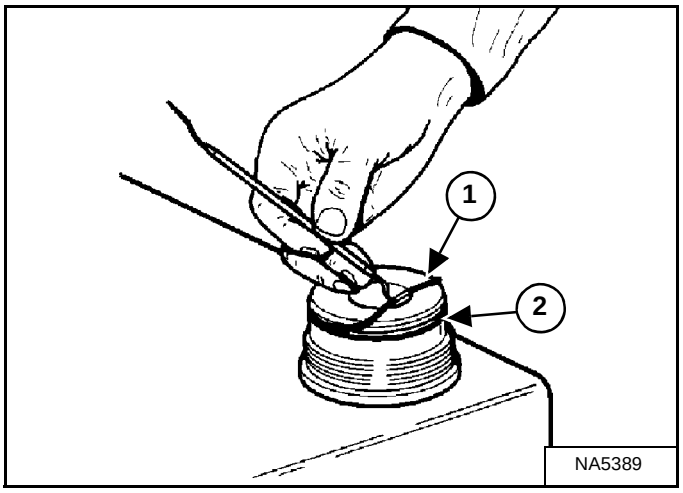
Disassembly (Cont'd)

Figure 60-10-11



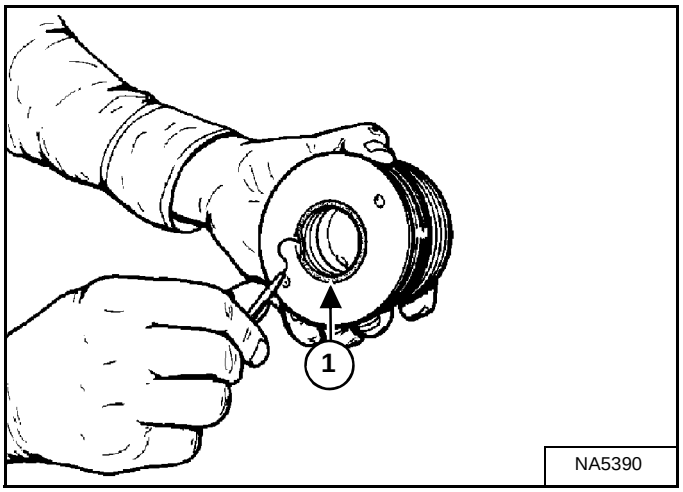
Remove the seal (Item 1) **[Figure 60-10-11]**.

Figure 60-10-12



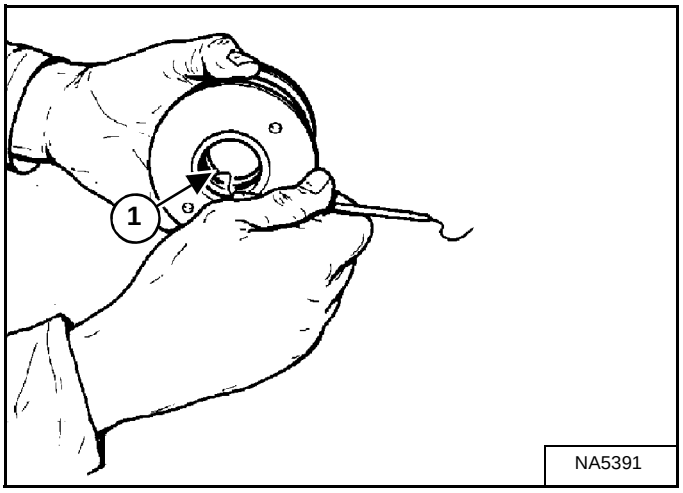
Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 60-10-12]**.

Figure 60-10-13



Remove the wiper seal (Item 1) **[Figure 60-10-13]**.

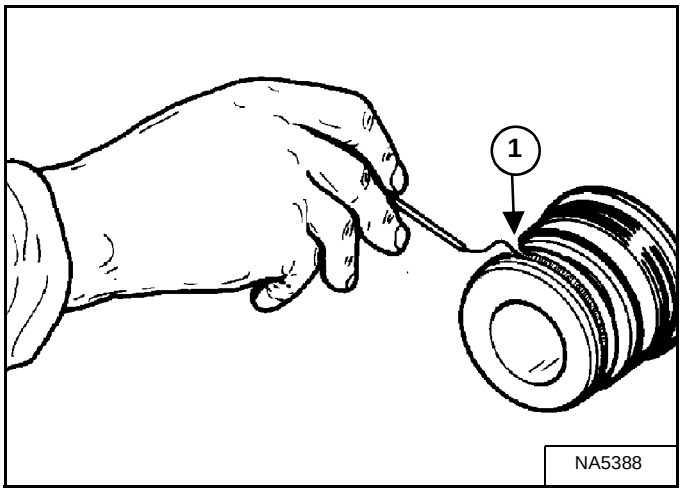
Figure 60-10-14



Remove the seal (Item 1) **[Figure 60-10-14]**.

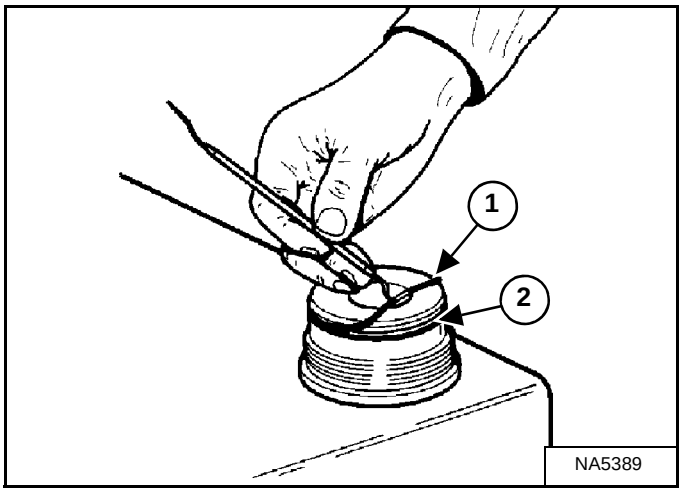
Disassembly (Cont'd)

Figure 60-11-11



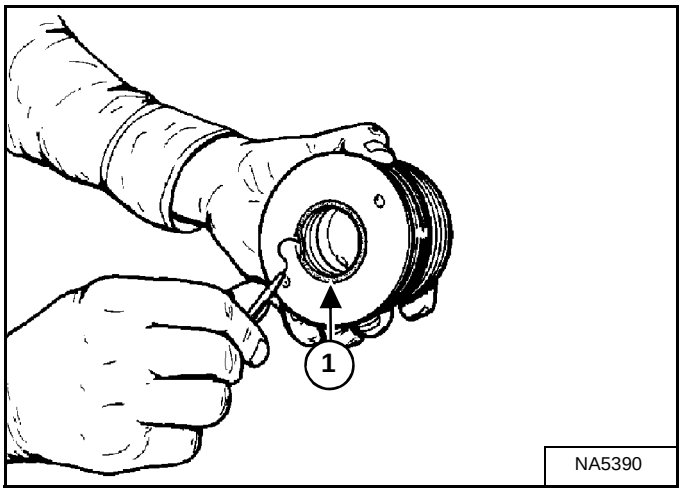
Remove the seal (Item 1) **[Figure 60-11-11]**.

Figure 60-11-12



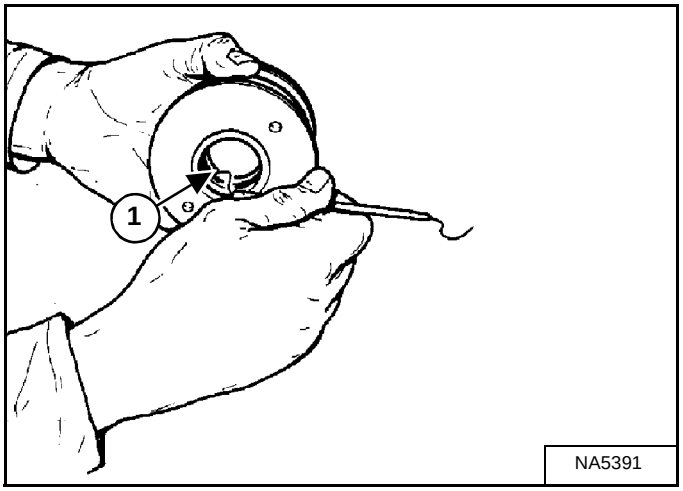
Remove the O-ring (Item 1) and back-up ring (Item 2) **[Figure 60-11-12]**.

Figure 60-11-13



Remove the wiper seal (Item 1) **[Figure 60-11-13]**.

Figure 60-11-14



Remove the seal (Item 1) **[Figure 60-11-14]**.

HYDRAULIC CONTROL VALVE

Removal And Installation

Raise the cargo box.

Lower the lift arm and stop the engine.

Relieve the pressure from the hydraulic system. (See Procedure on Page 10-160-1.)

IMPORTANT

When repairing hydrostatic and 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.

I-2003-0888

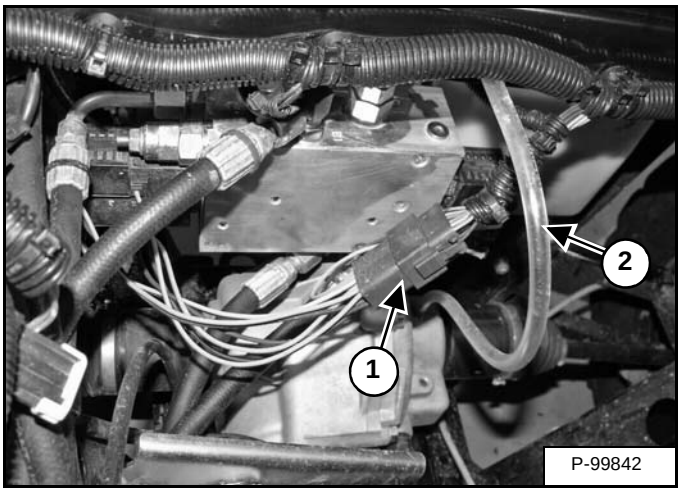
⚠ WARNING

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

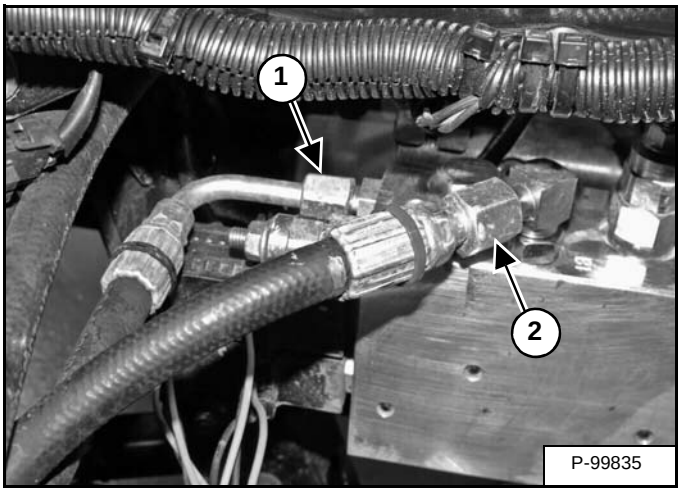
Figure 60-30-1



Disconnect the solenoid connector (Item 1) **[Figure 60-30-1]** from the main harness.

Move the rear gearcase breather hose (Item 2) **[Figure 60-30-1]** out of the way.

Figure 60-30-2



Disconnect the hose (Item 1) **[Figure 60-30-2]** from the top of the control valve.

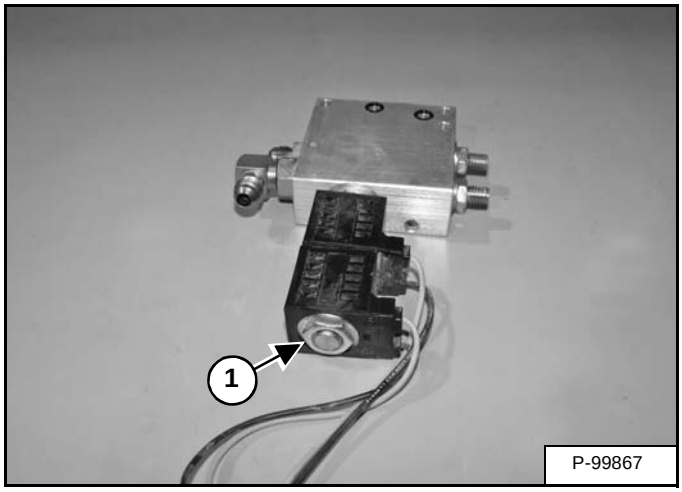
Disconnect the hose (Item 2) **[Figure 60-30-2]** from the side of the control valve.

NOTE: Mark all hoses and coils for proper location identification before removal.

AUXILIARY CONTROL VALVE (IF EQUIPPED) (CONT'D)

Disassembly And Assembly

Figure 60-40-5

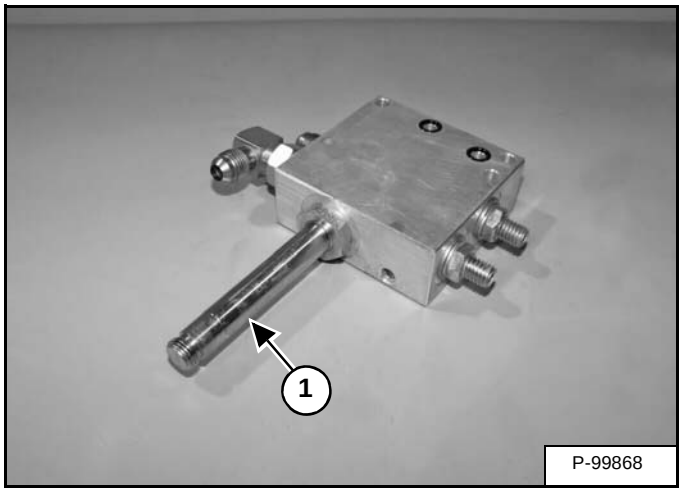


Remove the nut (Item 1) **[Figure 60-40-5]** from the solenoid coils. Remove the coils from the stems.

Installation: Tighten the nut to 3,9 - 4,5 N•m (35 - 40 in-lb) torque.

NOTE: Mark coils for correct orientation before removing from the stems.

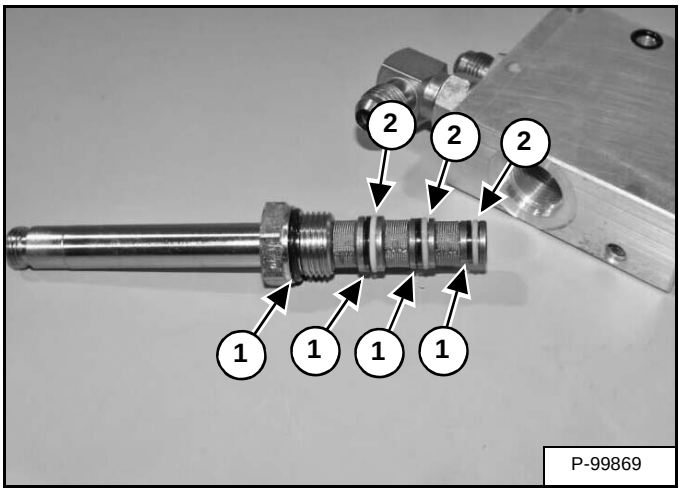
Figure 60-40-6



Remove the valve stem (Item 1) **[Figure 60-40-6]** from the auxiliary valve.

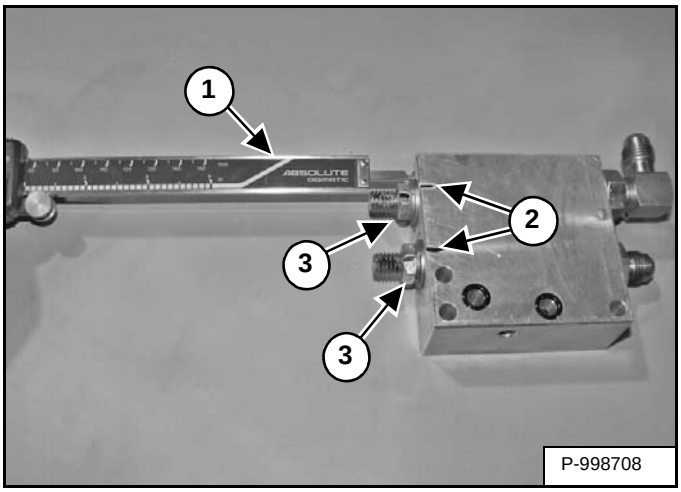
Installation: Tighten the valve stem to 16,4 - 17 N•m (145 - 165 in-lb) torque.

Figure 60-40-7



Remove the O-rings (Item 1) and back-up rings (Item 2) **[Figure 60-40-7]** from the valve stem.

Figure 60-40-8



Place a mark on each of the relief valve set screws for orientation. Measure the how far the relief valve stems (Item 1) protrude from the auxiliary valve with a caliper (Item 2) **[Figure 60-40-8]**.

Loosen the nuts (Item 3) **[Figure 60-40-8]** on the set screws.

Installation: Turn the relief valves in until the correct distance is achieved then tighten the nuts to 9 N•m (80 in-lb) torque.

Electrical

Alternator	55 Amp
Battery	12 volts, 540 CCA
Starter	12 volts, 1,2 kW (1.6 hp)
Instrumentation	**Warning lights (Red):** Parking Brake, Low Engine Oil Pressure, High Engine Temperature Light. **(Amber):** Glow Plug. **Indicator Lights (Orange):** Reverse (R). **Indicator Lights (Green):** Neutral (N). **Indicator Lights (White):** Low Gear (L) and High Gear (H). Hourmeter
Head Light	Low beam 2 x 35W / High Beam 2 x 35W
Tail Light	2 x incandescent

Drive System

Gearbox Ratio FWD - Low Gear	6.63:1
Gearbox Ratio FWD - High Gear	3.55:1
Gearbox Ratio Reverse	5.94:1
Final Drive ratio - Front	3.818
Final Drive ratio - Rear	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