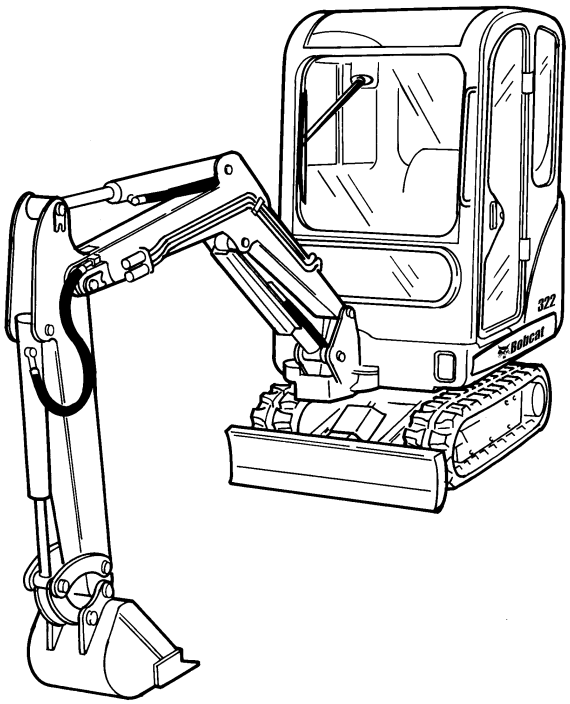
320
322

Bobcat®

Service Manual

320 - S/N 223911001 & Above
322 - S/N 224011001 & Above
(G Series)



6902668 (7-06) Printed in U.S.A.
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MAINTENANCE SAFETY

WARNING

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-2003-0903

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

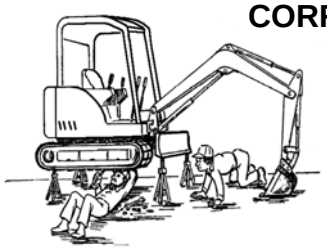
CORRECT



B-10731A

Never service the Bobcat Compact Excavator without instructions.

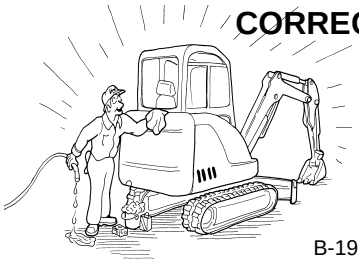
CORRECT



B-19964

Use the correct procedure to lift and support the excavator.

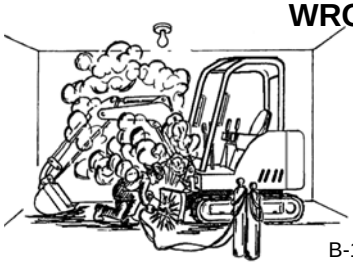
CORRECT



B-19959

Cleaning and maintenance are required daily.

WRONG



B-19965

Have good ventilation when welding or grinding painted parts.

Wear dust mask when grinding painted parts. Toxic dust and gas can be produced.

WRONG

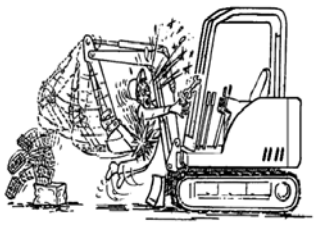


B-19960

Vent exhaust to outside when engine must be run for service.

Exhaust system must be tightly sealed. Exhaust fumes can kill without warning.

WRONG

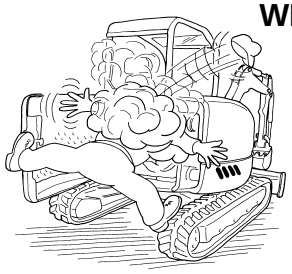


B-19966

Always lower the bucket and blade to the ground before doing any maintenance.

Never modify equipment or add attachments not approved by Bobcat Company.

WRONG



B-19962

Stop, cool and clean engine of flammable materials before checking fluids.

Never service or adjust machine with the engine running unless instructed to do so in the manual.

Avoid contact with leaking hydraulic fluid or diesel fuel under pressure. It can penetrate the skin or eyes.

Never fill fuel tank with engine running, while smoking, or when near open flame.

WRONG



B-19958

Keep body, jewelry and clothing away from moving parts, electrical contact, hot parts and exhaust.

Wear eye protection to guard from battery acid, compressed springs, fluids under pressure and flying debris when engines are running or tools are used. Use eye protections approved for type of welding.

Keep tailgate closed except for service. Close and latch tailgate before operating the excavator.

WRONG



B-19798

Lead-acid batteries produce flammable and explosive gases.

Keep arcs, sparks, flames and lighted tobacco away from batteries.

Batteries contain acid which burns eyes or skin on contact.

Wear protective clothing. If acid contacts body, flush well with water. For eye contact flush well and get immediate medical attention.

Maintenance procedures which are given in the Operation & Maintenance Manual can be performed by the owner/operator without any specific technical training. Maintenance procedures which are **not** in the Operation & Maintenance Manual must be performed **ONLY BY QUALIFIED BOBCAT SERVICE PERSONNEL. Always use genuine Bobcat replacement parts.** The Service Safety Training Course is available from your Bobcat dealer.

MSW28-0805


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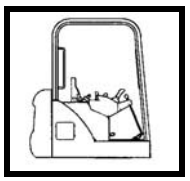

Bobcat®

FOREWORD

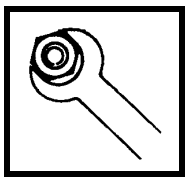
This manual is for the Bobcat Hydraulic Excavator mechanic. It provides necessary servicing and adjustment procedures for the hydraulic Excavator and its component parts and systems. Refer to the Operation & Maintenance Manual for operating instructions, starting procedure, daily checks, etc.

A general inspection of the following items must be made after the hydraulic Excavator has had service or repair:

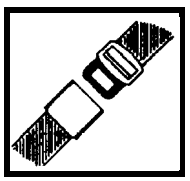
1. Check that ROPS/TOPS/ FOPS is in good condition and is NOT modified.



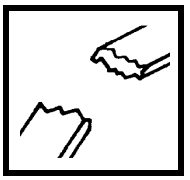
2. Check that ROPS/TOPS mounting hardware is tightened and is Bobcat approved.



3. The seat belt must be correctly installed, functional and in good condition.



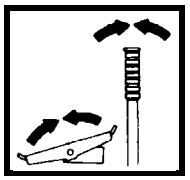
4. Inspect for loose or broken parts or connections.



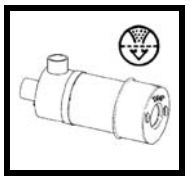
5. Machine signs must be legible and in the correct location.



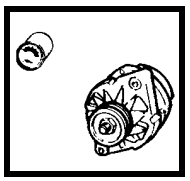
6. Steering levers, control levers and foot pedals must return to neutral. Check that foot pedals lock and control lever locks are in working order.



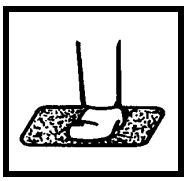
7. Inspect the air cleaner for damage or leaks. Check the condition of the filters.



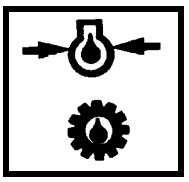
8. Check the electrical charging system.



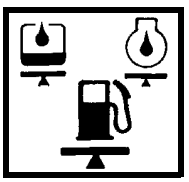
9. Safety treads must be in good condition.



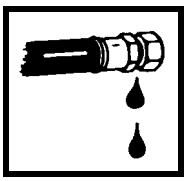
10. Check for correct function of indicator lamps (Optional on some models.



11. Check hydraulic fluid level, engine oil level and fuel supply.



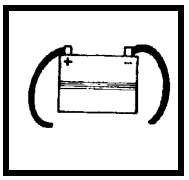
12. Inspect for fuel, oil or hydraulic fluid leaks.



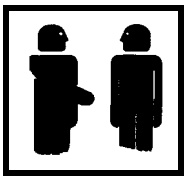
13. Lubricate the Excavator.



14. Check the condition of the battery and cables.



Recommend to the owner that all necessary corrections be made before the machine is returned to service.




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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

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-2003-0903

WARNING

Warnings on the machine and in the manuals are for your safety. Failure to obey warnings can cause injury or death.

W-2044-1285

IMPORTANT

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

I-2019-0284

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

- The Delivery Report is used to assure that complete instructions have been given to the new owner and that the machine is in safe operating condition.
- The Operation & Maintenance Manual delivered with the machine or attachment contains operating information as well as routine maintenance and service procedures. It is a part of the machine and can be stored in a container provided on the machine. Replacement Operation & Maintenance Manuals can be ordered from your Bobcat dealer.
- Machine signs (decals) instruct on the safe operation and care of your Bobcat machine 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 AEM Safety Manual delivered with the machine gives general safety information.
- The Service Manual and Parts Manual are available from your dealer for use by mechanics to do shop-type service and repair work.
- The Compact Excavator 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 Bobcat Excavator. The course is available in English and Spanish versions.
- Service Safety Training Courses are available from your Bobcat dealer or at **www.training.bobcat.com** or **www.bobcat.com**. They provide information for safe and correct service procedures.
- The Bobcat Compact Excavator Safety Video is available from your Bobcat dealer or at **www.training.bobcat.com** or **www.bobcat.com**.

The dealer and owner/operator review the recommended uses of the product when delivered. If the owner/operator will be using the machine for a different application(s) he or she must ask the dealer for recommendations on the new use.



Call Before You Dig

1-888-258-0808

When you call, you will be directed to a location in your state/city for information about buried lines (telephone, cable TV, water, sewer, gas, etc.)

SAFETY INSTRUCTIONS (CONT'D)

Fire Prevention

The machine and attachments have components that are at high temperature under normal operating conditions. The primary source of high temperatures is the engine and exhaust system. The electrical system, if damaged or incorrectly maintained, can be a source of arcs or sparks.

Flammable debris (leaves, straw, etc.) must be removed regularly. If flammable debris is allowed to accumulate, it will increase fire hazard. Clean often to avoid this accumulation. Flammable debris in the engine compartment is a potential hazard.

The spark arrestor muffler is designed to control the emission of hot particles from the engine and exhaust system, but the muffler and the exhaust gases are still hot.

- Do not use the machine where exhaust, arcs, sparks or hot components can contact flammable material, explosive dust or gases.

- The operator cab, engine compartment, and engine cooling system must be inspected every day and cleaned if necessary to prevent fire hazard and overheating.

- Check all electrical wiring and connections for damage. Keep the battery terminals clean and tight. Repair or replace any damaged part.

- Check fuel and hydraulic tubes, hoses and fittings for damage and leakage. Never use open flame or bare skin to check for leaks. Tighten or replace any parts that show leakage. Always clean fluid spills. Do not use gasoline or diesel fuel for cleaning parts. Use commercial nonflammable solvents.

- Do not use ether or starting fluids on any engine which has glow plugs. These starting aids can cause explosion and injure you or bystanders.

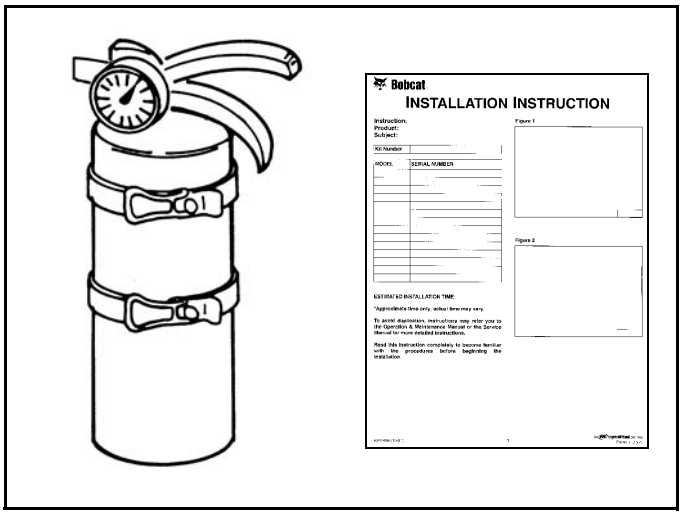
- Always clean the machine, disconnect the battery, and disconnect the wiring from the controllers before welding. Cover rubber hoses, battery and all other flammable parts. Keep a fire extinguisher near the machine when welding. Have good ventilation when grinding or welding painted parts. Wear a dust mask when grinding painted parts. Toxic dust or gas can be produced.

- Stop the engine and let it cool before adding fuel. NO SMOKING!

- Use the procedure in the Operation & Maintenance Manual for connecting the battery and for jump starting.

- Use the procedure in the Operation & Maintenance Manual for cleaning the spark arrestor muffler (if equipped).

Figure 1



- Know where fire extinguishers and first aid kits are located and how to use them. Fire extinguishers are available from your Bobcat dealer **[Figure 1]**.

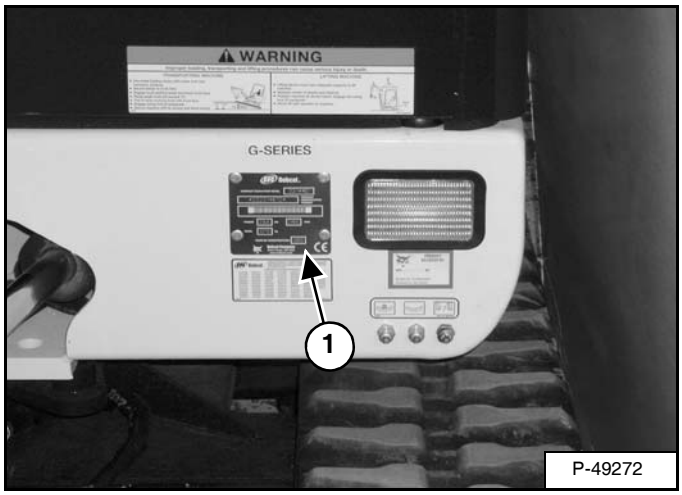

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SERIAL NUMBER LOCATIONS

Always use the serial number of the Excavator when requesting service information or when ordering parts. Early or later models (identification made by serial number) may use different parts, or it may be necessary to use a different procedure in doing a specific service operation.

Excavator Serial Number

Figure 1



The Excavator serial number plate (Item 1) is located on the frame of the machine in the location shown **[Figure 1]**.

Explanation of Excavator Serial Number:

XXXX XXXXX

- XXXXX — Module 2. - Production Sequence (Series)
- XXXX — Module 1. - Model / Engine Combination

1. The four digit Model/Engine Combination Module number identifies the model number and engine combination.

2. The five digit Production Sequence Number identifies the order which the Excavator is produced.

Engine Serial Number

Figure 2

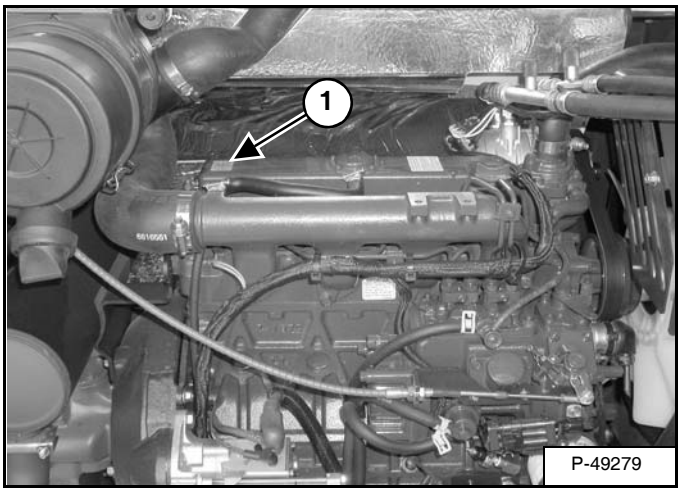
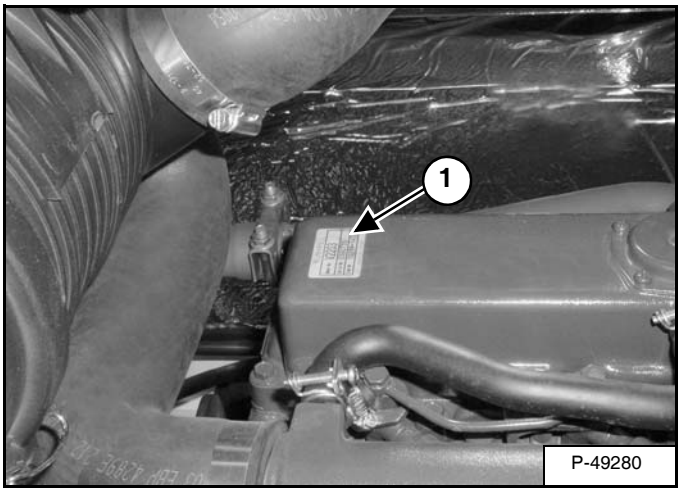


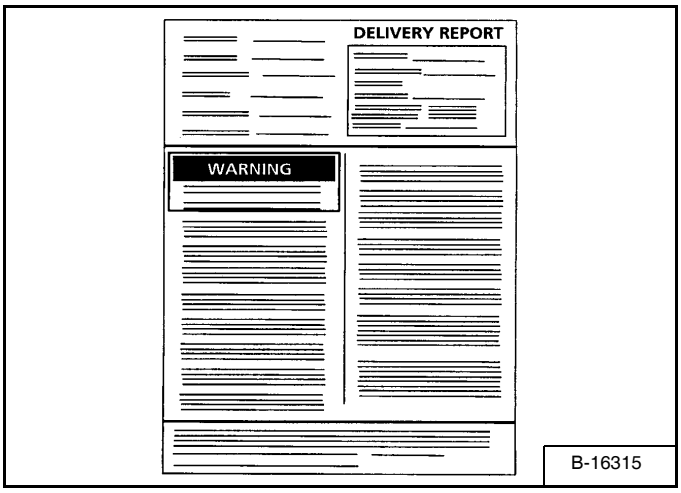
Figure 3



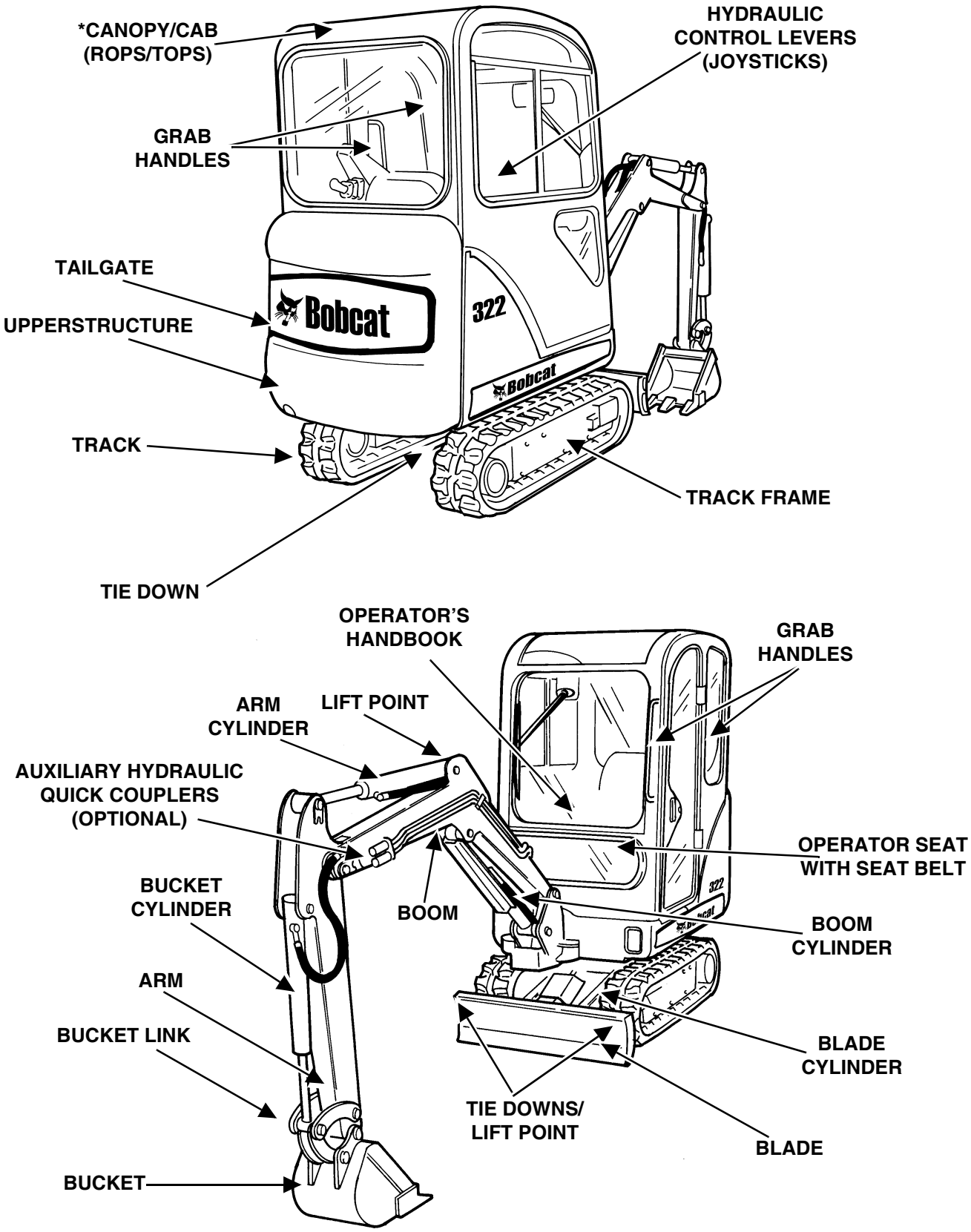
The engine serial number (Item 1) **[Figure 2]** & **[Figure 3]** is located on the engine in the locations shown.

DELIVERY REPORT

Figure 4



The delivery report must be filled out by the dealer and signed by the owner or operator when the Bobcat Excavator is delivered. An explanation of the form must be given to the owner. Make sure it is filled out completely **[Figure 4]**.



B-23067
B-23066

* FOGS (Falling Object Guards) is available from your Bobcat Excavator dealer.


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LIFTING AND BLOCKING THE EXCAVATOR

Procedure

Always park the machine on a level surface.

Figure 10-10-1



Raise one side of the machine (approximately 4 inches) using the boom and arm as shown in **[Figure 10-10-1]**.

Raise the blade fully and install jackstands under the blade and the track frame. Lower the machine until all machine weight is on the jackstands.

Stop the engine.

⚠ WARNING

Put jackstands under the blade and rear corners of the undercarriage before working under the machine. Failure to block up the machine may allow it to move or fall and result in injury or death

W-2218-1195

⚠ WARNING

AVOID INJURY OR DEATH

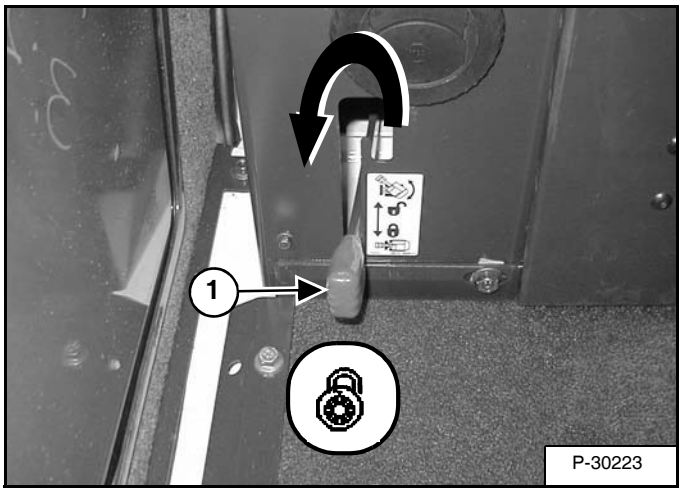
Keep fingers and hands out of pinch points when checking the track tension.

W-2142-0189


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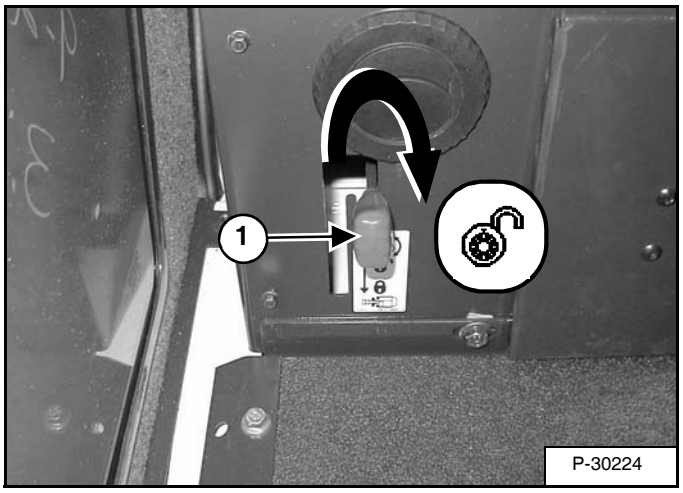
SWING LOCK

Figure 10-11-2



Move the lever (Item 1) **[Figure 10-11-2]** *down* to engage the Slew Lock. When the Slew Lock is engaged (locked), the upperstructure of the Excavator is locked to the track frame and will not rotate. The upper structure must be parallel to the track frame to engage the Slew Lock.

Figure 10-11-3



Move the lever (Item 1) **[Figure 10-11-3]** *up* to disengage the upperstructure from the track frame. Secure the lever in the unlocked position.

⚠ WARNING

AVOID INJURY

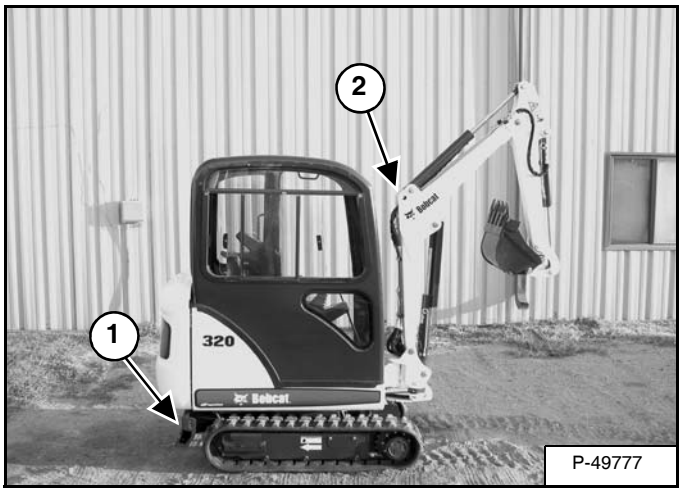
The slew lock lever must be engaged when transporting the machine.

W-2197-1203


Bobcat

LIFTING THE EXCAVATOR

Figure 10-12-4



Fully extend the cylinders of the bucket, arm, and boom so that the Excavator is in the position as shown **[Figure 10-12-4]**.

Engage the upperstructure slew lock. (See SWING LOCK on Page 10-11-1.)

Raise the blade all the way.

Put all the control levers in neutral.

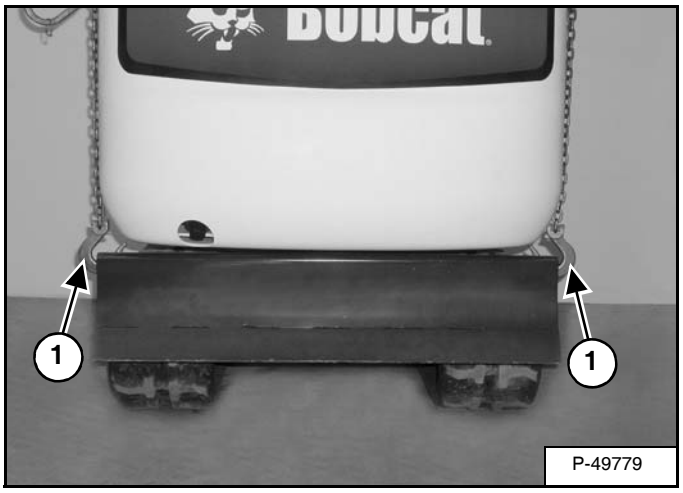
⚠ WARNING

AVOID INJURY OR DEATH

- **Use a lifting fixture with sufficient capacity for the weight of the Excavator plus any added attachments.**
- **Maintain center of gravity and balance when lifting.**
- **Do not swing boom or upperstructure. Engage the slew locking lever.**
- **Never lift with operator on machine.**

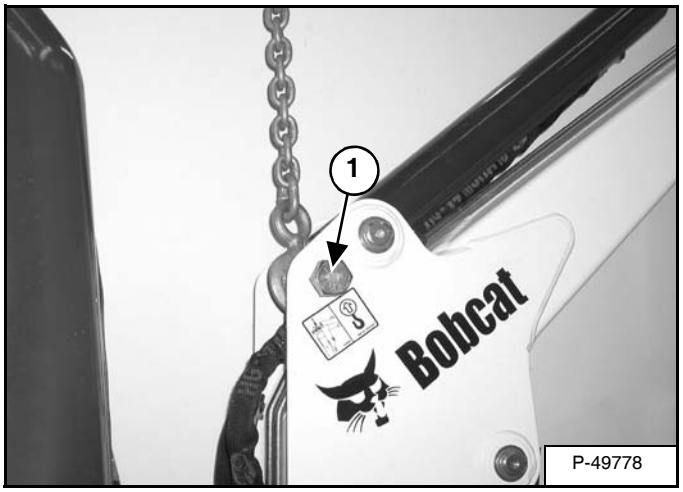
W-2202-0595

Figure 10-12-5



Fasten chains to the ends of the blade (Item 1) **[Figure 10-12-4]** and **[Figure 10-12-5]** and up to a lifting fixture above the canopy/cab. The lifting fixture must extend over the sides of the canopy/cab to prevent the chains from hitting the ROPS/TOPS.

Figure 10-12-6



Install a one inch (25 mm) bolt and nut (Grade 5 or 8) through the holes at the boom (Item 1) **[Figure 10-12-4]** and **[Figure 10-12-6]**. Fasten a chain from the bolt to the lift fixture.


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OPERATOR CAB ROPS/TOPS

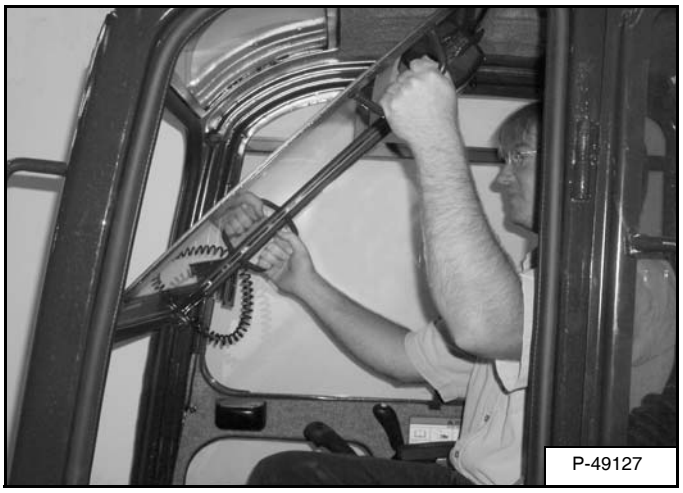
Emergency Exits

The left door, front window, and right side rear window provide exits.

Figure 10-20-7



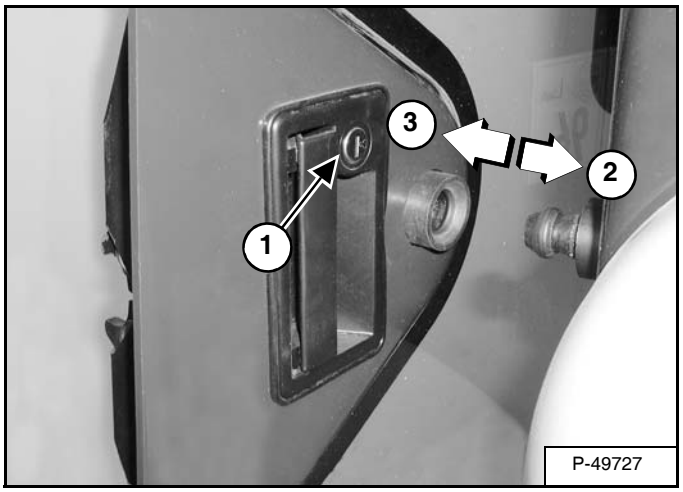
Figure 10-20-8



Slide the window to the front of the Excavator and exit through the side window **[Figure 10-20-7]**, or open the front window and exit **[Figure 10-20-8]**.

Cab Door

Figure 10-20-9



The cab door can be locked (Item 1) **[Figure 10-20-9]** with the same key as the starter switch.

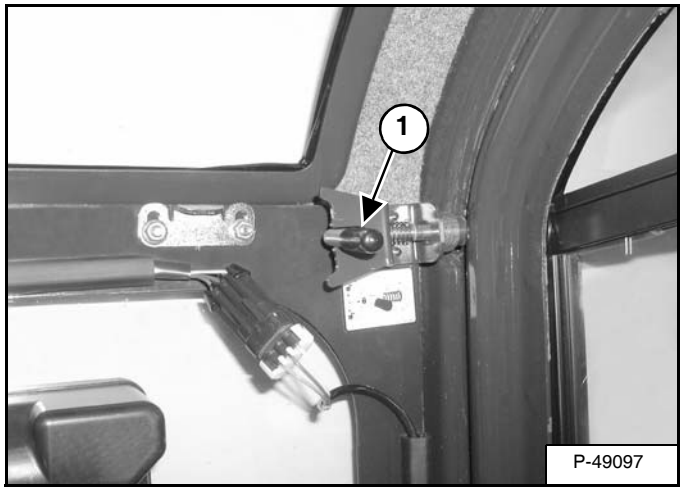
Push the door all the way open (Item 2) **[Figure 10-20-9]** until the latch engages to hold the door in the open position.

Pull the door away from the cab (Item 3) **[Figure 10-20-9]** to disengage the latch and close the door.

Front Window

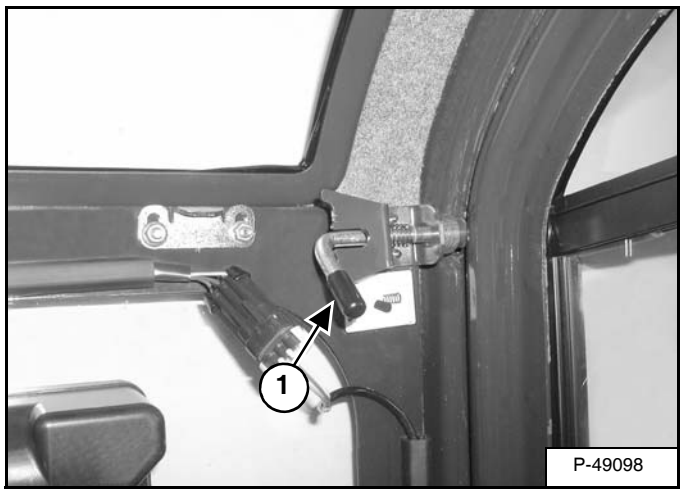
Opening The Front Window

Figure 10-20-10



Retract the two top window latch pins (Item 1) **[Figure 10-20-10]**.

Figure 10-20-11



Turn the two top latches (Item 1) **[Figure 10-20-11]** to the unlocked position.

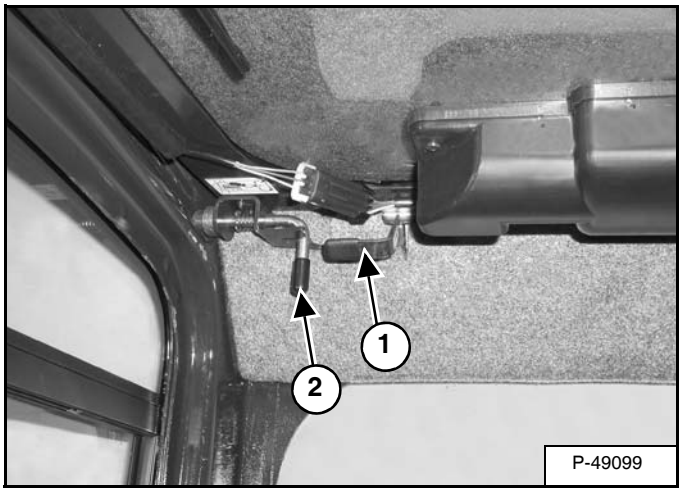
Figure 10-20-12



Use both window grab handles to pull the top of the window in **[Figure 10-20-12]**.

Continue moving the window in and up over the operator's head until the window is fully raised.

Figure 10-20-13



When the window is fully raised, the latch (Item 1) will close on the bracket. Turn the two top latches (Item 2) **[Figure 10-20-13]** to the locked position.

Closing The Front Window

Support the window while releasing both window latch pins and placing the pins in the unlocked position **[Figure 10-20-13 on Page 10-20-2]**.

Support the window using the left grab handle and pull down on the latch (Item 1) **[Figure 10-20-13 on Page 10-20-2]** to release the window.

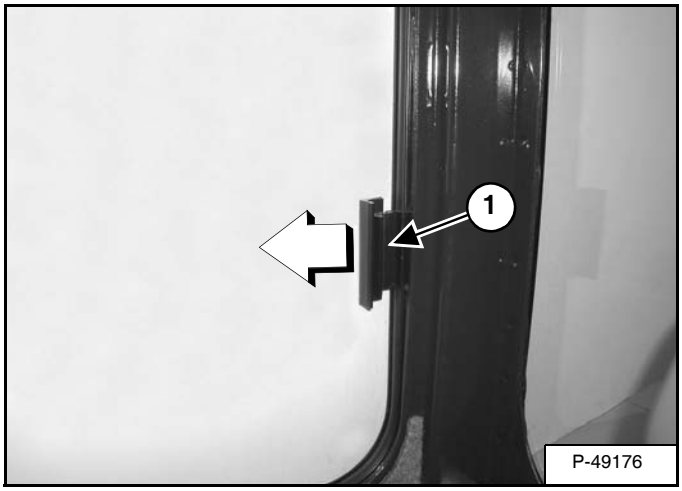
Use both window grab handles to pull the window down **[Figure 10-20-12 on Page 10-20-2]**.

Rotate the top latches (Item 1) **[Figure 10-20-11 on Page 10-20-2]** to the locked position (Item 1) **[Figure 10-20-10 on Page 10-20-2]**.

Right Side Windows

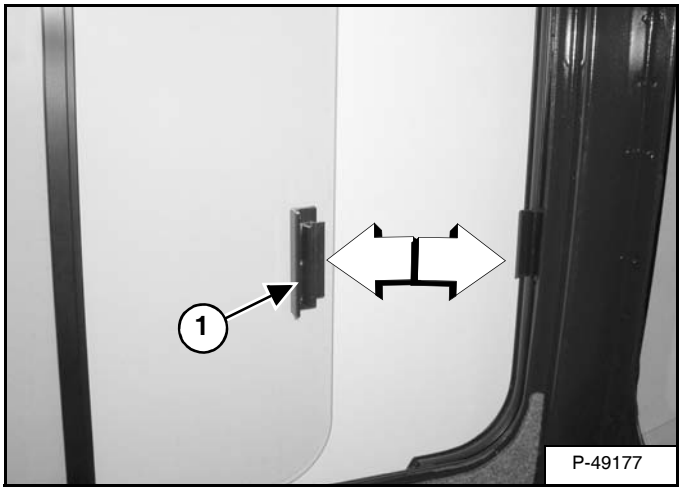
Opening the right rear window

Figure 10-20-14



Pull forward on the latch (Item 1) **[Figure 10-20-14]**.

Figure 10-20-15

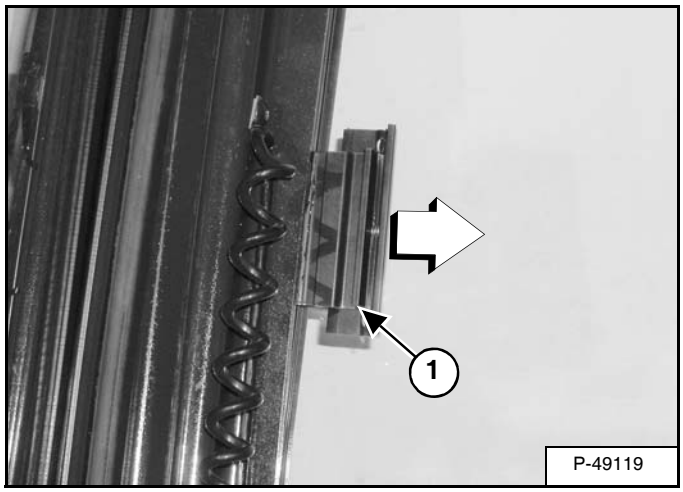


Pull the latch/handle (Item 1) **[Figure 10-20-15]** forward to open the window.

Push the handle back to close the window.

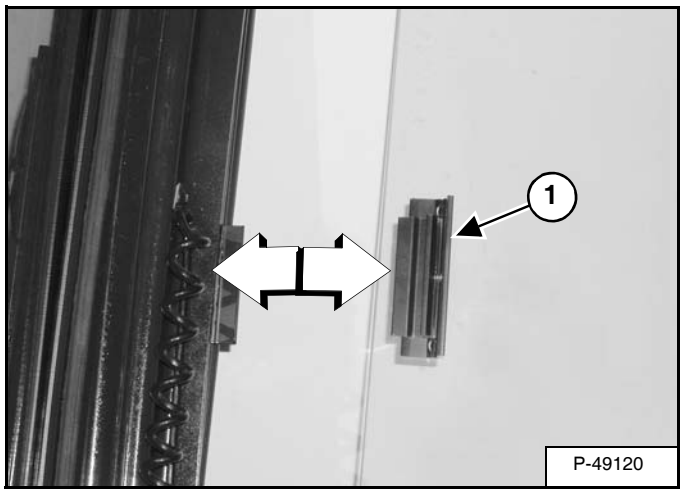
Opening the right front window

Figure 10-20-16



Pull back on the latch (Item 1) **[Figure 10-20-16]**.

Figure 10-20-17



Pull the latch/handle (Item 1) **[Figure 10-20-17]** back to open the window.

Push the handle forward to close the window.

TRANSPORTING THE EXCAVATOR

When transporting the machine, observe the rules, motor vehicle laws and vehicle limit ordinances. Use a transport and towing vehicle of adequate length and capacity.

Secure the parking brakes and block the wheels of the transport vehicle.

Remove the blade extensions (If equipped). See Blade Extension Removal And Installation. (See Extension Removal And Installation on Page 30-10-1)

Retract the track frame if required. See the correct Operation And Maintenance Manual for the proper procedure.

Align the ramps with the center of the transport vehicle. Secure the ramps to the truck bed and be sure ramp angle does not exceed 15 degrees.

Use metal loading ramps with a slip resistant surface that are the correct length and width, and can support the weight of the machine.

The rear of the trailer must be blocked or supported when loading or unloading the Excavator to prevent the front of the transport vehicle from raising.

Determine the direction of the track movement before moving the machine (blade forward). Engage the slew lock . (See SWING LOCK on Page 10-11-1.)

Figure 10-30-18



Move the machine forward onto the transport vehicle **[Figure 10-30-18]**.

Do not change direction of the machine while it is on the ramps. Lower the boom, arm, and bucket to the transport vehicle.

Stop the engine and remove the key. Put blocks under the front and rear of the tracks.

Figure 10-30-19



Figure 10-30-20



Fasten chains to the front corners of the blade and to the tie down loop at the rear **[Figure 10-30-19]** & **[Figure 10-30-20]** to prevent it from moving when going up or down slopes, or during sudden stops.

Use chain binders to tighten the chains and then safely tie the chain binder levers to prevent loosening.

⚠ WARNING

Adequately designed ramps of sufficient strength are needed to support the weight of the machine when loading onto a transport vehicle. Wood ramps can break and cause personal injury.

W-2058-0494


Bobcat®

TAILGATE

Opening And Closing The Tailgate

⚠ WARNING

AVOID INJURY OR DEATH

Never service or adjust the machine when the engine is running unless instructed to do so in the manual.

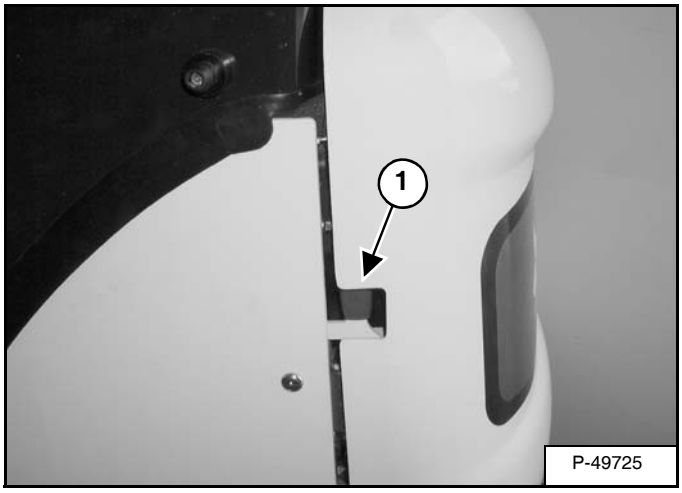
W-2012-0497

⚠ WARNING

Keep the rear door closed when operating the machine. Failure to do so could seriously injure a bystander.

W-2020-1285

Figure 10-40-1



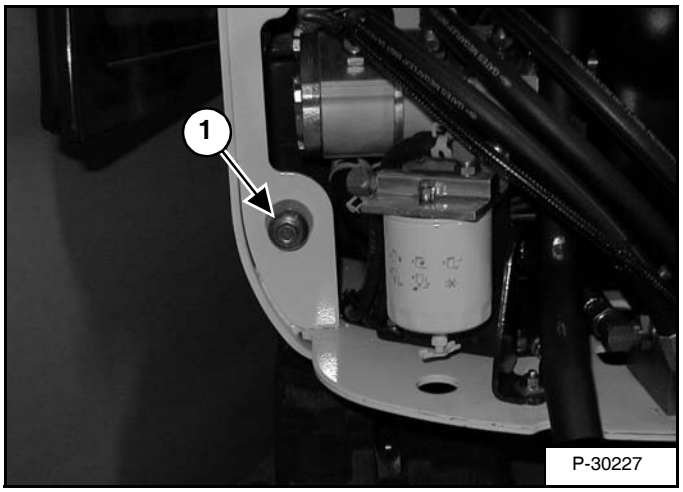
Release the latch (Item 1) **[Figure 10-40-1]** and pull the tailgate open.

Push firmly to close the tailgate.

Note: The tailgate can be locked using the start key.

Adjusting The Bumper

Figure 10-40-2

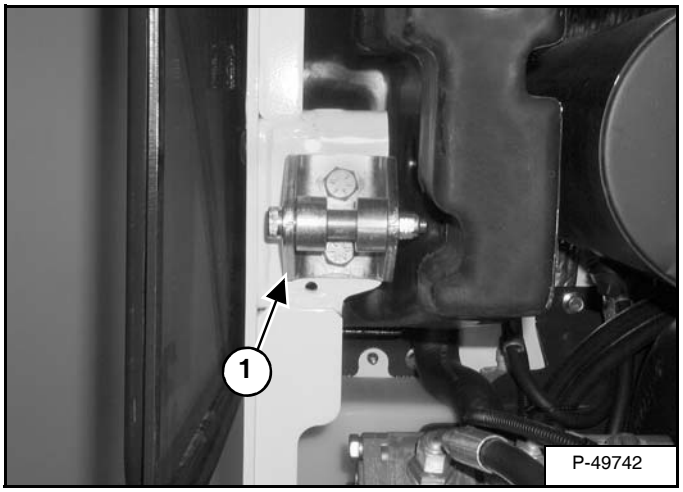


The door bumper (Item 1) **[Figure 10-40-2]** can be adjusted for alignment with the tailgate.

Close the tailgate before operating the Excavator.

Adjusting The Tailgate Latch

Figure 10-40-3



The door catch (Item 1) **[Figure 10-40-3]** can be adjusted by loosening the two bolts, moving the catch, and tightening the two bolts.

Close the tailgate before operating the Excavator.


Bobcat®

SERVICE SCHEDULE

Chart

Maintenance work must be done at regular intervals. Failure to do so will result in excessive wear and early failures. The service schedule is a guide for correct maintenance of the Bobcat Excavator.

⚠ WARNING

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-2003-0903

SERVICE SCHEDULE		HOURS					
ITEM	SERVICE REQUIRED	8-10	50	100	250	500	■ 1000
Engine Coolant	Check coolant level. Add premixed coolant as needed.						
Engine Oil	Check the engine oil level and add as needed.						
Hydraulic Fluid, Hoses and Tubelines	Check the hydraulic fluid level and add as needed. Check for damage and leaks. Repair or replace as needed.						
Engine Air Filter and Air System	Check condition indicator and empty dust cup as needed. Check air system for leaks.						
Tracks	Check and adjust track tension as needed.						
Indicators and Lights	Check for correct operation of all indicators and lights.						
Control Console Lockout	Check for proper function. Repair or replace as needed.						
Operator Canopy/Cab	Check condition. Check mounting hardware.						
Seat Belt	Check condition. Check mounting hardware.						
Safety Signs and Safety Treads	Check for damaged signs (decals) and safety treads. Replace any signs or safety treads that are damaged or worn.						
Pivot Points	Grease all machinery pivot points.						
Cab Heater Air Filter (Option)	Clean the filter as needed.						
Swing Circle and Pinion	Grease three fittings.						
Fuel Tank & Filter	Drain water and sediment from fuel tank and fuel filter.						
Battery	Check battery, cables, connections and electrolyte level. Add distilled water as needed.						
Engine Oil and Filter	Replace oil & filter. Use CD or better grade oil and Bobcat filter.		•				
Alternator / Fan Belt	Check condition of belt and adjust as needed.		•				
Spark Arrestor Muffler	Clean the spark chamber.						
Fuel Filter	Replace fuel filter.						
Travel Motor	Check lubricant level in both travel motors.			••			
Radiator, & Oil Cooler	Clean debris from the radiator fins.						
Hydraulic Filter	Replace the filter.			••			
Engine Air Cleaner	Replace the air cleaner filter.						
Alternator & Starter	Check the alternator and starter connections.			••			
Engine Valves	Check and adjust the engine valve clearance.						
Case Drain Filter	Replace the filter.						
Travel Motor	Replace lubricant in both travel motors.						
Engine Cooling System	Drain and flush the cooling system. Replace premixed coolant.						
Hydraulic System	Replace the hydraulic fluid and filters. Clean the reservoir.			••			

- **• Also at first 50 hours**
- **•• Also at *first* 100 Hours**
- **■ Or every 6 months.**

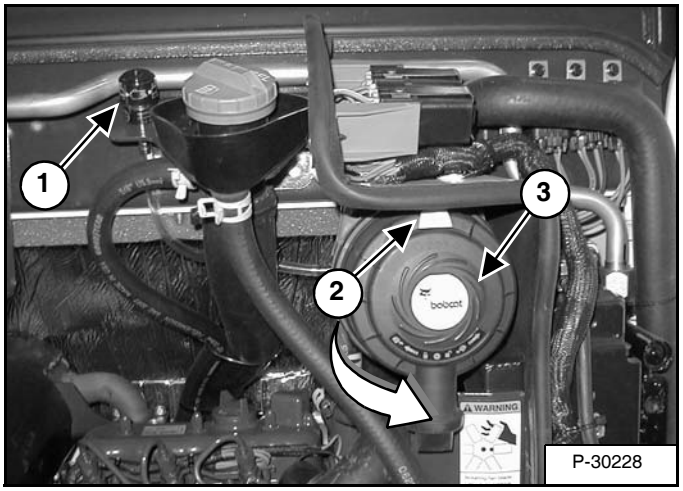

Bobcat®

AIR CLEANER SERVICE

See the SERVICE SCHEDULE for the correct service interval. (See SERVICE SCHEDULE on Page 10-50-1.)

Daily Check

Figure 10-60-4



Check the condition indicator (Item 1) **[Figure 10-60-4]**. If the red ring shows in the condition indicator, the filter needs to be replaced.

Replace the inner filter every third time the outer filter is replaced or as indicated.

Replacing The Filters

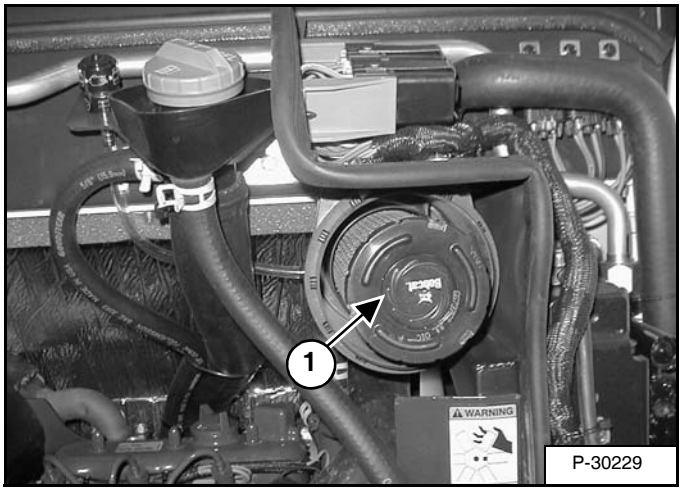
Outer Filter

Pull the locking tab (Item 2) **[Figure 10-60-4]**.

Turn the dust cup (Item 3) **[Figure 10-60-4]** counter-clockwise about 1/8 turn.

Remove and clean the dust cup.

Figure 10-60-5



Pull the outer filter (Item 1) **[Figure 10-60-5]** from the air cleaner housing.

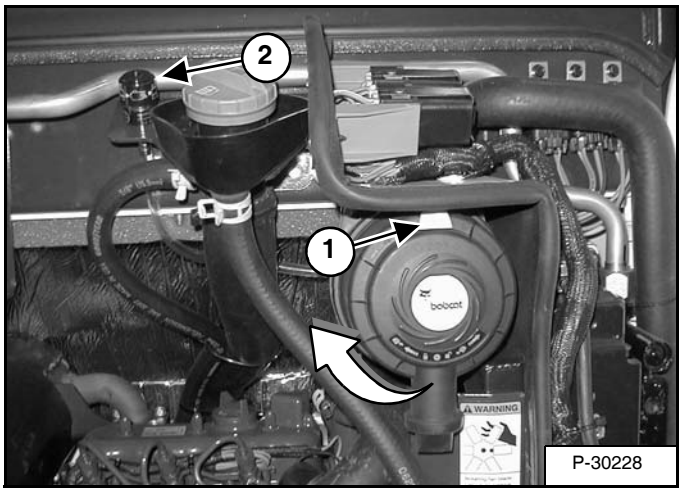
Check the housing for damage.

Clean the housing and the seal surface. DO NOT use compressed air.

Install a new outer filter.

Replacing The Filters (Cont'd)

Figure 10-60-6



Install the dust cup and turn about 1/8 turn **[Figure 10-60-6]**.

Push locking tab in (Item 1) **[Figure 10-60-6]**.

Check the air intake hose and the air cleaner housing for damage. Make sure all connections are tight.

Inner Filter

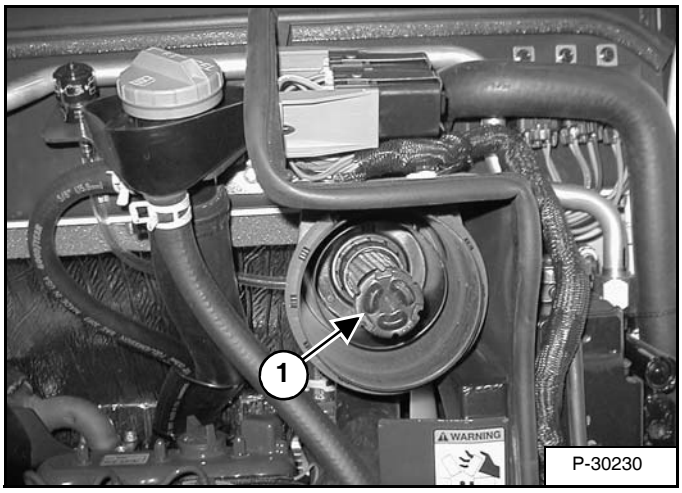
Only replace the inner filter under the following conditions:

- Replace the inner filter every *third* time the outer filter is replaced.
- After the outer filter has been replaced, press the button (Item 2) **[Figure 10-60-6]** on the top of the condition indicator and start the engine. Run at full RPM, then reduce engine speed and stop the engine. If the red ring shows in the condition indicator, replace the inner filter.

Remove the dust cup, outer filter and inner filter.

NOTE: Make sure all sealing surfaces are free of dirt and debris.

Figure PM-7



Install the new inner filter. **[Figure PM-7]**.

Install the outer filter and the dust cup.

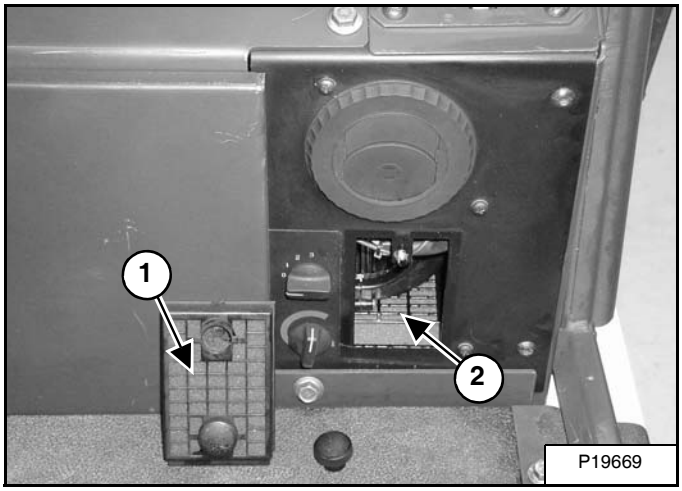
Press the button on the condition indicator to remove the red ring.

HEATER AIR FILTERS

Recirculation Filter

The recirculation filter must be cleaned regularly. The filter is located at the left of the operator seat.

Figure 10-61-8



The recirculation filter is located on the front of the heater panel (Item 1) **[Figure 10-61-8]**.

Remove the knobs and remove the filter. Wash the filter with a mild detergent and water. Dry the filter before installing. Install the filter and tighten knobs.

Fresh Air Filter

The fresh air filter must be cleaned regularly.

The fresh air filter is located on the bottom of the heater, (Item 2) **[Figure 10-61-8]**.

Remove the filter. Wash the filter with a mild detergent and water. Dry the filter before installing. Install the filter and secure.


Bobcat®

ENGINE COOLING SYSTEM

Check the cooling system every day to prevent overheating, loss of performance or engine damage.

Cleaning The Cooling System

Open the tailgate.

Use air pressure or water pressure to clean the radiator and oil cooler.

Checking Coolant Level

⚠ WARNING

AVOID BURNS

Do not remove radiator cap when the engine is hot. You can be seriously burned.

W-2070-1003

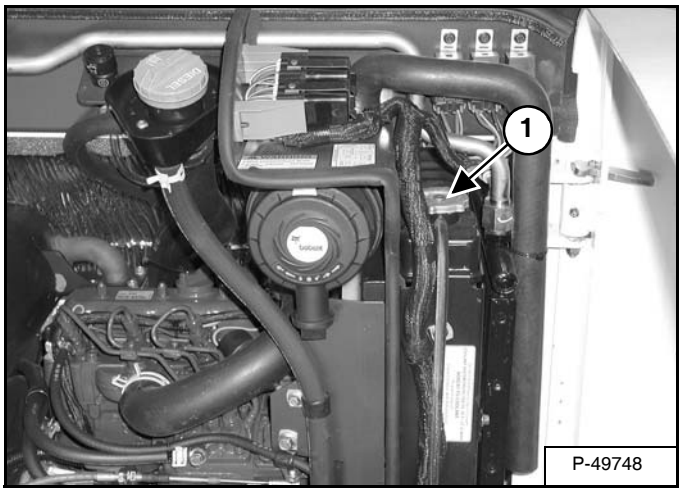
⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- **When fluids are under pressure.**
- **Flying debris or loose material is present.**
- **Engine is running.**
- **Tools are being used.**

W-2019-1285

Figure 10-70-9



When the engine is cool, remove the radiator cap (Item 1) **[Figure 10-70-9]**.

The coolant level must be 0.750 to 1.0 inch (20 - 25 mm) below the filler neck.

If the coolant level is low, add premixed coolant to the radiator.

IMPORTANT

AVOID ENGINE DAMAGE

Always use the correct ratio of water to antifreeze.

Too much antifreeze reduces cooling system efficiency and may cause serious premature engine damage.

Too little antifreeze reduces the additives which protect the internal engine components; reduces the boiling point and freeze protection of the system.

Always add a premixed solution. Adding full strength concentrated coolant can cause serious premature engine damage.

I-2124-0497

Replacing The Coolant

See the SERVICE SCHEDULE for correct service intervals. (See SERVICE SCHEDULE on Page 10-50-1.)

Turn the upperstructure so there is access to the engine and radiator from between the tracks. Stop the engine.

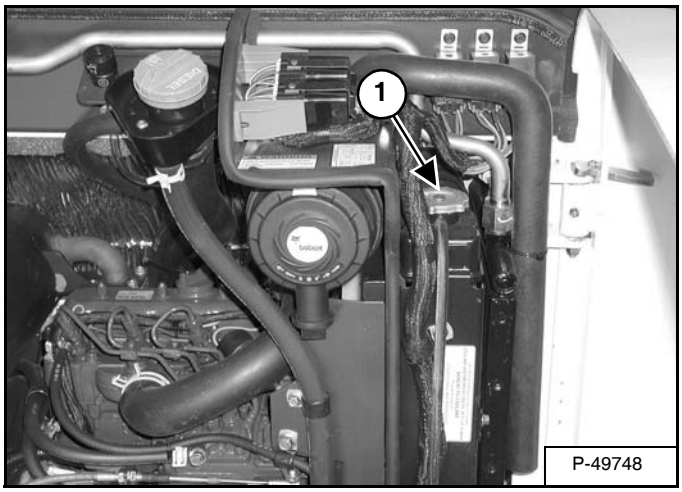
⚠ WARNING

AVOID BURNS

Do not remove radiator cap when the engine is hot. You can be seriously burned.

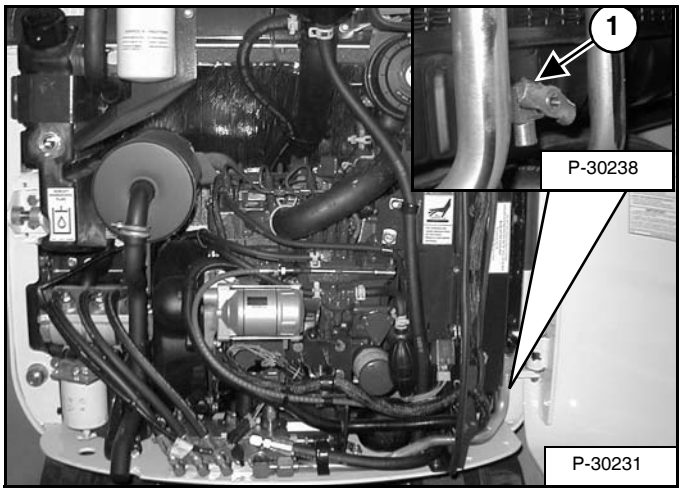
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Figure 10-70-10



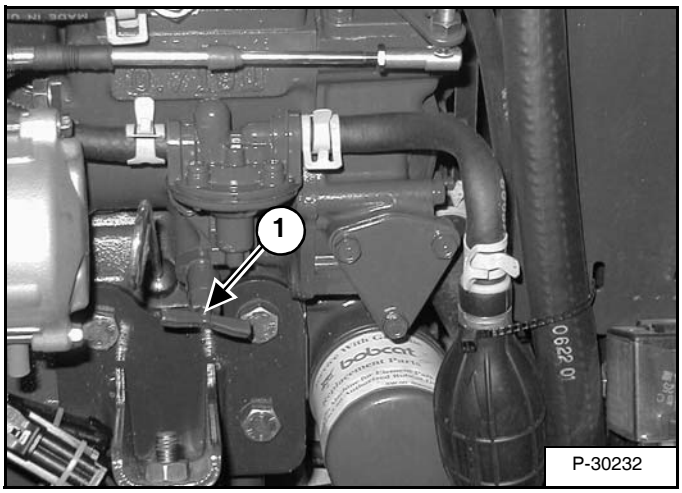
When the engine is cool, loosen and remove the radiator cap (Item 1) **[Figure 10-70-10]**.

Figure PM-11



Open the drain valve (Item 1) **[Figure PM-11]** at the bottom of the radiator and drain the coolant into a container.

Figure 10-70-12



Open the drain valve (Item 1) **[Figure 10-70-12]** on the engine block and drain the coolant into a container.

After all the coolant is removed, close the drain valve.

Recycle or dispose of the used coolant in an environmentally safe manner.

Mix the coolant in a separate container. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-60-1.)

NOTE: The cooling system is factory filled with propylene glycol (purple color). DO NOT mix propylene glycol with ethylene glycol.

Replacing The Coolant (Cont'd)

Add premixed coolant; 47% water and 53% propylene glycol to the recovery tank if the coolant level is low.

One gallon and one pint of propylene glycol mixed with one gallon of water is the correct mixture of coolant to provide a -34°F (-37°C) freeze protection.

IMPORTANT

AVOID ENGINE DAMAGE

Always use the correct ratio of water to antifreeze.

Too much antifreeze reduces cooling system efficiency and may cause serious premature engine damage.

Too little antifreeze reduces the additives which protect the internal engine components; reduces the boiling point and freeze protection of the system.

Always add a premixed solution. Adding full strength concentrated coolant can cause serious premature engine damage.

I-2124-0497

Use a refractometer to check the condition of propylene glycol in your cooling system.

Add premixed coolant until the level is correct.

Run the engine until it is at operating temperature. Stop the engine. Check the coolant level and add as needed. Install the radiator cap and tighten.

Add coolant to the recovery tank as needed.

Close the tailgate.


Bobcat®

FUEL SYSTEM

Fuel Specifications

Use only clean, high quality diesel fuel, Grade No. 2 or Grade No. 1.

The following is a suggested blending guideline which should prevent fuel gelling problems during freezing temperature

Temp. F° (C°)	No. 2	No. 1
+15° (9°)	100%	0%
Down to -20° (-29°)	50%	50%
Below -20° (-29°)	0%	100%

See your fuel supplier for local recommendations.

⚠ WARNING

Stop and cool the engine before adding fuel. NO SMOKING! Failure to obey warnings can cause an explosion or fire.

W-2063-0887

⚠ WARNING

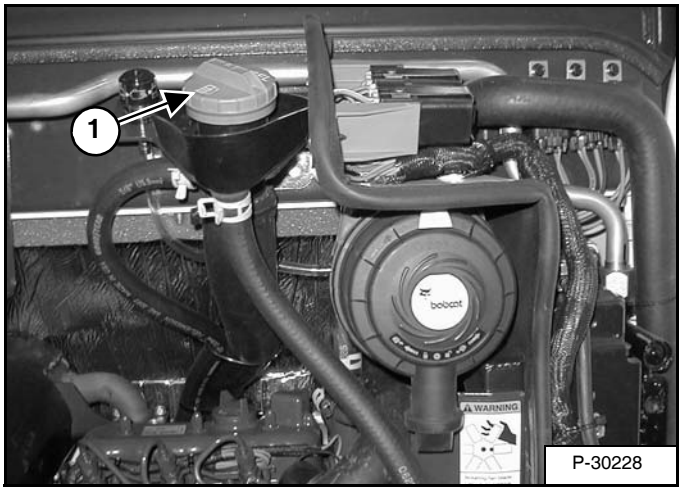
Always clean up spilled fuel or oil. Keep heat, flames, sparks or lighted tobacco away from fuel and oil. Failure to use care around combustibles can cause explosion or fire which can result in injury or death.

W-2103-1285

Filling The Fuel Tank

Open the tailgate.

Figure 10-80-1



Remove the fuel fill cap (Item 1) **[Figure 10-80-1]**.

Use a clean, approved safety container to add fuel. Add fuel only in an area that has a free movement of air and no flames or sparks. **NO SMOKING!**

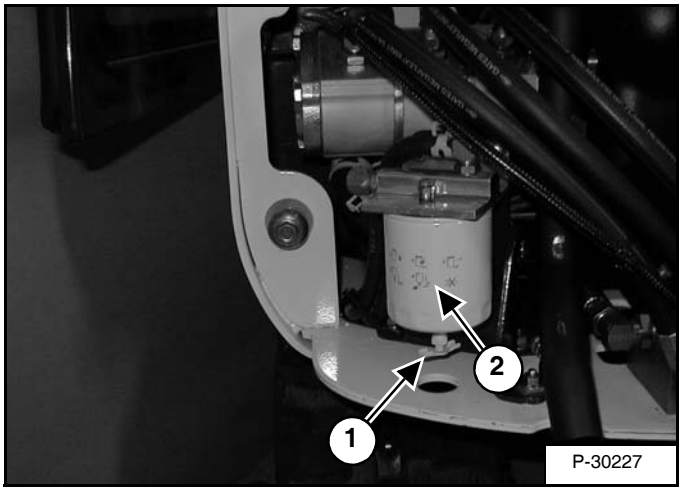
Install and tighten the fuel fill cap. Close the tailgate.

See the SERVICE SCHEDULE for the service interval when to remove water from or replace the fuel filter. (See SERVICE SCHEDULE on Page 10-50-1.)

Removing Water From The Fuel Filter

Open the tailgate.

Figure 10-80-2



Loosen the drain (Item 1) **[Figure 10-80-2]** at the bottom of the filter to drain water from the filter.

Replacing The Fuel Filter

Remove the filter (Item 2) **[Figure 10-80-2]**.

Clean the area around the filter housing. Put clean oil on the seal of the new filter. Install the fuel filter and hand tighten.

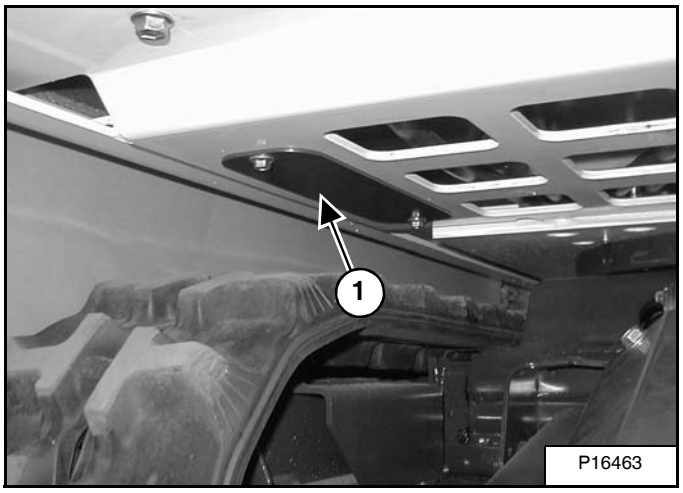
Remove the air from the fuel system. See Removing Water From The Fuel Filter on Page 10-80-2

Draining The Fuel Tank

See the SERVICE SCHEDULE for the correct service interval. (See SERVICE SCHEDULE on Page 10-50-1.)

Turn the upperstructure until the fuel tank drain is centered between the rear tracks.

Figure 10-80-3



Remove the access panel (Item 1) **[Figure 10-80-3]** on the bottom of the engine compartment. Loosen the clamp and disconnect the fuel hose.

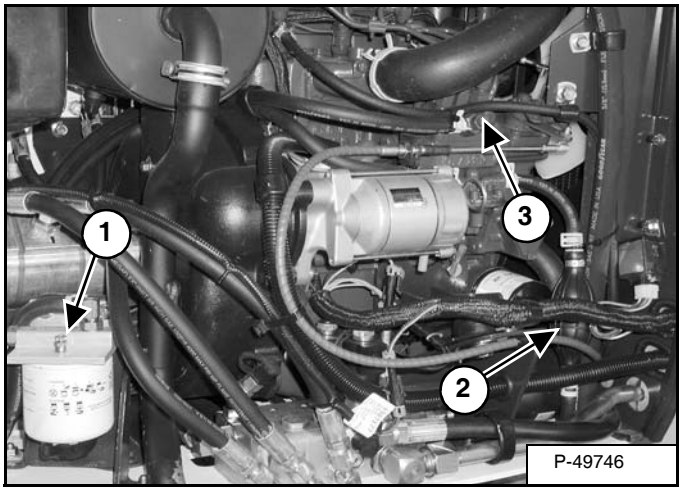
Drain the fuel into a container.

Reuse, recycle or dispose of fuel in an environmentally safe manner.

Removing Air From The Fuel System

After replacing the fuel filter or when the fuel tank has run out of fuel, air must be removed from the fuel system before starting the engine.

Figure 10-80-4



Open the fuel filter vent (Item 1) **[Figure 10-80-4]**.

Operate the hand pump (priming bulb) (Item 2) **[Figure 10-80-4]** until the fuel flows from the vent with no air bubbles.

Close the vent (Item 1) **[Figure 10-80-4]** on the fuel filter housing.

Start the engine. It may be necessary to open the vent (Item 3) **[Figure 10-80-4]** (at the fuel injection pump) briefly until the engine runs smoothly.

⚠ WARNING

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-2072-0496

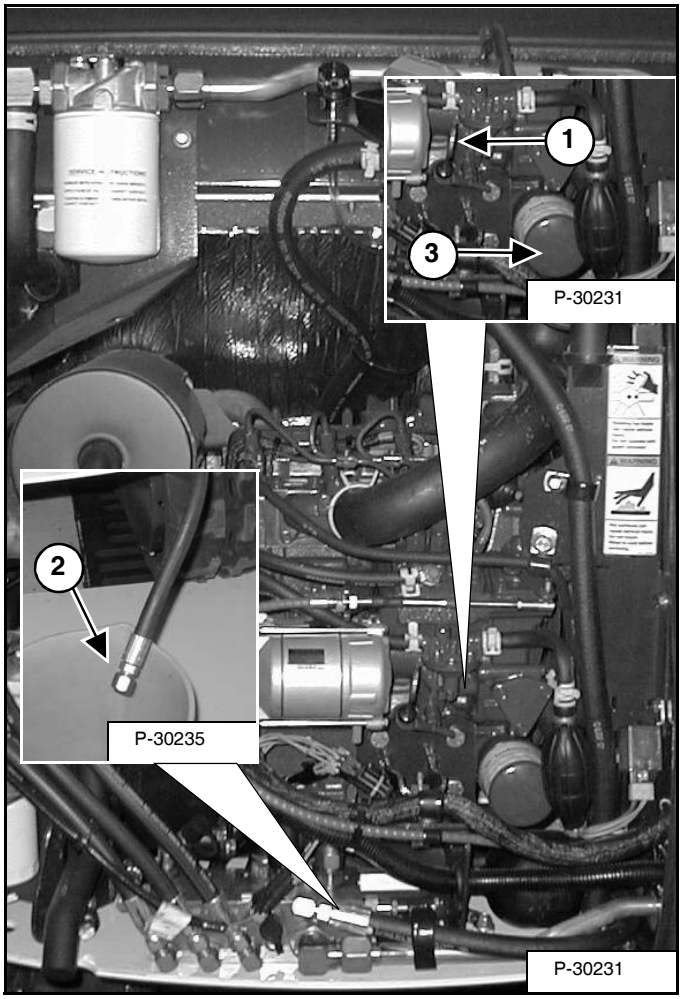

Bobcat®

ENGINE LUBRICATION SYSTEM

Checking Engine Oil

Check the engine oil every day before starting the engine for the work shift.

Figure 10-90-5

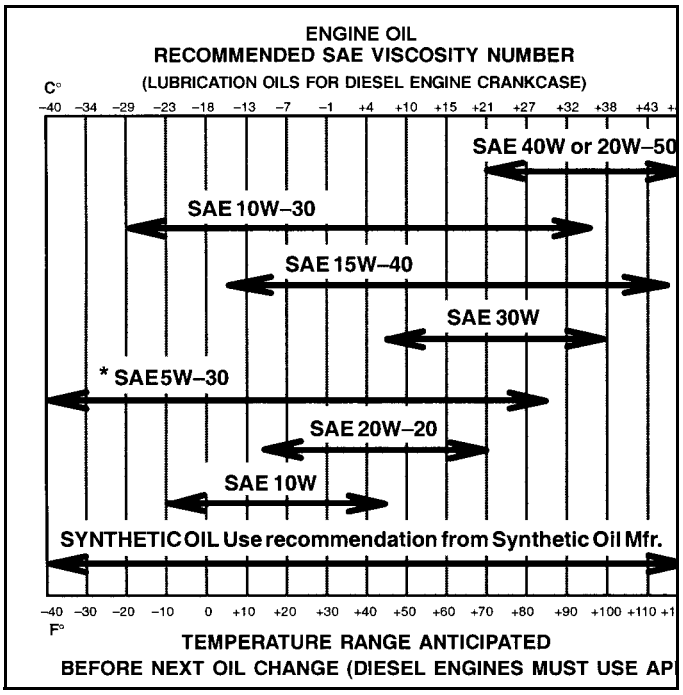


Open the rear door and remove the dipstick (Item 1) **[Figure 10-90-5]**.

Keep the oil level between the marks on the dipstick.

Oil Chart

Figure 10-90-6



Use a good quality motor oil that meets the correct API Service Classification. See the oil chart **[Figure 10-90-6]**.

Replacing Oil And Filter

See the SERVICE SCHEDULE for the service interval for replacing the engine oil and filter. (See SERVICE SCHEDULE on Page 10-50-1.)

Run the engine until it is at operating temperature. Stop the engine.

Open the rear door.

Remove the drain plug (Item 2) **[Figure 10-90-5 on Page 1]**. Drain the oil into a container and recycle or dispose of used oil in an environmentally safe manner.

Remove the oil filter element (Item 3) **[Figure 10-90-5 on Page 1]** and clean the filter housing surface.

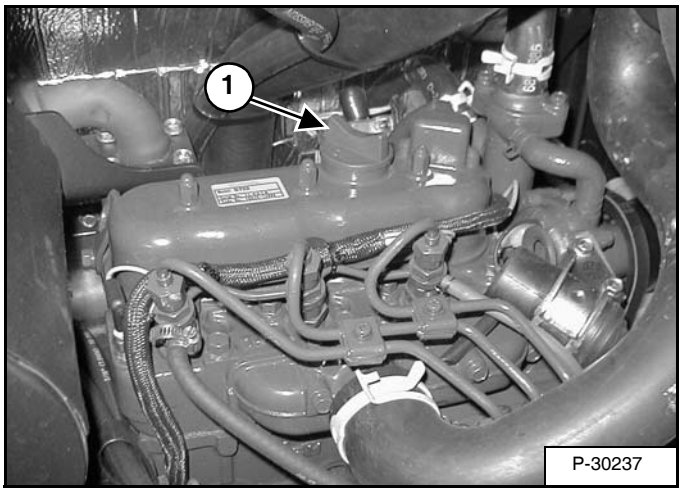
Use a genuine Bobcat filter element.

Put clean oil on the filter gasket.

Install the filter and hand tighten.

Install and tighten the oil drain plug.

Figure 10-90-7



Remove the fill cap (Item 1) **[Figure 10-90-7]**.

Put in 3.4 qts. (3,2 L) of oil into the engine. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-60-1.)

Install the fill cap.

Start the engine and let it run for several minutes.

Stop the engine. Check for leaks at the oil filter. Check the oil level.

Add oil as needed if it is not at the top mark on the dipstick.

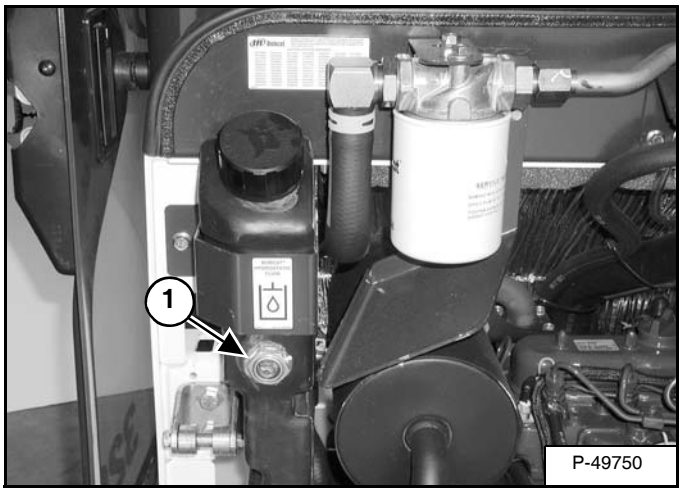
HYDRAULIC SYSTEM

Checking And Adding Hydraulic Oil

Put the machine on a level surface.

Retract the arm and bucket cylinders, put the bucket on the ground and raise the blade. Stop the engine.

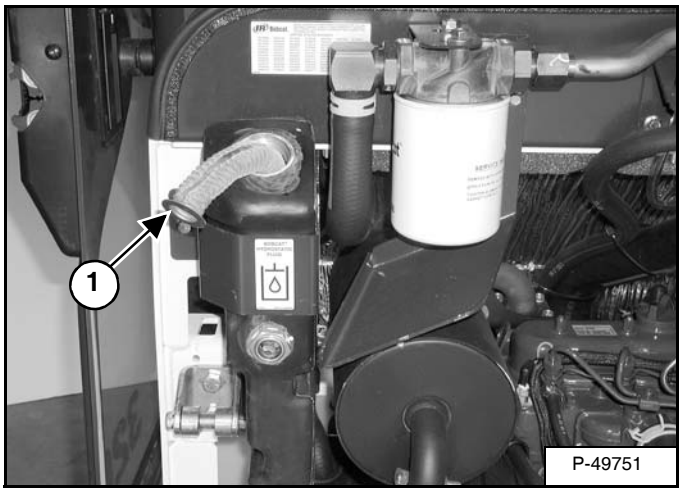
Figure 10-100-8



Open the tailgate. The fluid must be at the center of the sight gauge (Item 1) **[Figure 10-100-8]**.

Remove oil fill cap (Item 2) **[Figure 10-100-8]**.

Figure 10-100-9



Check the condition of the screen (Item 1) **[Figure 10-100-9]** in the fill neck of the reservoir. The screen must be installed in fill neck when adding oil.

Add the correct fluid to the reservoir until it is at the center of the sight gauge (Item 1) **[Figure 10-100-8]**. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-60-1.)

Install the cap. Close the tailgate.

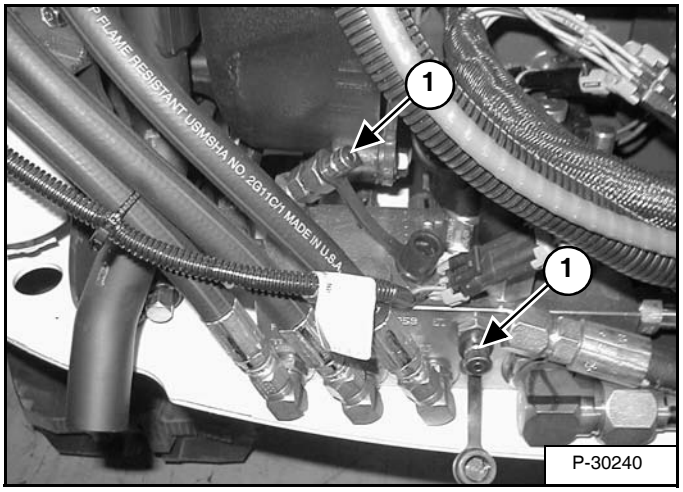
⚠ WARNING

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 which can result in injury or death.

W-2103-1285

Diagnostic Couplers

Figure 10-100-10



The diagnostic couplers (Item 1) **[Figure 10-100-10]** are located on the hydraulic block.

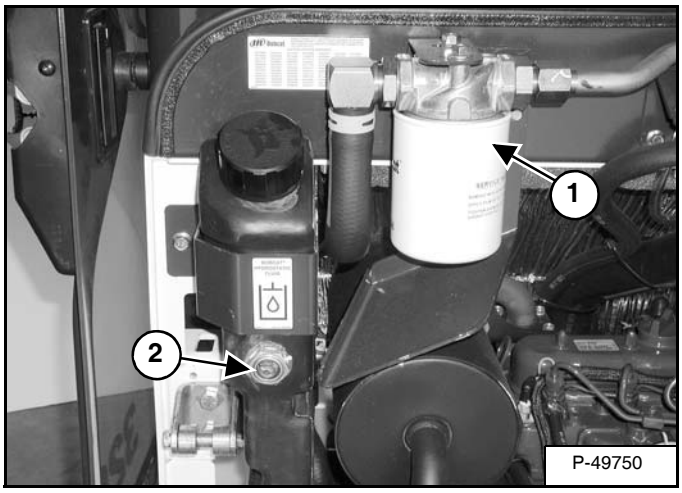
The couplers can be used by your Bobcat dealer to check circuit pressures.

Replacing The Hydraulic Filter

See the SERVICE SCHEDULE for the correct service interval. (See SERVICE SCHEDULE on Page 10-50-1.)

Open the tailgate.

Figure 10-100-11



Remove the filter (Item 1) **[Figure 10-100-11]**.

Clean the housing where the filter gasket makes contact.

Put clean hydraulic fluid on the gasket. Install the new filter and hand tighten only.

Start the engine. Run the Excavator through the hydraulic functions. Stop the engine. Check the fluid level at the sight gauge (Item 2) **[Figure 10-100-11]** and add as needed. Check the filter area for leaks.

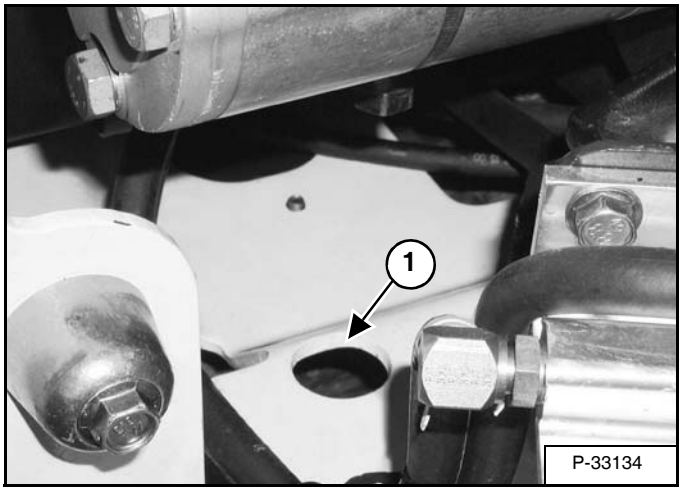
Replacing Hydraulic Oil

See the SERVICE SCHEDULE for the correct service interval. (See SERVICE SCHEDULE on Page 10-50-1.)

Retract the arm and bucket cylinders, lower the bucket to the ground. Stop the engine.

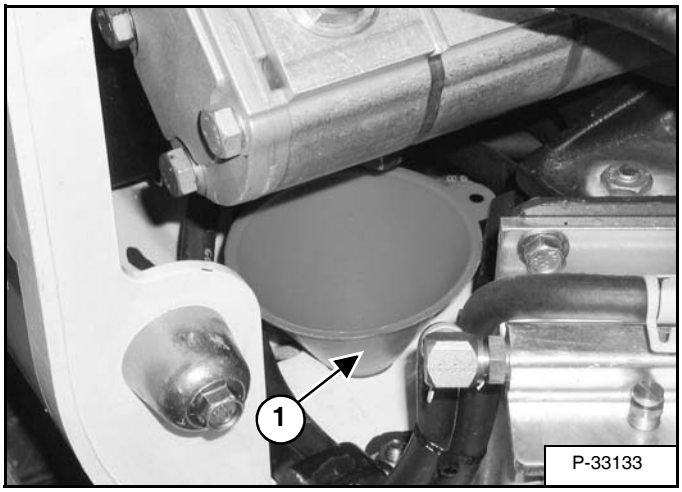
Remove and replace the hydraulic filter.

Figure 10-100-12



A hole (Item 1) **[Figure 10-100-12]** is provided in the housing for ease of draining the hydraulic fluid.

Figure 10-100-13

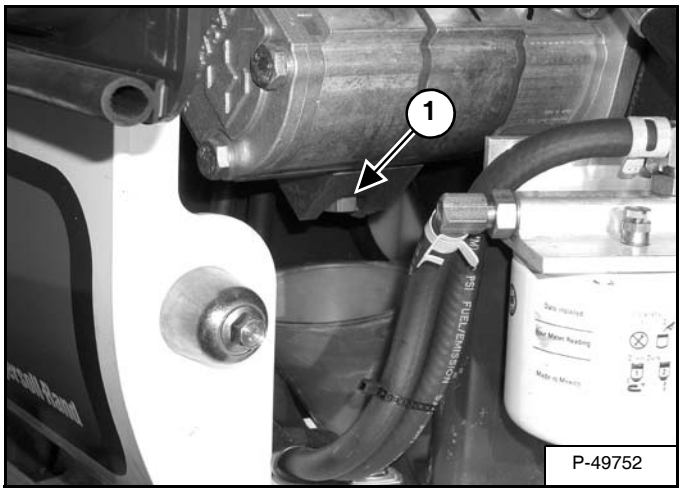


Install a funnel (Item 1) **[Figure 10-100-13]** in the hole.

Place a container under the funnel.

Replacing Hydraulic Oil (Cont'd)

Figure 10-100-14



Remove the drain plug (Item 1) **[Figure 10-100-14]** and drain the hydraulic fluid into the container.

IMPORTANT

Fluid such as engine oil, hydraulic fluid, coolants, grease, etc. must be deposed of in an environmentally safe manner. Some regulations require that certain spills and leaks on the ground must be cleaned in a specific manner. See local, state and federal regulations for the correct disposal.

I-2067-0499

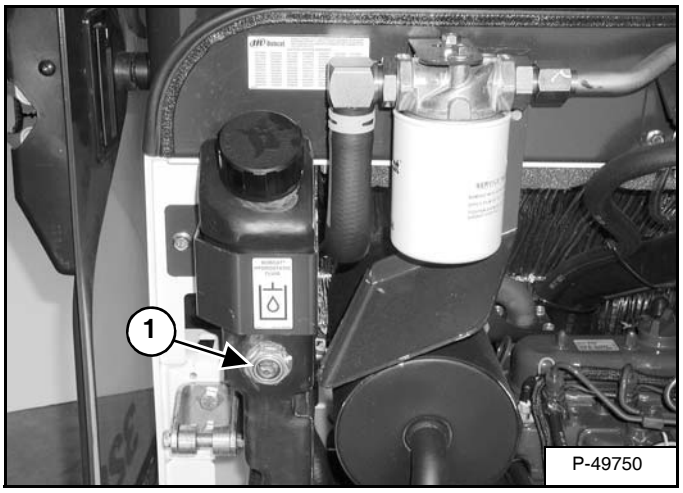
IMPORTANT

If the fluid is being drained because of a system failure, remove and clean all hydraulic lines.

I-2045-0788

Install the drain plug.

Figure 10-100-15



Add fluid to the reservoir until it is at the center of the sight gauge (Item 1) **[Figure 10-100-15]**. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-60-1.)

Run the Excavator through the hydraulic functions. Stop the engine. Check the fluid level and add as needed.


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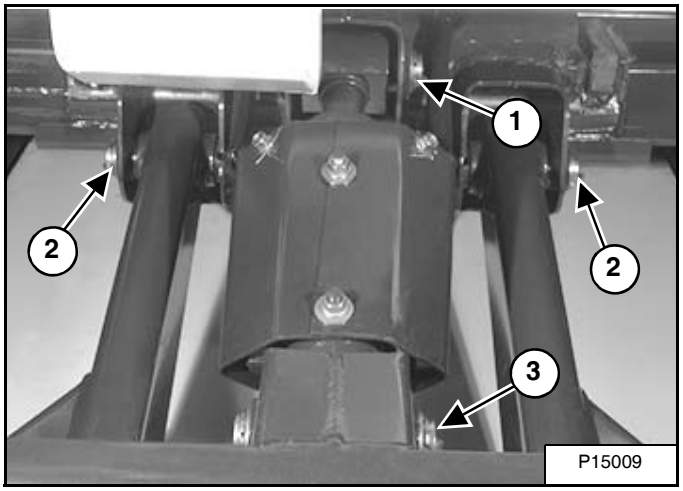
LUBRICATION OF THE HYDRAULIC EXCAVATOR

Lubricate the Hydraulic Excavator as specified in the SERVICE SCHEDULE for the best performance of the machine. (See SERVICE SCHEDULE on Page 10-50-1.)

Record the operating hours each time you lubricate the Hydraulic Excavator.

Always use a good quality lithium based multi-purpose grease when lubricating the Excavator. Apply the lubricant until extra grease shows.

Figure 10-110-16



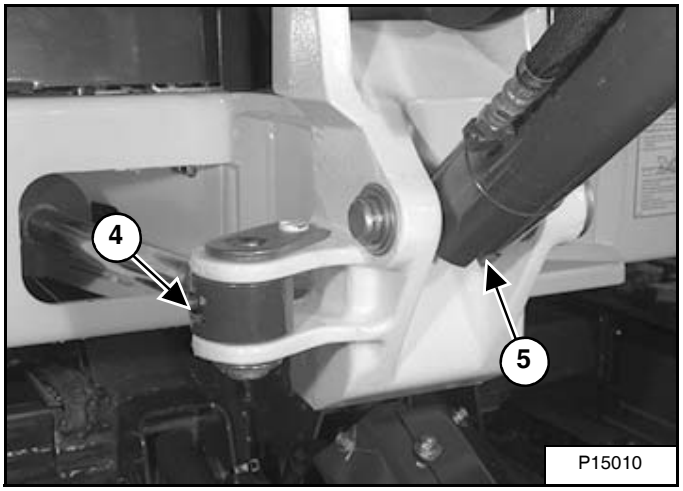
Ref Description (# of Fittings)

1. Blade Cylinder-Rod End, every 8-10 hours (1) **[Figure 10-110-16]**

2. Blade Pivots, every 8-10 hours (2) **[Figure 10-110-16]**

3. Blade Cylinder-Base End, every 8-10 hours (1) **[Figure 10-110-16]**

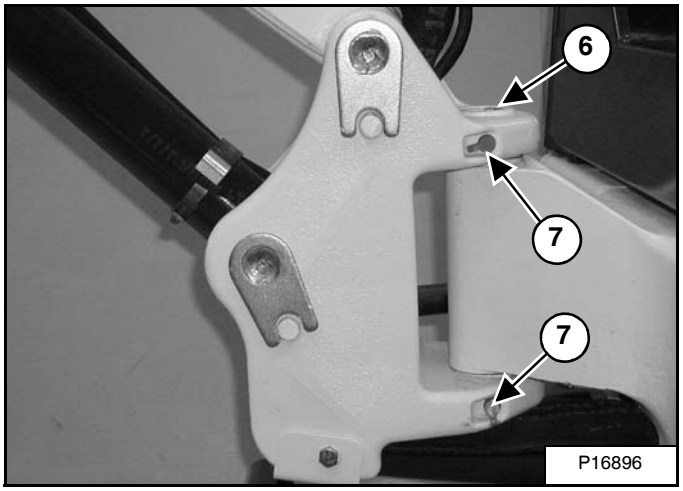
Figure 10-110-17



4. Boom Swing Cylinder-Rod End, every 8-10 hours (1) **[Figure 10-110-17]**

5. Boom Cylinder-Base End, every 8-10 hours (1) **[Figure 10-110-17]**

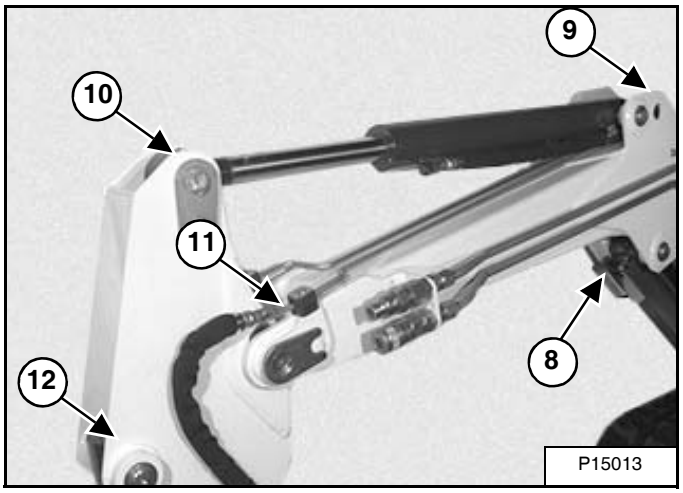
Figure 10-110-18



6. Boom Base Pivot, every 8-10 hours (1) **[Figure 10-110-18]**

7. Boom Swing Pivot, every 8-10 hours (2) **[Figure 10-110-18]**

Figure 10-110-19



8. Boom Cylinder-Rod End, every 8-10 hours (1) **[Figure 10-110-19]**

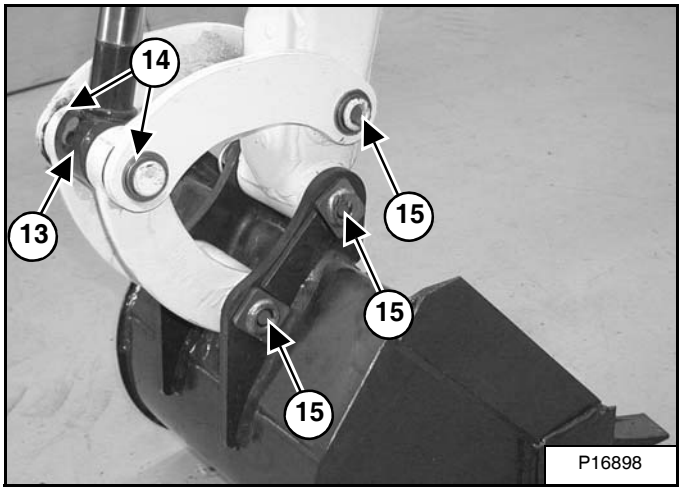
9. Arm Cylinder-Base End, every 8-10 hours (1) **[Figure 10-110-19]**

10. Arm Cylinder-Rod End, every 8-10 hours (1) **[Figure 10-110-19]**

11. Arm Pivot, every 8-10 hours (1) **[Figure 10-110-19]**

12. Bucket Cylinder-Base End, every 8-10 hours (1) **[Figure 10-110-19]**

Figure 10-110-20

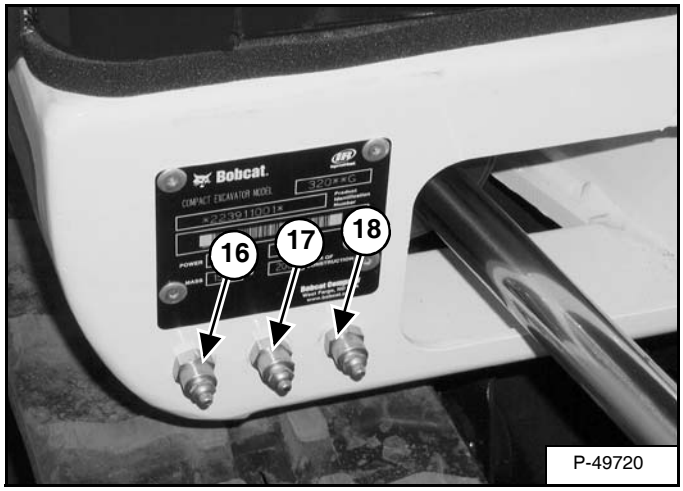


13. Bucket Cylinder-Rod End, every 8-10 hours (1) **[Figure 10-110-20]**

14. Bucket Link Pivots, every 8-10 hours (2) **[Figure 10-110-20]**

15. Bucket Pivots, every 8-10 hours (3) **[Figure 10-110-20]**

Figure 10-110-21



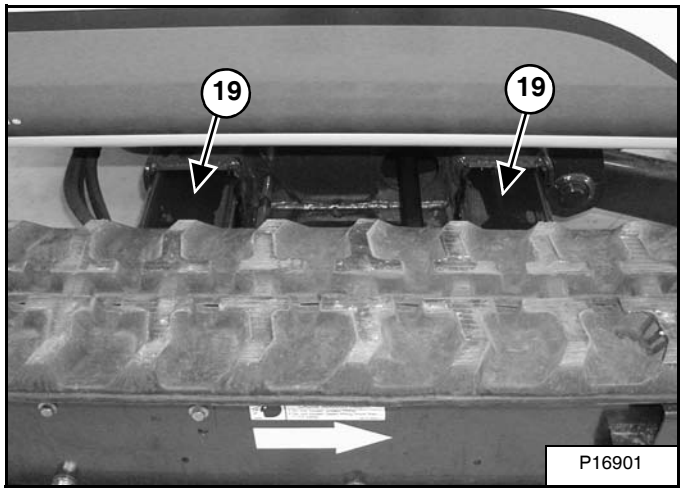
16. Swing Circle Pinion, every 50 hours. Pump 4 times with a grease gun. Rotate the upperstructure 180° and repeat. **[Figure 10-110-21]**

17. Swing Circle Bearing, every 50 hours **[Figure 10-110-21]**

NOTE: Do not over-grease the swing circle; damage to the seal could result. Pump 4 to 5 times with a grease gun. Rotate the upperstructure 90° and repeat three more times.

18. Boom Swing Cylinder-Base End every 50 hours **[Figure 10-110-21]**

Figure 10-110-22



19. Track Expansion Tube, as required **[Figure 10-110-22]**.

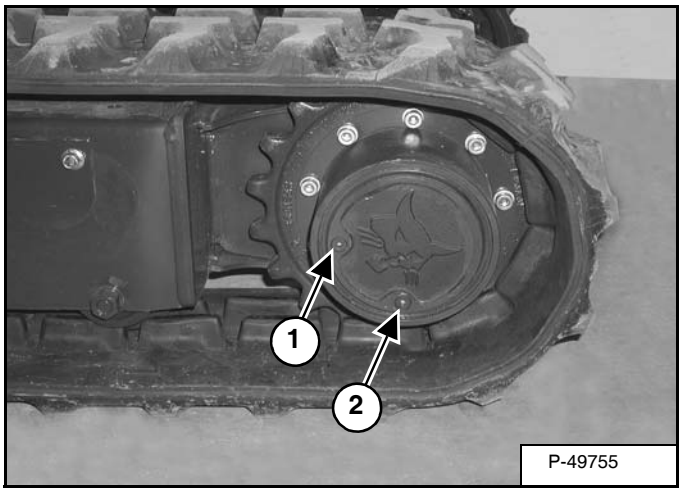
NOTE: Spread lubriplate gearshield extra heavy grease evenly on wear surfaces on both sides

of Excavator as required.

TRAVEL MOTOR

Checking Oil Level

Figure 10-120-23



Put the machine on a level surface with the plugs positioned as shown (Items 1 & 2) **[Figure 10-120-23]**.

Remove the plug (Item 1) **[Figure 10-120-23]**. The oil level should be at the bottom edge of the plug hole.

Add gear lube through the hole if the oil level is below the hole. See Chart for capacity and type. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-60-1.)

Install and tighten both plugs.

Repeat the procedure for the other side.

Draining The Travel Motor

See Service Schedule for the correct service interval. (See SERVICE SCHEDULE on Page 10-50-1)

Put the machine on a level surface with the plugs positioned as shown (Items 1 & 2) **[Figure 10-120-23]**.

Remove the bottom plug (Item 2) and top plug (Item 1) **[Figure 10-120-23]** and drain into a container. Recycle or dispose of the used lubricant in an environmentally safe manner.

After all the gear lube is removed, install plug (Item 2) **[Figure 10-120-23]**.

Add gear lube to the plug hole (Item 1) **[Figure 10-120-23]** until the gear lube level is at the bottom edge of the plug hole. See Chart for capacity and type. (See FUEL, COOLANT AND LUBRICANTS on Page SPEC-60-1.)

Install and tighten the plug.

Repeat the procedure for the other side.


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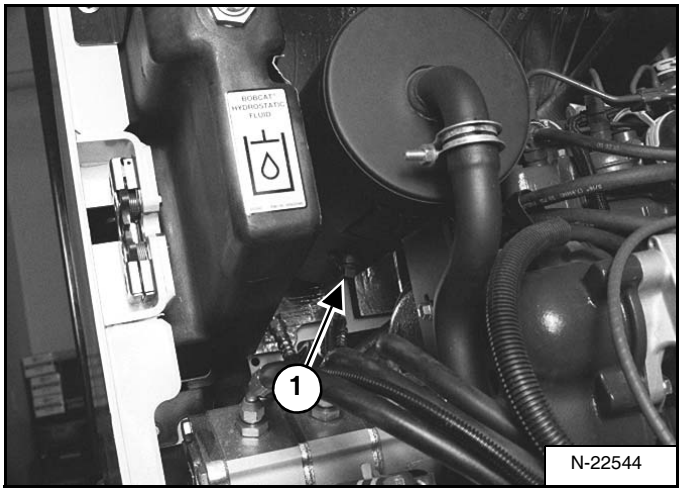
SPARK ARRESTOR MUFFLER

See the SERVICE SCHEDULE for the correct service interval. (See SERVICE SCHEDULE on Page 10-50-1.)

Do not operate the Excavator with a defective exhaust system.

Stop the engine. Open the rear door.

Figure 10-130-1



Remove the plug (Item 1) **[Figure 10-130-1]** from the bottom of the muffler.

Start the engine and run for about ten seconds while a second person, wearing safety glasses, holds a piece of wood over the outlet of the muffler. (The carbon deposits will be forced out of the muffler cleanout hole.)

Stop the engine. Install and tighten the plug.

Close the rear door.

⚠ WARNING

When an engine is running in an enclosed area, fresh air must be added to avoid concentration of exhaust fumes. If the engine is stationary, vent the exhaust outside. Exhaust fumes contain odorless, invisible gases which can kill without warning.

W-2050-1285

⚠ WARNING

Stop engine and allow the muffler to cool before cleaning the spark chamber. Wear safety goggles. Failure to obey can cause serious injury.

W-2011-1285

⚠ WARNING

Never use machine in atmosphere with explosive dust or gases or where exhaust can contact flammable material. Failure to obey warnings can cause injury or death.

W-2068-1285

⚠ WARNING

When the engine is running during service, the steering levers must be in neutral.

Failure to do so can cause injury or death.

W-2203-0595


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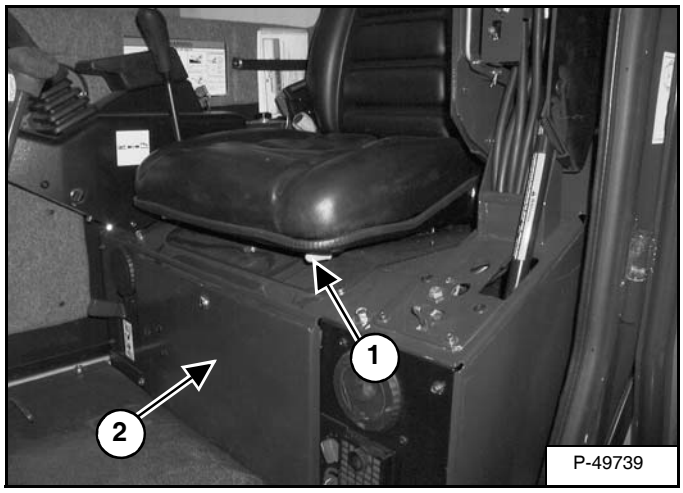
ALTERNATOR BELT

Adjusting The Alternator Belt

Replace the belt if it has stretched or there are cracks in the belt. Replace the pulley if the belt contacts the bottom of the groove in the pulley.

Stop the engine.

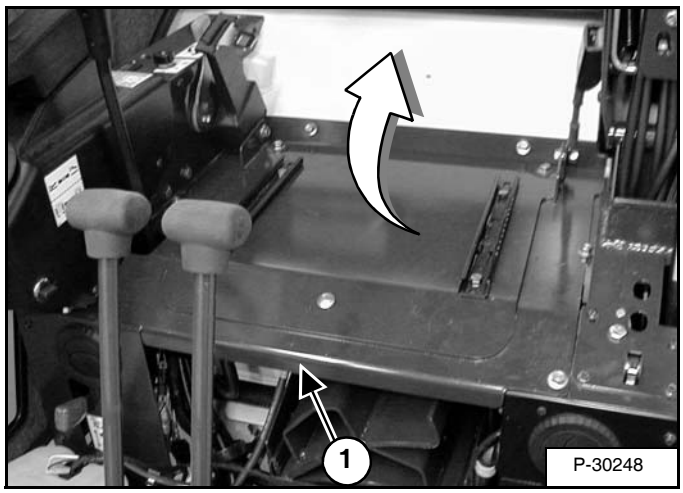
Figure 10-140-2



Release the seat lever (Item 1) **[Figure 10-140-2]**. Pull the seat to the front and remove it from the Excavator.

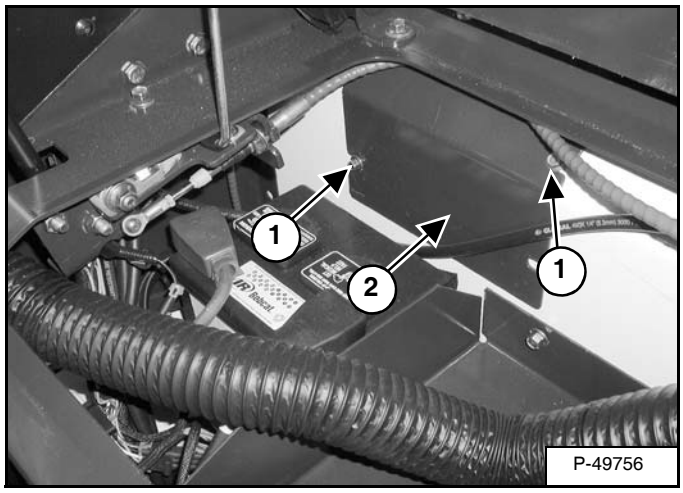
Use the start key to remove the cover (Item 1) **[Figure 10-140-2]** from the storage compartment.

Figure 10-140-3



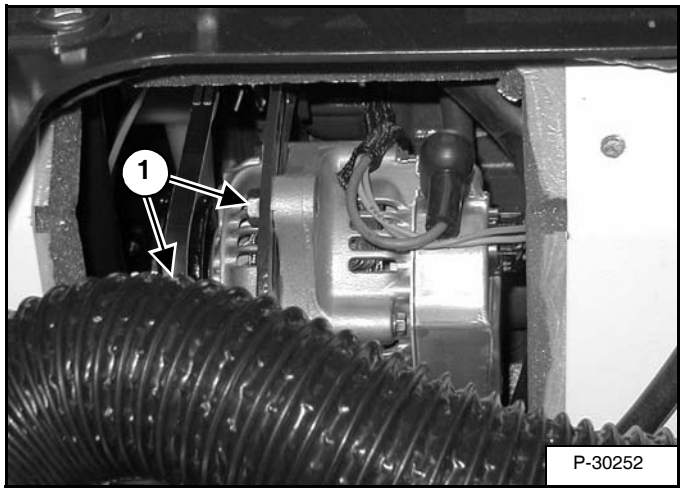
Reach into the storage compartment (Item 1) and turn the release for the seat pan. Raise the seat pan and tip it toward the rear of the machine **[Figure 10-140-3]**.

Figure 10-140-4



Remove two bolts (Item 1) and remove the access panel (Item 2) **[Figure 10-140-4]**.

Figure 10-140-5



Loosen the alternator mounting and adjustment bolts (Item 1) **[Figure 10-140-5]**.

Move the alternator toward the front of the machine **[Figure 10-140-5]** until the belt has 0.50 inch (13 mm) movement at the middle of the belt span with 13 lbs. (58 N) of force.

Tighten the mounting and adjustment bolts.

Install the access panel, lower the seat pan and engage the latch.

Install the seat and the storage compartment cover.


Bobcat®

SEAT BELT

Inspection And Maintenance

WARNING

Failure to properly inspect and maintain the seat belt can cause lack of operator restraint resulting in serious injury or death.

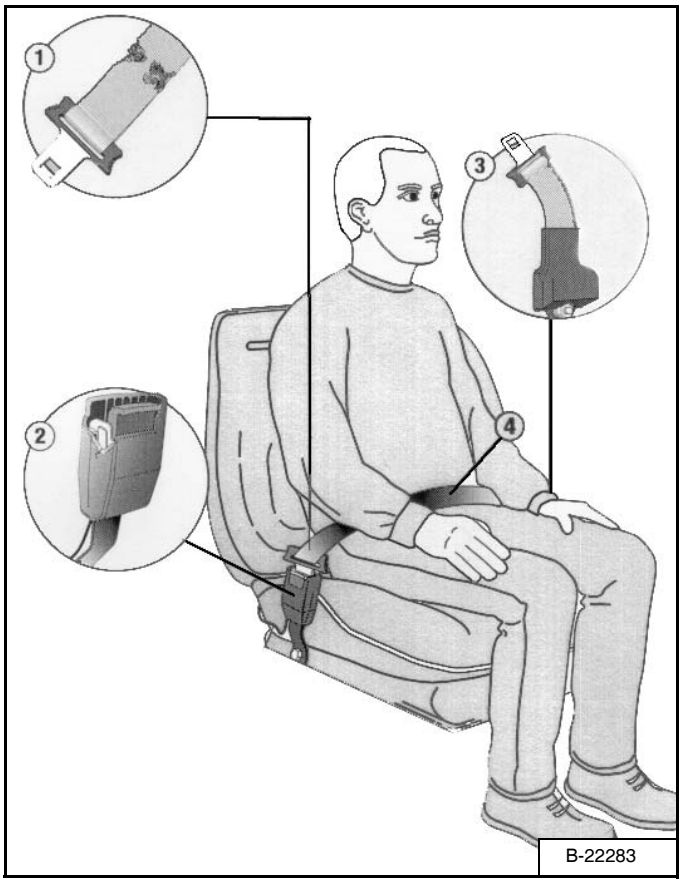
W-2466-0703

Check the seat belt daily for correct function.

Inspect the seat belt system thoroughly yearly or more often if the machine is exposed to severe environmental conditions or applications.

The seat belt system should be repaired or replaced if it shows cuts, fraying, extreme or unusual wear, significant discolorations due to ultraviolet (UV) rays from the sun, dusty/dirty conditions, abrasion to the seat belt webbing, or damage to the buckle, latch plate, retractor (if equipped), or hardware.

Figure 10-150-6



The items below are referenced in **[Figure 10-150-6]**.

1. Check the seat belt webbing. If the system is equipped with a retractor, pull the webbing completely out and inspect the full length of the webbing. look for cuts, wear, fraying, dirt and stiffness.

2. Check the buckle and latch for proper function. Make sure latch plate is not excessively worn, deformed or buckle is not damaged.

3. Check the retractor web storage device (if equipped) by extending the seat belt webbing to determine if it extends and retracts the webbing correctly.

4. Check webbing in areas exposed to ultraviolet (UV) rays from the sun or extreme dust or dirt. If the original color of the webbing in these areas is extremely faded and / or the webbing is packed with dirt, the webbing strength may have weakened.

See your Bobcat dealer for approved seat belt system replacement parts for your machine.


Bobcat®

CONTROL CONSOLE LOCKOUTS

Inspection And Maintenance

Figure 10-160-7

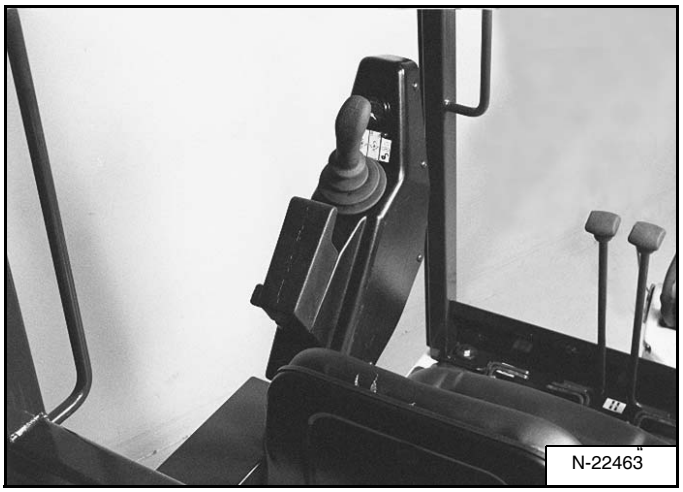


Figure 10-160-8



When either console is raised **[Figure 10-160-7]** & **[Figure 10-160-8]**, the hydraulic control levers (joysticks) and traction system must not function.

Sit in the operator's seat, fasten the seat belt and start the engine.

Raise the left console. (Green light on the consoles will go off.)

Move the joystick control levers. There should be no movement of the boom, crowd, house swing or bucket.

Move the steering control levers. there should be no movement of the Excavator tracks.

Lower the left console. Raise the right console and repeat the inspection procedure.

The joystick control levers and traction system must be deactivated when either console is raised.

Service the system if these controls do not deactivate when either control console is raised. (See your Bobcat dealer for service.)


Bobcat®

HYDRAULIC SYSTEM

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HYDRAULIC/HYDROSTATIC SCHEMATIC
320L (S/N 223911001 AND ABOVE)

(PRINTED JULY 2006)
V-0849le

LEGEND

(1) HYDRAULIC RESERVOIR
(PRESSURIZED)with FILL
STRAINER
Capacity . . . . . 6.8 Qts. (6,5 L)

(2) PRESSURIZED BREATHER/FILL CAP
with FILTER
5 PSI (0,34 Bar) - Outlet
0.435 PSI (0,03 Bar) - Inlet

(3) SOLENOID VALVE - SYSTEM BY-PASS

(4) MAIN RELIEF VALVE
2500 PSI (172 Bar)

(5) TEST PORT - "G" Port - Gauge Test Port

(6) HYDRAULIC FILTER ELEMENT
10 Micron

(7) FILTER BY-PASS 25 PSI (1,72 Bar)

(8) SWING MOTOR CROSS PORT RELIEF
VALVE . . . . . 1475 PSI (102 Bar)
When Tested at "G" Port

(9) HYDRAULIC PUMP . Triple Section -
Gear Pump:
Pump Section 1
8.0 GPM (30,0 L/min.) at High Engine Idle
Pump Sections 2 & 3
4.0 GPM (15,0 L/min.) at High Engine Idle

(10) TRAVEL MOTOR SPOOL - RIGHT HAND

(11) TRAVEL MOTOR SPOOL - LEFT HAND

(12) ORIFICE . . . . .0.040 inch (1,02 mm)

(13) PORT RELIEF VALVE
Boom Cylinder (Rod End)
3335 PSI (230 Bar)

(14) PORT RELIEF VALVE
Boom Cylinder (Base End)
3335 PSI (230 Bar)

(15) PORT RELIEF VALVE
Bucket Cylinder (Rod End)
3335 PSI (230 Bar)

(16) PORT RELIEF VALVE
Bucket Cylinder (Base End)
2900 PSI (200 Bar)

(17) PORT RELIEF VALVE
Arm Cylinder (Rod End)
3335 PSI (230 Bar)

(18) PORT RELIEF VALVE
Arm Cylinder (Base End)
2900 PSI (200 Bar)

(19) TEST PORT - "F" Port - Factory Fill Port

(20) PRESSURE REDUCING VALVE
435 PSI (30 Bar)

(21) ACCUMULATOR
Nitrogen . . . . . 165 PSI (11 Bar)
non-rechargeable

(22) CONSOLE LOCK OUT SOLENOID

(23) BUILD UP VALVE . 218 PSI (15 Bar)

(24) ORIFICE . . . . . 0.063" (1.70 mm)
Bore of Tee Fitting

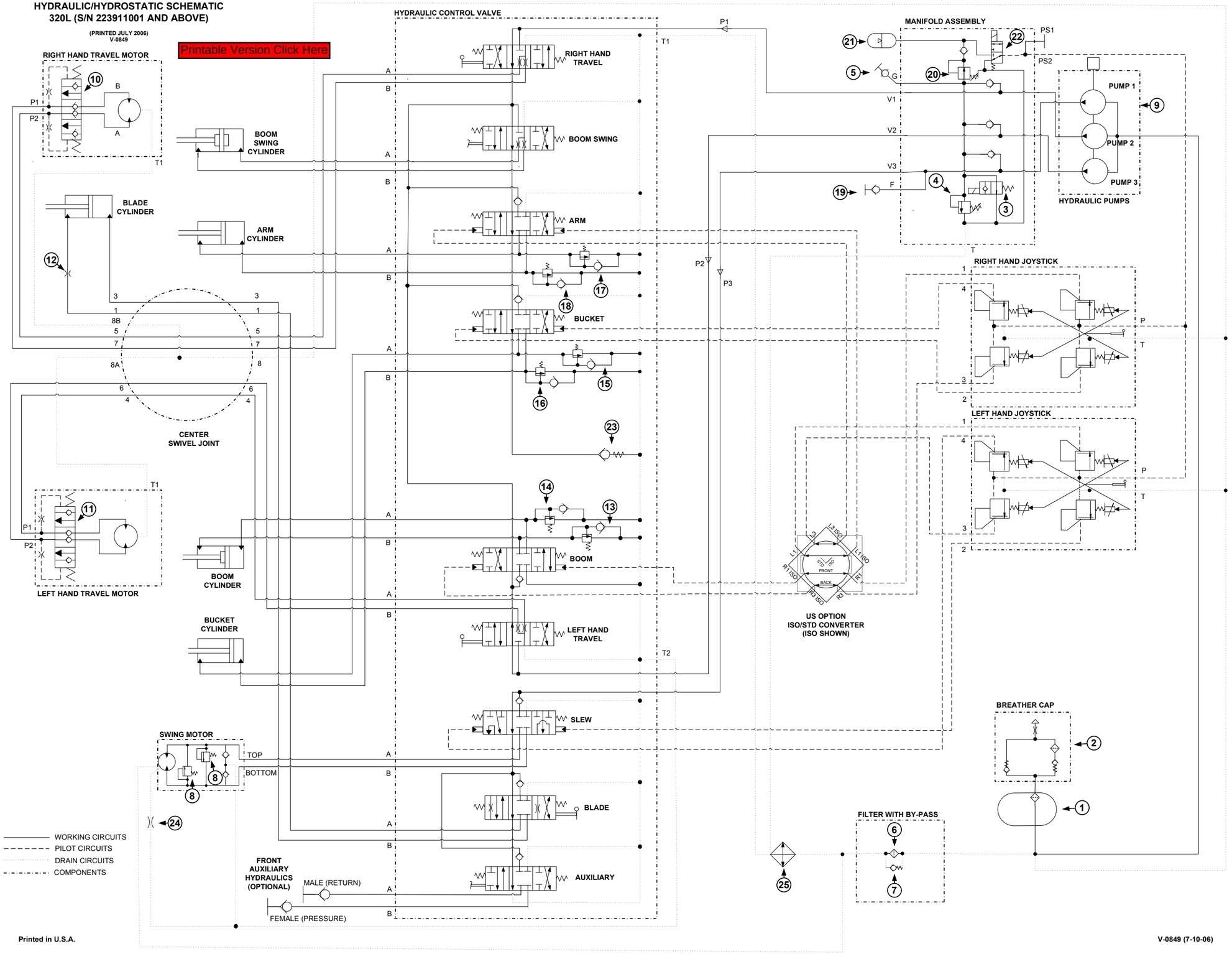
(25) OIL COOLER

NOTE: Unless otherwise specified springs have NO significant pressure value.

HYDRAULIC/HYDROSTATIC SCHEMATIC
320L (S/N 223911001 AND ABOVE)

(PRINTED JULY 2006)
V-0849

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Printed in U.S.A.

V-0849 (7-10-06)

HYDRAULIC/HYDROSTATIC SCHEMATIC
320 (S/N 223911001 AND ABOVE))
322 (S/N 224011001 AND ABOVE)

(PRINTED JULY 2006)
V-0488le

LEGEND

(1) HYDRAULIC RESERVOIR
(PRESSURIZED)with FILL
STRAINER
Capacity . . . . . 6.8 Qts. (6,5 L)

(2) PRESSURIZED BREATHER/FILL CAP
with FILTER
5 PSI (0,34 Bar) - Outlet
0.435 PSI (0,03 Bar) - Inlet

(3) SOLENOID VALVE - SYSTEM BY-PASS

(4) MAIN RELIEF VALVE
2500 PSI (172 Bar)

(5) SOLENOID VALVE - TWO SPEED

(6) HYDRAULIC FILTER ELEMENT
10 Micron

(7) FILTER BY-PASS 25 PSI (1,72 Bar)

(8) SWING MOTOR CROSS PORT RELIEF
VALVE . . . . . 1475 PSI (102 Bar)
When Tested at "G" Port

(9) HYDRAULIC PUMP . Triple Section -
Gear Pump:
Pump Section 1
8.0 GPM (30,0 L/min.) at High Engine Idle
Pump Sections 2 & 3
4.0 GPM (15,0 L/min.) at High Engine Idle

(10) TRAVEL MOTOR SPOOL - RIGHT HAND

(11) TRAVEL MOTOR SPOOL - LEFT HAND

(12) ORIFICE . . . . .0.040 inch (1,02 mm)

(13) PORT RELIEF VALVE
Boom Cylinder (Rod End)
3335 PSI (230 Bar)

(14) PORT RELIEF VALVE
Boom Cylinder (Base End)
3335 PSI (230 Bar)

(15) PORT RELIEF VALVE
Bucket Cylinder (Rod End)
3335 PSI (230 Bar)

(16) PORT RELIEF VALVE
Bucket Cylinder (Base End)
2900 PSI (200 Bar)

(17) PORT RELIEF VALVE
Arm Cylinder (Rod End)
3335 PSI (230 Bar)

(18) PORT RELIEF VALVE
Arm Cylinder (Base End)
2900 PSI (200 Bar)

(19) SOLENOID VALVE . . . . . 322 ONLY
Blade/Track Expansion

(20) PRESSURE REDUCING VALVE
435 PSI (30 Bar)

(21) ACCUMULATOR
Nitrogen . . . . . 165 PSI (11 Bar)
non-rechargeable

(22) CONSOLE LOCK OUT SOLENOID

(23) BUILD UP VALVE . 218 PSI (15 Bar)

(24) ORIFICE . . . . . 0.063" (1.70 mm)
Bore of Tee Fitting

(25) OIL COOLER

(26) TEST PORT - "F" Port - Factory Fill Port

(27) TEST PORT - "G" Port - Gauge Test Port

NOTE: Unless otherwise specified springs have NO significant pressure value.

Printable Version Click Here

HYDRAULIC/HYDROSTATIC SCHEMATIC
320 (S/N 223911001 AND ABOVE)
322 (S/N 224011001 AND ABOVE)

(PRINTED JULY 2006)
V-0488

HYDRAULIC CONTROL VALVE

RIGHT HAND TRAVEL MOTOR

CENTER SWIVEL JOINT 320 ONLY

BOOM SWING CYLINDER

BLADE CYLINDER

ARM CYLINDER

CENTER SWIVEL JOINT 322 ONLY

EXPAND CYL 322 ONLY

BOOM CYLINDER

BUCKET CYLINDER

LEFT HAND TRAVEL MOTOR

SWING MOTOR

RIGHT HAND TRAVEL

BOOM SWING

ARM

BUCKET

BOOM

LEFT HAND TRAVEL

SLEW

BLADE

AUXILIARY

FRONT AUXILIARY HYDRAULICS

MALE (RETURN)

FEMALE (PRESSURE)

MANIFOLD ASSEMBLY

HYDRAULIC PUMPS

PUMP 1

PUMP 2

PUMP 3

RIGHT HAND JOYSTICK

LEFT HAND JOYSTICK

US OPTION
ISO/STD CONVERTER
(ISO SHOWN)

BREATHER CAP

FILTER WITH BY-PASS

WORKING CIRCUITS
PILOT CIRCUITS
DRAIN CIRCUITS
COMPONENTS

Printed in U.S.A.

V-0488 (7-10-06)

Glossary Of Hydraulic/Hydrostatic Symbols For Excavators

GLOSSARY OF HYDRAULIC/HYDROSTATIC SYMBOLS FOR EXCAVATORS

SYMBOL DESCRIPTION

FLOW LINES and CONNECTIONS

WORKING CIRCUITS – Continuous, Solid Line – Working (Main) Line, Return Line (line conducting fluid from working devices to the reservoir) and Feed Line (main line conductor)

PILOT PRESSURE – Dashed Line – Pilot Line (line which conducts control fluid)

DRAIN CIRCUITS – Dotted Line – Drain Line (drain or bleed line – line conducting fluid from a component housing to the reservoir)

COMPONENTS – Long Chain Line – Enclosure outline for several components assembled in one unit

MECHANICAL CONNECTIONS – Double Line (Shaft, Lever, Piston Rod)

CONNECTED JUNCTION OF OIL LINES (Flow Line Connection)

OIL LINES CROSSING (NOT Connected)

COUPLER – Quick–Acting Coupling (uncoupled, closed by non–return valve)

SYMBOL DESCRIPTION

BASIC and MISCELLANEOUS SYMBOLS

RESTRICTION – Line with Fixed Restriction – Affected by Viscosity (property of resistance to flowing fluid)

VARIABLE ADJUSTMENT RESTRICTION – Regulated or Variable Restriction

TEMPERATURE CONTROL – (indication of temperature)

TEMPERATURE INDICATOR – (temperature measurement – thermometer)

FILTER (strainer or screen) – For fluid conditioning

VENTED AND FILTERED RESERVOIR (reservoir open to atmosphere)

OIL COOLER (heat exchanger) – The arrows in the diamond indicate the extraction of heat (heat dissipation)

PRESSURE SENSOR – Varies electric signal with pressure

DIFFERENTIAL PRESSURE SWITCH – Switch activates when pressure difference reaches specified level

PRESSURE SWITCH – Switch activates when pressure reaches specified level

MUFFLER (silencer) – Reduces noise

MS-1892-1 (6-2-98)

Glossary Of Hydraulic/Hydrostatic Symbols For Excavators (Cont'd)

GLOSSARY OF HYDRAULIC/HYDROSTATIC SYMBOLS FOR EXCAVATORS

SYMBOL DESCRIPTION

CYLINDER: Equipment to convert hydraulic energy into linear energy and in which the fluid pressure operates alternately in both directions (forward and backward strokes)



DOUBLE ACTING HYDRAULIC CYLINDER, UNEQUAL DISPLACEMENT – With single piston rod



DOUBLE ACTING HYDRAULIC CYLINDER, UNEQUAL DISPLACEMENT and CUSHION ON ONE END – With single piston rod

PUMP: To convert mechanical energy into hydraulic energy



FIXED CAPACITY DISPLACEMENT HYDRAULIC PUMP – With one direction of flow



VARIABLE CAPACITY DISPLACEMENT BIDIRECTIONAL HYDRAULIC PUMP – With two directions of flow (bidirectional)

MOTOR: To convert hydraulic energy into rotary mechanical energy



FIXED CAPACITY DISPLACEMENT BIDIRECTIONAL HYDRAULIC MOTOR – With two directions of flow (bidirectional)

SYMBOL DESCRIPTION

CONTROL MECHANISMS



CONTROL VALVE WITH DETENT (Holds Valve in Position) – device for maintaining a given position (mechanical)



CONTROL VALVE ACTIVATED BY A PULL BUTTON (manual)



CONTROL VALVE ACTIVATED BY A PUSH–PULL BUTTON (manual)



CONTROL VALVE ACTIVATED BY A LEVER (manual)



CONTROL VALVE ACTIVATED BY A PEDAL (manual)



CONTROL VALVE WITH SPRING RETURN (mechanical)



CONTROL VALVE ACTIVATED BY AN ELECTRIC SOLENOID (electrical)



CONTROL VALVE ACTIVATED BY PILOT PRESSURE (indirect control, pilot actuated by application of pressure)

MS-1892-2 (6-2-98)

Glossary Of Hydraulic/Hydrostatic Symbols For Excavators (Cont'd)

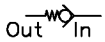
GLOSSARY OF HYDRAULIC/HYDROSTATIC SYMBOLS FOR EXCAVATORS

SYMBOL DESCRIPTION

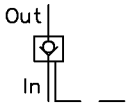
NON–RETURN VALVE, SHUTTLE VALVE: Valve which allows free flow in one direction only



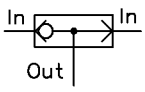
NON–RETURN VALVE (Check Valve) – Used as Replenishing Valve, Load Check Valve or Anticavitation Valve – Opens if the Inlet pressure is higher than the Outlet pressure. Often contains internal spring which has NO significant pressure value



SPRING LOADED VALVE (Bypass Valve) – Opens if the Inlet pressure is greater than the Outlet pressure plus the spring pressure

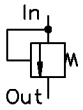


PILOT CONTROLLED NON–RETURN VALVE – It is possible to open the valve by pilot pressure

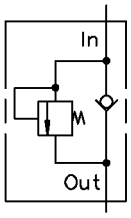


SHUTTLE VALVE – The Inlet port connected to the higher pressure is automatically connected to the Outlet port while the other Inlet port is closed

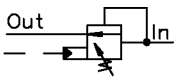
PRESSURE CONTROL VALVE: Valve ensuring the control of pressure



RELIEF VALVE – When the Inlet pressure overcomes the opposing force of the spring, the valve opens permitting flow from the Outlet port.



RELIEF/REPLENISHING VALVE or RELIEF/ANTICAVITATION VALVE – When the Inlet pressure overcomes the opposing force of the spring, the valve opens permitting flow from the Outlet port – Allows free flow in the opposite direction

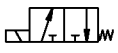


DUAL PRESSURE RELIEF VALVE – When the inlet pressure overcomes the opposing force of the spring, the valve opens permitting flow from the Outlet port. Pilot pressure provides a second pressure value.

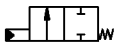
DIRECTIONAL CONTROL VALVE: Valve providing for the opening (fully or restricted) or the closing of one or more flow paths (represented by several squares)



TWO PORTS and CLOSED FLOW PATHS

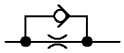


SOLENOID ACTIVATED DIRECTIONAL CONTROL VALVE (Two Position) – controlled by an electric solenoid (with return spring)

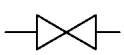


PILOT ACTIVATED DIRECTIONAL CONTROL VALVE (Two Position) – controlled by pressure (with return spring)

FLOW CONTROL VALVE: Valve controlling the flow in one or both directions



ONE WAY RESTRICTOR VALVE (Non–Return Valve with Restriction) – Unit allowing free flow in one direction but restricted flow in the other direction



TOW VALVE – Normally in closed position

MS-1892-3 (6-2-98)

Troubleshooting The Hydraulic Circuit

TROUBLESHOOTING THE HYDRAULIC CIRCUIT		
PROBLEM	**CAUSE**	**CORRECTION**
No hydraulic operation at one or more circuits.	Hydraulic oil level low.	Refill with correct oil.
	Hydraulic pump drive coupling damaged.	Replace.
	Hydraulic pump defective.	Check, repair or replace.
	Main relief valve defective.	Readjust or replace.
Hydraulic power insufficient to one or more circuits.	Main relief valve pressure setting incorrect.	Readjust or replace.
Hydraulic speed too slow.	Hydraulic oil level or viscosity incorrect.	Refill or replace.
	Engine RPM reduced.	Readjust or replace.
	Control valve linkage defective.	Check, repair or replace
	Hydraulic pump volume low.	Check, repair or replace.
Oil temperature too high.	Oil cooler or radiator fins plugged.	Clean oil cooler external surface.
	Hydraulic oil level low.	Refill or replace.
	Non recommended hydraulic oil	Replace.
	Relief valve excessively activated.	Use proper operating procedures.
	One or more relief valves not set correctly.	Test, readjust or replace.
	Extreme operating conditions. High ambient temperature (IE: enclosed structure).	
	Alternator belt loose.	Tighten alternator belt.

Troubleshooting The Cylinder Circuit

TROUBLESHOOTING THE CYLINDER CIRCUIT		
PROBLEM	**CAUSE**	**CORRECTION**
Cylinder inoperable.	Control console(s) raised.	Lower control console.
	Loose fittings or broken hoses.	Repair or replace.
	Lever linkage misadjusted.	Readjust.
	Control console lockout switch.	Readjust or replace.
	Cylinder internal leakage excessive.	Repair or replace.
	Control lever (joystick) manifold solenoid coil defective.	Test, repair or replace.
	Control lever (joystick) manifold solenoid valve defective.	Test, repair or replace.
	Control lever (joystick) manifold pressure reducing valve defective.	Test, repair or replace.
	Control lever (joystick) internal leakage excessive.	Repair or replace.
Cylinder force insufficient.	Main relief valve pressure too low.	Readjust or replace.
	Work port relief pressure too low.	Readjust or replace.
Cylinder speed too slow.	Lever linkage misadjusted.	Readjust.
	Cylinder internal leakage excessive.	Repair or replace.
	Control lever (joystick) manifold solenoid valve defective.	Repair or replace.
	Control lever (joystick) manifold pressure reducing valve defective.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Control lever (joystick) internal leakage excessive.	Repair or replace.
Cylinder drift excessive.	Cylinder internal leakage excessive.	Repair or replace.
	Work port relief valve seals leaking.	Test, repair or replace.
	Control valve internal leakage excessive.	Repair or replace.

Troubleshooting The Swing (Upperstructure Slew) Circuit

TROUBLESHOOTING THE SWING (UPPERSTRUCTURE SLEW) CIRCUIT		
PROBLEM	**CAUSE**	**CORRECTION**
Swing not operating.	Control console(s) raised.	Lower control console(s).
	Control console lockout switch defective.	Readjust or replace.
	Swing lock pin engaged.	Disengage lock pin.
	Control lever (joystick) manifold pressure reducing valve defective.	Repair or replace.
	Control lever (joystick) manifold solenoid coil defective.	Replace.
	Control lever (joystick) manifold solenoid valve defective.	Repair or replace.
	Swing motor gear defective.	Repair or replace.
	Control lever (joystick) internal leakage excessive.	Repair or replace
	Swing motor defective.	Repair or replace.
Swing force.	Main relief valve set too low.	Readjust or replace.
	Swing motor relief valve pressure too low.	Readjust or replace.
Swing speed too slow.	Pump flow low.	Check, repair or replace.
	Blocked or restricted line to swing motor.	Replace.
	Control lever (joystick) internal leakage excessive.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Swing motor internal leakage excessive.	Repair or replace.
Swing over run excessive.	Control valve spool sticking.	Repair or replace.
	Control lever (joystick) spool sticking.	Repair or replace.
	Swing motor relief valve set too low.	Repair or replace.
	Swing motor internal leakage excessive.	Repair or replace.

Troubleshooting The Travel Circuit

TROUBLESHOOTING THE TRAVEL CIRCUIT		
PROBLEM	**CAUSE**	**CORRECTION**
Travel system inoperable.	Lever linkage incorrectly adjusted.	Readjust.
	Track tension too tight.	Readjust.
	Defective pump.	Check, repair or replace.
	Travel motor counterbalance spool sticking.	Repair or replace.
	Travel motor internal leakage excessive.	Repair or replace.
	Travel motor defective.	Repair or replace.
	Travel motor gears defective.	Repair or replace.
	Swivel joint defective.	Repair or replace.
	Main relief valve pressure too low.	Readjust or replace.
Travel power.	Track tension too tight.	Readjust.
	Main relief valve pressure too low.	Readjust or replace.
	Travel motor counterbalance spool sticking.	Repair or replace.
Speed too slow.	Lever linkage incorrectly adjusted.	Readjust.
	Swivel joint internal leakage excessive.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Low pump pressure.	Check, repair or replace.
	Travel motor internal leakage excessive.	Repair or replace.
Machine not running straight.	Lever linkage incorrectly adjusted.	Readjust.
	Track tension not equal.	Readjust.
	Pump output not equal.	Repair or replace.
	Travel motor internal leakage not equal.	Repair or replace.
	Travel motor counterbalance spool sticking.	Repair or replace.
	Main relief valve pressure set too low.	Repair or replace.
	Swivel joint internal leakage excessive.	Repair or replace.
	Control valve internal leakage not equal.	Repair or replace.
Machine will not hold on slope or while digging.	Travel motor counterbalance valve leakage excessive.	Repair or replace.
	Hose damage.	Replace.
Blade drops while machine is moving.	Lever linkage misadjusted.	Readjust.
	Cylinder internal leakage excessive.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Swivel joint internal leakage from travel motor pressure circuit into blade cylinder circuit.	Repair or replace.


Bobcat®

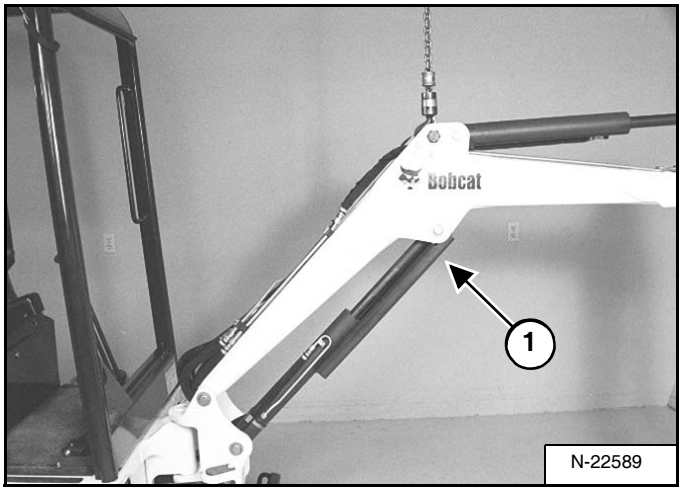
BOOM CYLINDER

Testing

Lower the boom/bucket and blade to the ground.

Stop the engine. Raise the control console.

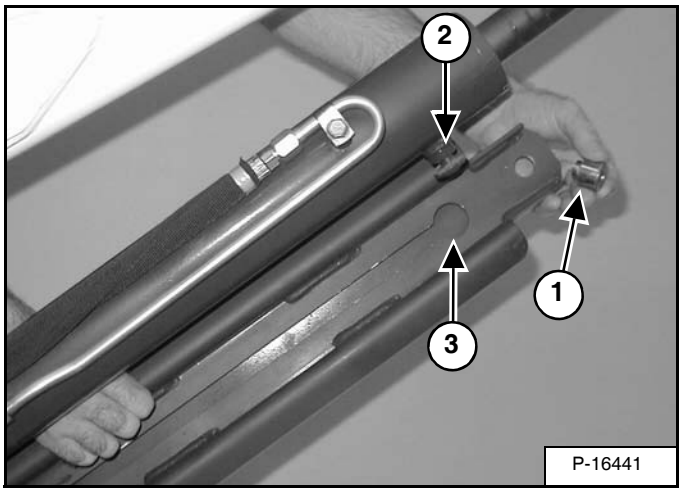
Figure 20-20-1



Support the boom using a chain hoist **[Figure 20-20-1]**.

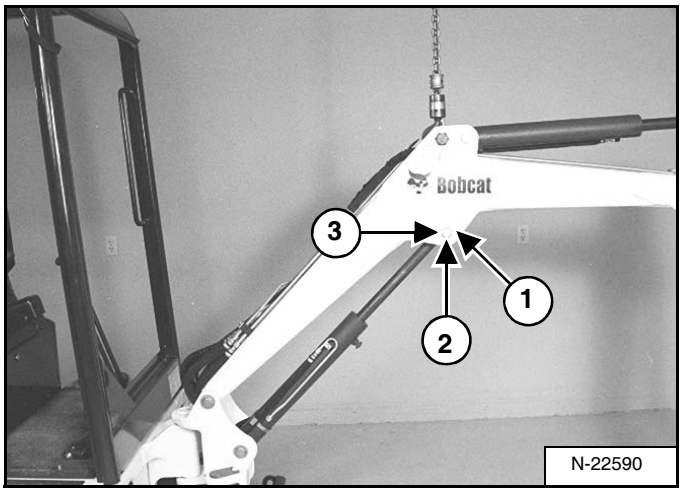
Remove the boom shield mounting bolt (Item 1) **[Figure 20-20-1]**.

Figure 20-20-2



Remove the spacer (Item 1) and slide the shield down until the shield can be removed from the boom cylinder shield mounting stud (Item 2). The shield will come out of the key hole (Item 3) **[Figure 20-20-2]**.

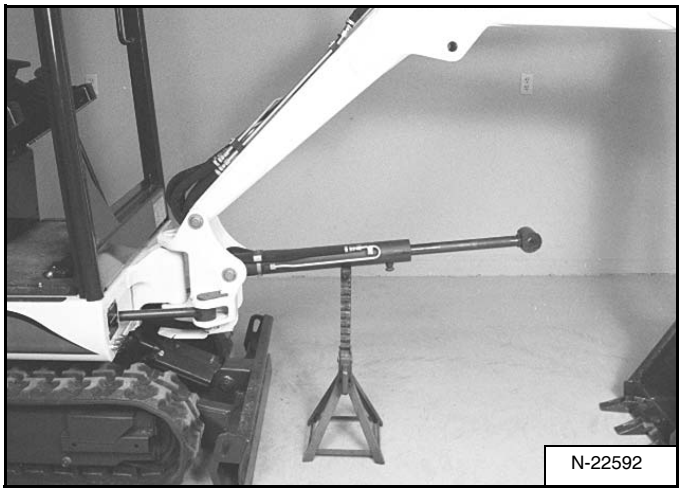
Figure 20-20-3



Remove the retaining ring (Item 1) and washer (Item 2) **[Figure 20-20-3]** from the rod end pivot pin.

Remove the pivot pin (Item 3) **[Figure 20-20-3]**.

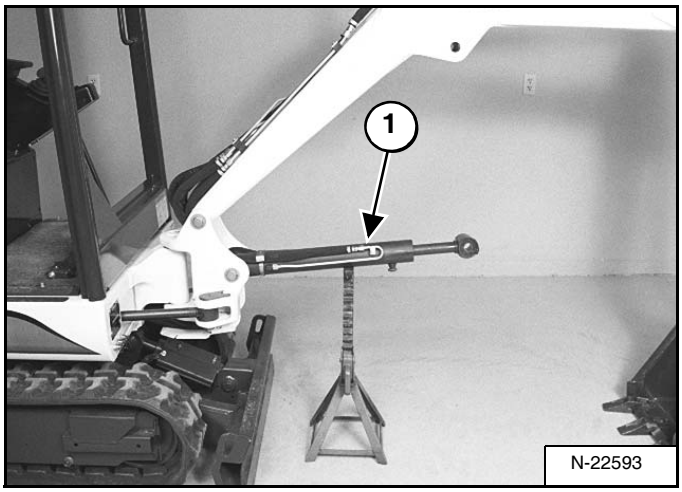
Figure 20-20-4



Support the boom cylinder **[Figure 20-20-4]**.

Testing (Cont'd)

Figure 20-20-5



Lower control console and fasten the seat belt. Start the engine and retract the boom cylinder **[Figure 20-20-5]**.

With the key in the ON position and the engine stopped, move the hydraulic controls to release the hydraulic pressure. Raise the control console.

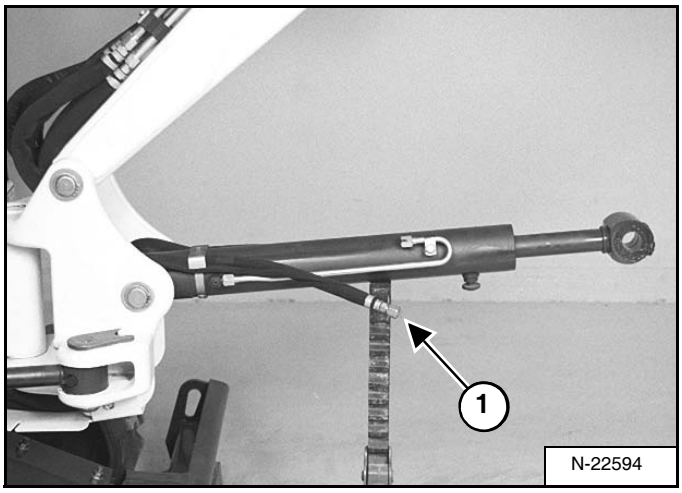
⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

Disconnect the boom cylinder base end hose (Item 1) **[Figure 20-20-5]** at the hose tubeline connection.

Figure 20-20-6



Install a cap (Item 1) **[Figure 20-20-6]** on the hose fitting and tighten.

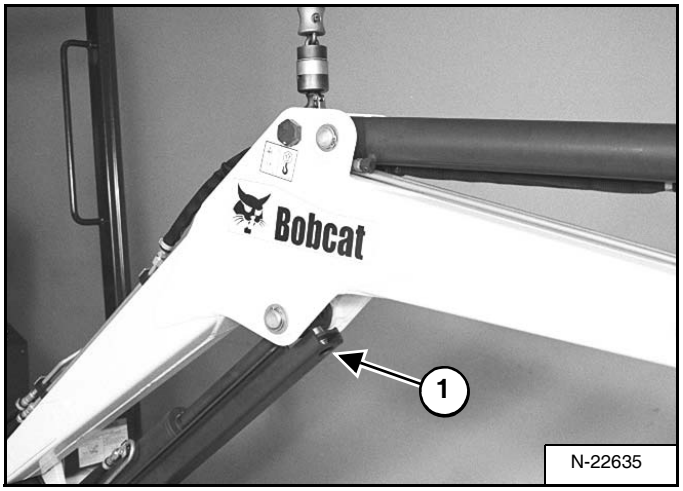
Lower control console and fasten seat belt. Start the engine and retract the boom cylinder.

If there is any leakage from the base end fitting on the boom cylinder, remove the cylinder for repair or replacement.

Removal and Installation

Lower the boom/bucket and blade to the ground. Stop the engine.

Figure 20-20-7



Support the boom using a chain hoist **[Figure 20-20-7]**.

With the key in the ON position, move the hydraulic controls to release the hydraulic pressure.

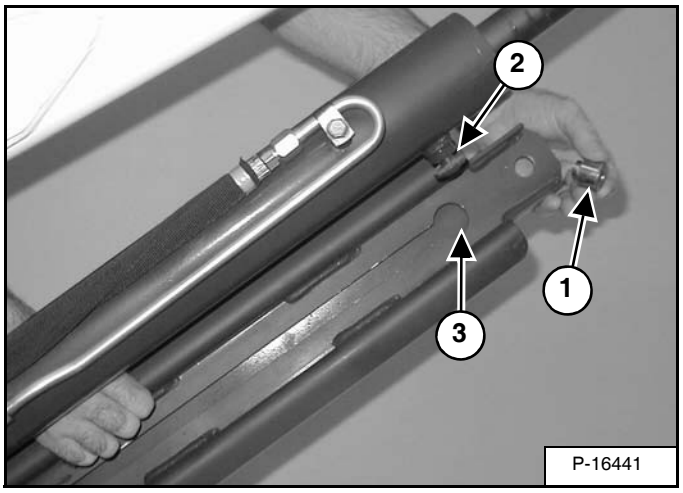
IMPORTANT

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.

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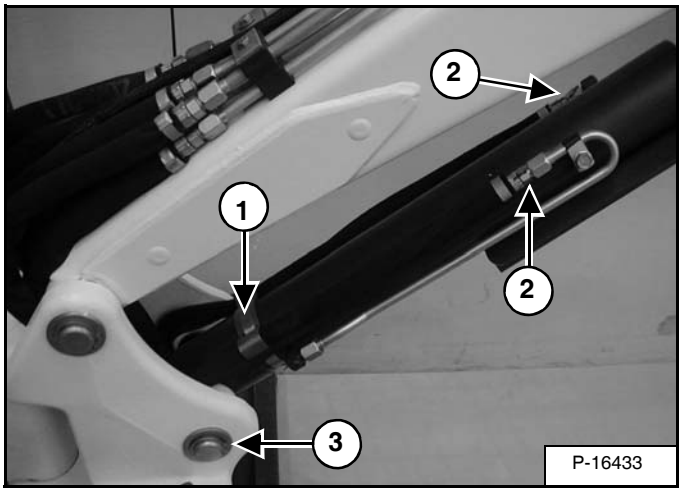
Remove the boom shield mounting bolt (Item 1) **[Figure 20-20-7]**.

Figure 20-20-8



Remove the spacer (Item 1) and slide the shield down until the shield can be removed from boom cylinder shield mounting stud (Item 2). The shield will come out of the key hole (Item 3) **[Figure 20-20-8]**.

Figure 20-20-9



Remove hose retainer clamp (Item 1) **[Figure 20-20-9]** from hoses and cylinder.

Disconnect and cap the two hoses (Item 2) **[Figure 20-20-9]** from the boom cylinder.

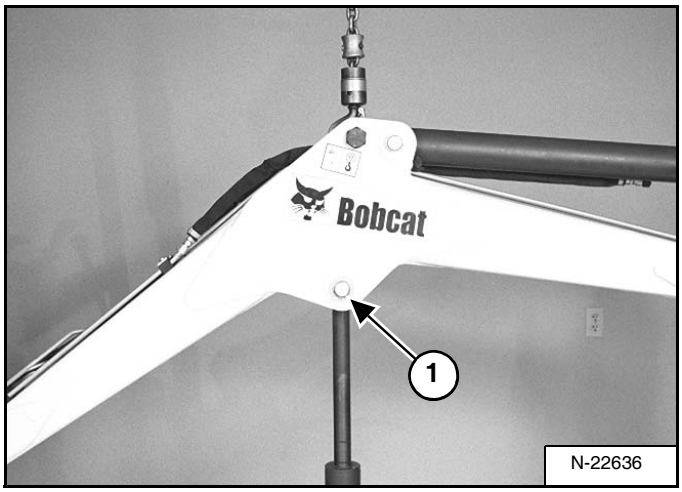
Remove the snap ring (Item 3) **[Figure 20-20-9]** and washers from the boom cylinder base end pin.

Remove the cylinder base end pin.

Lower the base end of the cylinder to the floor.

Removal and Installation (Cont'd)

Figure 20-20-10



Remove the snap ring (Item 1) **[Figure 20-20-10]** and washer from the cylinder rod end pin.

Remove the cylinder rod end pin. Remove the boom cylinder from the boom.

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

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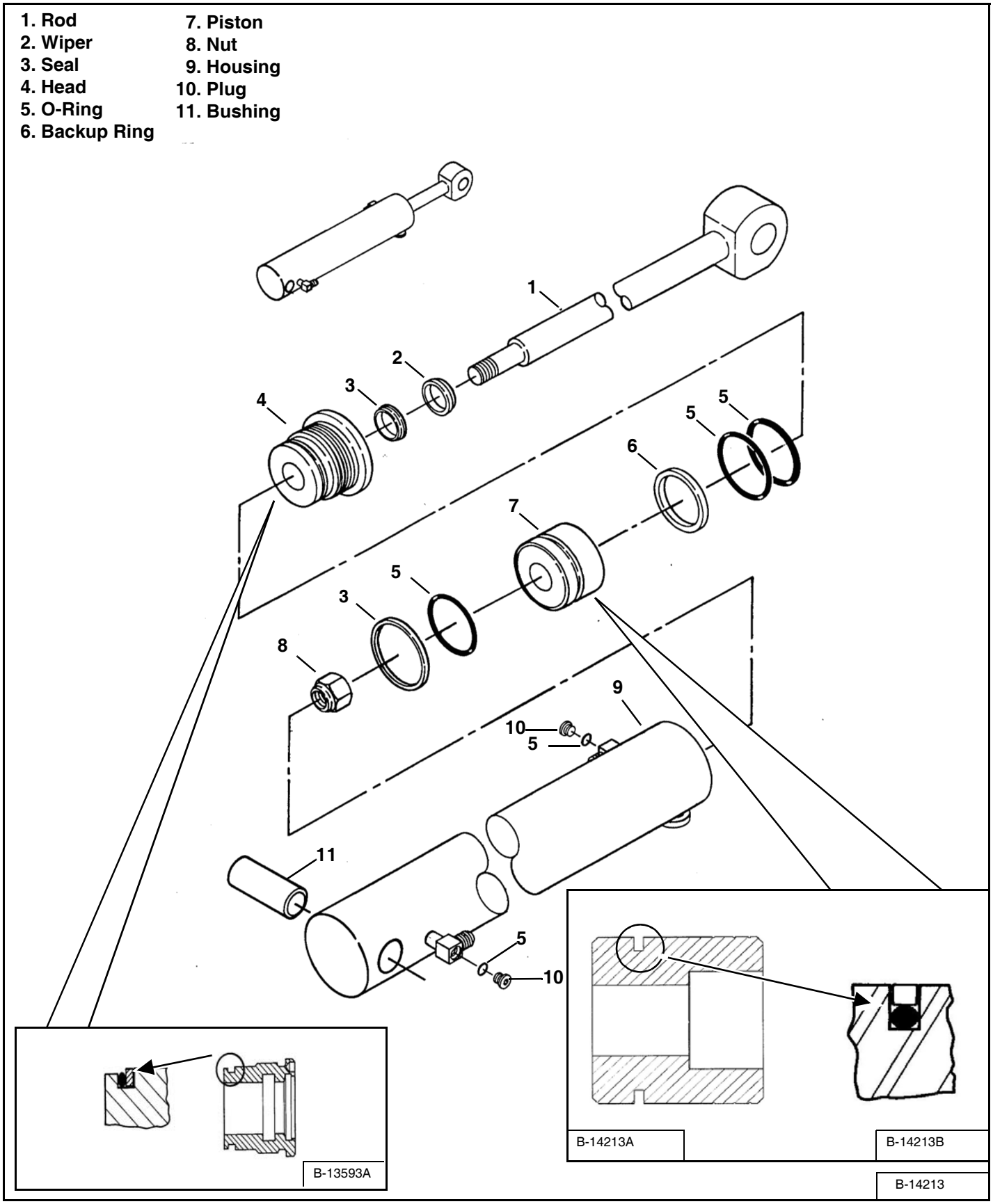
⚠ WARNING

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 which can result in injury or death.

W-2103-1285

Parts Identification

1. Rod
2. Wiper
3. Seal
4. Head
5. O-Ring
6. Backup Ring
7. Piston
8. Nut
9. Housing
10. Plug
11. Bushing



BOOM CYLINDER (CONT'D)

Disassembly

Clean the outside of the boom cylinder before disassembly.

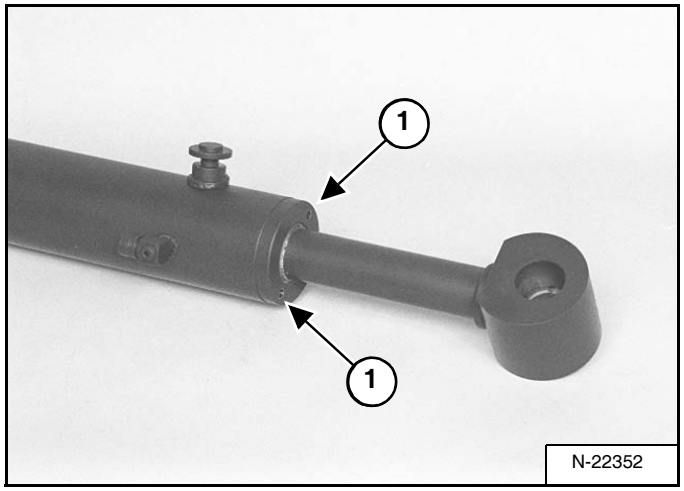
Use the following tools to disassemble the cylinder:

MEL1074 - O-ring Seal Hook
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-1 - Standard Pins

Hold the hydraulic cylinder over a drain pan and move the rod in and out slowly to remove the fluid from the cylinder.

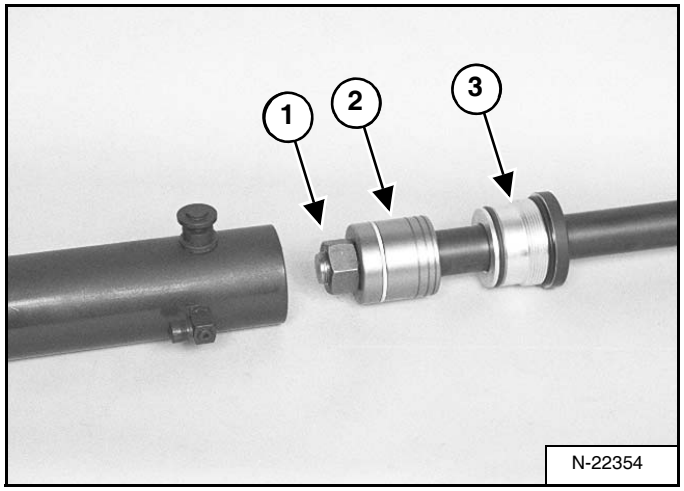
Put the base end of the cylinder in a vise.

Figure 20-20-11



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-20-11]** to loosen the head.

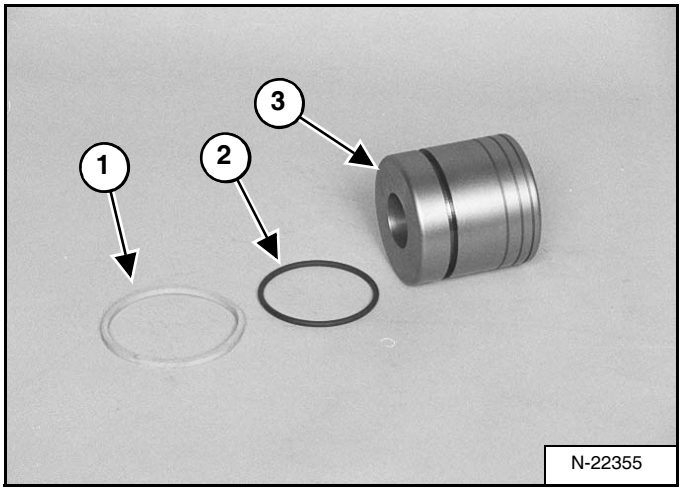
Figure 20-20-12



Remove the head and the rod assembly from the cylinder **[Figure 20-20-12]**. Put the rod end in a vise.

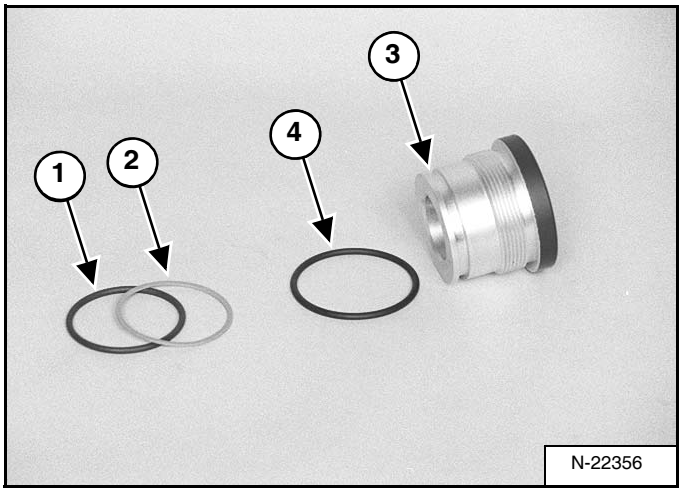
Remove the nut (Item 1), piston (Item 2) and head (Item 3) **[Figure 20-20-12]**.

Figure 20-20-13



Cushion Piston: Remove the seal (Item 1) and O-ring (Item 2) from the piston (Item 3) **[Figure 20-20-13]**.

Figure 20-20-14

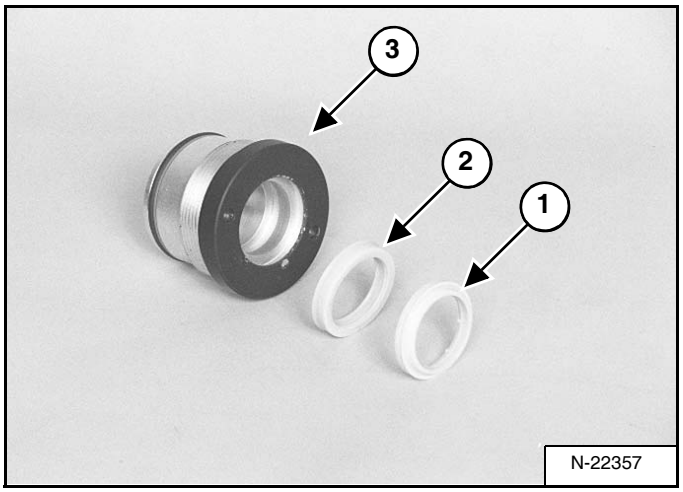


Remove the O-ring (Item 1) and the back-up ring (Item 2) from the groove in the head (Item 3) **[Figure 20-20-14]**.

Remove the O-ring (Item 4) **[Figure 20-20-14]**.

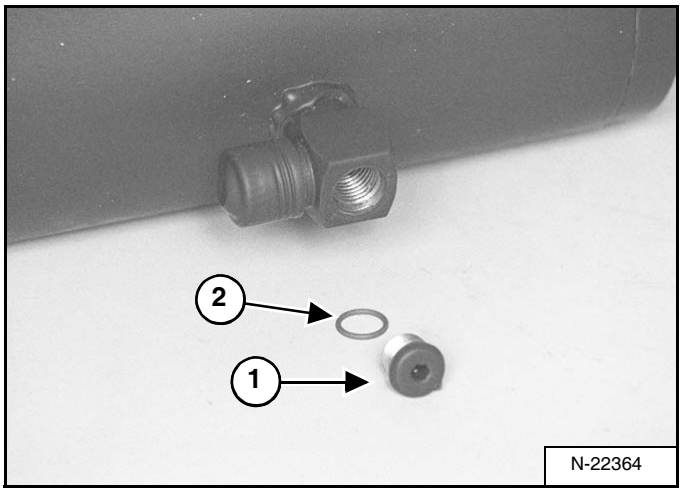
Disassembly (Cont'd)

Figure 20-20-15



Remove the wiper seal (Item 1) and rod seal (Item 2) from the inside of the head (Item 3) **[Figure 20-20-15]**.

Figure 20-20-16



Remove plug (Item 1) and O-ring (Item 2) **[Figure 20-20-16]**.

Assembly

Use the following tools to assemble the cylinder:

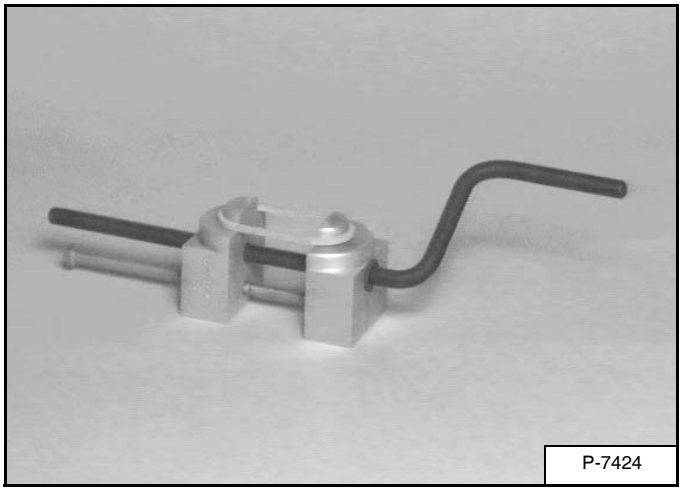
MEL1396 - Universal Seal Expander
MEL1033 - Rod Seal Installation Tool
Piston Ring Compressor
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-1 - Standard Pins

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-20-17

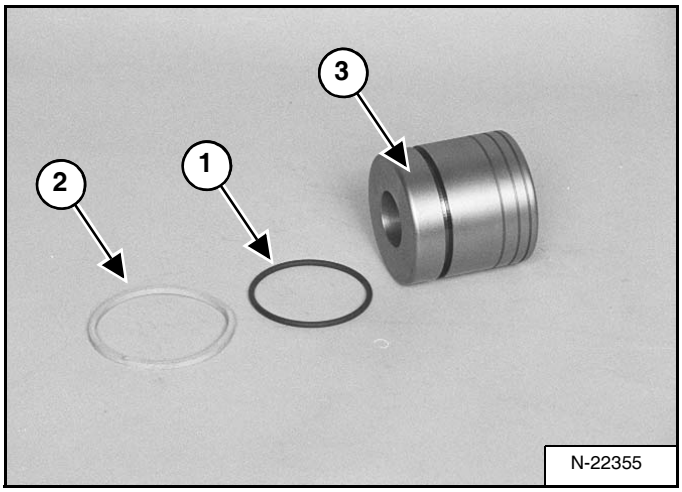


Install new seal on the tool and slowly stretch it until it fits the piston **[Figure 20-20-17]**.

Allow the seal to stretch for 30 seconds before installing it on the piston.

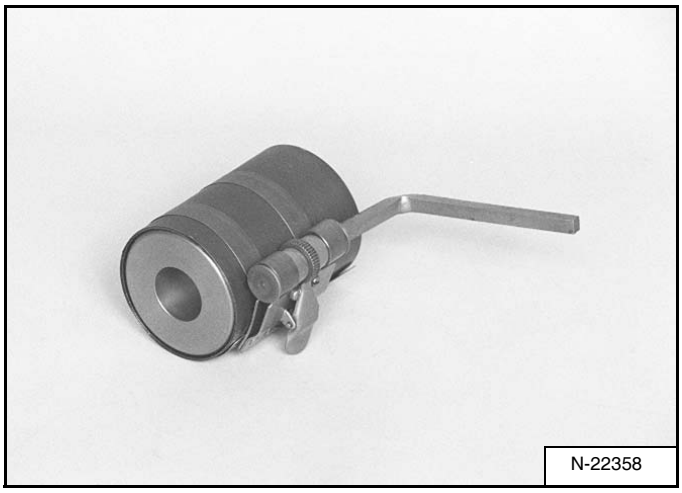
Assembly (Cont'd)

Figure 20-20-18



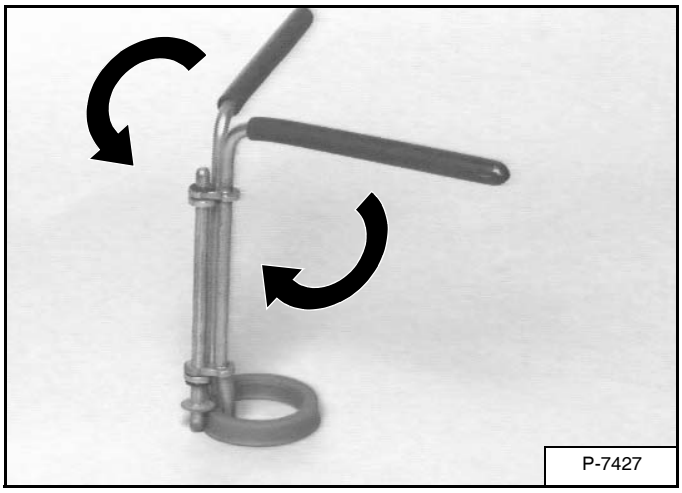
Cushion Piston: Install the O-ring (Item 1) and seal (Item 2) on the piston (Item 3) **[Figure 20-20-18]**.

Figure 20-20-19



Use a ring compressor to compress the seal to the correct size. Leave the piston in the compressor for about three minutes **[Figure 20-20-19]**.

Figure 20-20-20

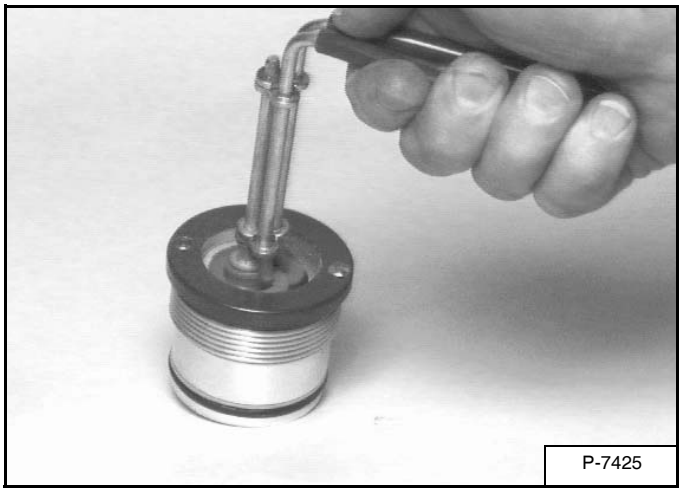


Install the rod seal on the rod seal tool **[Figure 20-20-20]**.

NOTE: During installation the spring side of the seal must be toward the inside of the cylinder.

Rotate the handles to collapse the rod seal **[Figure 20-20-20]**.

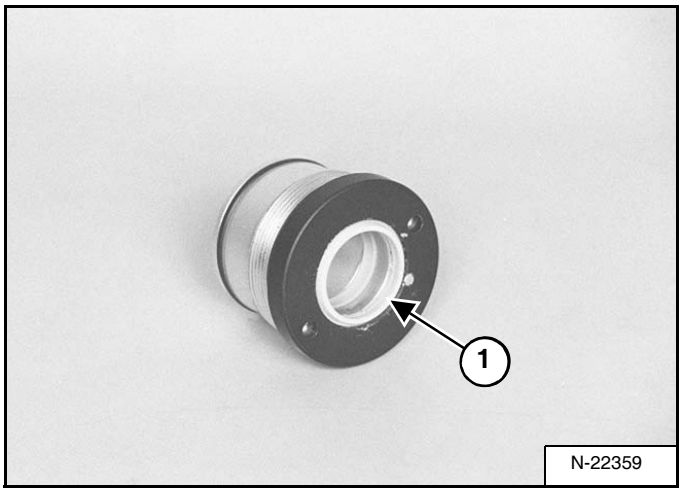
Figure 20-20-21



Install the rod seal in the head **[Figure 20-20-21]**.

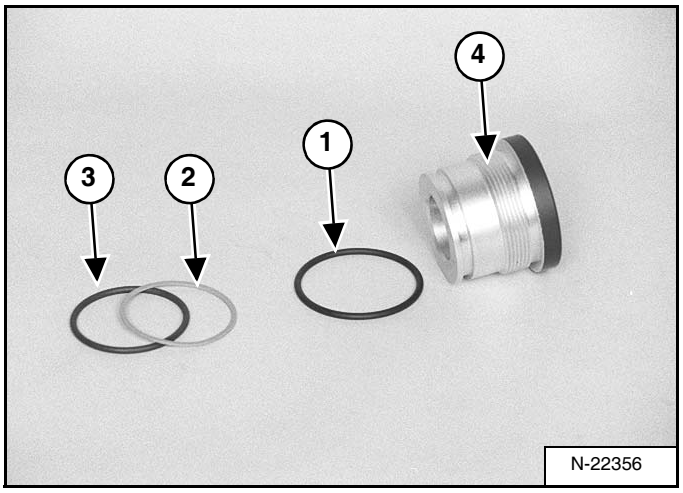
Assembly (Cont'd)

Figure 20-20-22



Install the wiper seal with the wiper (Item 1) **[Figure 20-20-22]** toward the outside of the head.

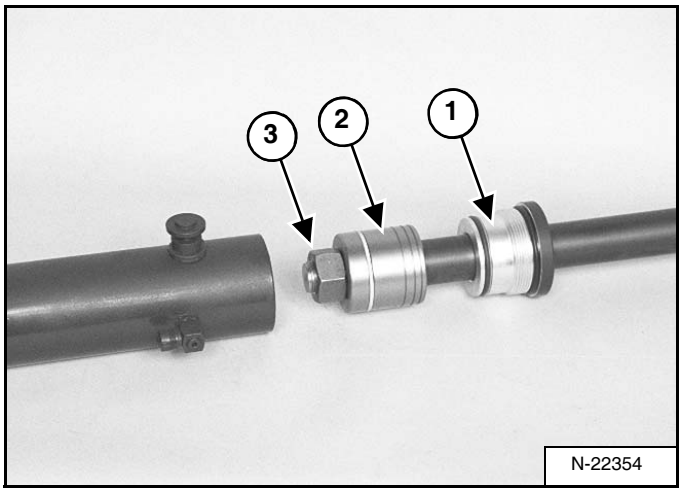
Figure 20-20-23



Install the O-ring (Item 1) **[Figure 20-20-23]**.

Install the back-up ring (Item 2) and O-ring (Item 3) into the groove on the head (Item 4) **[Figure 20-20-23]**.

Figure 20-20-24



Install the head (Item 1) and the piston (Item 2) **[Figure 20-20-24]** on the rod as shown.

Grease the piston where the nut contacts the piston. Do not get grease on the threads.

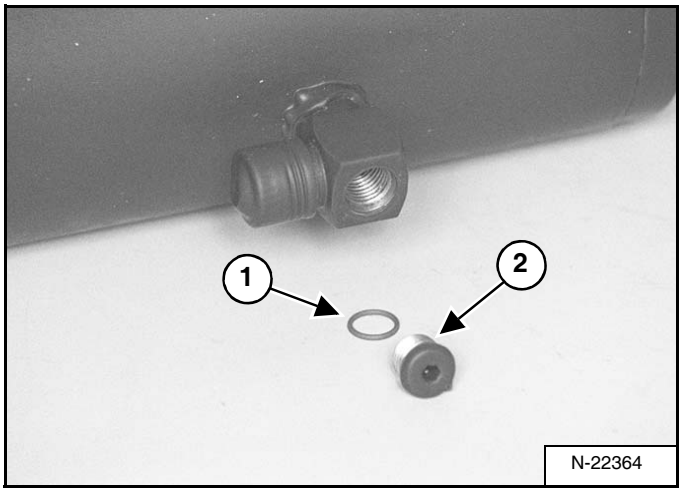
Provide an adequate support for the cylinder before tightening.

Install the nut (Item 3) **[Figure 20-20-24]**.

NOTE: Clean and dry the rod threads, from the kit install a NEW NUT with pre-applied LOCTITE.

Tighten the nut to 600 ft.-lbs. (813 Nm) torque.

Figure 20-20-25



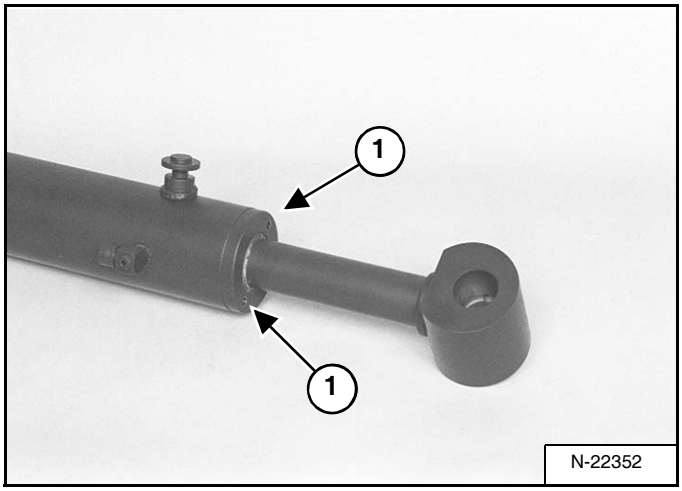
Install the O-ring (Item 1) and plug (Item 2) **[Figure 20-20-25]**.

Tighten the plug to 8 ft.-lbs. (11 Nm) torque.

Assembly (Cont'd)

Put the base end of the hydraulic cylinder in a vise.

Figure 20-20-26



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-20-26]** to tighten the head. Head to be torqued until flush with end of the housing.

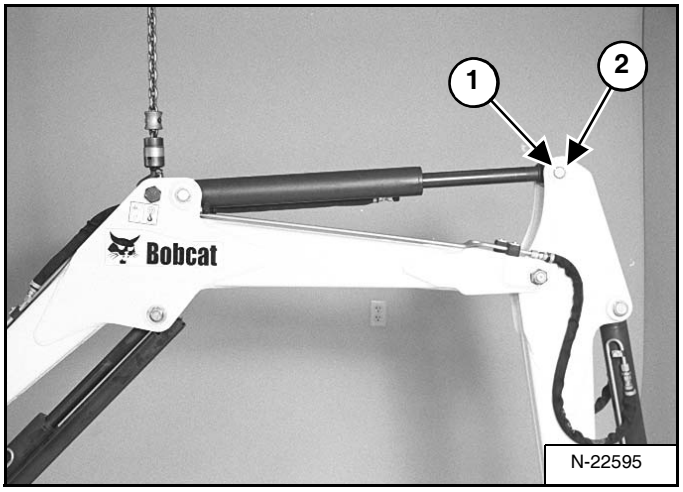
ARM CYLINDER

Testing

Lower the boom/bucket and blade to the ground.

Stop the engine. Raise the control console.

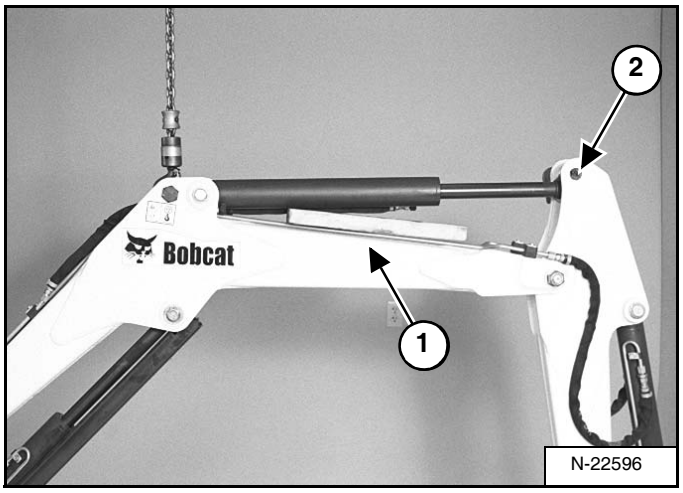
Figure 20-21-1



Support the boom using a chain hoist **[Figure 20-21-1]**.

Remove the retaining ring (Item 1) and washer (Item 2) **[Figure 20-21-1]** from the rod end pivot pin.

Figure 20-21-2



Support the arm cylinder (Item 1) **[Figure 20-21-2]**.

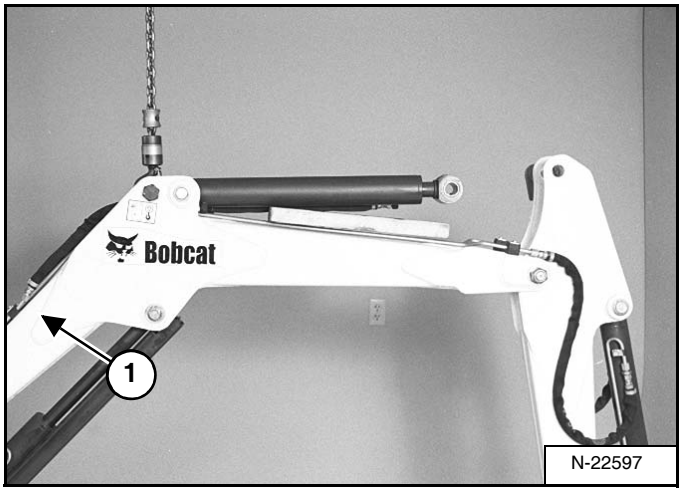
Remove the pivot pin (Item 2) **[Figure 20-21-2]**.

⚠ WARNING

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Figure 20-21-3



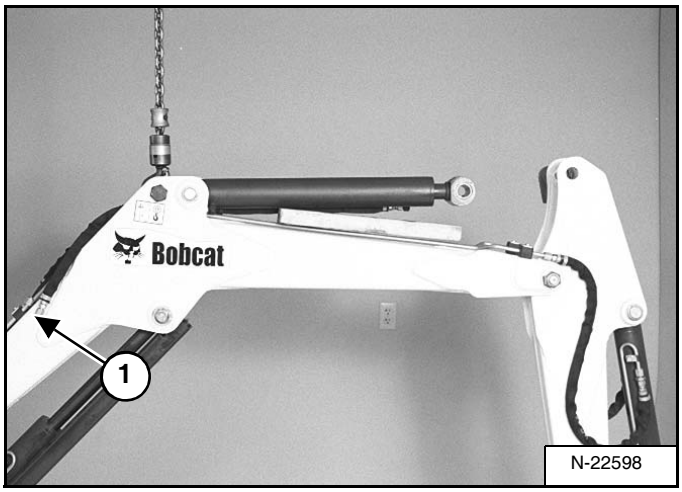
Lower control console and fasten the seat belt. Start the engine and retract the arm cylinder **[Figure 20-21-3]**.

Stop the engine. With the key in the ON position, move the hydraulic controls to release the hydraulic pressure. Raise the control console.

Disconnect the arm cylinder base end hose (Item 1) **[Figure 20-21-3]** back at the hose tubeline connection.

Testing (Cont'd)

Figure 20-21-4



Install a plug (Item 1) **[Figure 20-21-4]** on the tubeline and tighten.

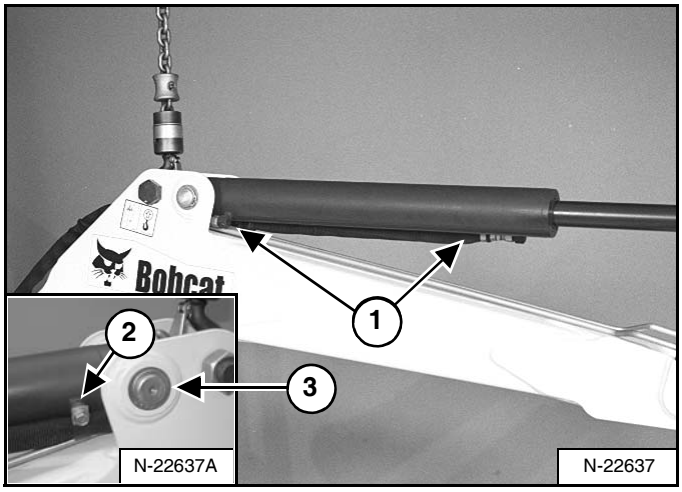
Lower control console and fasten the seat belt. Start the engine and retract the arm cylinder.

If there is any leakage from the base end hose on the arm cylinder, remove the cylinder for repair or replacement.

Removal and Installation

Lower the boom/bucket and blade to the ground. Stop the engine.

Figure 20-21-5



Support the boom using a chain hoist **[Figure 20-21-5]**.

With the key in the ON position, move the hydraulic controls to release the hydraulic pressure.

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.

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Remove and plug the two hoses (Item 1) **[Figure 20-21-5]** from the arm cylinder.

Remove the hose clamp (Item 2) **[Figure 20-21-5]** from the arm cylinder.

Remove the snap ring (Item 3) **[Figure 20-21-5]** and washer from the boom cylinder base end pin.

Remove the cylinder base end pin.

Removal And Installation (Cont'd)

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

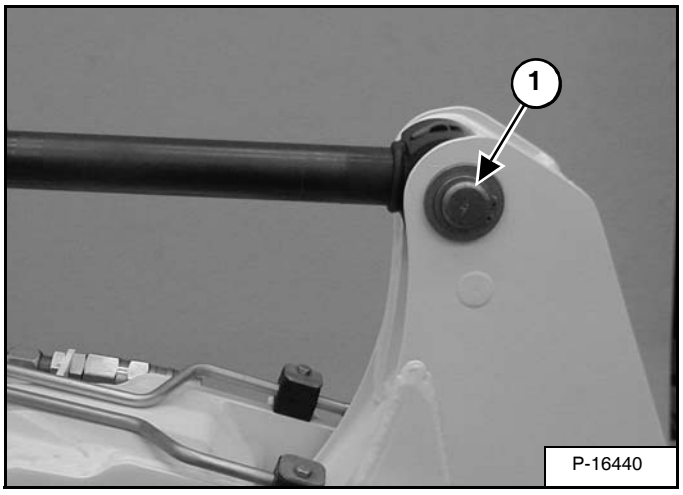
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⚠ WARNING

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 which can result in injury or death.

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Figure 20-21-6



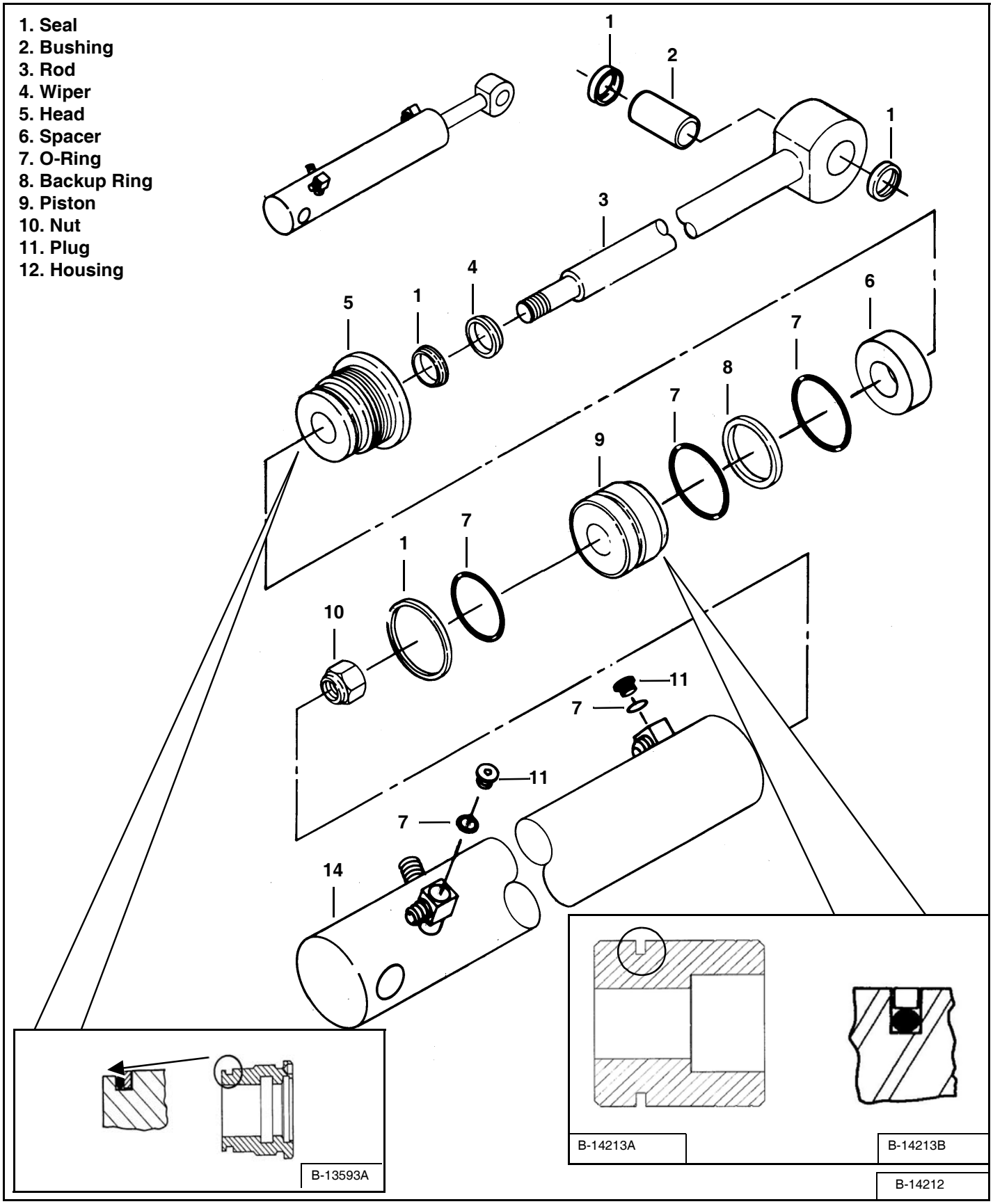
Remove the snap ring (Item 1) **[Figure 20-21-6]** and washer from the cylinder rod end pin.

Remove the cylinder rod end pin.

Remove the cylinder from the arm.

Parts Identification

1. Seal
2. Bushing
3. Rod
4. Wiper
5. Head
6. Spacer
7. O-Ring
8. Backup Ring
9. Piston
10. Nut
11. Plug
12. Housing



ARM CYLINDER (CONT'D)

Disassembly

Clean the outside of the arm cylinder before disassembly.

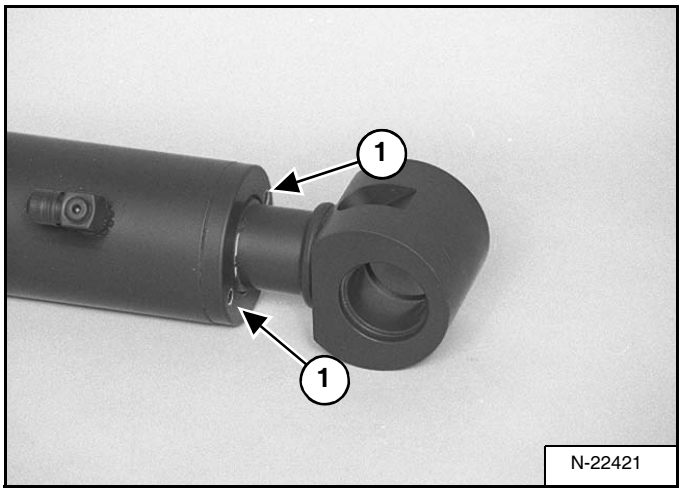
Use the following tools to disassemble the cylinder:

MEL1074 - O-ring Seal Hook
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-2 - Special Offset Pins

Hold the hydraulic cylinder over a drain pan and move the rod in and out slowly to remove the fluid from the cylinder.

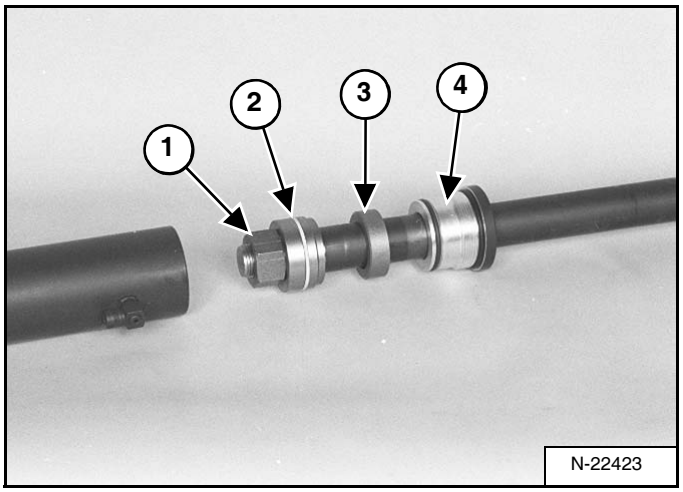
Put the base end of the cylinder in a vise.

Figure 20-21-7



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-21-7]** to loosen the head.

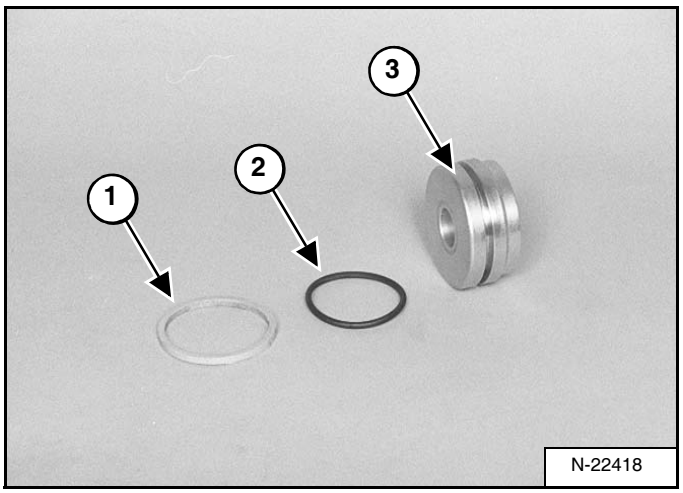
Figure 20-21-8



Remove the head and the rod assembly from the cylinder **[Figure 20-21-8]**. Put the rod end in a vise.

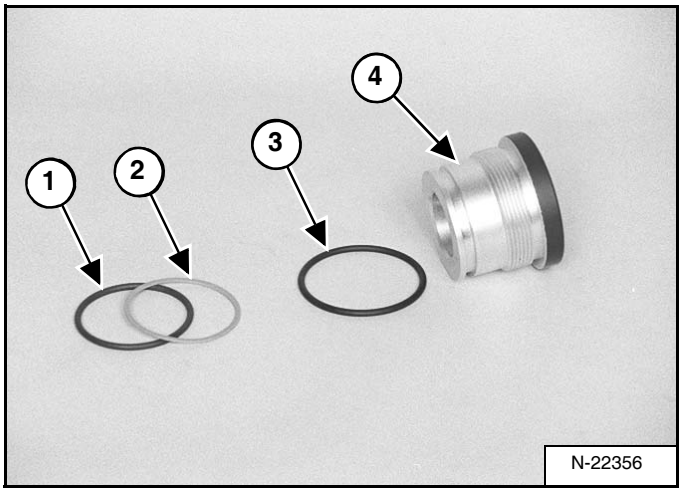
Remove the nut (Item 1), piston (Item 2), spacer (Item 3) **[Figure 20-21-8]** and head (Item 4) **[Figure 20-21-8]**.

Figure 20-21-9



Standard Piston: Remove the seal (Item 1) and O-ring (Item 2) from the piston (Item 3) **[Figure 20-21-9]**.

Figure 20-21-10

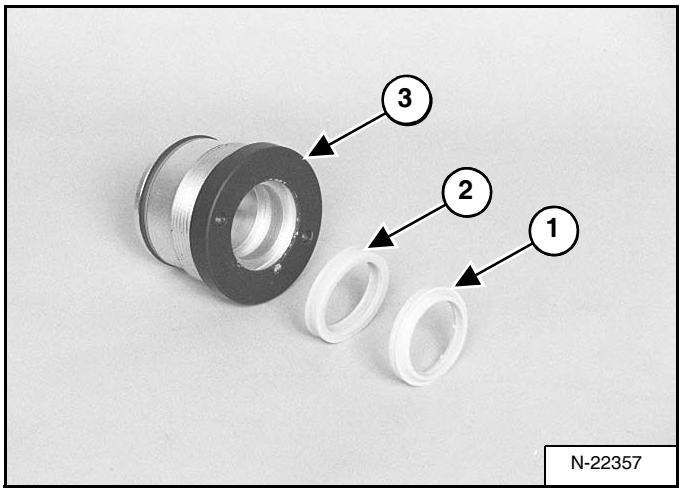


Remove the O-ring (Item 1) and the back-up ring (Item 2) from the groove in the head (Item 3) **[Figure 20-21-10]**.

Remove the O-ring (Item 4) **[Figure 20-21-10]**.

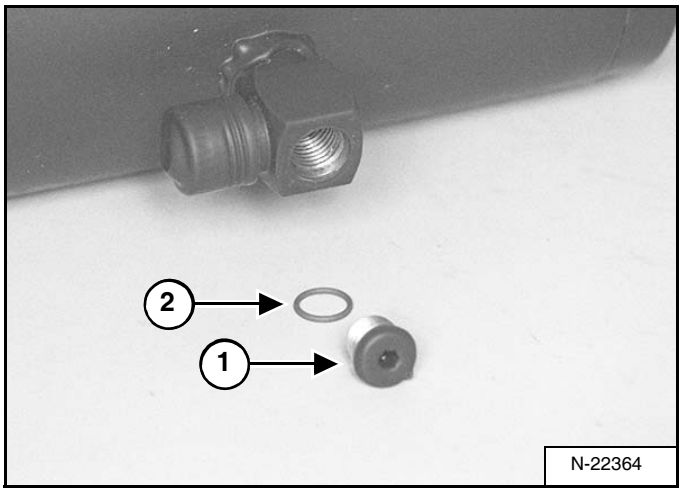
Disassembly (Cont'd)

Figure 20-21-11



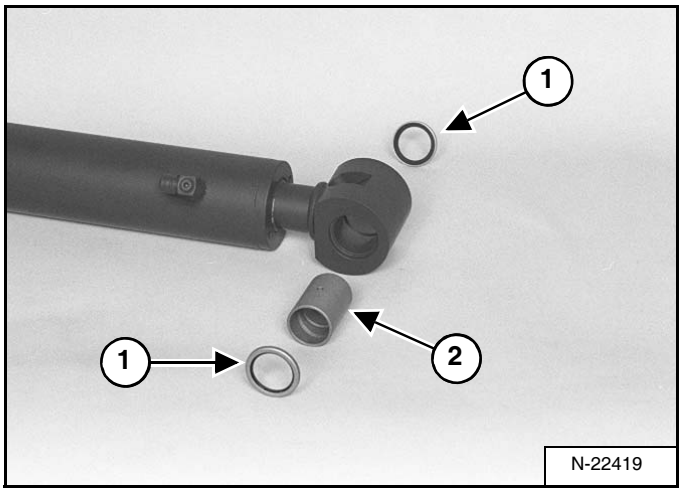
Remove the wiper seal (Item 1) and rod seal (Item 2) from the inside of the head (Item 3) **[Figure 20-21-11]**.

Figure 20-21-12



Remove plug (Item 1) and O-ring (Item 2) **[Figure 20-21-12]**.

Figure 20-21-13



Remove the seals (Item 1) and bushing (Item 2) **[Figure 20-21-13]**.

Assembly

Use the following tools to assemble the cylinder:

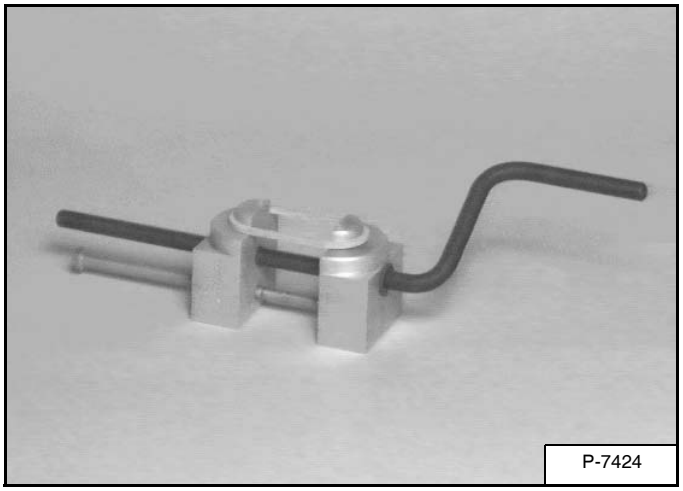
MEL1396 - Universal Seal Expander
MEL1033 - Rod Seal Installation Tool
Piston Ring Compressor
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-2 - Special Offset Pins

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

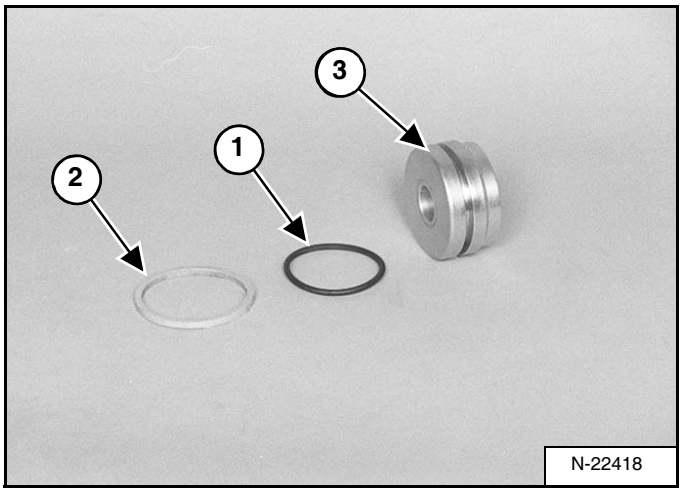
Figure 20-21-14



Install the seal on the tool and slowly stretch it until it fits the piston **[Figure 20-21-14]**.

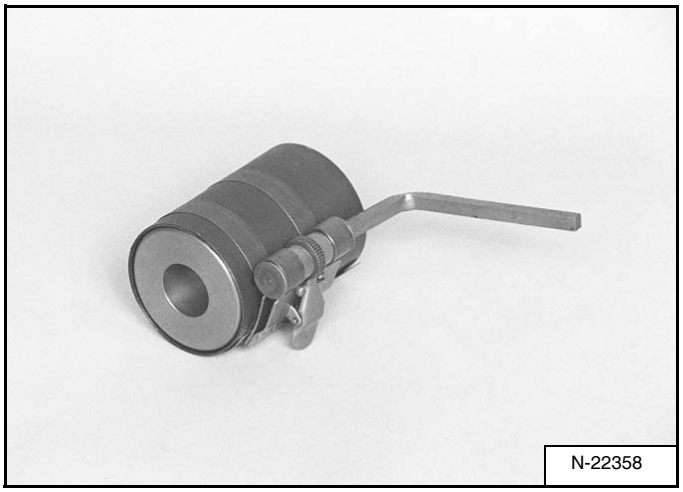
Allow the seal to stretch for 30 seconds before installing it on the piston.

Figure 20-21-15



Standard Piston: Install the O-ring (Item 1) and seal (Item 2) on the piston (Item 3) **[Figure 20-21-15]**.

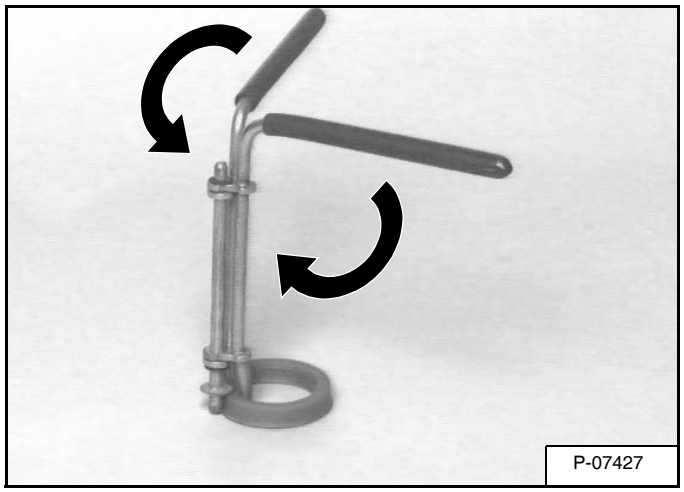
Figure 20-21-16



Use a ring compressor to compress the seal to the correct size. Leave the piston in the compressor for about three minutes **[Figure 20-21-16]**.

Assembly (Cont'd)

Figure 20-21-17

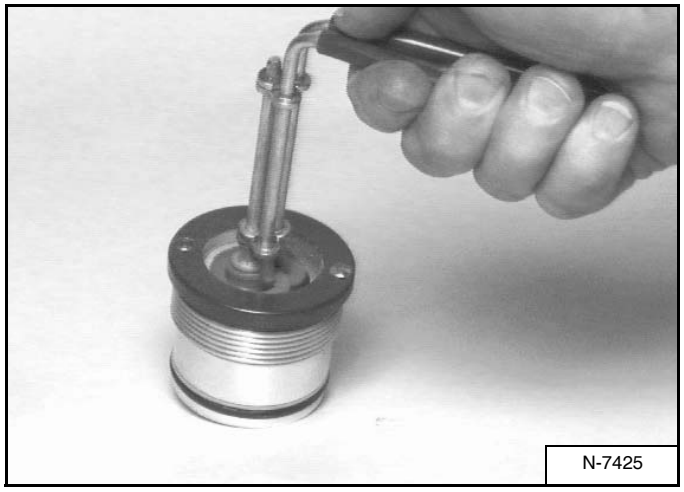


Install the rod seal on the rod seal tool **[Figure 20-21-17]**.

NOTE: During installation the spring side of the seal must be toward the inside of the cylinder.

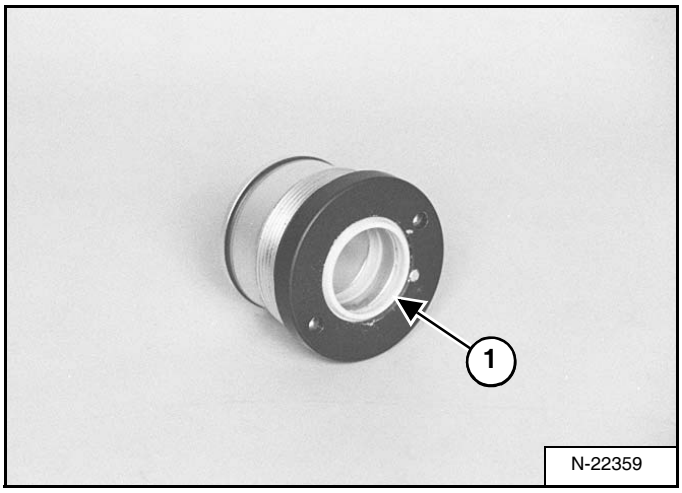
Rotate the handles to collapse the rod seal **[Figure 20-21-17]**.

Figure 20-21-18



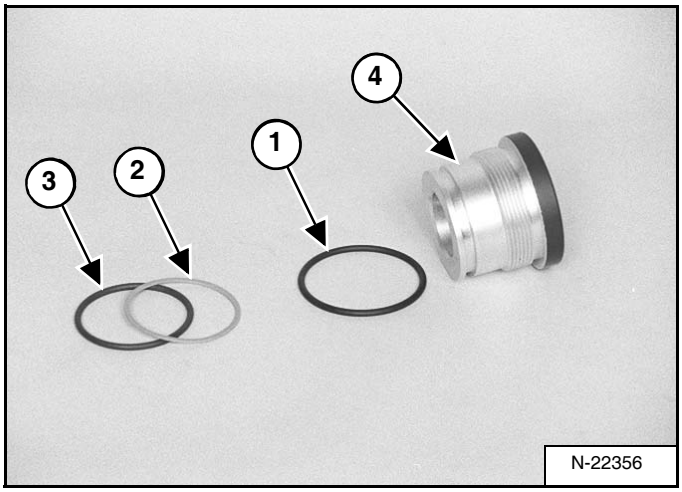
Install the rod seal in the head **[Figure 20-21-18]**.

Figure 20-21-19



Install the wiper seal with the wiper (Item 1) **[Figure 20-21-19]** toward the outside of the head.

Figure 20-21-20



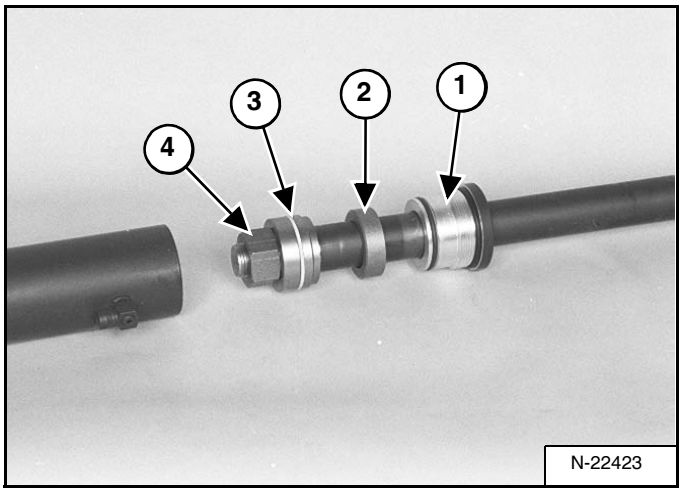
Install the O-ring (Item 1) **[Figure 20-21-20]**.

Install the back-up ring (Item 2) and O-ring (Item 3) into the groove on the head (Item 4) **[Figure 20-21-20]**.

ARM CYLINDER (CONT'D)

Assembly (Cont'd)

Figure 20-21-21



Install the head (Item 1), spacer (Item 2) and the piston (Item 3) **[Figure 20-21-21]** on the rod.

Grease the piston where the nut contacts the piston. Do not get grease on the threads.

Provide an adequate support for the cylinder before tightening.

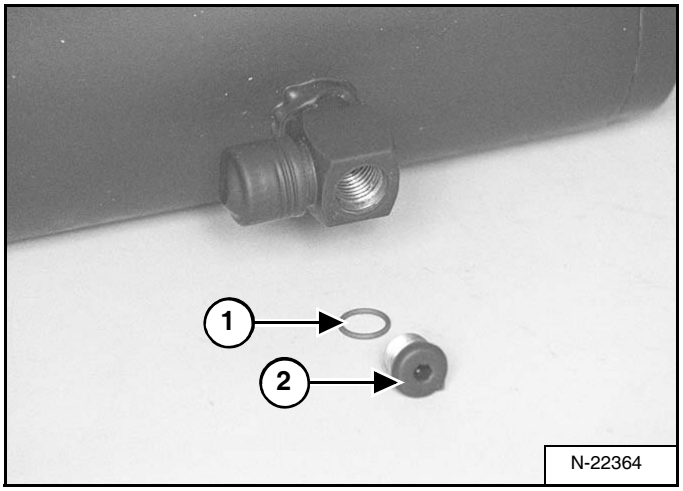
Install the nut (Item 4) **[Figure 20-21-21]**.

NOTE: Clean and dry the rod threads, from the kit install a NEW NUT with pre-applied LOCTITE.

Reclean thread area for LOCTITE residue.

Tighten the nut to 850 ft.-lbs. (1152 Nm) torque.

Figure 20-21-22

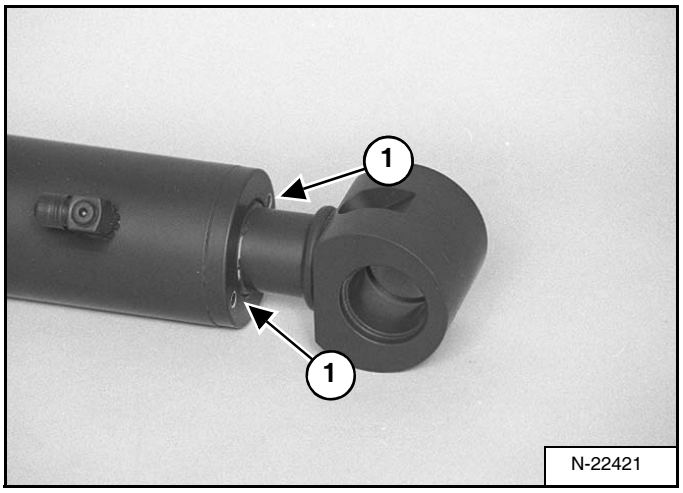


Install the O-ring (Item 1) and plug (Item 2) **[Figure 20-21-22]**.

Tighten the plug to 8 ft.-lbs. (11 Nm) torque.

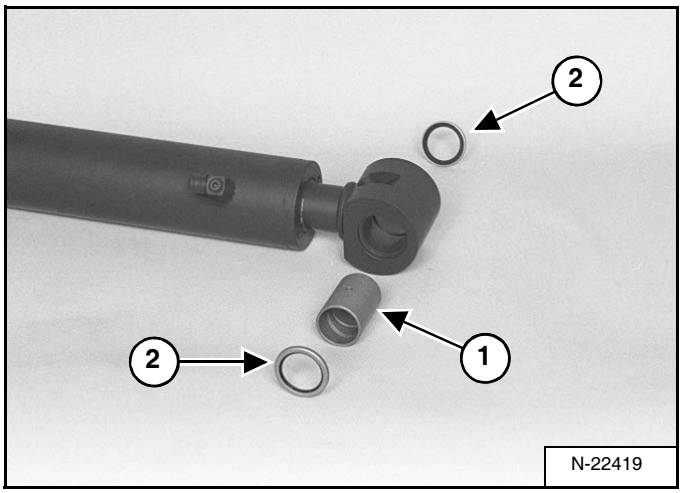
Put the base end of the hydraulic cylinder in a vise.

Figure 20-21-23



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-21-23]** to tighten the head. Head to be torqued until flush with end of the housing.

Figure 20-21-24



Install the bushing (Item 1) **[Figure 20-21-24]**. The bushing must be aligned with the grease channel in the rod end of the cylinder.

Install the seals (Item 2) **[Figure 20-21-24]** with the lips facing out.


Bobcat®

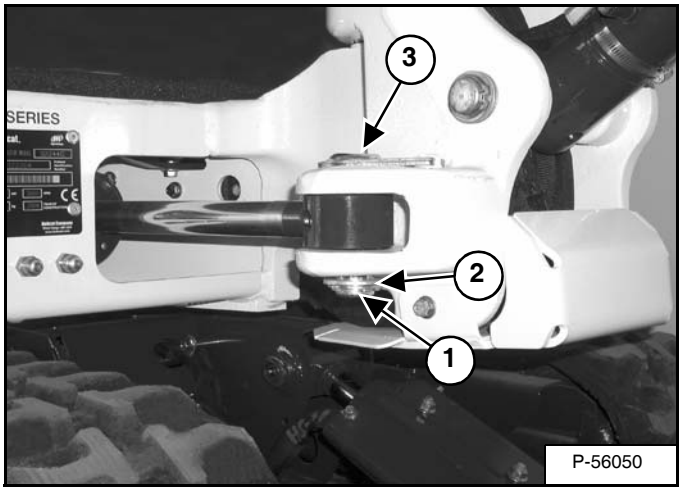
BOOM SWING CYLINDER

Testing

Lower the boom/bucket and blade to the ground.

Stop the engine. Raise the control console.

Figure 20-22-1



Remove the retaining ring (Item 1) and washers (Item 2) from the rod end pivot pin (Item 3) **[Figure 20-22-1]**.

Remove the pivot pin.

Figure 20-22-2



Lower the control console and fasten the seat belt. Start the engine and retract the swing cylinder **[Figure 20-22-2]**.

Stop the engine. With the key in the ON position, move the hydraulic controls to release the hydraulic pressure. Raise the control console.

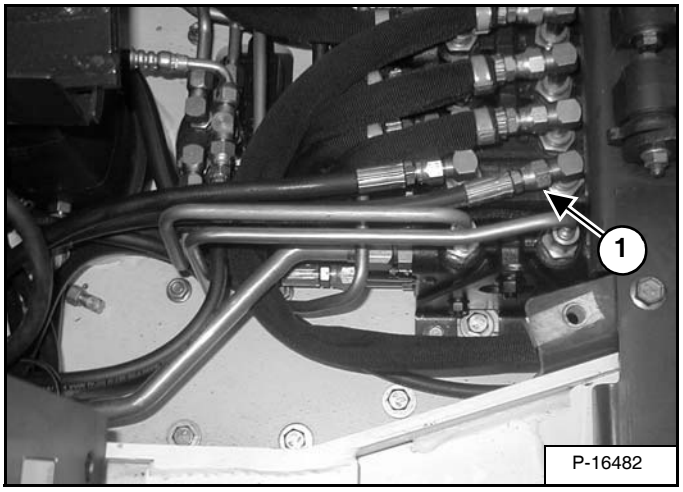
Figure 20-22-3



Support the rod end of the cylinder **[Figure 20-22-3]**

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

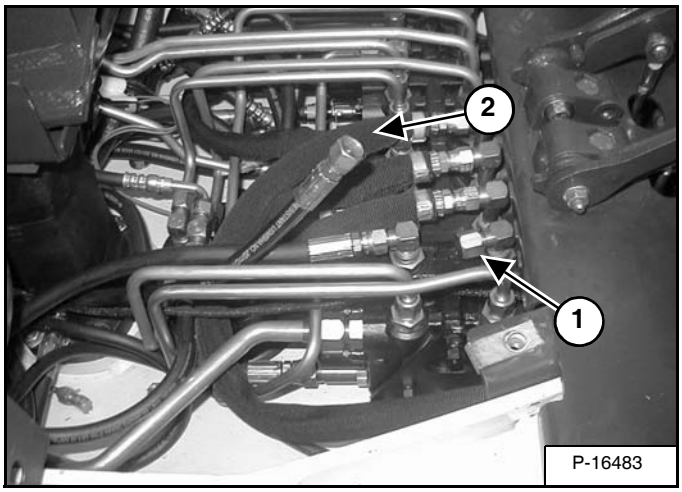
Figure 20-22-4



Remove the base end hose (Item 1) **[Figure 20-22-4]** at the control valve assembly connection.

Testing (Cont'd)

Figure 20-22-5



Install a cap (Item 1) **[Figure 20-22-5]** on the control valve assembly fitting and tighten.

Lower control console and fasten the seat belt. Start the engine and retract the cylinder.

If there is any leakage from the base end hose (Item 2) **[Figure 20-22-5]** on the cylinder, remove the cylinder for repair or replacement.

Removal and Installation

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

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

⚠ WARNING

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 which can result in injury or death.

W-2103-1285

Swing the upperstructure so the pin in the base end of the cylinder is located between the tracks.

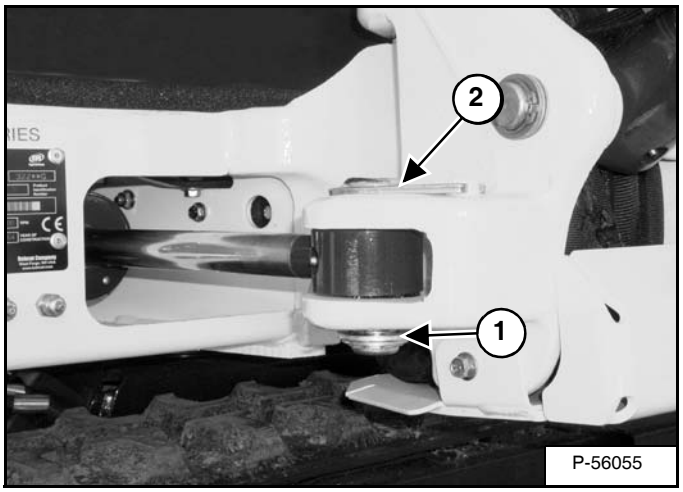
Offset the boom slightly for additional working space.

Lower the boom/bucket and blade to the ground. Stop the engine.

Remove the floormat and floorplate. (See Removal and Installation on Page 40-120-1.)

Removal and Installation (Cont'd)

Figure 20-22-6

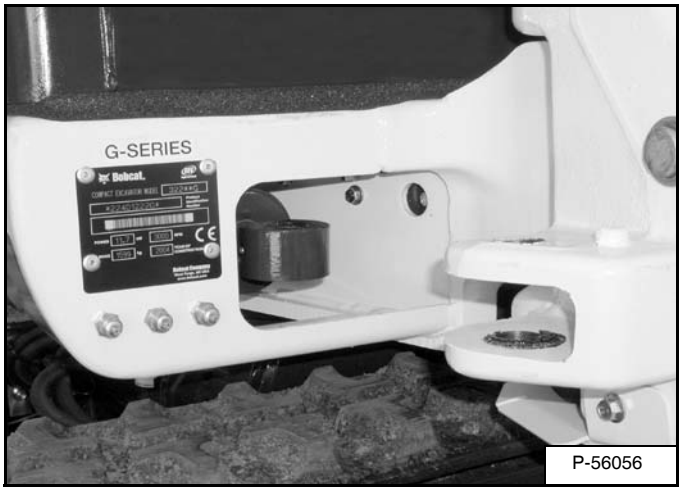


Remove the snap ring (Item 1) **[Figure 20-22-6]** and washers from the rod end pin.

Remove the pivot pin (Item 2) **[Figure 20-22-6]**.

Lower the control console and fasten the seat belt.

Figure 20-22-7



Start the Excavator and fully retract the cylinder **[Figure 20-22-7]**.

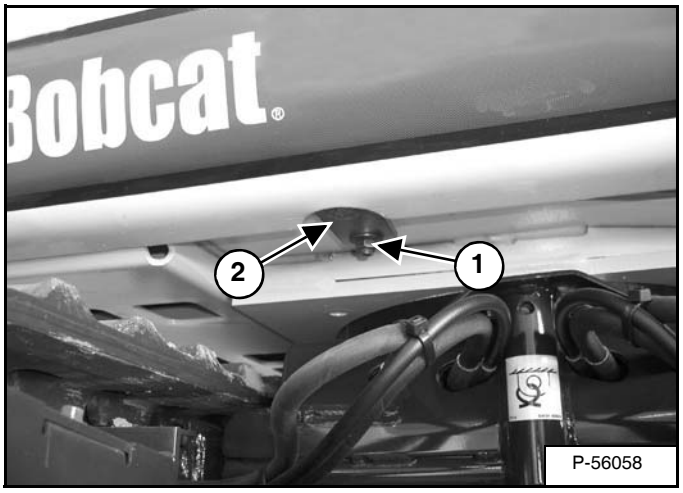
Stop the engine.

Figure 20-22-8



Support the rod end of the cylinder **[Figure 20-22-8]**.

Figure 20-22-9



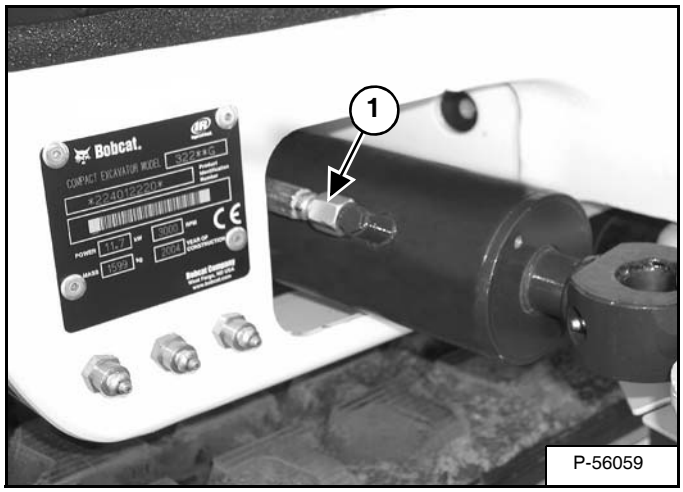
Remove the base end pin retainer bolt, washer and spacer (Item 1) **[Figure 20-22-9]** from under the upperstructure.

Installation: Tighten the bolt to 29-37 ft.-lbs. (39-50 Nm) torque.

Remove the pivot pin (Item 2) **[Figure 20-22-9]** down.

Removal and Installation (Cont'd)

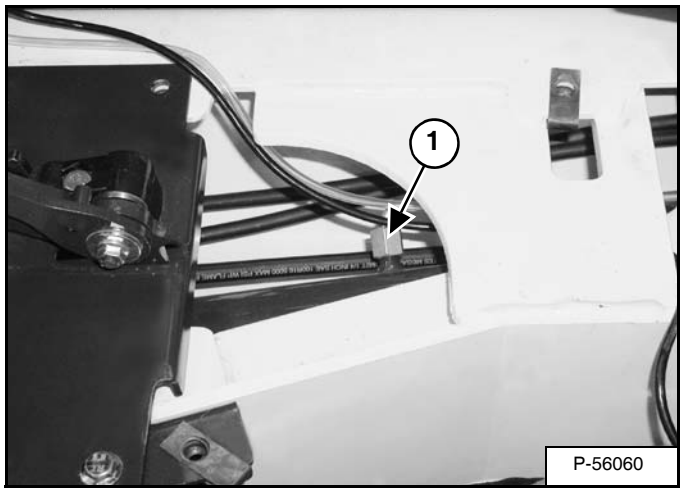
Figure 20-22-10



Slide the cylinder forward **[Figure 20-22-10]**.

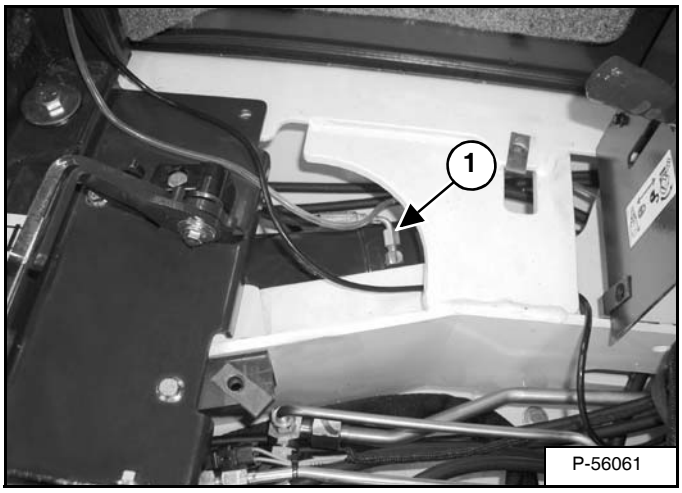
Remove the hose (Item 1) **[Figure 20-22-10]**.

Figure 20-22-11



Remove the hose (Item 1) **[Figure 20-22-11]**.

Figure 20-22-12



Remove the grease hose (Item 1) **[Figure 20-22-12]**.

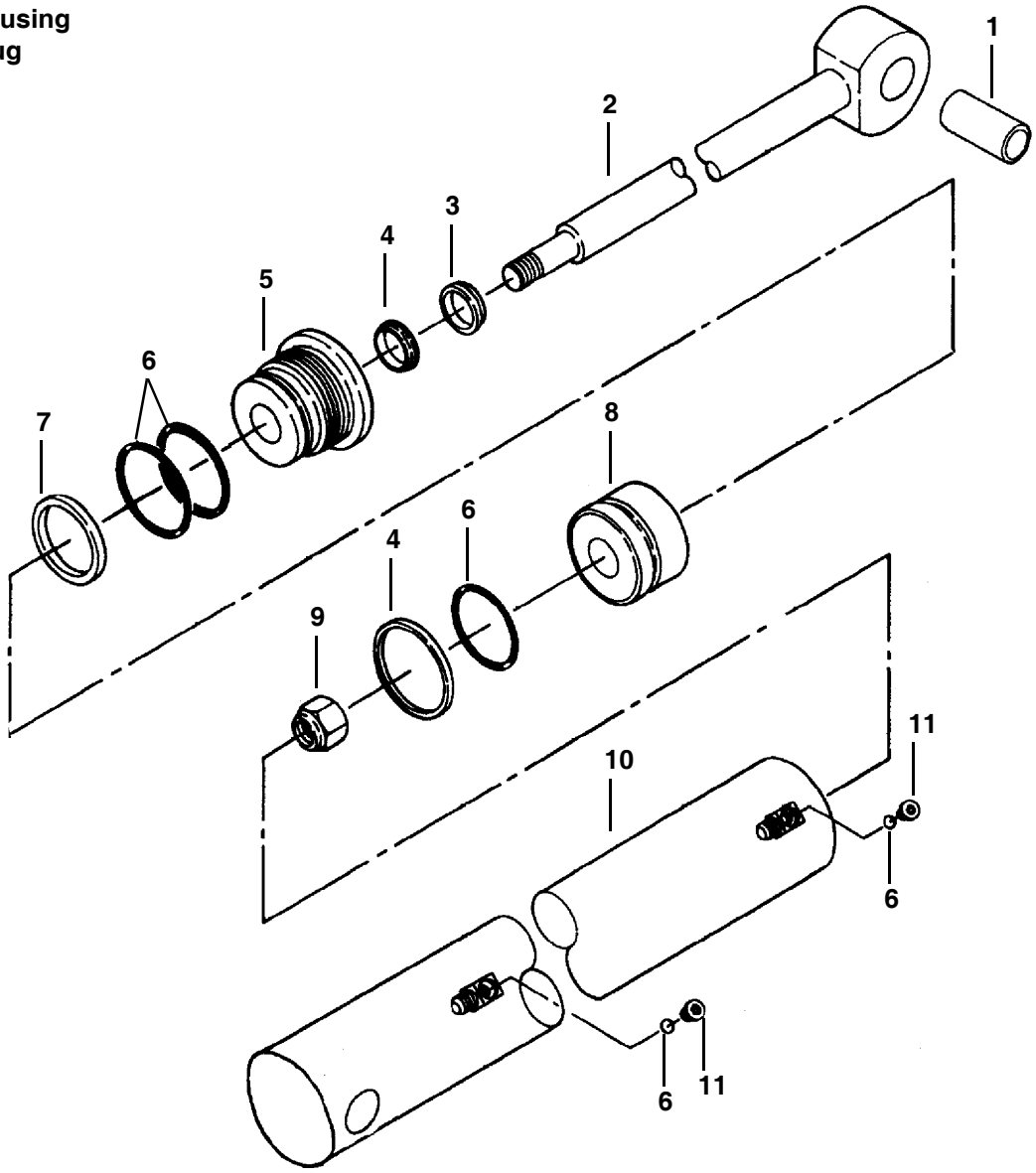
Figure 20-22-13



Slide the cylinder out the front of the Excavator frame **[Figure 20-22-13]**.

Parts Identification

1. Bushing
2. Rod
3. Wiper
4. Seal
5. Head
6. O-Ring
7. Backup Ring
8. Piston
9. Nut
10. Housing
11. Plug



C-3317C

Disassembly

Clean the outside of the boom swing cylinder before disassembly.

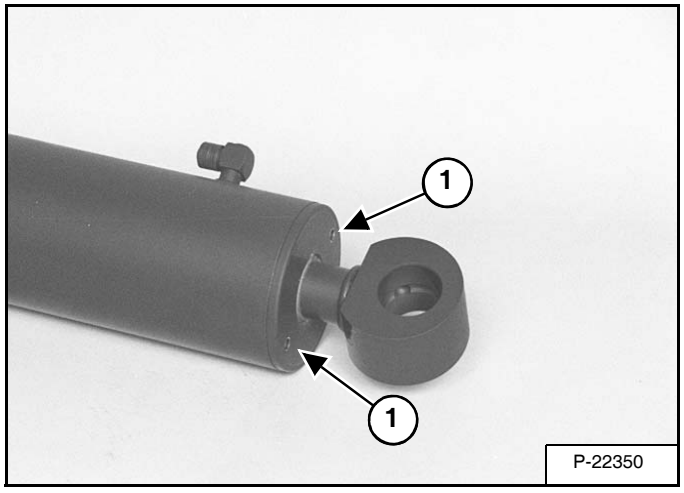
Use the following tools to disassemble the cylinder:

MEL1074 - O-ring Seal Hook
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-1 - Standard Pins

Hold the hydraulic cylinder over a drain pan and move the rod in and out slowly to remove the fluid from the cylinder.

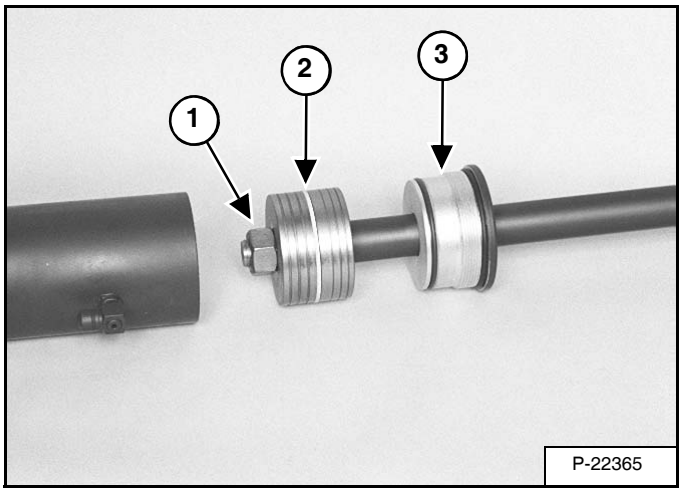
Put the base end of the cylinder in a vise.

Figure 20-22-14



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-22-14]** to loosen the head.

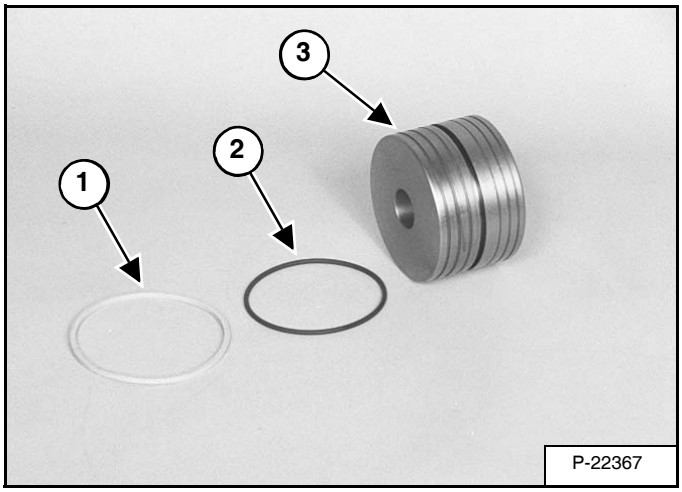
Figure 20-22-15



Remove the head and the rod assembly from the cylinder **[Figure 20-22-15]**. Put the rod end in a vise.

Remove the nut (Item 1), piston (Item 2) and head (Item 3) **[Figure 20-22-15]**.

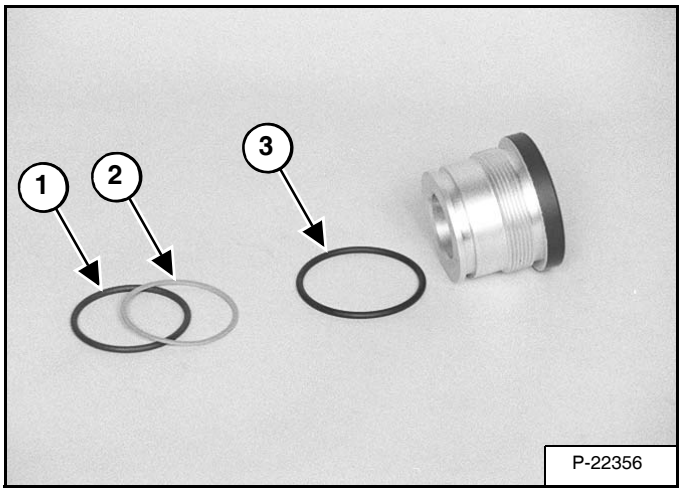
Figure 20-22-16



Remove the seal (Item 1) and O-ring (Item 2) from the piston (Item 3) **[Figure 20-22-16]**.

Disassembly (Cont'd)

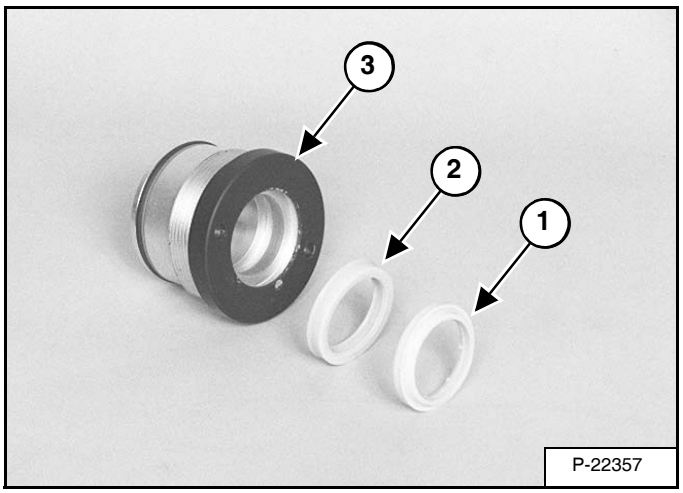
Figure 20-22-17



Remove the O-ring (Item 1) and the back-up ring (Item 2) **[Figure 20-22-17]**.

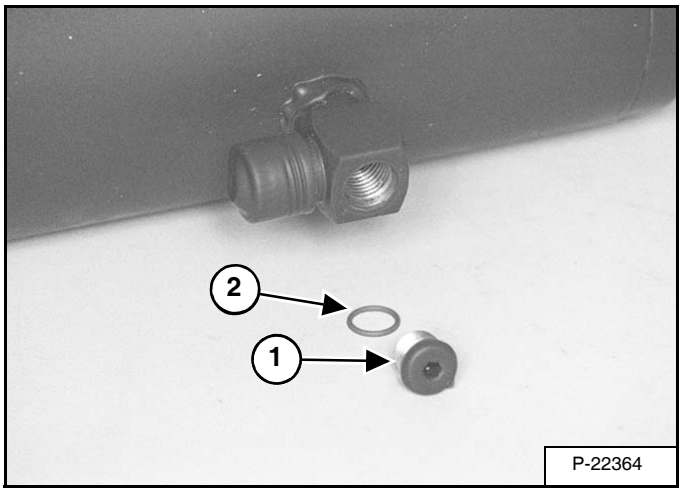
Remove the O-ring (Item 3) **[Figure 20-22-17]**.

Figure 20-22-18



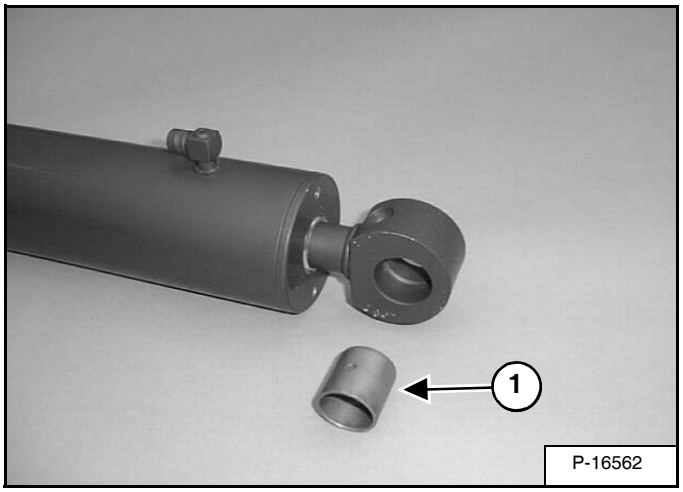
Remove the wiper seal (Item 1) and rod seal (Item 2) from the inside of the head (Item 3) **[Figure 20-22-18]**.

Figure 20-22-19



Remove plug (Item 1) and O-ring (Item 2) **[Figure 20-22-19]**.

Figure 20-22-20



Remove the bushing (Item 1) **[Figure 20-22-20]**.

Assembly

Use the following tools to assemble the cylinder:

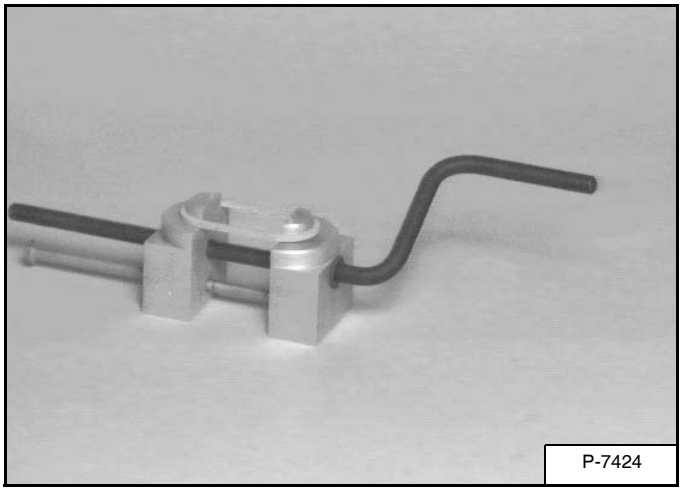
MEL1396 - Universal Seal Expander
MEL1033 - Rod Seal Installation Tool
Piston Ring Compressor
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-1 - Standard Pins

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

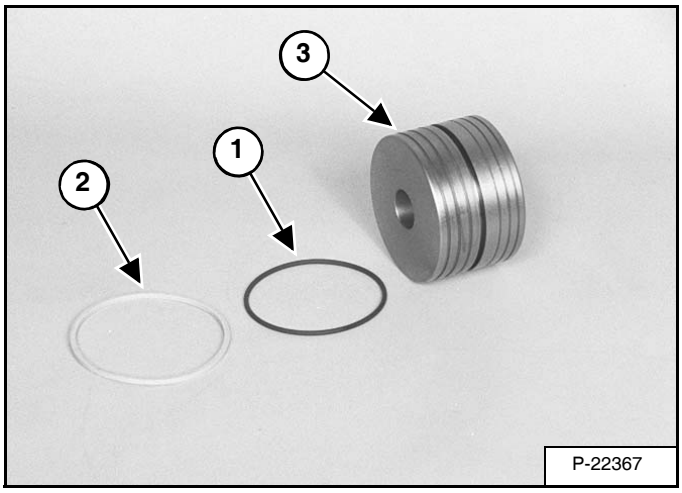
Figure 20-22-21



Install the seal on the tool and slowly stretch it until it fits the piston **[Figure 20-22-21]**.

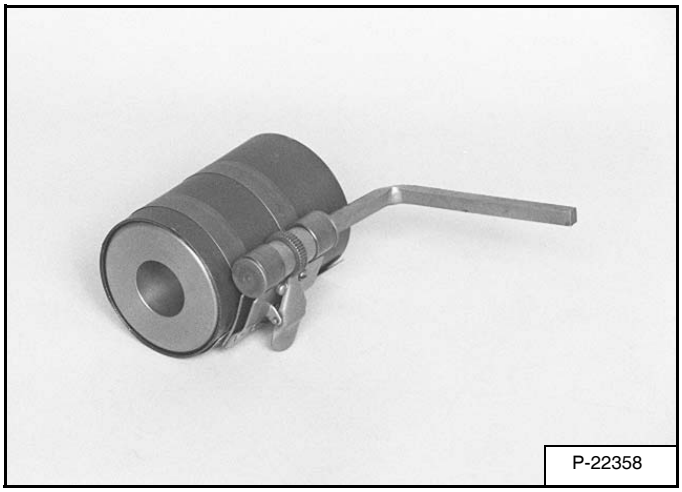
Allow the seal to stretch for 30 seconds before installing it on the piston.

Figure 20-22-22



Install the O-ring (Item 1) and seal (Item 2) on the piston (Item 3) **[Figure 20-22-22]**.

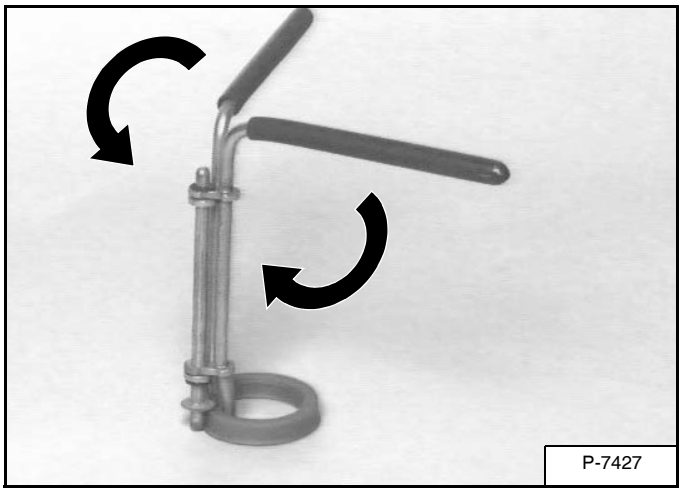
Figure 20-22-23



Use a ring compressor to compress the seal to the correct size. Leave the piston in the compressor for about three minutes **[Figure 20-22-23]**.

Assembly (Cont'd)

Figure 20-22-24

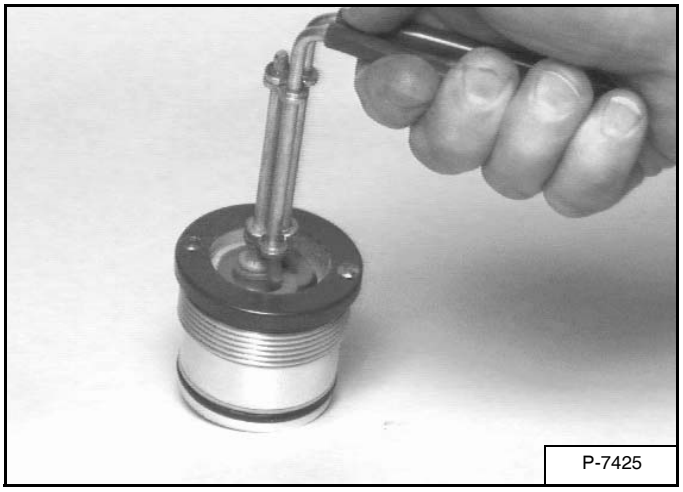


Install the rod seal on the rod seal tool **[Figure 20-22-24]**.

NOTE: During installation the spring side of the seal must be toward the inside of the cylinder.

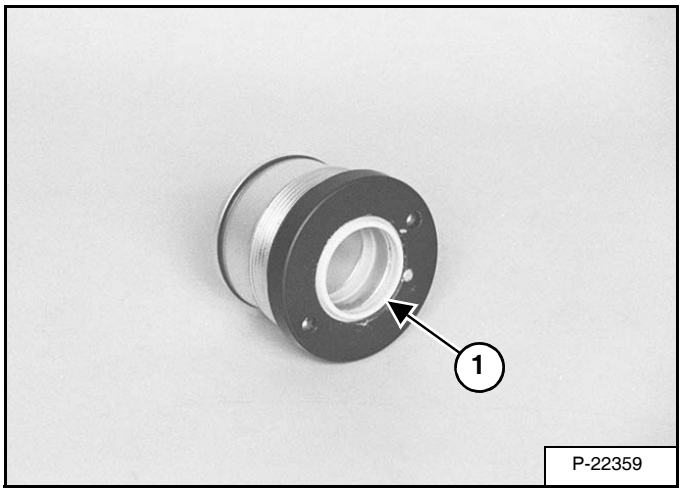
Rotate the handles to collapse the rod seal **[Figure 20-22-24]**.

Figure 20-22-25



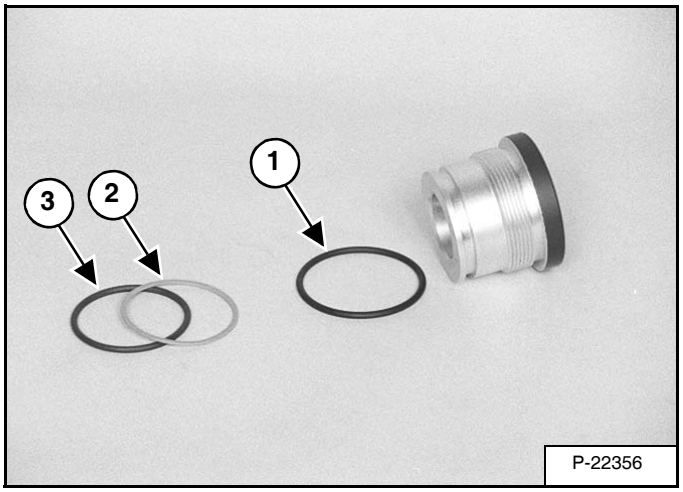
Install the rod seal in the head **[Figure 20-22-25]**.

Figure 20-22-26



Install the wiper seal with the wiper (Item 1) **[Figure 20-22-26]** toward the outside of the head.

Figure 20-22-27



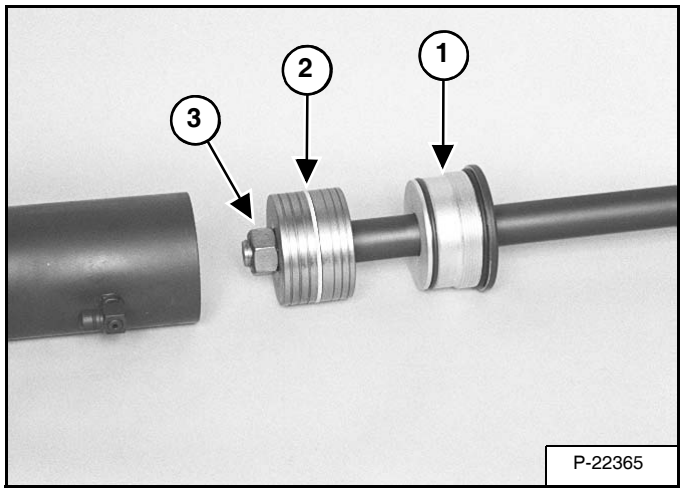
Install the O-ring (Item 1) **[Figure 20-22-27]**.

Install the back-up ring (Item 2) and O-ring (Item 3) **[Figure 20-22-27]**.

BOOM SWING CYLINDER (CONT'D)

Assembly (Cont'd)

Figure 20-22-28



Install the head (Item 1) and the piston (Item 2) **[Figure 20-22-28]** on the rod.

Grease the piston where the nut contacts the piston. Do not get grease on the threads.

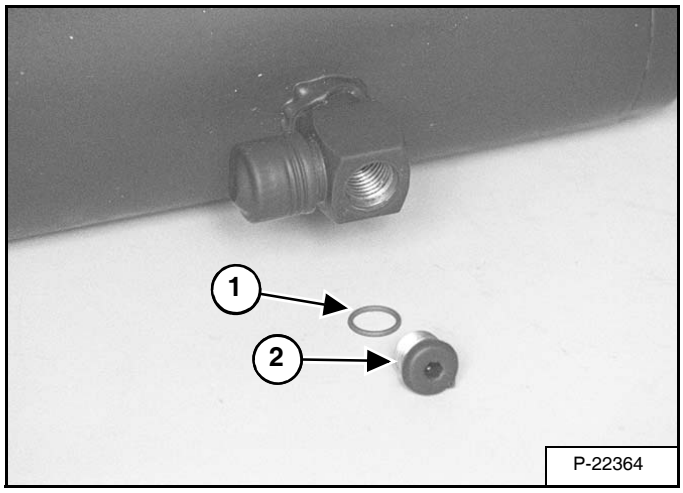
Provide an adequate support for the cylinder before tightening.

Install the nut (Item 3) **[Figure 20-22-28]**.

NOTE: Clean and dry the rod threads, from the kit install a NEW NUT with pre-applied LOCTITE.

Tighten the nut to 300 ft.-lbs. (407 Nm) torque.

Figure 20-22-29

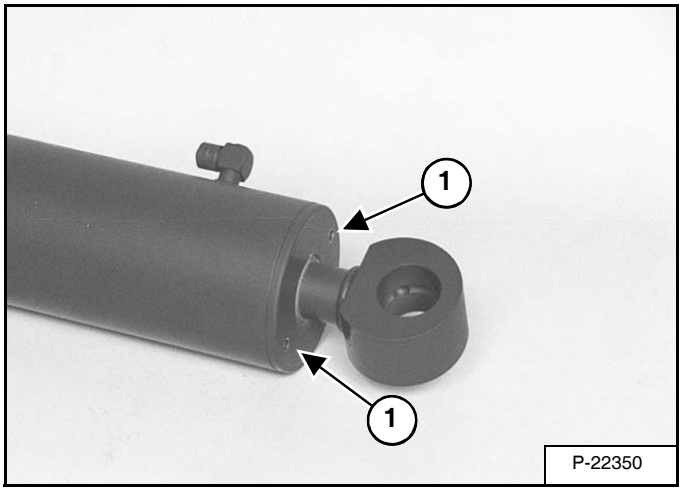


Install O-ring (Item 1) and plug (Item 2) **[Figure 20-22-29]**.

Tighten the plug to 8 ft.-lbs. (11 Nm) torque.

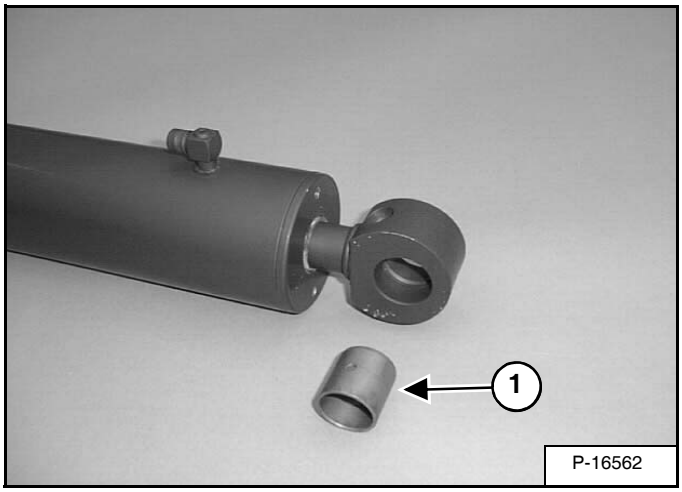
Put the base end of the hydraulic cylinder in a vise.

Figure 20-22-30



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-22-30]** to tighten the head. Head to be torqued until flush with end of the housing.

Figure 20-22-31

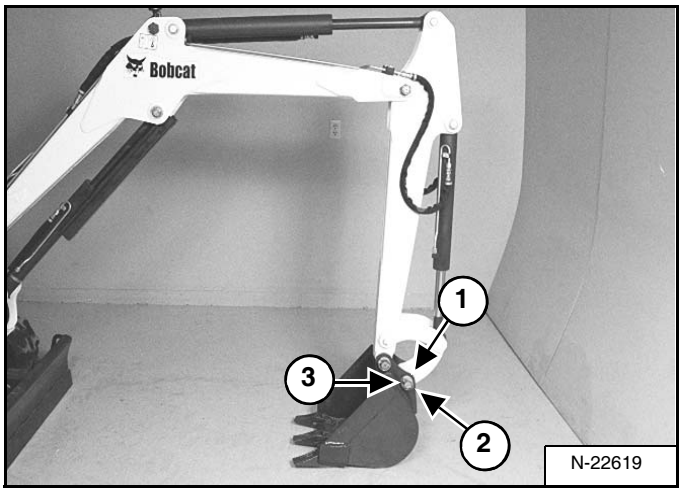


Install the bushing (Item 1) **[Figure 20-22-31]**. The bushing must be aligned with the grease channel in the rod end of the cylinder.

BUCKET CYLINDER

Testing

Figure 20-23-1



Lower the boom/bucket and blade to the ground **[Figure 20-23-1]**.

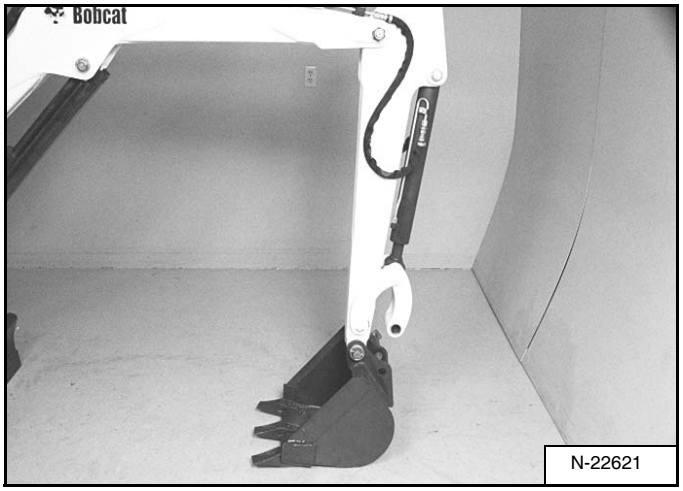
Stop the engine. Raise the control console.

Support the boom using a chain hoist **[Figure 20-23-1]**.

Remove the retaining pin (Item 1) and washers (Item 2) **[Figure 20-23-1]** from the outside pivot pin.

Remove the pivot pin (Item 3) **[Figure 20-23-1]**.

Figure 20-23-2



Lower control console and fasten the seat belt. Start the engine and retract the bucket cylinder **[Figure 20-23-2]**.

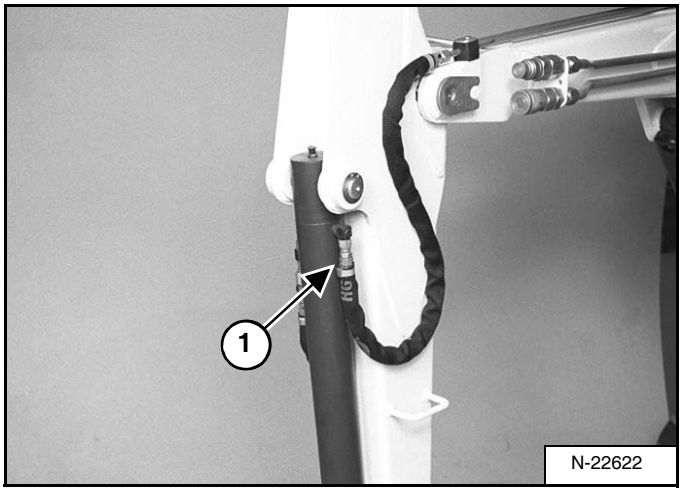
Stop the engine. With the key in the ON position, move the hydraulic controls to release the hydraulic pressure. Raise the control console.

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

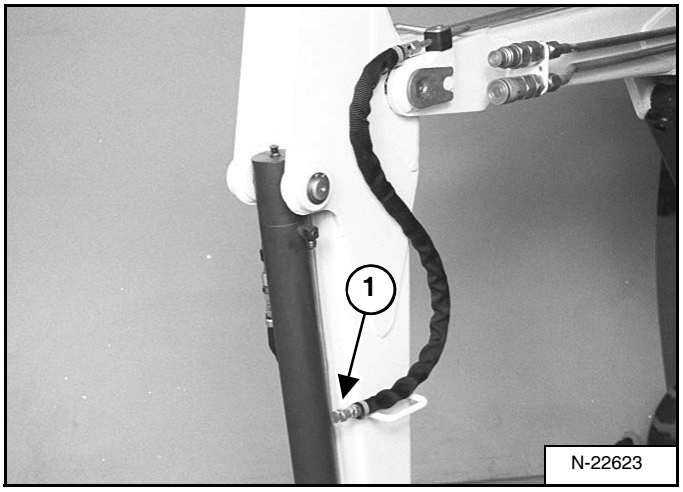
W-2145-0290

Figure 20-23-3



Remove the bucket cylinder base end hose (Item 1) **[Figure 20-23-3]**.

Figure 20-23-4



Install a plug (Item 1) **[Figure 20-23-4]** on the hose fitting and tighten.

Lower control console and fasten the seat belt. Start the engine and retract the bucket cylinder.

BUCKET CYLINDER (CONT'D)

Testing (Cont'd)

If there is any leakage from the base end fitting on the bucket cylinder, remove the cylinder for repair or replacement.

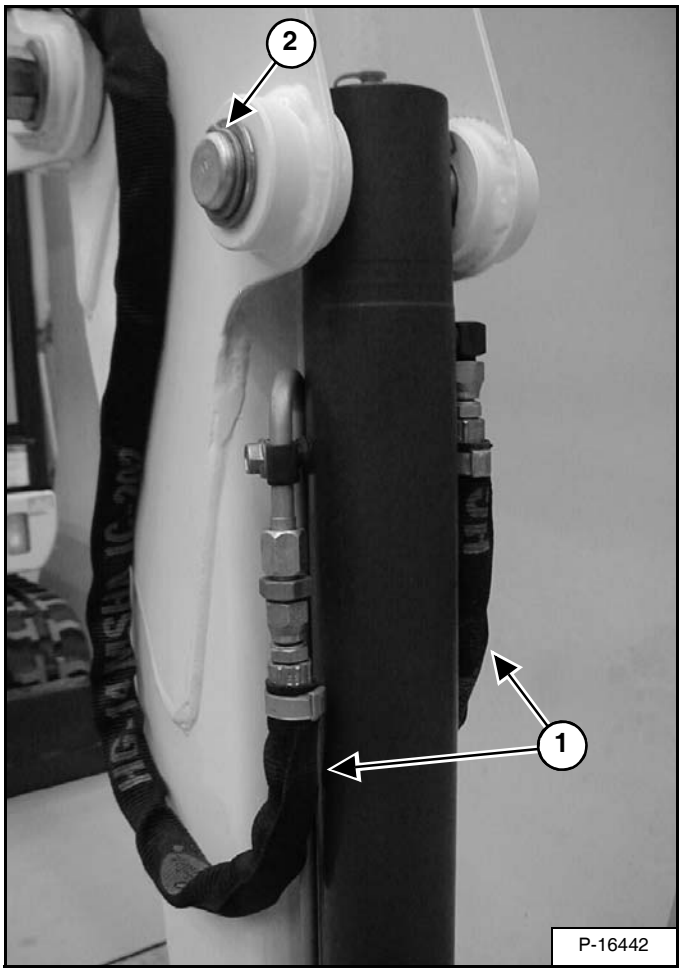
Removal and Installation

Lower the boom/bucket and blade to the ground. Stop the engine.

Support the boom using a chain hoist.

With the key in the ON position, move the hydraulic controls to release the hydraulic pressure.

Figure 20-23-5

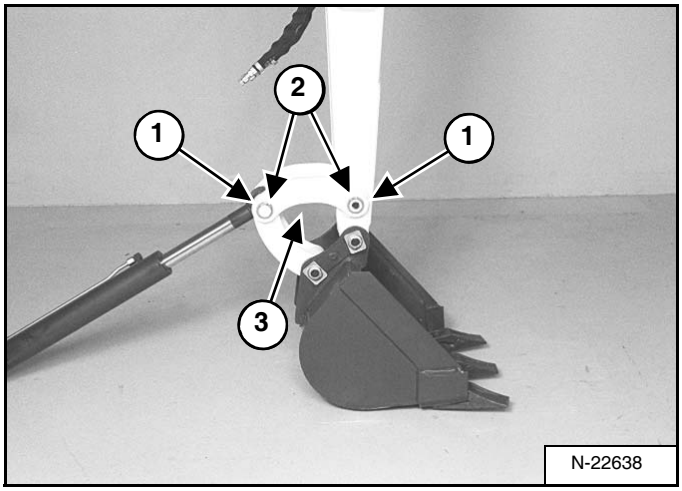


Remove and plug the two hoses (Item 1) **[Figure 20-23-5]** from the bucket cylinder.

Remove the snap ring (Item 2) **[Figure 20-23-5]** and washer from the cylinder base end pin.

Remove the base end pin and lower the base end to the floor.

Figure 20-23-6



Remove the two snap rings (Item 1) and two washers (Item 2) **[Figure 20-23-6]**.

Remove the bucket link (Item 3) **[Figure 20-23-6]**.

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

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

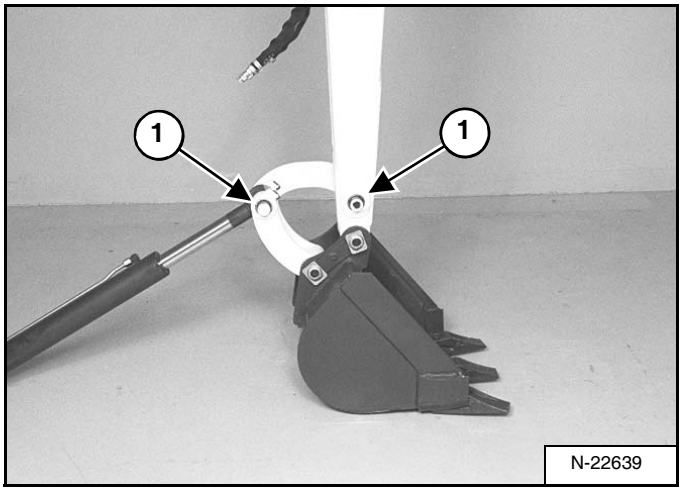
Removal and Installation (Cont'd)

⚠ WARNING

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 which can result in injury or death.

W-2103-1285

Figure 20-23-7

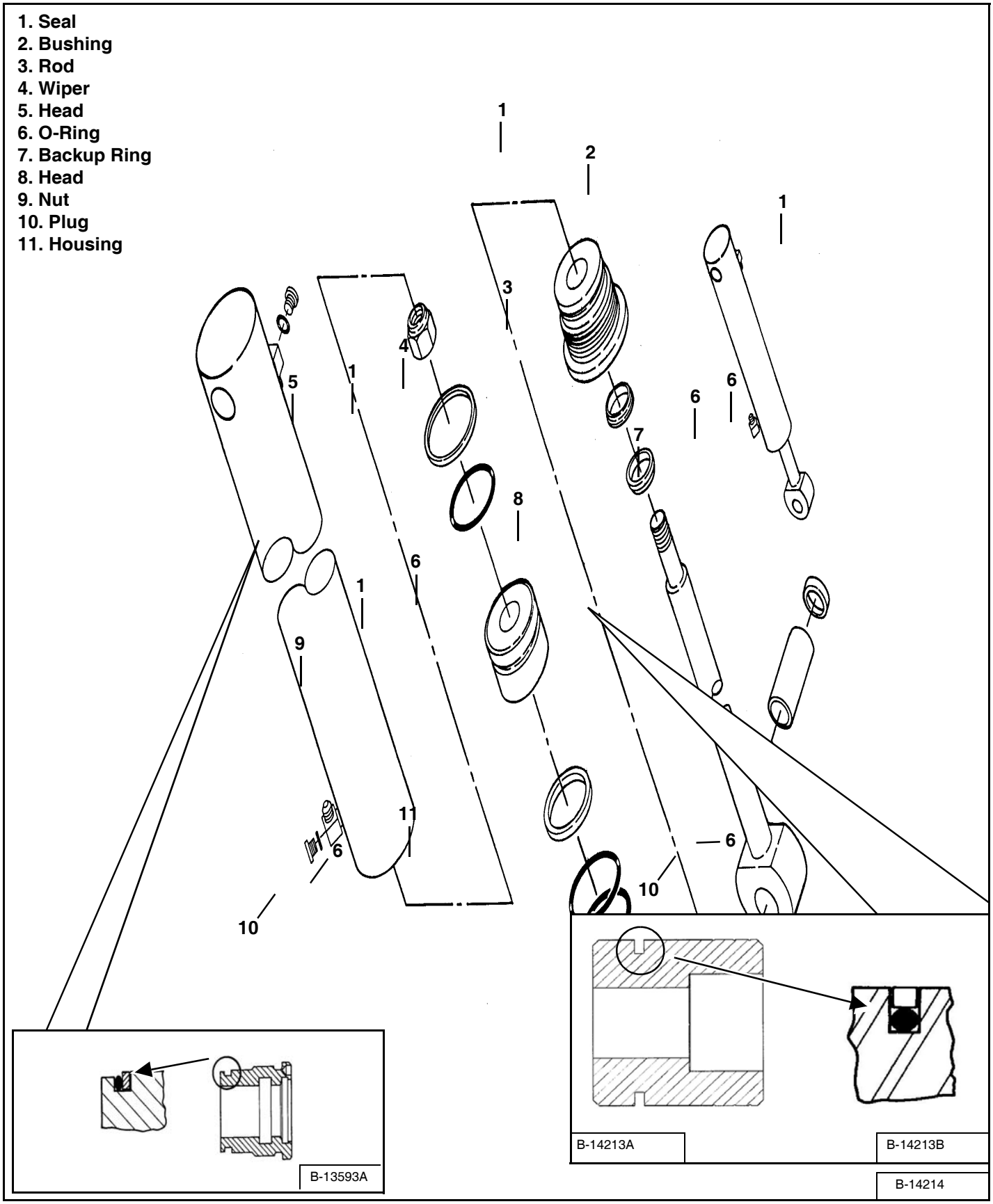


Remove the bucket link pins (Item 1) **[Figure 20-23-7]**.

Remove the bucket cylinder.

Parts Identification

1. Seal
2. Bushing
3. Rod
4. Wiper
5. Head
6. O-Ring
7. Backup Ring
8. Head
9. Nut
10. Plug
11. Housing



BUCKET CYLINDER (CONT'D)

Disassembly

Clean the outside of the bucket cylinder before disassembly.

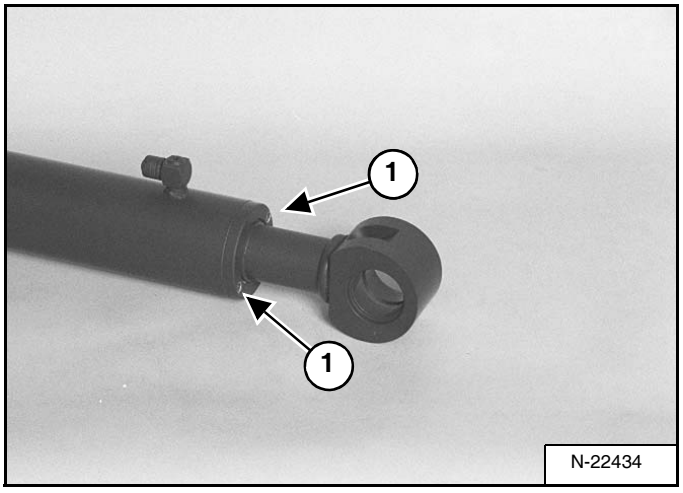
Use the following tools to disassemble the cylinder:

MEL1074 - O-ring Seal Hook
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-2 - Special Offset Pins

Hold the hydraulic cylinder over a drain pan and move the rod in and out slowly to remove the fluid from the cylinder.

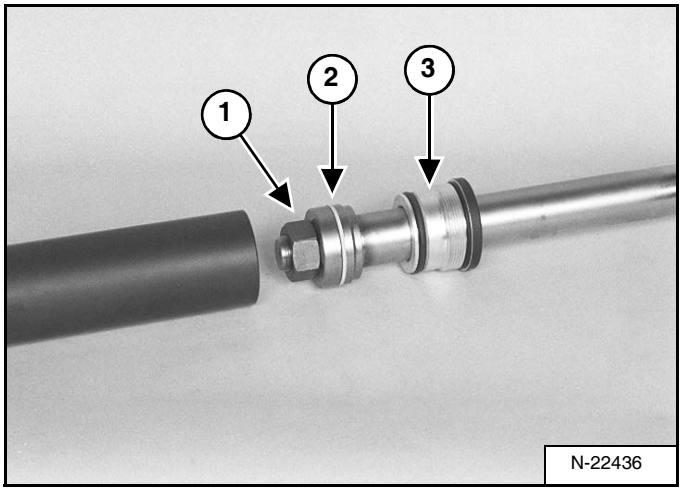
Put the base end of the cylinder in a vise.

Figure 20-23-8



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-23-8]** to loosen the head.

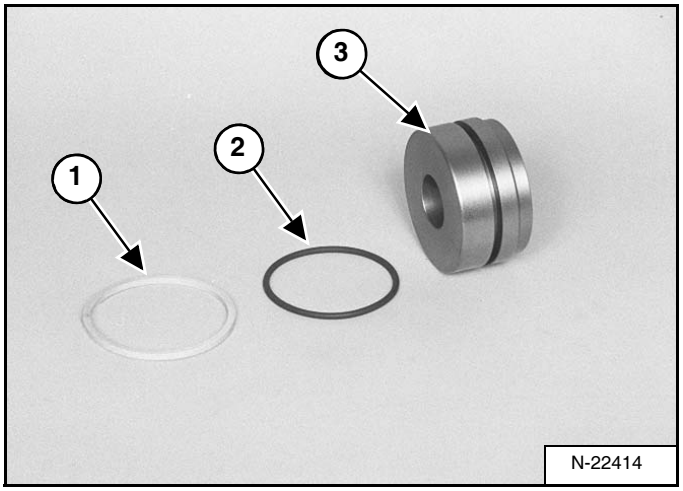
Figure 20-23-9



Remove the head and the rod assembly from the cylinder **[Figure 20-23-9]**. Put the rod end in a vise.

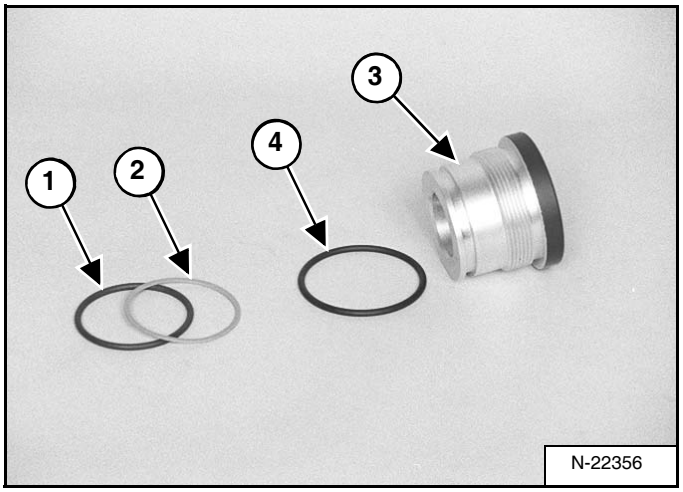
Remove the nut (Item 1), piston (Item 2) and head (Item 3) **[Figure 20-23-9]**.

Figure 20-23-10



Standard Piston: Remove the seal (Item 1) and O-ring (Item 2) from the piston (Item 3) **[Figure 20-23-10]**.

Figure 20-23-11

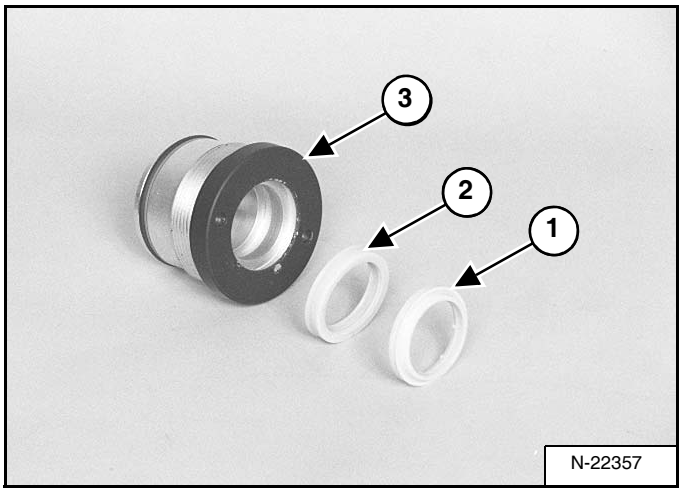


Remove the O-ring (Item 1) and the back-up ring (Item 2) from the groove in the head (Item 3) **[Figure 20-23-11]**.

Remove the O-ring (Item 4) **[Figure 20-23-11]**.

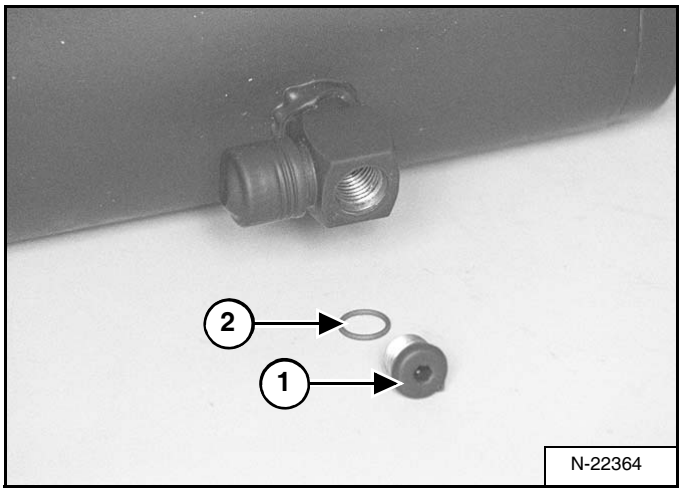
Disassembly (Cont'd)

Figure 20-23-12



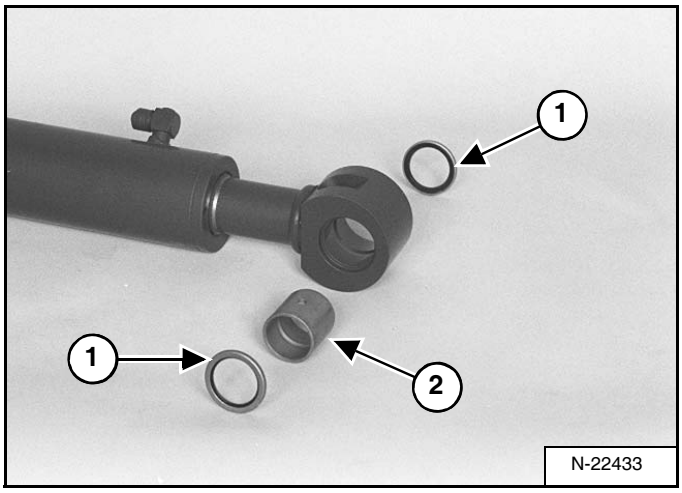
Remove the wiper seal (Item 1) and rod seal (Item 2) from the inside of the head (Item 3) **[Figure 20-23-12]**.

Figure 20-23-13



Remove plug (Item 1) and O-ring (Item 2) **[Figure 20-23-13]**.

Figure 20-23-14



Remove the seals (Item 1) and bushing (Item 2) **[Figure 20-23-14]**.

Assembly

Use the following tools to assemble the cylinder:

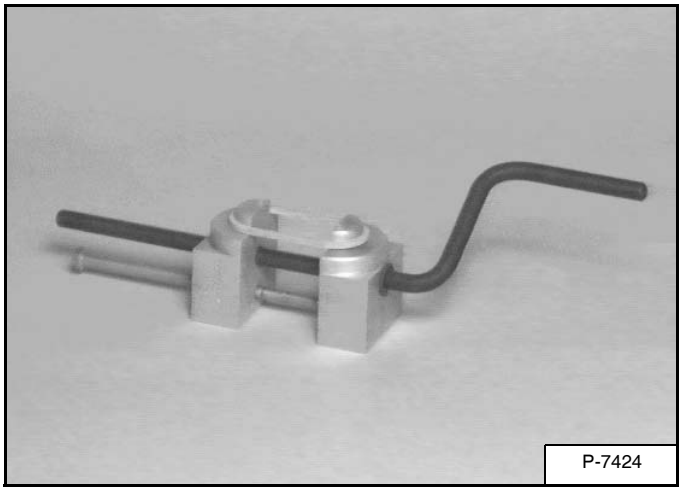
MEL1396 - Universal Seal Expander
MEL1033 - Rod Seal Installation Tool
Piston Ring Compressor
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-2 - Special Offset Pins

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

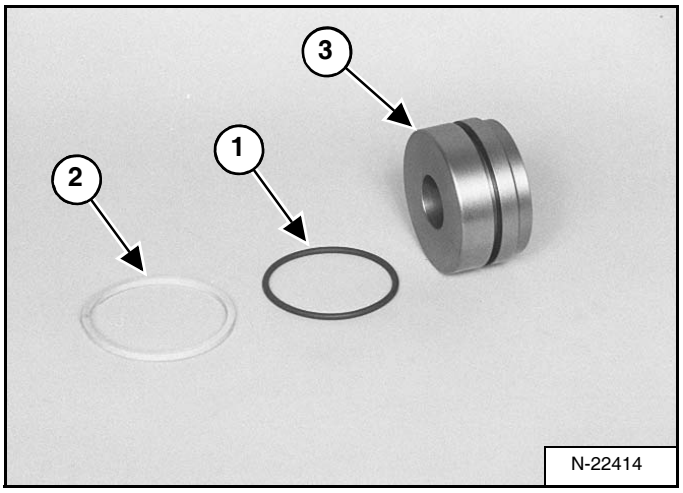
Figure 20-23-15



Install the seal on the tool and slowly stretch it until it fits the piston **[Figure 20-23-15]**.

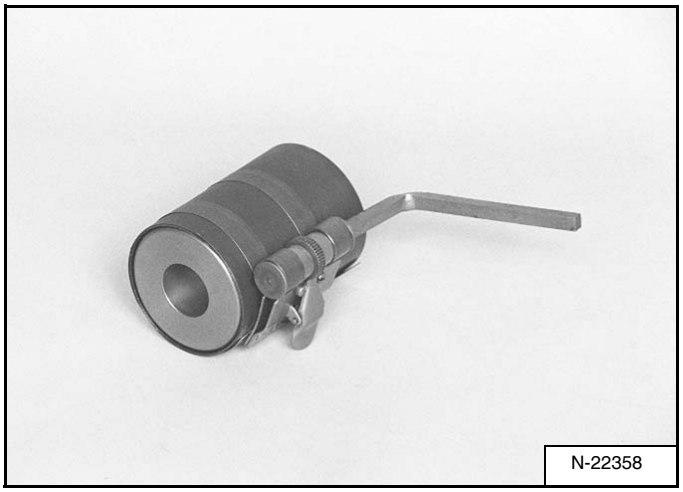
Allow the seal to stretch for 30 seconds before installing it on the piston.

Figure 20-23-16



Standard Piston: Install the O-ring (Item 1) and seal (Item 2) on the piston (Item 3) **[Figure 20-23-16]**.

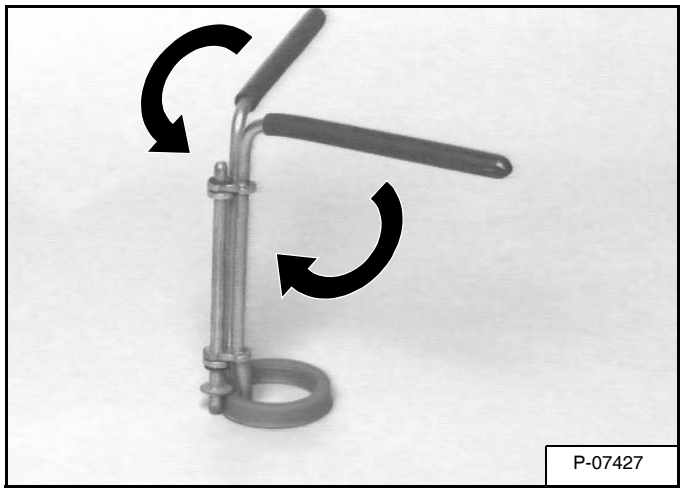
Figure 20-23-17



Use a ring compressor to compress the seal to the correct size. Leave the piston in the compressor for about three minutes **[Figure 20-23-17]**.

Assembly (Cont'd)

Figure 20-23-18

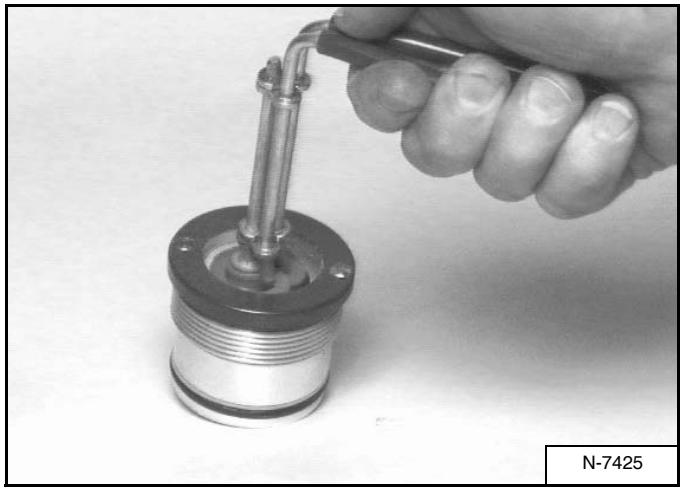


Install the rod seal on the rod seal tool **[Figure 20-23-18]**.

NOTE: During installation the spring side of the seal must be toward the inside of the cylinder.

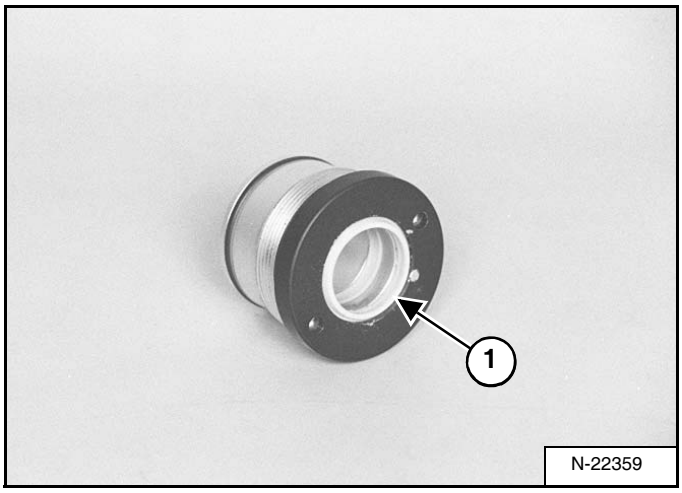
Rotate the handles to collapse the rod seal **[Figure 20-23-18]**.

Figure 20-23-19



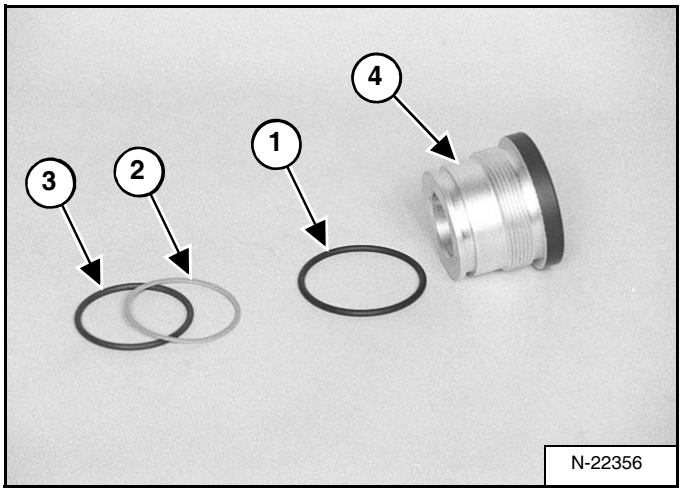
Install the rod seal in the head **[Figure 20-23-19]**.

Figure 20-23-20



Install the wiper seal with the wiper (Item 1) **[Figure 20-23-20]** toward the outside of the head.

Figure 20-23-21

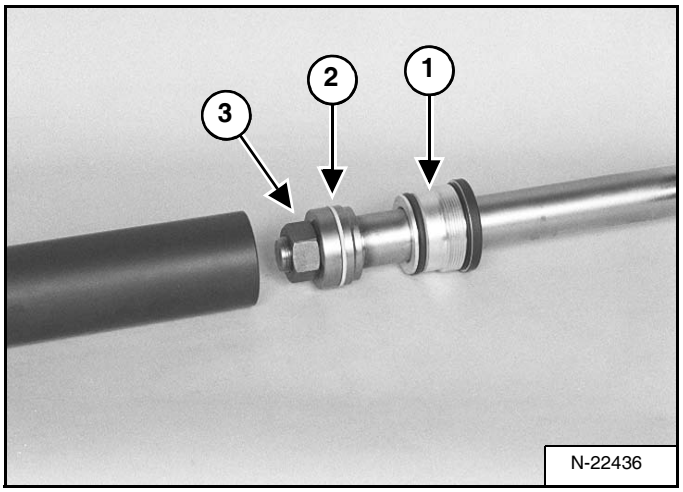


Install the O-ring (Item 1) **[Figure 20-23-21]**.

Install the back-up ring (Item 2) and O-ring (Item 3) into the groove on the head (Item 4) **[Figure 20-23-21]**.

Assembly (Cont'd)

Figure 20-23-22



Install the head (Item 1) **[Figure 20-23-22]** and the piston (Item 2) **[Figure 20-23-22]** on the rod.

Grease the piston where the nut contacts the piston. Do not get grease on the threads.

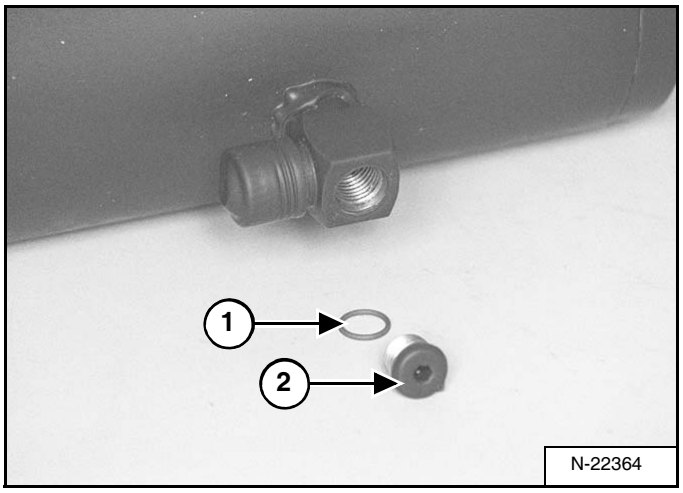
Provide an adequate support for the cylinder before tightening.

Install the nut (Item 3) **[Figure 20-23-22]**.

NOTE: Clean and dry the rod threads, from the kit install a NEW NUT with pre-applied LOCTITE.

Tighten the nut to 600 ft.-lbs. (813 Nm) torque.

Figure 20-23-23



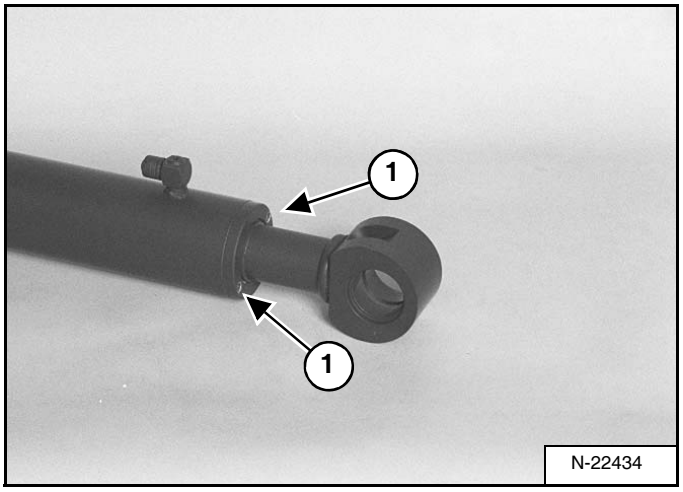
Install O-ring (Item 1) and plug (Item 2) **[Figure 20-23-23]**.

Tighten the plug to 8 ft.-lbs. (11 Nm) torque.

Put the base end of the hydraulic cylinder in a vise.

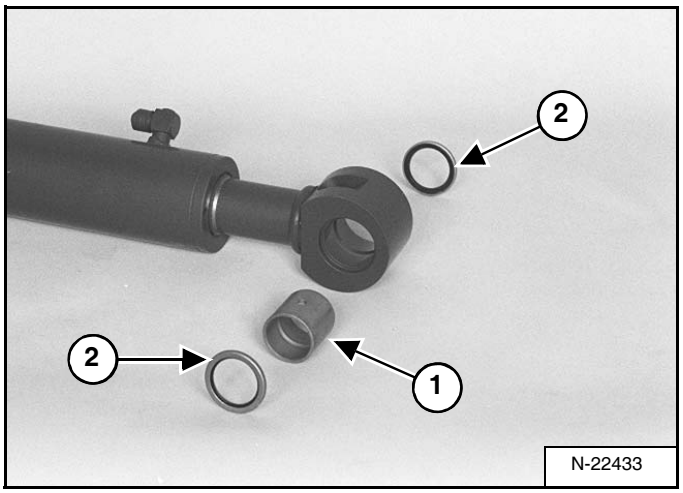
Be careful no to damage the cylinder tube.

Figure 20-23-24



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-23-24]** to tighten the head. Head to be torqued until flush with end of cylinder housing.

Figure 20-23-25



Install the bushing (Item 1) **[Figure 20-23-25]**. The bushing must be aligned with the grease channel in the rod end of the cylinder.

Install the seals (Item 2) **[Figure 20-23-25]** with the lips facing out.


Bobcat®

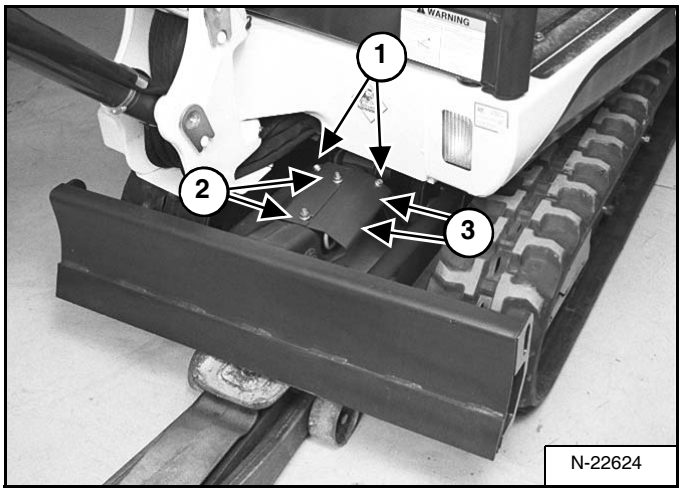
BLADE CYLINDER

Testing

Swing the upperstructure out of the way. Lower the boom/bucket to the ground. Raise the blade up until it stops.

Stop the engine.

Figure 20-24-1

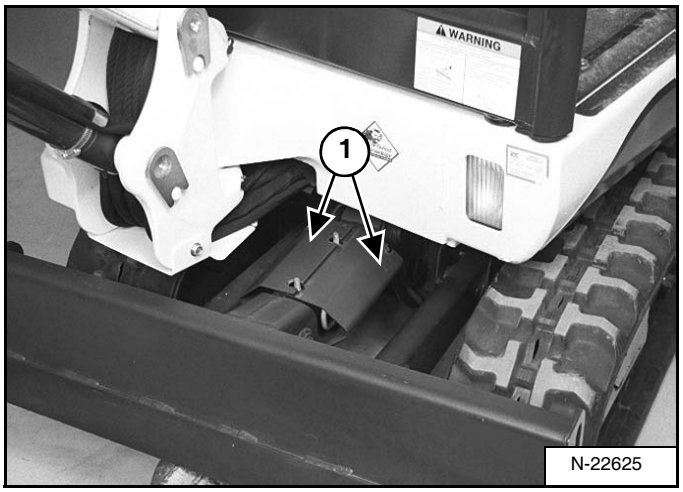


Support the blade **[Figure 20-24-1]**. With the key in the ON position, move the blade control to release the hydraulic pressure. Raise the control console.

Loosen and slide the hose clamps (Item 1) **[Figure 20-24-1]** off the shield.

Remove the top two nuts (Item 2) and loosen the bottom two nuts (Item 3) **[Figure 20-24-1]** fastening the shield to the blade cylinder.

Figure 20-24-2



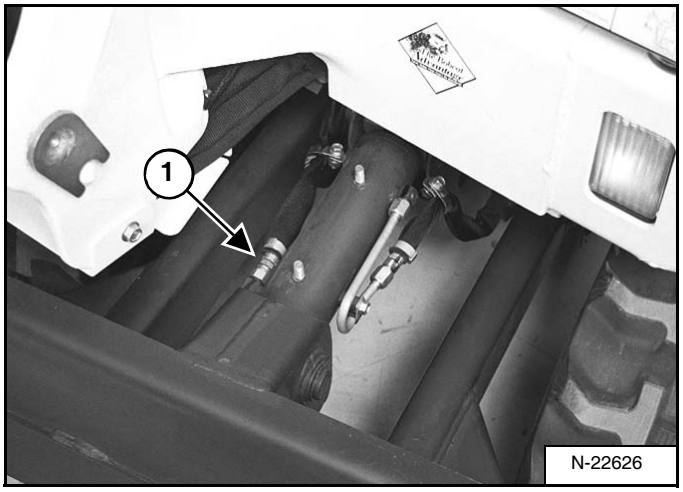
Remove the blade cylinder shields (Item 1) **[Figure 20-24-2]** from the blade cylinder.

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

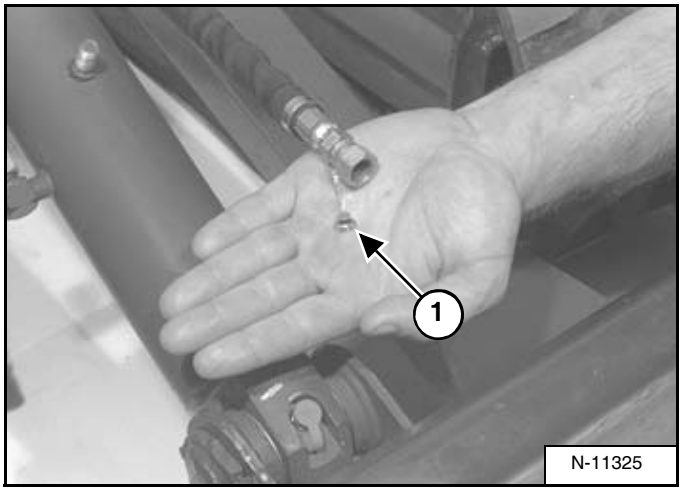
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Figure 20-24-3



Remove the blade cylinder base end hose (Item 1) **[Figure 20-24-3]**.

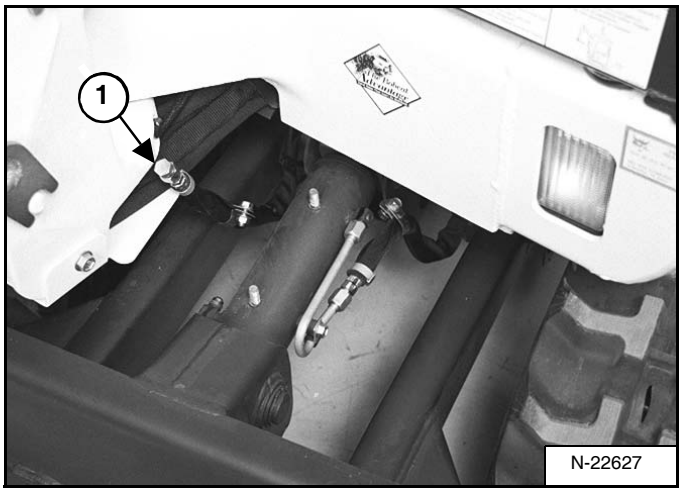
Figure 20-24-4



NOTE: Use care not to lose the orifice (Item 1) [Figure 20-24-4] located in the blade cylinder base end hose. (If equipped)

Testing (Cont'd)

Figure 20-24-5



Install a plug (Item 1) **[Figure 20-24-5]** on the hose fitting and tighten.

Lower control console. Start the engine and retract the blade cylinder.

If there is any leakage from the base end fitting on the blade cylinder, remove the cylinder for repair or replacement.

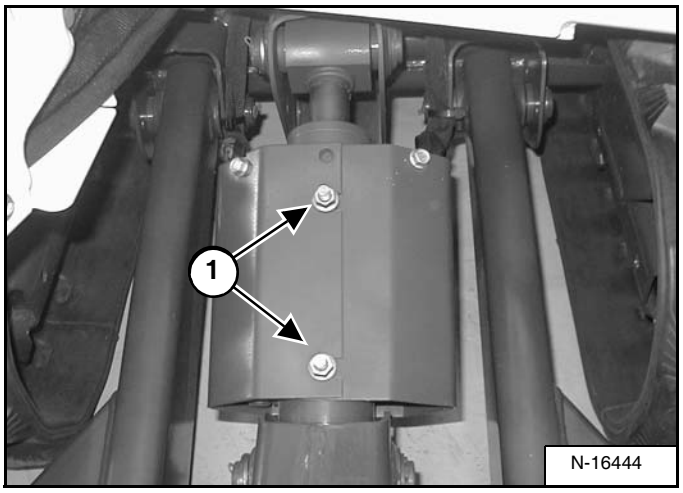
BLADE CYLINDER (CONT'D)

Removal and Installation

Lower the boom/bucket and blade to the ground. Stop the engine.

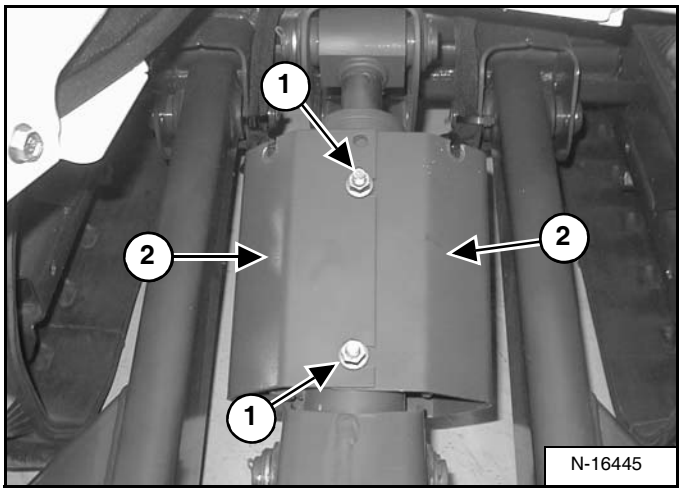
With the key in the ON position, move the blade control to release the hydraulic pressure.

Figure 20-24-6



Loosen the two bolts (Item 1) **[Figure 20-24-6]** and slide hose clamps off of shield.

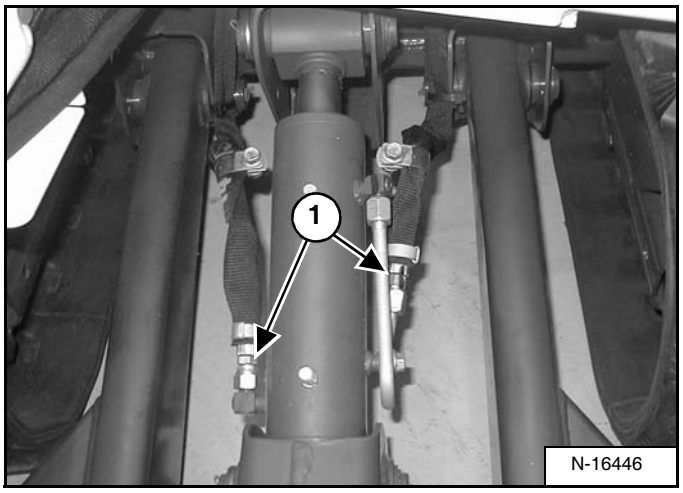
Figure 20-24-7



Remove the top two nuts (Item 1) **[Figure 20-24-7]** and loosen the bottom two nuts fastening the shield to the blade cylinder.

Remove the blade cylinder shields (Item 2) **[Figure 20-24-7]**.

Figure 20-24-8



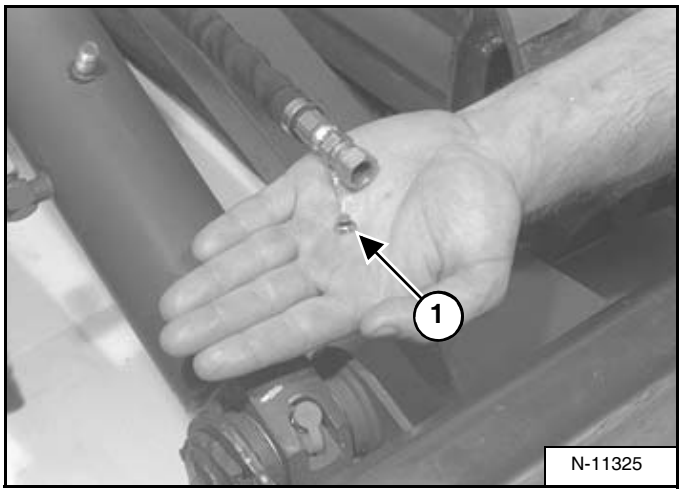
Remove and plug the blade cylinder hoses (Item 1) **[Figure 20-24-8]**.

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.

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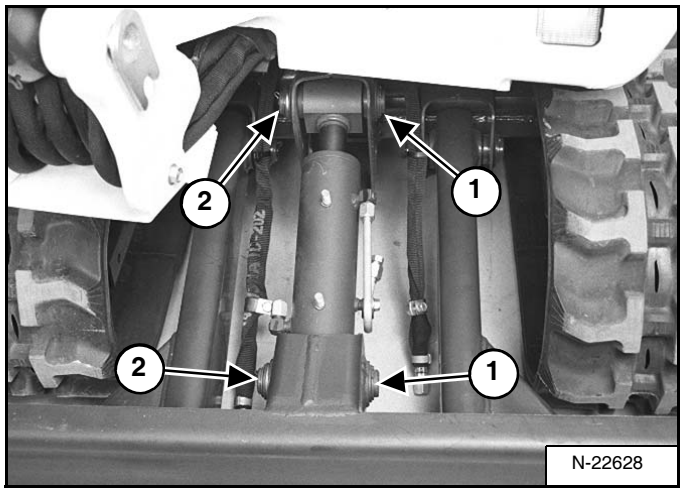
Figure 20-24-9



NOTE: Use care not to lose the orifice (Item 1) [Figure 20-24-9] located in the cylinder base end hose. (If equipped)

Removal and Installation

Figure 20-24-10



Remove the snap rings (Item 1) **[Figure 20-24-10]** and washers from the cylinder base and rod ends.

Remove the cylinder retaining pins (Item 2) **[Figure 20-24-10]**.

Remove the blade cylinder.

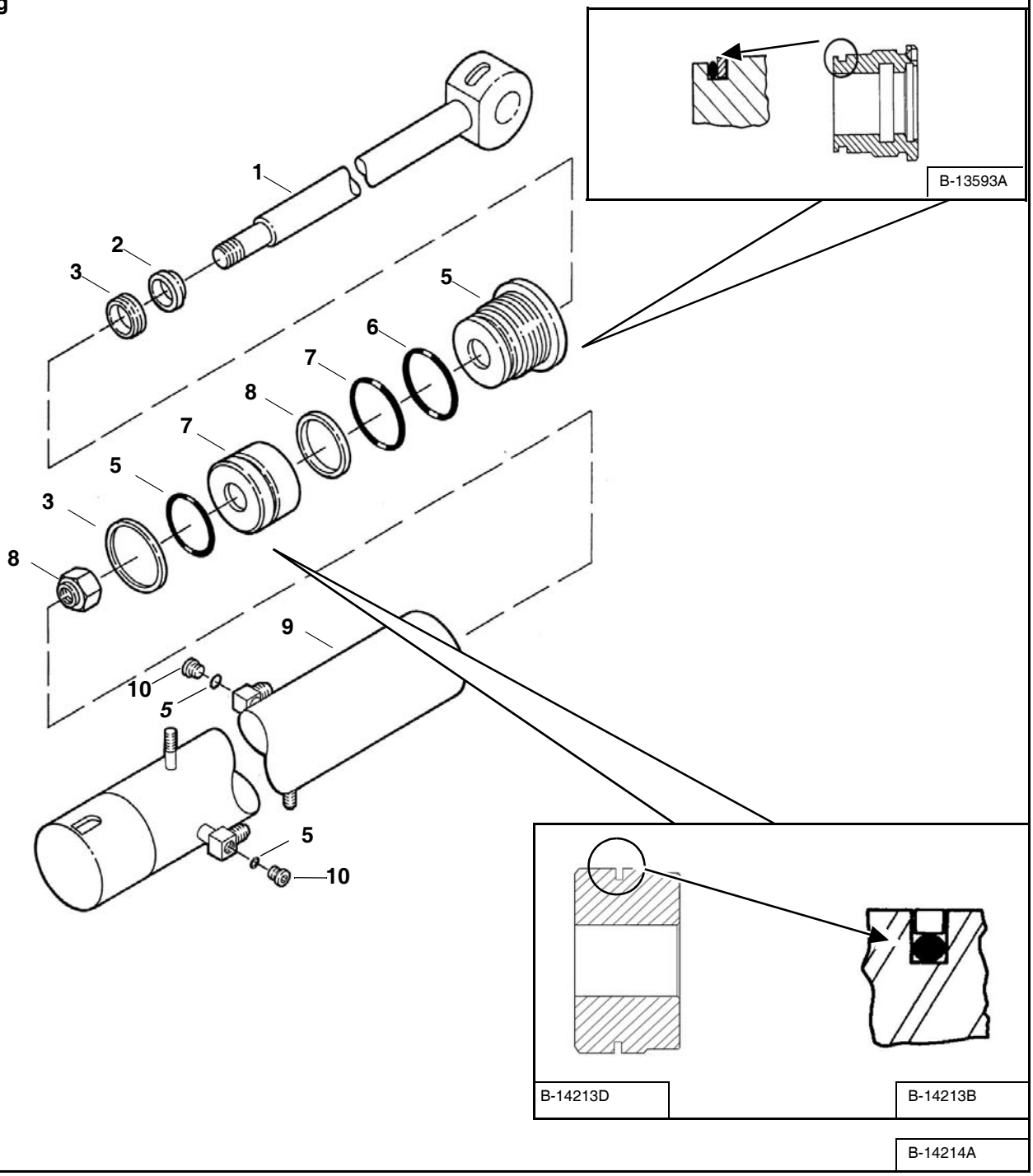
⚠ WARNING

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 which can result in injury or death.

W-2103-1285

Parts Identification

1. Rod
2. Wiper
3. Seal
4. Head
5. O-ring
6. Backup Ring
7. Piston
8. Nut
9. Housing
10. Plug



BLADE CYLINDER (CONT'D)

Disassembly

Clean the outside of the blade cylinder before disassembly.

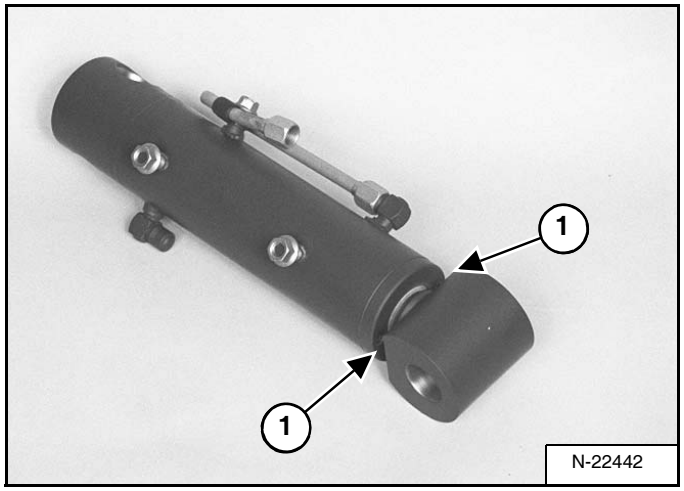
Use the following tools to disassemble the cylinder:

MEL1074 - O-ring Seal Hook
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-2 - Special Offset Pins

Hold the hydraulic cylinder over a drain pan and move the rod in and out slowly to remove the fluid from the cylinder.

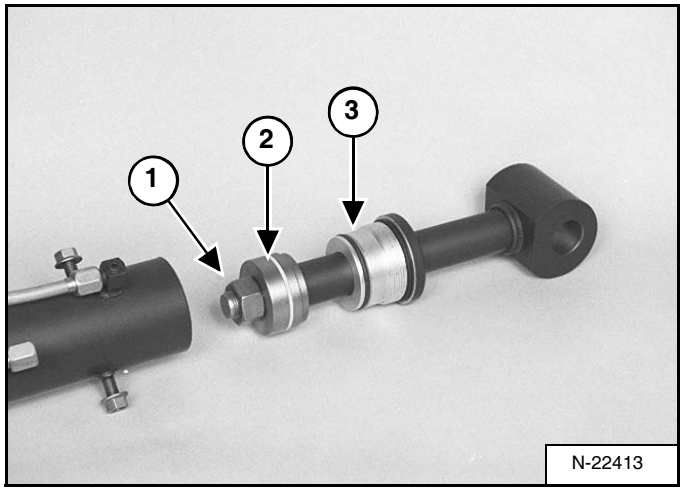
Put the base end of the cylinder in a vise.

Figure 20-24-11



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-24-11]** to loosen the head.

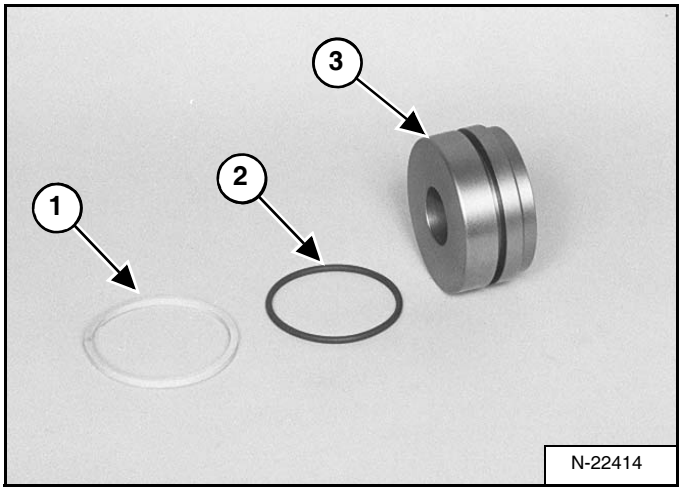
Figure 20-24-12



Remove the head and the rod assembly from the cylinder **[Figure 20-24-12]**. Put the rod end in a vise.

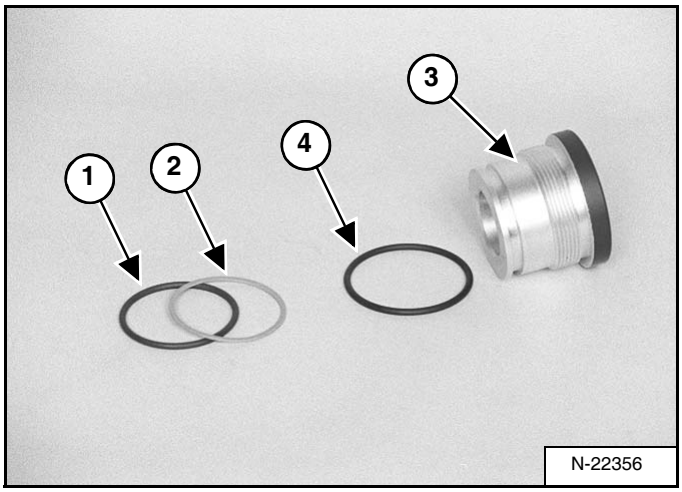
Remove the nut (Item 1), piston (Item 2) and head (Item 3) **[Figure 20-24-12]**.

Figure 20-24-13



Standard Piston: Remove the seal (Item 1) and O-ring (Item 2) from the piston (Item 3) **[Figure 20-24-13]**.

Figure 20-24-14

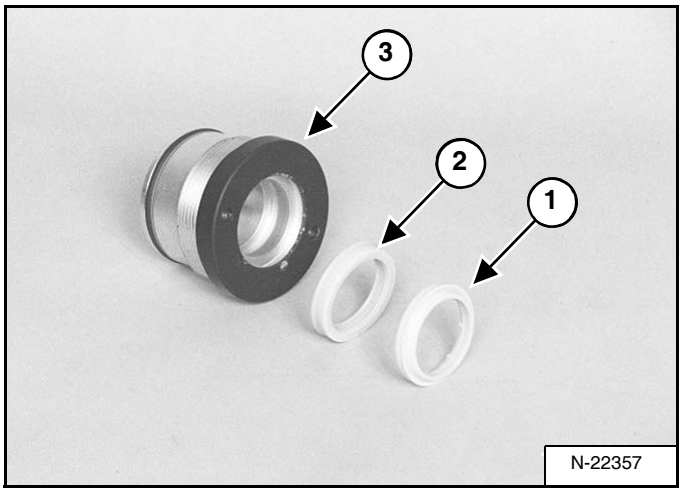


Remove the O-ring (Item 1) and the back-up ring (Item 2) from the groove in the head (Item 3) **[Figure 20-24-14]**.

Remove the O-ring (Item 4) **[Figure 20-24-14]**.

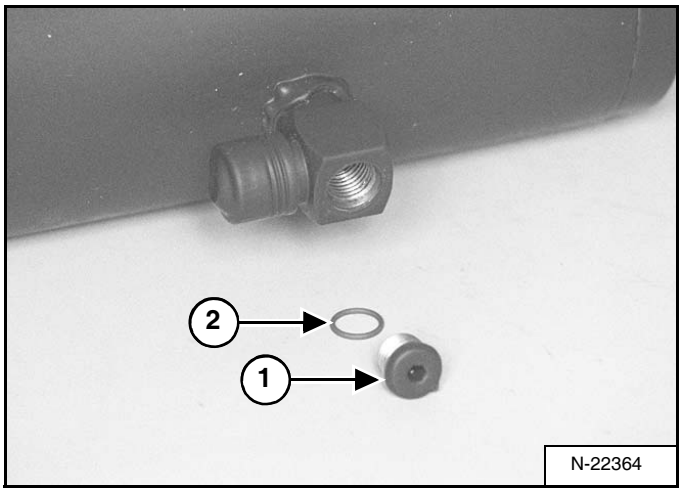
Disassembly (Cont'd)

Figure 20-24-15



Remove the wiper seal (Item 1) and rod seal (Item 2) from the inside of the head (Item 3) **[Figure 20-24-15]**.

Figure 20-24-16



Remove plug (Item 1) and O-ring (Item 2) **[Figure 20-24-16]**.

Assembly

Use the following tools to assemble the cylinder:

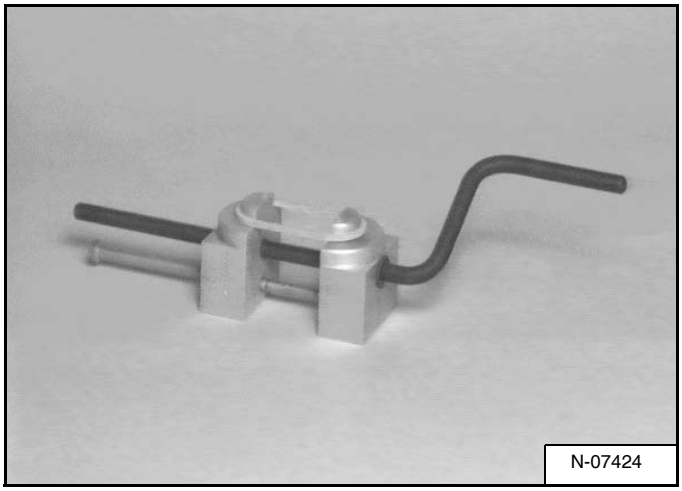
MEL1396 - Universal Seal Expander
MEL1033 - Rod Seal Installation Tool
Piston Ring Compressor
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-1 - Standard Pins

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

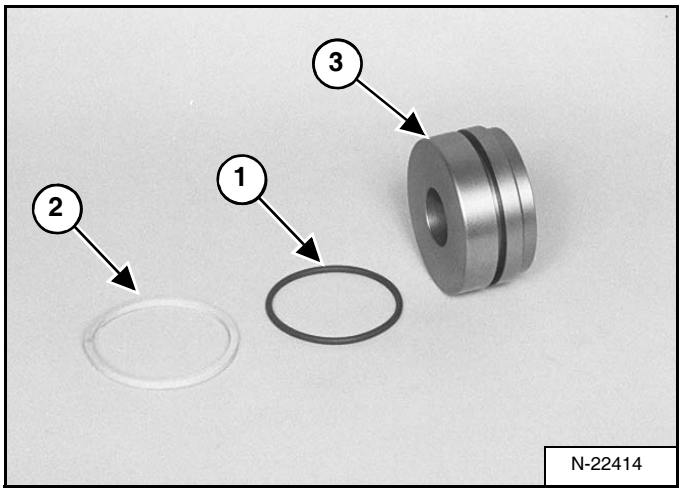
Figure 20-24-17



Install the seal on the tool and slowly stretch it until it fits the piston **[Figure 20-24-17]**.

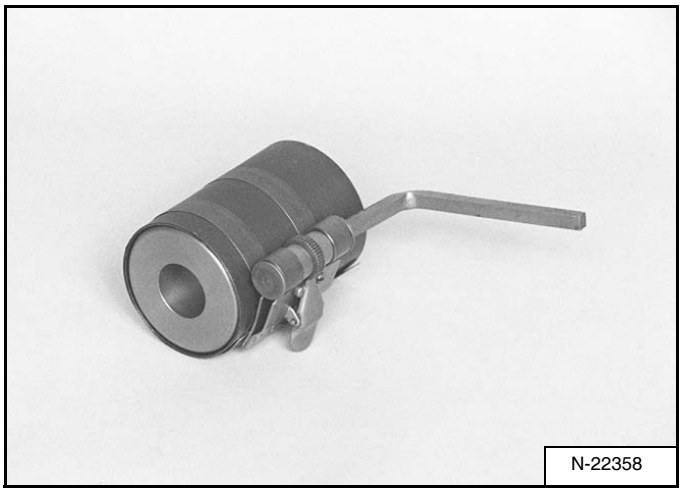
Allow the seal to stretch for 30 seconds before installing it on the piston.

Figure 20-24-18



Standard Piston: Install the O-ring (Item 1) and seal (Item 2) on the piston (Item 3) **[Figure 20-24-18]**.

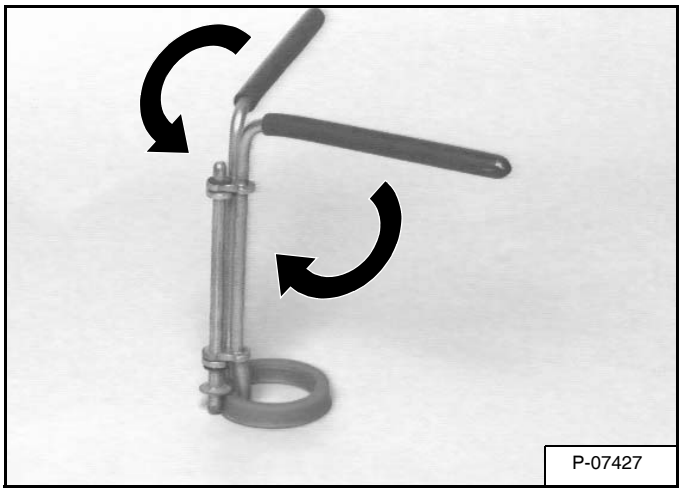
Figure 20-24-19



Use a ring compressor to compress the seal to the correct size. Leave the piston in the compressor for about three minutes **[Figure 20-24-19]**.

Assembly (Cont'd)

Figure 20-24-20

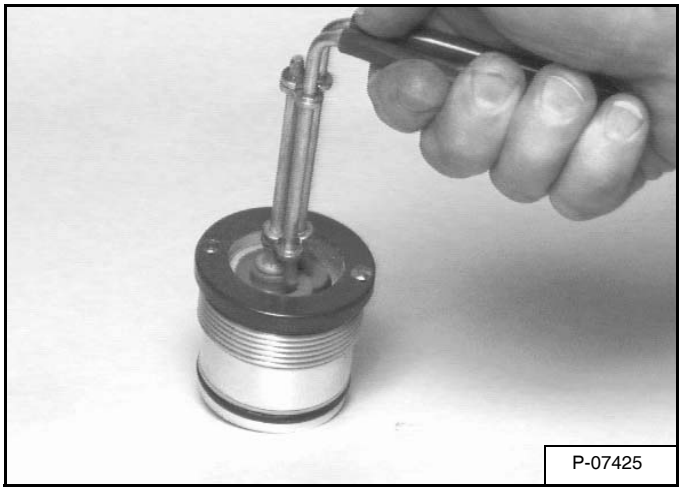


Install the rod seal on the rod seal tool **[Figure 20-24-20]**.

NOTE: During installation the spring side of the seal must be toward the inside of the cylinder.

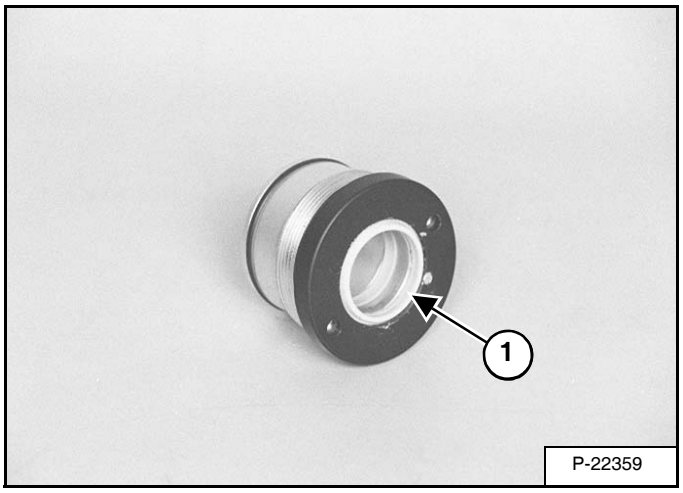
Rotate the handles to collapse the rod seal **[Figure 20-24-20]**.

Figure 20-24-21



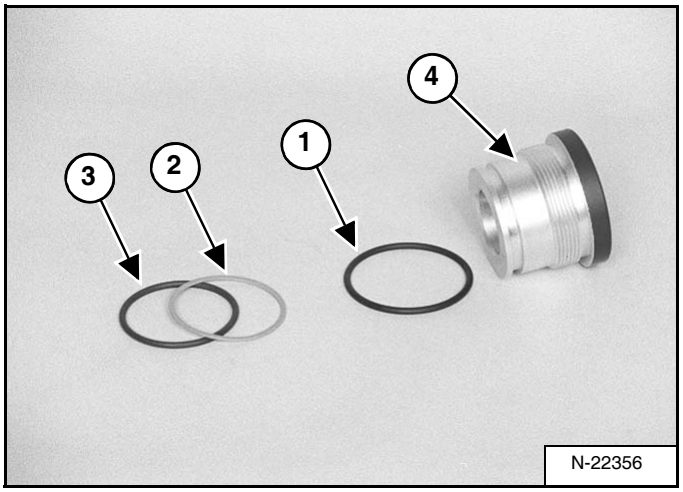
Install the rod seal in the head **[Figure 20-24-21]**.

Figure 20-24-22



Install the wiper seal with the wiper (Item 1) **[Figure 20-24-22]** toward the outside of the head.

Figure 20-24-23

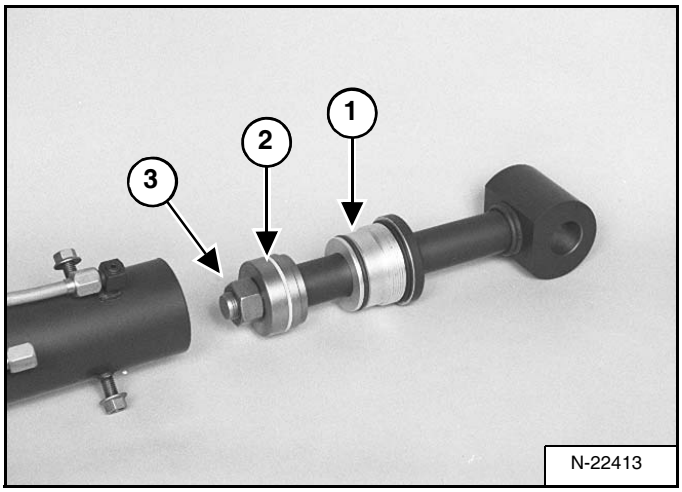


Install the O-ring (Item 1) **[Figure 20-24-23]**.

Install the back-up ring (Item 2) and O-ring (Item 3) into the groove on the head (Item 4) **[Figure 20-24-23]**.

Assembly (Cont'd)

Figure 20-24-24



Install the head (Item 1) and piston (Item 2) **[Figure 20-24-24]** on the rod.

Grease the piston where the nut contacts the piston. Do not get grease on the threads.

Provide an adequate support for the cylinder before tightening.

Install the nut (Item 3) **[Figure 20-24-24]**.

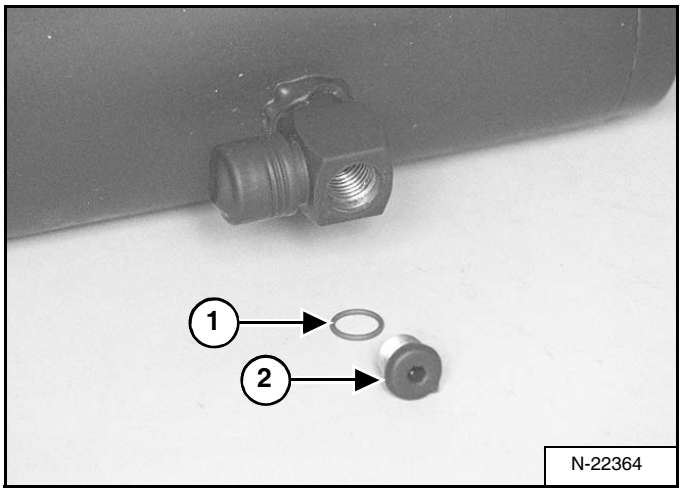
NOTE: Clean and dry the rod threads. From the kit install a NEW NUT with pre-applied LOCTITE.

Tighten 0.875 inch nuts with the aluminum piston to 250 ft.-lbs. (339 Nm) torque.

Tighten 0.875 inch nuts with the gray iron piston to 350 ft.-lbs. (474 Nm) torque.

Tighten 1.0 inch nuts with the gray iron piston to 600 ft.-lbs. (814 Nm) torque.

Figure 20-24-25

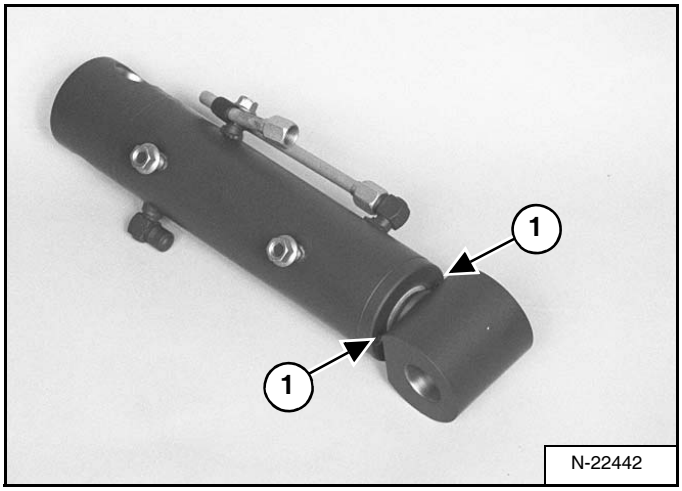


Install O-ring (Item 1) and plug (Item 2) **[Figure 20-24-25]**.

Tighten the plug to 8 ft.-lbs. (11 Nm) torque.

Put the base end of the hydraulic cylinder in a vise.

Figure 20-24-26



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-24-26]** to tighten the head. Head to be torqued until flush with end of the housing.

TRACK FRAME EXPANSION CYLINDER

Testing

Retract the track frame fully.

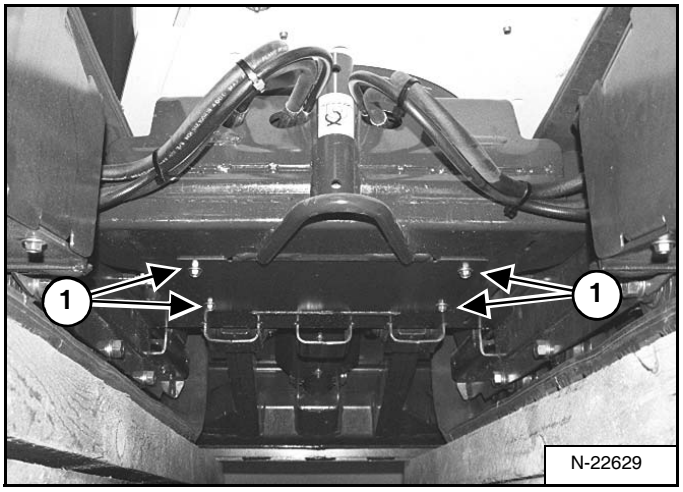
Figure 20-25-1



Place blocks under the Excavator tracks. Lower the bucket to the ground and the blade on the blocks **[Figure 20-25-1]**.

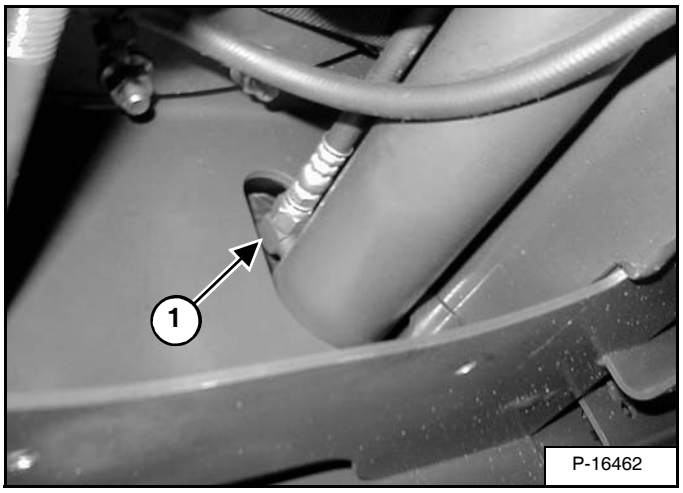
Stop the engine. Raise the control console.

Figure 20-25-2



Remove the four bolts (Item 1) **[Figure 20-25-2]** fastening the cover to the bottom side of the undercarriage. Remove the cover.

Figure 20-25-3



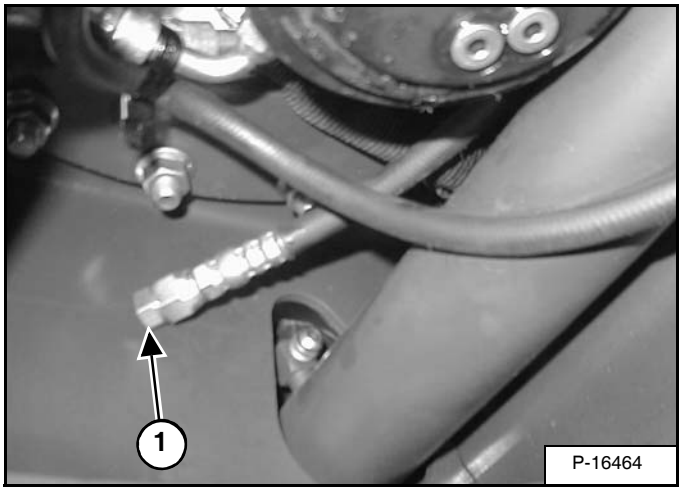
Remove the expansion cylinder base end hose (Item 1) **[Figure 20-25-3]**.

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

Figure 20-25-4



Install a plug (Item 1) **[Figure 20-25-4]** on the hose fitting and tighten.

Lower control console and fasten the seat belt. Start the engine and retract the expansion cylinder.

TRACK FRAME EXPANSION CYLINDER (CONT'D)

Testing (Cont'd)

If there is any leakage from the base end fitting on the expansion cylinder, remove the cylinder for repair or replacement.

Removal And Installation

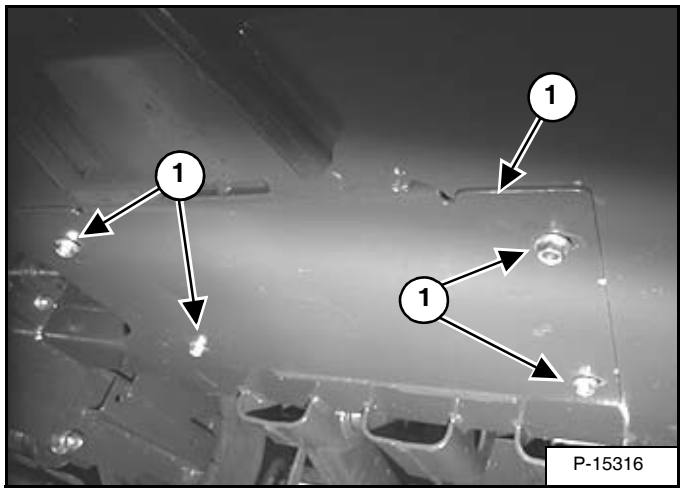
Expand the track frame fully.

Figure 20-25-5



Place blocks under the Excavator tracks for increased access to the expansion cylinder **[Figure 20-25-5]**.

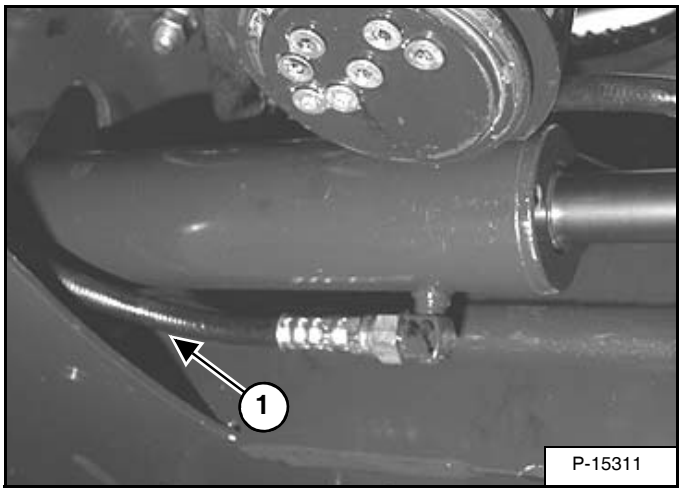
Figure 20-25-6



Remove the four bolts (Item 1) **[Figure 20-25-6]**.

Remove the access plate (Item 2) **[Figure 20-25-6]**.

Figure 20-25-7



Remove the hose (Item 1) **[Figure 20-25-7]** from the cylinder rod end.

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

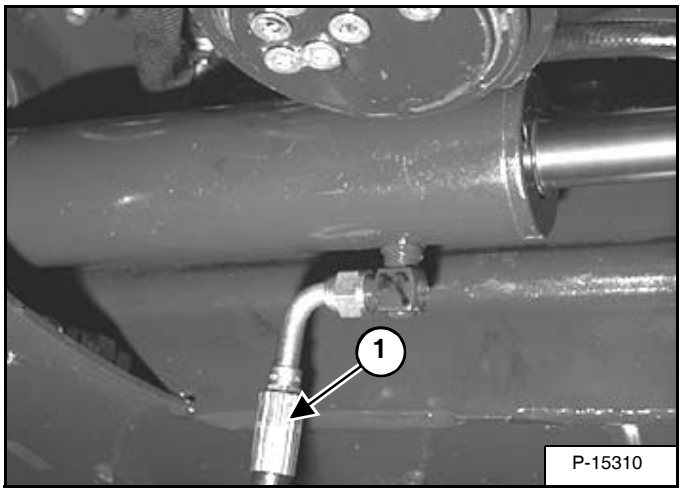
⚠ WARNING

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W-2145-0290

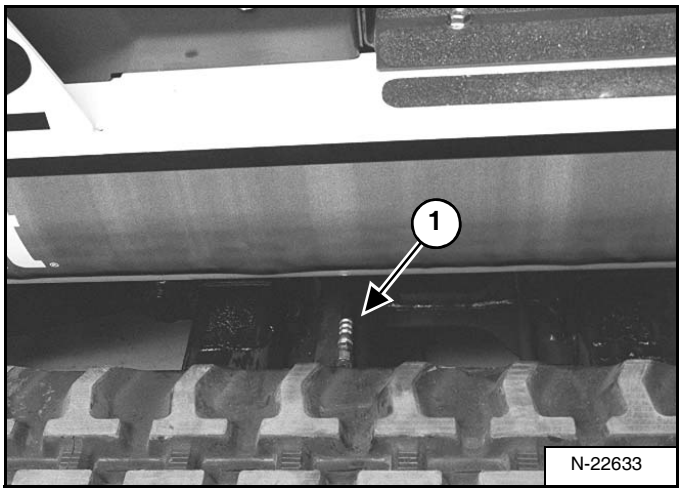
Removal And Installation (Cont'd)

Figure 20-25-8



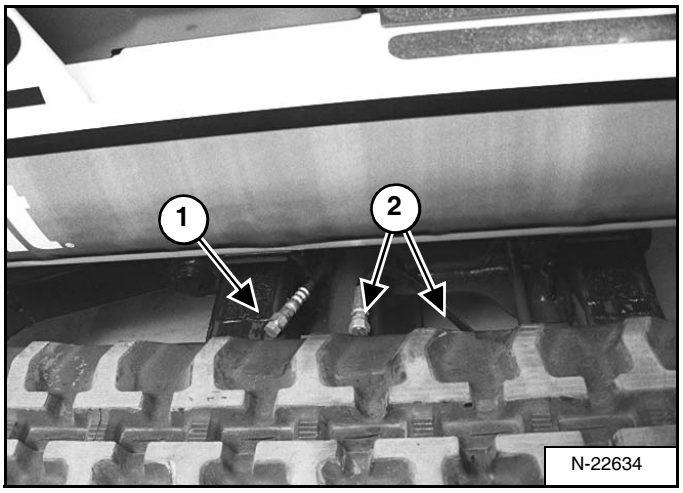
Install a hose (Item 1) **[Figure 20-25-8]** on the cylinder rod end. Place the other end of the hose in a drain pan.

Figure 20-25-9



Remove the hose (Item 1) **[Figure 20-25-9]** from the cylinder base end.

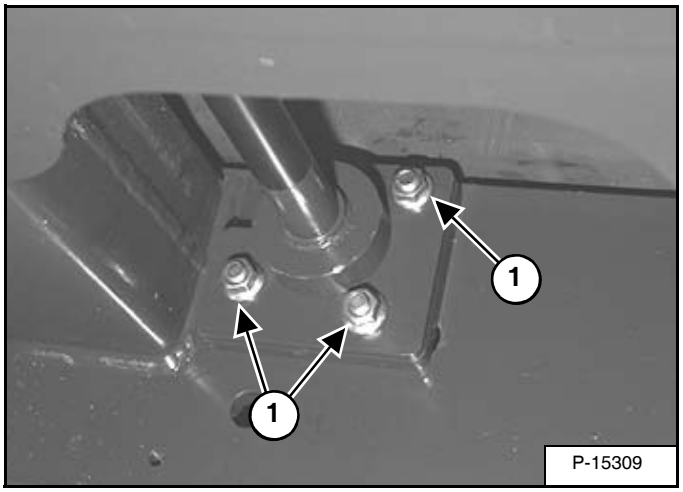
Figure 20-25-10



Plug the base end hose (Item 1) **[Figure 20-25-10]**.

Install a hose (Item 2) **[Figure 20-25-10]** on the cylinder base end. Place the other end of the hose in a drain pan.

Figure 20-25-11

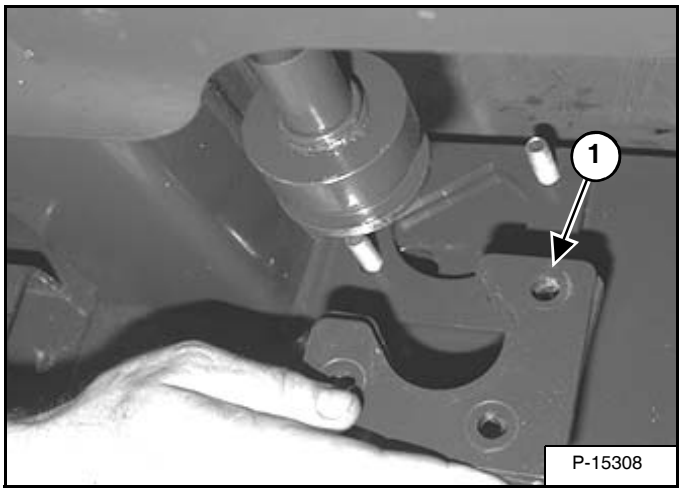


Remove the three nuts (Item 1) **[Figure 20-25-11]** from the rod end of the cylinder.

Installation: Tighten the nuts to 32-35 ft lbs (43-47 Nm) torque.

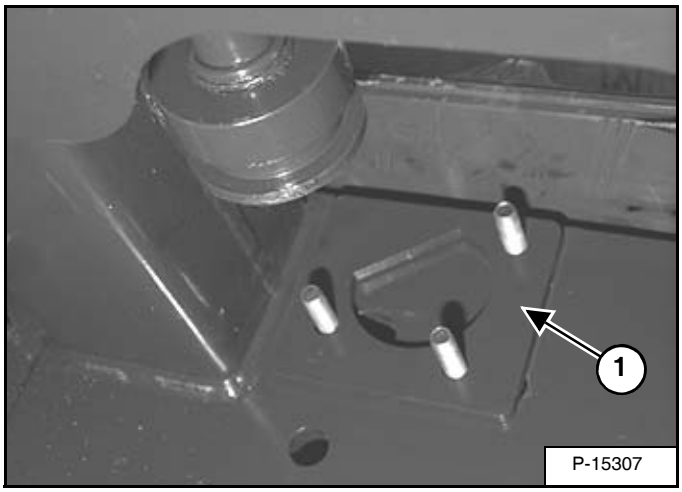
Removal And Installation (Cont'd)

Figure 20-25-12



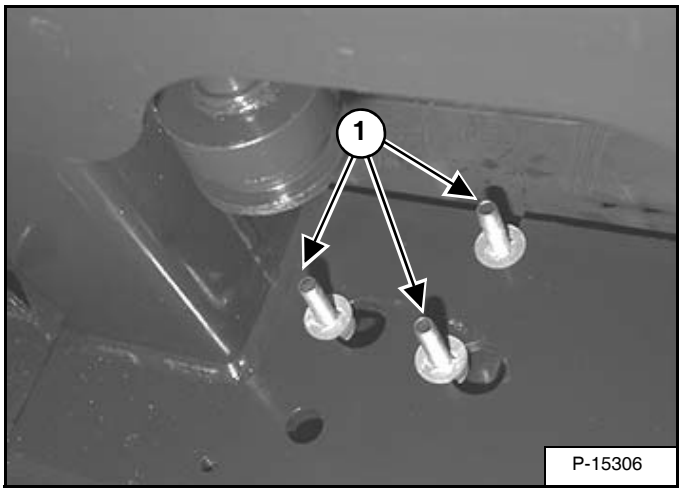
Slightly compress the cylinder. Remove the two plates (Item 1) **[Figure 20-25-12]** from the rod end of the cylinder.

Figure 20-25-13



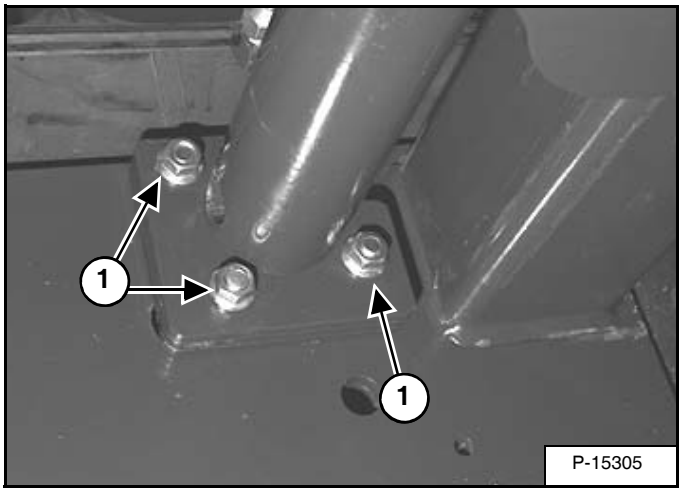
Remove the mount plate (Item 1) **[Figure 20-25-13]** from the track frame.

Figure 20-25-14



Remove the three bolts (Item 1) **[Figure 20-25-14]** and retaining clips from the track frame.

Figure 20-25-15

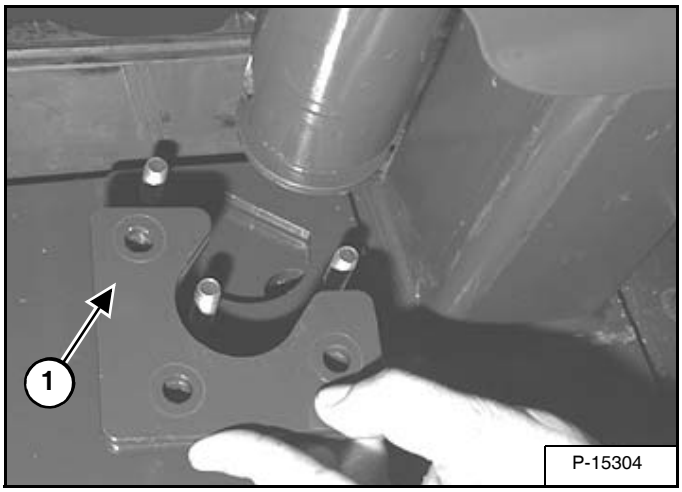


Remove the three nuts (Item 1) **[Figure 20-25-15]** from the base end of the cylinder.

Installation: Tighten the nuts to 32-35 ft.-lbs. (43-47 Nm) torque.

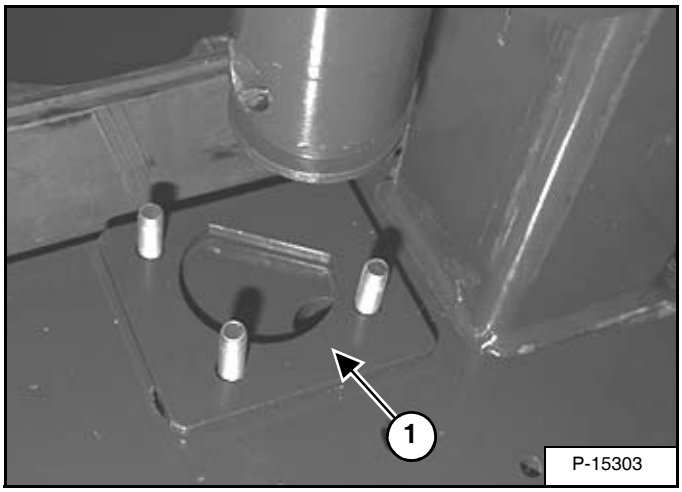
Removal And Installation (Cont'd)

Figure 20-25-16



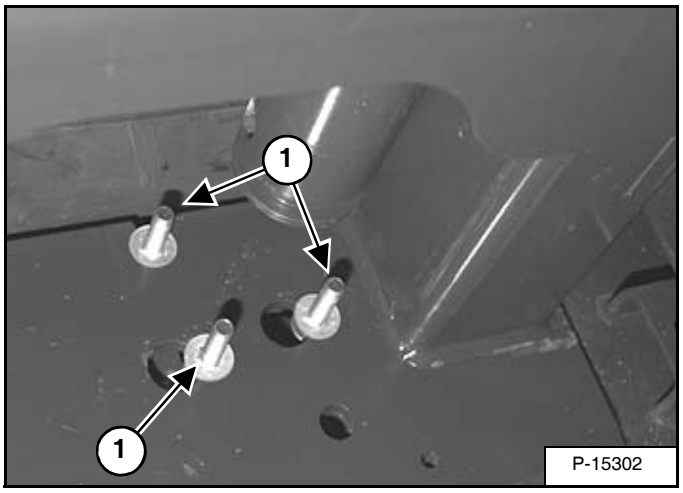
Pull the cylinder out of the mount. Remove the two plates (Item 1) **[Figure 20-25-16]** from the base end of the cylinder.

Figure 20-25-17



Remove the mount plate (Item 1) **[Figure 20-25-17]** from the track frame.

Figure 20-25-18

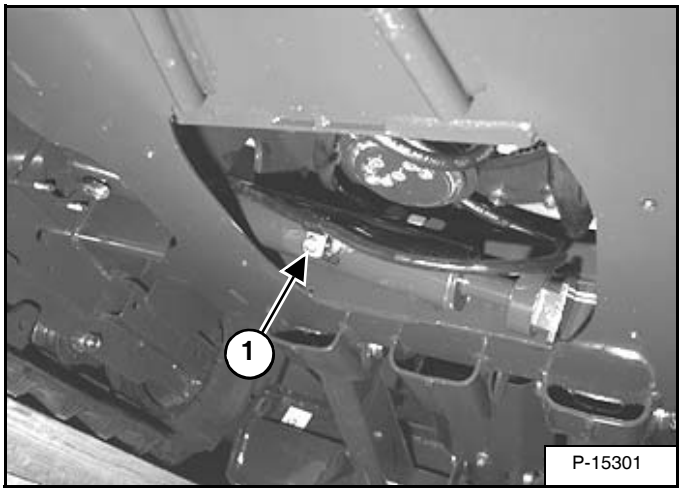


Remove the three bolts (Item 1) **[Figure 20-25-18]** and retaining clips from the track frame.

Compress the cylinder.

Rotate the cylinder until the hose clamp is accessible.

Figure 20-25-19



Remove the bolt (Item 1) **[Figure 20-25-19]**.

Remove the cylinder.

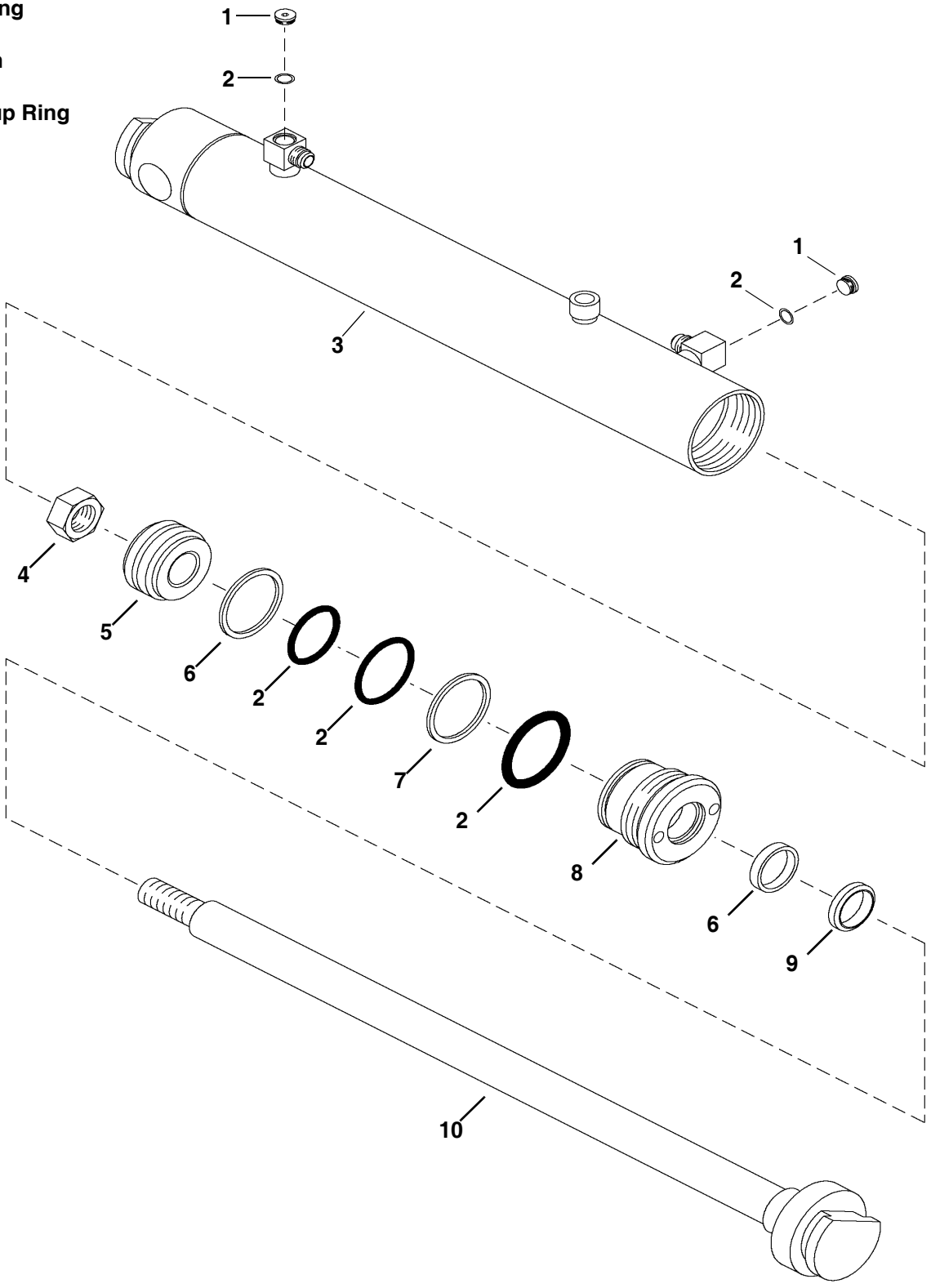
⚠ WARNING

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 which can result in injury or death.

W-2103-1285

Parts Identification

1. Plug
2. O-ring
3. Housing
4. Nut
5. Piston
6. Seal
7. Backup Ring
8. Head
9. Wiper
10. Rod



MS-1027

TRACK FRAME EXANSION CYLINDER (CONT'D)

Disassembly

Clean the outside of the expansion cylinder before disassembly.

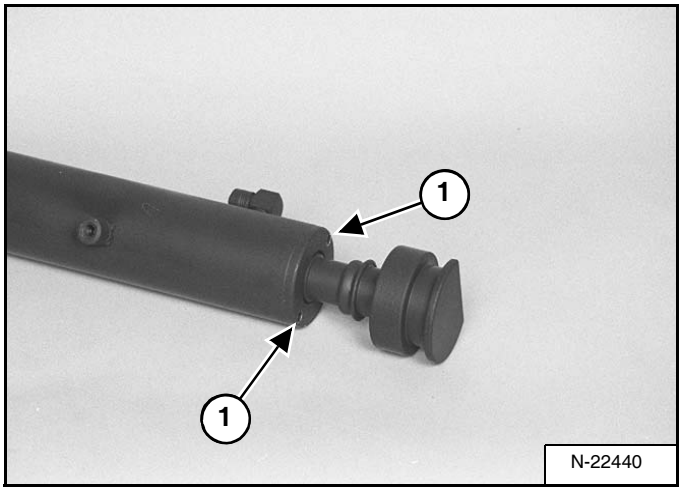
Use the following tools to disassemble the cylinder:

MEL1074 - O-ring Seal Hook
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-1 - Standard Pins

Hold the hydraulic cylinder over a drain pan and move the rod in and out slowly to remove the fluid from the cylinder.

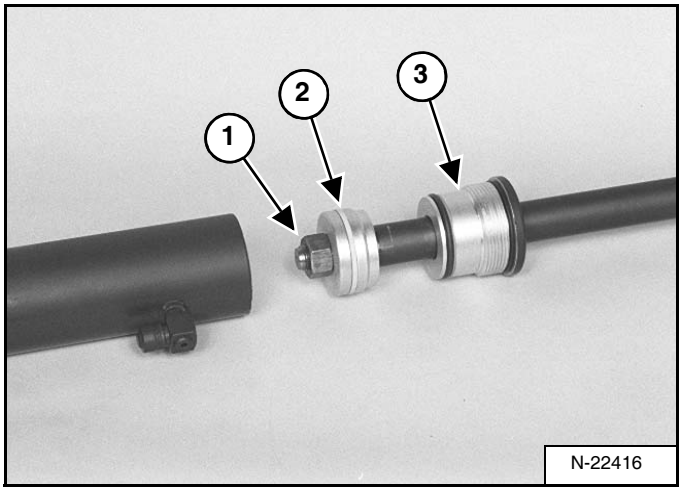
Put the base end of the cylinder in a vise.

Figure 20-25-20



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-25-20]** to loosen the head.

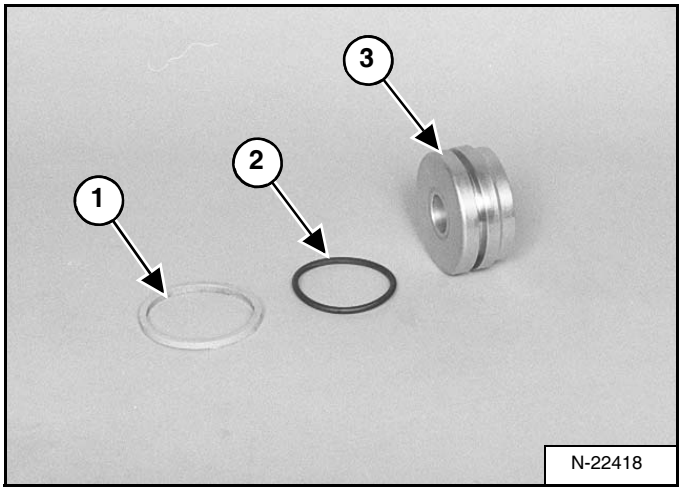
Figure 20-25-21



Remove the head and the rod assembly from the cylinder **[Figure 20-25-21]**. Put the rod end in a vise.

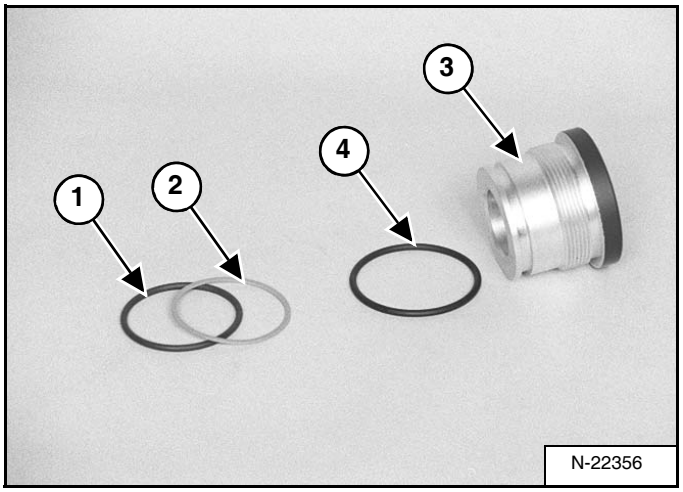
Remove the nut (Item 1), piston (Item 2) and head (Item 3) **[Figure 20-25-21]**.

Figure 20-25-22



Standard Piston: Remove the seal (Item 1) and O-ring (Item 2) from the piston (Item 3) **[Figure 20-25-22]**.

Figure 20-25-23

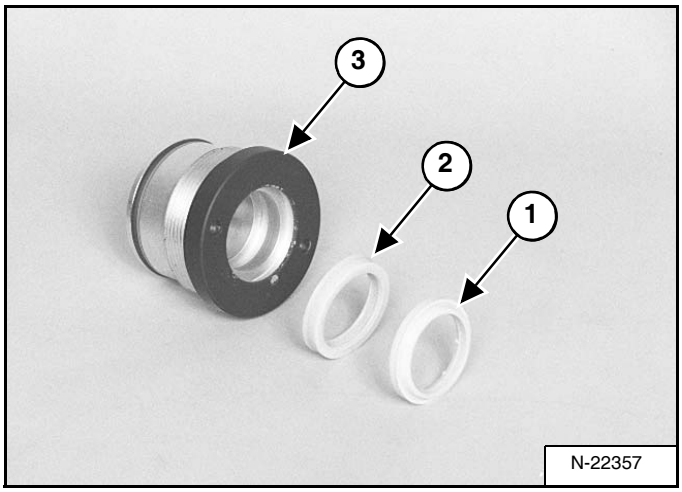


Remove the O-ring (Item 1) and the back-up ring (Item 2) from the groove in the head (Item 3) **[Figure 20-25-23]**.

Remove the thin O-ring (Item 4) **[Figure 20-25-23]**.

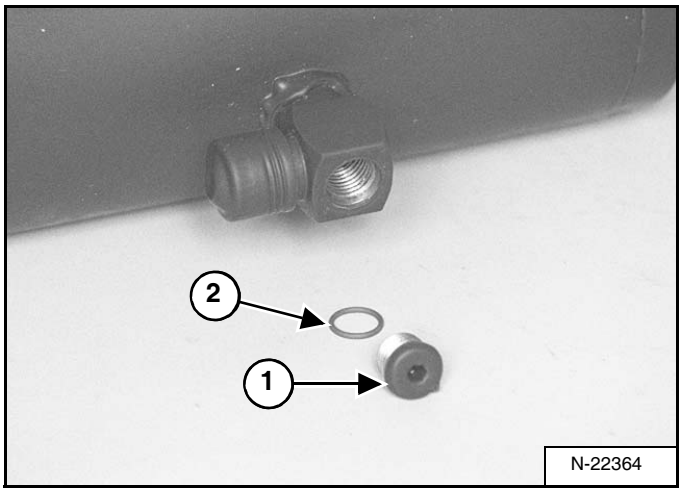
Disassembly (Cont'd)

Figure 20-25-24



Remove the wiper seal (Item 1) and rod seal (Item 2) from the inside of the head (Item 3) **[Figure 20-25-24]**.

Figure 20-25-25



Remove plug (Item 1) and O-ring (Item 2) **[Figure 20-25-25]**.

Assembly

Use the following tools to assemble the cylinder:

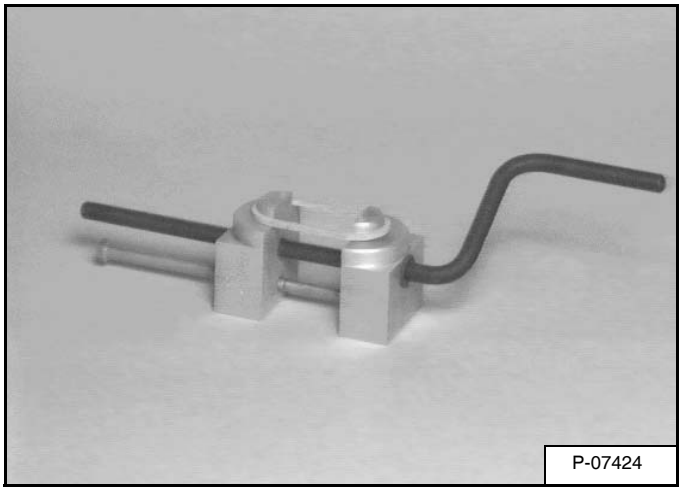
MEL1396 - Universal Seal Expander
MEL1033 - Rod Seal Installation Tool
Piston Ring Compressor
MEL1075 - Adjustable Gland Nut Wrench
MEL1075-1 - Standard Pins

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-25-26

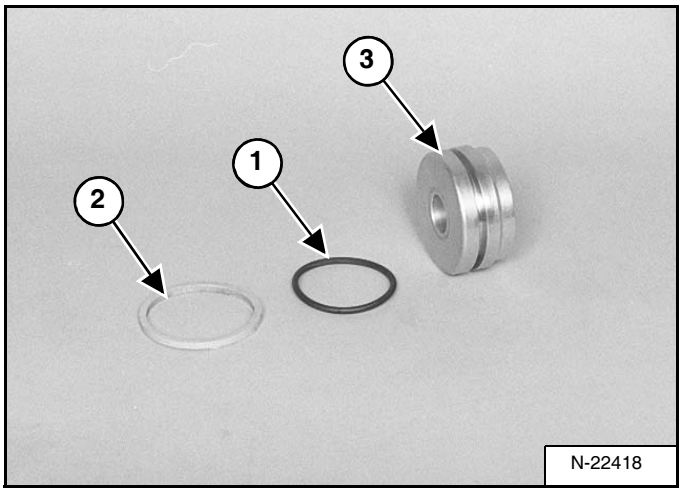


Install the seal on the tool and slowly stretch it until it fits the piston **[Figure 20-25-26]**.

Allow the seal to stretch for 30 seconds before installing it on the piston.

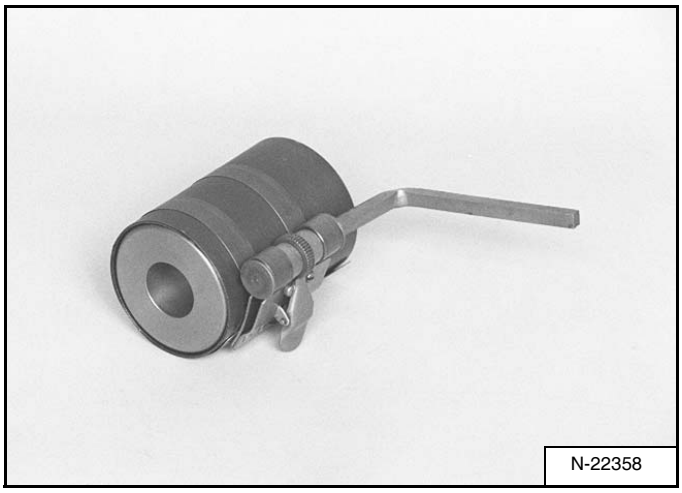
Assembly (Cont'd)

Figure 20-25-27



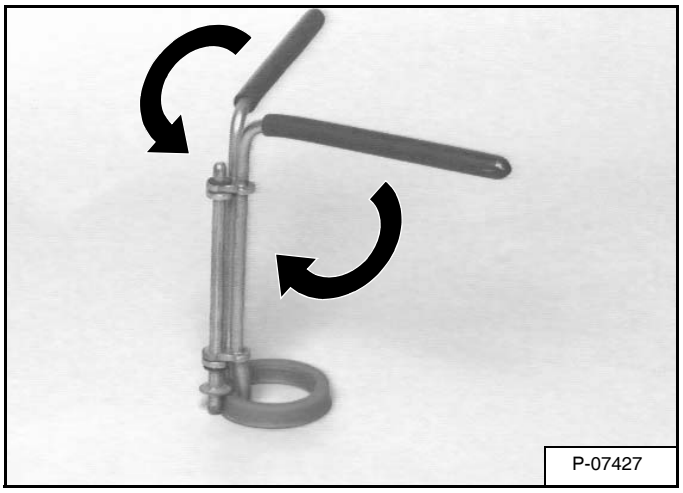
Standard Piston: Install the O-ring (Item 1) and seal (Item 2) on the piston (Item 3) **[Figure 20-25-27]**.

Figure 20-25-28



Use a ring compressor to compress the seal to the correct size. Leave the piston in the compressor for about three minutes **[Figure 20-25-28]**.

Figure 20-25-29

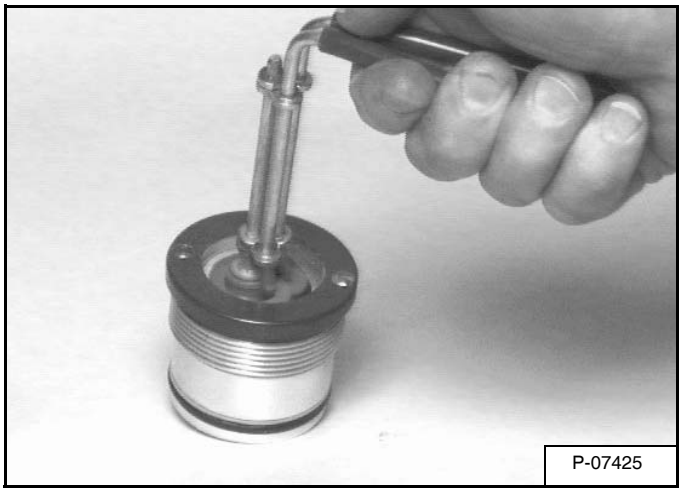


Install the rod seal on the rod seal tool **[Figure 20-25-29]**.

NOTE: During installation the spring side of the seal must be toward the inside of the cylinder.

Rotate the handles to collapse the rod seal **[Figure 20-25-29]**.

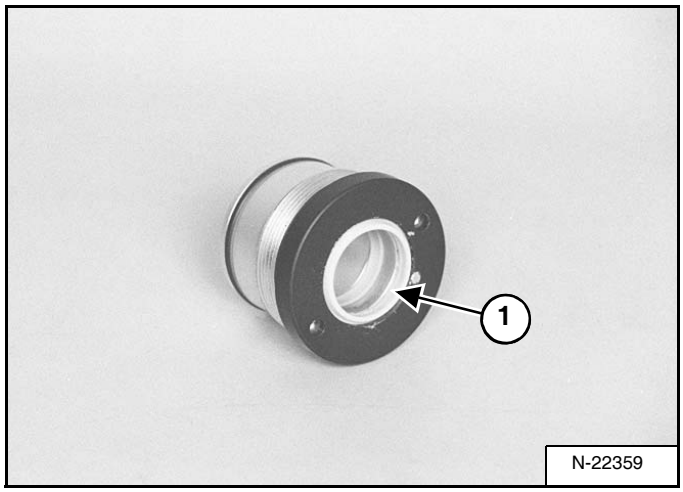
Figure 20-25-30



Install the rod seal in the head **[Figure 20-25-30]**.

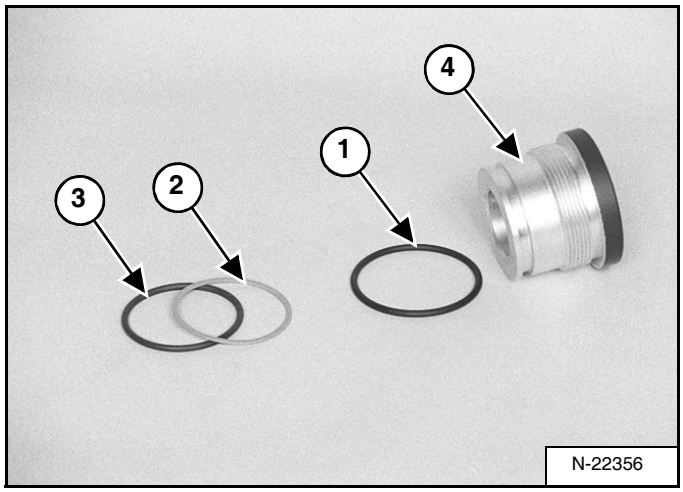
Assembly (Cont'd)

Figure 20-25-31



Install the wiper seal with the wiper (Item 1) **[Figure 20-25-31]** toward the outside of the head.

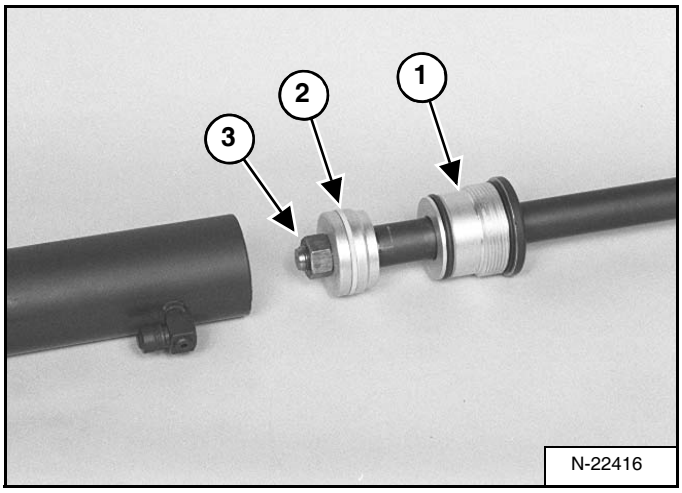
Figure 20-25-32



Install the O-ring (Item 1) **[Figure 20-25-32]**.

Install the back-up ring (Item 2) and thick O-ring (Item 3) into the groove on the head (Item 4) **[Figure 20-25-32]**.

Figure 20-25-33



Install the head (Item 1) and the piston (Item 2) **[Figure 20-25-33]** on the rod.

Grease the piston where the nut contacts the piston. Do not get grease on the threads.

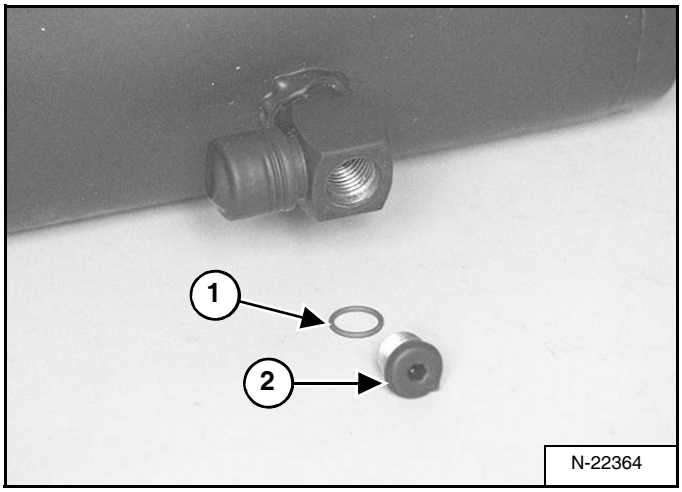
Provide an adequate support for the cylinder before tightening.

Install the nut (Item 3) **[Figure 20-25-33]**.

NOTE: Clean and dry the rod threads, from the kit install a NEW NUT with pre-applied LOCTITE.

Tighten the nut to 90 ft.-lbs. (122 Nm) torque.

Figure 20-25-34



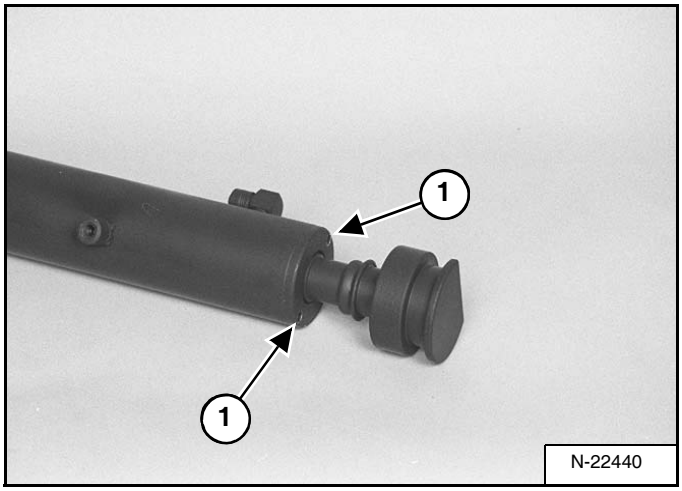
Install the O-ring (Item 1) **[Figure 20-25-34]** and plug (Item 2) **[Figure 20-25-34]**.

Tighten the plug to 8 ft.-lbs. (11 Nm) torque.

Assembly (Cont'd)

Put the base end of the hydraulic cylinder in a vise.

Figure 20-25-35



Insert the adjustable gland nut wrench into the two holes (Item 1) **[Figure 20-25-35]** to tighten the head. Head to be torqued until flush with end of the housing.

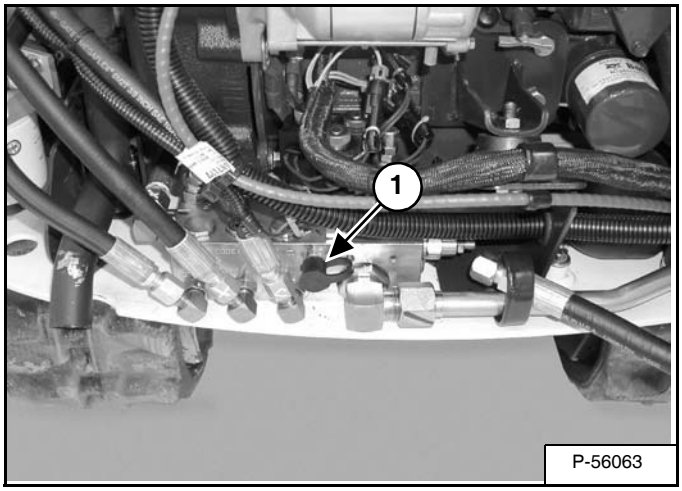

Bobcat®

MAIN RELIEF VALVE

Testing And Adjusting The Main Relief Valve

All testing is done with the hydraulic oil at operating temperature and the engine at high speed setting of 2550-2620 RPM.

Figure 20-30-1



There is one diagnostic coupler (Item 1) **[Figure 20-30-1]** on the manifold assembly for checking each of the pump section pressure.

The following tools will be needed for the testing at the diagnostic coupler:

MEL1355 - Test Kit includes the following:
MEL1355-3 - 5000 PSI Gauge
MEL1355-12 - Coupler
MEL1355-9 - Thermometer

System Pressures At Gauge Port Specifications

TEST CONDITIONS

1. Engine High Idle Speed

2. Warm oil over relief function to minimum 150° F (66° C). Cycle all functions during warm up procedure. Warm oil until the pressure build-up valve stabilizes near its target pressure.

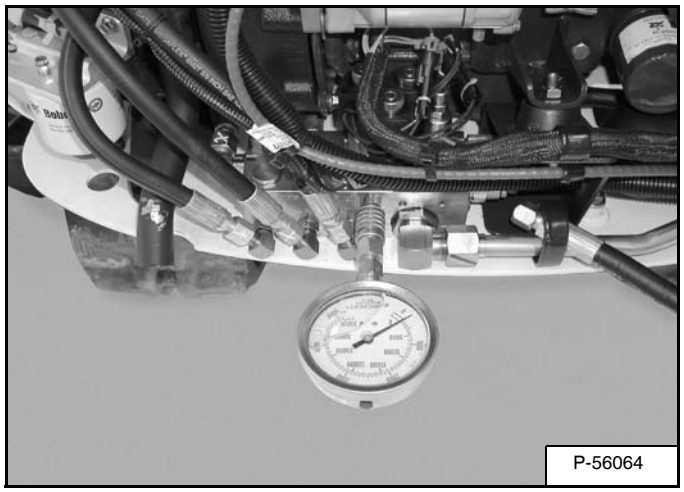
3. Activate function until cylinder movement stops. Hold

SYSTEM CHECK	FUNCTION TO ENGAGE	CIRCUIT PRESSURIZED	TEST PORT	TARGET (PSI)	ACCEPTABLE RANGE (PSI)
JOYSTICK PILOT PRESSURE	ANY JOYSTICK FUNCTION	JOYSTICK PILOT	*	435	406 - 450
PRESSURE BUILD - UP VALVE	NONE - CONSOLE DOWN	P2 & P3	G	415	345-485
SYSTEM BY - PASS	NONE - CONSOLE UP	DUMP TO TANK	G	115	MAX ALLOWABLE 155
MAIN RELIEF ON MANIFOLD BLOCK	BOOM	P3	G	2475	2375-2525
MAIN RELIEF ON MANIFOLD BLOCK	AUXILIARY	P1	G	2515	2415-2565
MAIN RELIEF ON MANIFOLD BLOCK	ARM	P2 & P3	G	2515	2415-2565
SWING MOTOR - CROSS PORT RELIEF	SLEW RIGHT	P1	G	1475	1400-1550
SWING MOTOR - CROSS PORT RELIEF	SLEW LEFT	P1	G	1475	1400-1550

** Under seat at bulkhead*

Testing And Adjusting The Main Relief Valve (Cont'd)

Figure 20-30-2



Connect the test gauge coupler from the test kit to the "G" diagnostic port **[Figure 20-30-2]**.

Lower the control console and fasten seat belt.

Start the engine and run at low RPM until hydraulic fluid is at operating temperatures 150° F (66° C).

With the hydraulic fluid at operating temperature, run engine at full RPM.

Operate the following circuits over relief and record the pressure for each circuit.

NOTE: Do not operate the blade circuit due to a by-pass orifice in spool.

The main relief valve pressure at "G" diagnostic port **[Figure 20-30-2]** should be as follows:

Boom up:
2375 - 2525 PSI (163.8 - 174 Bar)

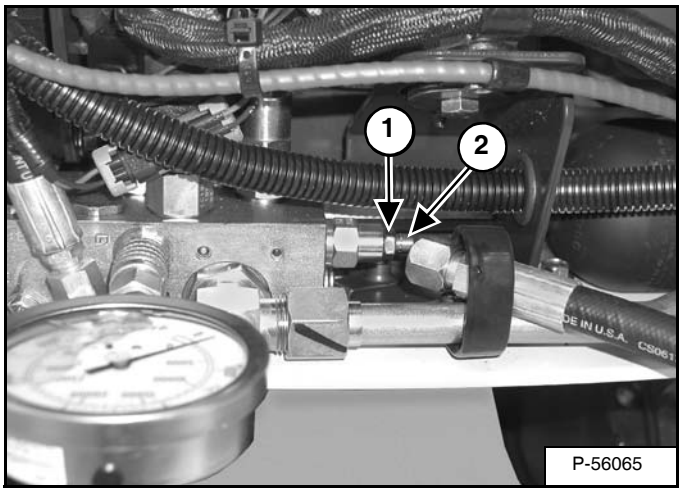
Arm in:
2415 - 2565 (166.5 - 176.9 Bar)

Auxiliary:
2415 - 2565 (166.5 - 176.9 Bar)

NOTE: The pressure rise in the arm in and auxiliary circuits is caused by increased flow.

Stop the engine.

Figure 20-30-3



If adjustment is needed, loosen the nut (Item 1) **[Figure 20-30-3]**.

Turn the adjustment bolt (Item 2) **[Figure 20-30-3]** clockwise to increase the pressure or counterclockwise to decrease the pressure.

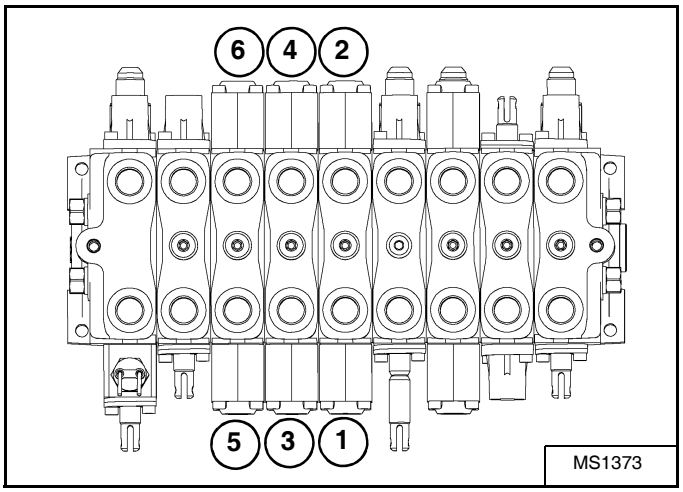
Tighten the nut (Item 1) **[Figure 20-30-3]**.

Retest the main relief valve after adjustment.

PORT RELIEF VALVES

Testing And Adjusting The Port Relief Valve Pressure

Figure 20-31-1



Boom Port Relief set at:

Rod End (Item 1) **[Figure 20-31-1]** 3335 PSI (230 Bar)

Base End (Item 2) **[Figure 20-31-1]** 3335 PSI (230 Bar)

Bucket Port Relief set at:

Rod End (Item 3) **[Figure 20-31-1]** 3335 PSI (230 Bar)

Base End (Item 4) **[Figure 20-31-1]** 2900 PSI (200 Bar)

Arm Port Relief set at:

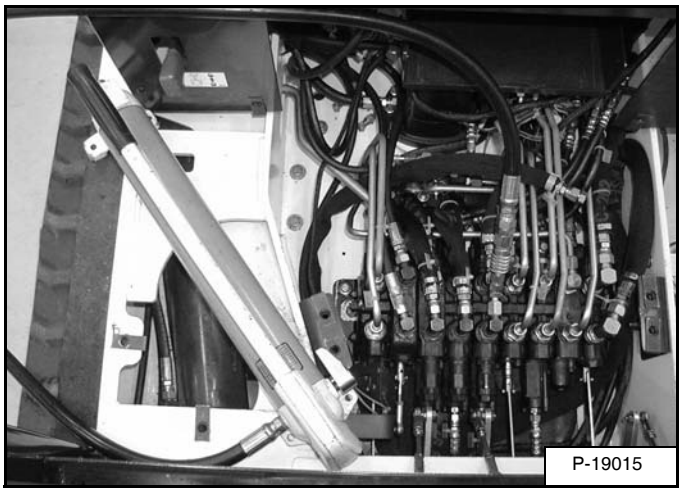
Rod End (Item 5) **[Figure 20-31-1]** 3335 PSI (230 Bar)

Base End (Item 6) **[Figure 20-31-1]** 2900 PSI (200 Bar)

NOTE: The reliefs are located below the spool covers on the valve sections.

A portable hydraulic hand pump will be used to test the work port relief valves. The hand pump must have clean hydraulic fluid that is compatible with the Bobcat hydraulic fluid.

Figure 20-31-2



Install the hand pump hose and a pressure gauge (minimum of 5000 PSI) into the valve section work port in which the port relief valve is located **[Figure 20-31-2]**. Slowly pressurize this section with the hand pump until the port relief valve opens and make a note of the pressure reading.

NOTE: Pumping the hand pump too fast will alter the pressure readings up to 50 PSI (3.4 Bar).

If the port relief pressure setting is incorrect, replace the port relief valve.

⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- **When fluids are under pressure.**
- **Flying debris or loose material is present.**
- **Engine is running.**
- **Tools are being used.**

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Bobcat®

CROSSPORT RELIEF VALVES

Testing And Adjusting The Crossport Relief Valve

The hydraulic system has two crossport relief valves that protect the swing motor from high pressure.

The following tools will be needed for the testing at the diagnostic coupler:

MEL1355 - Test Kit includes the following:
MEL1355-3 - 5000 PSI Gauge
MEL1355-12 - Coupler
MEL1355-9 - Thermometer

System Pressures At Gauge Port Specifications

TEST CONDITIONS

1. Engine High Idle Speed

2. Warm oil over relief function to minimum 150° F (66° C). Cycle all functions during warm up procedure. Warm oil until the pressure build-up valve stabilizes near its target pressure.

3. Activate function until cylinder movement stops. Hold over relief for 5-10 seconds.
   Record pressure.

Open the tailgate.

Figure 20-32-1

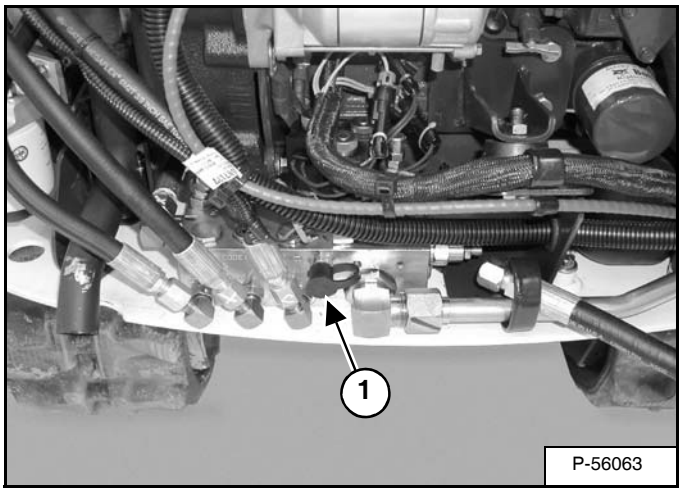
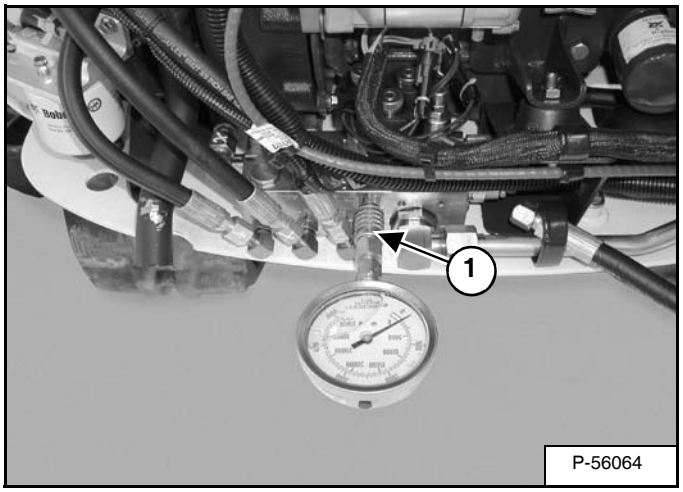


Figure 20-32-2



Connect the test gauge coupler from the test kit to the “G” diagnostic port (Item 1) **[Figure 20-32-1]** & **[Figure 20-32-2]**.

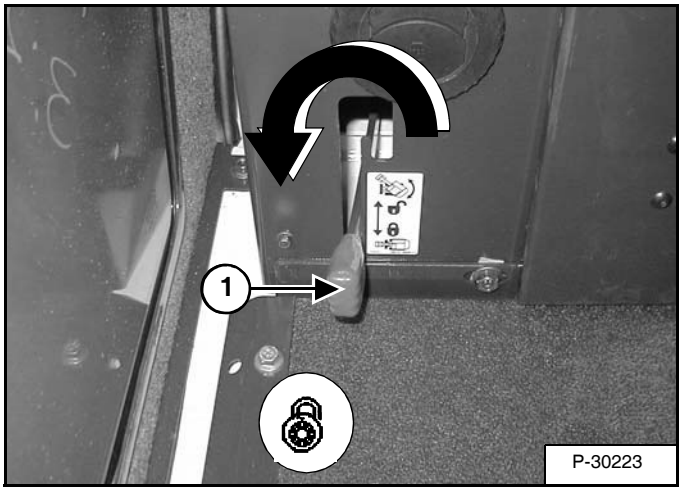
Lower the control console and fasten the seat belt.

SYSTEM CHECK	FUNCTION TO ENGAGE	CIRCUIT PRESSURIZED	TEST PORT	TARGET (PSI)	ACCEPTABLE RANGE (PSI)
JOYSTICK PILOT PRESSURE	ANY JOYSTICK FUNCTION	JOYSTICK PILOT	*	435	406 - 450
PRESSURE BUILD - UP VALVE	NONE - CONSOLE DOWN	P2 & P3	G	415	345-485
SYSTEM BY - PASS	NONE - CONSOLE UP	DUMP TO TANK	G	115	MAX ALLOWABLE 155
MAIN RELIEF ON MANIFOLD BLOCK	BOOM	P3	G	2475	2375-2525
MAIN RELIEF ON MANIFOLD BLOCK	AUXILIARY	P1	G	2515	2415-2565
MAIN RELIEF ON MANIFOLD BLOCK	ARM	P2 & P3	G	2515	2415-2565
SWING MOTOR - CROSS PORT RELIEF	SWING RIGHT	P1	G	1475	1400-1550
SWING MOTOR - CROSS PORT RELIEF	SWING LEFT	P1	G	1475	1400-1550

**Under seat at bulkhead*

Testing And Adjusting The Crossport Relief Valve (Cont'd)

Figure 20-32-3



Start the engine and run at low RPM until the hydraulic fluid is at operating temperatures 150° F (66° C).

Move the swing lock lever (Item 1) **[Figure 20-32-3]** to the locked position.

With the hydraulic fluid at operating temperature, run engine at full RPM.

Move the left control lever (joystick) to engage the swing circuit in the clockwise direction. Record the pressure.

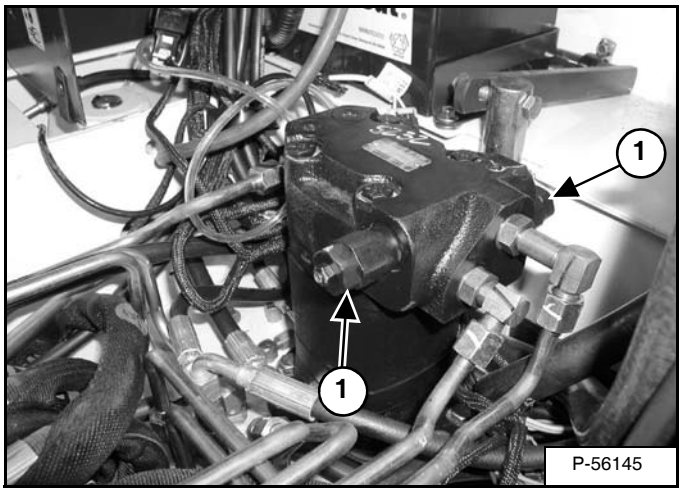
Move the left control lever (joystick) to engage the swing circuit in the counterclockwise direction. Record the pressure.

The swing (Slew) crossport relief valve pressure at "G" diagnostic port **[Figure 20-32-2]** should be as follows:

1475 PSI (102 Bar) with an acceptable range of 1400-1550 PSI (97-107 Bar).

If the pressure is incorrect, remove the blade extension tray. (See Removal And Installation on Page 40-210-1.)

Figure 20-32-4



Remove the two crossport relief valves (Item 1) **[Figure 20-32-4]**.

Clean the two crossport relief valves.

Install the two crossport relief valves and tighten to 30-40 ft.-lbs. (40,6-46,1 Nm).

Retest the crossport relief valves after cleaning.

If pressure is still incorrect, replace the crossport relief valves.

PRESSURE REDUCING VALVE

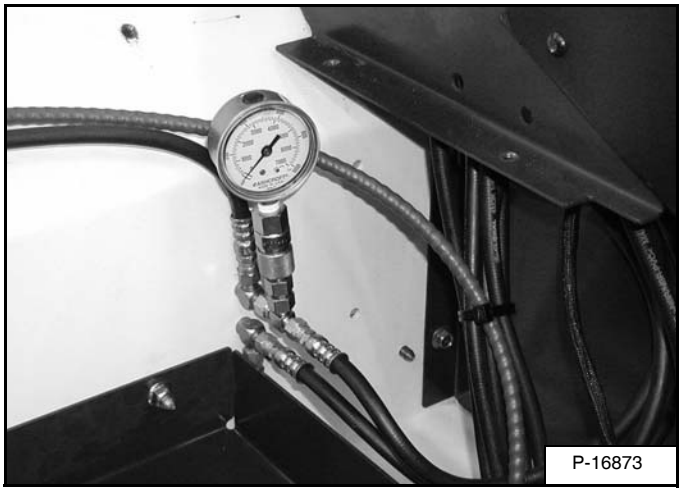
Testing And Adjusting The Pressure Reducing Valve

The following tools will be needed for testing the pressure reducing valve:

MEL1355 - Test Kit includes the following:
MEL1355-2 - 1000 PSI Gauge
MEL1355-9 - Thermometer

Remove the seat and raise the seat mount. (See Removal And Installation on Page 40-40-1.)

Figure 20-33-5



Install a 1000 PSI (6895 kPa) gauge on the tee fitting **[Figure 20-33-5]**.

Lower control console and fasten seat belt.

Start the engine and warm the hydraulic fluid to operating temperatures 150°F (66°C).

With the hydraulic fluid at operating temperature, run engine at full RPM.

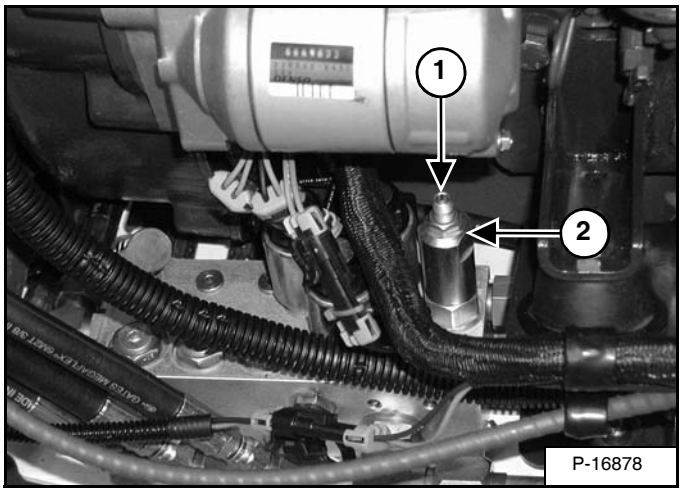
Operate the circuit over relief and record the pressure.

The pressure reducing valve pressure at the bulkhead fitting **[Figure 20-33-5]** should be as follows:

435 psi (30 Bar) with an acceptable range of 406-450 psi (28-31 Bar)

Stop the engine.

Figure 20-33-6



If adjustment is needed, loosen the nut (Item 1) **[Figure 20-33-6]**.

Turn the adjustment screw (Item 2) **[Figure 20-33-6]** clockwise to increase the pressure or counterclockwise to decrease the pressure.

Tighten the nut (Item 1) **[Figure 20-33-6]**.

Retest the pressure reducing valve after adjustment.

If pressure is still incorrect, remove the pressure reducing valve from the manifold assembly and inspect.

Testing And Adjusting The Pressure Reducing Valve (Cont'd)

Inspect the port of the pressure reducing valve on the manifold assembly to verify no damage. If damaged replace manifold assembly.

Figure 20-33-7

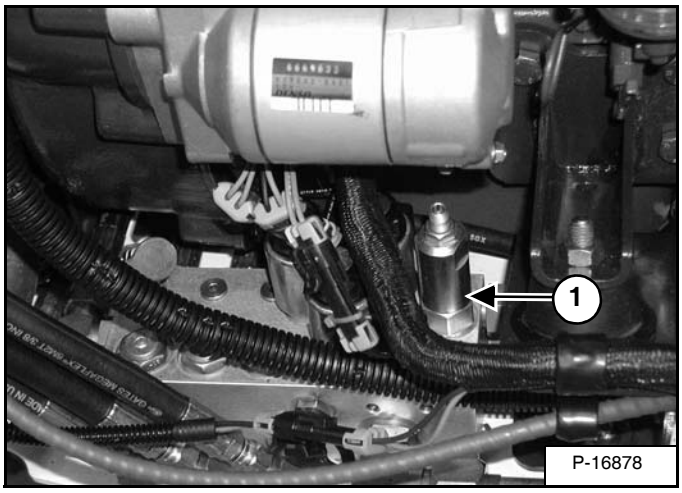
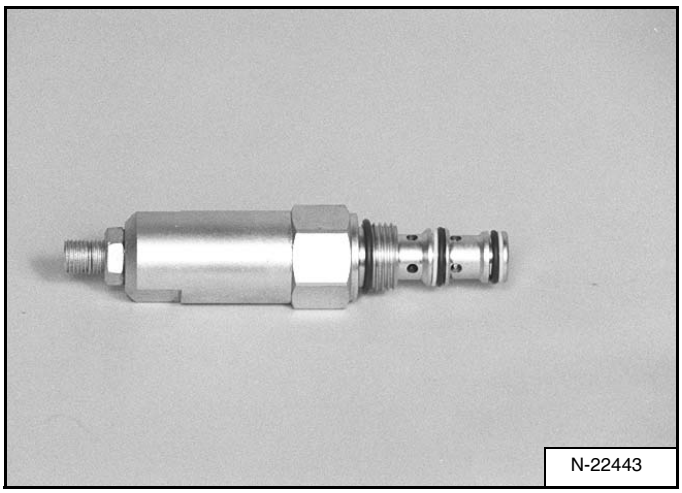


Figure 20-33-8



Inspect the O-rings and back-up rings on the pressure reducing valve (Item 1) **[Figure 20-33-7]** & **[Figure 20-33-8]**. If O-rings and back-up rings are worn or damaged, replace O-rings and back-up rings. (See Testing And Adjusting The Pressure Reducing Valve on Page 20-33-1.)

Re-install the pressure reducing valve in the manifold assembly.

Repeat pressure reducing valve test.

If the O-rings and back-up rings were not worn or damaged and the pressures at the bulkhead fitting could not be achieved, replace pressure reducing valve.

HYDRAULIC CONTROL VALVE (320 / 322)

Description

The hydraulic control valve has 3335 PSI (230 Bar) and 2900 PSI (200 Bar) work port relief valves for the boom, bucket and arm sections.

The 218 PSI (15 Bar) buildup valve is located in the bucket section.

Removal And Installation

Lower the boom/bucket and blade to the ground.

With the engine off, turn the start key to the ON position and move both hydraulic control levers to relieve hydraulic pressure.

IMPORTANT

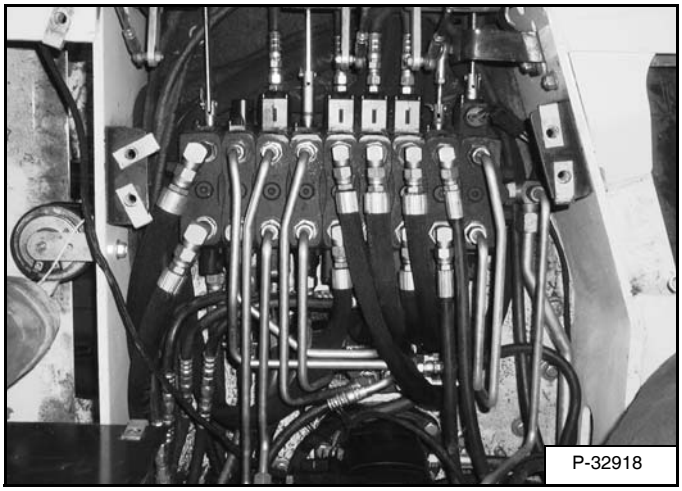
When repairing hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I-2003-0888

Remove the floormat and floorplate. (See Removal and Installation on Page 40-120-1.)

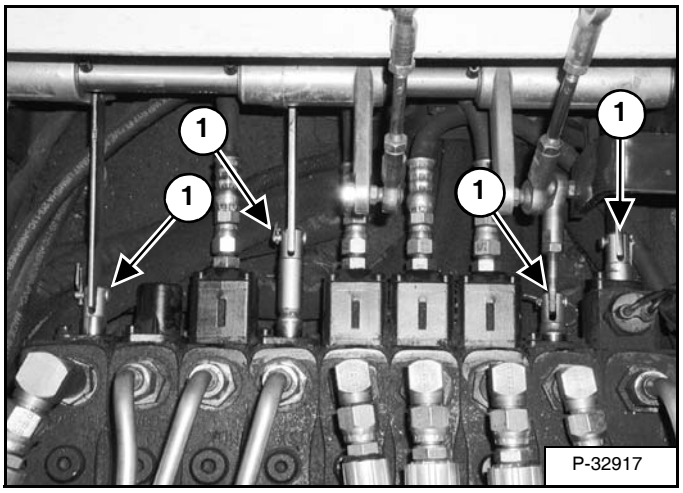
Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Figure 20-40-1



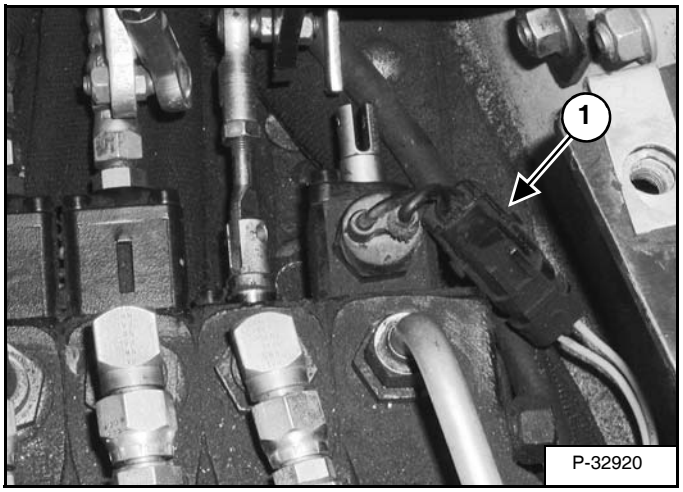
Mark all tubes and hoses for ease of assembly **[Figure 20-40-1]**.

Figure 20-40-2



Remove the clevis pins and cotter pins (Item 1) **[Figure 20-40-2]**.

Figure 20-40-3



Disconnect the wire harness (Item 1) **[Figure 20-40-3]** from the two speed switch.

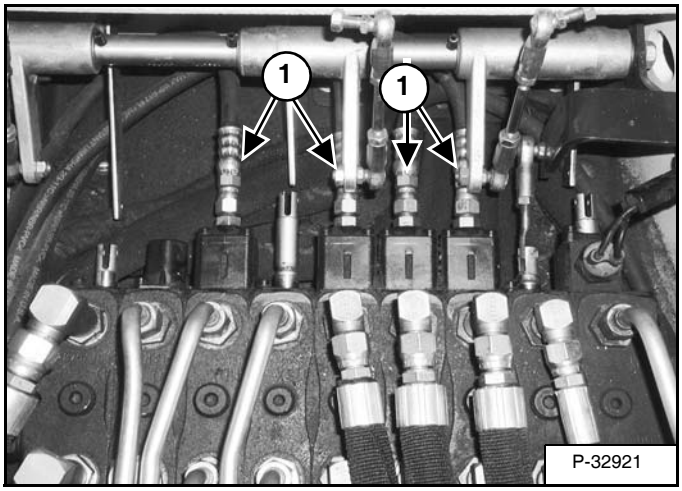
⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

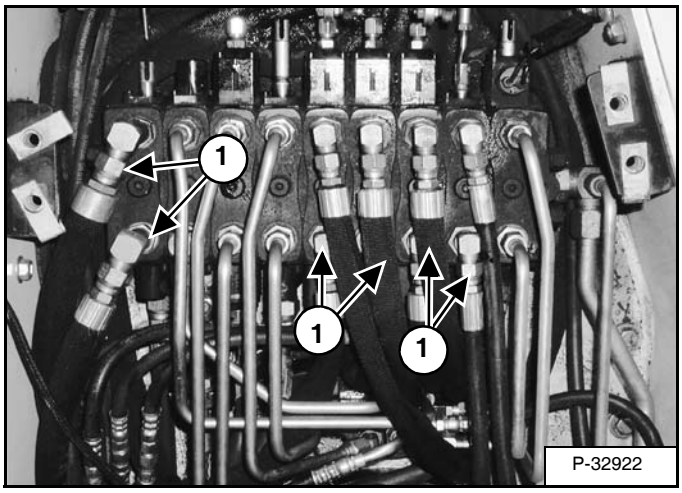
Removal and Installation (Cont'd)

Figure 20-40-4



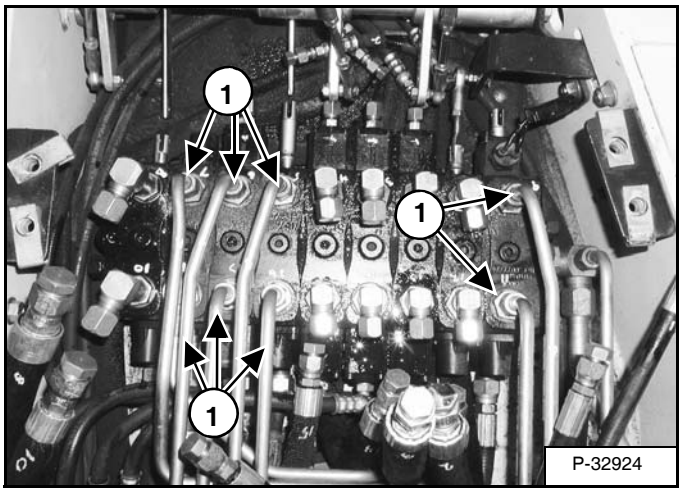
Remove the hoses (Item 1) **[Figure 20-40-4]**.

Figure 20-40-5



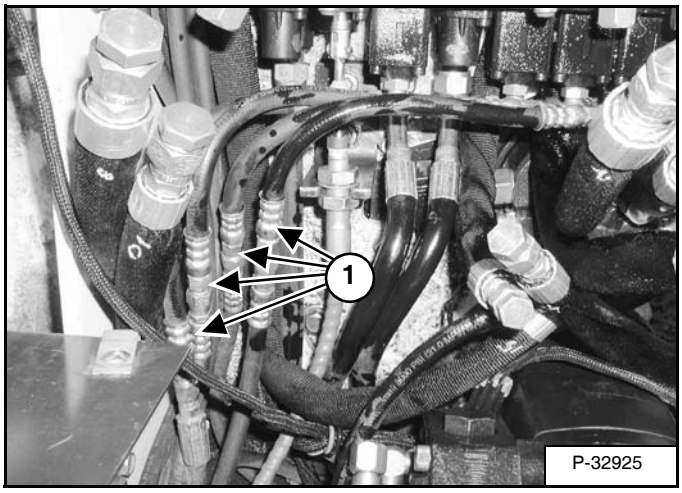
Remove the hoses (Item 1) **[Figure 20-40-5]** from the top of the control valve.

Figure 20-40-6



Remove the tubelines (Item 1) **[Figure 20-40-6]**.

Figure 20-40-7

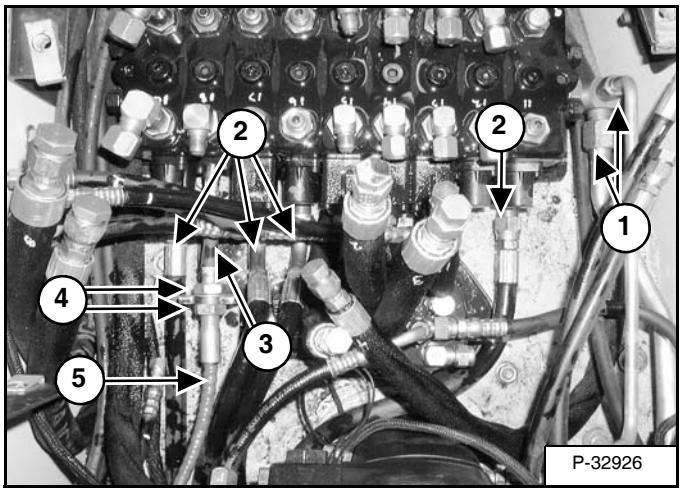


Remove the hoses (Item 1) **[Figure 20-40-7]**.

NOTE: The hoses will be removed with the valve.

Removal and Installation (Cont'd)

Figure 20-40-8



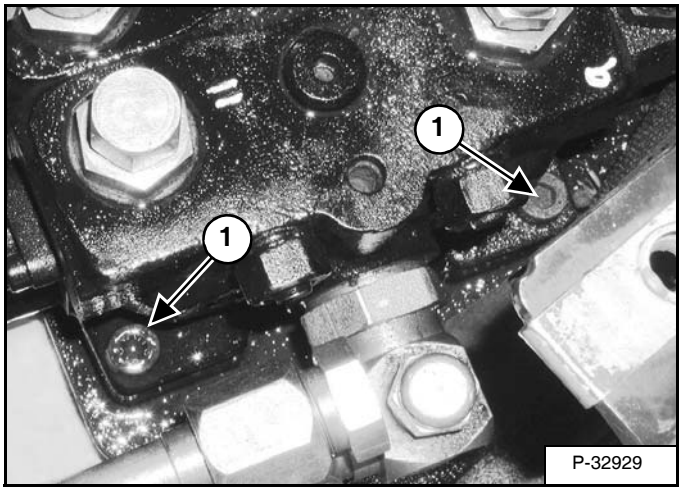
Disconnect the tubelines (Item 1) **[Figure 20-40-8]** from the control valve.

Disconnect the hoses (Item 2) **[Figure 20-40-8]** from the control valve.

Remove the clevis pin and cotter pin (Item 3) **[Figure 20-40-8]** from the blade cable linkage.

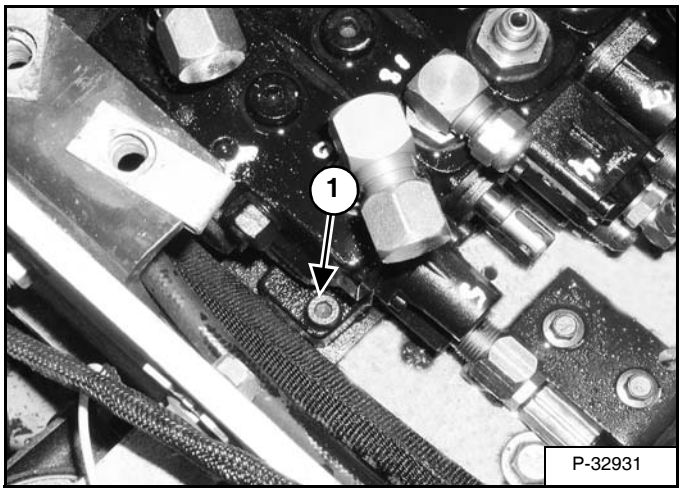
Loosen the nuts (Item 4) and remove the cable linkage (Item 5) **[Figure 20-40-8]**.

Figure 20-40-9



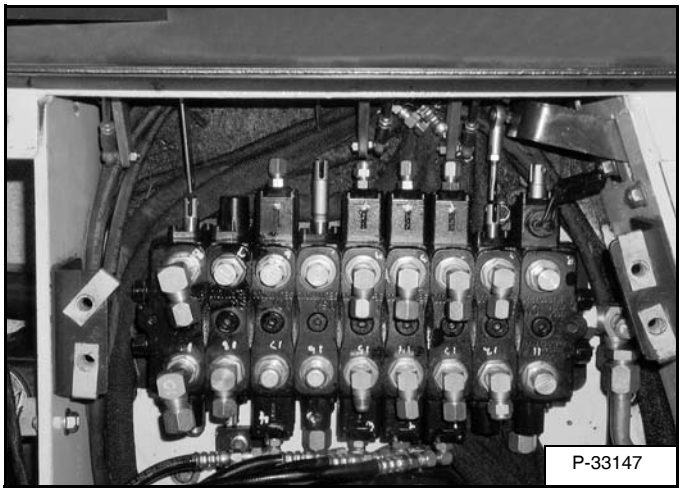
Remove the bolts (Item 1) **[Figure 20-40-9]**.

Figure 20-40-10



Remove the bolt (Item 1) **[Figure 20-40-10]**.

Figure 20-40-11

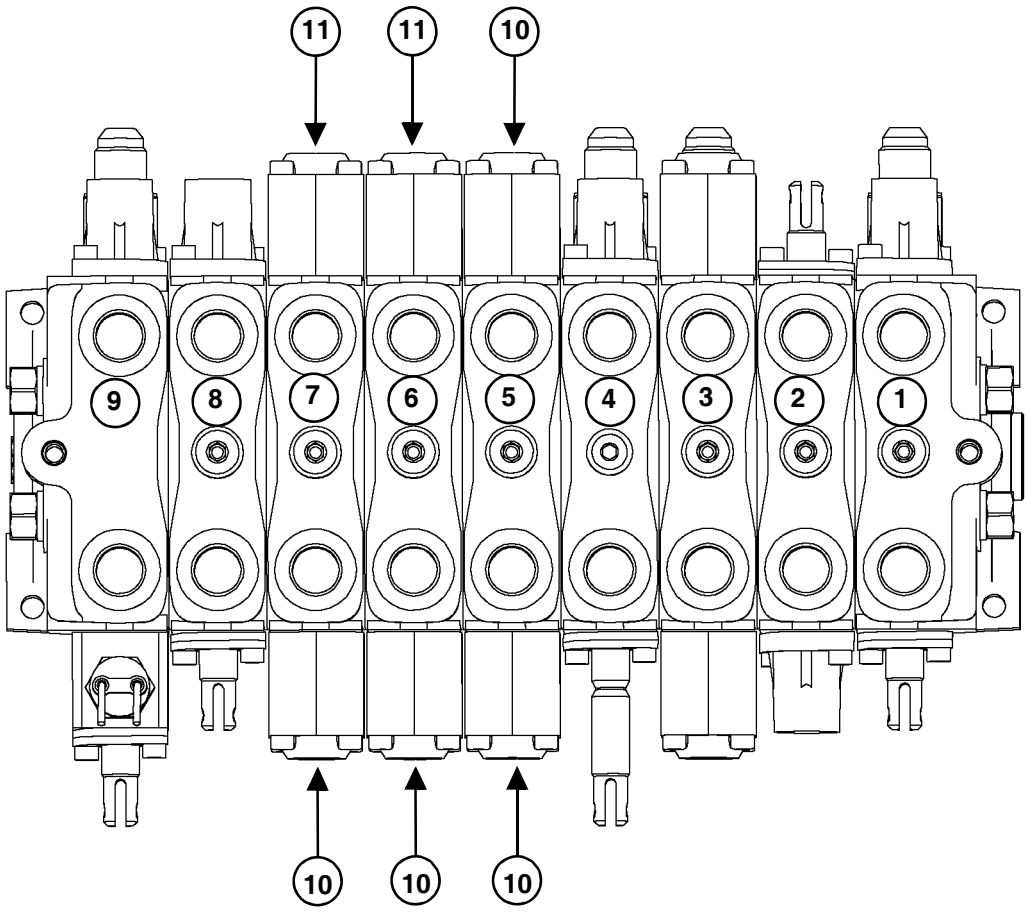


Remove the control valve **[Figure 20-40-11]**.

HYDRAULIC CONTROL VALVE (320 / 322) (CONT'D)

Parts Identification

Item Description
1. AUXILIARY SECTION
2. BLADE SECTION
3. SWING SECTION
4. LEFT TRAVEL SECTION
5. BOOM SECTION
6. BUCKET SECTION
7. ARM SECTION
8. BOOM SWING SECTION
9. RIGHT TRAVEL SECTION
10. PORT RELIEF - 3335 PSI (330 Bar) (Below Spool Cover)
11. PORT RELIEF - 2900 PSI (200 Bar) (Below Spool Cover)



MS-1373

Disassembly

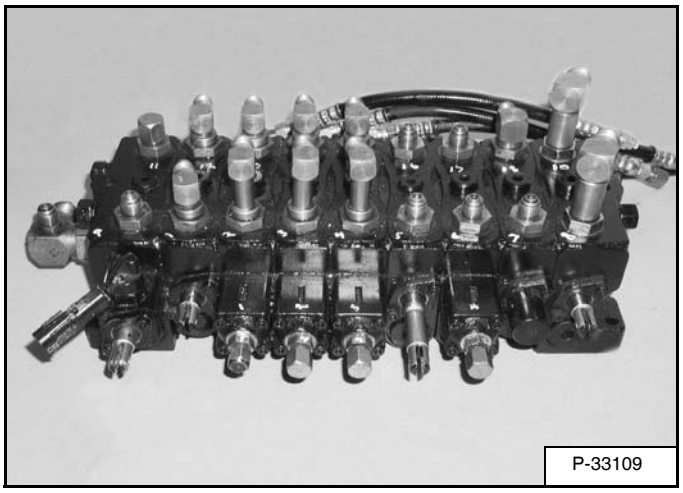
Clean the outside of the hydraulic control valve before disassembly.

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.

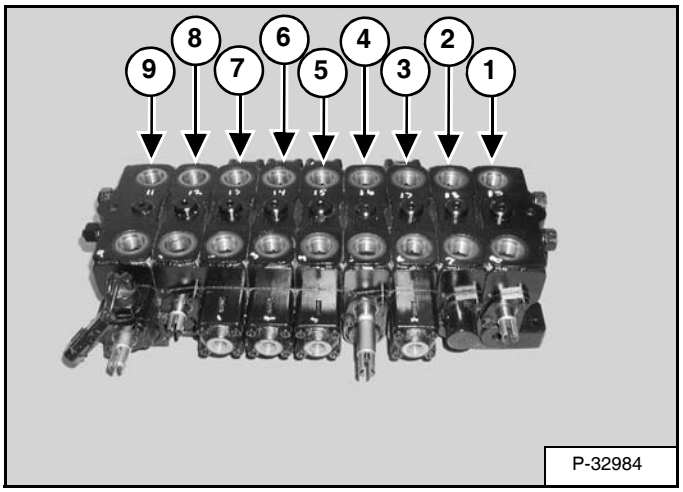
I-2003-0888

Figure 20-40-12



Remove the hoses and fittings **[Figure 20-40-12]**.

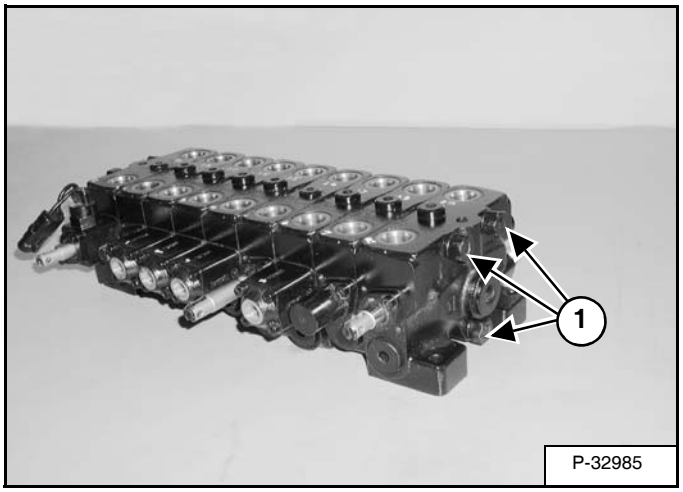
Figure 20-40-13



Mark the valve sections for ease of assembly **[Figure 20-40-13]**.

1. Auxiliary Valve
2. Blade Valve
3. Swing Valve
4. Left Travel Valve
5. Boom Valve
6. Bucket Valve
7. Arm Valve
8. Boom Swing Valve
9. Right Travel Valve

Figure 20-40-14



Remove the tie rod nuts (Item 1) **[Figure 20-40-14]** and washers.

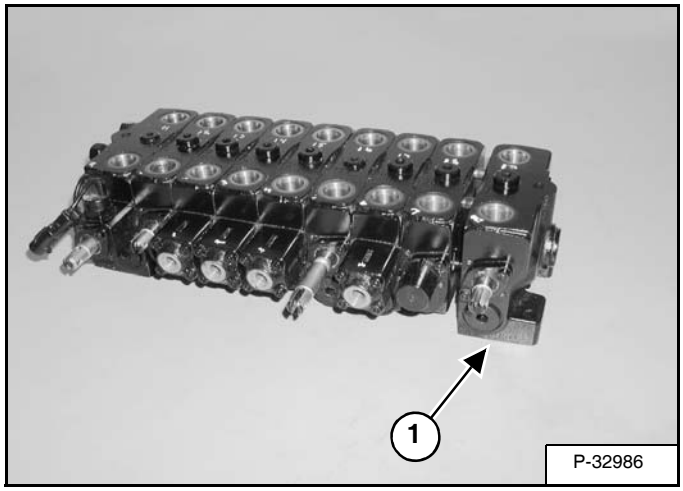
Auxiliary Valve Section Disassembly And Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

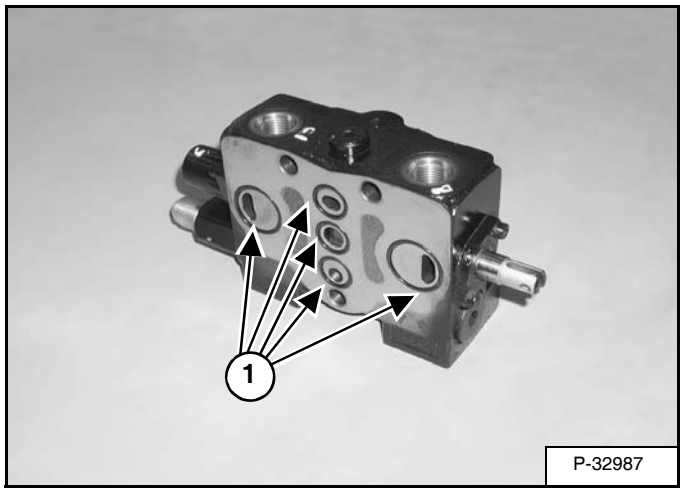
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-40-15



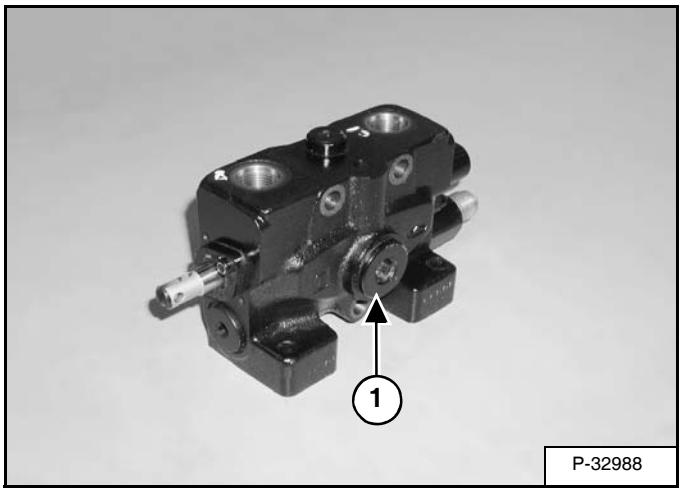
Remove the auxiliary valve section (Item 1) **[Figure 20-40-15]** from the valve assembly.

Figure 20-40-16



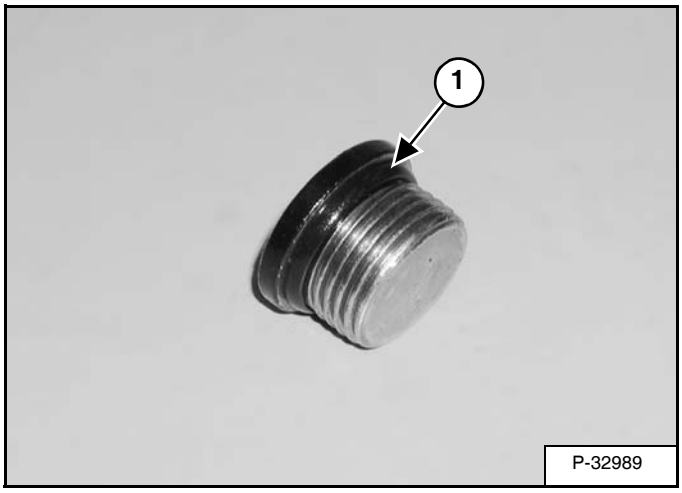
Remove the O-rings (Item 1) **[Figure 20-40-16]** from the auxiliary valve block.

Figure 20-40-17



Remove the plug (Item 1) **[Figure 20-40-17]**.

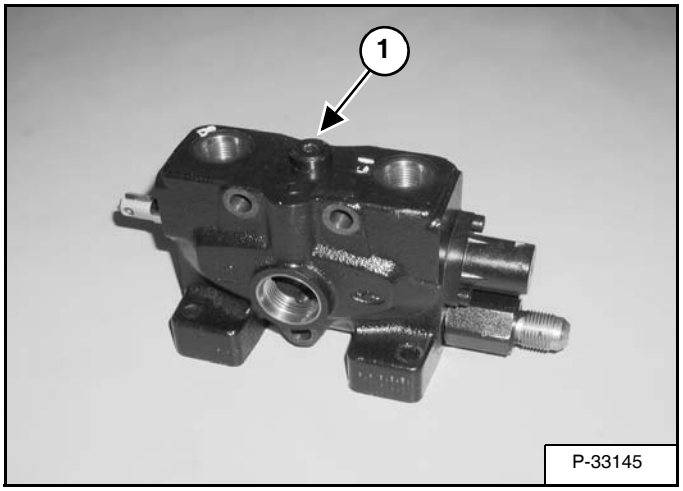
Figure 20-40-18



Remove the O-ring (Item 1) **[Figure 20-40-18]** from the plug.

Auxiliary Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-19

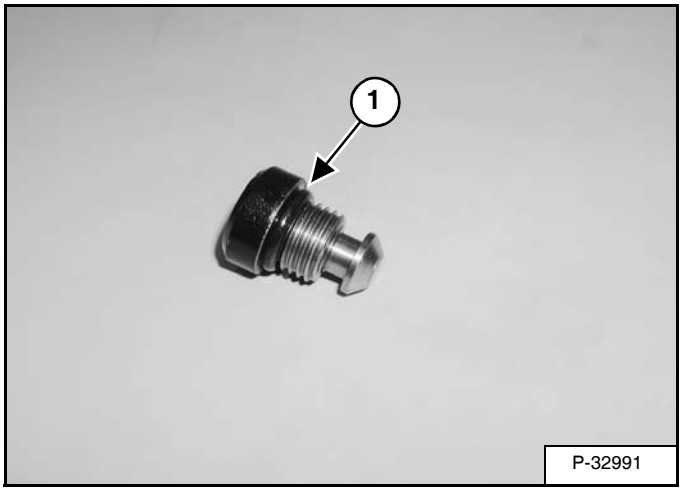


Remove the load check valve assembly (Item 1) **[Figure 20-40-19]**.

NOTE: The load check valve assembly is serviced only as a unit.

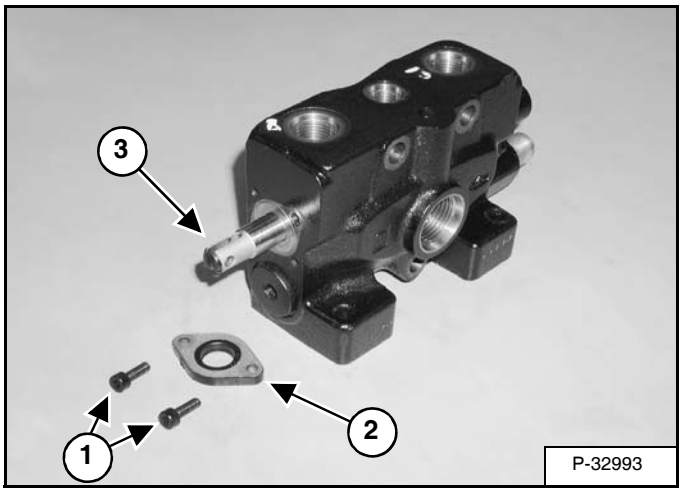
Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

Figure 20-40-20



Remove the O-ring (Item 1) **[Figure 20-40-20]** from the load check valve.

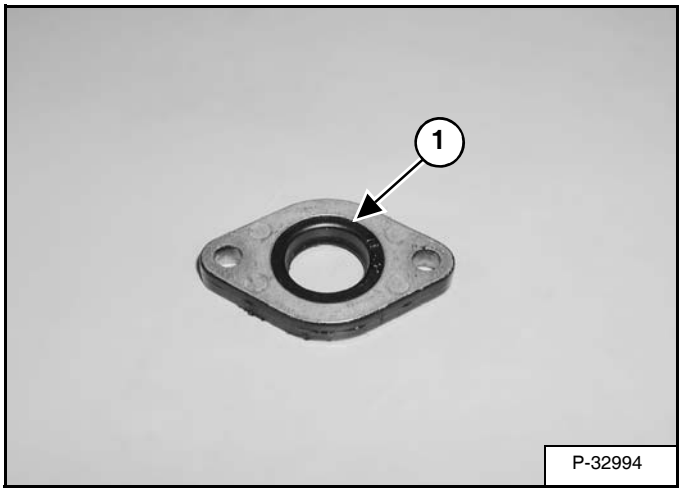
Figure 20-40-21



Remove the bolts (Item 1) and retaining plate (Item 2) from the actuating end of the spool (Item 3) **[Figure 20-40-21]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

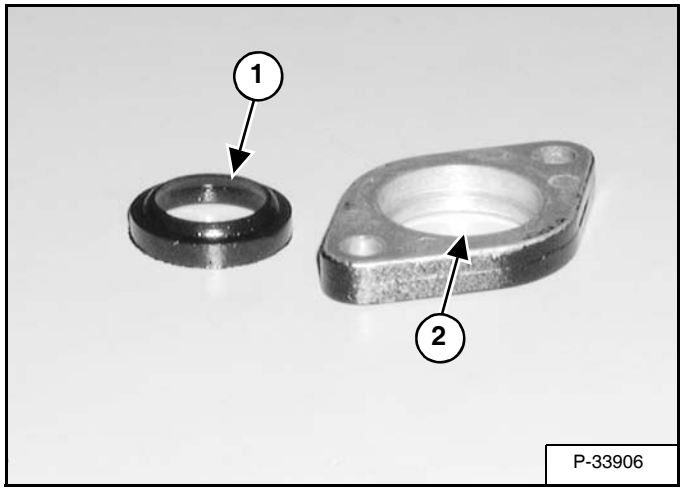
Figure 20-40-22



Remove the seal (Item 1) **[Figure 20-40-22]** from the retaining plate.

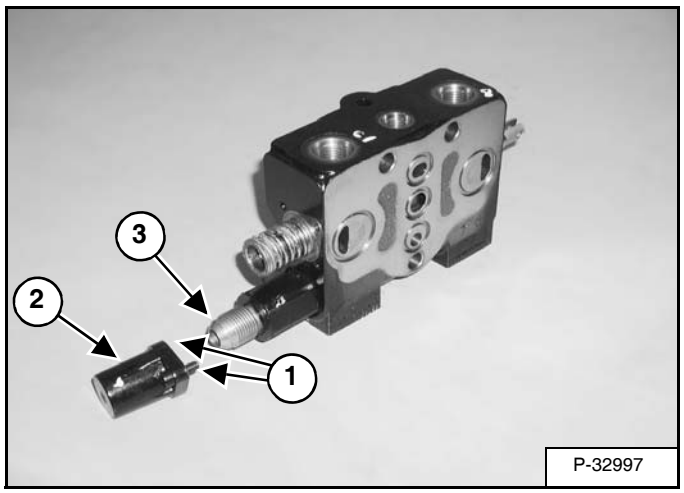
Auxiliary Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-23



Installation: Make sure the lip (Item 1) on the seal fits inside the lip on the retaining plate (Item 2) **[Figure 20-40-23]**.

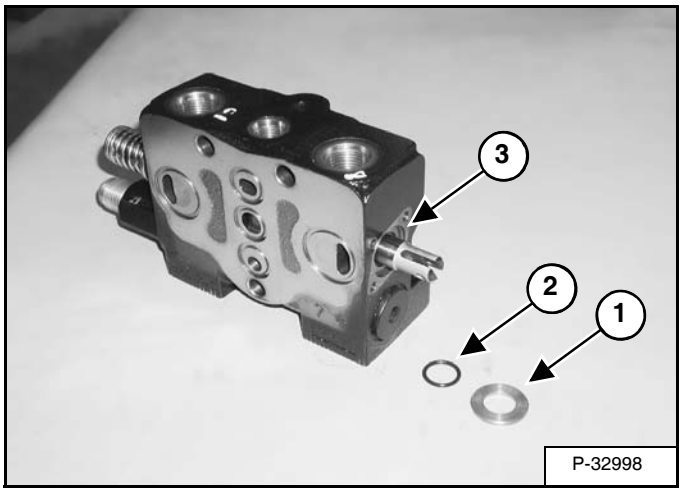
Figure 20-40-24



Remove the bolts (Item 1) and end cap (Item 2) from the spool (Item 3) **[Figure 20-40-24]**.

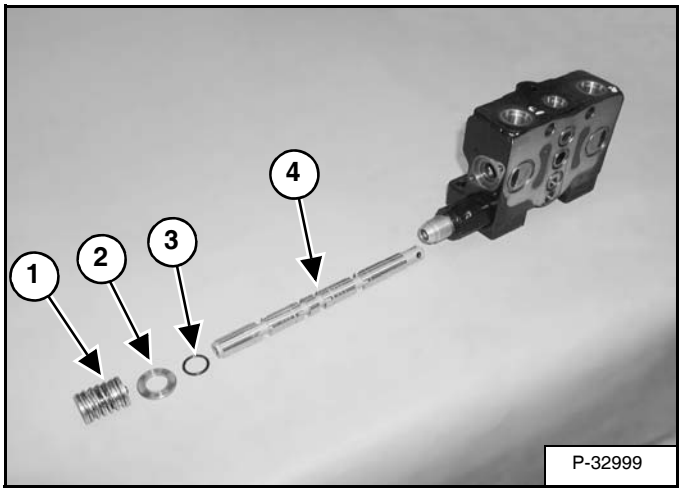
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-25



Remove the washer (Item 1) and O-ring (Item 2) from the actuating end of the spool (Item 3) **[Figure 20-40-25]**.

Figure 20-40-26



Remove the spring assembly (Item 1), washer (Item 2), O-ring (Item 3) and spool (Item 4) **[Figure 20-40-26]** from the auxiliary valve.

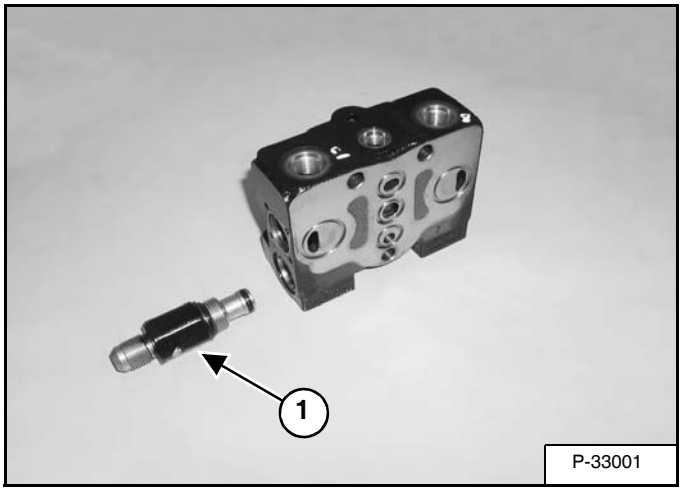
The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface and do not interchange spools and valve blocks.

Installation: Tighten the spring retaining bolt to 18 ft.-lb. (24 N•m) torque.

Auxiliary Valve Section Disassembly And Assembly (Cont'd)

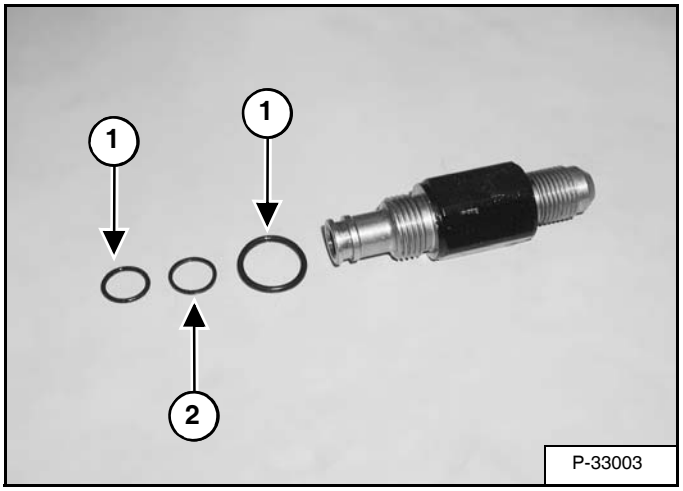
Figure 20-40-27



Remove the fitting (Item 1) **[Figure 20-40-27]** from the auxiliary valve.

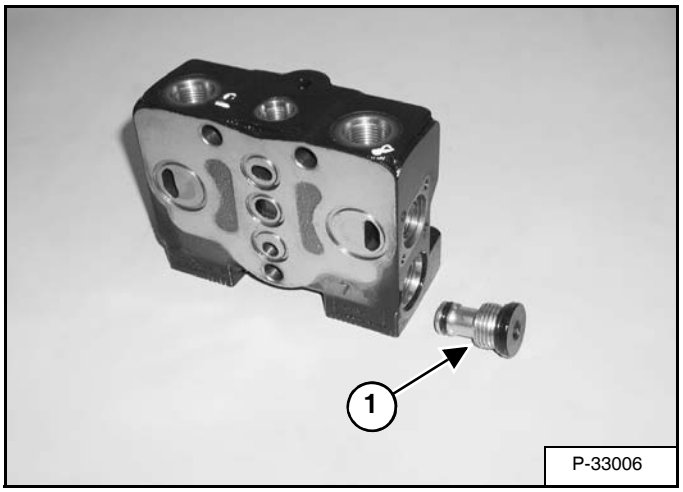
Installation: Tighten the fitting to 31 ft.-lb. (42 N•m) torque.

Figure 20-40-28



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-28]** from the fitting.

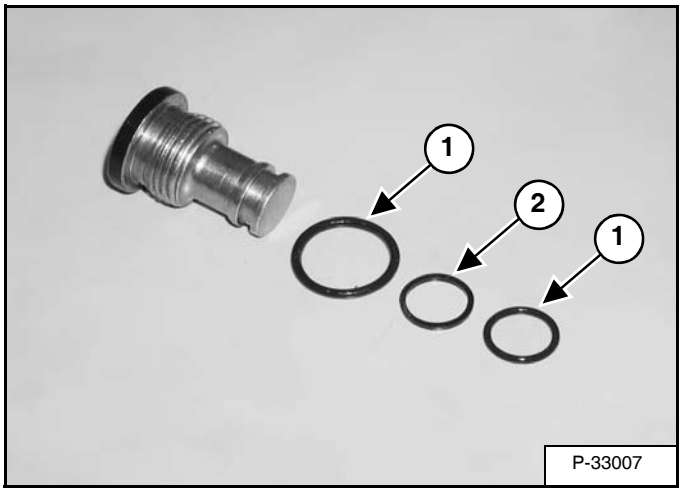
Figure 20-40-29



Remove the plug (Item 1) **[Figure 20-40-29]**.

Installation: Tighten the plug to 31 ft.-lb. (42 N•m) torque.

Figure 20-40-30



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-30]** from the plug.

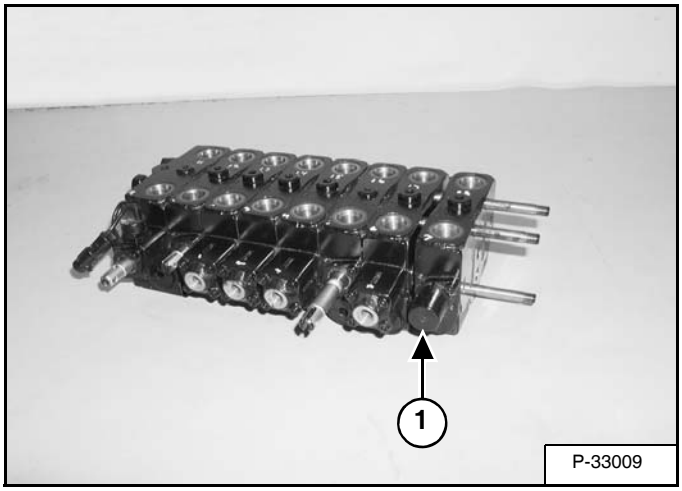
Blade Valve Section Disassembly And Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

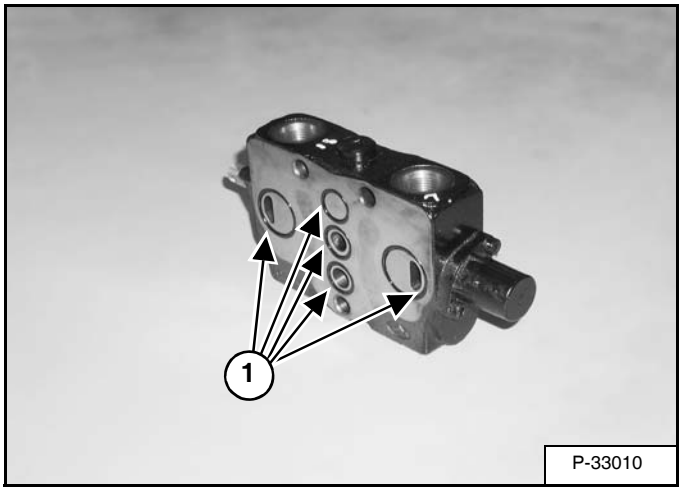
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-40-31



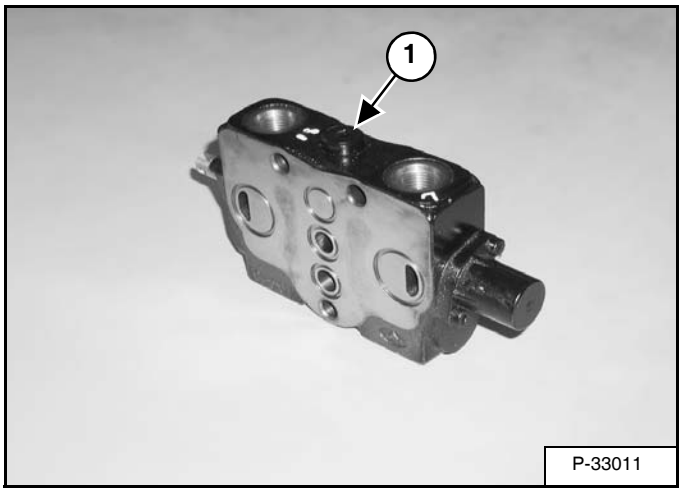
Remove the blade valve section (Item 1) **[Figure 20-40-31]** from the valve assembly.

Figure 20-40-32



Remove the O-rings (Item 1) **[Figure 20-40-32]** from the blade valve block.

Figure 20-40-33



Remove the load check valve (Item 1) **[Figure 20-40-34]**.

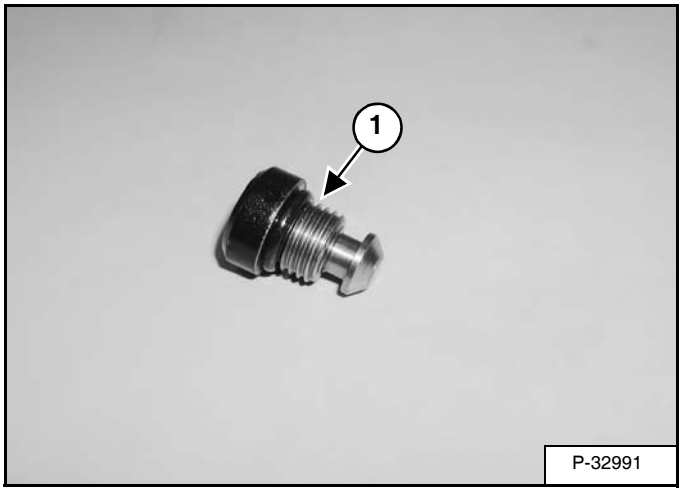
Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

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.

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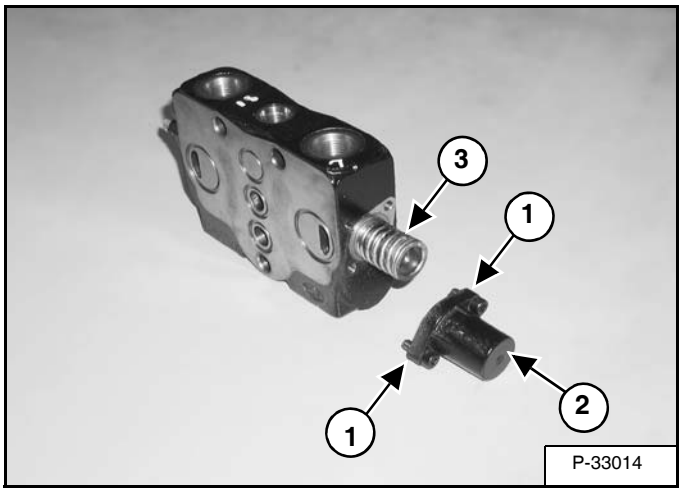
Figure 20-40-34



Remove the O-ring (Item 1) **[Figure 20-40-34]** from the load check valve.

Blade Valve Section Disassembly And Assembly (Cont'd)

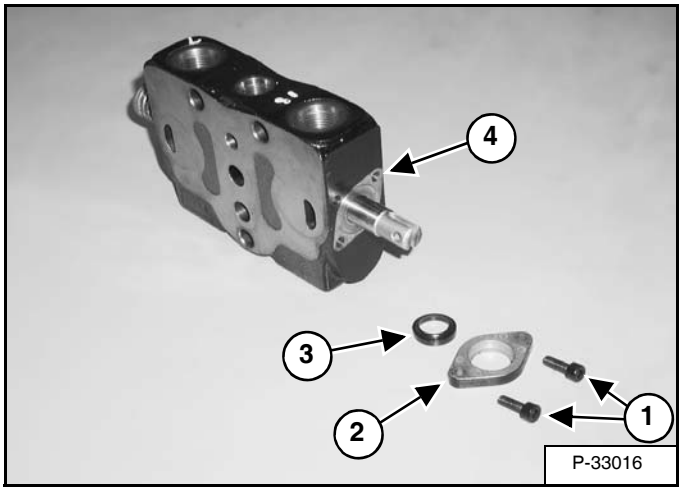
Figure 20-40-35



Remove the bolts (Item 1) and cover (Item 2) from the spool (Item 3) **[Figure 20-40-35]**.

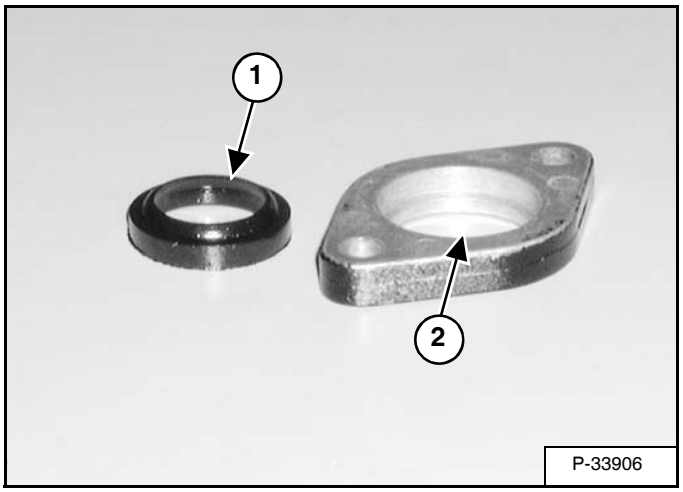
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-36



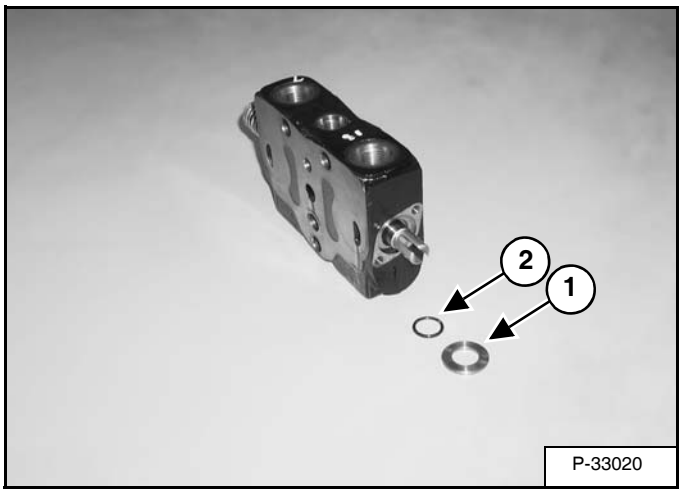
Remove the bolts (Item 1), spool retainer (Item 2) and seal (Item 3) from the actuating end of the spool (Item 4) **[Figure 20-40-36]**.

Figure 20-40-37



Installation: Make sure the lip (Item 1) on the seal fits inside the lip of the retainer (Item 2) **[Figure 20-40-37]**. Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

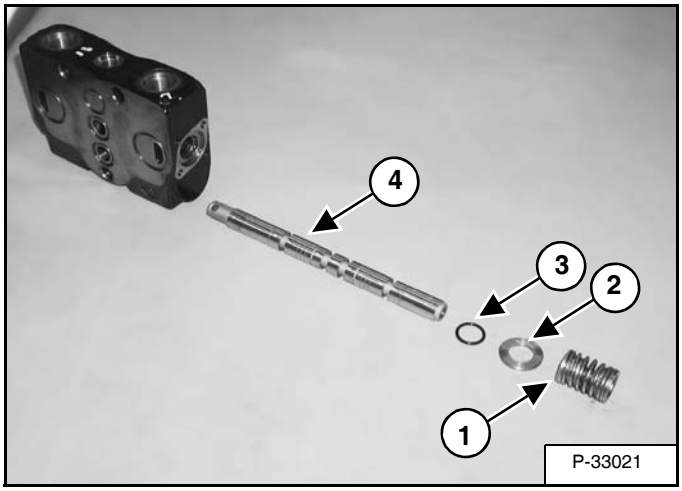
Figure 20-40-38



Remove the washer (Item 1) and O-ring (Item 2) **[Figure 20-40-38]**.

Blade Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-39



Remove the spring assembly (Item 1), washer (Item 2), O-ring (Item 3) and spool (Item 4) **[Figure 20-40-39]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Installation: Tighten the spring retaining bolt to 18 ft.-lb. (24 N•m) torque.

Slew Valve Section Disassembly And Assembly

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.

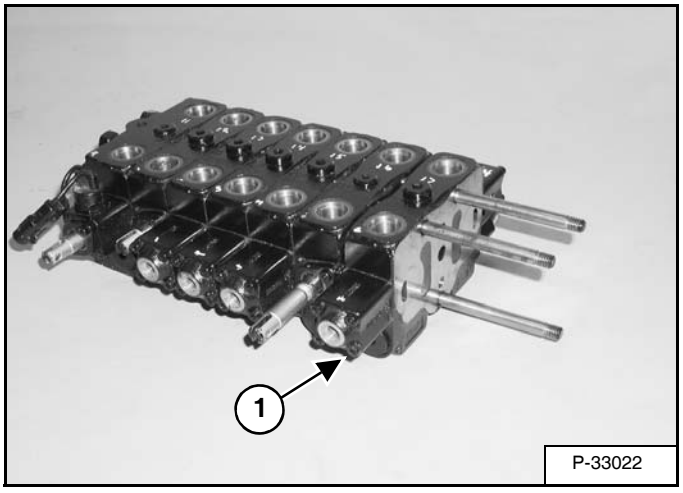
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

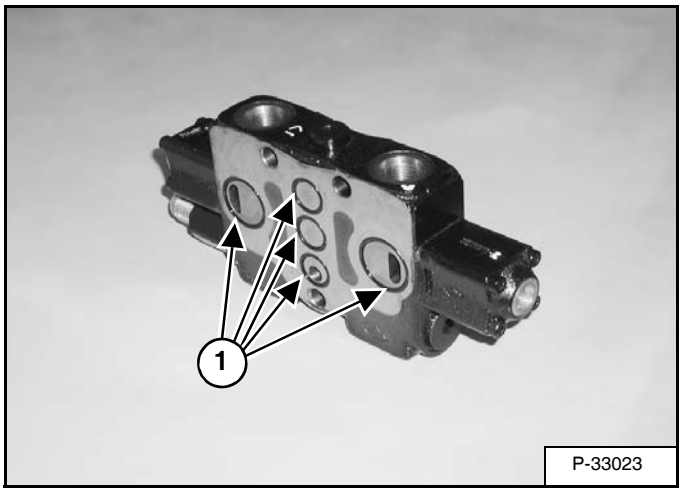
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-40-40



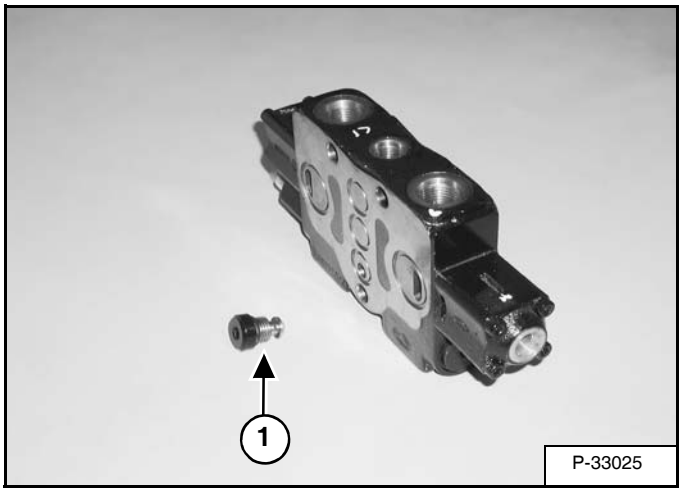
Remove the slew valve section (Item 1) **[Figure 20-40-40]** from the valve assembly.

Figure 20-40-41



Remove the O-rings (Item 1) **[Figure 20-40-41]** from the swing valve block.

Figure 20-40-42

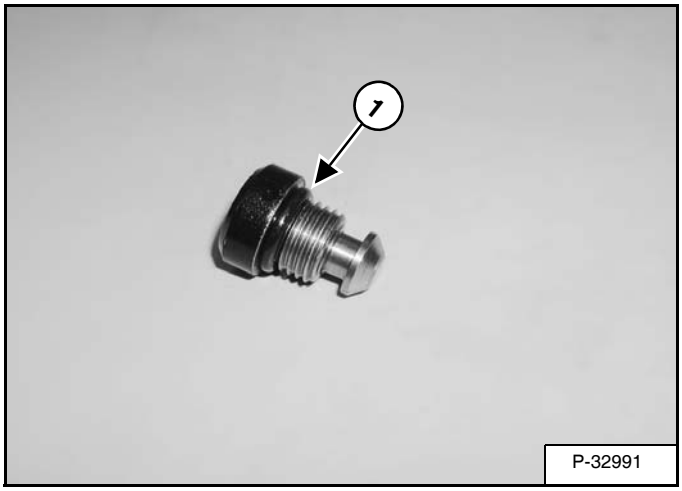


Remove the load check valve (Item 1) **[Figure 20-40-42]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

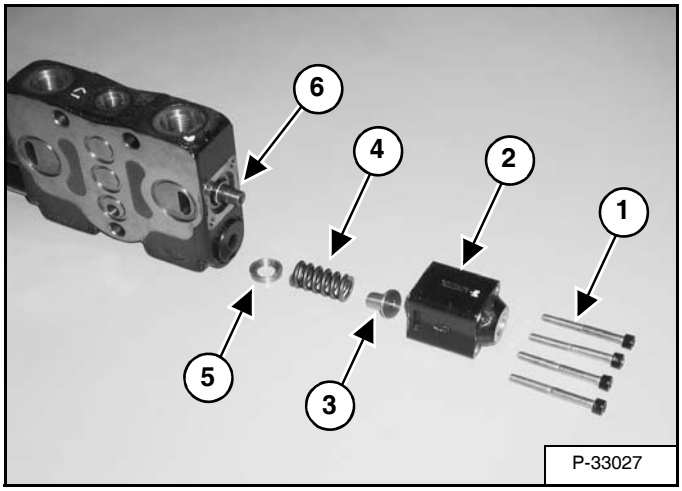
Slew Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-43



Remove the O-ring (Item 1) **[Figure 20-40-43]** from the load check valve.

Figure 20-40-44

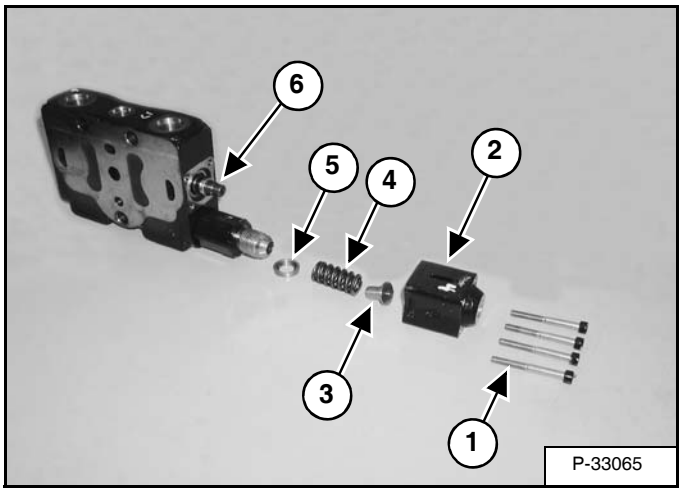


Remove the bolts (Item 2), actuator (Item 2), spring retainer (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-40-44]**.

NOTE: Install the lip of the spring retainer (Item 5) over the spool (Item 6) [Figure 20-40-44].

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-45



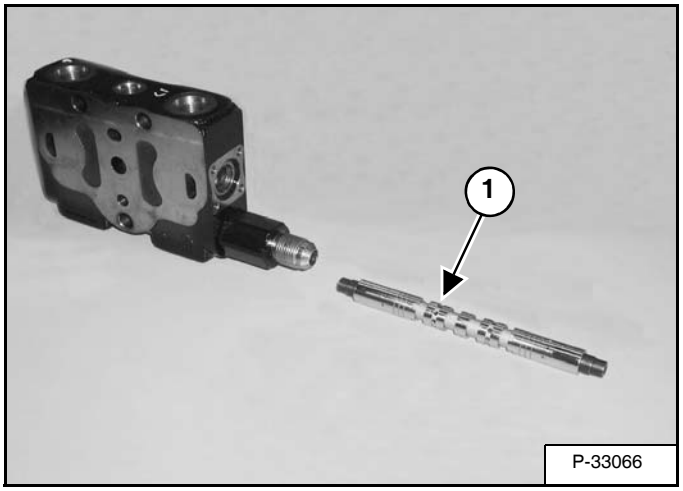
Remove the bolts (Item 1), spool cover (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-40-45]**.

NOTE: Install the lip of the spring retainer (Item 5) over the spool (Item 6) [Figure 20-40-45].

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Slew Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-46

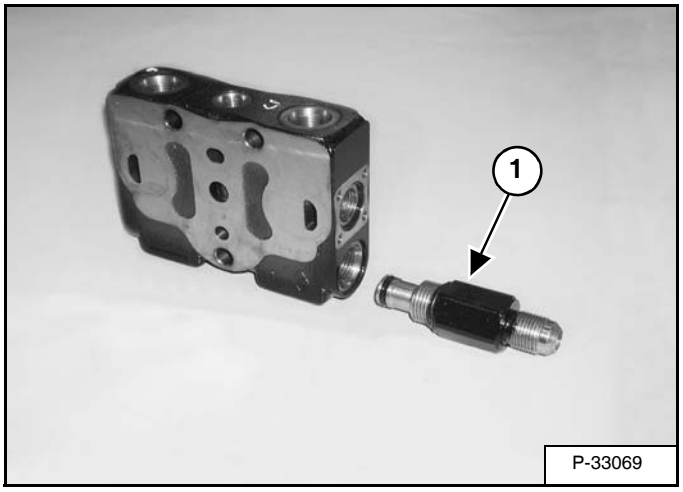


Remove the spool (Item 1) **[Figure 20-40-46]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface and do not interchange spools and valve blocks.

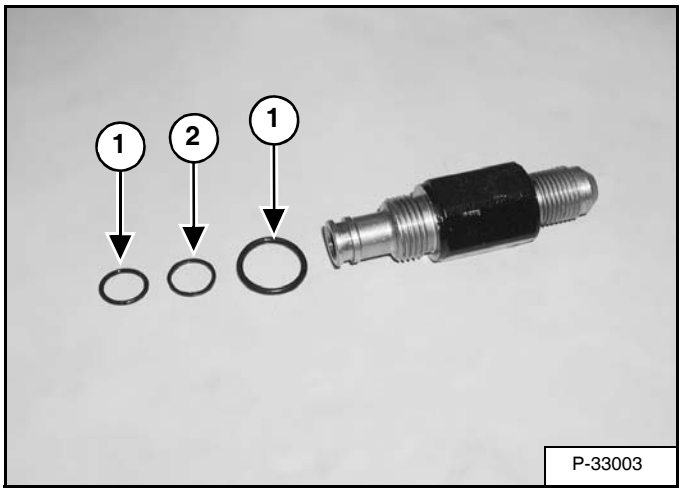
Figure 20-40-47



Remove the fitting (Item 1) **[Figure 20-40-47]**.

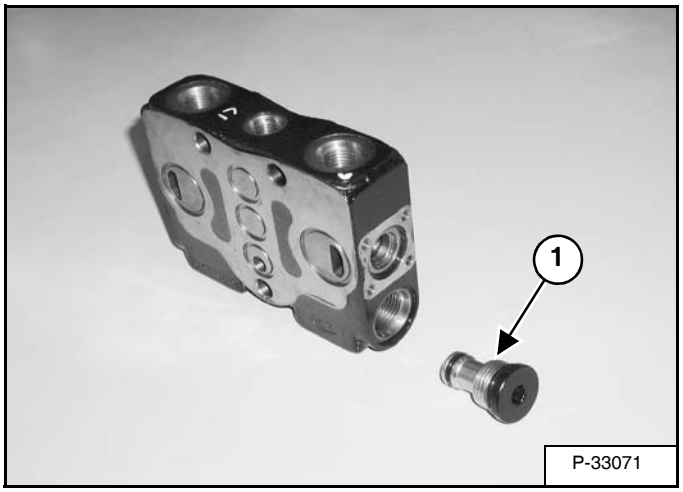
Installation: Tighten the fitting to 31 ft.-lb. (42 N•m) torque.

Figure 20-40-48



Remove the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-40-48]** from the fitting.

Figure 20-40-49

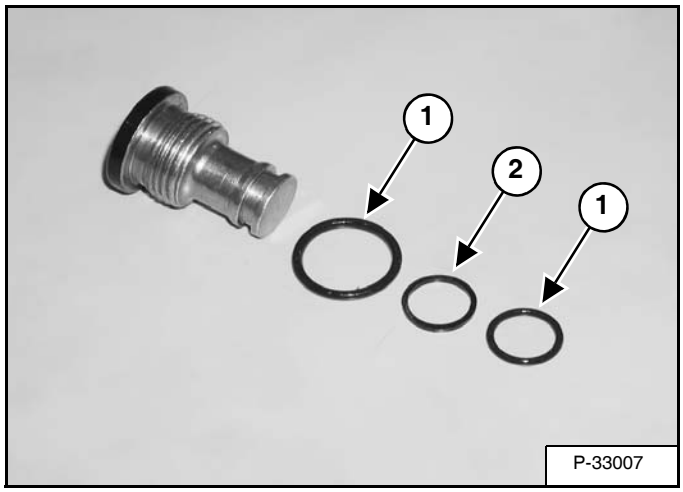


Remove the plug (Item 1) [**[Figure 20-40-49]**

Installation: Tighten the plug to 31 ft.-lb. (42 N•m) torque.

Slew Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-50



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-50]** from the plug.

Left Travel Valve Section Disassembly and Assembly

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.

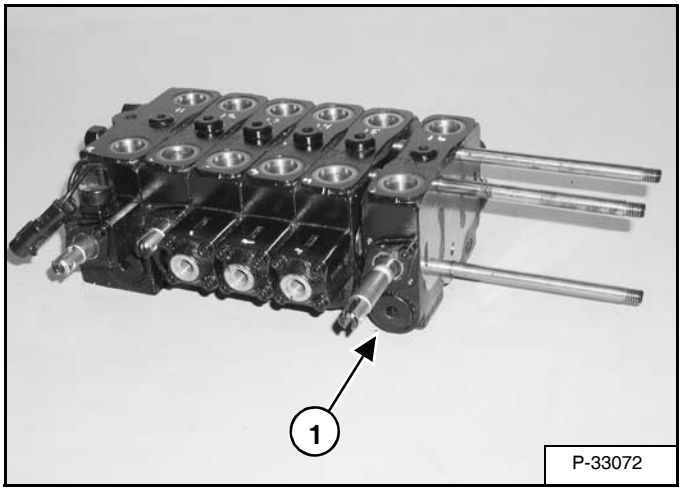
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

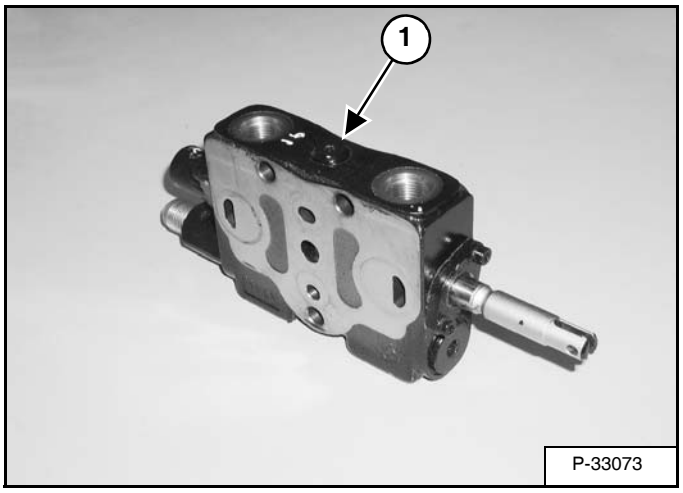
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-40-51



Remove the left travel valve section (Item 1) **[Figure 20-40-51]** from the valve assembly.

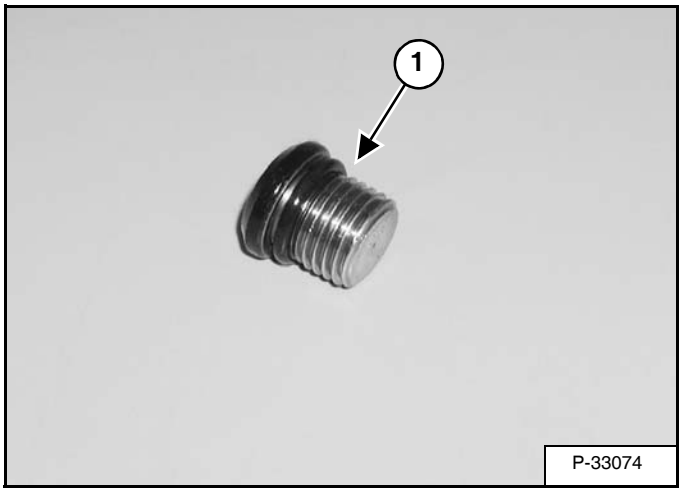
Figure 20-40-52



Remove the plug (Item 1) **[Figure 20-40-52]** from the left travel valve block.

Installation: Tighten the plug to 18 ft.-lb. (24 N•m) torque.

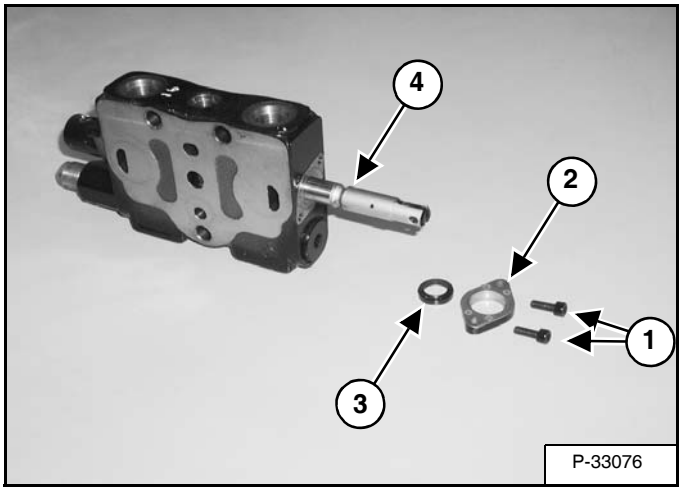
Figure 20-40-53



Remove the O-ring (Item 1) **[Figure 20-40-53]** from the plug.

Left Travel Valve Section Disassembly and Assembly (Cont'd)

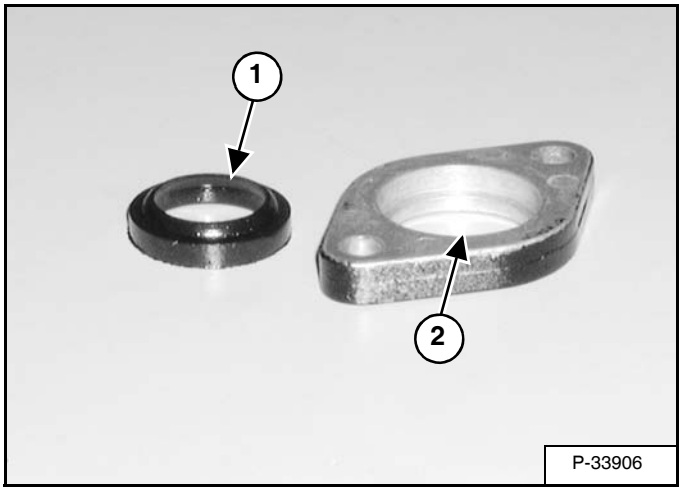
Figure 20-40-54



Remove the bolts (Item 1) retainer (Item 2) and seal (Item 3) from the spool (Item 4) **[Figure 20-40-54]**.

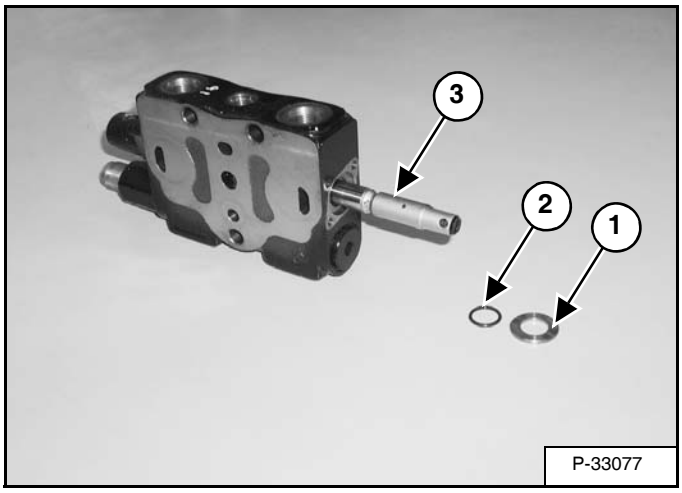
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-55



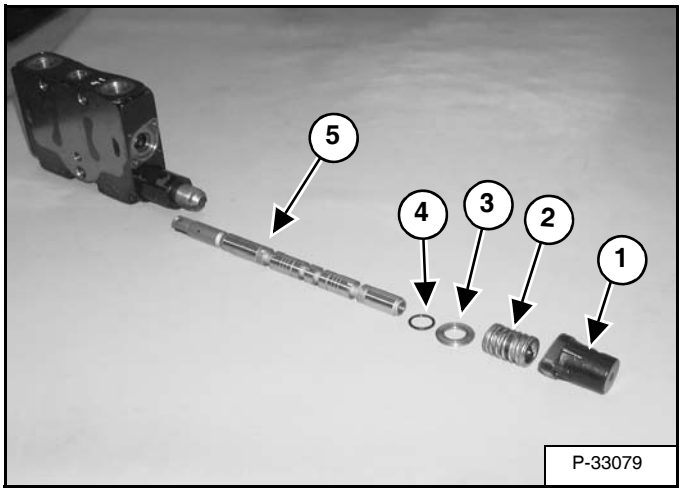
Installation: Make sure the lip (Item 1) of the seal fits inside the retainer (Item 2) **[Figure 20-40-55]**.

Figure 20-40-56



Remove the washer (Item 1) and O-ring (Item 2) from the actuating end of the spool (item 3) **[Figure 20-40-56]**.

Figure 20-40-57



Remove the cap and bolts (Item 1) spring assembly (Item 2), washer (Item 3), O-ring (Item 4) and spool (Item 5) **[Figure 20-40-57]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

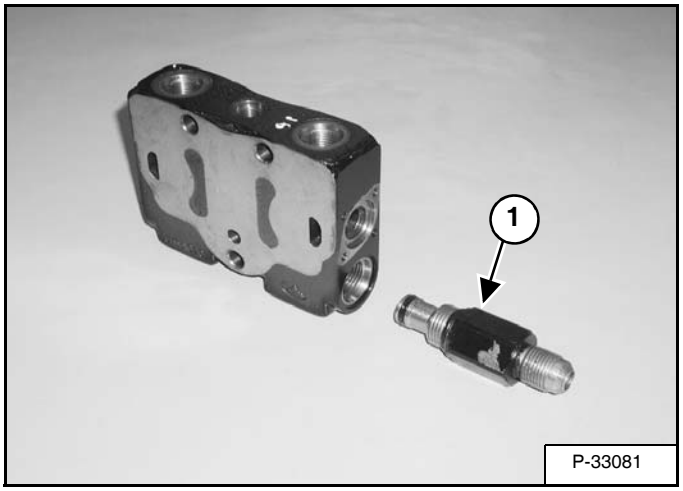
The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Installation: Tighten the spring assembly (Item 2) **[Figure 20-40-57]** to 18 ft.-lb. (24 N•m) torque.

Left Travel Valve Section Disassembly and Assembly (Cont'd)

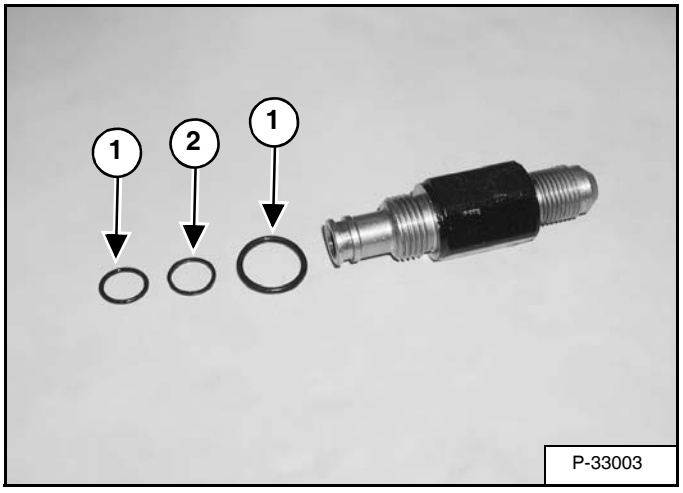
Figure 20-40-58



Remove the fitting (Item 1) **[Figure 20-40-58]**.

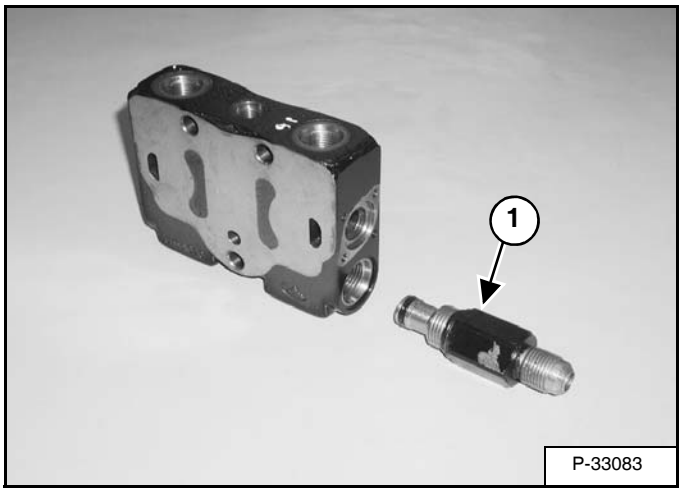
Installation: Tighten the fitting to 31 ft.-lb. (42 N•m) torque.

Figure 20-40-59



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-59]** from the fitting.

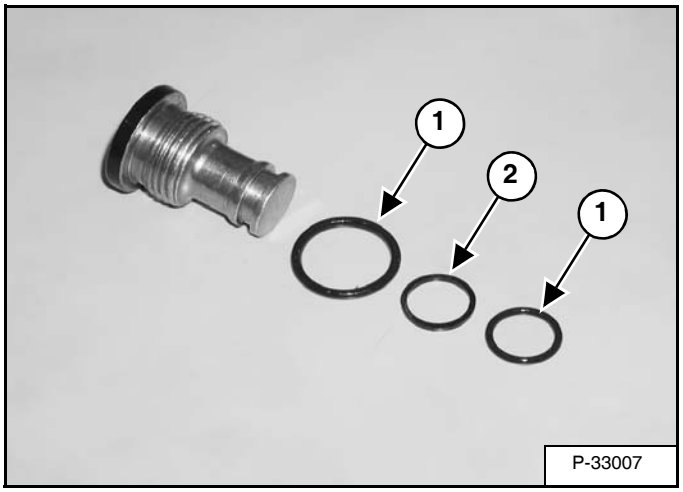
Figure 20-40-60



Remove the plug (Item 1) **[Figure 20-40-60]**.

Installation: Tighten the plug to 31 ft.-lb. (42 N•m) torque.

Figure 20-40-61



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-40-61]** from the plug.

Boom Valve Section Disassembly and Assembly

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.

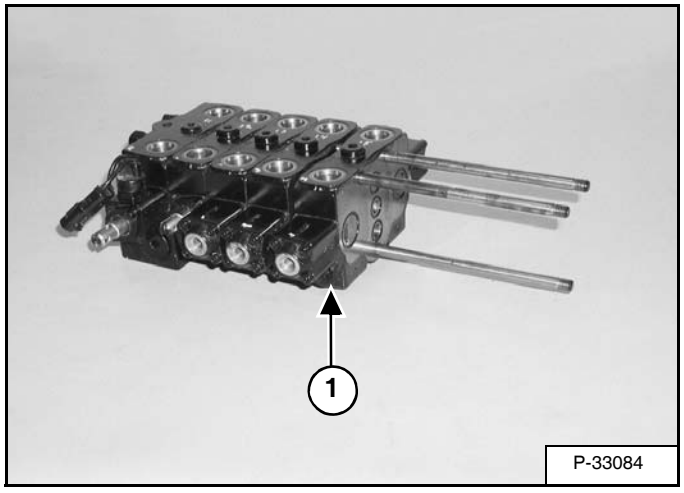
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

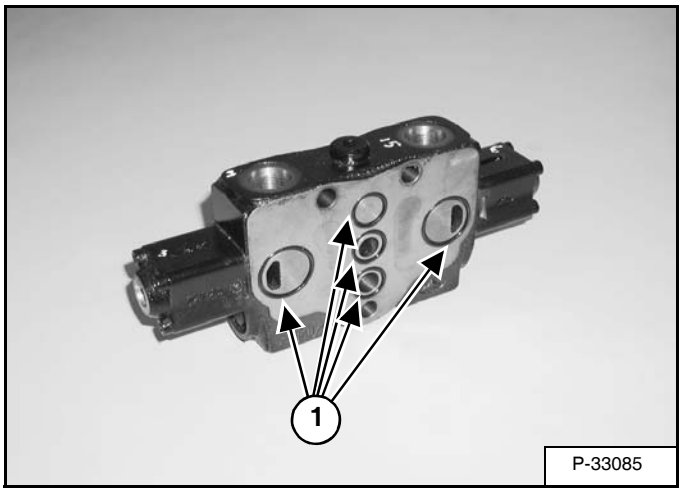
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-40-62



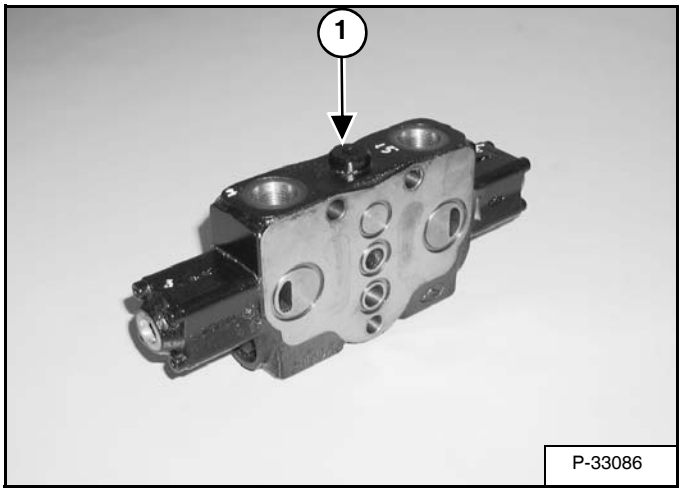
Remove the boom valve section (Item 1) **[Figure 20-40-62]** from the valve assembly.

Figure 20-40-63



Remove the O-rings (Item 1) **[Figure 20-40-63]** from the boom valve block.

Figure 20-40-64

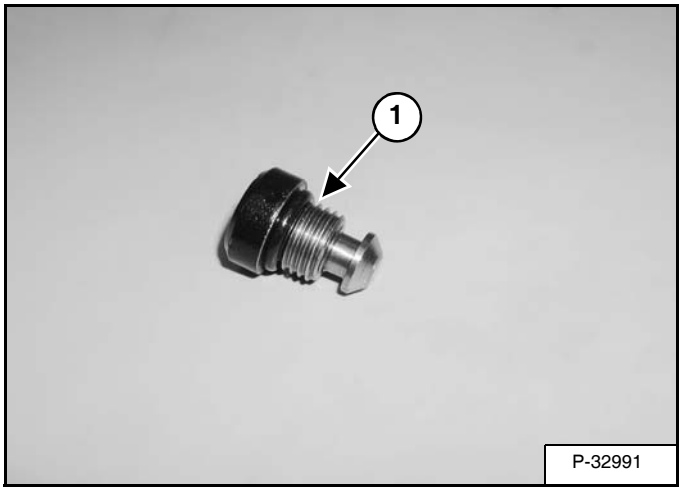


Remove the load check valve (Item 1) **[Figure 20-40-64]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

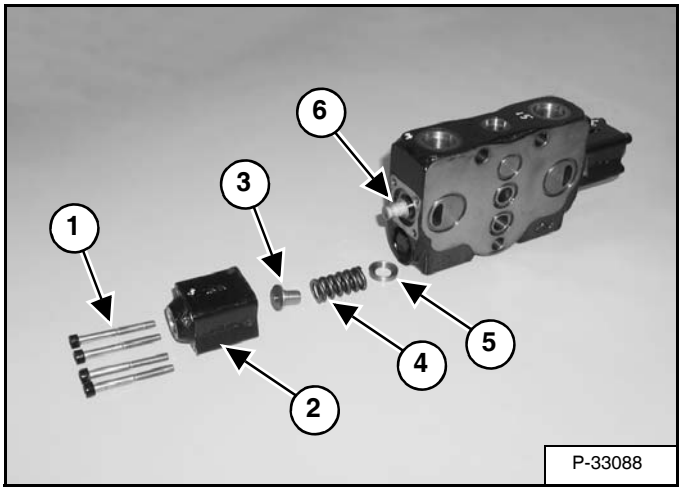
Boom Valve Section Disassembly and Assembly (Cont'd)

Figure 20-40-65



Remove the O-ring (Item 1) **[Figure 20-40-65]** from the load check valve.

Figure 20-40-66

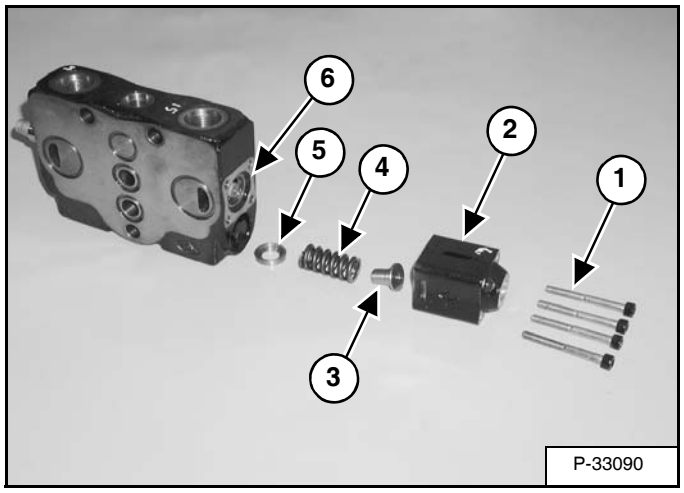


Remove the bolts (Item 1), spool cover (Item 2), spring retainer (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-40-66]**.

Installation: Install the lip of the spring retainer (Item 5) over the spool (Item 6) **[Figure 20-40-66]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-67

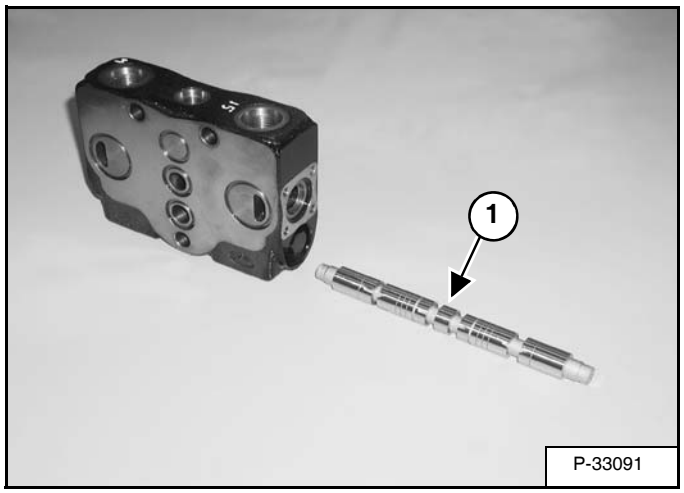


Remove the bolts (Item 1), spool cover (Item 2), spring retainer (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-40-67]**.

Installation: Make sure the lip on the spring retainer (Item 5) fits over the spool (Item 6) **[Figure 20-40-67]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-68



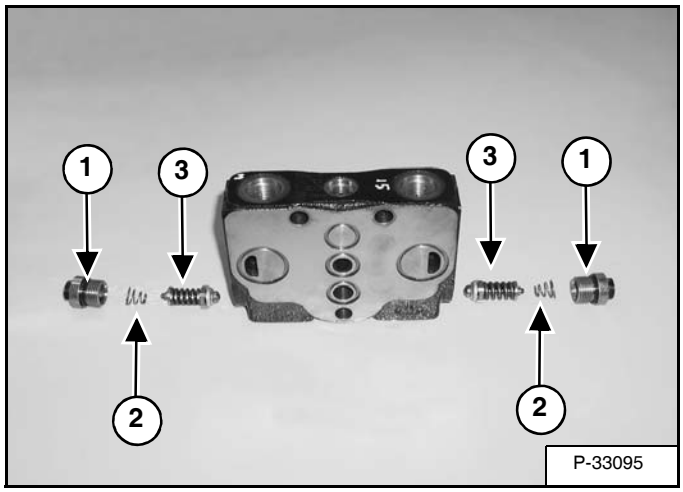
Remove the spool (Item 1) **[Figure 20-40-68]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Boom Valve Section Disassembly and Assembly (Cont'd)

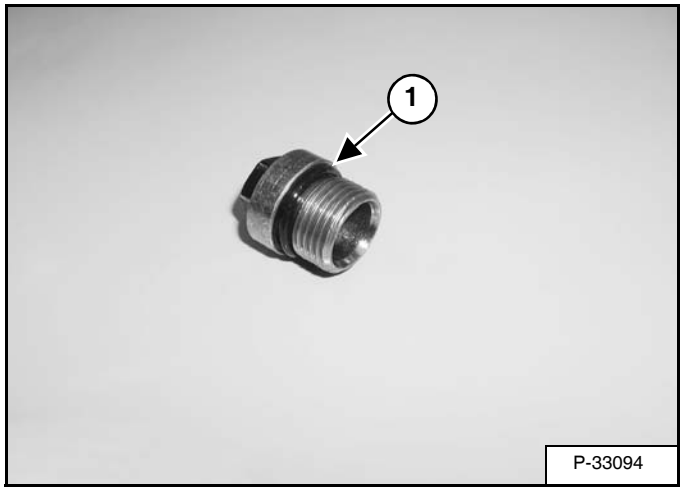
Figure 20-40-69



Remove the plug (Item 1), spring (Item 2) and spring assembly (Item 3) **[Figure 20-40-69]** from both relief valves.

Installation: Tighten the plugs to 18 ft.-lb. (24 N•m) torque.

Figure 20-40-70



Remove the O-ring (Item 1) **[Figure 20-40-70]** from the plug.

Bucket Valve Section Disassembly and Assembly

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.

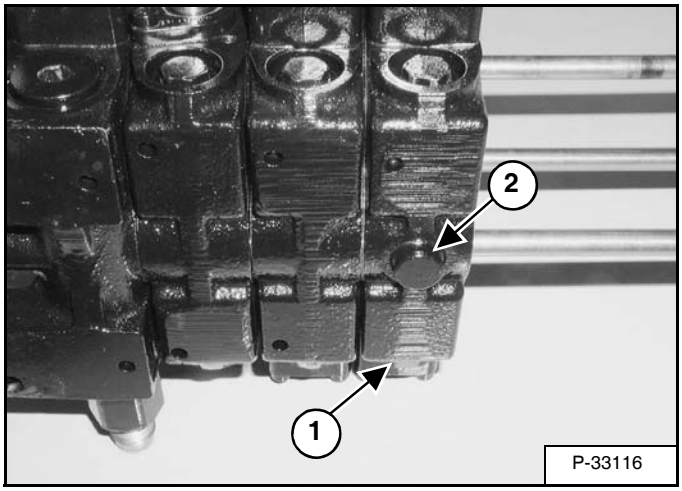
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

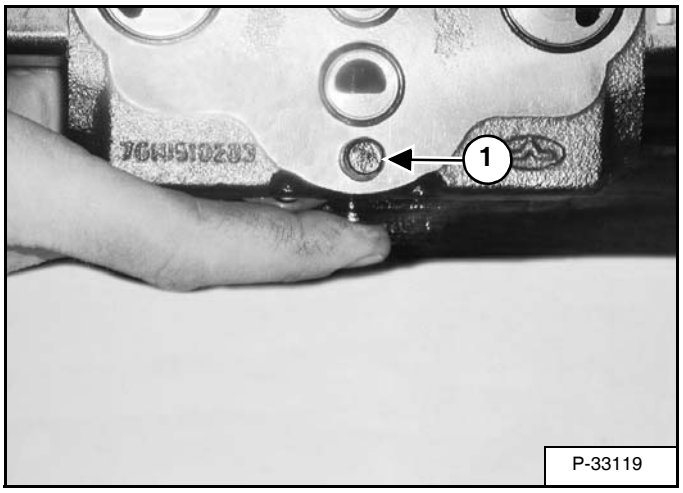
Figure 20-40-71



Remove the bucket valve section (Item 1) from the valve assembly by depressing the buildup valve (Item 2) **[Figure 20-40-71]** and sliding the valve section off the tie rods.

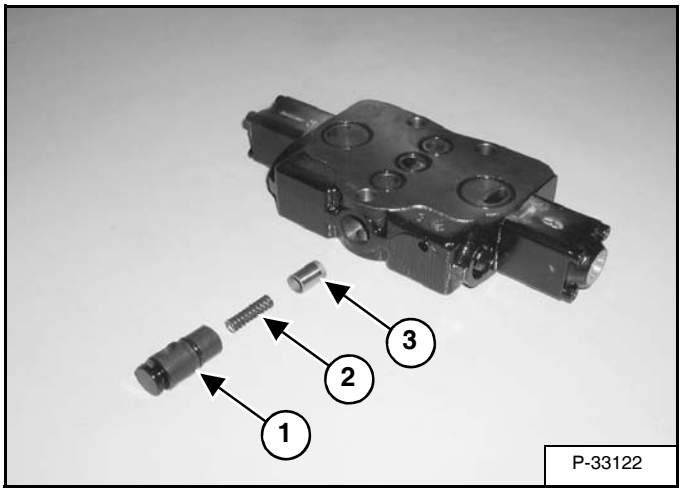
NOTE: Use care while removing the bucket valve section. The buildup valve is spring loaded.

Figure 20-40-72



Installation: Align the hole in the buildup valve with the hole (Item 1) **[Figure 20-40-72]** in the bucket valve section. Fully depress the buildup valve and slide the bucket valve section on the tie rods.

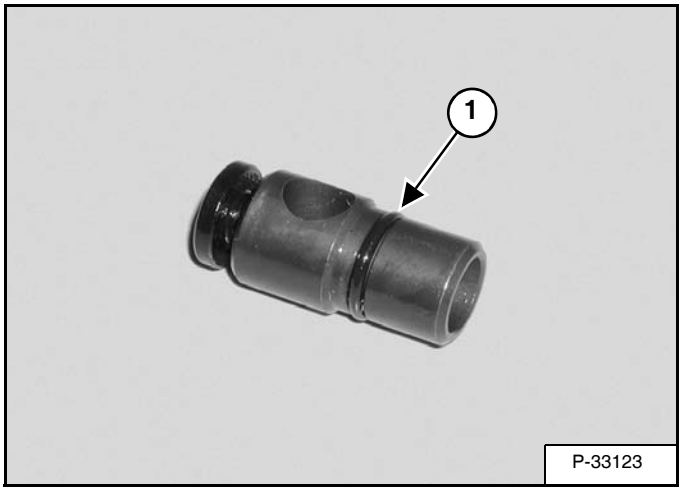
Figure 20-40-73



Remove the buildup valve (Item 1), spring (Item 2) and piston (Item 3) **[Figure 20-40-73]**.

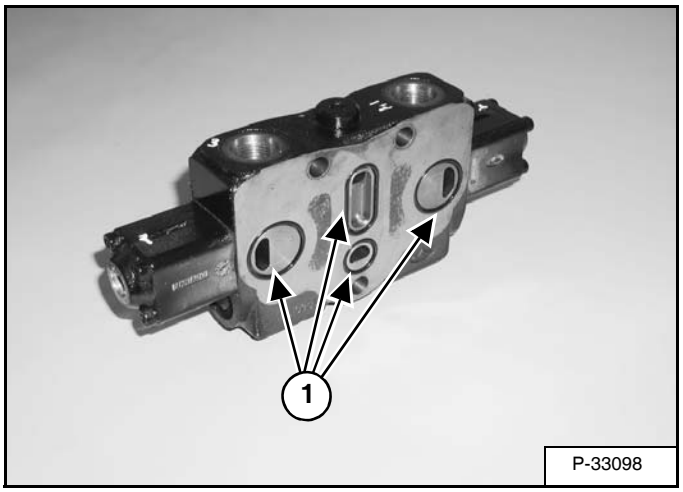
Bucket Valve Section Disassembly and Assembly (Cont'd)

Figure 20-40-74



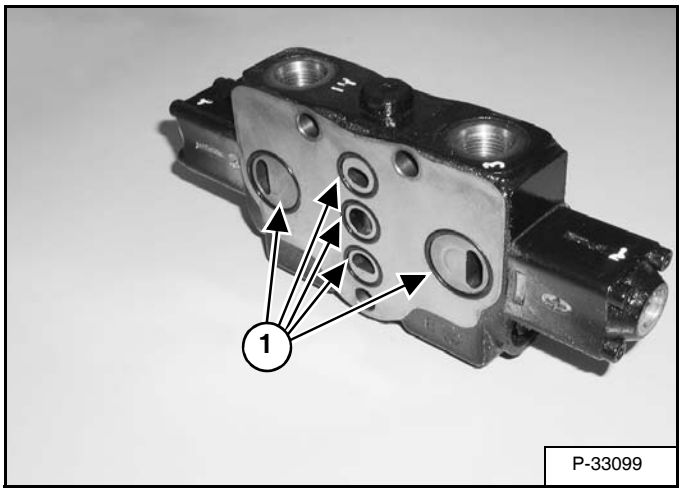
Remove the O-ring (Item 1) **[Figure 20-40-74]**.

Figure 20-40-75



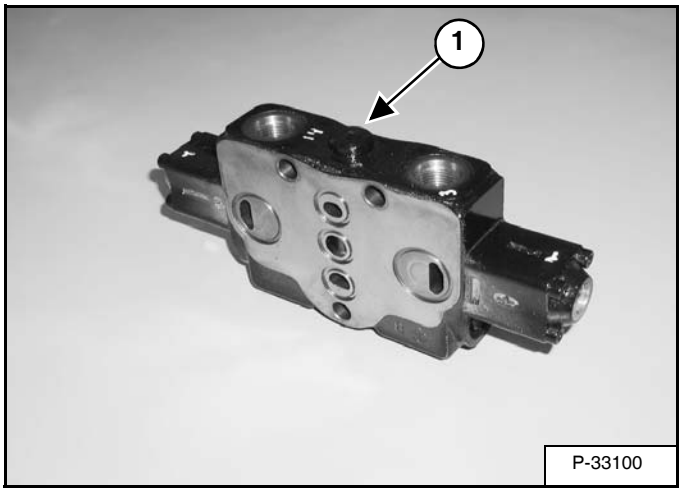
Remove the O-rings (Item 1) **[Figure 20-40-75]** from the side of the bucket valve section.

Figure 20-40-76



Remove the O-rings (Item 1) **[Figure 20-40-76]** from the opposite side of the bucket valve section.

Figure 20-40-77

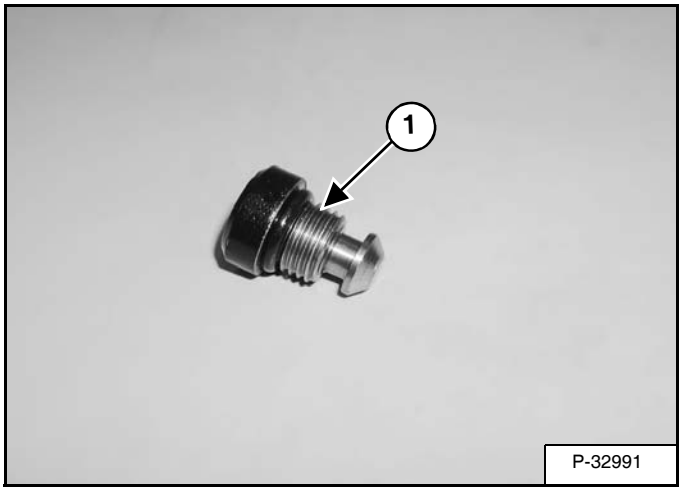


Remove the load check valve (Item 1) **[Figure 20-40-77]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

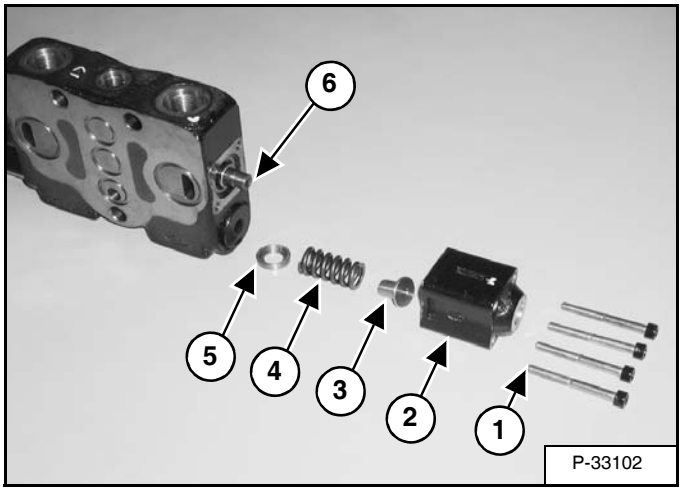
Bucket Valve Section Disassembly and Assembly (Cont'd)

Figure 20-40-78



Remove the O-ring (Item 1) **[Figure 20-40-78]** from the load check valve.

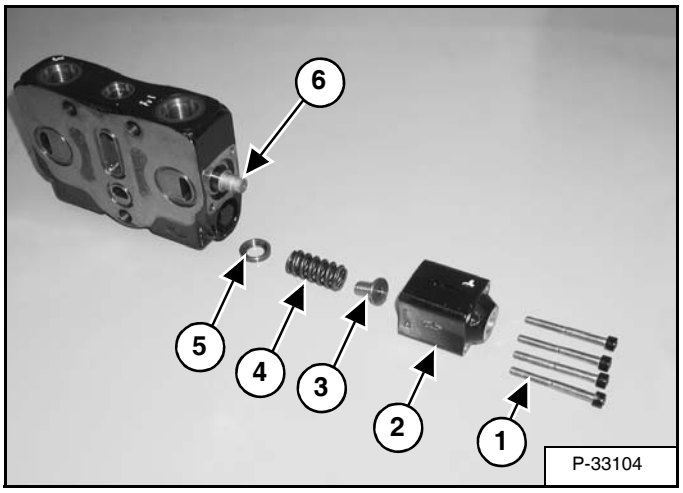
Figure 20-40-79



Remove the bolts (Item 1), spool cover (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-40-79]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-80

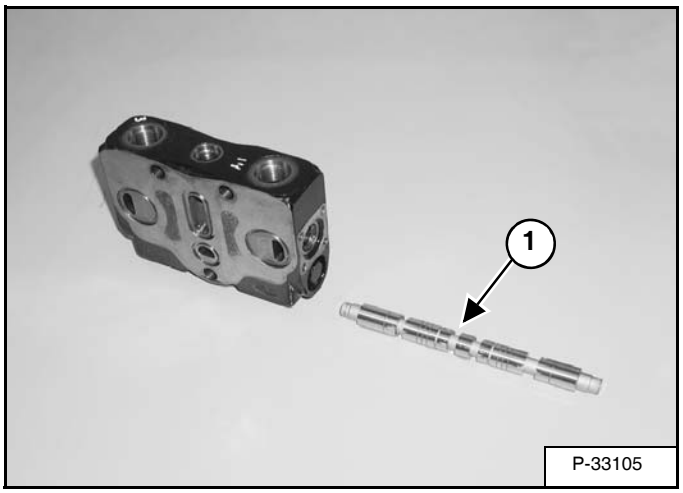


Remove the bolts (Item 1), actuator (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-40-80]**.

Installation: Install the lip of the spring retainer (Item 5) over the spool (Item 6) **[Figure 20-40-80]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-81



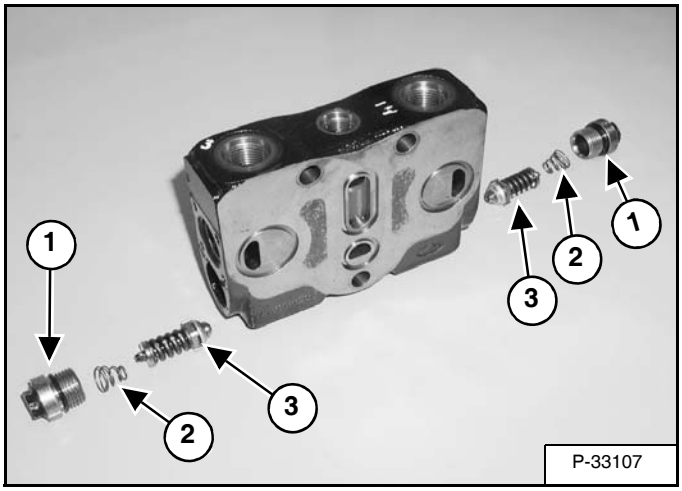
Remove the spool (Item 1) **[Figure 20-40-81]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Bucket Valve Section Disassembly and Assembly (Cont'd)

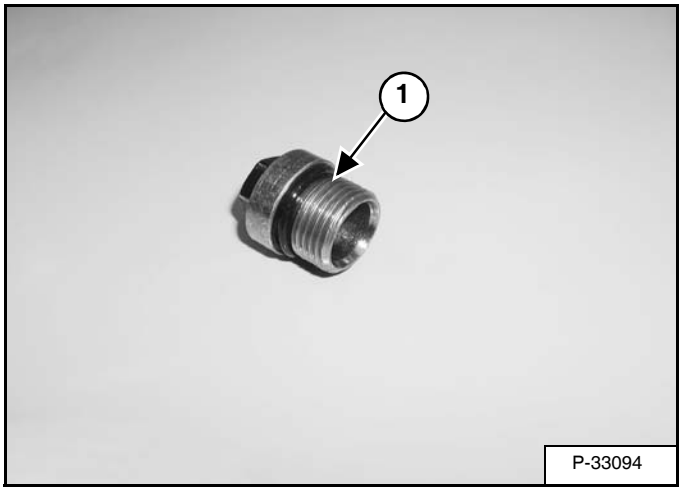
Figure 20-40-82



Remove the plug (Item 1), spring (Item 2) and valve assembly (Item 3) **[Figure 20-40-82]** from both relief valves.

Installation: Tighten the plugs to 8 ft.-lb. (24 N•m) torque.

Figure 20-40-83



Remove the O-ring (Item 1) **[Figure 20-40-83]** from both plugs.

Arm Valve Section Disassembly and Assembly

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.

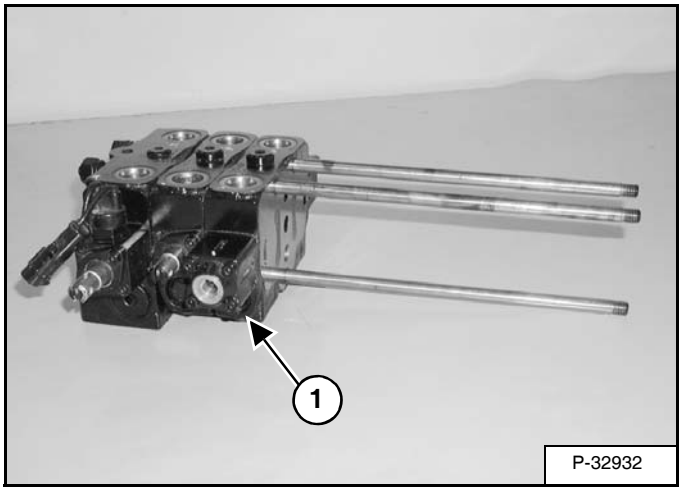
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

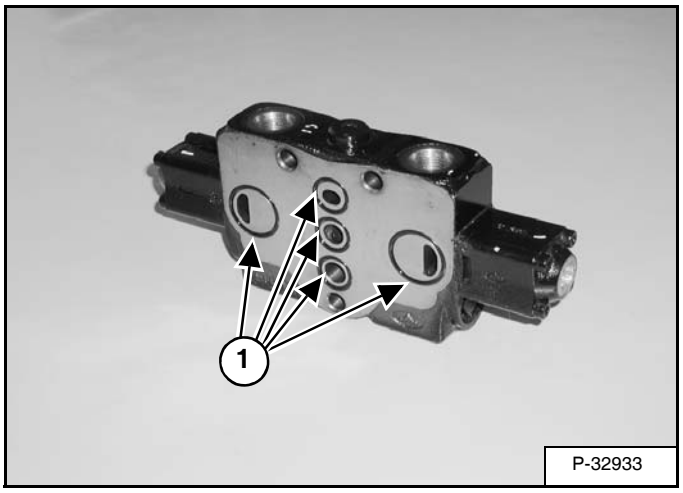
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-40-84



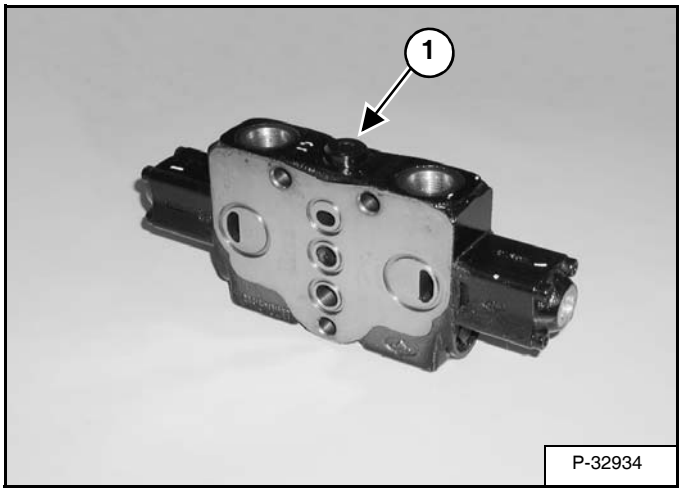
Remove the arm valve section (Item 1) **[Figure 20-40-84]** from the valve assembly.

Figure 20-40-85



Remove the O-rings (Item 1) **[Figure 20-40-85]** from the arm valve block.

Figure 20-40-86

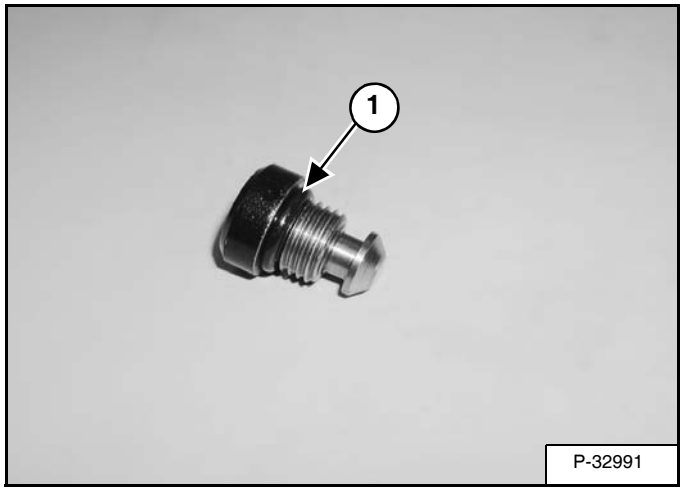


Remove the load check valve (Item 1) **[Figure 20-40-86]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

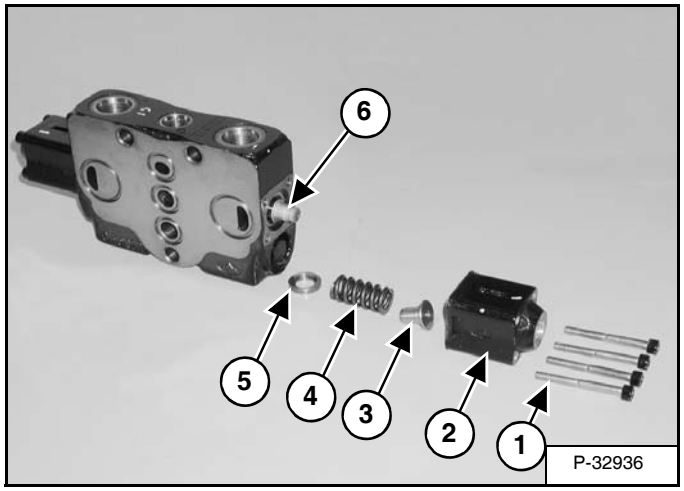
Arm Valve Section Disassembly and Assembly (Cont'd)

Figure 20-40-87



Remove the O-ring (Item 1) **[Figure 20-40-87]** from the load check valve.

Figure 20-40-88

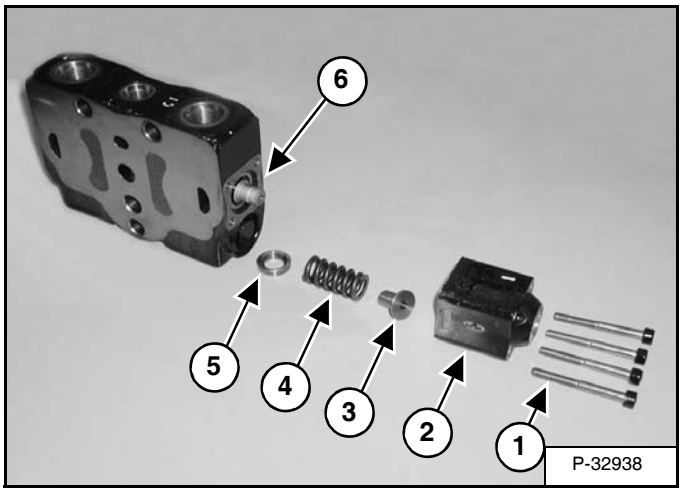


Remove the bolts (Item 1) spool cover (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-40-88]**.

Installation: Install the lip of the spring retainer (Item 5) over the spool (Item 6) **[Figure 20-40-88]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-89

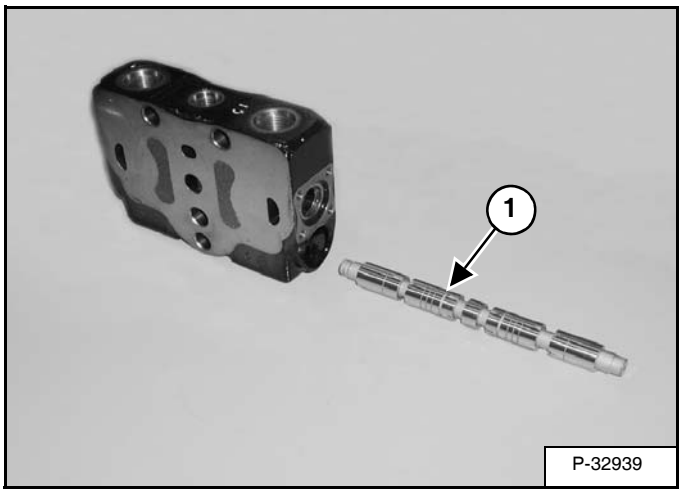


Remove the bolts (Item 1), spool cover (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-40-89]**.

Installation: Install the lip of the spring retainer (Item 5) over the spool (Item 6) **[Figure 20-40-89]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-90



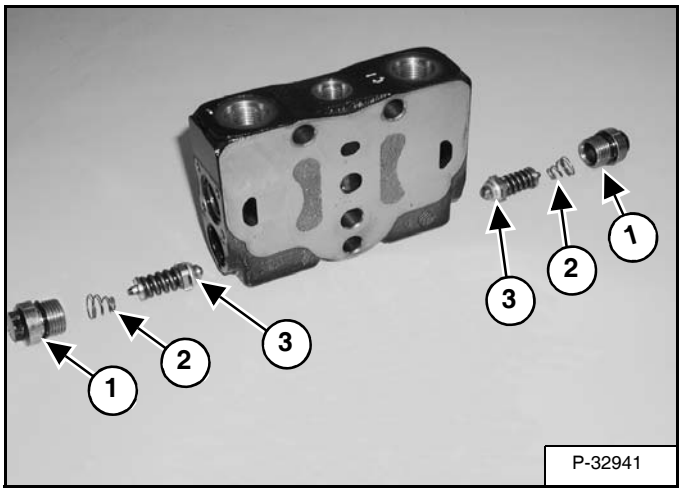
Remove the spool (item 1) **[Figure 20-40-90]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Arm Valve Section Disassembly and Assembly (Cont'd)

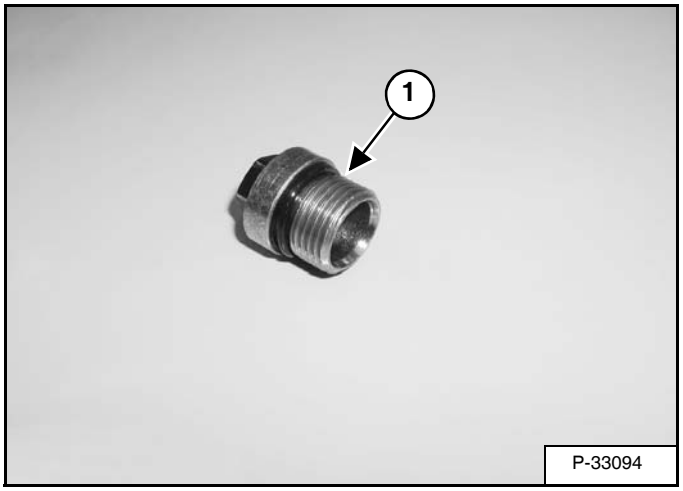
Figure 20-40-91



Remove the plug (Item 1), spring (Item 2) and relief valve assemblies (Item 3) **[Figure 20-40-91]** from both relief valves.

Installation: Tighten the plugs to 18 ft.-lb. (24 N•m) torque.

Figure 20-40-92



Remove the O-ring (Item 1) **[Figure 20-40-91]** from the plugs.

Boom Swing Valve Section Disassembly And Assembly

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.

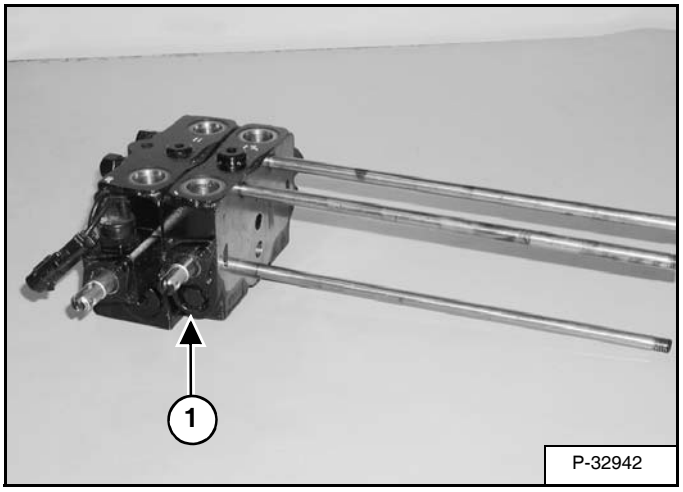
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

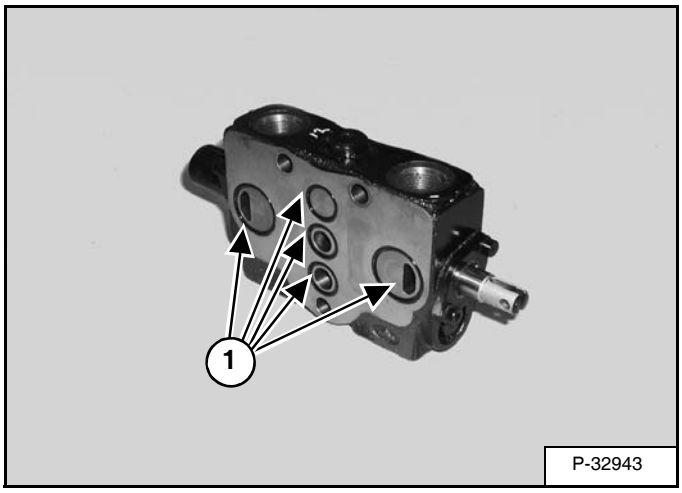
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-40-93



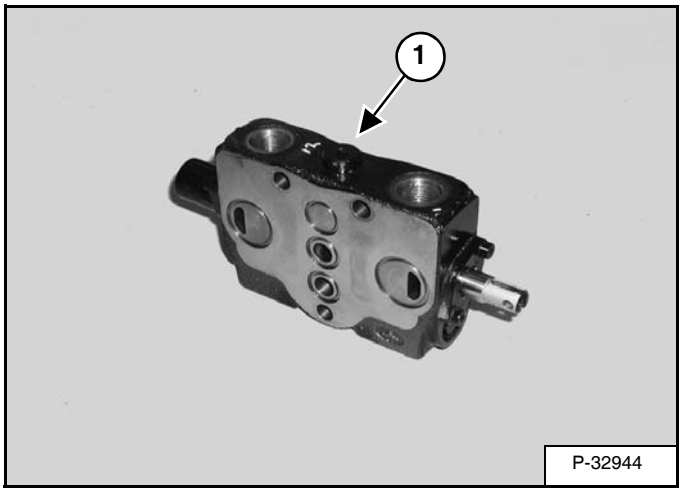
Remove the boom swing valve section (Item 1) **[Figure 20-40-93]** from the valve assembly.

Figure 20-40-94



Remove the O-rings (Item 1) **[Figure 20-40-94]** from the boom swing valve block.

Figure 20-40-95

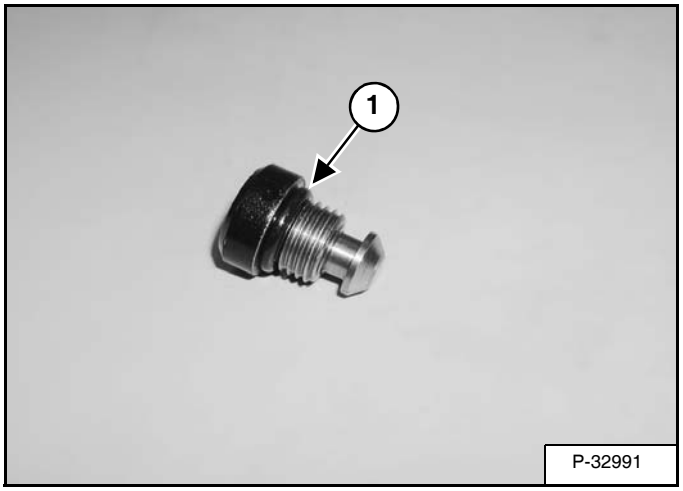


Remove the load check valve (Item 1) **[Figure 20-40-95]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

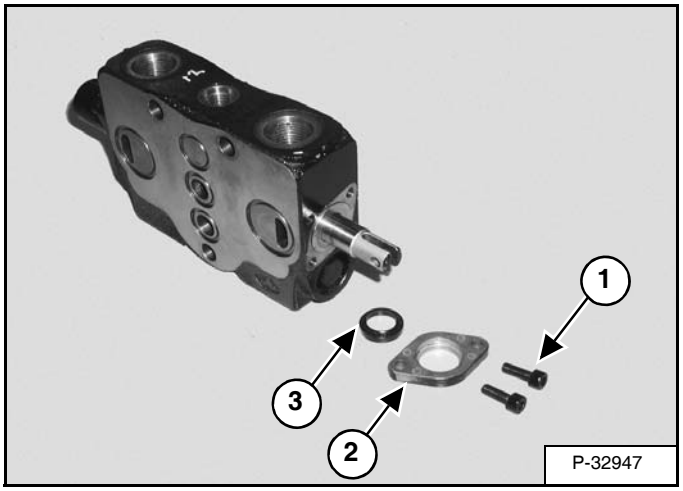
Boom Swing Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-96



Remove the O-ring (Item 1) **[Figure 20-40-96]** from the load check valve.

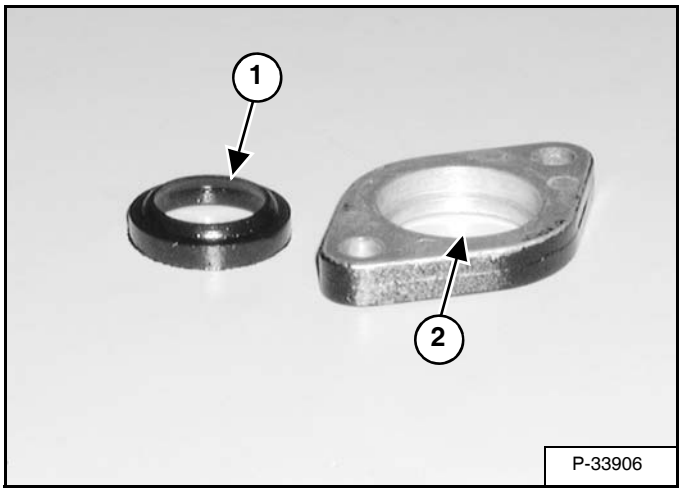
Figure 20-40-97



Remove the bolts (Item 1), retainer (Item 2) and seal (Item 3) **[Figure 20-40-97]**.

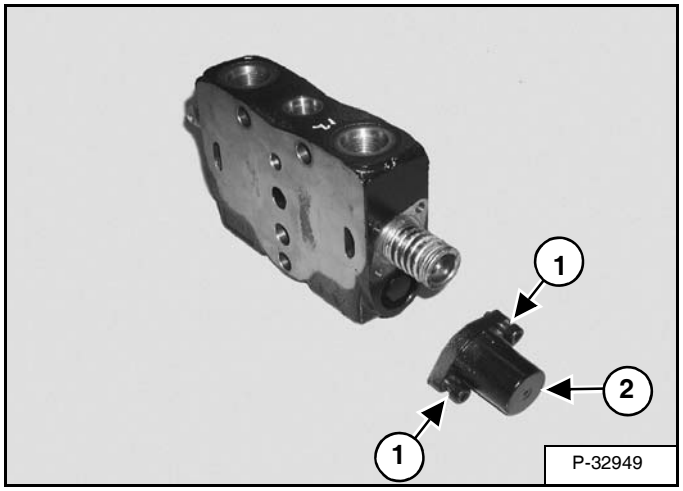
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-98



Installation: Make sure the lip (Item 1) on the seal fits inside the retainer (Item 2) **[Figure 20-40-97]**.

Figure 20-40-99

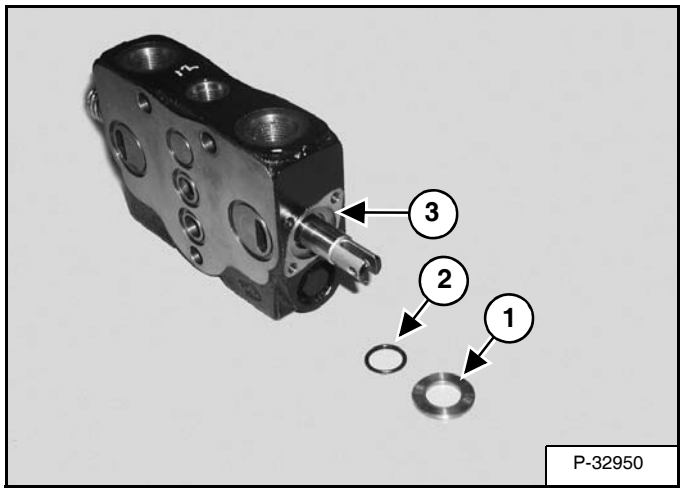


Remove the bolts (Item 1) and cap (Item 2) **[Figure 20-40-99]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

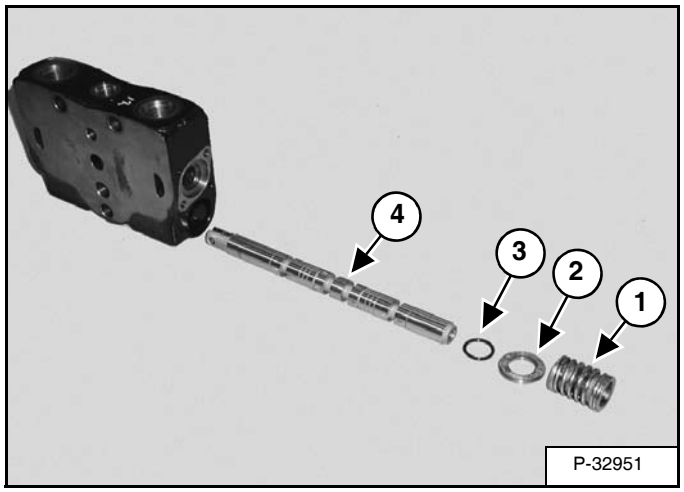
Boom Swing Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-100



Remove the washer (Item 1) and O-ring (Item 2) from the actuating end of the spool (Item 3) **[Figure 20-40-100]**.

Figure 20-40-101



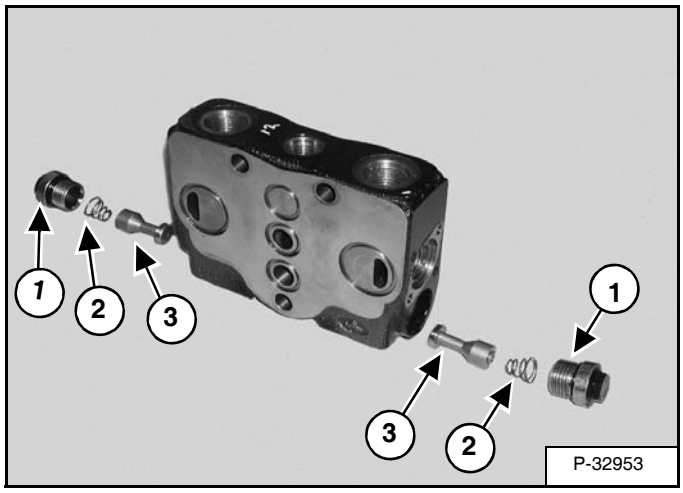
Remove the spring assembly (Item 1), washer (Item 2), O-ring (Item 3) and spool (Item 4) **[Figure 20-40-101]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Installation: Tighten the spring retaining screw to 18 ft.-lbs. (24 Nm) torque.

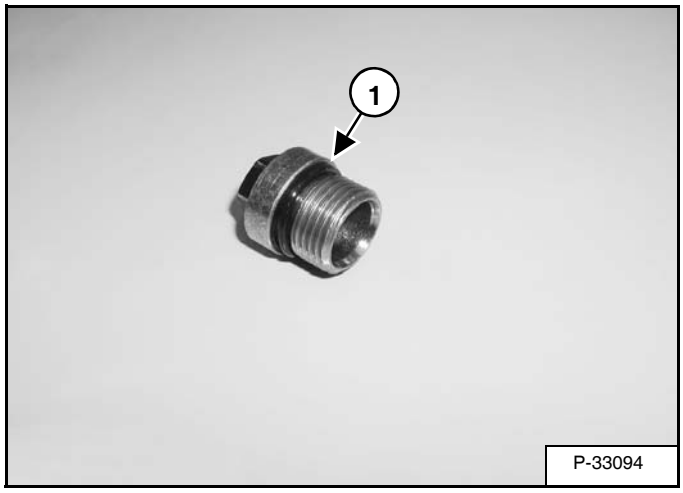
Figure 20-40-102



Remove the plug (Item 1), spring (Item 2) and valve assembly (Item 3) **[Figure 20-40-102]** from both relief valves.

Installation: Tighten the plugs to 18 ft.-lb. (24 N•m) torque.

Figure 20-40-103



Remove the O-ring (Item 1) **[Figure 20-40-103]** from the plugs.

Right Travel Valve Section Disassembly And Assembly

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.

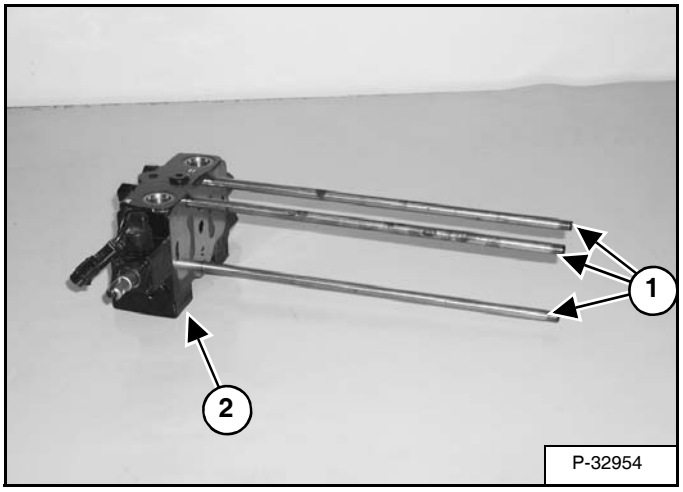
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

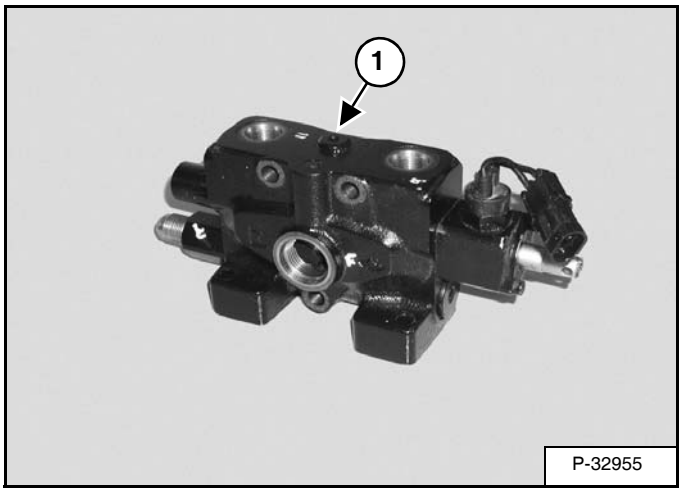
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-40-104



Remove the tie rods (Item 1) from the right travel valve section (Item 2) **[Figure 20-40-104]**.

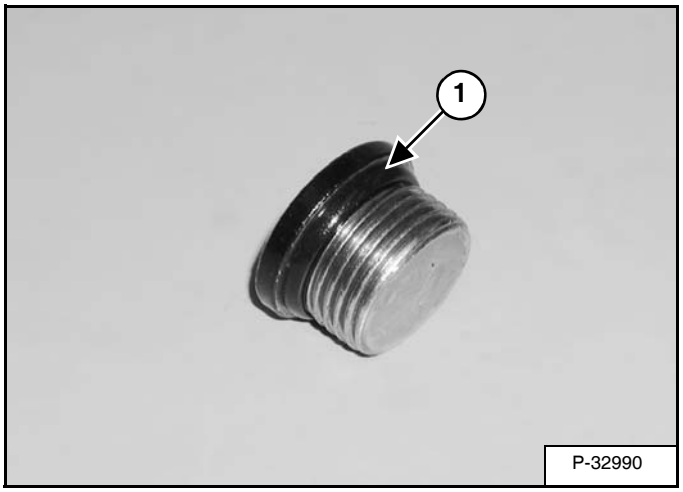
Figure 20-40-105



Remove the plug (Item 1) **[Figure 20-40-105]** from the right travel valve section.

Installation: Tighten the plug to 18 ft.-lb. (24 N•m) torque.

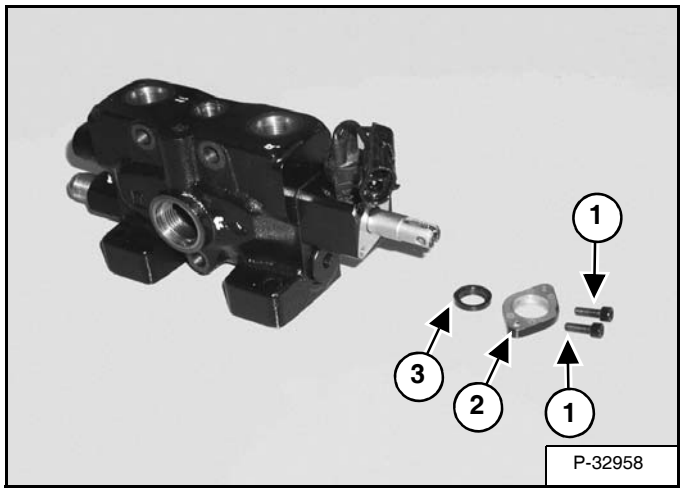
Figure 20-40-106



Remove the O-ring (Item 1) **[Figure 20-40-106]** from the plug.

Right Travel Valve Section Disassembly And Assembly (Cont'd)

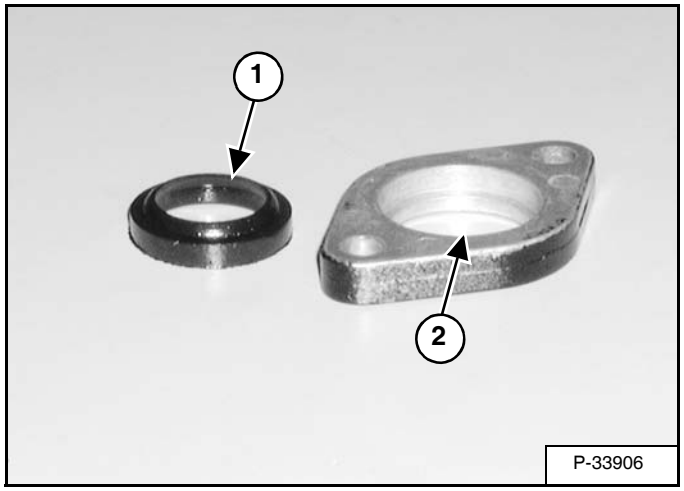
Figure 20-40-107



Remove the bolts (Item 1), retaining plate (Item 2) and seal (Item 3) **[Figure 20-40-107]**.

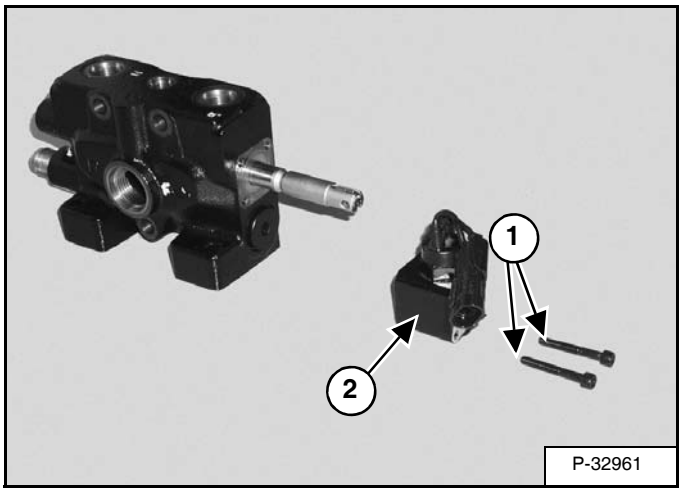
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-108



Installation: Make sure the lip (Item 1) of the seal fits inside the retaining plate (Item 2) **[Figure 20-40-107]**.

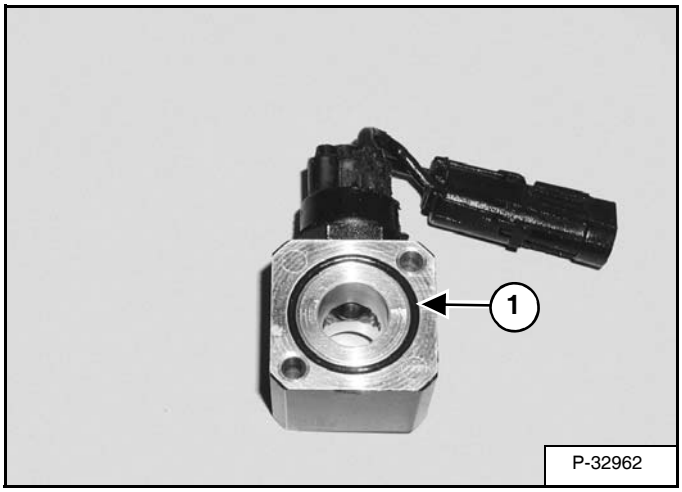
Figure 20-40-109



Remove the bolts (Item 1) and spool cover (Item 2) **[Figure 20-40-109]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

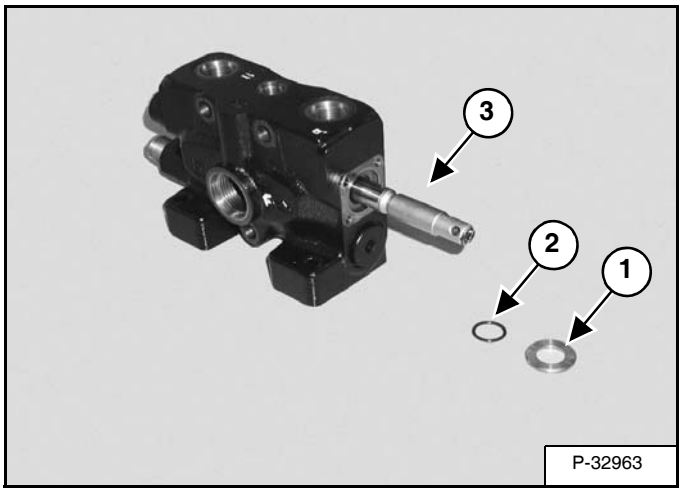
Figure 20-40-110



Remove the O-ring (Item 1) **[Figure 20-40-110]**.

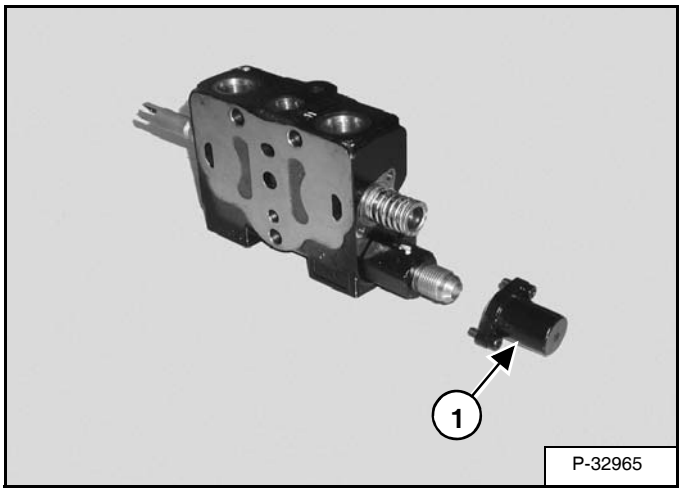
Right Travel Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-111



Remove the washer (Item 1) and O-ring (Item 2) from the spool (Item 3) **[Figure 20-40-111]**.

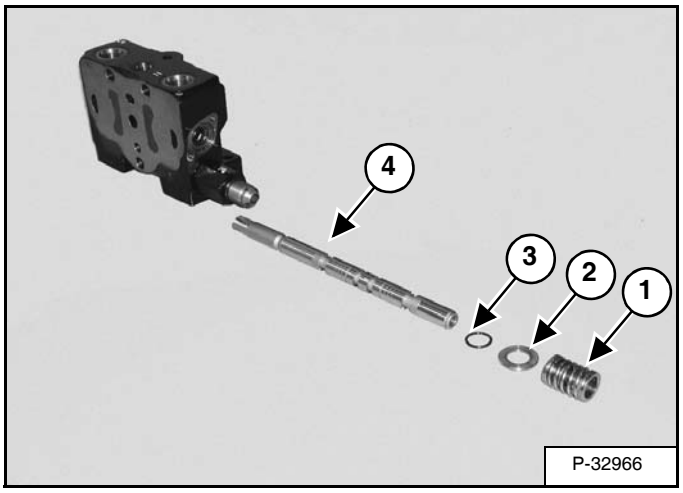
Figure 20-40-112



Remove the bolts and cap (Item 1) **[Figure 20-40-112]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-40-113



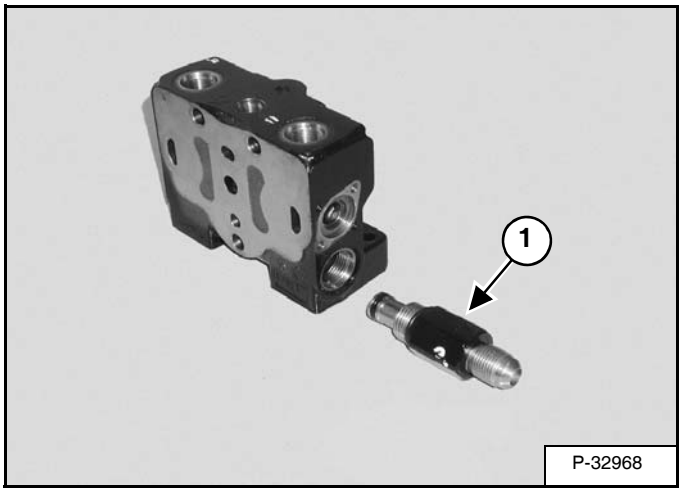
Remove the spring assembly (Item 1), washer (Item 2), O-ring (Item 3) and spool (Item 4) **[Figure 20-40-113]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Installation: Tighten the spring retaining screw to 18 ft.-lb. (24 N•m) torque.

Figure 20-40-114

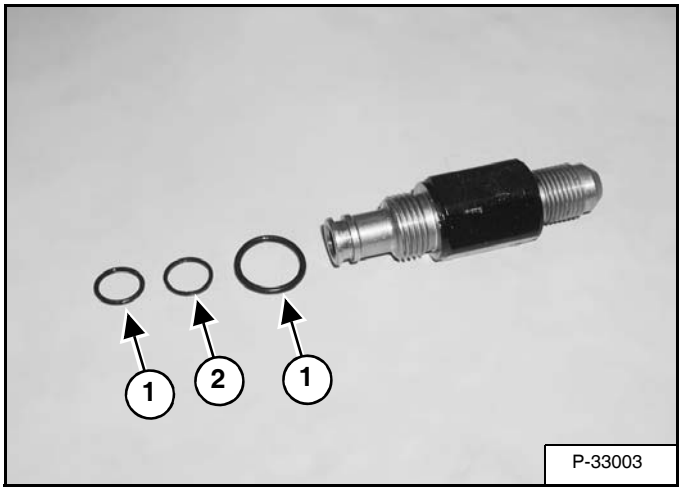


Remove the fitting (Item 1) **[Figure 20-40-114]**.

Installation: Tighten the fitting to 31 ft.-lb. (42 N•m) torque.

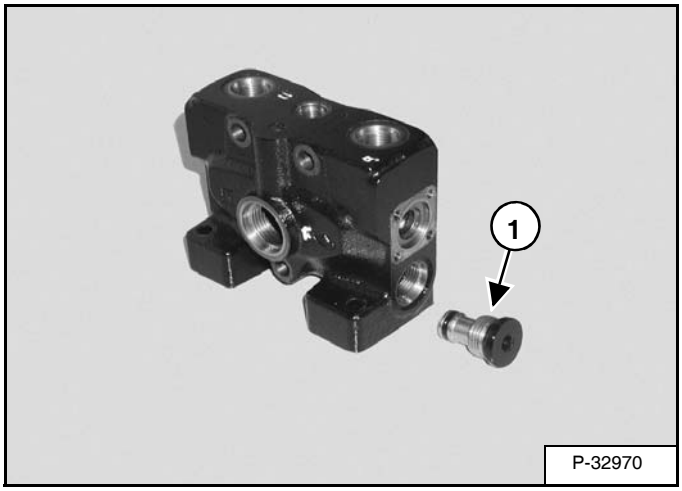
Right Travel Valve Section Disassembly And Assembly (Cont'd)

Figure 20-40-115



Remove the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-40-115]** from the fitting.

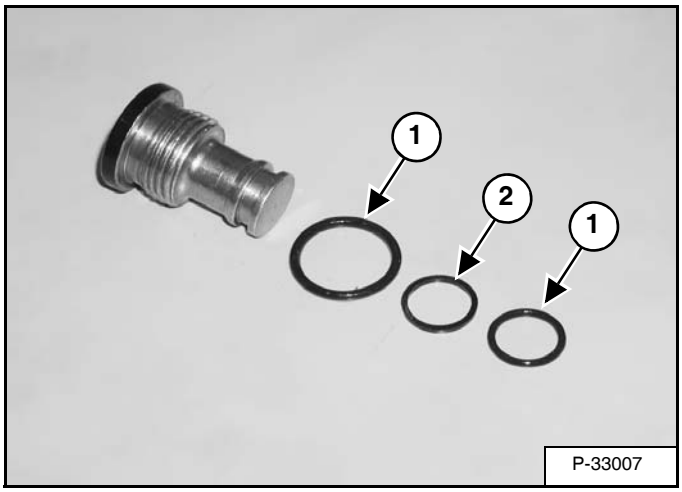
Figure 20-40-116



Remove the plug (Item 1) **[Figure 20-40-116]**.

Installation: Tighten the plug to 31 ft.-lb. (42 N•m) torque.

Figure 20-40-117



Remove the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-40-117]** from the plug.

Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

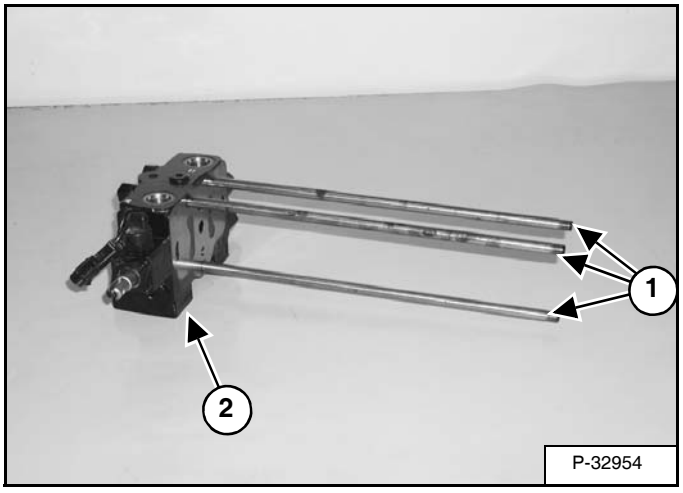
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

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.

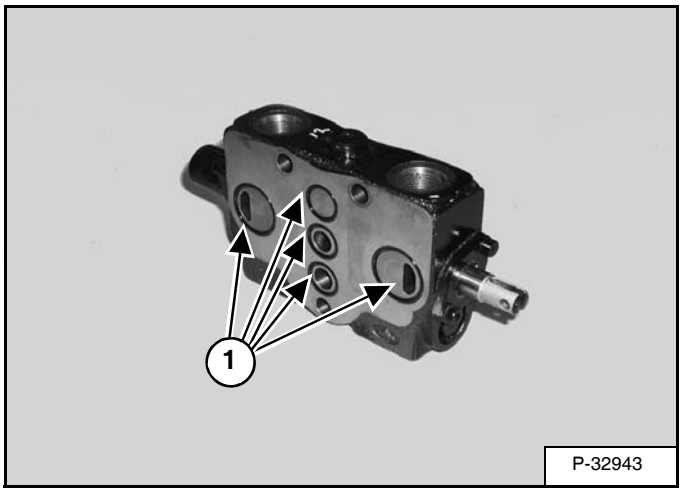
I-2003-0888

Figure 20-40-118



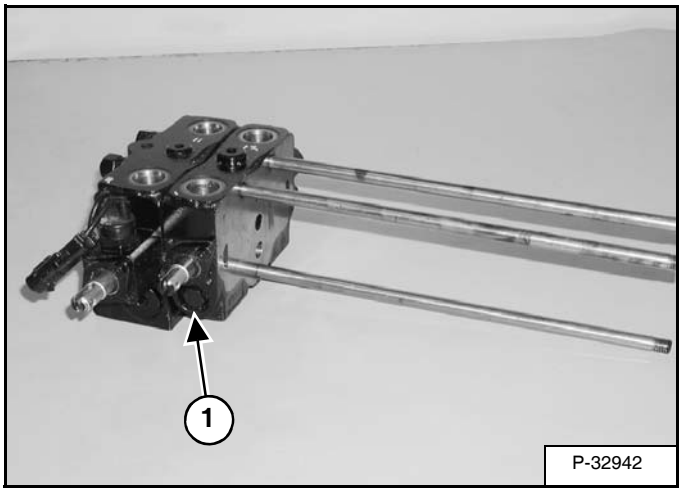
Install the tie rods (Item 1) on the right travel valve section (Item 2) **[Figure 20-40-118]**.

Figure 20-40-119



Install the O-rings (Item 1) **[Figure 20-40-119]** on the boom swing valve section.

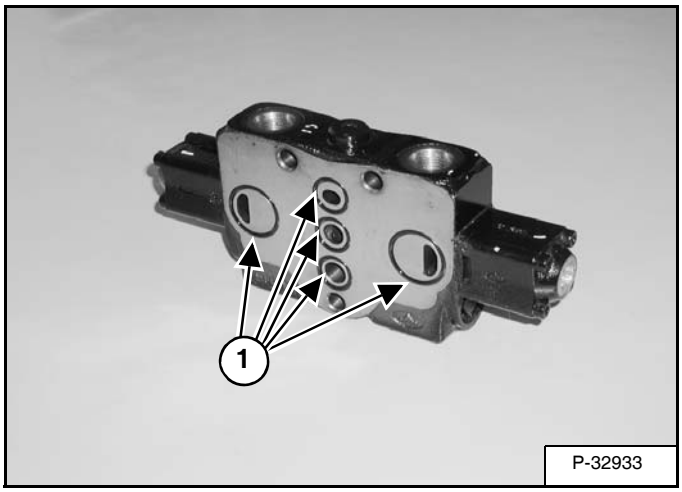
Figure 20-40-120



Install the boom swing valve section (Item 1) **[Figure 20-40-120]** on the tie rods.

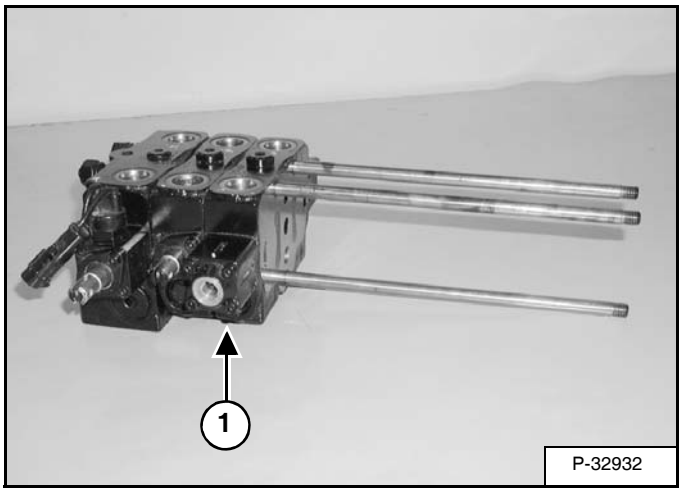
Assembly (Cont'd)

Figure 20-40-121



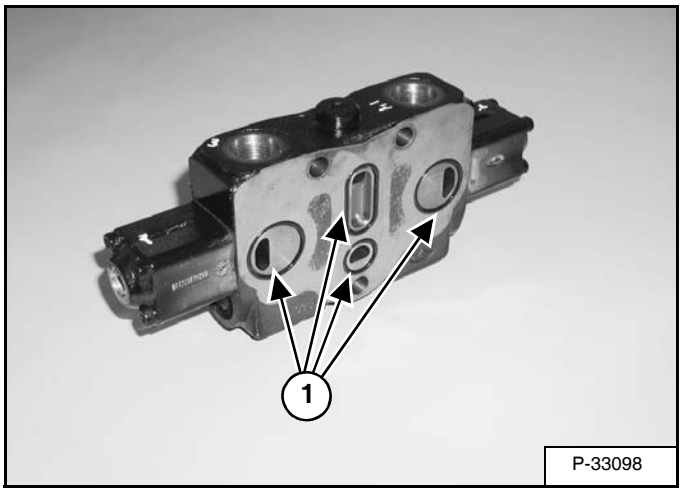
Install the O-rings (Item 1) **[Figure 20-40-121]** on the arm valve section.

Figure 20-40-122



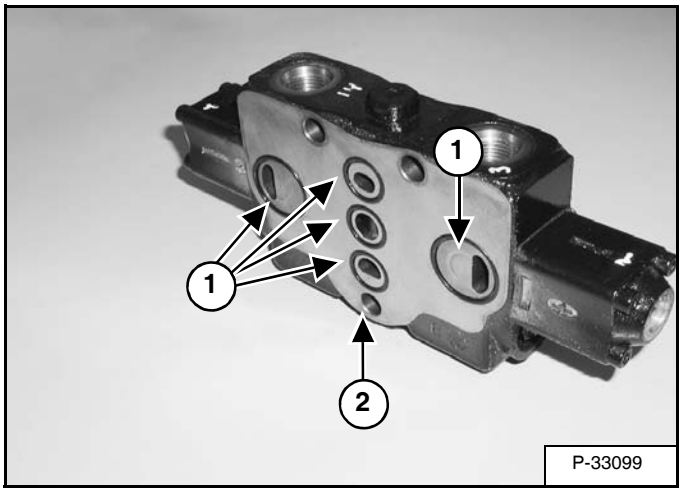
Install the arm valve section (Item 1) **[Figure 20-40-122]** on the tie rods.

Figure 20-40-123



Install the O-rings (Item 1) **[Figure 20-40-123]** on the right side of the bucket valve.

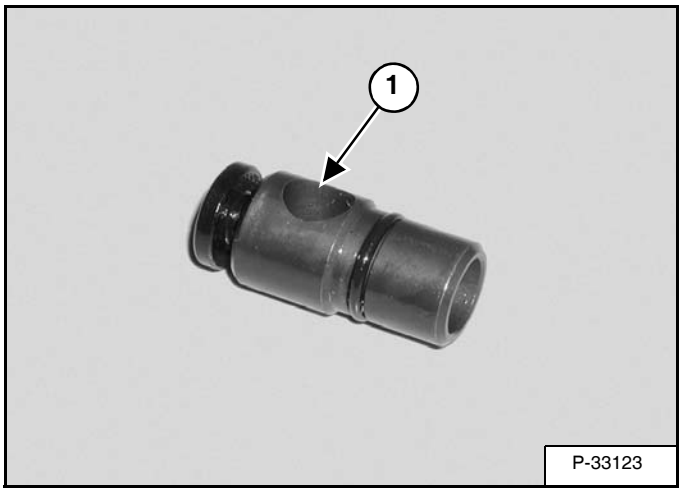
Figure 20-40-124



Install the O-rings (Item 1) **[Figure 20-40-124]** on the left side of the bucket valve section.

Assembly (Cont'd)

Figure 20-40-125



Align the hole (Item 1) in the buildup valve with the hole (Item 2) **[Figure 20-40-124]** in the bucket valve section.

Figure 20-40-126

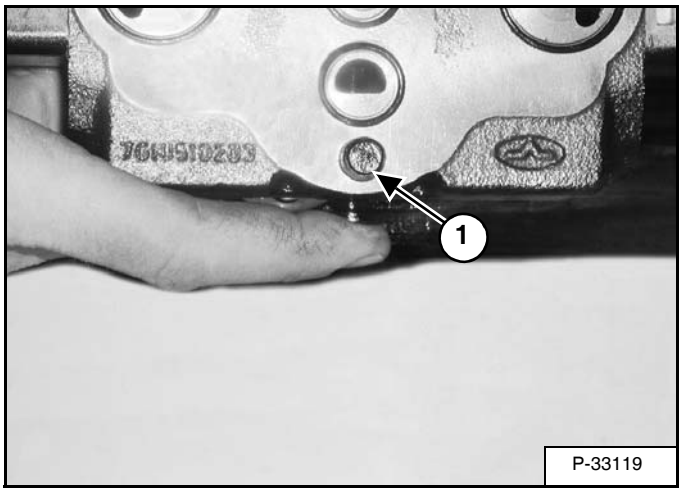
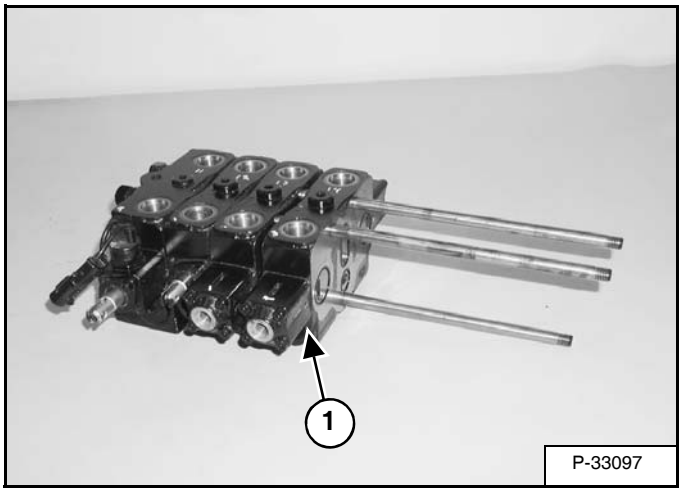


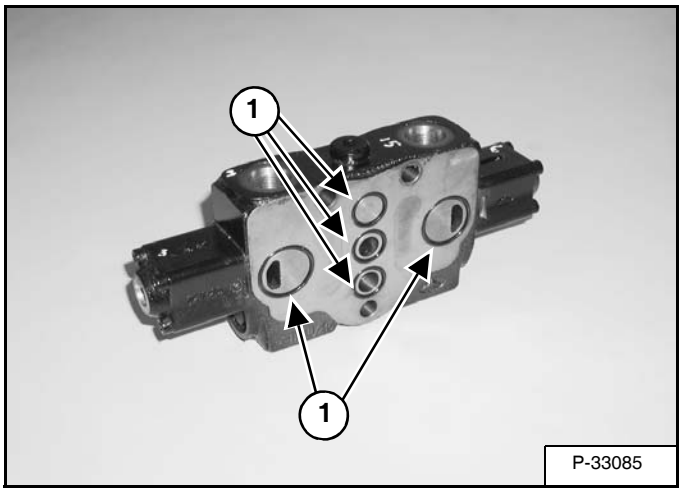
Figure 20-40-127



Fully depress the buildup valve (Item 1) **[Figure 20-40-126]** and install the bucket valve section (Item 1) **[Figure 20-40-127]** on the tie rods.

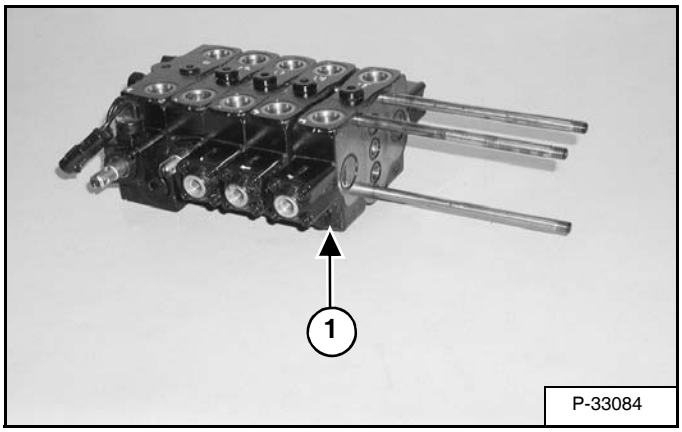
Assembly (Cont'd)

Figure 20-40-128



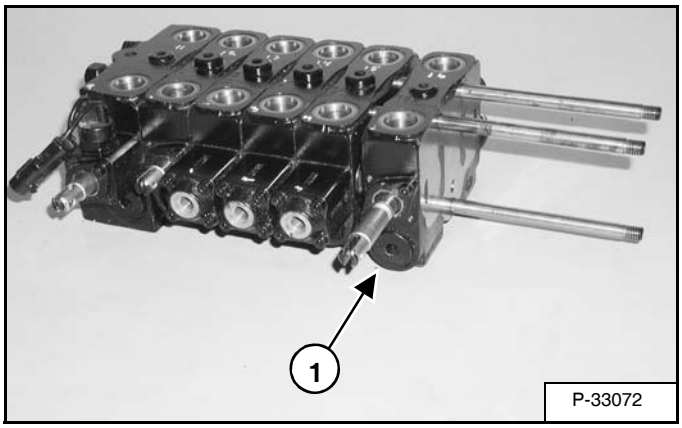
Install the O-rings (Item 1) **[Figure 20-40-128]** on the boom valve section.

Figure 20-40-129



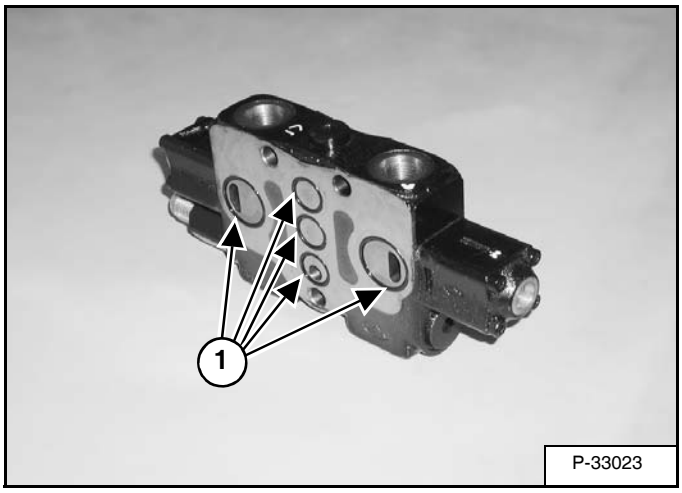
Install the boom valve section (Item 1) **[Figure 20-40-129]** on the tie rods.

Figure 20-40-130



Install the left travel valve section (Item 1) **[Figure 20-40-130]** on the tie rods.

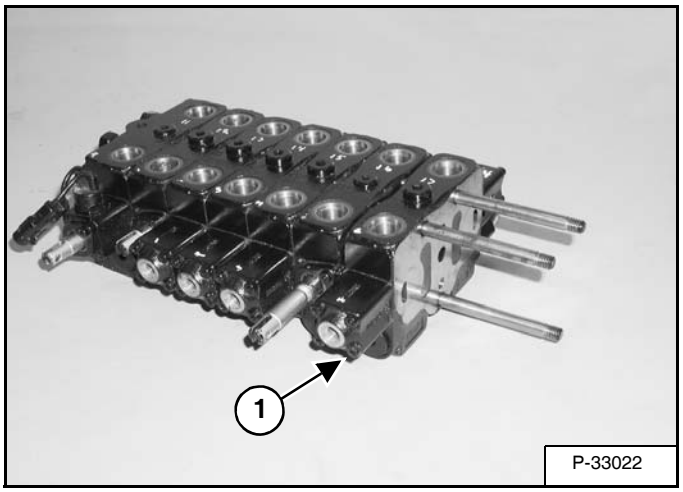
Figure 20-40-131



Install the O-rings (Item 1) **[Figure 20-40-131]** on the swing valve section.

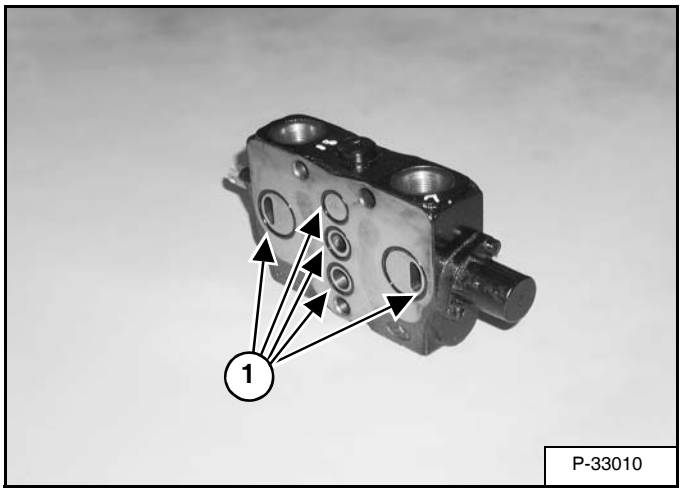
Assembly (Cont'd)

Figure 20-40-132



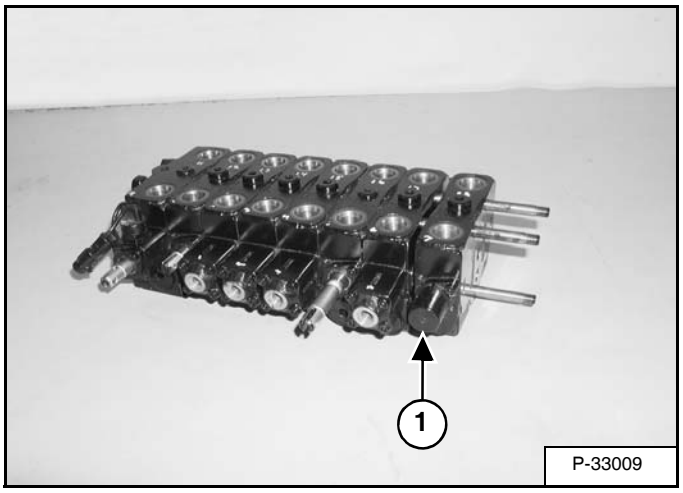
Install the swing valve section (Item 1) **[Figure 20-40-132]** on the tie rods.

Figure 20-40-133



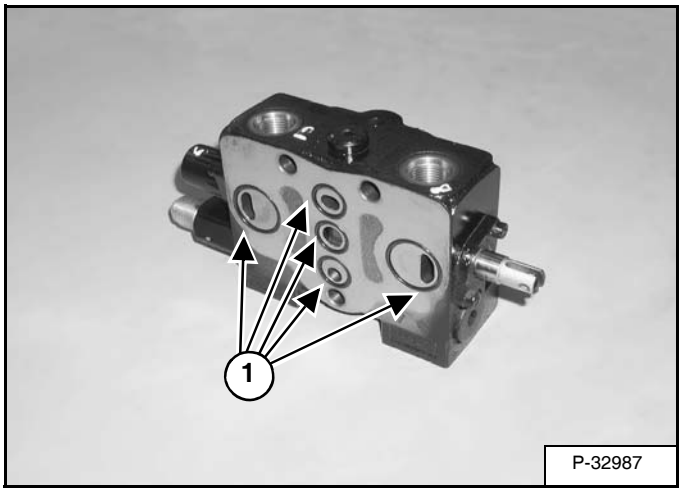
Install the O-rings (Item 1) **[Figure 20-40-133]** on the blade valve section.

Figure 20-40-134



Install the blade valve section (Item 1) **[Figure 20-40-134]** on the tie rods.

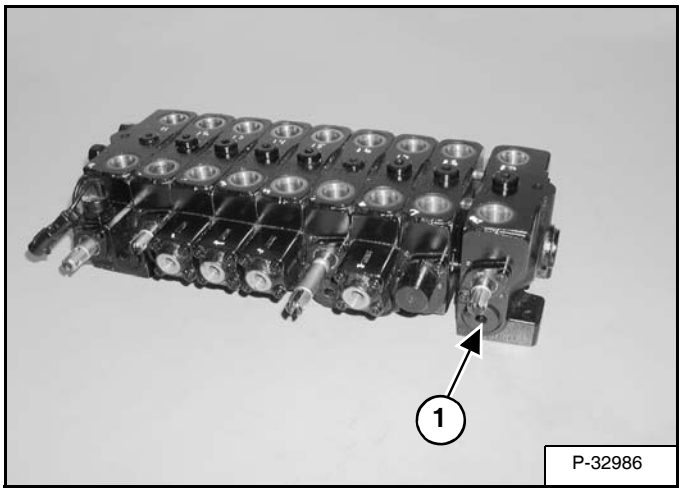
Figure 20-40-135



Install the O-rings (Item 1) **[Figure 20-40-135]** on the auxiliary valve section.

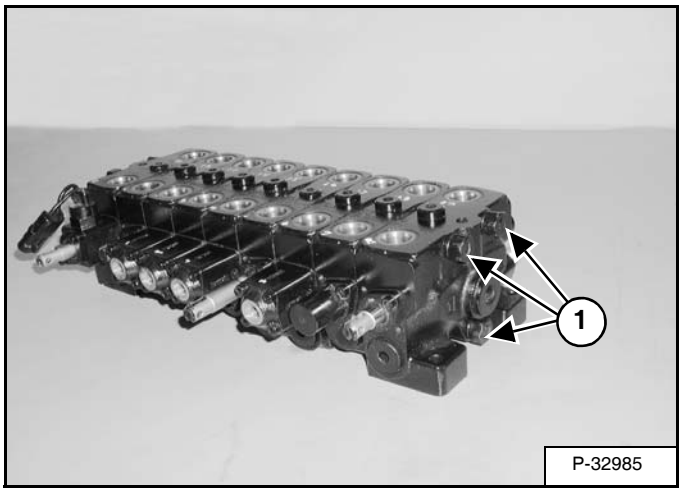
Assembly (Cont'd)

Figure 20-40-136



Install the auxiliary valve section (Item 1) **[Figure 20-40-136]** on the tie rods.

Figure 20-40-137



Install the washers and nuts (Item 1) **[Figure 20-40-137]** on the tie rods, finger tight.

Be sure the valve assembly does not rock on a flat surface.

Initially tighten the tie rod nuts (Item 1) **[Figure 20-40-137]** to 10 ft.-lb. (13 N•m) torque in a crisscross manner.

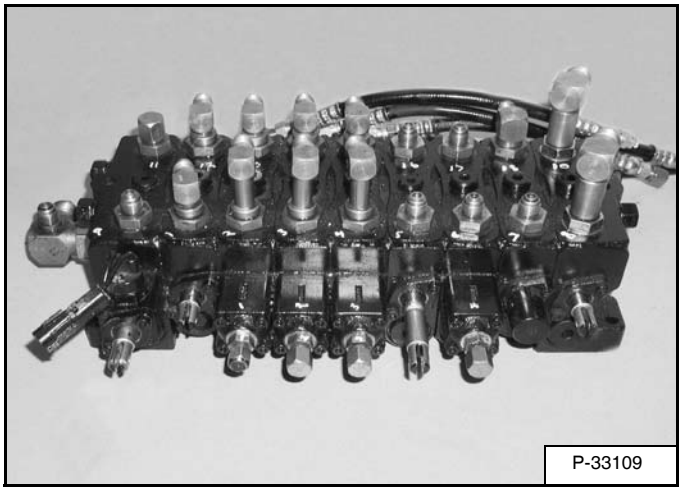
Final tighten the tie rod nuts (Item 1) **[Figure 20-40-137]** to 18 ft.-lb. (24 N•m) torque.

The valve assembly must not have any spacing between the valve sections and the spools must be free when pushed in and released.

The spools must not stick, if the spools do stick, loosen the tie rod nuts and tighten per above information.

Recheck the control valve assembly for level settings.

Figure 20-40-138



Install the hoses and fittings **[Figure 20-40-138]**.

HYDRAULIC CONTROL VALVE (320L)

Description

The hydraulic control valve has 3335 PSI (230 bar) and 2900 PSI (200 bar) work port relief valves for the boom, bucket and arm sections.

The 218 PSI (15 bar) buildup valve is located in the bucket section.

Removal And Installation

Lower the boom/bucket and blade to the ground.

With the engine off, turn the start key to the ON position and move both hydraulic control levers to relieve hydraulic pressure.

IMPORTANT

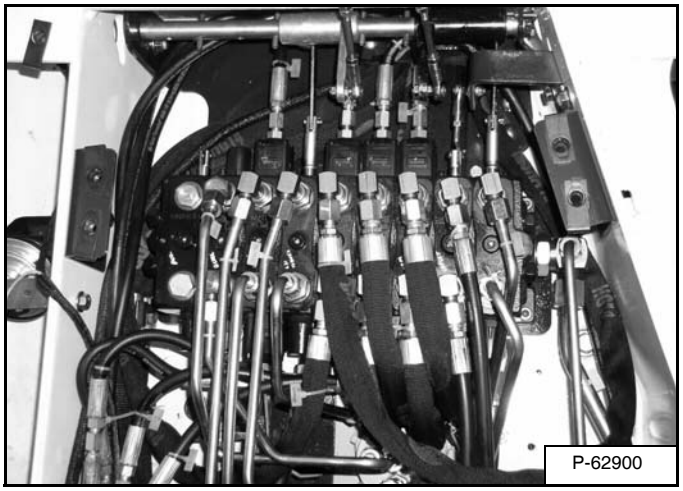
When repairing hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

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Remove the floormat and floor panels. (See Removal and Installation on Page 40-140-1.)

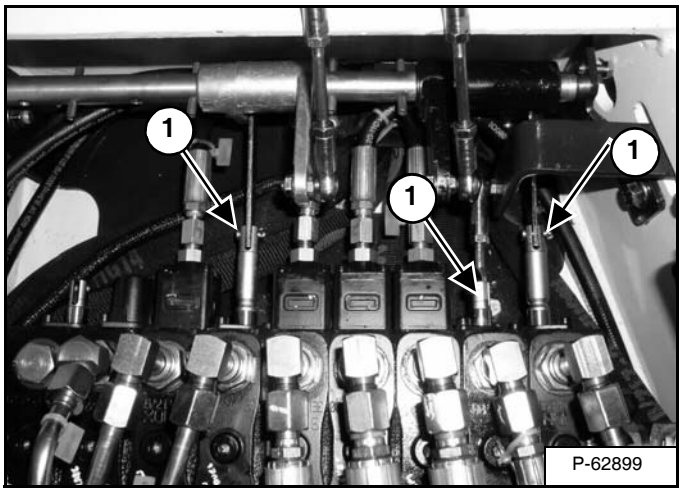
Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Figure 20-41-1



Mark all tubes and hoses for ease of assembly **[Figure 20-41-1]**.

Figure 20-41-2



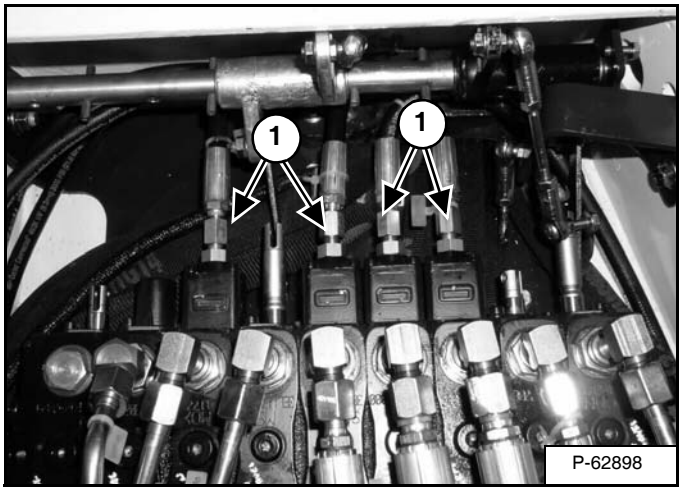
Remove the clevis pins and cotter pins (Item 1) **[Figure 20-41-2]**.

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

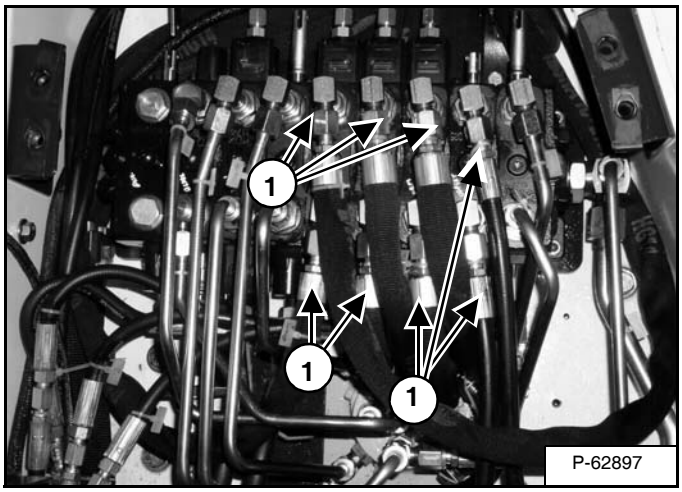
Figure 20-41-3



Remove the hoses (Item 1) **[Figure 20-41-3]**.

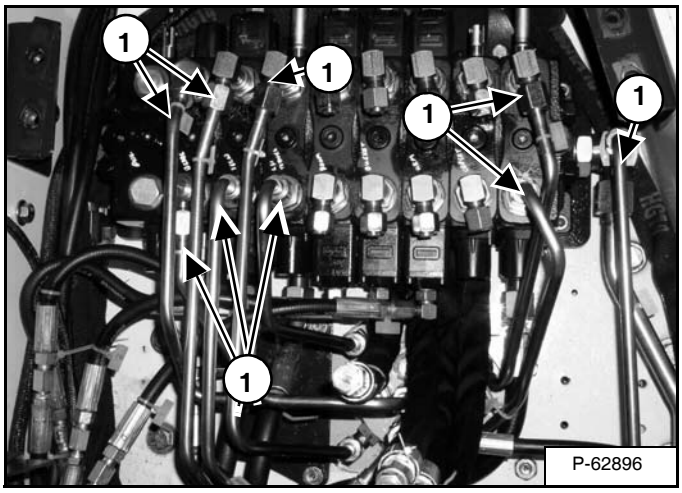
Removal And Installation (Cont'd)

Figure 20-41-4



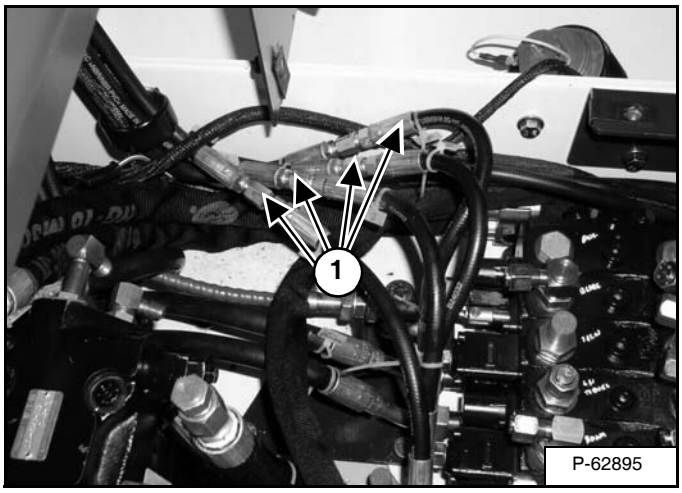
Remove the hoses (Item 1) **[Figure 20-41-4]** from the top of the control valve.

Figure 20-41-5



Remove the tubelines (Item 1) **[Figure 20-41-5]**.

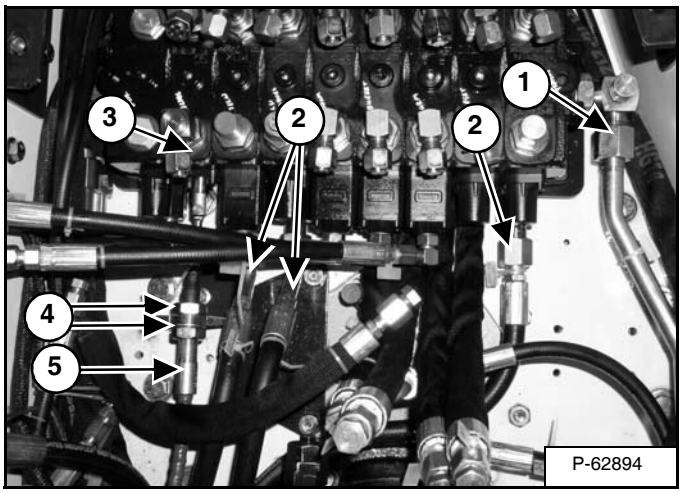
Figure 20-41-6



Disconnect the hoses (Item 1) **[Figure 20-41-6]**.

NOTE: The hoses will be removed with the valve.

Figure 20-41-7



Disconnect the tubeline (Item 1) **[Figure 20-41-7]** from the control valve.

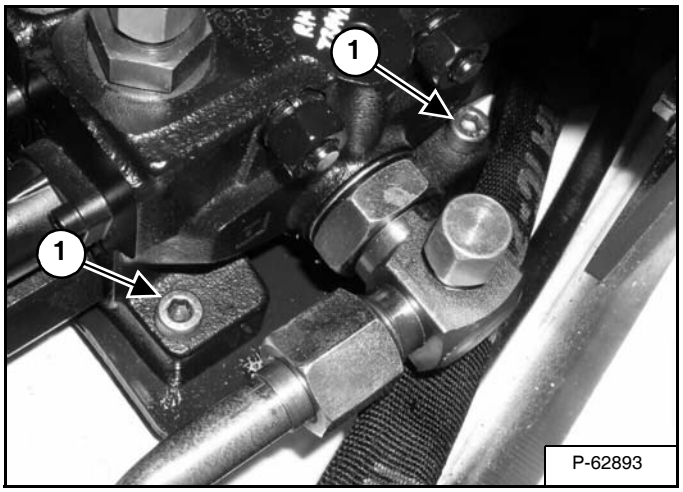
Disconnect the hoses (Item 2) **[Figure 20-41-7]** from the control valve.

Remove the clevis pin and cotter pin (Item 3) **[Figure 20-41-7]** from the blade cable linkage.

Loosen the nuts (Item 4) and remove the cable linkage (Item 5) **[Figure 20-41-7]**.

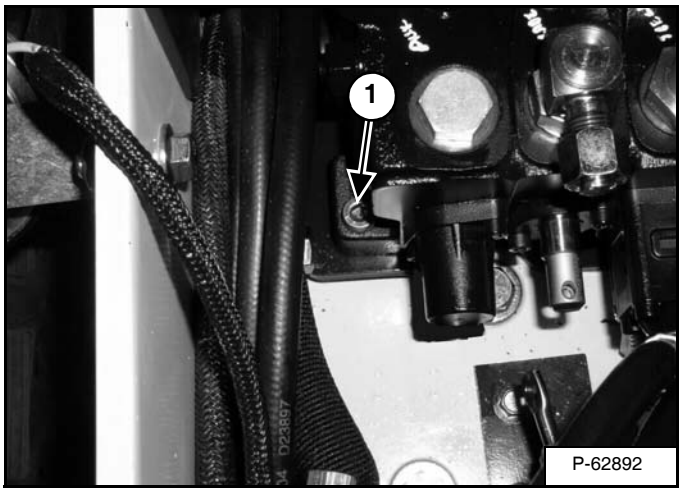
Removal And Installation (Cont'd)

Figure 20-41-8



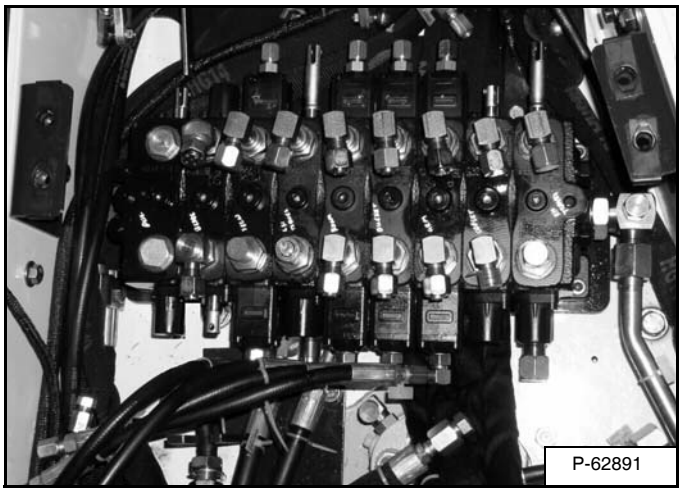
Remove the bolts and nuts (Item 1) **[Figure 20-41-8]**.

Figure 20-41-9



Remove the bolt and nut (Item 1) **[Figure 20-41-9]**.

Figure 20-41-10



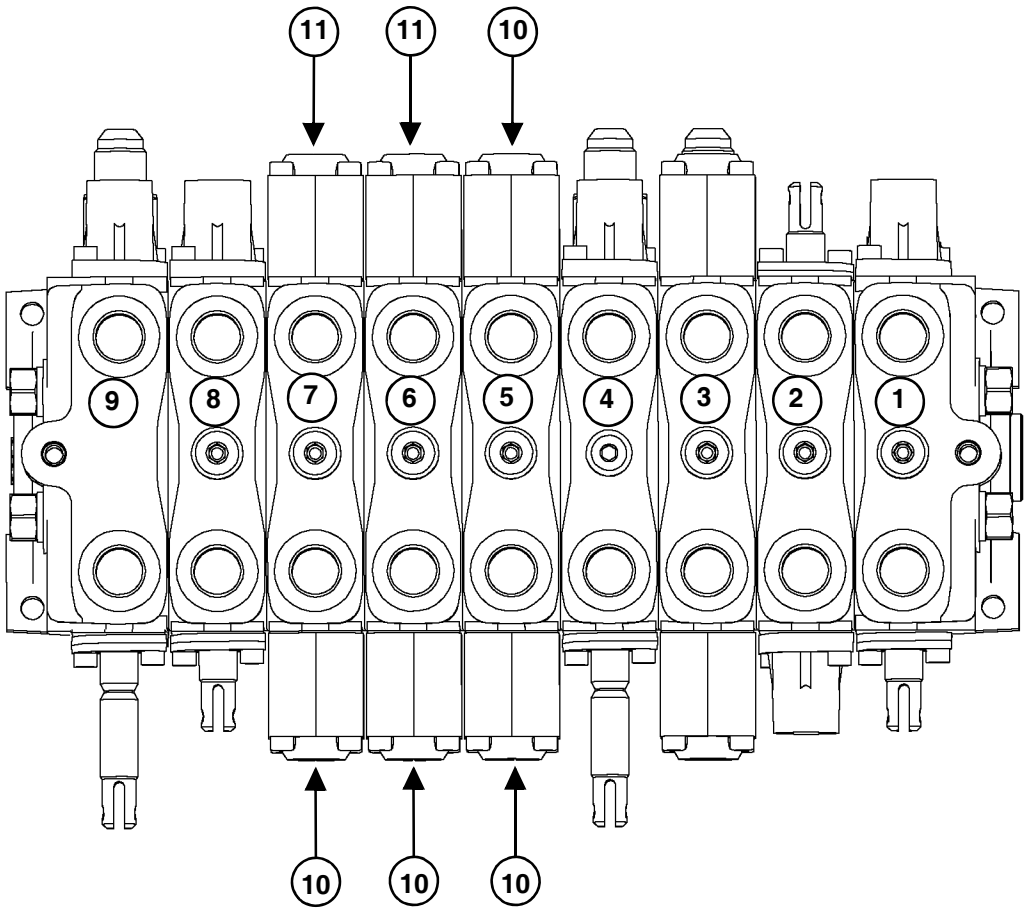
Remove the control valve **[Figure 20-41-10]**.

HYDRAULIC CONTROL VALVE (320L) (CONT'D)

Parts Identification

Item Description

1. AUXILIARY SECTION
2. BLADE SECTION
3. SLEW SECTION
4. LEFT TRAVEL SECTION
5. BOOM SECTION
6. BUCKET SECTION
7. ARM SECTION
8. BOOM SWING SECTION
9. RIGHT TRAVEL SECTION
10. PORT RELIEF - 3335 PSI (330 bar) (Below Spool Cover)
11. PORT RELIEF - 2900 PSI (200 bar) (Below Spool Cover)



MS1373A

Disassembly

Clean the outside of the hydraulic control valve before disassembly.

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.

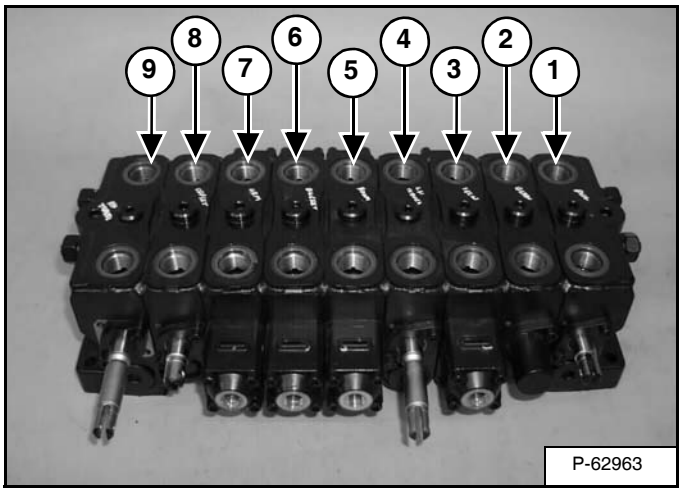
I-2003-0888

Figure 20-41-11



Remove the hoses and fittings **[Figure 20-41-11]**.

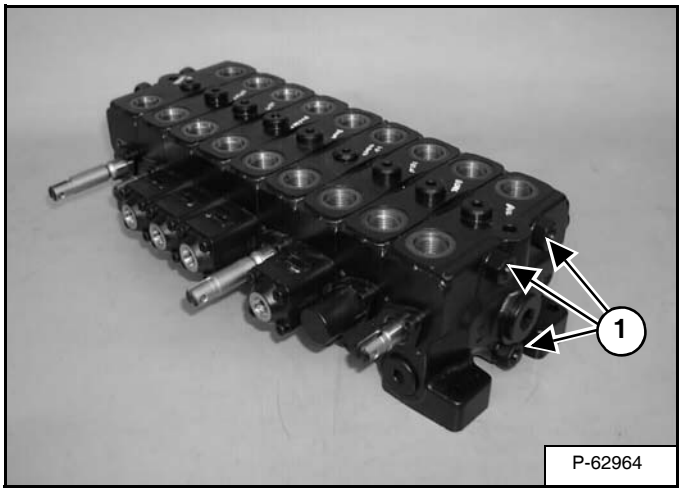
Figure 20-41-12



Mark the valve sections for ease of assembly **[Figure 20-41-12]**.

1. Auxiliary Valve
2. Blade Valve
3. Slew Valve
4. Left Travel Valve
5. Boom Valve
6. Bucket Valve
7. Arm Valve
8. Boom Swing Valve
9. Right Travel Valve

Figure 20-41-13



Remove the tie rod nuts (Item 1) **[Figure 20-41-13]** and washers.

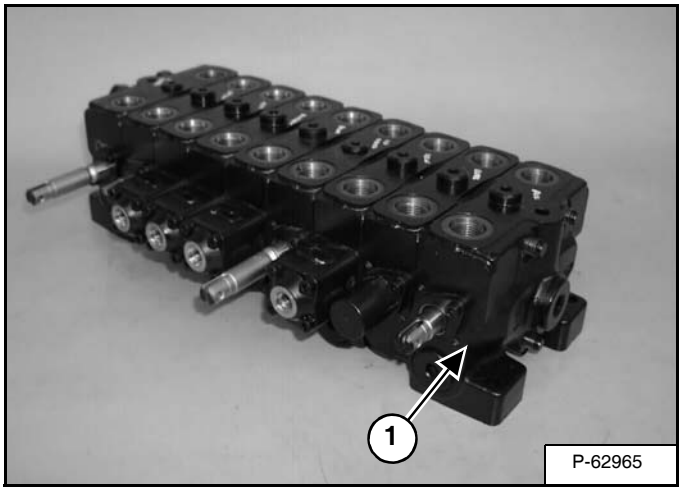
Auxiliary Valve Section Disassembly And Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

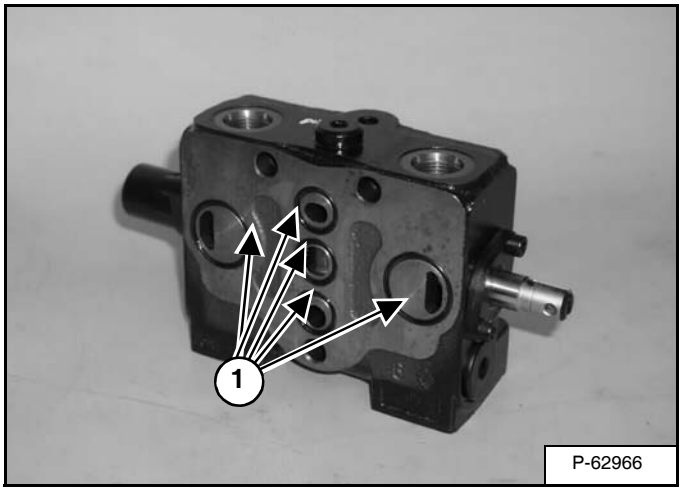
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-41-14



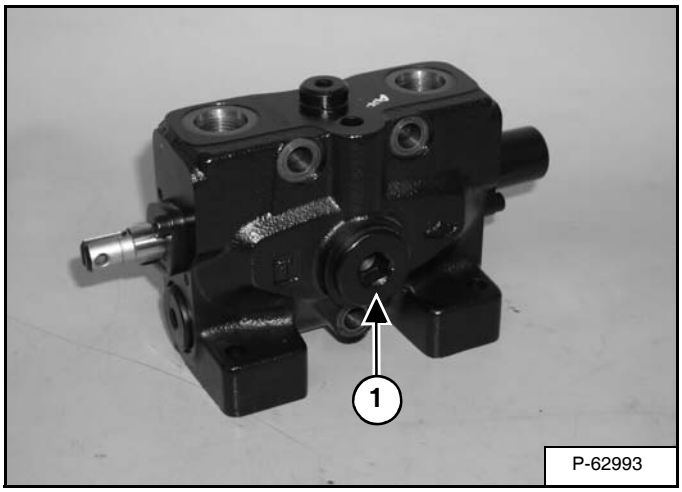
Remove the auxiliary valve section (Item 1) **[Figure 20-41-14]** from the valve assembly.

Figure 20-41-15



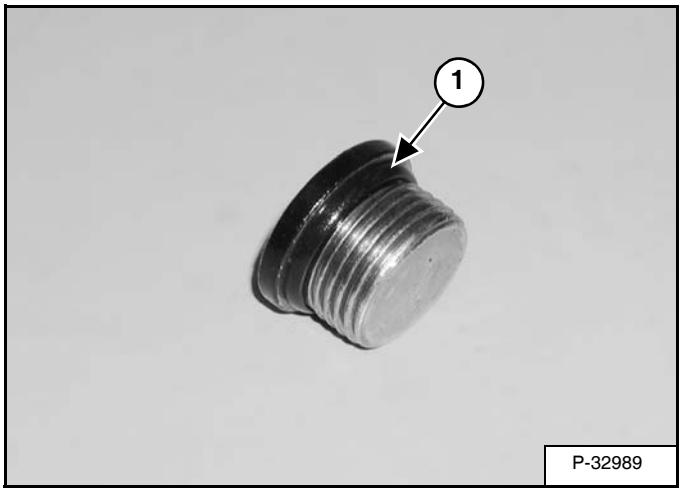
Remove the O-rings (Item 1) **[Figure 20-41-15]** from the auxiliary valve block.

Figure 20-41-16



Remove the plug (Item 1) **[Figure 20-41-16]**.

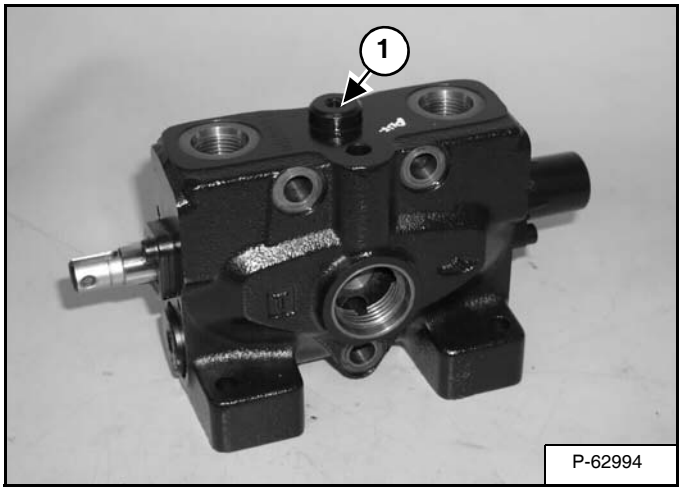
Figure 20-41-17



Remove the O-ring (Item 1) **[Figure 20-41-17]** from the plug.

Auxiliary Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-18

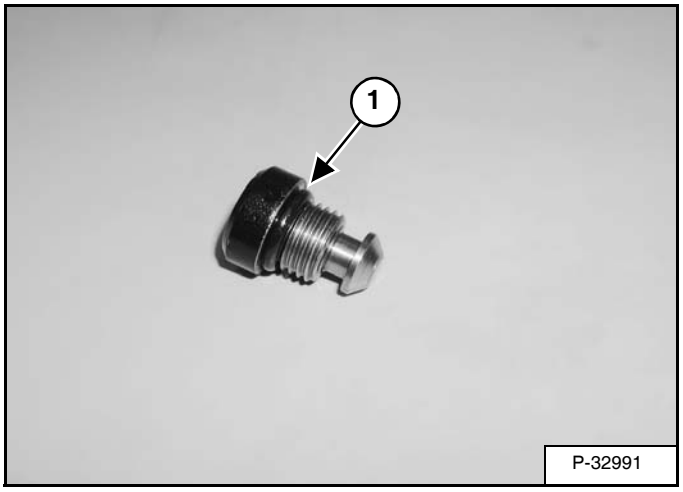


Remove the load check valve assembly (Item 1) **[Figure 20-41-18]**.

NOTE: The load check valve assembly is serviced only as a unit.

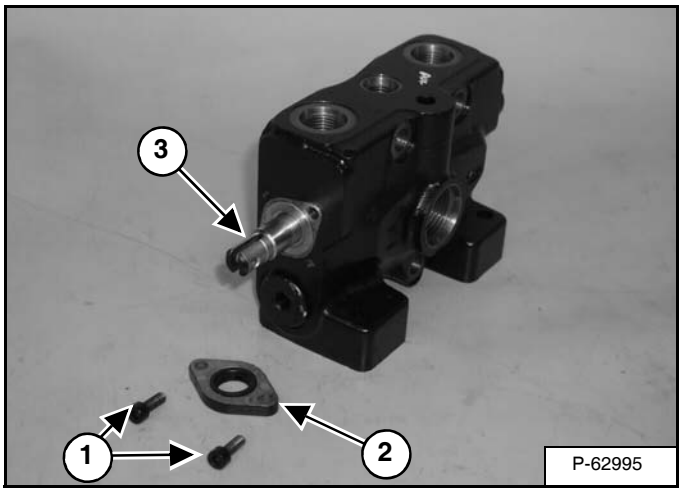
Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

Figure 20-41-19



Remove the O-ring (Item 1) **[Figure 20-41-19]** from the load check valve.

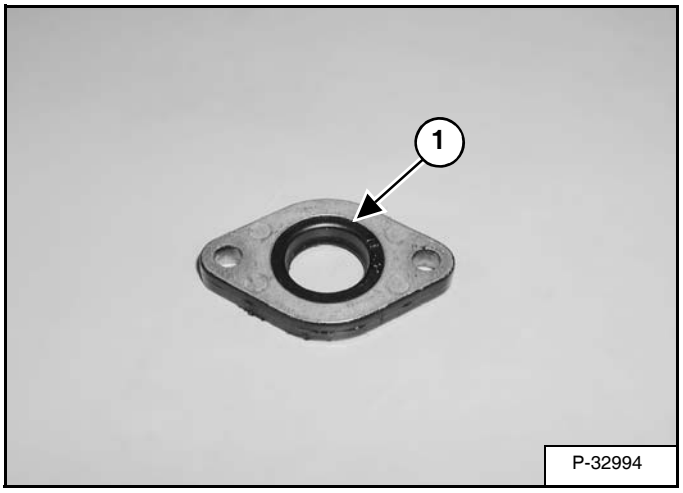
Figure 20-41-20



Remove the bolts (Item 1) and retaining plate (Item 2) from the actuating end of the spool (Item 3) **[Figure 20-41-20]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

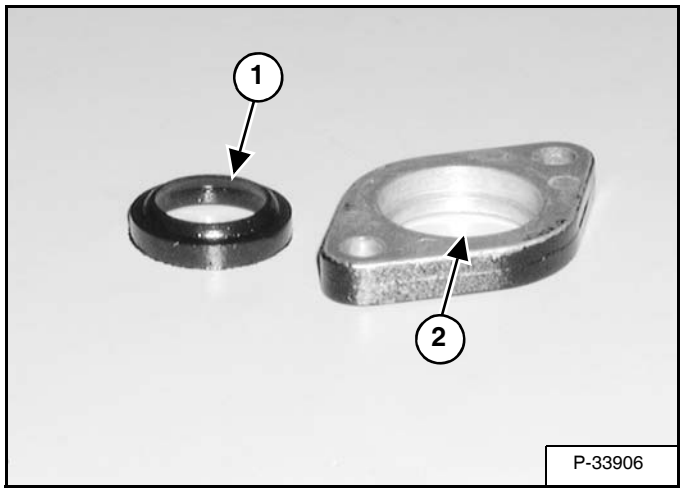
Figure 20-41-21



Remove the seal (Item 1) **[Figure 20-41-21]** from the retaining plate.

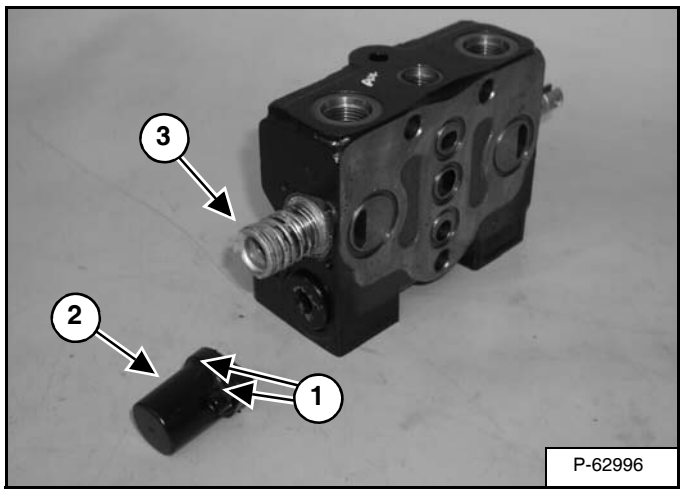
Auxiliary Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-22



Installation: Make sure the lip (Item 1) on the seal fits inside the lip on the retaining plate (Item 2) **[Figure 20-41-22]**.

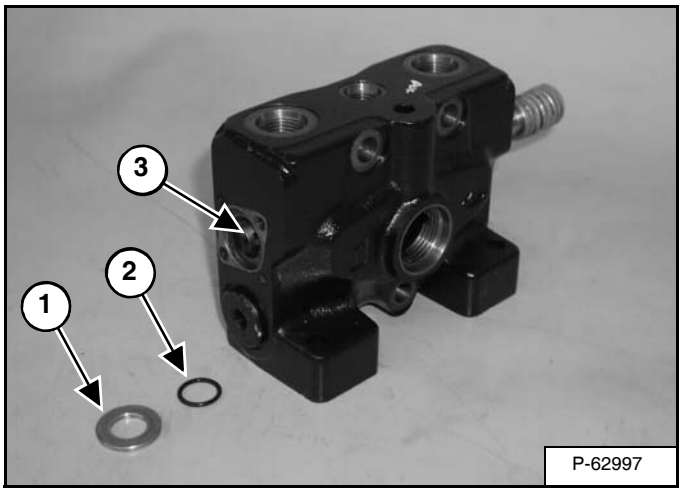
Figure 20-41-23



Remove the bolts (Item 1) and end cap (Item 2) from the spool (Item 3) **[Figure 20-41-23]**.

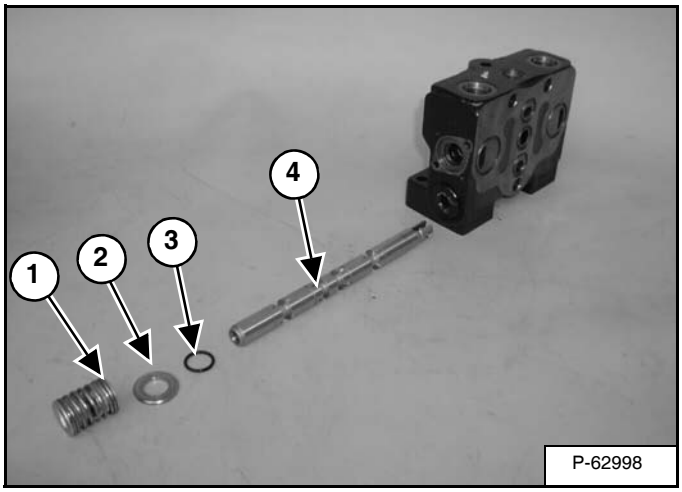
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-24



Remove the washer (Item 1) and O-ring (Item 2) from the actuating end of the spool (Item 3) **[Figure 20-41-24]**.

Figure 20-41-25



Remove the spring assembly (Item 1), washer (Item 2), O-ring (Item 3) and spool (Item 4) **[Figure 20-41-25]** from the auxiliary valve.

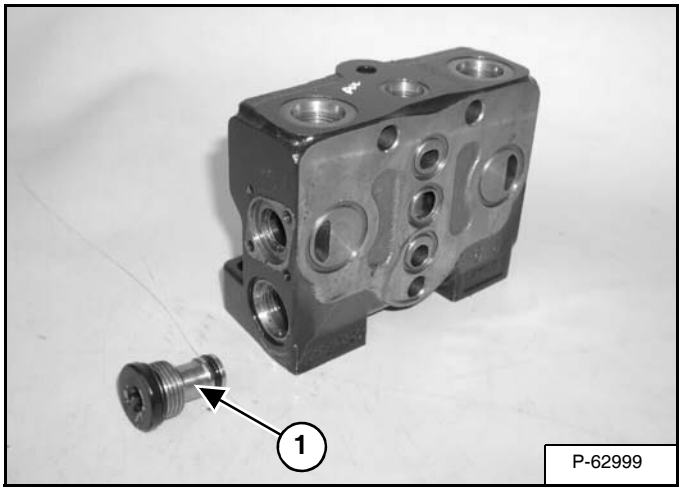
The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface and do not interchange spools and valve blocks.

Installation: Tighten the spring retaining bolt to 18 ft.-lb. (24 N•m) torque.

Auxiliary Valve Section Disassembly And Assembly (Cont'd)

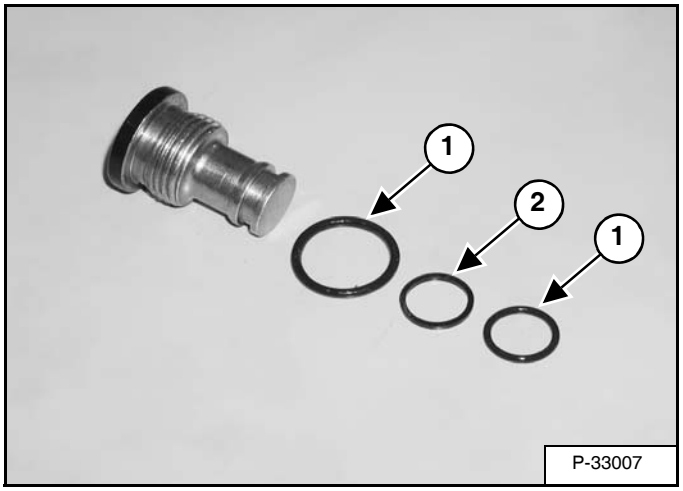
Figure 20-41-26



Remove the fitting (Item 1) **[Figure 20-41-26]** from the auxiliary valve.

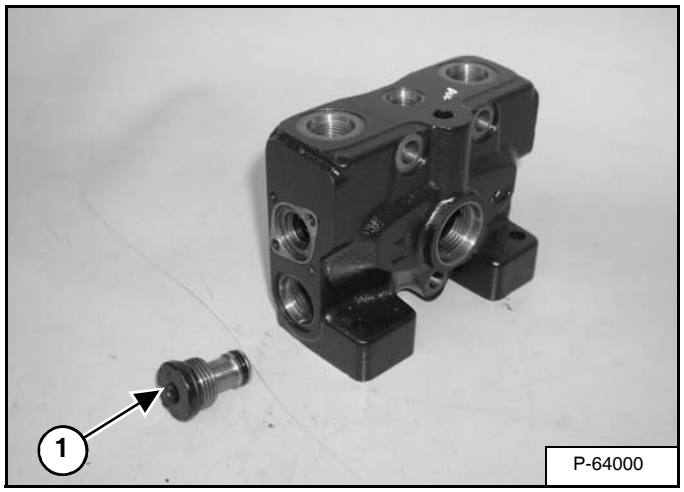
Installation: Tighten the fitting to 31 ft.-lb. (42 N•m) torque.

Figure 20-41-27



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-41-27]** from the plug.

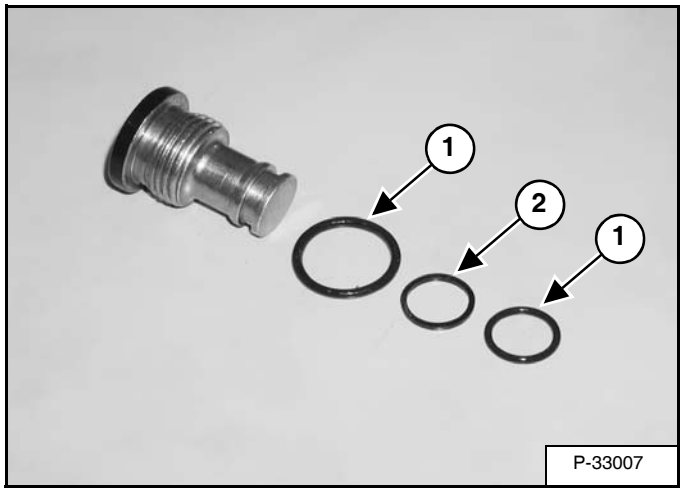
Figure 20-41-28



Remove the plug (Item 1) **[Figure 20-41-28]**.

Installation: Tighten the plug to 31 ft.-lb. (42 N•m) torque.

Figure 20-41-29



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-41-29]** from the plug.

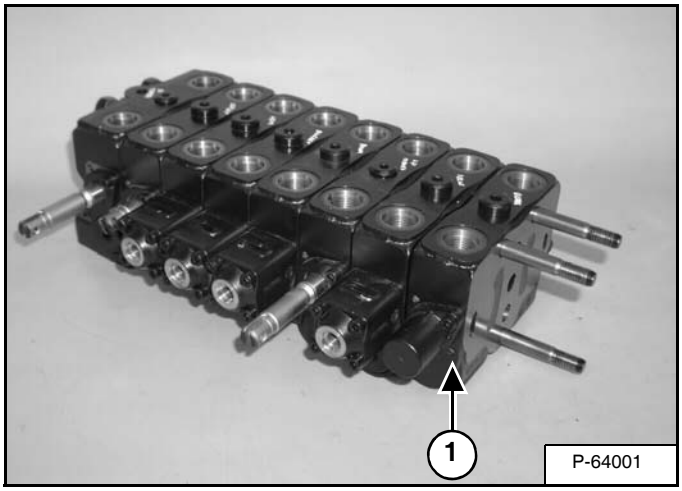
Blade Valve Section Disassembly And Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

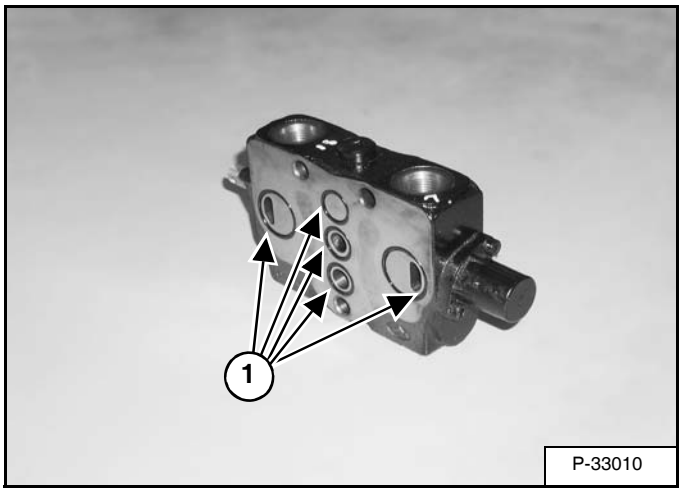
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-41-30



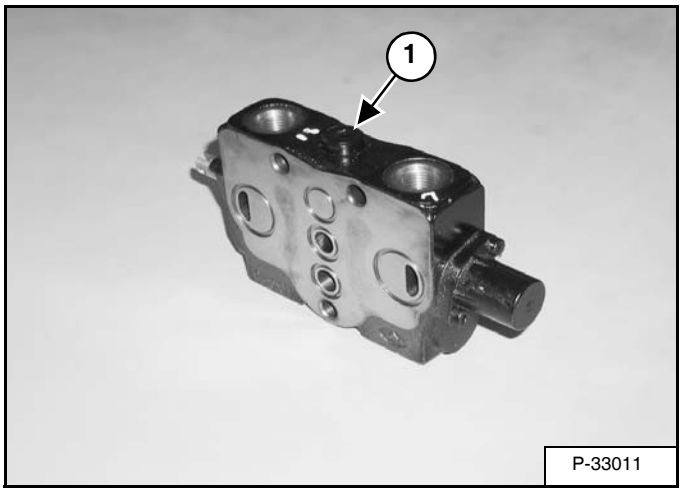
Remove the blade valve section (Item 1) **[Figure 20-41-30]** from the valve assembly.

Figure 20-41-31



Remove the O-rings (Item 1) **[Figure 20-41-31]** from the blade valve block.

Figure 20-41-32



Remove the load check valve (Item 1) **[Figure 20-41-32]**.

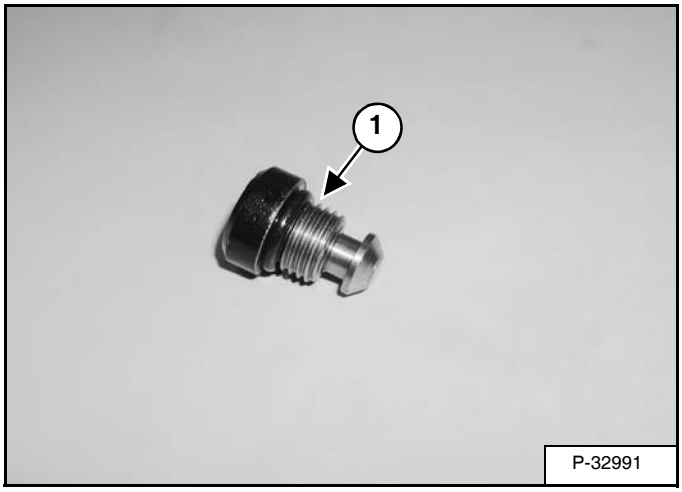
Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

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.

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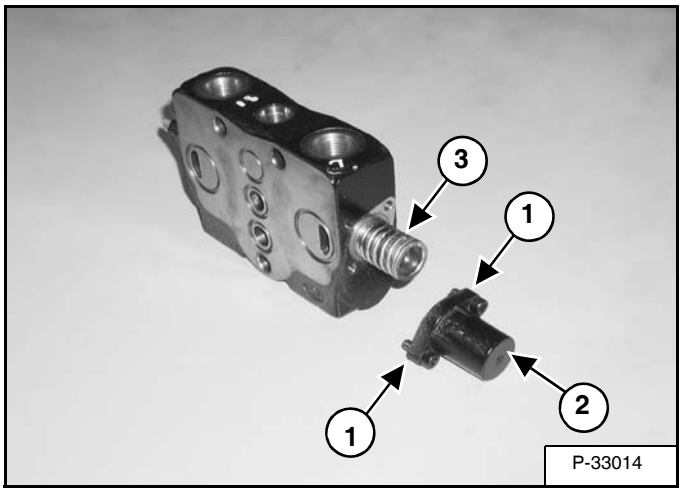
Figure 20-41-33



Remove the O-ring (Item 1) **[Figure 20-41-33]** from the load check valve.

Blade Valve Section Disassembly And Assembly (Cont'd)

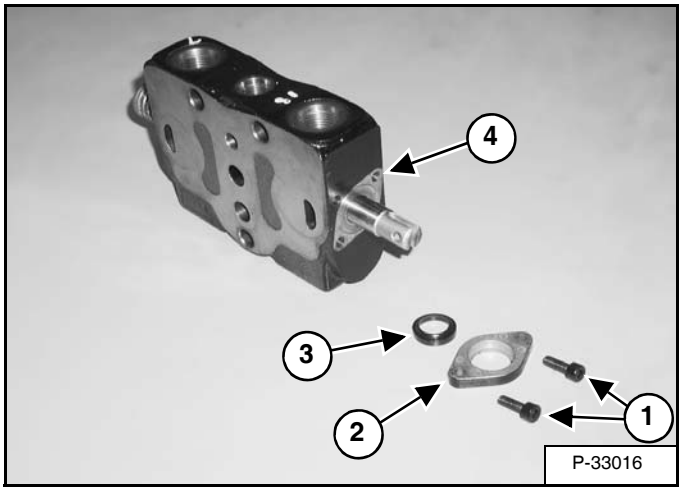
Figure 20-41-34



Remove the bolts (Item 1) and cover (Item 2) from the spool (Item 3) **[Figure 20-41-34]**.

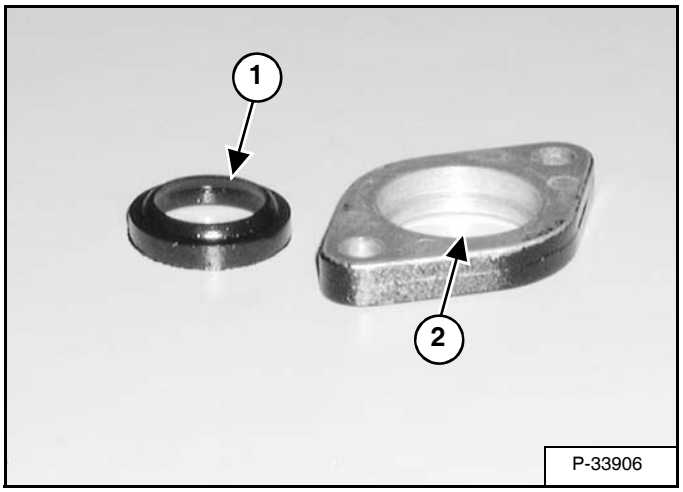
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-35



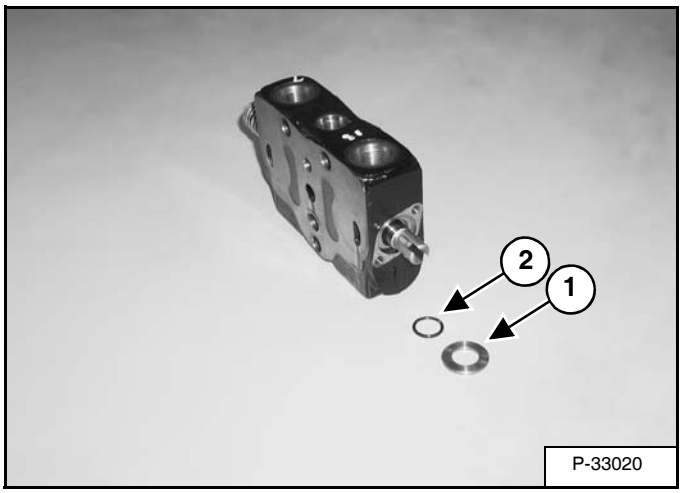
Remove the bolts (Item 1), spool retainer (Item 2) and seal (Item 3) from the actuating end of the spool (Item 4) **[Figure 20-41-35]**.

Figure 20-41-36



Installation: Make sure the lip (Item 1) on the seal fits inside the lip of the retainer (Item 2) **[Figure 20-41-36]**. Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

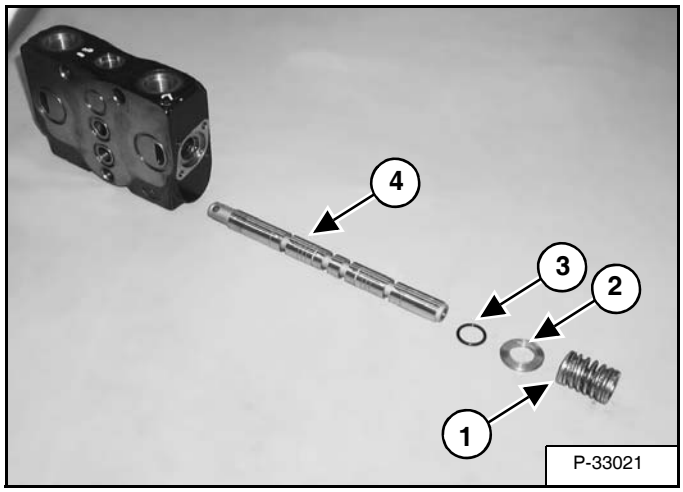
Figure 20-41-37



Remove the washer (Item 1) and O-ring (Item 2) **[Figure 20-41-37]**.

Blade Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-38



Remove the spring assembly (Item 1), washer (Item 2), O-ring (Item 3) and spool (Item 4) **[Figure 20-41-38]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Installation: Tighten the spring retaining bolt to 18 ft.-lb. (24 N•m) torque.

Slew Valve Section Disassembly And Assembly

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.

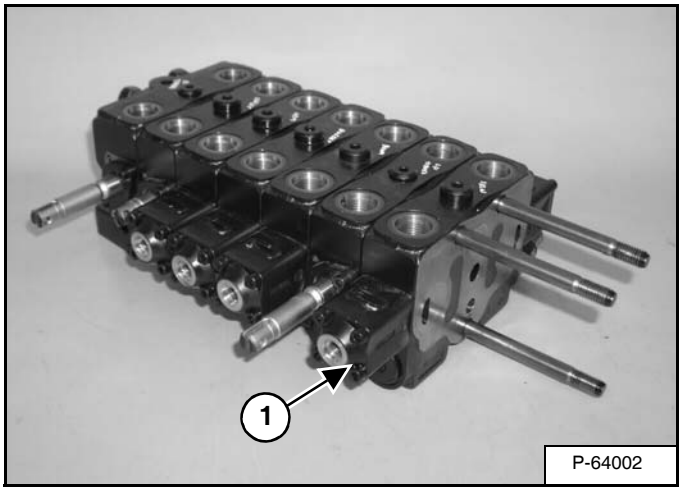
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

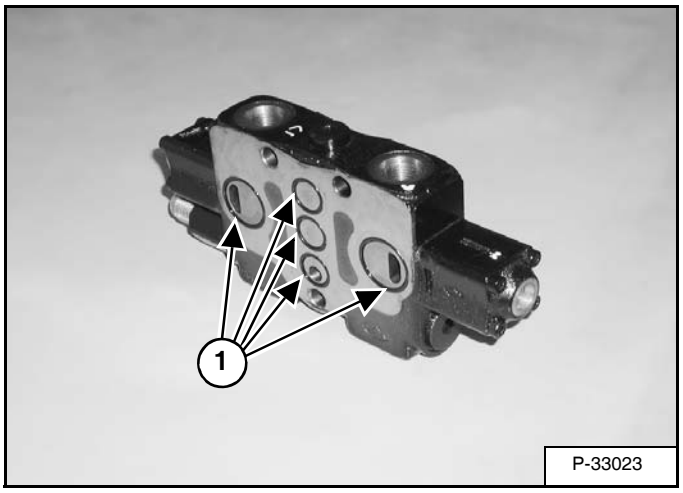
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-41-39



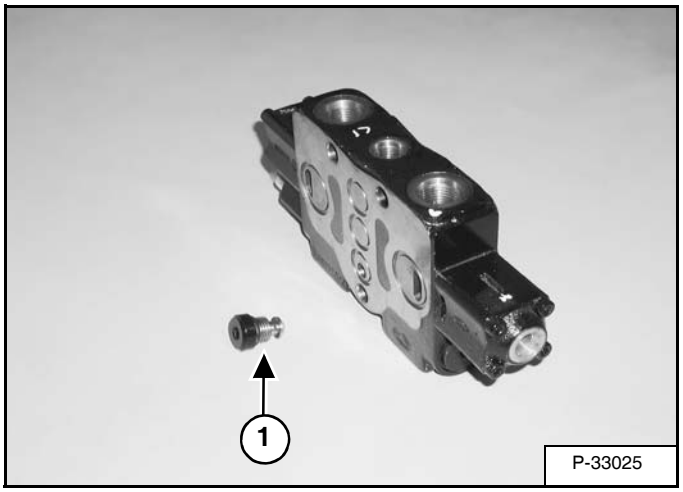
Remove the slew valve section (Item 1) **[Figure 20-41-39]** from the valve assembly.

Figure 20-41-40



Remove the O-rings (Item 1) **[Figure 20-41-40]** from the slew valve block.

Figure 20-41-41

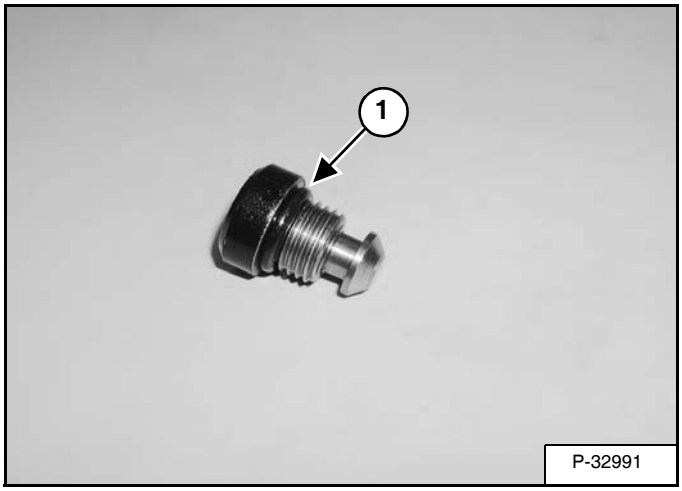


Remove the load check valve (Item 1) **[Figure 20-41-41]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

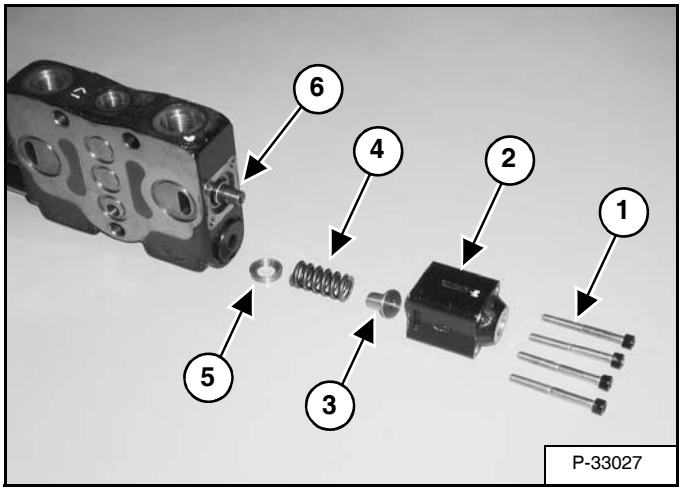
Slew Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-42



Remove the O-ring (Item 1) **[Figure 20-41-42]** from the load check valve.

Figure 20-41-43

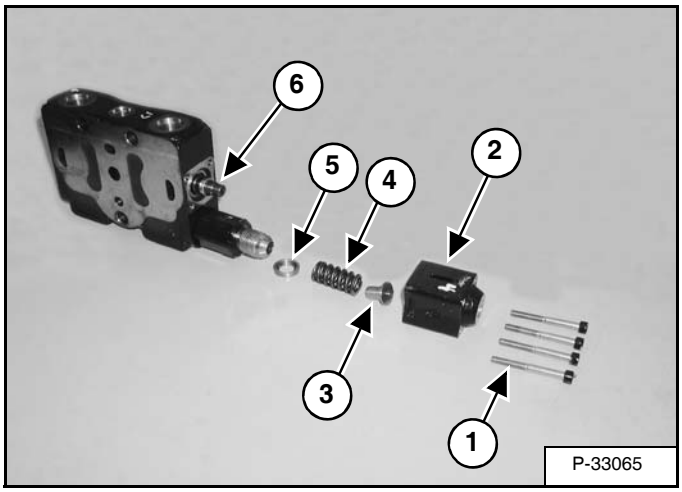


Remove the bolts (Item 1), actuator (Item 2), spring retainer (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-41-43]**.

NOTE: Install the lip of the spring retainer (Item 5) over the spool (Item 6) [Figure 20-41-43].

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-44



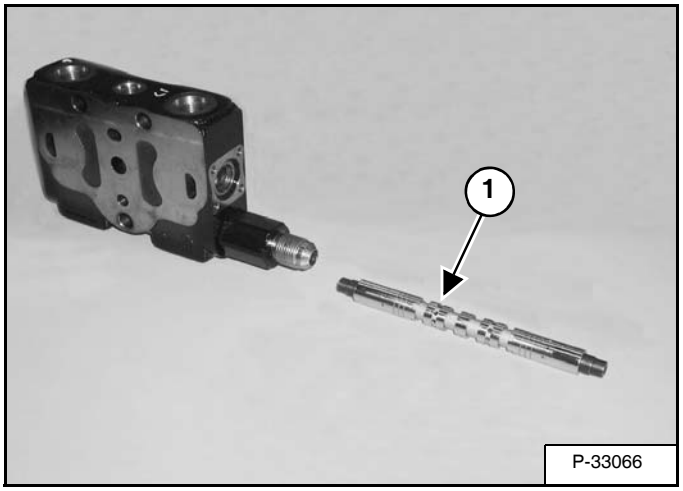
Remove the bolts (Item 1), spool cover (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-41-44]**.

NOTE: Install the lip of the spring retainer (Item 5) over the spool (Item 6) [Figure 20-41-44].

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Slew Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-45

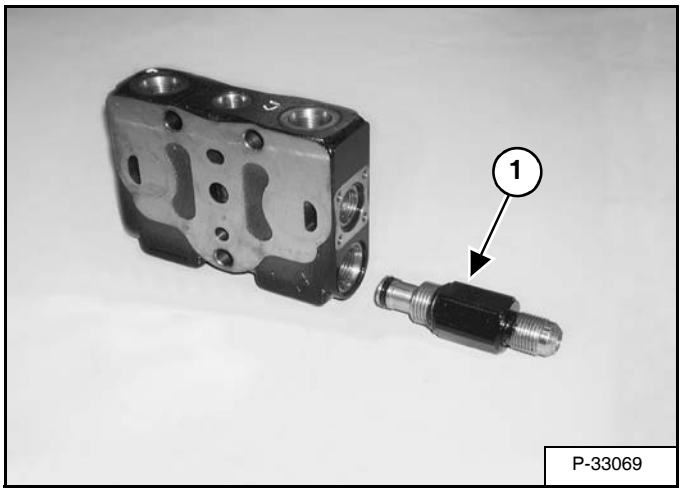


Remove the spool (Item 1) **[Figure 20-41-45]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface and do not interchange spools and valve blocks.

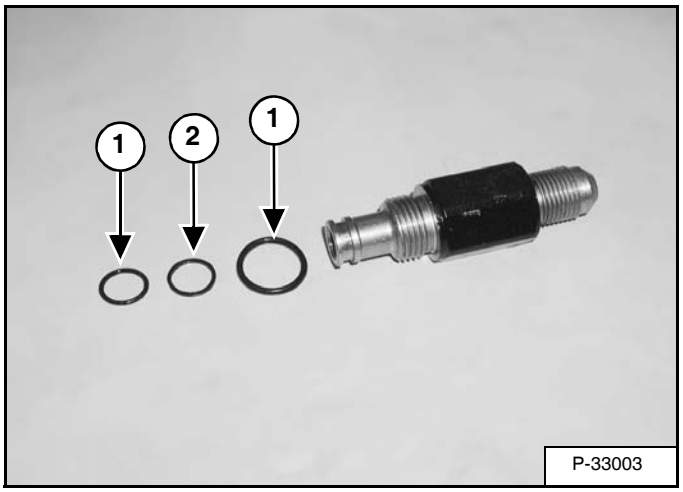
Figure 20-41-46



Remove the fitting (Item 1) **[Figure 20-41-46]**.

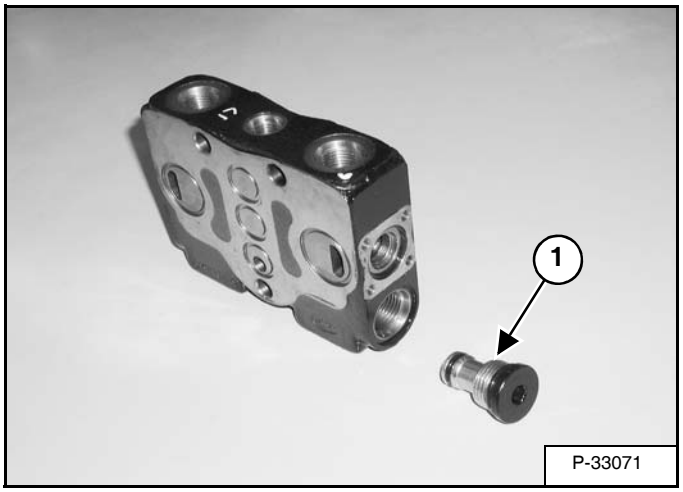
Installation: Tighten the fitting to 31 ft.-lb. (42 N•m) torque.

Figure 20-41-47



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-41-47]** from the fitting.

Figure 20-41-48

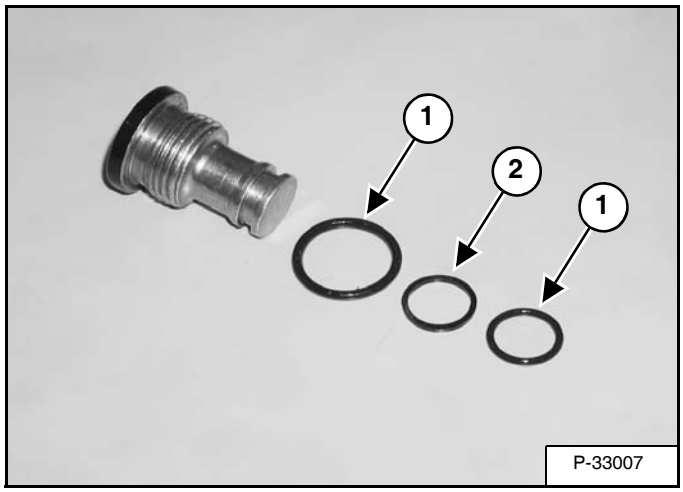


Remove the plug (Item 1) [**[Figure 20-41-48]**

Installation: Tighten the plug to 31 ft.-lb. (42 N•m) torque.

Slew Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-49



Remove the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-41-49]** from the plug.

Left Travel Valve Section Disassembly And Assembly

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.

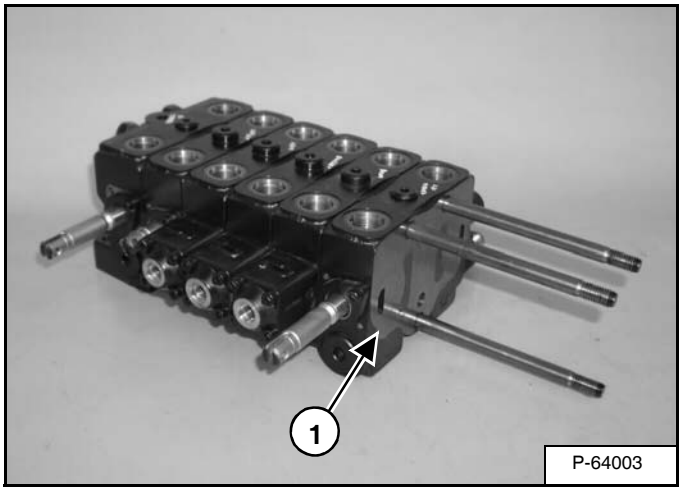
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

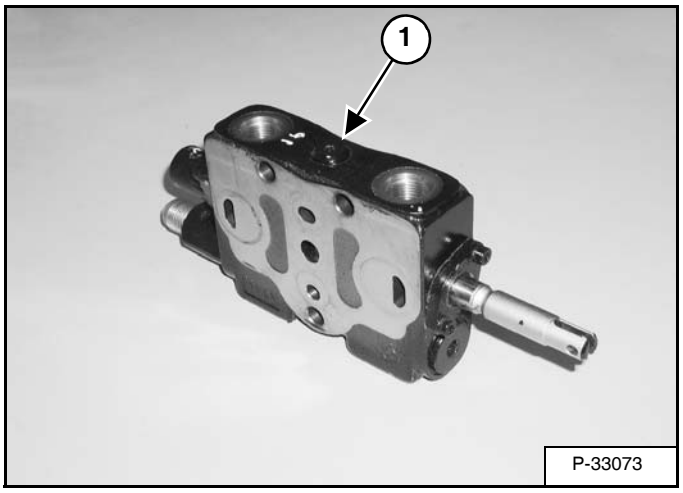
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-41-50



Remove the left travel valve section (Item 1) **[Figure 20-41-50]** from the valve assembly.

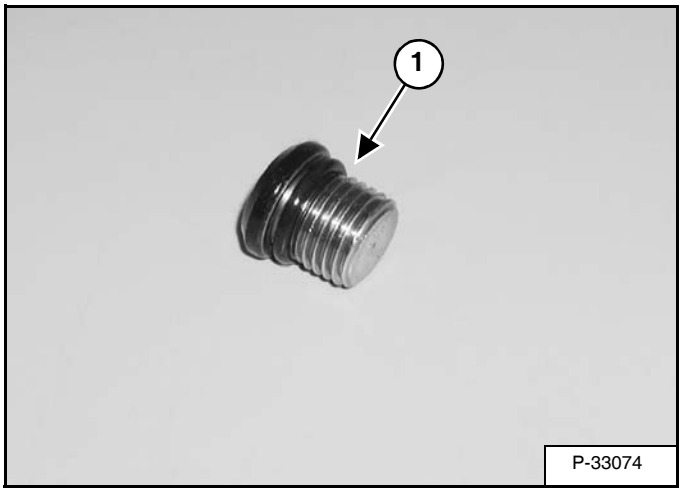
Figure 20-41-51



Remove the plug (Item 1) **[Figure 20-41-51]** from the left travel valve block.

Installation: Tighten the plug to 18 ft.-lb. (24 N•m) torque.

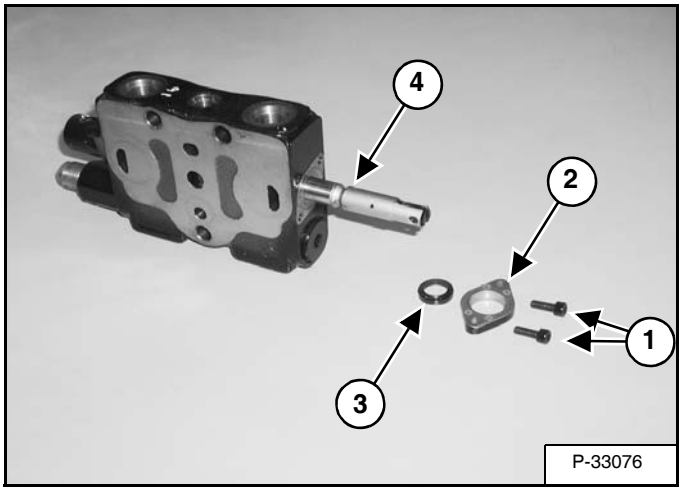
Figure 20-41-52



Remove the O-ring (Item 1) **[Figure 20-41-52]** from the plug.

Left Travel Valve Section Disassembly And Assembly (Cont'd)

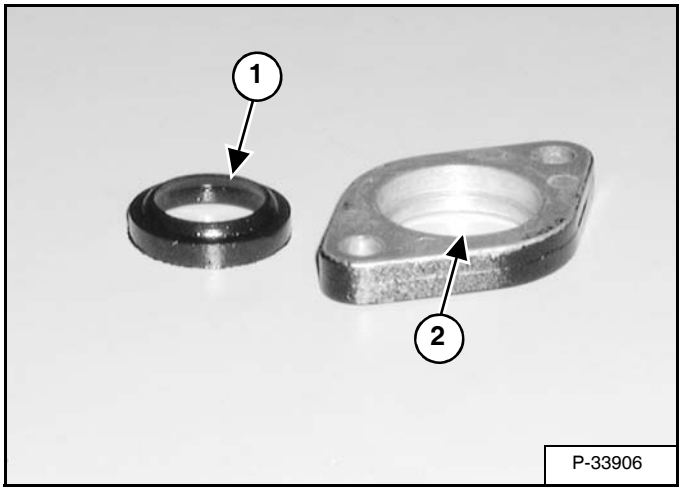
Figure 20-41-53



Remove the bolts (Item 1) retainer (Item 2) and seal (Item 3) from the spool (Item 4) **[Figure 20-41-53]**.

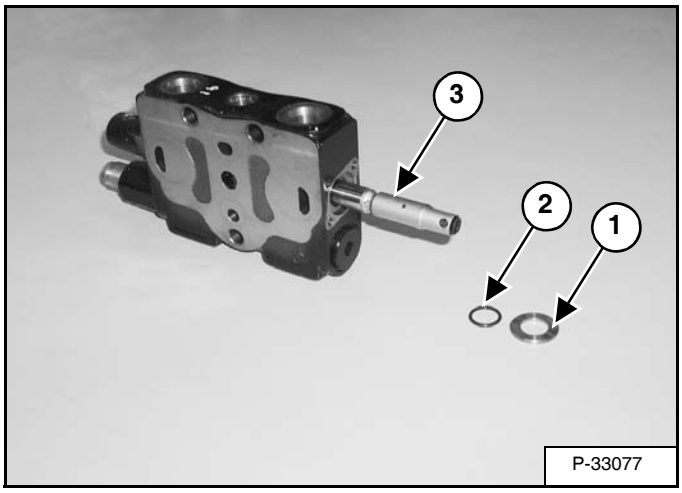
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-54



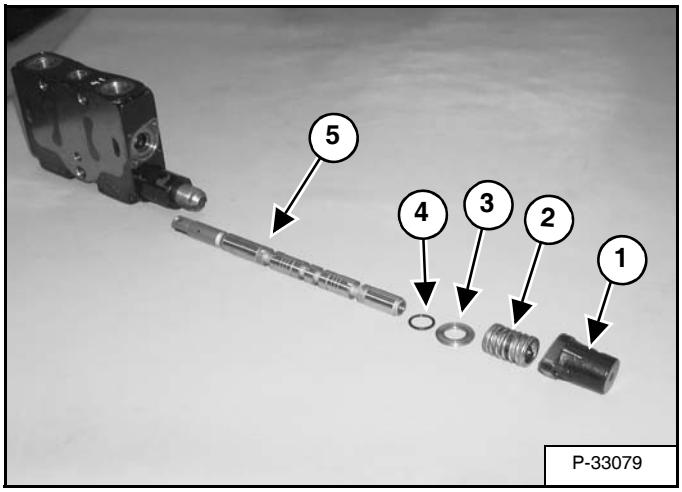
Installation: Make sure the lip (Item 1) of the seal fits inside the retainer (Item 2) **[Figure 20-41-54]**.

Figure 20-41-55



Remove the washer (Item 1) and O-ring (Item 2) from the actuating end of the spool (Item 3) **[Figure 20-41-55]**.

Figure 20-41-56



Remove the cap and bolts (Item 1) spring assembly (Item 2), washer (Item 3), O-ring (Item 4) and spool (Item 5) **[Figure 20-41-56]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

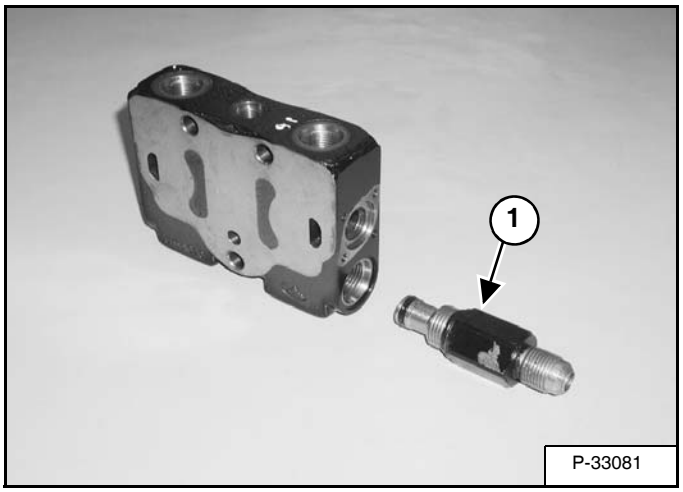
The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Installation: Tighten the spring assembly (Item 2) **[Figure 20-41-56]** to 18 ft.-lb. (24 N•m) torque.

Left Travel Valve Section Disassembly And Assembly (Cont'd)

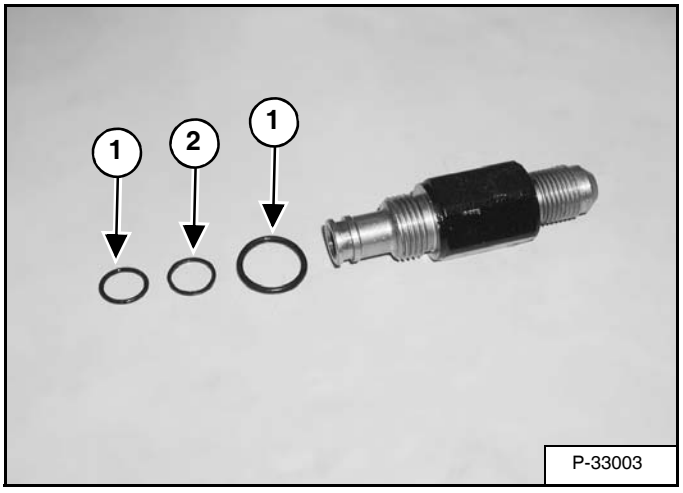
Figure 20-41-57



Remove the fitting (Item 1) **[Figure 20-41-57]**.

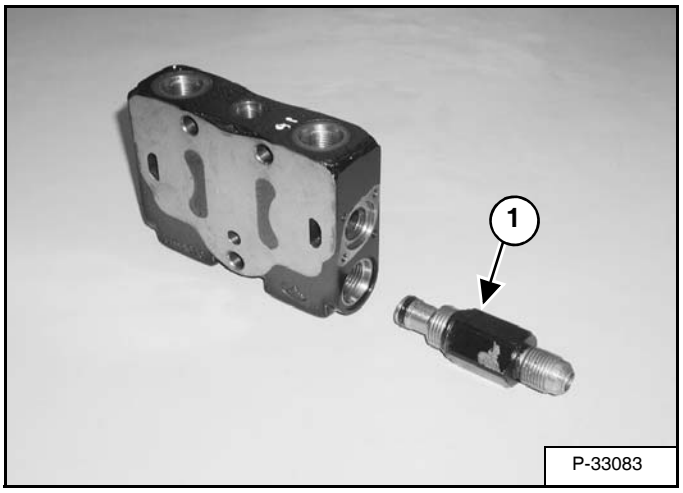
Installation: Tighten the fitting to 31 ft.-lb. (42 N•m) torque.

Figure 20-41-58



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-41-58]** from the fitting.

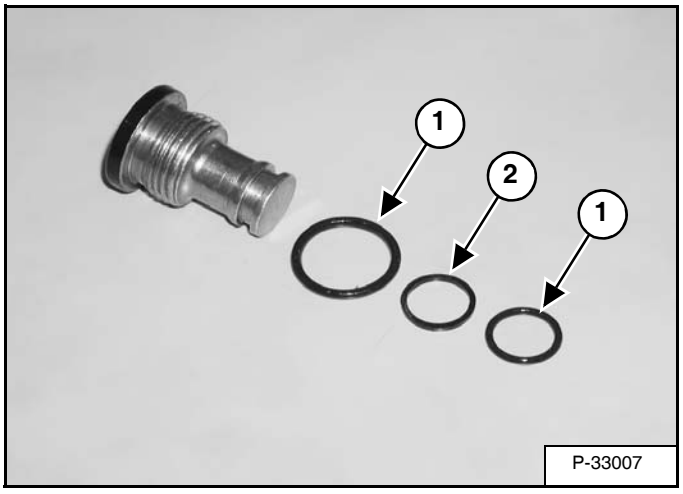
Figure 20-41-59



Remove the plug (Item 1) **[Figure 20-41-59]**.

Installation: Tighten the plug to 31 ft.-lb. (42 N•m) torque.

Figure 20-41-60



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-41-60]** from the plug.

Boom Valve Section Disassembly And Assembly

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.

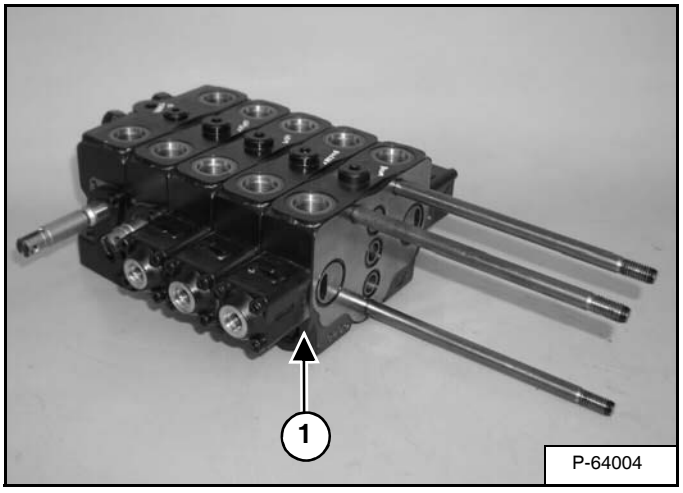
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

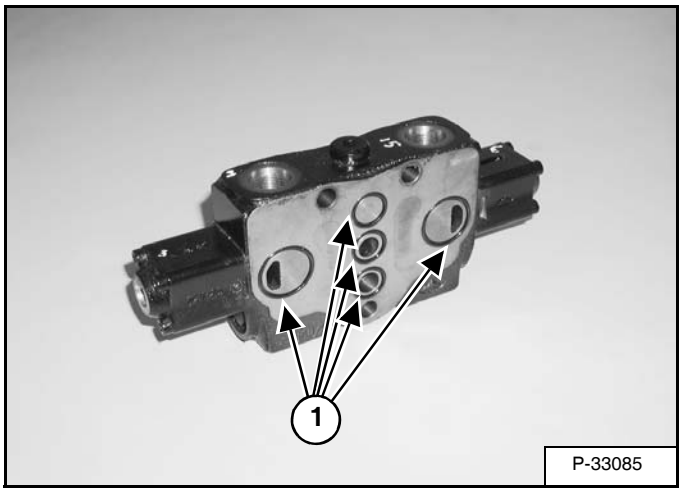
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-41-61



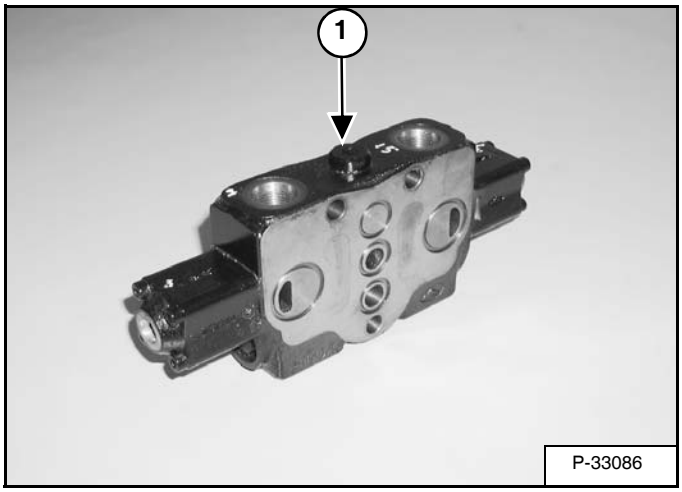
Remove the boom valve section (Item 1) **[Figure 20-41-61]** from the valve assembly.

Figure 20-41-62



Remove the O-rings (Item 1) **[Figure 20-41-62]** from the boom valve block.

Figure 20-41-63

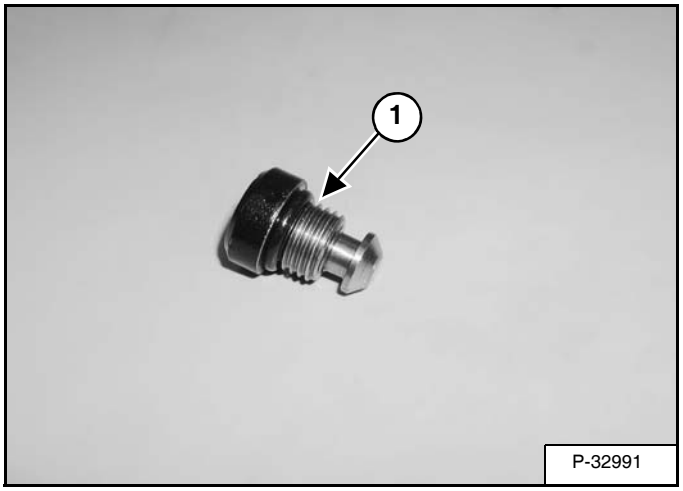


Remove the load check valve (Item 1) **[Figure 20-41-63]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

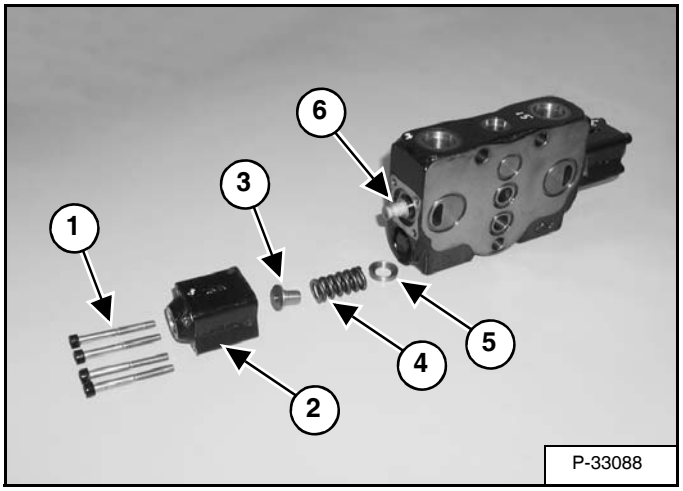
Boom Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-64



Remove the O-ring (Item 1) **[Figure 20-41-64]** from the load check valve.

Figure 20-41-65

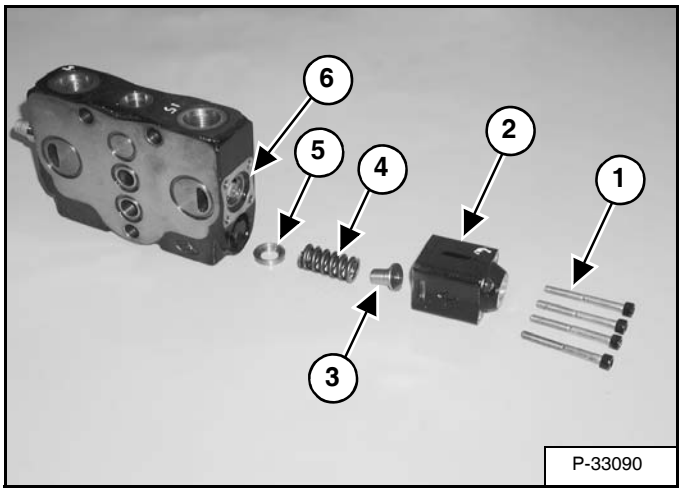


Remove the bolts (Item 1), spool cover (Item 2), spring retainer (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-41-65]**.

Installation: Install the lip of the spring retainer (Item 5) over the spool (Item 6) **[Figure 20-41-65]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-66

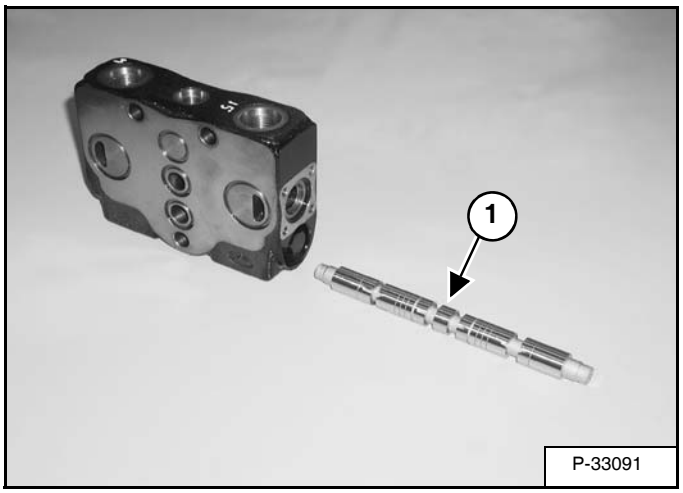


Remove the bolts (Item 1), spool cover (Item 2), spring retainer (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-41-66]**.

Installation: Make sure the lip on the spring retainer (Item 5) fits over the spool (Item 6) **[Figure 20-41-66]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-67



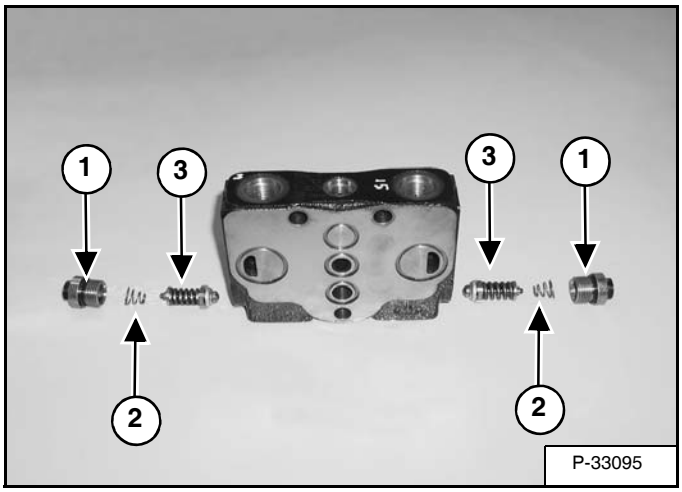
Remove the spool (Item 1) **[Figure 20-41-67]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Boom Valve Section Disassembly And Assembly (Cont'd)

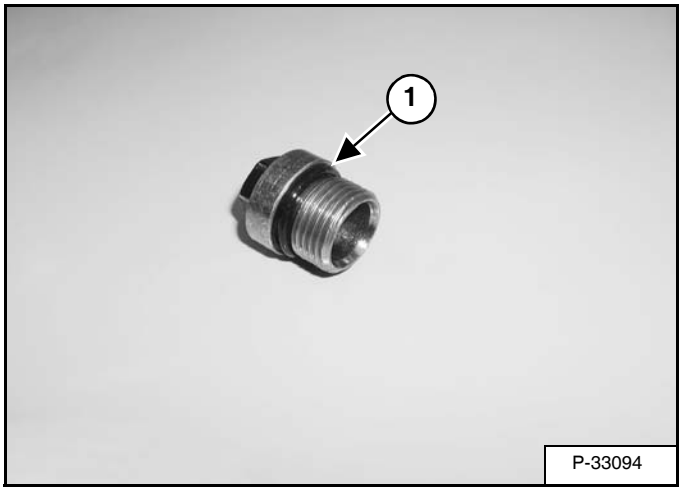
Figure 20-41-68



Remove the plug (Item 1), spring (Item 2) and spring assembly (Item 3) **[Figure 20-41-68]** from both relief valves.

Installation: Tighten the plugs to 18 ft.-lb. (24 N•m) torque.

Figure 20-41-69



Remove the O-ring (Item 1) **[Figure 20-41-69]** from the plug.

Bucket Valve Section Disassembly And Assembly

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.

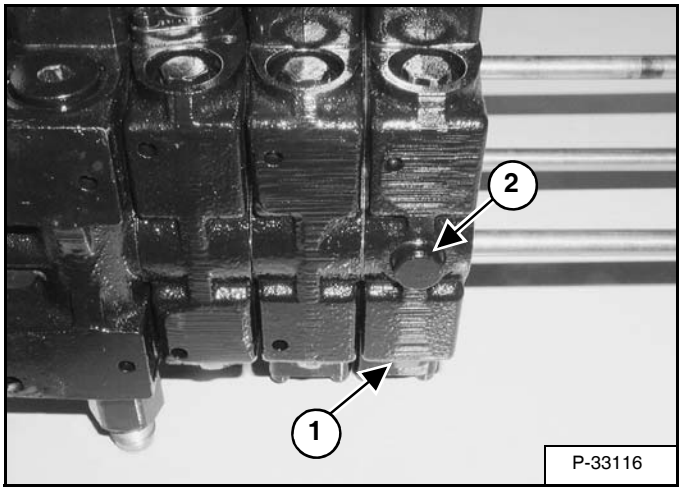
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

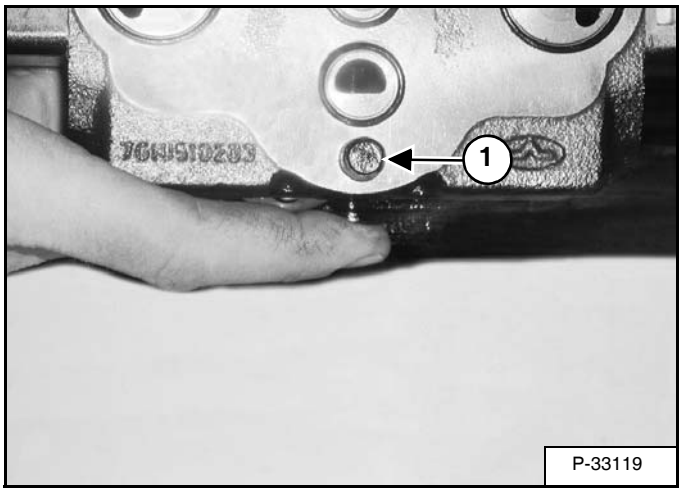
Figure 20-41-70



Remove the bucket valve section (Item 1) from the valve assembly by depressing the buildup valve (Item 2) **[Figure 20-41-70]** and sliding the valve section off the tie rods.

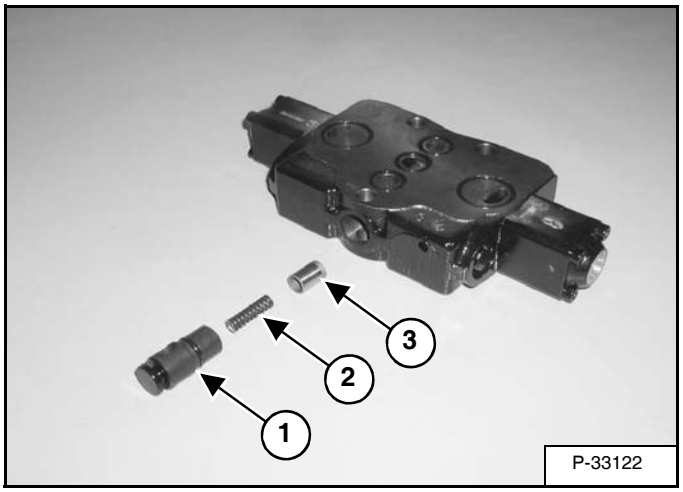
NOTE: Use care while removing the bucket valve section. The buildup valve is spring loaded.

Figure 20-41-71



Installation: Align the hole in the buildup valve with the hole (Item 1) **[Figure 20-41-71]** in the bucket valve section. Fully depress the buildup valve and slide the bucket valve section on the tie rods.

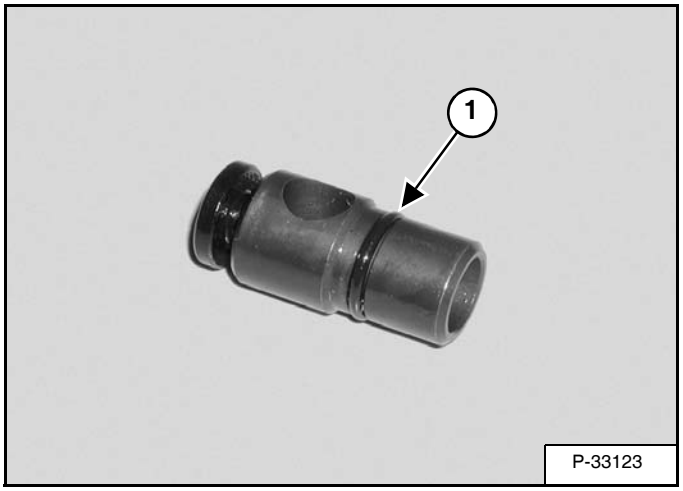
Figure 20-41-72



Remove the buildup valve (Item 1), spring (Item 2) and piston (Item 3) **[Figure 20-41-72]**.

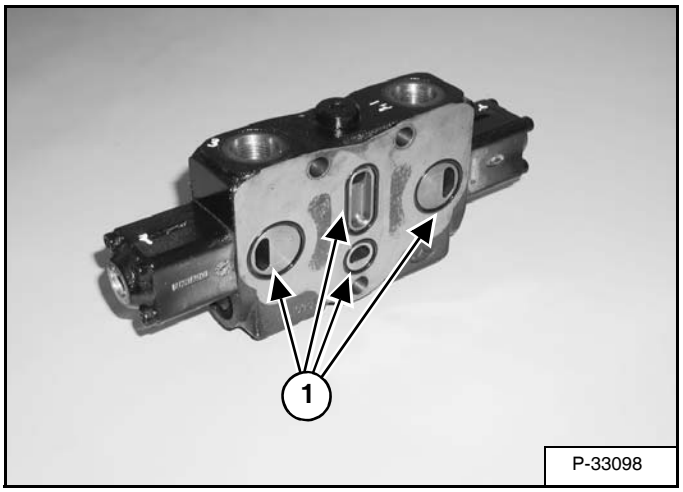
Bucket Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-73



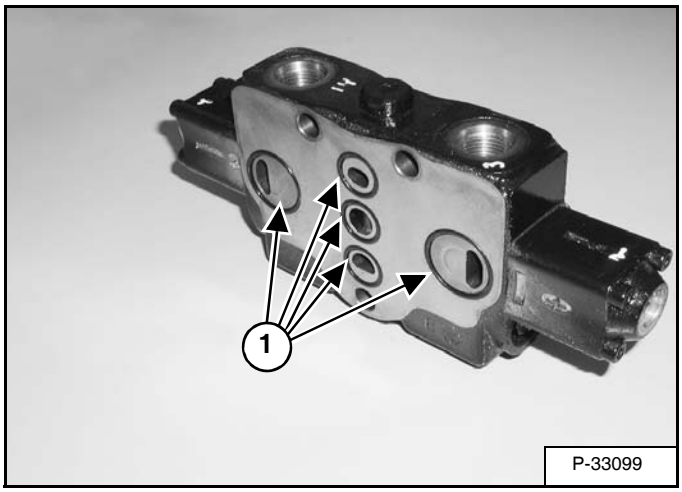
Remove the O-ring (Item 1) **[Figure 20-41-73]**.

Figure 20-41-74



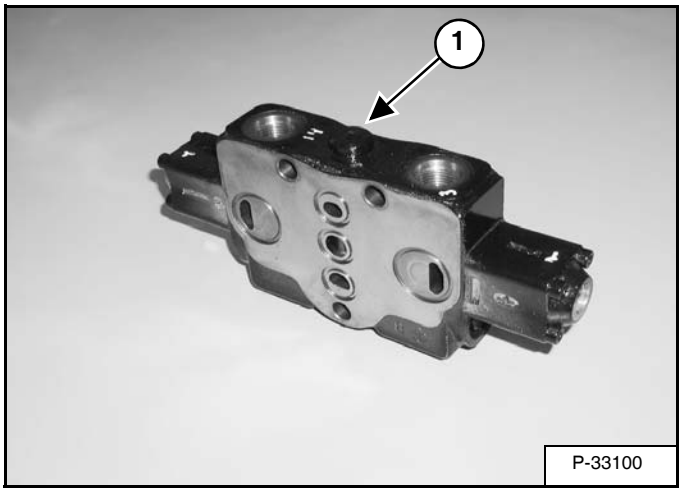
Remove the O-rings (Item 1) **[Figure 20-41-74]** from the side of the bucket valve section.

Figure 20-41-75



Remove the O-rings (Item 1) **[Figure 20-41-75]** from the opposite side of the bucket valve section.

Figure 20-41-76

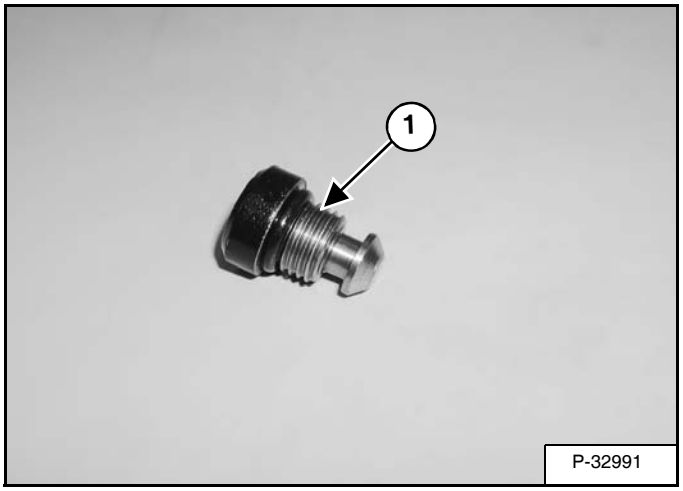


Remove the load check valve (Item 1) **[Figure 20-41-76]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

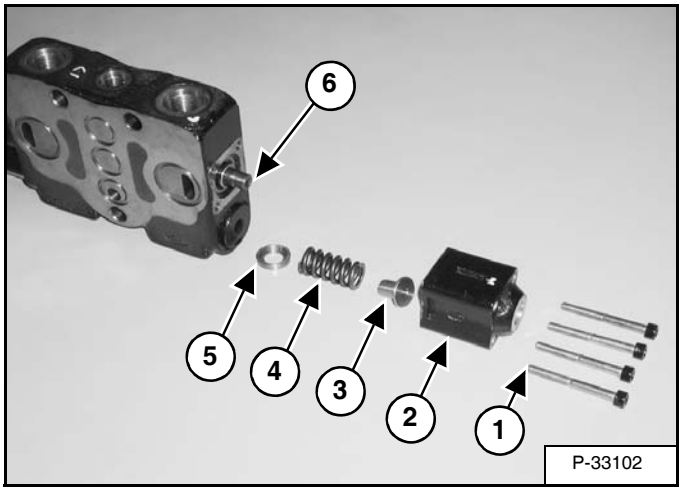
Bucket Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-77



Remove the O-ring (Item 1) **[Figure 20-41-77]** from the load check valve.

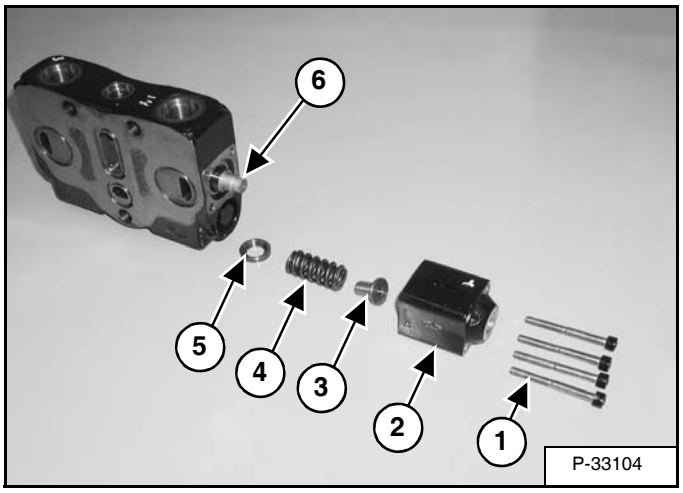
Figure 20-41-78



Remove the bolts (Item 1), spool cover (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-41-78]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-79

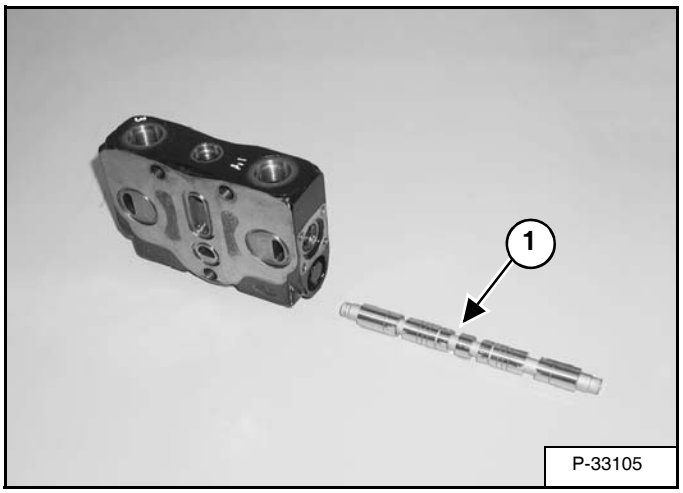


Remove the bolts (Item 1), actuator (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-41-79]**.

Installation: Install the lip of the spring retainer (Item 5) over the spool (Item 6) **[Figure 20-41-79]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-80



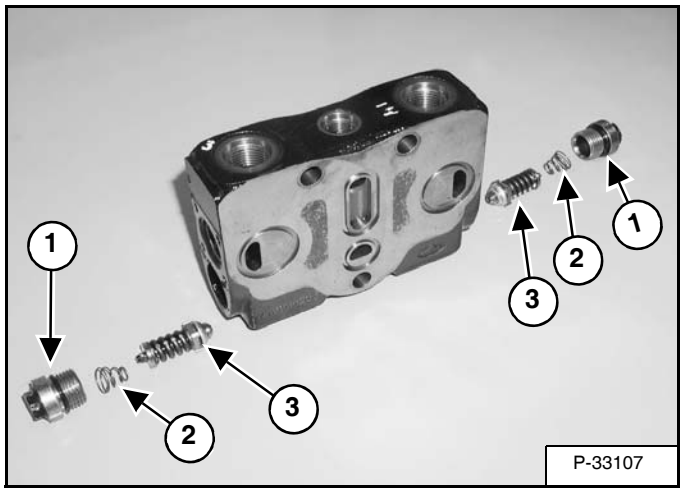
Remove the spool (Item 1) **[Figure 20-41-80]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Bucket Valve Section Disassembly And Assembly (Cont'd)

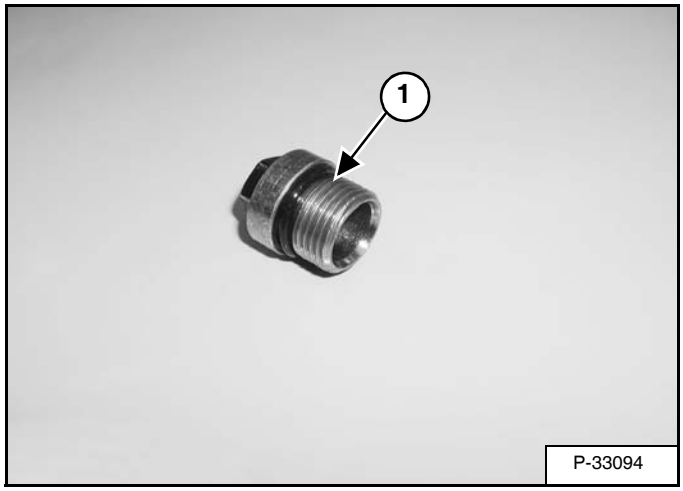
Figure 20-41-81



Remove the plug (Item 1), spring (Item 2) and valve assembly (Item 3) **[Figure 20-41-81]** from both relief valves.

Installation: Tighten the plugs to 8 ft.-lb. (24 N•m) torque.

Figure 20-41-82



Remove the O-ring (Item 1) **[Figure 20-41-82]** from both plugs.

Arm Valve Section Disassembly And Assembly

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.

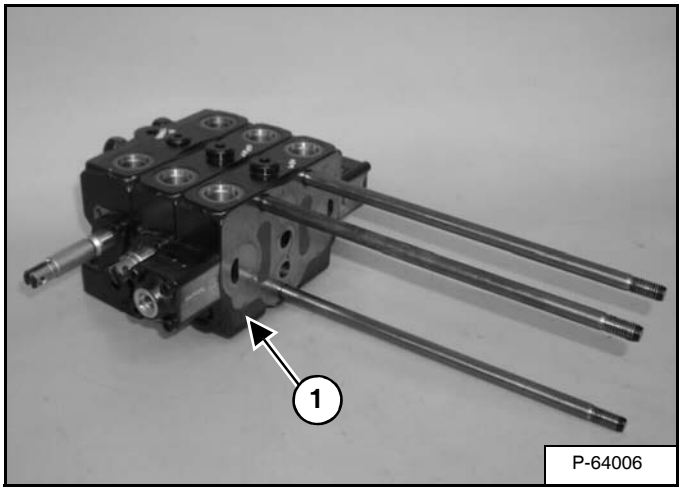
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

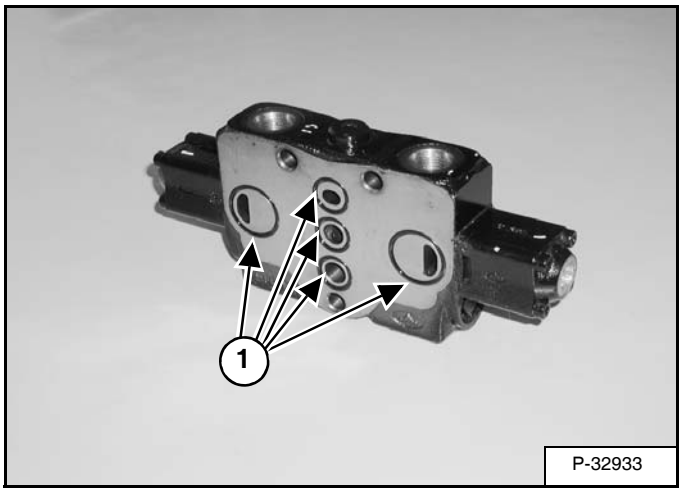
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-41-83



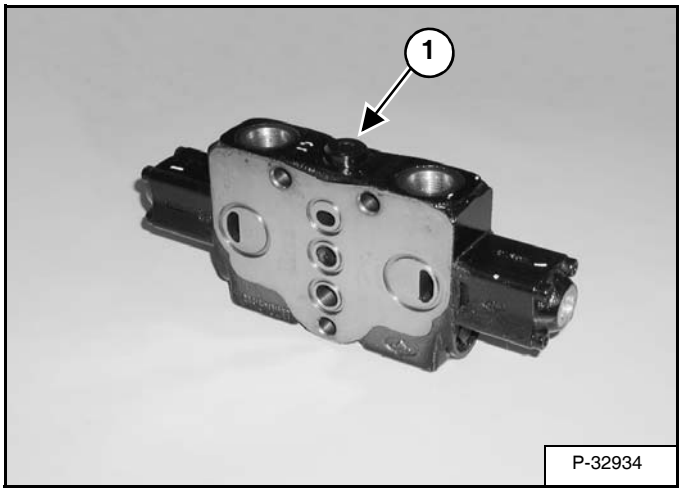
Remove the arm valve section (Item 1) **[Figure 20-41-83]** from the valve assembly.

Figure 20-41-84



Remove the O-rings (Item 1) **[Figure 20-41-84]** from the arm valve block.

Figure 20-41-85

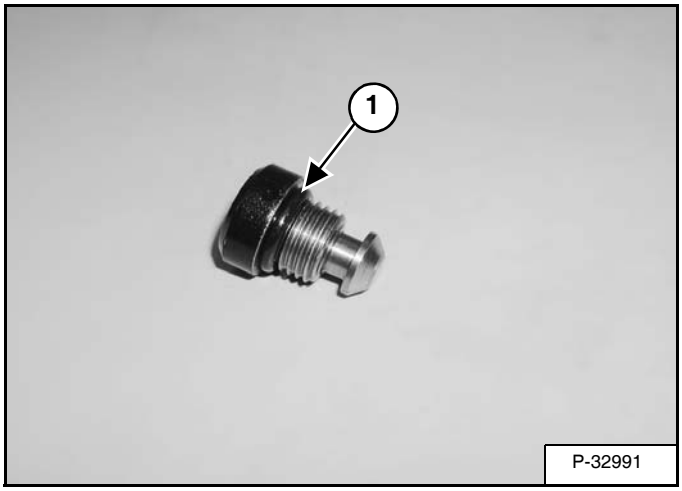


Remove the load check valve (Item 1) **[Figure 20-41-85]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

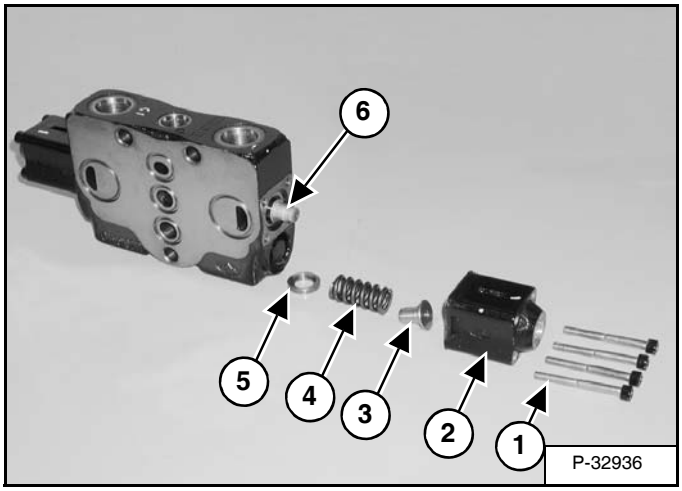
Arm Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-86



Remove the O-ring (Item 1) **[Figure 20-41-86]** from the load check valve.

Figure 20-41-87

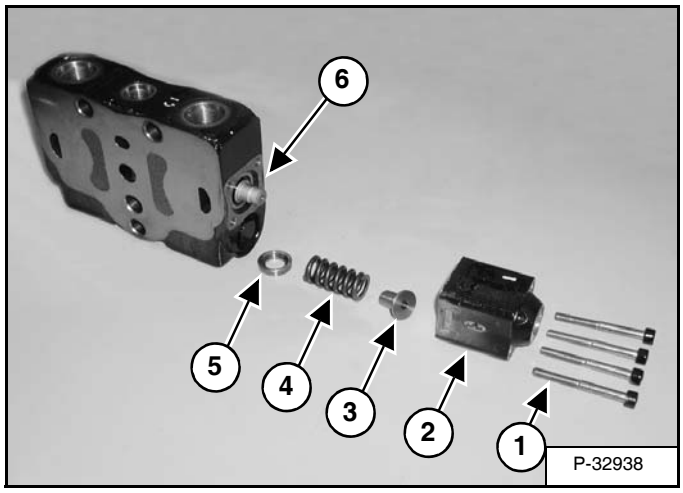


Remove the bolts (Item 1) spool cover (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-41-87]**.

Installation: Install the lip of the spring retainer (Item 5) over the spool (Item 6) **[Figure 20-41-87]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-88

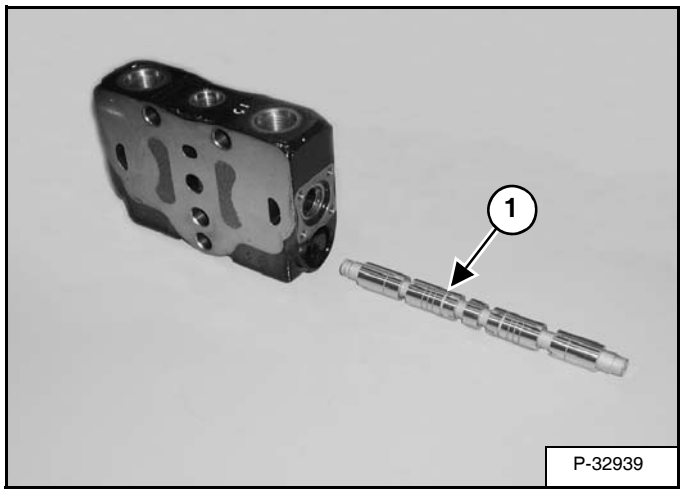


Remove the bolts (Item 1), spool cover (Item 2), spring seat (Item 3), spring (Item 4) and spring retainer (Item 5) **[Figure 20-41-88]**.

Installation: Install the lip of the spring retainer (Item 5) over the spool (Item 6) **[Figure 20-41-88]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-89



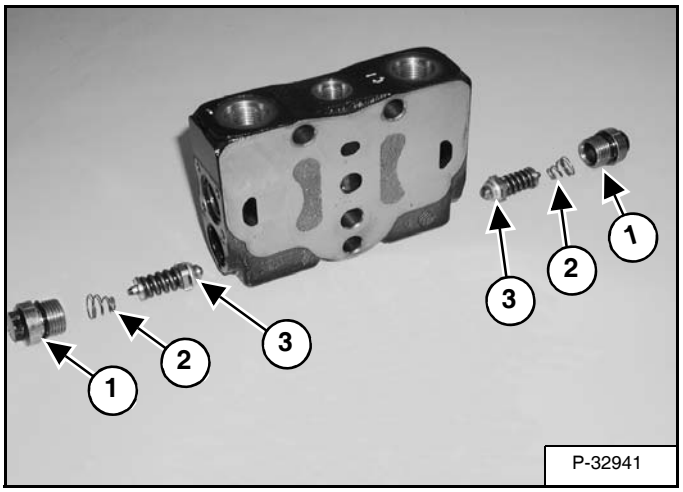
Remove the spool (Item 1) **[Figure 20-41-89]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Arm Valve Section Disassembly And Assembly (Cont'd)

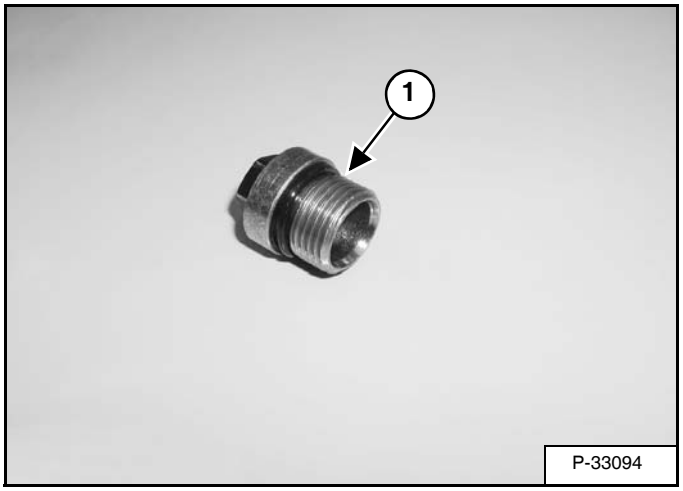
Figure 20-41-90



Remove the plug (Item 1), spring (Item 2) and relief valve assemblies (Item 3) **[Figure 20-41-90]** from both relief valves.

Installation: Tighten the plugs to 18 ft.-lb. (24 N•m) torque.

Figure 20-41-91



Remove the O-ring (Item 1) **[Figure 20-41-91]** from the plugs.

Boom Swing Valve Section Disassembly And Assembly

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.

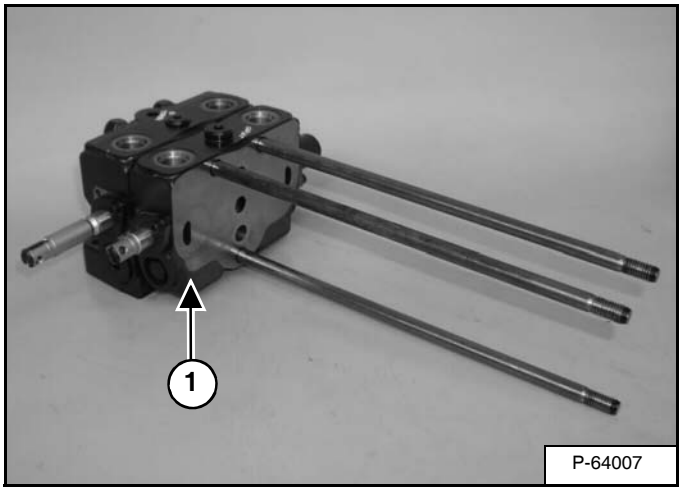
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

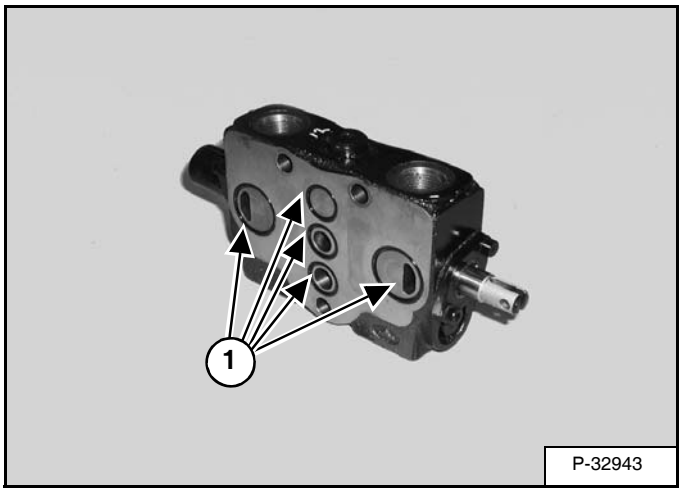
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-41-92



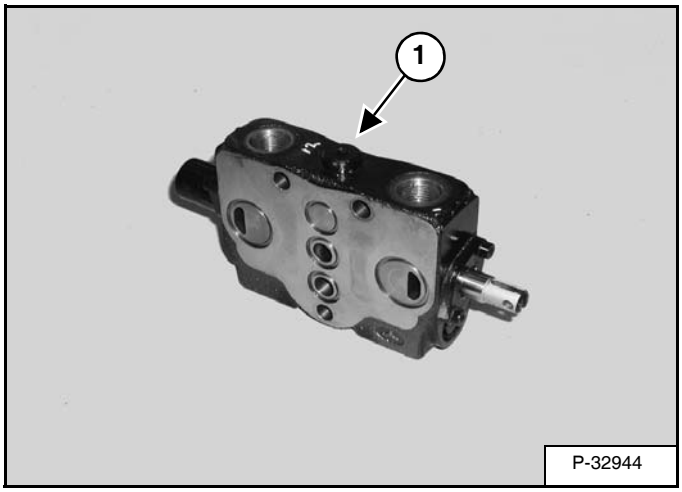
Remove the boom swing valve section (Item 1) **[Figure 20-41-92]** from the valve assembly.

Figure 20-41-93



Remove the O-rings (Item 1) **[Figure 20-41-93]** from the boom swing valve block.

Figure 20-41-94

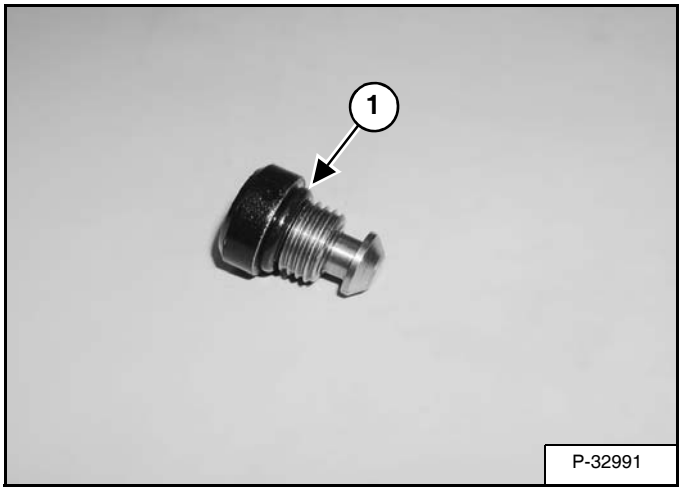


Remove the load check valve (Item 1) **[Figure 20-41-94]**.

Installation: Tighten the load check valve to 18 ft.-lb. (24 N•m) torque.

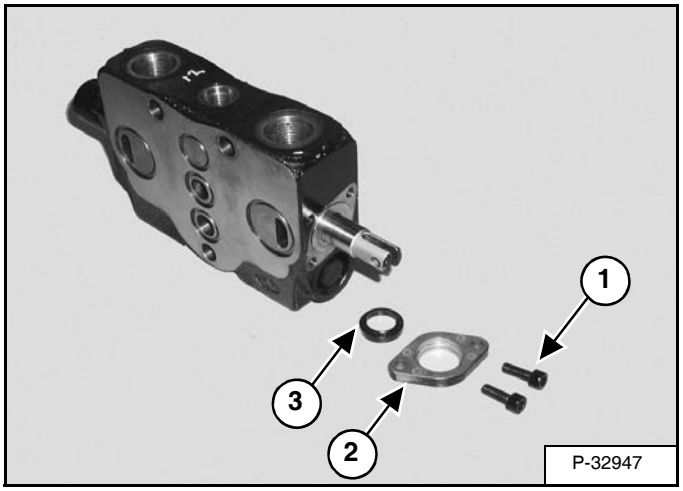
Boom Swing Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-95



Remove the O-ring (Item 1) **[Figure 20-41-95]** from the load check valve.

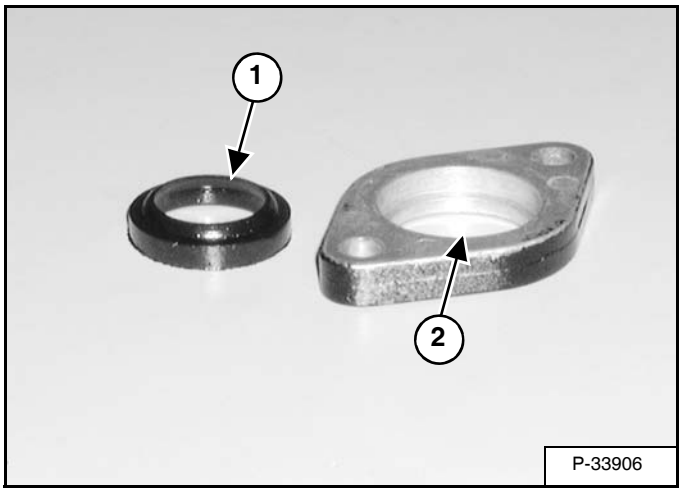
Figure 20-41-96



Remove the bolts (Item 1), retainer (Item 2) and seal (Item 3) **[Figure 20-41-96]**.

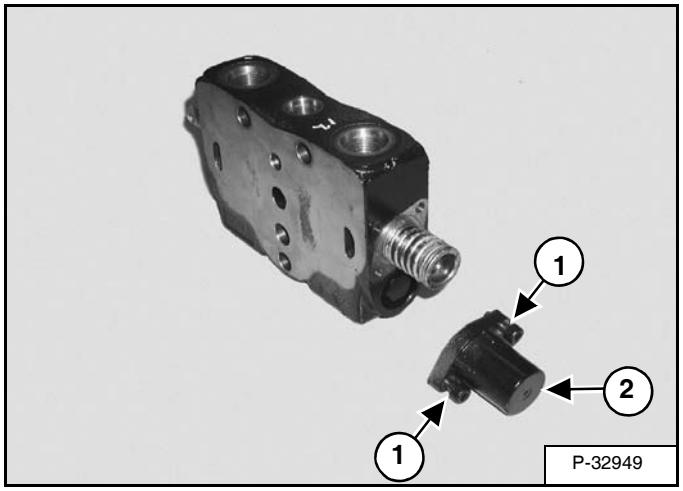
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-97



Installation: Make sure the lip (Item 1) on the seal fits inside the retainer (Item 2) **[Figure 20-41-97]**.

Figure 20-41-98

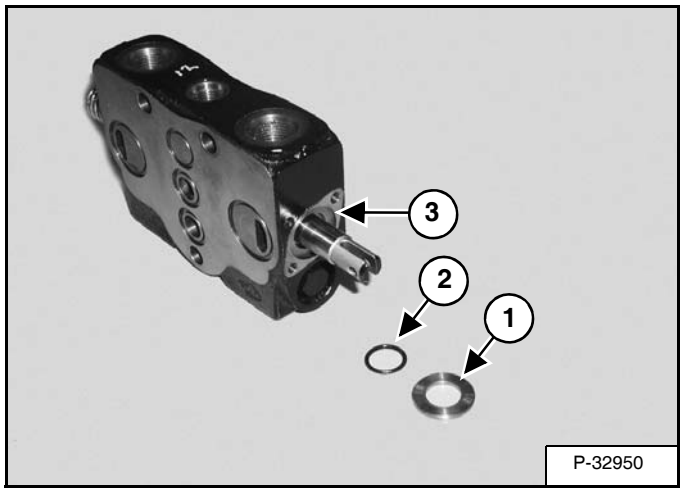


Remove the bolts (Item 1) and cap (Item 2) **[Figure 20-41-98]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

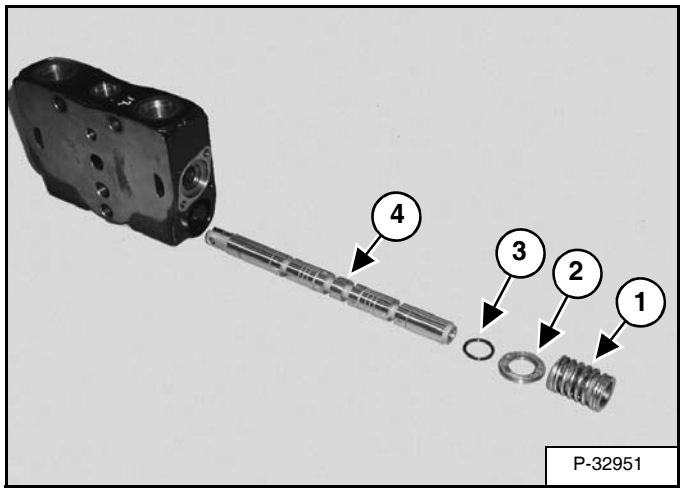
Boom Swing Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-99



Remove the washer (Item 1) and O-ring (Item 2) from the actuating end of the spool (Item 3) **[Figure 20-41-99]**.

Figure 20-41-100



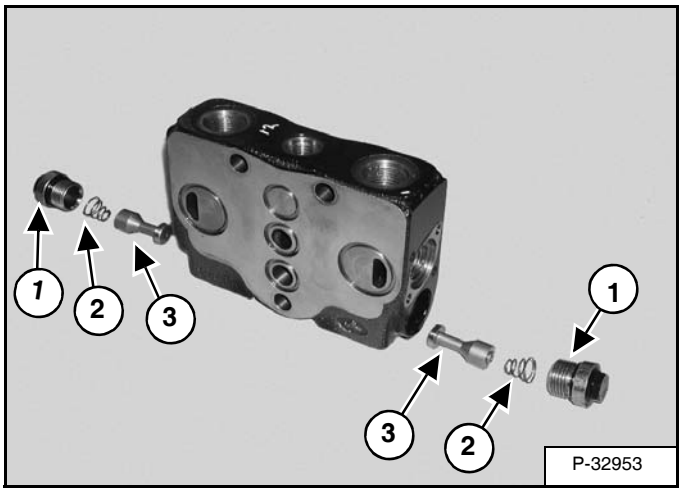
Remove the spring assembly (Item 1), washer (Item 2), O-ring (Item 3) and spool (Item 4) **[Figure 20-41-100]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Installation: Tighten the spring retaining screw to 18 ft.-lb. (24 N•m) torque.

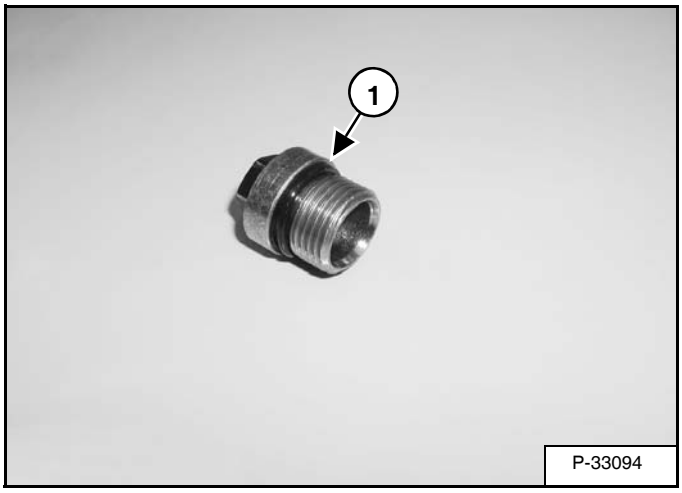
Figure 20-41-101



Remove the plug (Item 1), spring (Item 2) and valve assembly (Item 3) **[Figure 20-41-101]** from both relief valves.

Installation: Tighten the plugs to 18 ft.-lb. (24 N•m) torque.

Figure 20-41-102



Remove the O-ring (Item 1) **[Figure 20-41-102]** from the plugs.

Right Travel Valve Section Disassembly And Assembly

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.

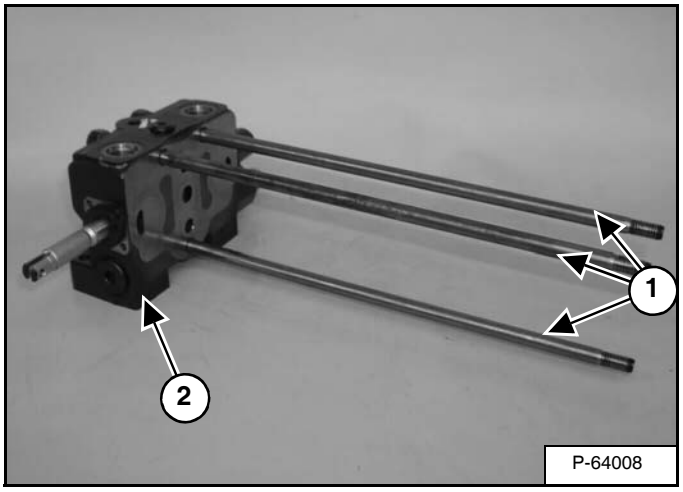
I-2003-0888

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

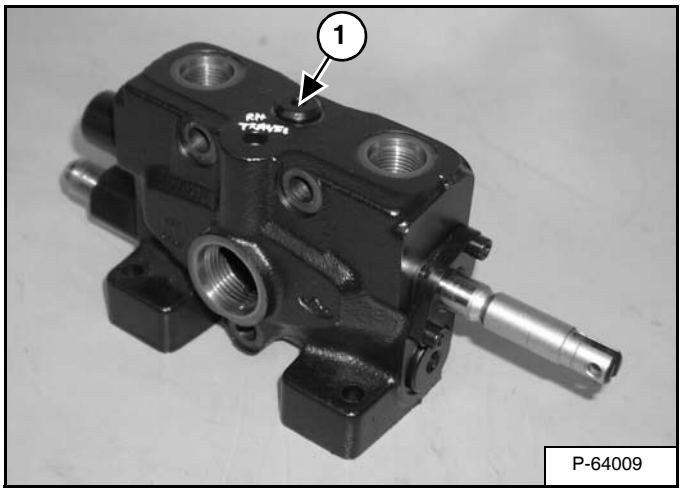
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-41-103



Remove the tie rods (Item 1) from the right travel valve section (Item 2) **[Figure 20-41-103]**.

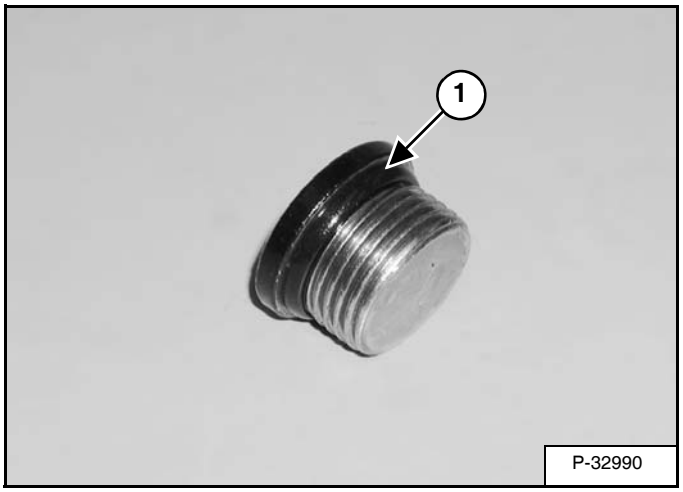
Figure 20-41-104



Remove the plug (Item 1) **[Figure 20-41-104]** from the right travel valve section.

Installation: Tighten the plug to 18 ft.-lb. (24 N•m) torque.

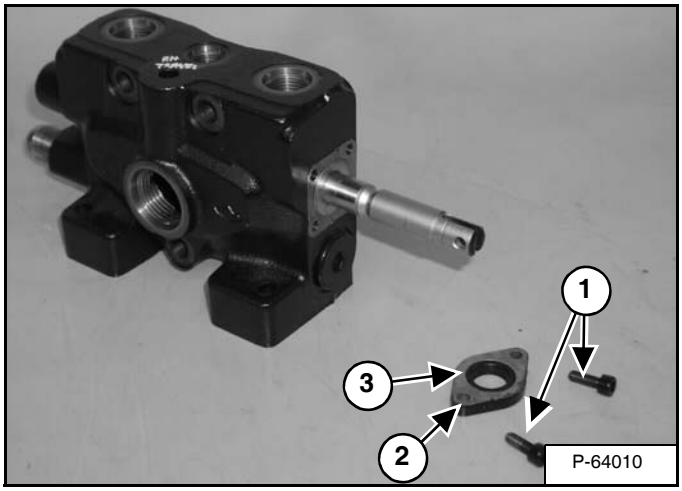
Figure 20-41-105



Remove the O-ring (Item 1) **[Figure 20-41-105]** from the plug.

Right Travel Valve Section Disassembly And Assembly (Cont'd)

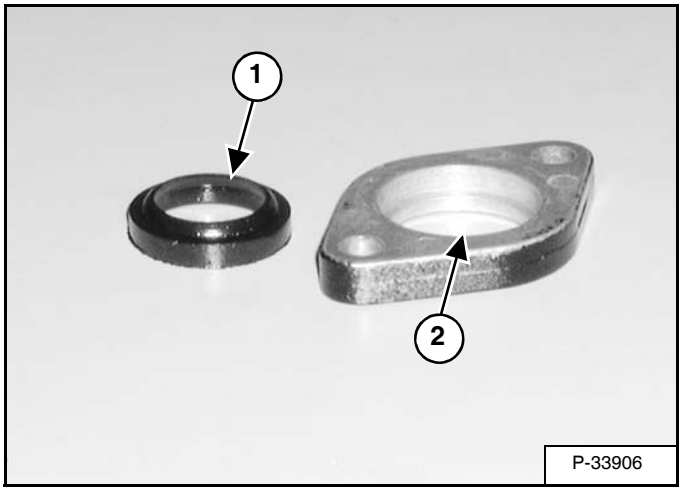
Figure 20-41-106



Remove the bolts (Item 1), retaining plate (Item 2) and seal (Item 3) **[Figure 20-41-106]**.

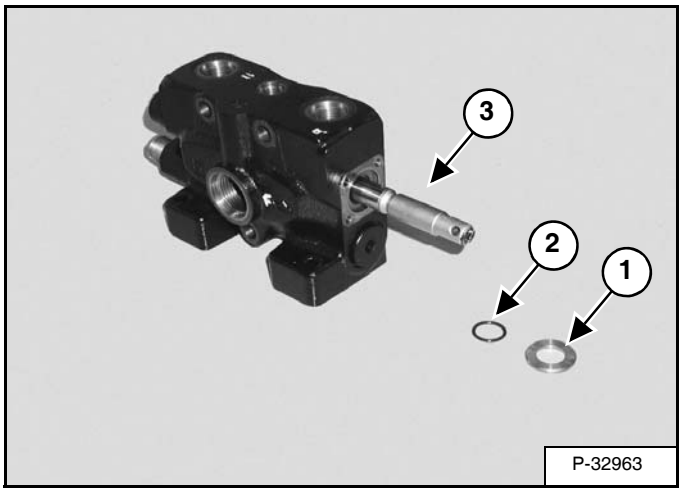
Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Figure 20-41-107



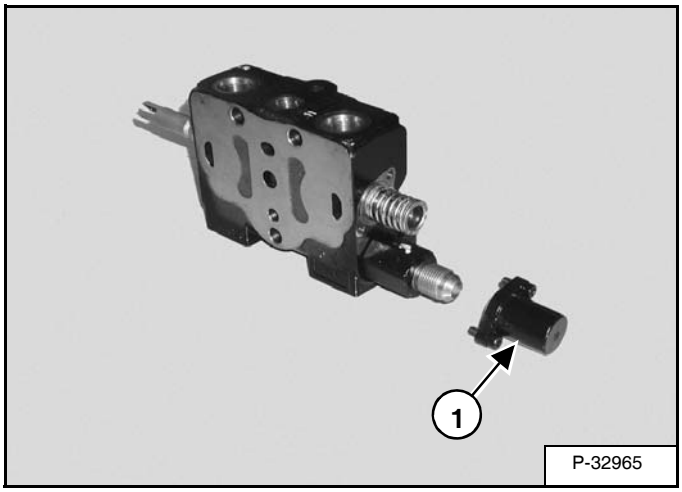
Installation: Make sure the lip (Item 1) of the seal fits inside the retaining plate (Item 2) **[Figure 20-41-107]**.

Figure 20-41-108



Remove the washer (Item 1) and O-ring (Item 2) from the spool (Item 3) **[Figure 20-41-108]**.

Figure 20-41-109

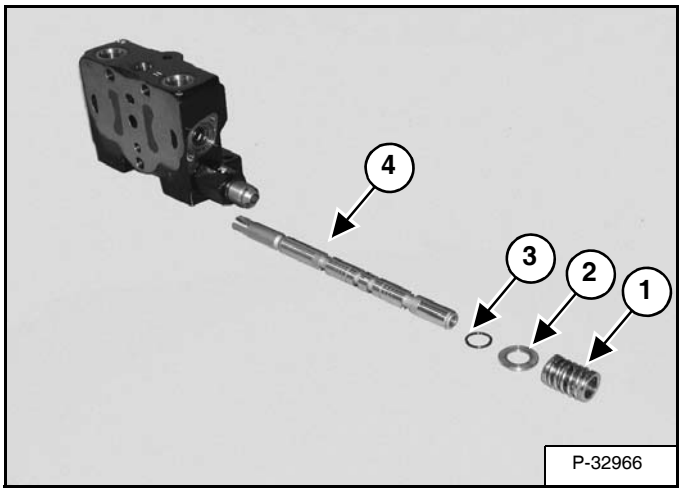


Remove the bolts and cap (Item 1) **[Figure 20-41-109]**.

Installation: Tighten the bolts to 5 ft.-lb. (6,6 N•m) torque.

Right Travel Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-110



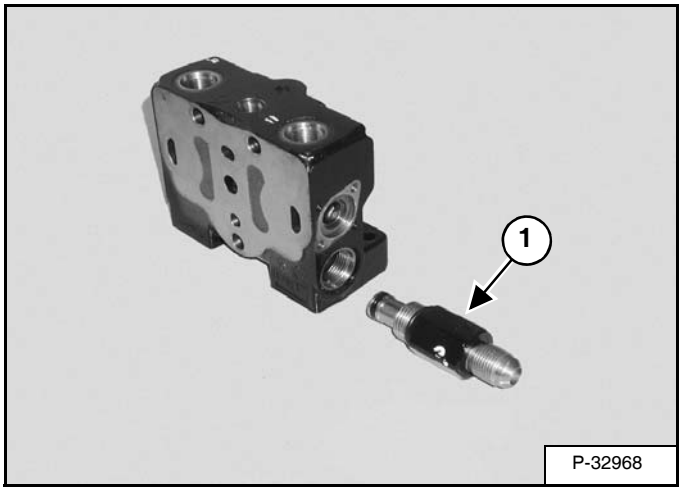
Remove the spring assembly (Item 1), washer (Item 2), O-ring (Item 3) and spool (Item 4) **[Figure 20-41-110]**.

The spool and valve block are not serviced separately.

NOTE: When the spool is removed, use care not to scratch the spool surface. Do not interchange spools and valve blocks.

Installation: Tighten the spring retaining screw to 18 ft.-lb. (24 N•m) torque.

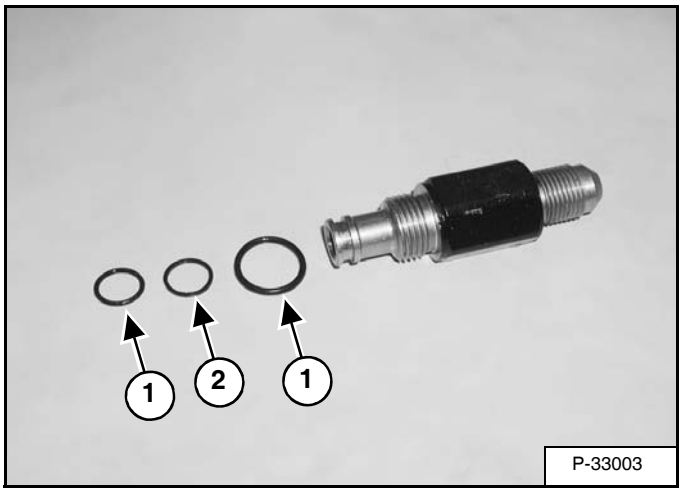
Figure 20-41-111



Remove the fitting (Item 1) **[Figure 20-41-111]**.

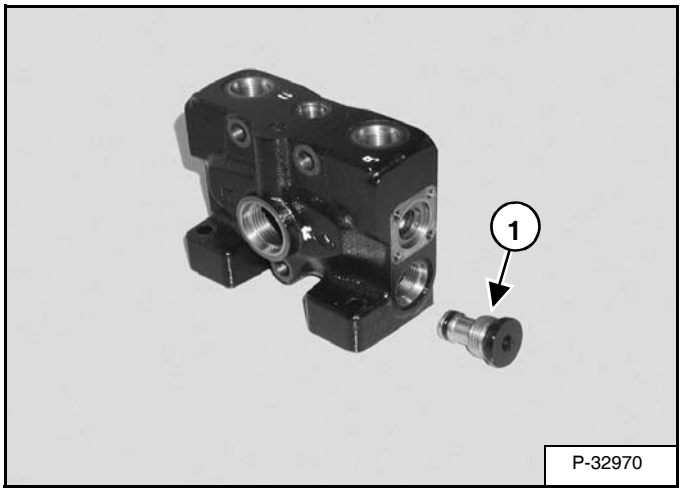
Installation: Tighten the fitting to 31 ft.-lb. (42 N•m) torque.

Figure 20-41-112



Remove the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-41-112]** from the fitting.

Figure 20-41-113

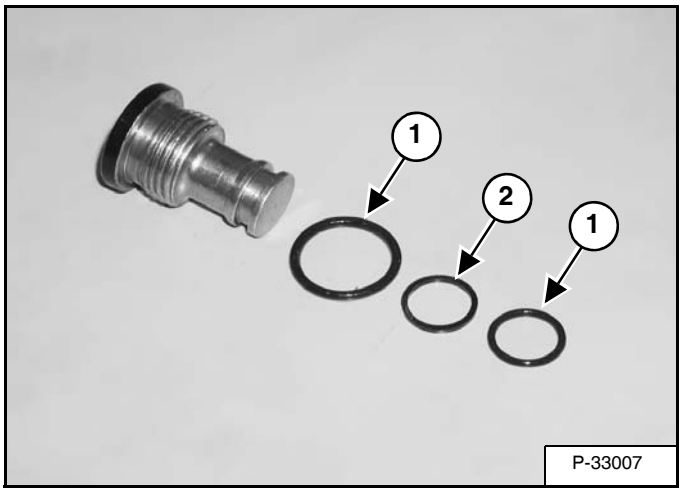


Remove the plug (Item 1) **[Figure 20-41-113]**.

Installation: Tighten the plug to 31 ft.-lb. (42 N•m) torque.

Right Travel Valve Section Disassembly And Assembly (Cont'd)

Figure 20-41-114



Remove the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-41-114]** from the plug.

Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

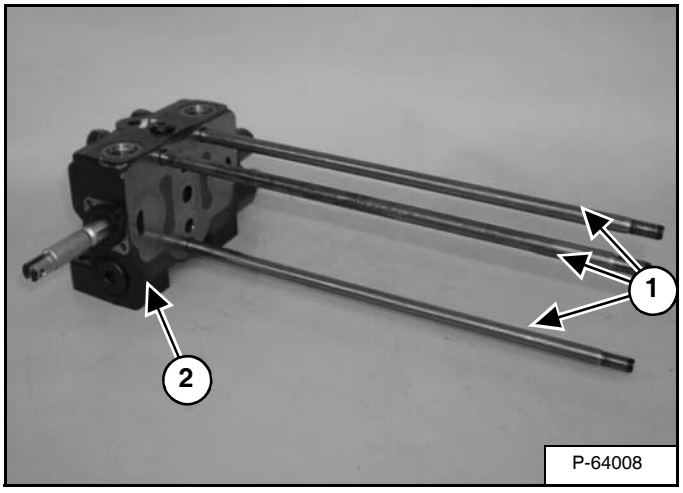
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

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.

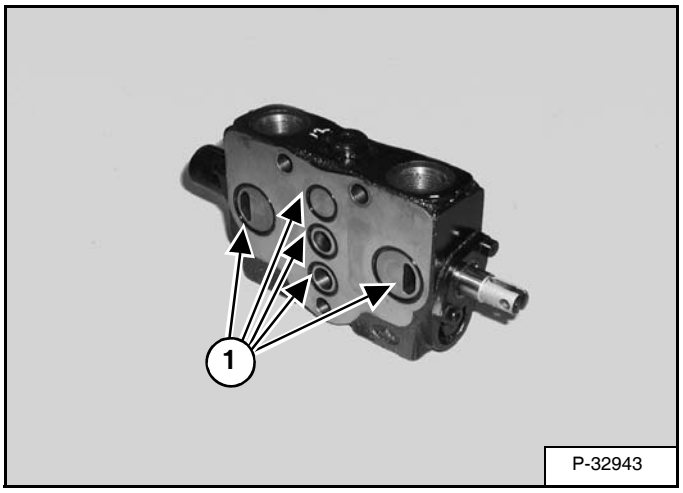
I-2003-0888

Figure 20-41-115



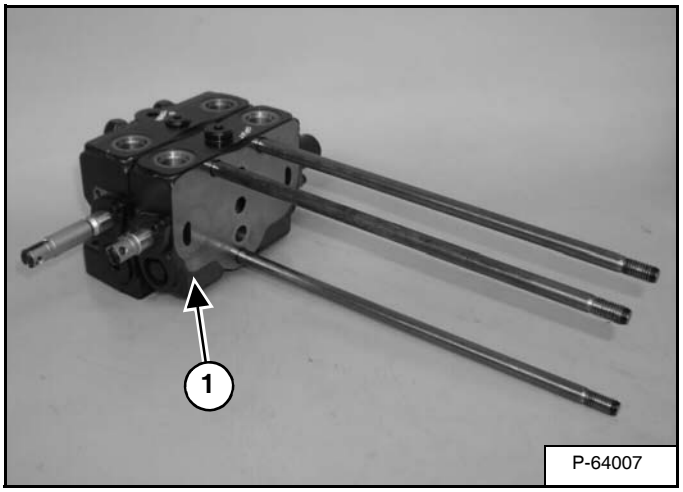
Install the tie rods (Item 1) on the right travel valve section (Item 2) **[Figure 20-41-115]**.

Figure 20-41-116



Install the O-rings (Item 1) **[Figure 20-41-116]** on the boom swing valve section.

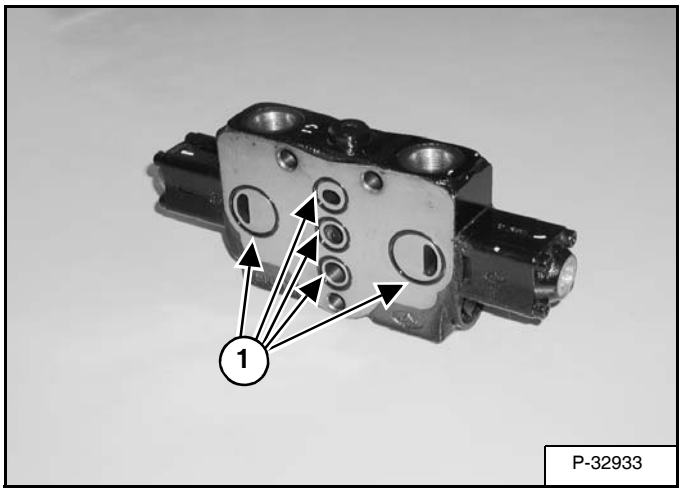
Figure 20-41-117



Install the boom swing valve section (Item 1) **[Figure 20-41-117]** on the tie rods.

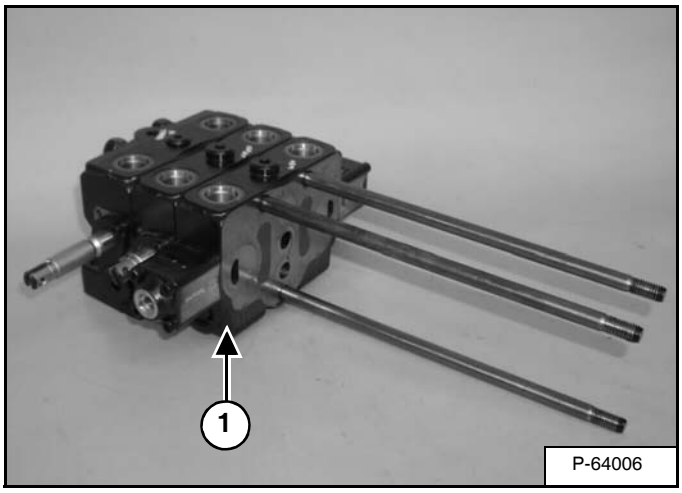
Assembly (Cont'd)

Figure 20-41-118



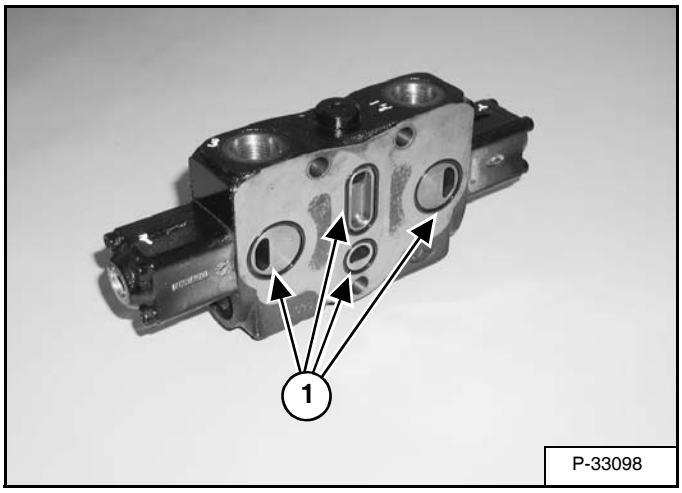
Install the O-rings (Item 1) **[Figure 20-41-118]** on the arm valve section.

Figure 20-41-119



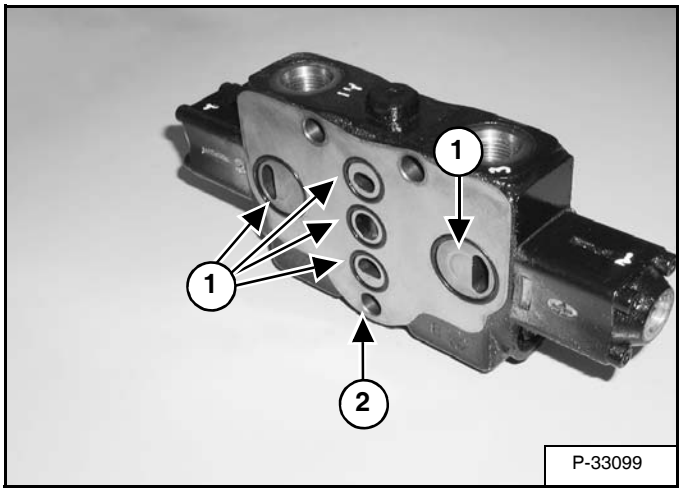
Install the arm valve section (Item 1) **[Figure 20-41-119]** on the tie rods.

Figure 20-41-120



Install the O-rings (Item 1) **[Figure 20-41-120]** on the right side of the bucket valve.

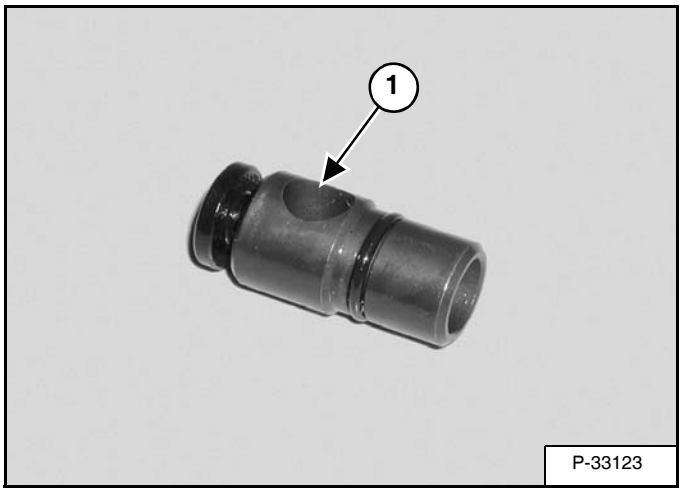
Figure 20-41-121



Install the O-rings (Item 1) **[Figure 20-41-121]** on the left side of the bucket valve section.

Assembly (Cont'd)

Figure 20-41-122



Align the hole (Item 1) **[Figure 20-41-122]** in the buildup valve with the hole (Item 2) **[Figure 20-41-121]** in the bucket valve section.

Figure 20-41-123

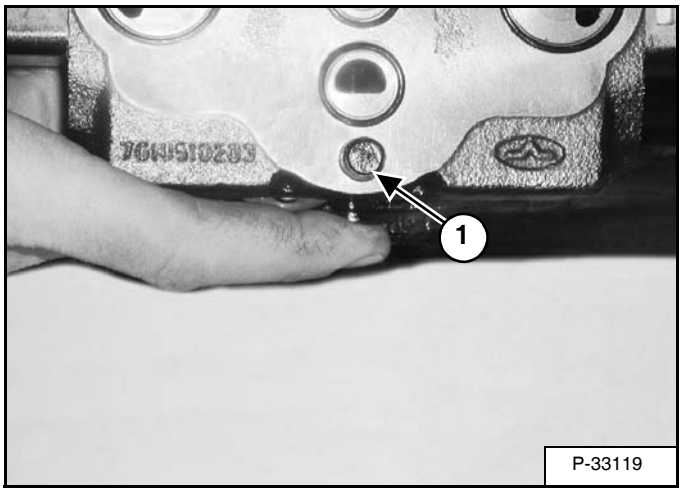
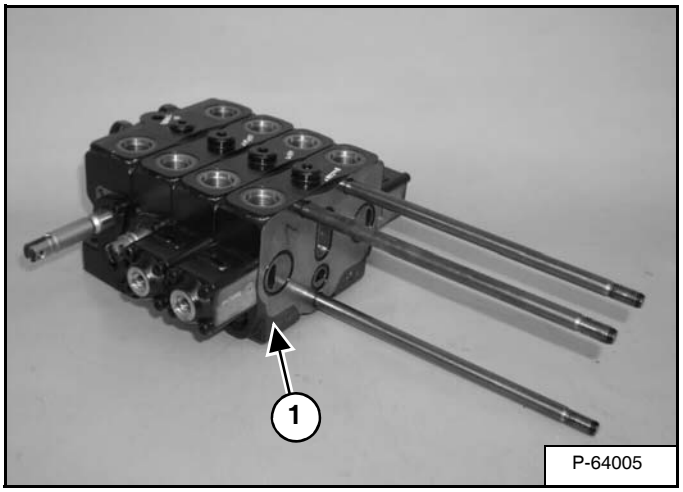


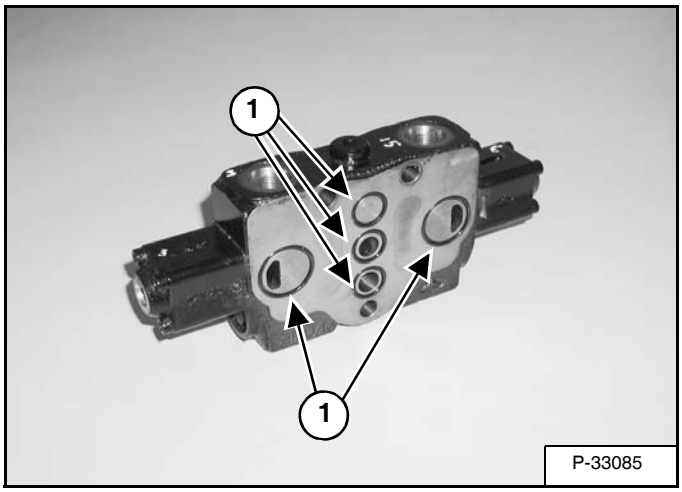
Figure 20-41-124



Fully depress the buildup valve (Item 1) **[Figure 20-41-123]** and install the bucket valve section (Item 1) **[Figure 20-41-124]** on the tie rods.

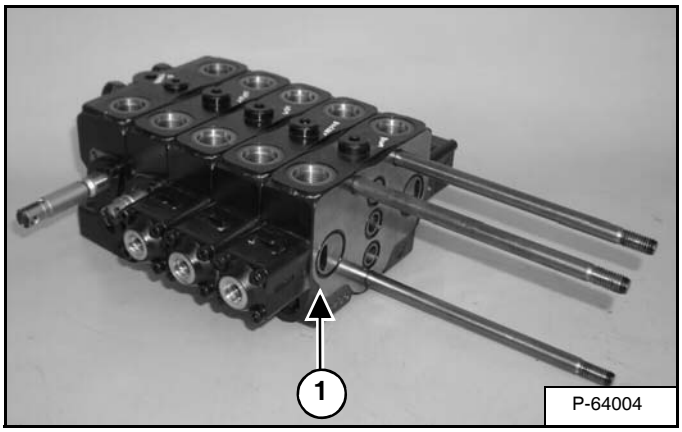
Assembly (Cont'd)

Figure 20-41-125



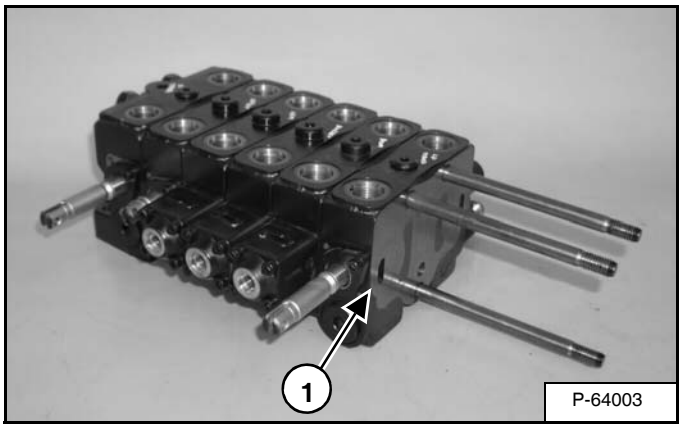
Install the O-rings (Item 1) **[Figure 20-41-125]** on the boom valve section.

Figure 20-41-126



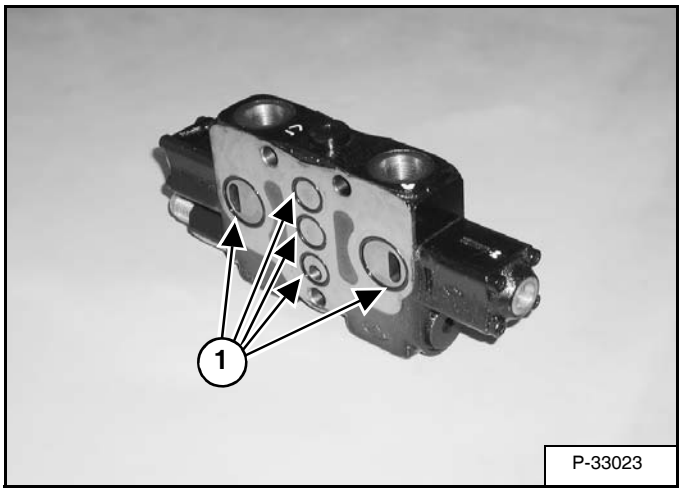
Install the boom valve section (Item 1) **[Figure 20-41-126]** on the tie rods.

Figure 20-41-127



Install the left travel valve section (Item 1) **[Figure 20-41-127]** on the tie rods.

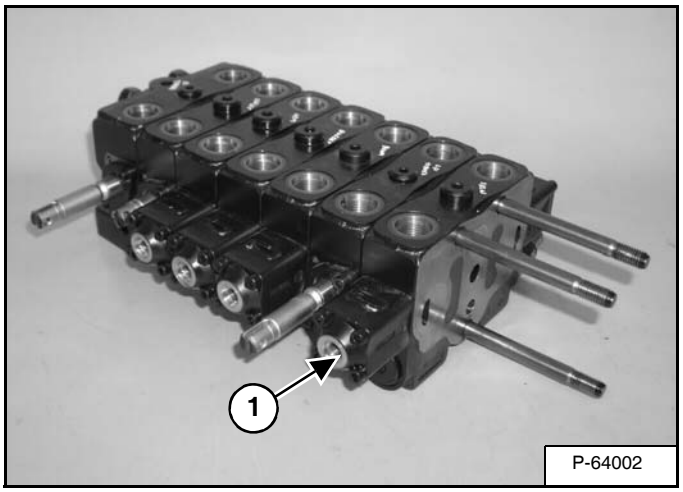
Figure 20-41-128



Install the O-rings (Item 1) **[Figure 20-41-128]** on the slew valve section.

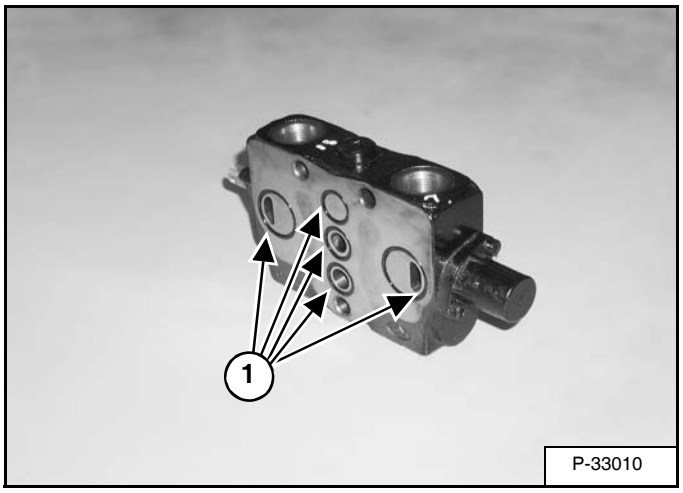
Assembly (Cont'd)

Figure 20-41-129



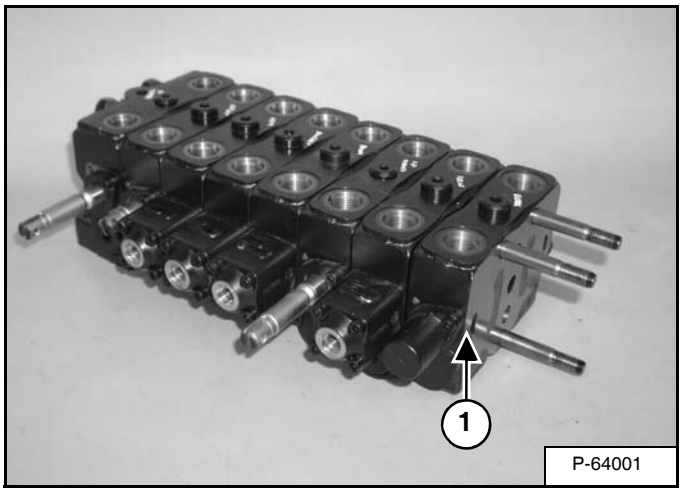
Install the slew valve section (Item 1) **[Figure 20-41-129]** on the tie rods.

Figure 20-41-130



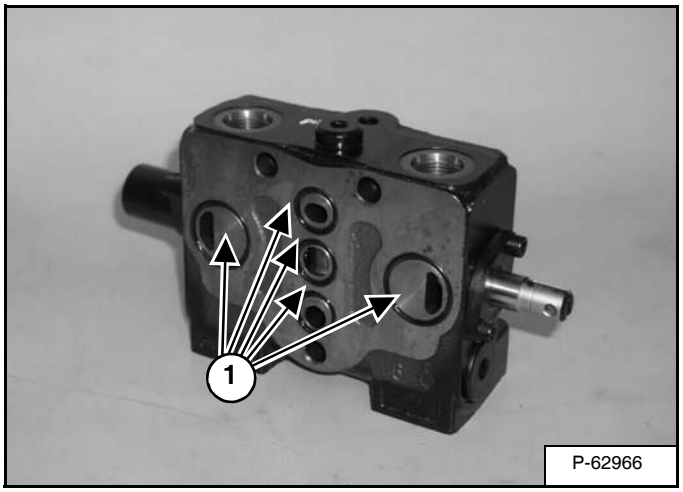
Install the O-rings (Item 1) **[Figure 20-41-130]** on the blade valve section.

Figure 20-41-131



Install the blade valve section (Item 1) **[Figure 20-41-131]** on the tie rods.

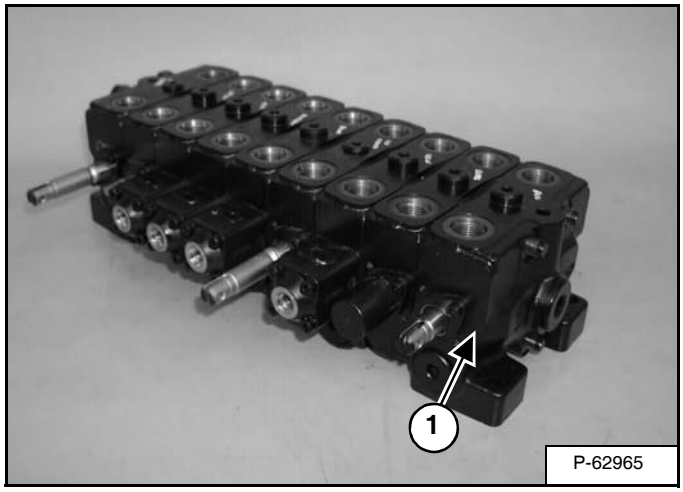
Figure 20-41-132



Install the O-rings (Item 1) **[Figure 20-41-132]** on the auxiliary valve section.

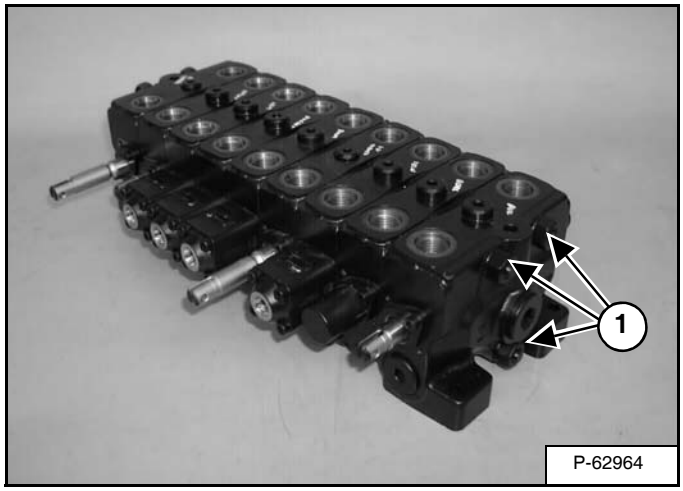
Assembly (Cont'd)

Figure 20-41-133



Install the auxiliary valve section (Item 1) **[Figure 20-41-133]** on the tie rods.

Figure 20-41-134



Install the washers and nuts (Item 1) **[Figure 20-41-134]** on the tie rods, finger tight.

Be sure the valve assembly does not rock on a flat surface.

Initially tighten the tie rod nuts (Item 1) **[Figure 20-41-134]** to 10 ft.-lb. (13 N•m) torque in a crisscross manner.

Final tighten the tie rod nuts (Item 1) **[Figure 20-41-134]** to 18 ft.-lb. (24 N•m) torque.

The valve assembly must not have any spacing between the valve sections and the spools must be free when pushed in and released.

The spools must not stick, if the spools do stick, loosen the tie rod nuts and tighten per above information.

Recheck the control valve assembly for level settings.

Figure 20-41-135



Install the hoses and fittings **[Figure 20-41-135]**.

HYDRAULIC PUMP

Testing The Hydraulic Pump

The hydraulic pump flow is 3.96 GPM (15 L/min.) for pump sections one and 7.92 GPM (30 L/min.) for pump section three at 3000 RPM.

NOTE: Pump Section 1 is closest to the engine.

The following tool will be needed for the hydraulic pump test:

MEL10003 - Hydraulic Tester

Stop the engine.

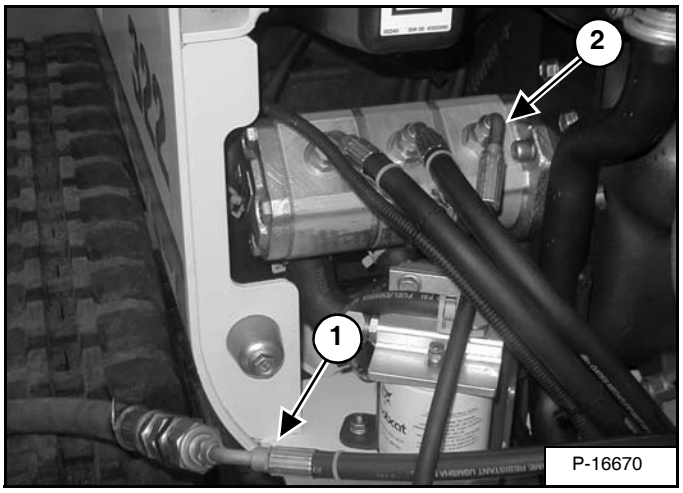
Open the tailgate.

Figure 20-50-139



Remove the outlet hose, of the section to be tested, from the hydraulic pump section for testing **[Figure 20-50-139]**.

Figure 20-50-140

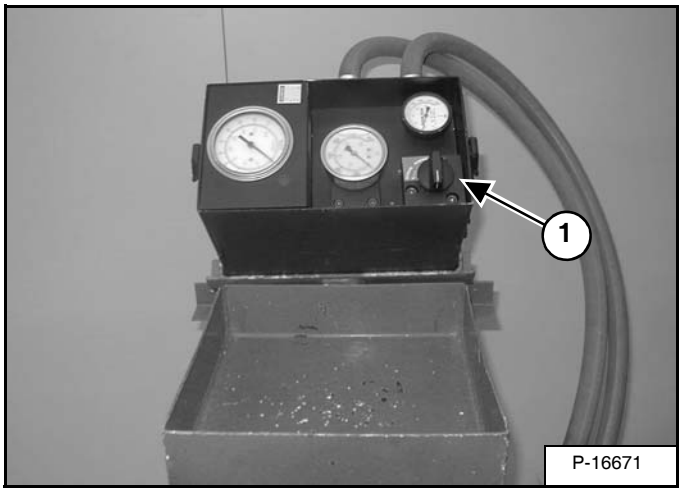


Connect the hose removed from the pump (Item 1) **[Figure 20-50-140]** to the outlet of the tester.

Connect the inlet hose of the tester to the fitting on the pump (Item 2) **[Figure 20-50-140]**.

NOTE: The tester connections will be the same for each pump section.

Figure 20-50-141



NOTE: Open the flow control knob on the hydraulic tester (Item 1) [Figure 20-50-141] fully to prevent pump damage.

Start the engine and run at low RPM until the hydraulic fluid is warm 150°F (66°C). Make sure the tester is connected correctly. If no flow is indicated at the tester, the hoses are connected wrong.

Increase the engine speed to full RPM.

Record the pump free flow GPM (L/min).

Testing The Hydraulic Pump (Cont'd)

Close the flow control knob (Item 1) **[Figure 20-50-141 on Page 1]** slowly to approximately 100 PSI below the relief valve setting which is 2475 PSI (170 Bar) for pump section three and 2515 PSI (173 Bar) for pump section one and two.

Record the pump high pressure flow GPM (L/min).

NOTE: The high pressure flow must be at least 80% of free flow.

$$\%= \frac{\text{HIGH PRESSURE FLOW (GPM)}}{\text{FREE FLOW (GPM)}} \times 100$$

If the high pressure flow is less than 80% of free flow, remove the hydraulic pump for repair or replacement.

Repeat the testing procedure for each pump section.

Removal And Installation

Lower the boom/bucket and blade to the ground.

Relieve hydraulic pressure.

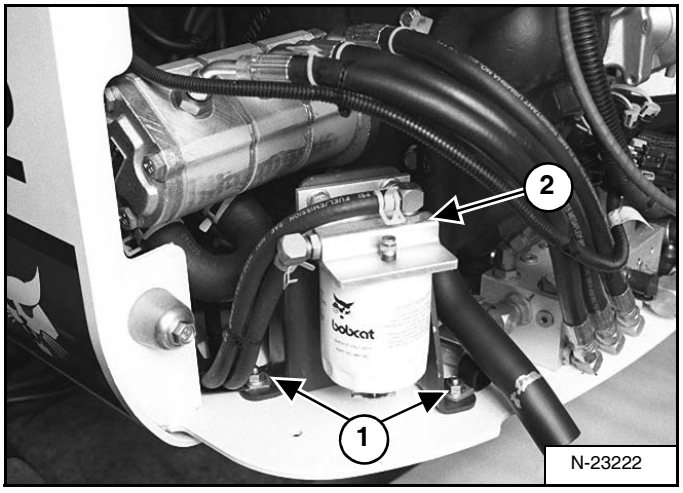
Drain the hydraulic reservoir. (See Replacing Hydraulic Oil on Page 10-100-2.)

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.

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Figure 20-50-142



Remove the bolts and nuts (Item 1) **[Figure 20-50-142]** from the fuel filter bracket.

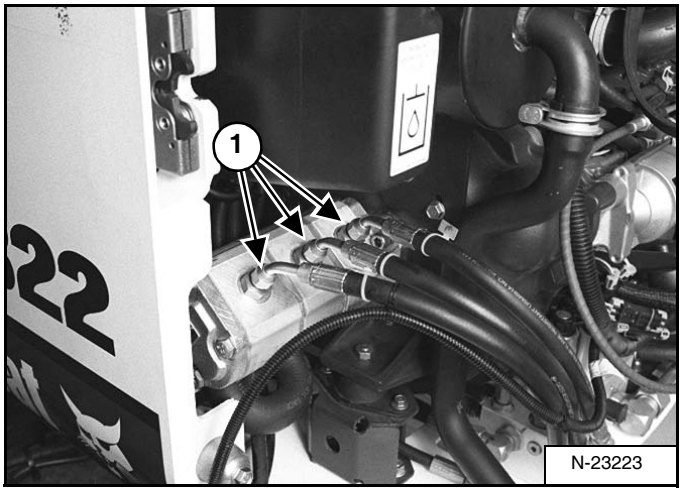
Move the fuel filter and bracket assembly (Item 2) **[Figure 20-50-142]** away from the front of the hydraulic pump.

WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

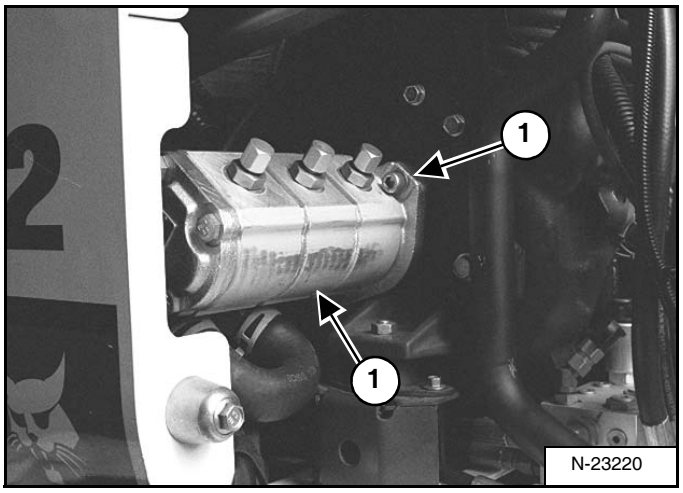
Figure 20-50-143



Remove the three pressure hoses (Item 1) **[Figure 20-50-143]**.

Cap and plug the hoses and fittings.

Figure 20-50-144

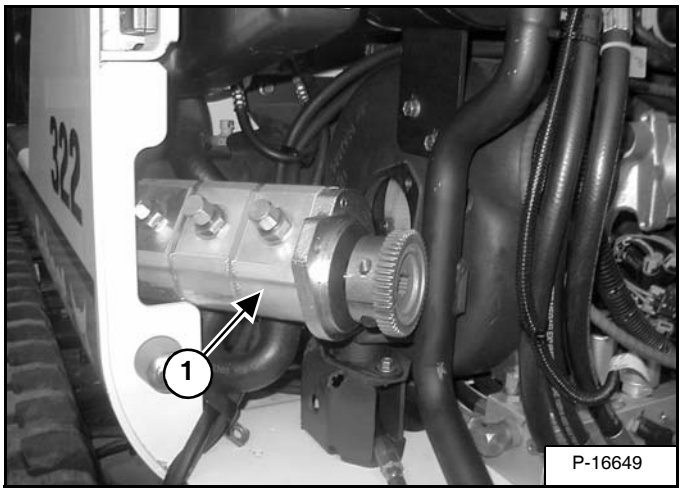


Remove the bolts (Item 1) **[Figure 20-50-144]** from the pump flange.

Installation: Tighten the bolts to 29-37 ft.-lb. (40-50 N•m) torque.

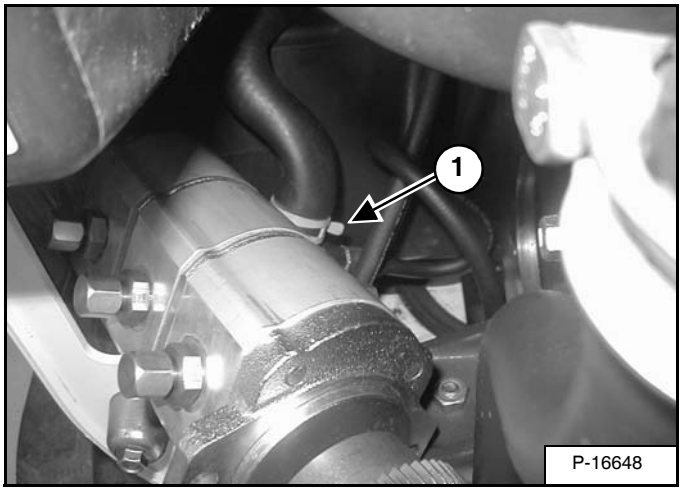
Removal And Installation (Cont'd)

Figure 20-50-145



Remove the hydraulic pump (Item 1) from the flywheel housing by sliding the pump straight out and pivoting the end of the pump to the back of the Excavator **[Figure 20-50-145]** to clear the flywheel housing. Pull the pump outwards until the splined coupler is loose from the flywheel coupling.

Figure 20-50-146

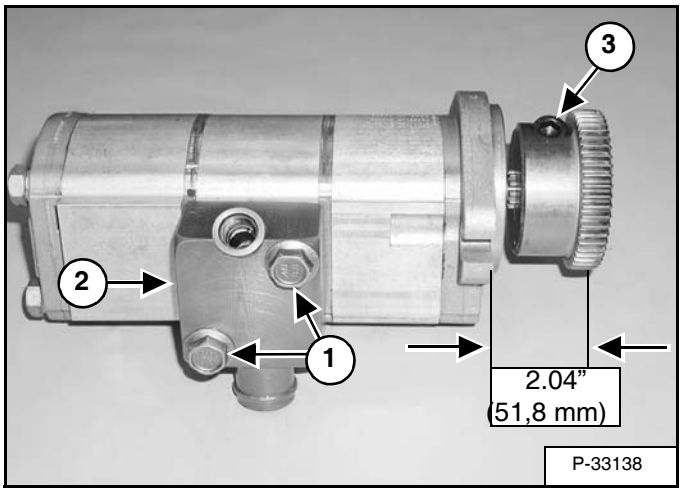


Release the hose clamp (Item 1) **[Figure 20-50-146]** on the inlet hose and pull the inlet hose off of the pump.

Remove the hydraulic pump from the Excavator.

NOTE: Early style pumps used two inlet hoses and elbows. Later style pumps use the single inlet block (as shown).

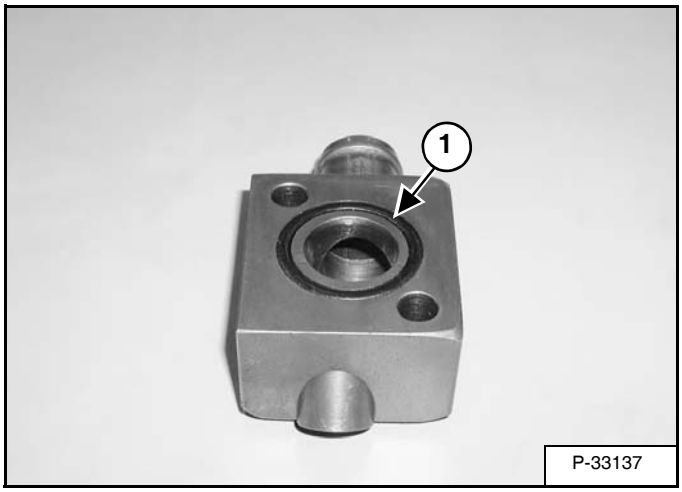
Figure 20-50-147



Remove the two bolts (Item 1) from the inlet block (Item 2) **[Figure 20-50-147]**.

Remove the inlet block. (Later style only, early style used two elbow fittings.)

Figure 20-50-148



Remove the O-ring (Item 1) **[Figure 20-50-148]** from the inlet block.

Coupler Removal And Installation

Loosen the bolt (Item 3) **[Figure 20-50-147]** from the coupler.

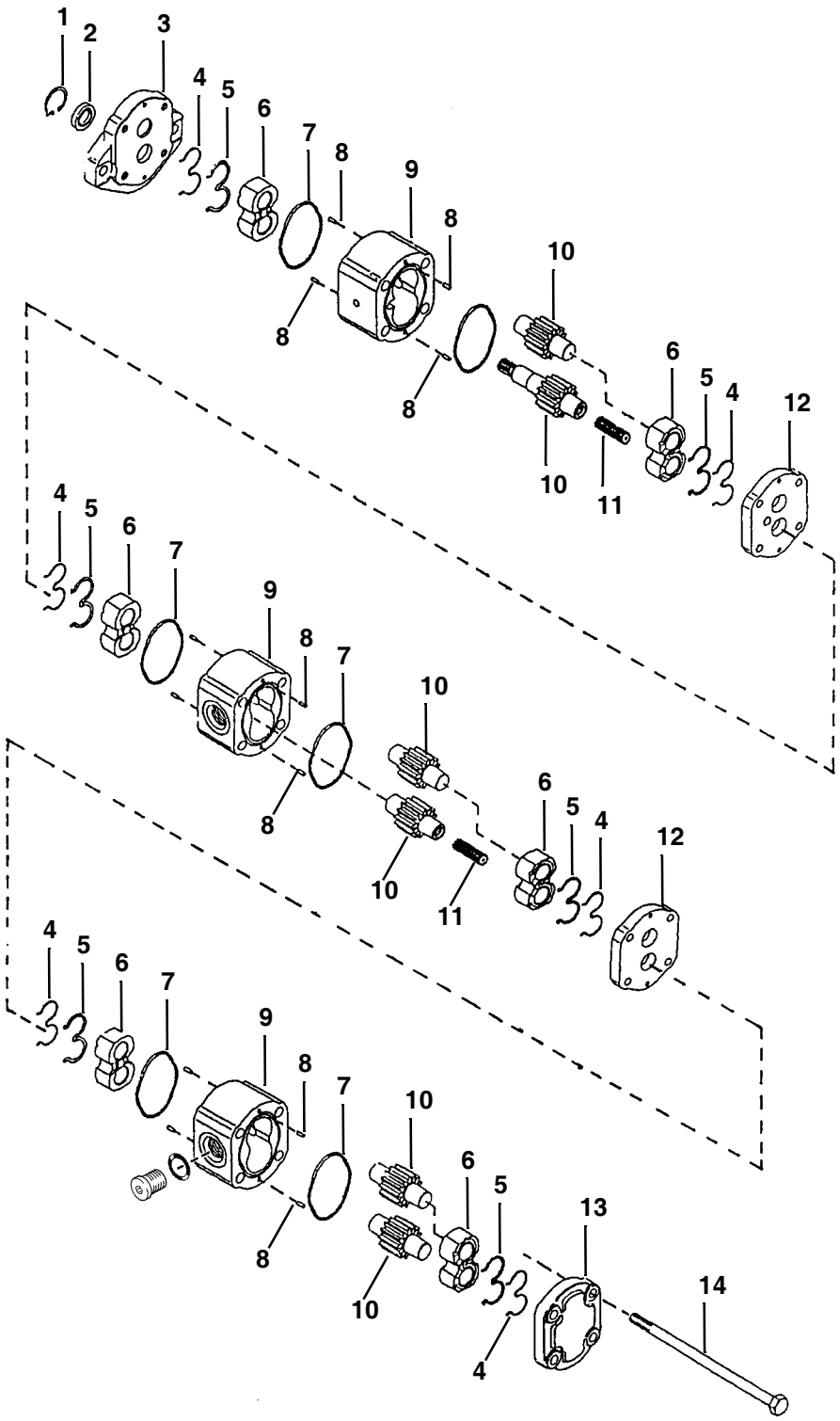
Slide the coupler off of the pump shaft.

When installing the coupler, maintain 2.04 inch (51,8 mm) gap from the pump mount flange to the coupler **[Figure 20-50-147]**.

Tighten the bolt (Item 3) **[Figure 20-50-147]** to 36 ft.-lb. (48 N•m) torque.

Parts Identification

1. Snap Ring
2. Seal
3. End Plate
4. Backup Ring
5. E-Seal
6. Bearing
7. O-ring
8. Dowel Pin
9. Housing
10. Gear
11. Coupler
12. Plate
13. End Cap
14. Bolt



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Disassembly

Photos may appear different than your pump but the procedure is the same. Later model pumps used one inlet port verses the early style with two inlet ports (as shown in these photos).

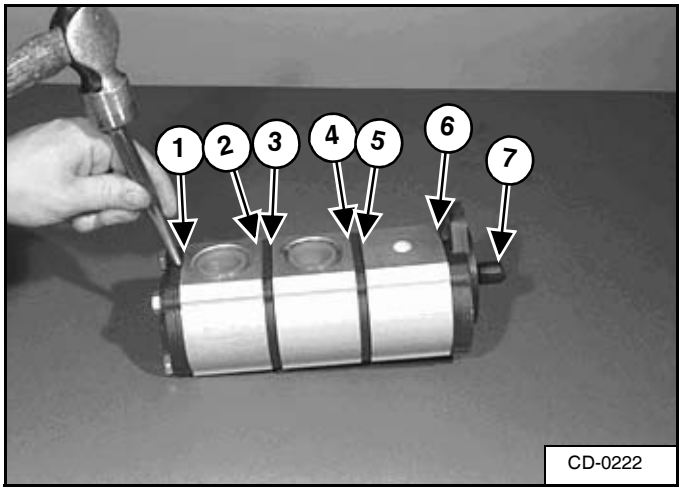
Clean the outside of the gear pump before disassembly.

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.

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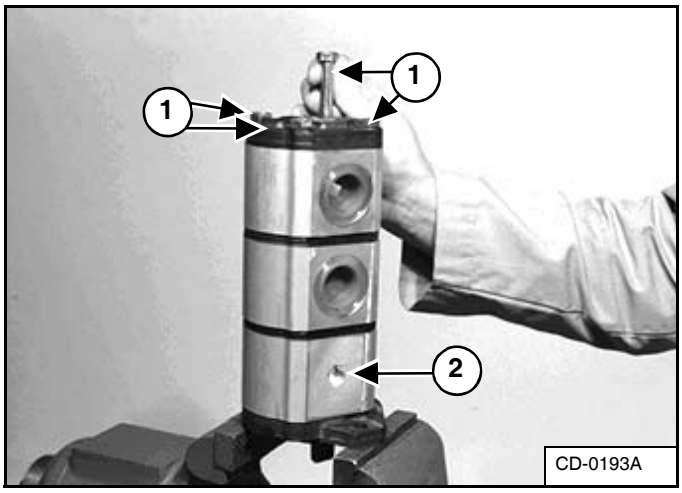
Figure 20-50-149



Using a center punch, mark both sides of each separation point (Items 1-6) **[Figure 20-50-149]** on the inlet side of the pump, as shown, with the corresponding separation point number.

Tape the shaft splines (Item 7) **[Figure 20-50-149]** to make sure that the splines will not damage the oil seal when the shaft is removed.

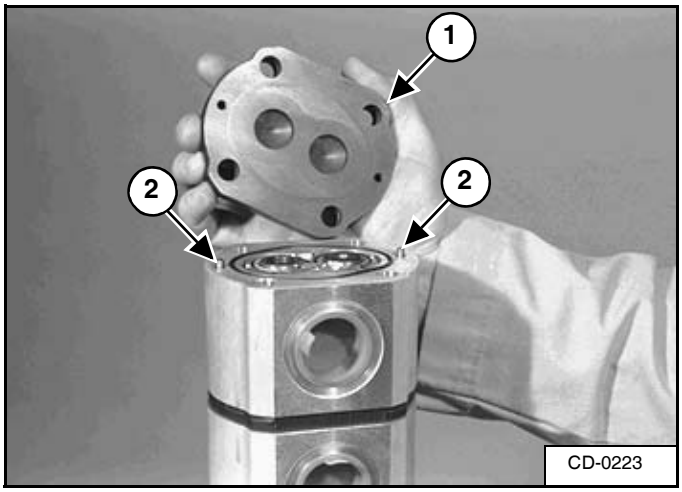
Figure 20-50-150



Put the pump, mounting flange down, in a protected jaw vise. Remove the four assembly bolts (Item 1) **[Figure 20-50-150]**.

NOTE: The pump has only two inlet ports. The pump section without the inlet port is located in section 1 (closest to the input shaft) (Item 2) [Figure 20-50-150].

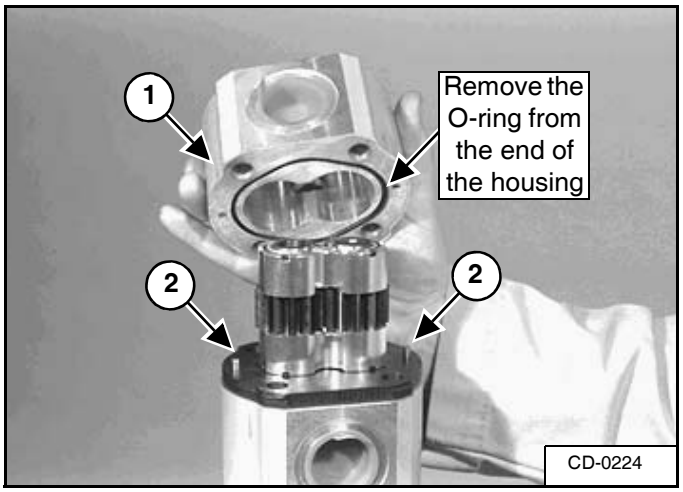
Figure 20-50-151



Remove the end cap (or separating plate) (Item 1) and two dowel pins (Item 2) **[Figure 20-50-151]**.

Disassembly (Cont'd)

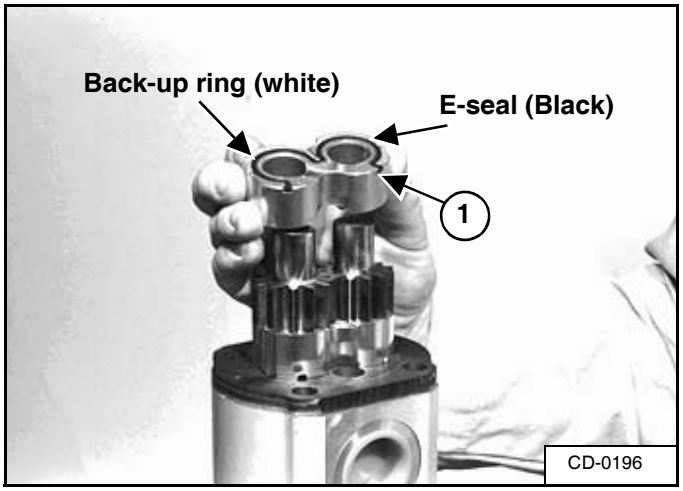
Figure 20-50-152



Remove the gear housing (Item 1) and two dowel pins (Item 2) **[Figure 20-50-152]**.

Remove the O-ring from each end of the gear housing **[Figure 20-50-152]**.

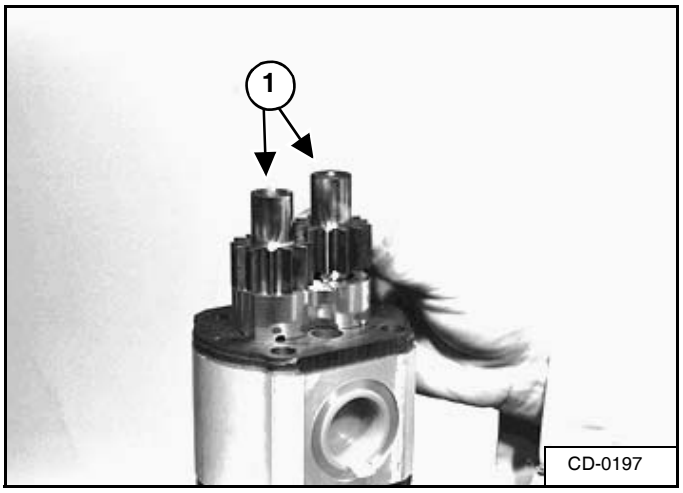
Figure 20-50-153



Remove the upper bearing (Item 1) **[Figure 20-50-153]**.

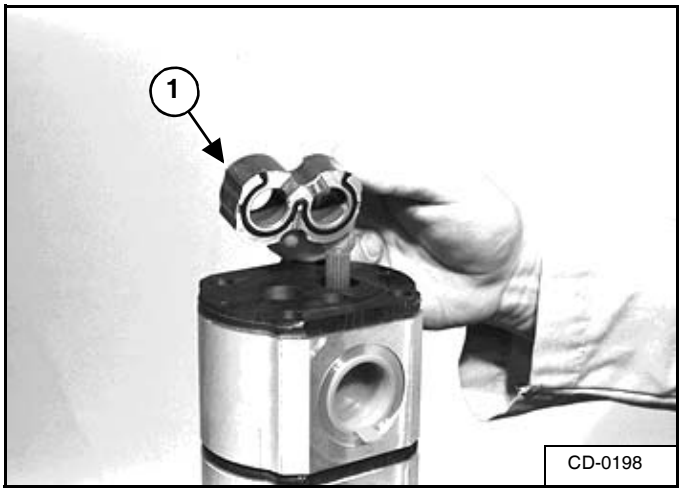
Remove the back-up ring and E-seal from the bearing.

Figure 20-50-154



Remove the drive and idler gears (Item 1) **[Figure 20-50-154]**.

Figure 20-50-155

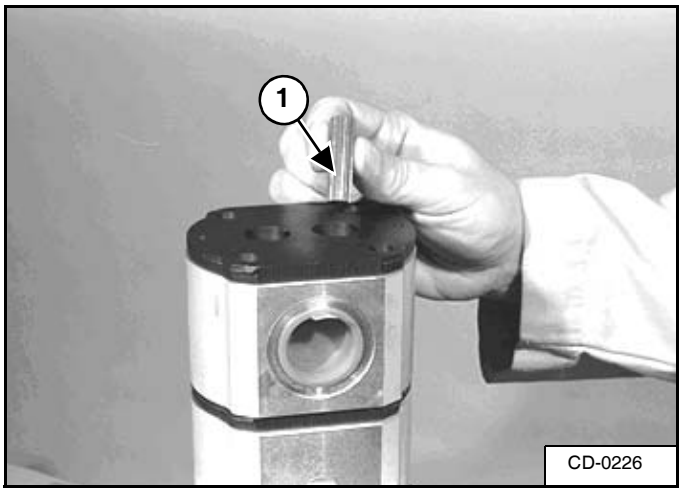


Remove the lower bearing (Item 1) **[Figure 20-50-155]**.

Remove the back-up ring and E-seal from the bearing.

Disassembly (Cont'd)

Figure 20-50-156

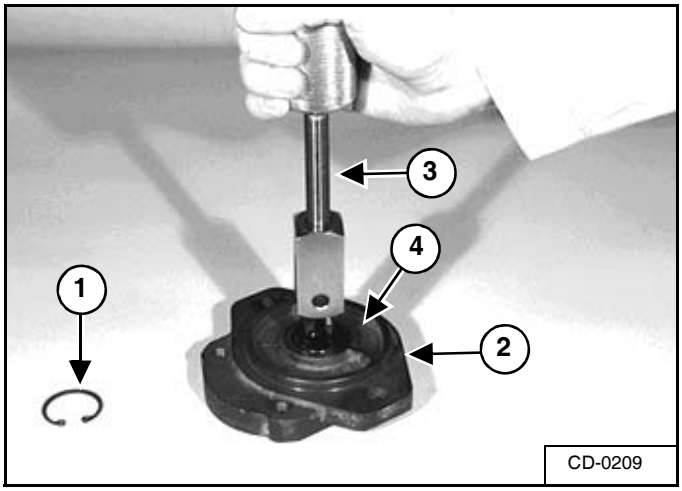


Remove the coupling (Item 1) **[Figure 20-50-156]**.

Repeat step **[Figure 20-50-151 on Page 6]** through step **[Figure 20-50-156]** to disassemble each of the remaining pump sections. Keep the parts from each section separate from the other sections.

NOTE: The gear housing, two bearings, drive gear and idler gear in each pump section are not serviced separately. These parts are matched sets which are run in at the factory. If any part is damaged, the entire section must be replaced.

Figure 20-50-157



Remove the retaining ring (Item 1) from the mounting flange, (Item 2). Using a seal puller (Item 3), remove the oil seal (Item 4) **[Figure 20-50-157]**.

Assembly

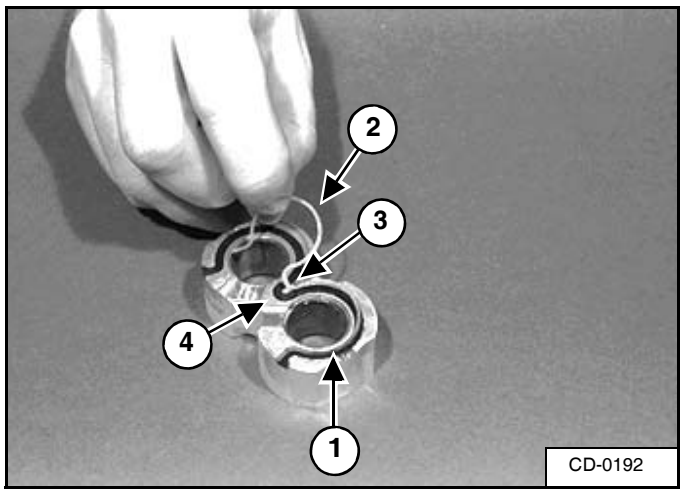
Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid and all E-seals with assembly lube before installation.

Use the correct size driver and install the oil seal (seal lips to the inside of the pump) (Item 4) into the mounting flange (Item 2). Install the retaining ring (Item 1) **[Figure 20-50-157]**.

Figure 20-50-158



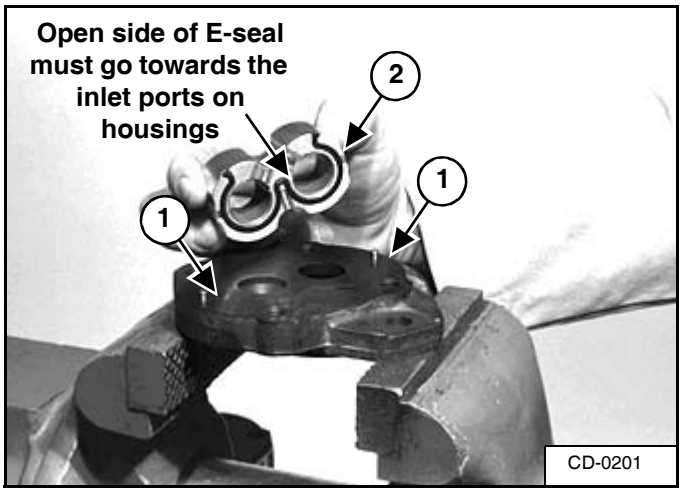
Install an E-seal (Item 1) **[Figure 20-50-158]** stepped side up, into each E-seal groove. Push each E-seal down into the groove.

Install the back-up ring (Item 2) **[Figure 20-50-158]** into the groove made by the E-seal and bearing. Push the back-up ring down flush with the E-seal.

NOTE: There is a notch (Items 3 & 4) [Figure 20-50-158] in the center of the back-up ring and E-seal. When installing the back-up ring, make sure that these notches are aligned. If the back-up ring or E-seal are not installed correctly the back-up ring will not sit flush with the E-seal.

Assembly (Cont'd)

Figure 20-50-159

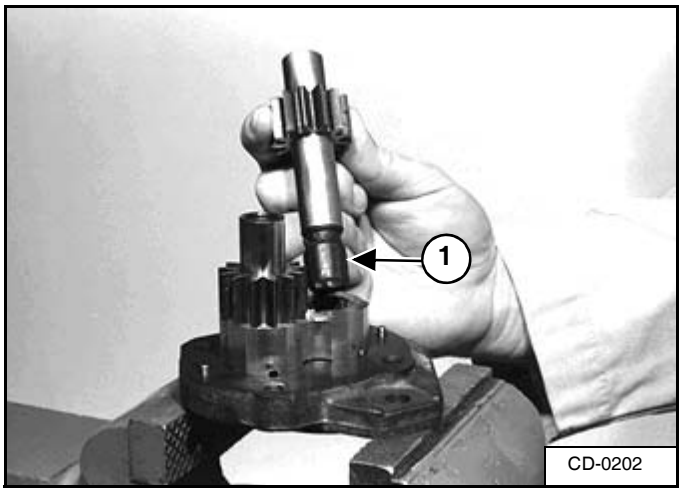


Put the mounting flange, oil seal side down, in a protected jaw vise **[Figure 20-50-159]**.

Install the two dowel pins (Item 1) **[Figure 20-50-159]** into the mounting flange (or separating plate).

Install the lower bearing (Item 2), seal side down, on the mounting flange (or separating plate). The open side of the E-seal must point toward the inlet port side (marked side) of the pump **[Figure 20-50-159]**.

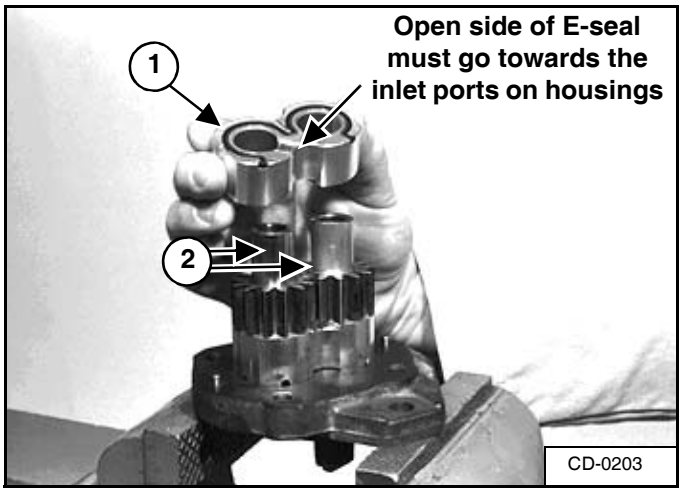
Figure 20-50-160



Tape the splined end (Item 1) **[Figure 20-50-160]** of the drive gear to make sure that the splines will not damage the oil seal during installation.

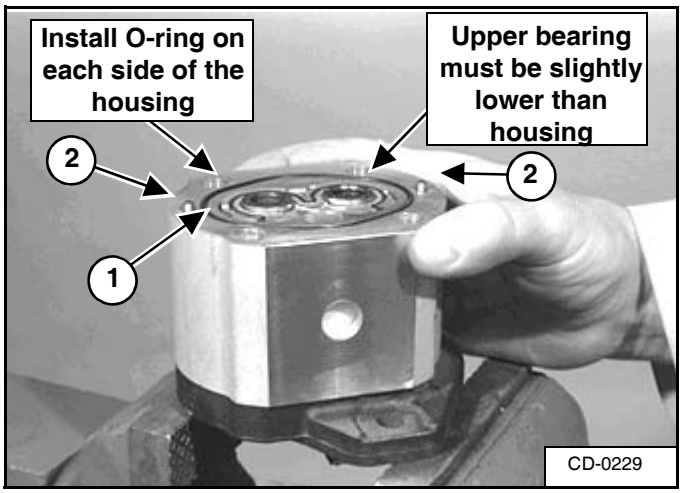
Apply oil to the drive gear and idler gear and to the side faces of the gears. Install the gears into the lower bearing **[Figure 20-50-160]**.

Figure 20-50-161



Install the upper bearing (Item 1), seal side up, on the drive and idler gears (Item 2). The open side of the E-seal must point toward the inlet port side (marked side) of the pump **[Figure 20-50-161]**.

Figure 20-50-162



Install O-rings (Item 1) **[Figure 20-50-162]** on each end of the gear housing.

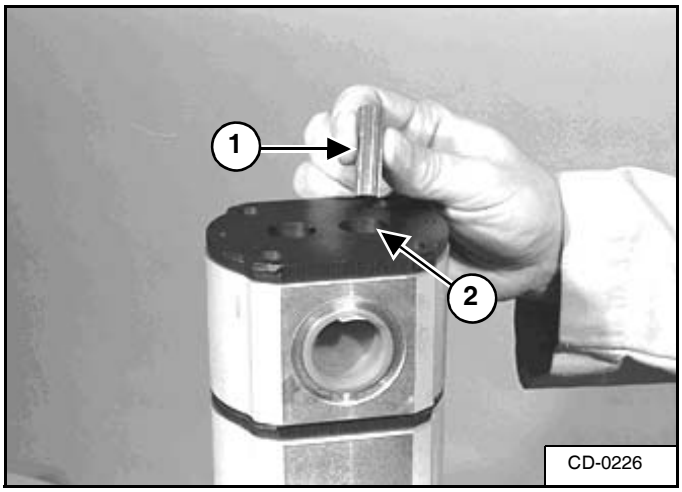
Align the marks made during disassembly on the gear housing and mounting flange (or separating plate). Carefully install the gear housing over the bearings and gears **[Figure 20-50-162]**.

NOTE: The upper bearing must be slightly lower than the gear housing. If the bearing is higher than the housing, disassemble the pump section to verify that the E-seal, back-up ring, or O-ring have not moved out of position.

Install the two dowel pins (Item 2) **[Figure 20-50-162]** into the gear housing.

Assembly (Cont'd)

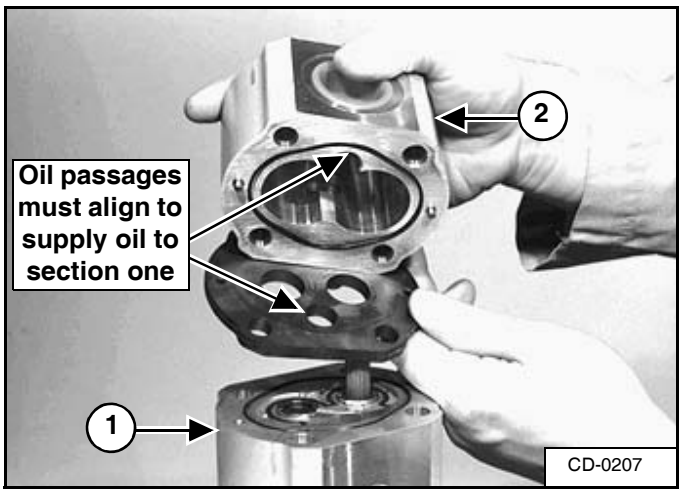
Figure 20-50-163



Apply oil to the coupling (Item 1) **[Figure 20-50-163]**.

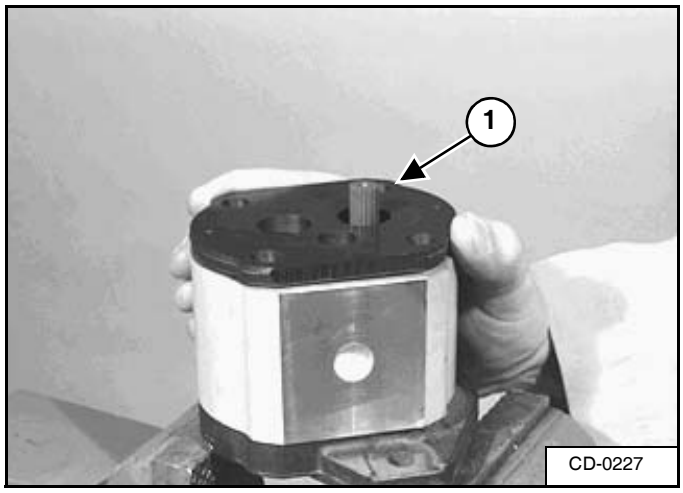
Install the coupling into the drive gear (Item 2) **[Figure 20-50-163]**.

Figure 20-50-164



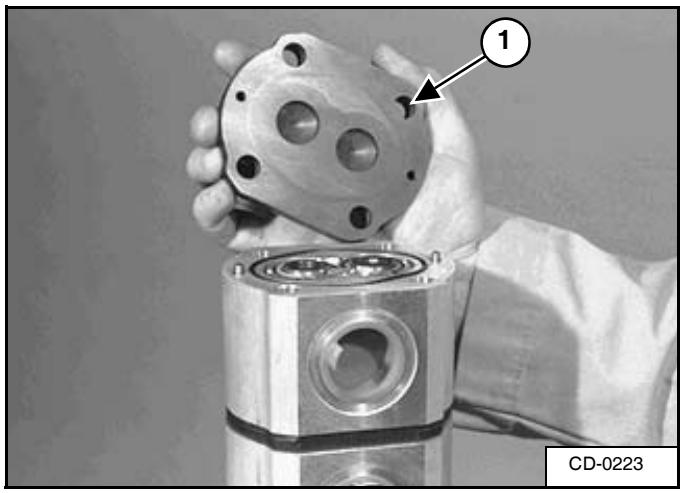
NOTE: When installing the first section gear housing (Item 1) (with no inlet port), make sure that the oil passage in the housing and the separation plate align. Section one gear housing must receive oil flow through this passage from section two (center) gear housing (Item 2) [Figure 20-50-164].

Figure 20-50-165



Align the marks made during disassembly on the separating plate and gear housing. Install the separating plate (Item 1) **[Figure 20-50-165]**.

Figure 20-50-166



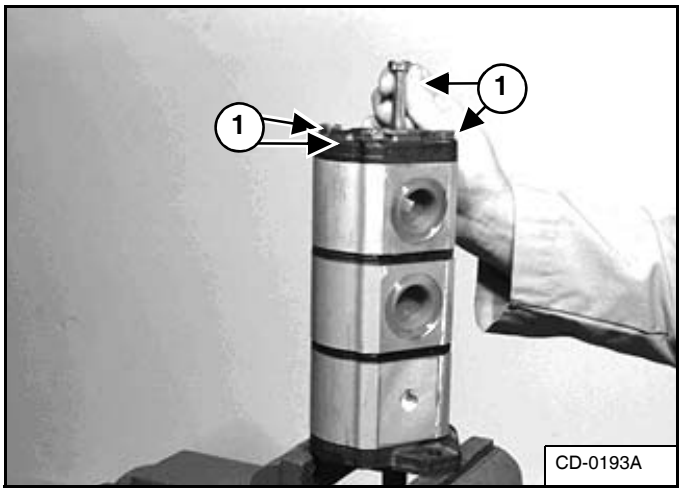
Repeat step **[Figure 20-50-158 on Page 8]** through Page 20-50-11 step **[Figure 20-50-162 on Page 9]** to assemble pump section 2.

Repeat step **[Figure 20-50-158 on Page 8]** through step **[Figure 20-50-162 on Page 9]** to assemble pump section 3.

Align the marks made during disassembly on the end cap and gear housing. Install the end cap (Item 1) **[Figure 20-50-166]**.

Assembly (Cont'd)

Figure 20-50-167



Install the four assembly bolts (Item 1) **[Figure 20-50-167]**.

Evenly tighten the bolts to a final torque of 38-43 ft.-lb. (52-58 N•m).

Rotate the input shaft periodically while tightening the bolts to make sure the pump is assembled correctly.

Using a locking plier, rotate the pump shaft to be sure there is no binding.

NOTE: Use care not to damage the pump shaft.


Bobcat®

MANIFOLD ASSEMBLY/ACCUMULATOR

Description

NOTE: The 320L manifold is not equipped with a two speed solenoid. The photos may appear different, the procedure is the same.

The manifold body contains a two speed solenoid valve, a system bypass valve, a pressure reducing valve and a safety relief valve.

The body is connected to the accumulator.

The manifold supplies 435 PSI (30 Bar) to the joysticks to activate the control valve spools.

The accumulator provides short term reserve pressure for joystick function with the engine off and the key in the ON position.

Removal And Installation

Lower the boom/bucket and blade to the ground.

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

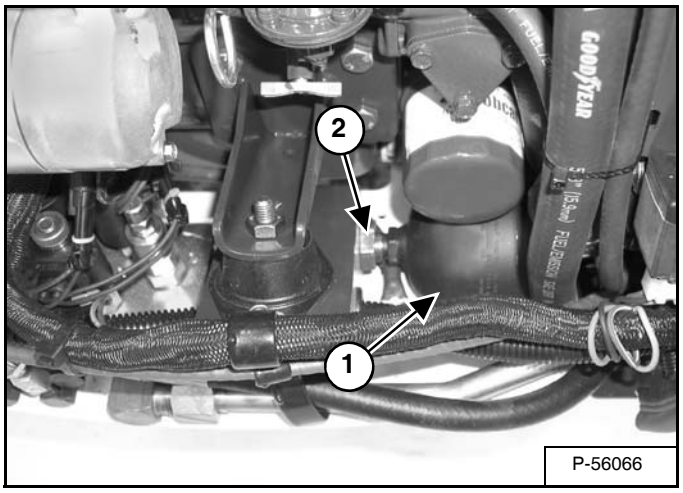
IMPORTANT

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

From the operator's seat, drain the residual pressure from the accumulator by stroking a function with the engine off and the key in the run position.

Figure 20-60-1



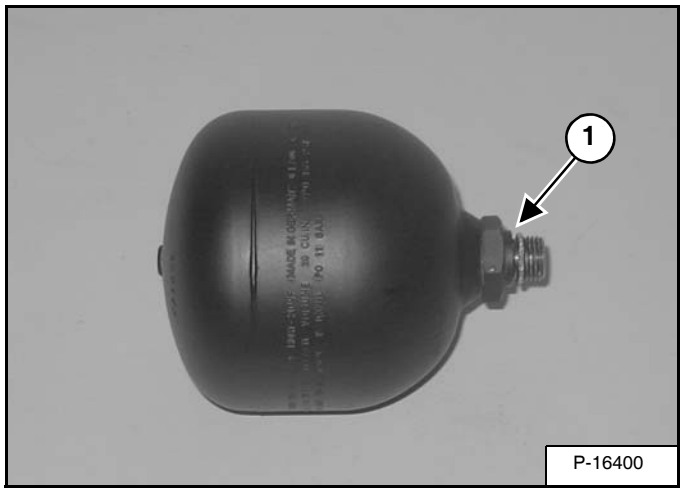
Open the tailgate. Remove the accumulator (Item 1) **[Figure 20-60-1]** from the manifold.

Installation: Tighten the accumulator and O-ring to 22-24 ft.-lb. (29-33 N•m) torque.

Remove the nut (Item 2) **[Figure 20-60-1]**.

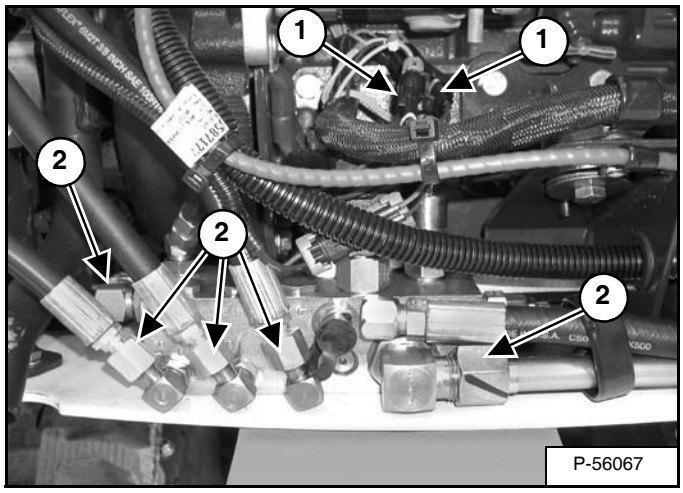
Removal And Installation (Cont'd)

Figure 20-60-2



Remove the O-ring (Item 1) **[Figure 20-60-2]** from the accumulator.

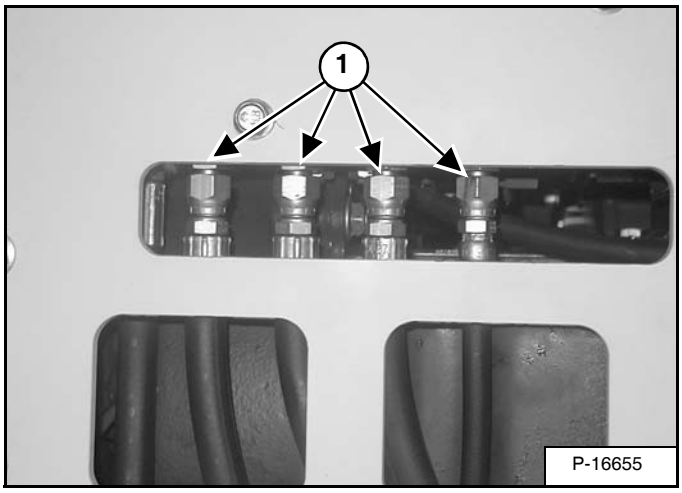
Figure 20-60-3



Disconnect the wire harnesses (Item 1) **[Figure 20-60-3]** from the coils.

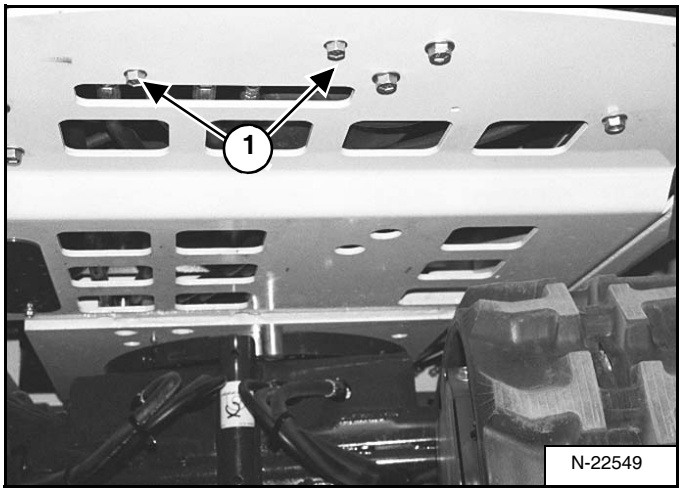
Mark and remove the hoses and tubelines (Item 2) **[Figure 20-60-3]** from the manifold.

Figure 20-60-4



Mark and remove the hoses (Item 1) **[Figure 20-60-4]** from under the upperstructure.

Figure 20-60-5

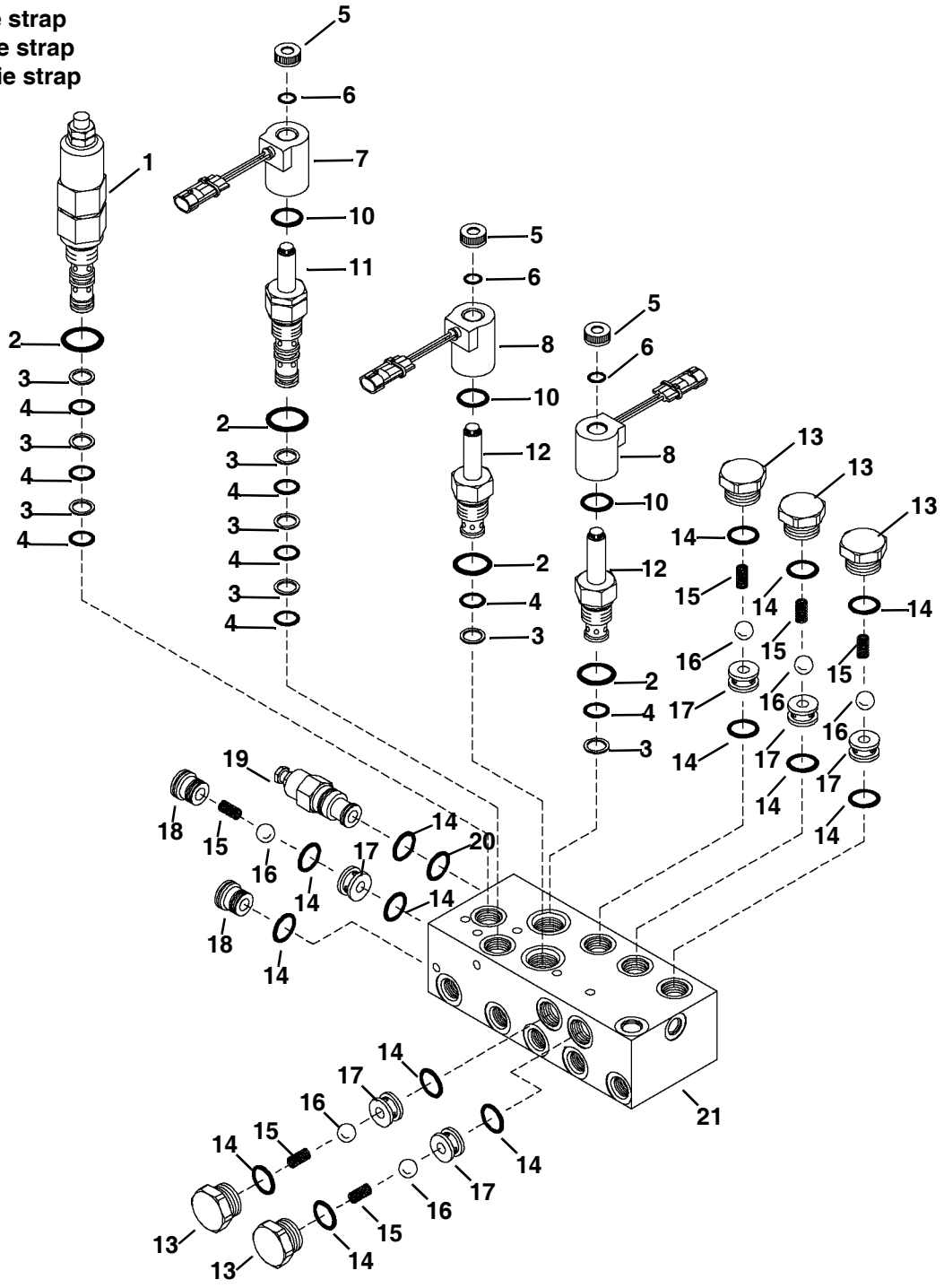


Remove the bolts (Item 1) **[Figure 20-60-5]** from under the upperstructure.

Remove the manifold.

Parts Identification (S/N 223911001 - 223911247 & S/N 224011001 - 224012293)

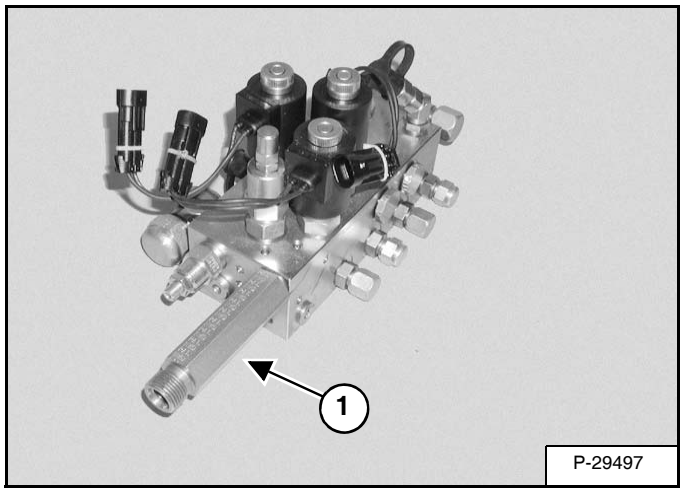
1. Pressure Reducing Valve
2. O-Ring
3. Backup Ring
4. O-Ring
5. O-Ring
6. Nut
7. Coil with green tie strap
8. Coil with yellow tie strap
9. Coil with orange tie strap
10. O-Ring
11. Solenoid
12. Solenoid
13. Plug
14. O-Ring
15. Spring
16. Bolt
17. Seat
18. Plug
19. Relief Valve
20. O-Ring
21. Valve Body



MS-1400A

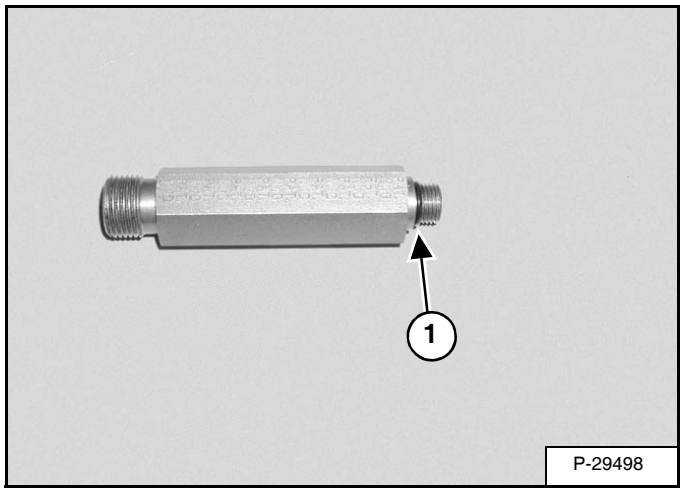
Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293)

Figure 20-60-6



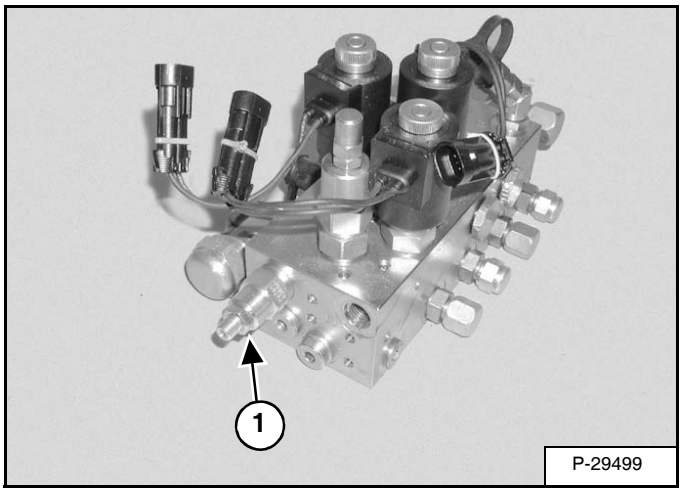
Remove the accumulator extension (Item 1) **[Figure 20-60-6]** from the manifold.

Figure 20-60-7



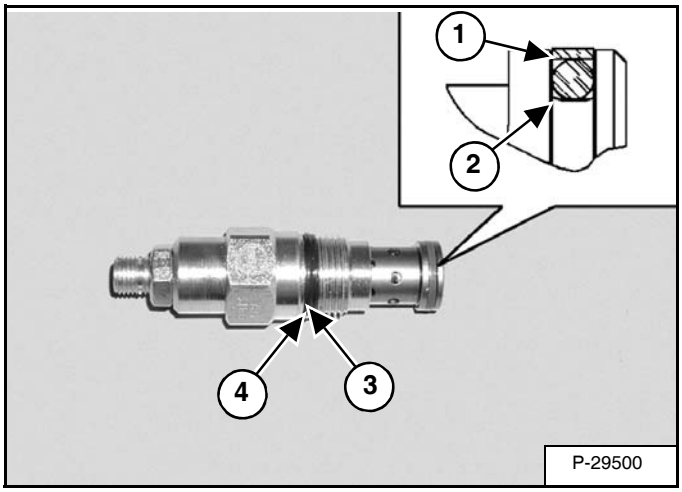
Remove the O-ring (Item 1) **[Figure 20-60-7]** from the accumulator extension.

Figure 20-60-8



Remove the relief valve (Item 1) **[Figure 20-60-8]** from the manifold.

Figure 20-60-9

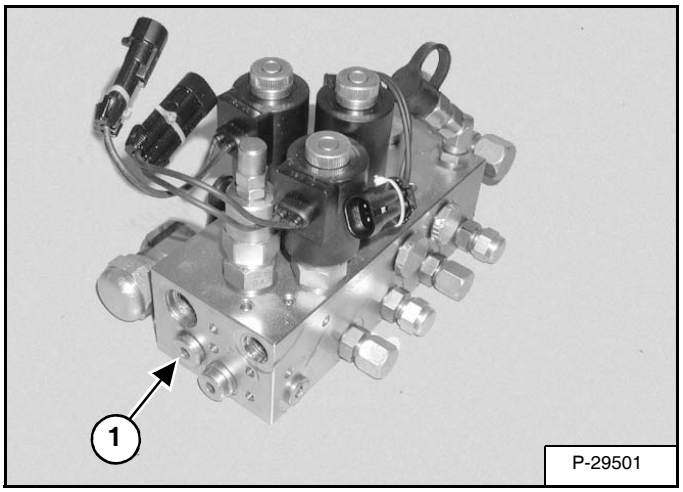


Remove the seal (Item 1) and O-ring (Item 2) **[Figure 20-60-9]** from the relief valve.

Remove the backup ring (Item 3) and O-ring (Item 4) **[Figure 20-60-9]** from the relief valve.

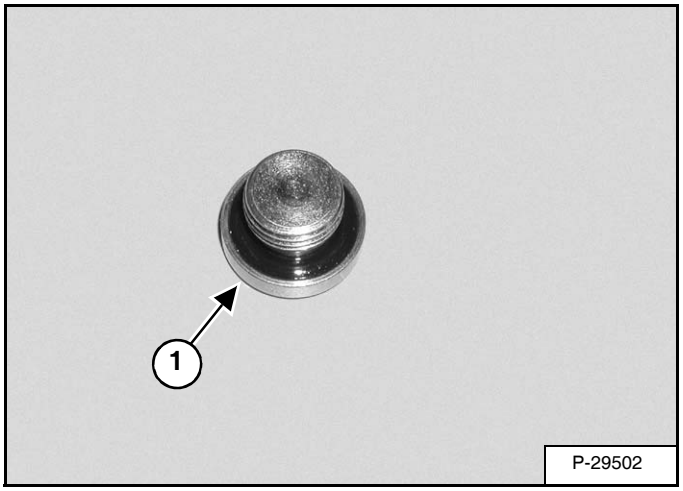
Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-10



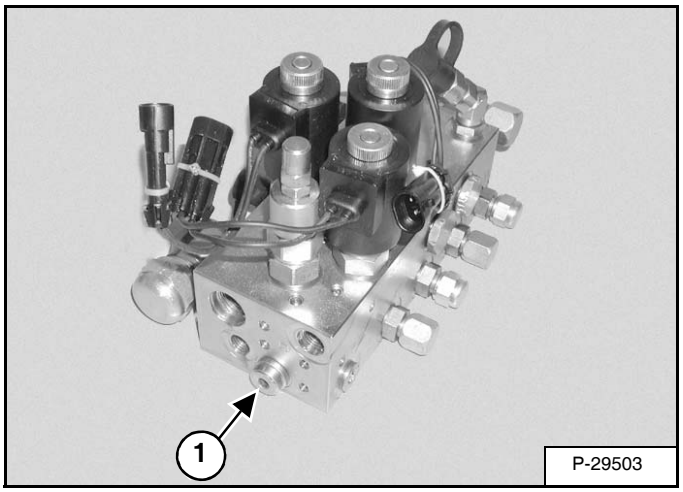
Remove the plug (Item 1) **[Figure 20-60-10]** from the manifold.

Figure 20-60-11



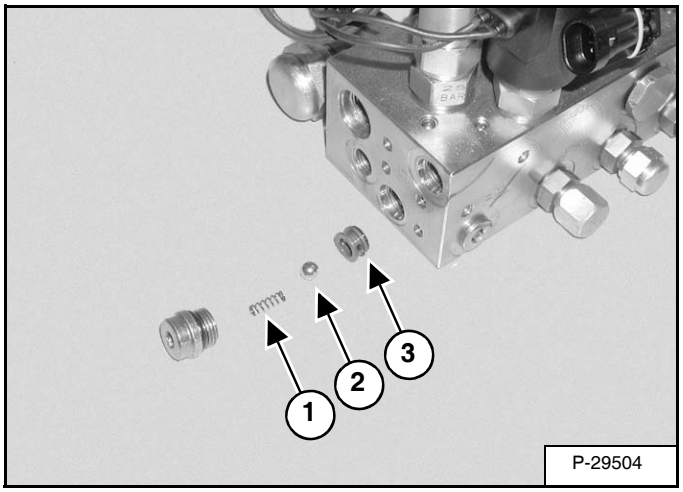
Remove the O-ring (Item 1) **[Figure 20-60-11]** from the plug.

Figure 20-60-12



Remove the plug (Item 1) **[Figure 20-60-12]** from the manifold.

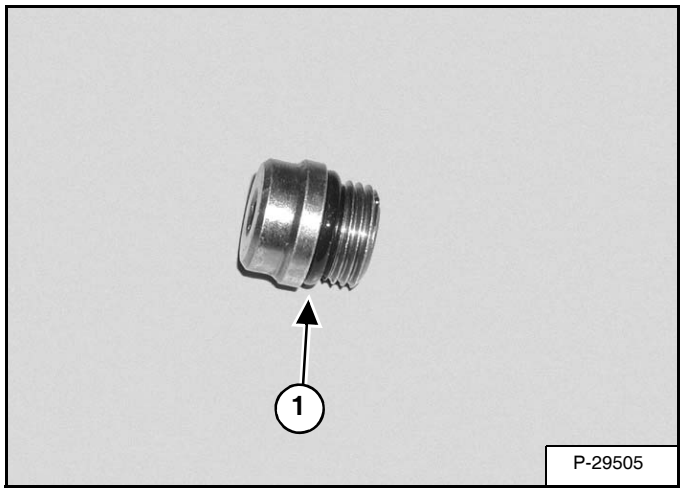
Figure 20-60-13



Remove the spring (Item 1), check ball (Item 2) and seat (Item 3) **[Figure 20-60-13]**.

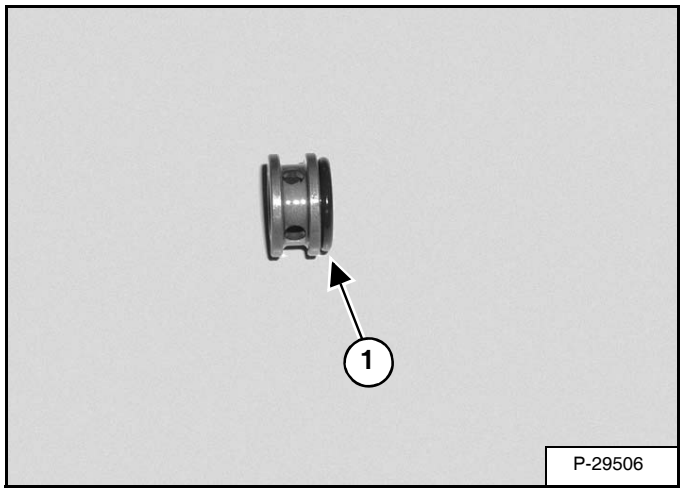
Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-14



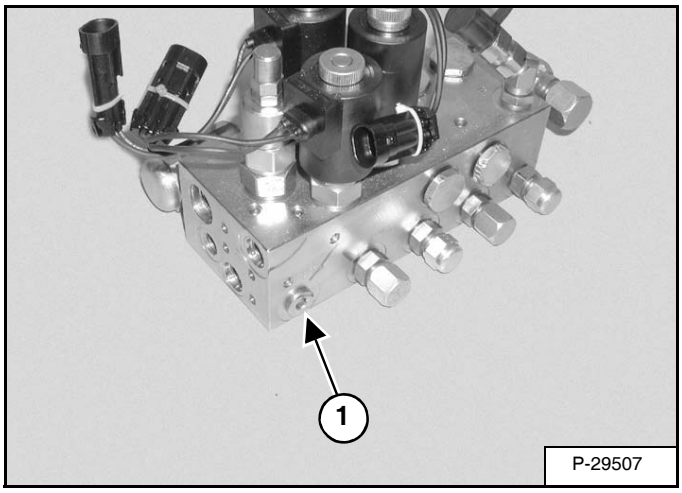
Remove the O-ring (Item 1) **[Figure 20-60-14]** from the plug.

Figure 20-60-15



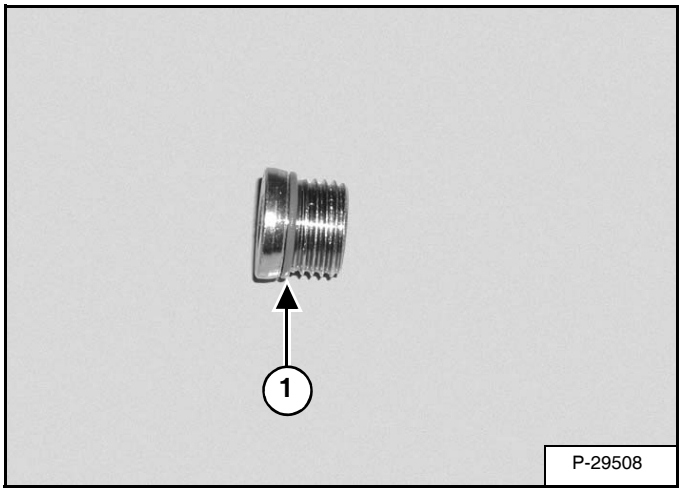
Remove the O-ring (Item 1) **[Figure 20-60-15]** from the seat.

Figure 20-60-16



Remove the plug (Item 1) **[Figure 20-60-16]**.

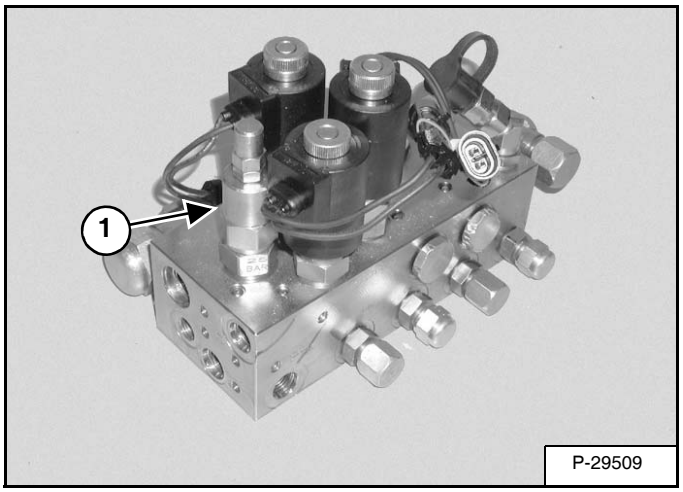
Figure 20-60-17



Remove the O-ring (Item 1) **[Figure 20-60-17]** from the plug.

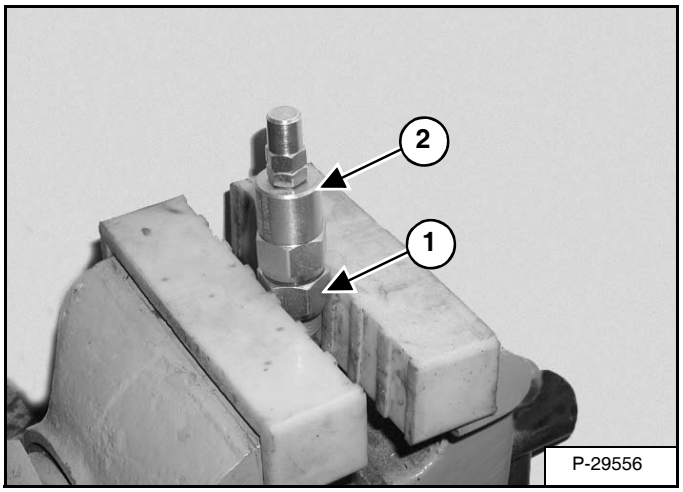
Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-18



Remove the pressure reducing valve (Item 1) **[Figure 20-60-18]** from the manifold.

Figure 20-60-19

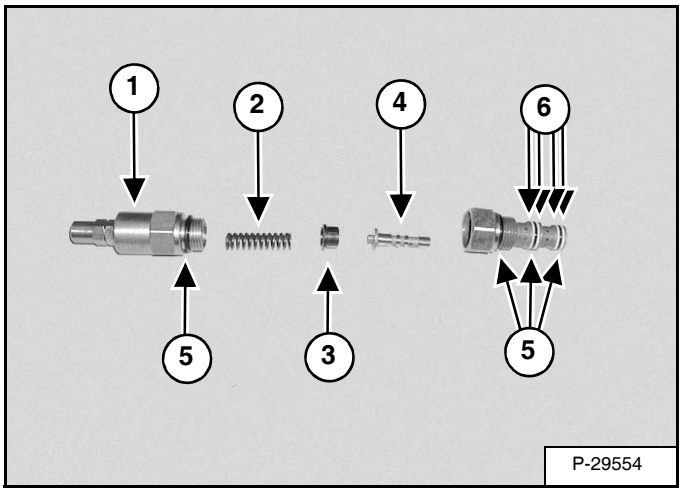


Place the bottom of the pressure reducing valve (Item 1) **[Figure 20-60-19]** in a vise equipped with padded jaws.

Loosen the top of the pressure reducing valve (Item 2) **[Figure 20-60-19]**.

Remove the valve from the vise.

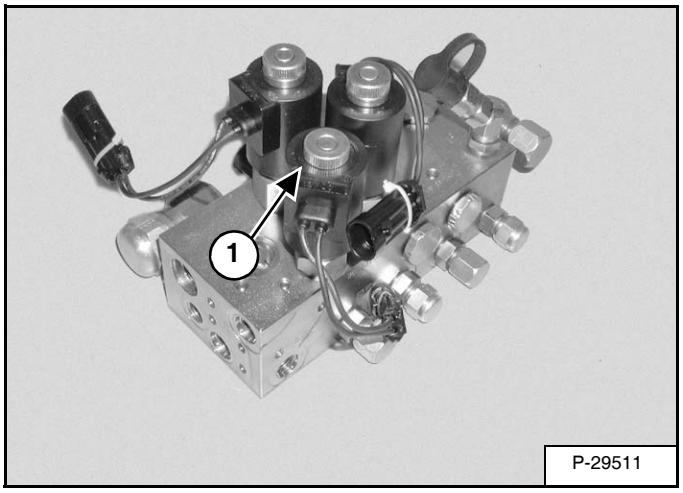
Figure 20-60-20



Remove the top of the valve (Item 1), spring (Item 2), spring seat (Item 3) and spool (Item 4) **[Figure 20-60-20]** from the bottom of the valve.

Remove the O-rings (Item 5) and back-up rings (Item 6) **[Figure 20-60-20]**.

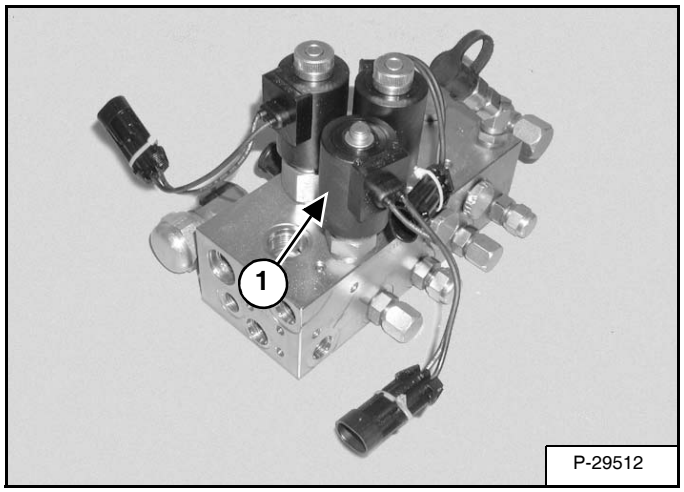
Figure 20-60-21



Remove the nut (Item 1) **[Figure 20-60-21]** from the joystick lockout solenoid.

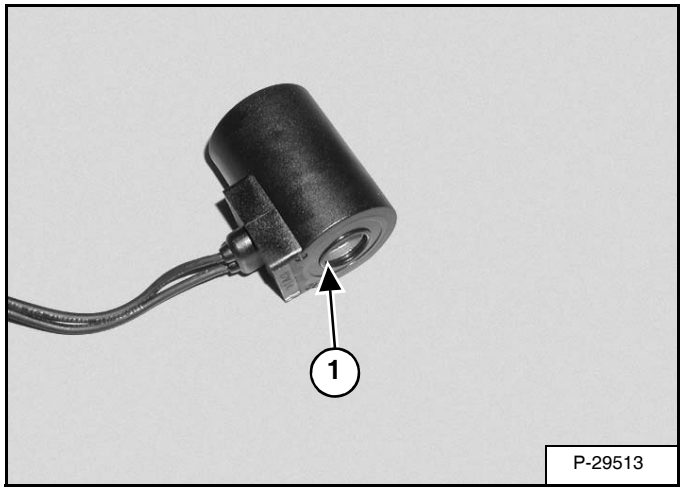
Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-22



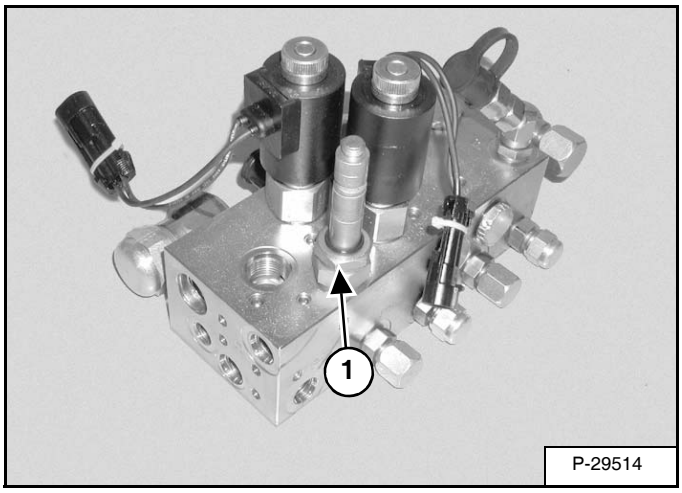
Remove the coil with the green tie strap (Item 1) **[Figure 20-60-22]** from the solenoid.

Figure 20-60-23



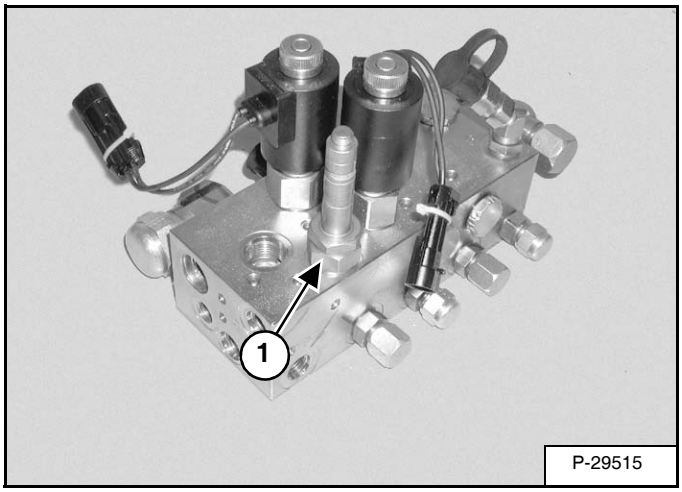
Remove the O-ring (Item 1) **[Figure 20-60-23]** from the coil.

Figure 20-60-24



Remove the O-ring (Item 1) **[Figure 20-60-24]** from the solenoid.

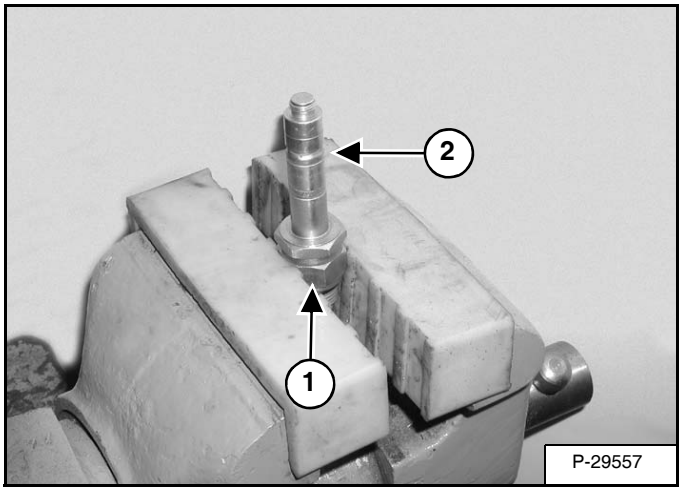
Figure 20-60-25



Remove the solenoid (Item 1) **[Figure 20-60-25]**.

Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-26

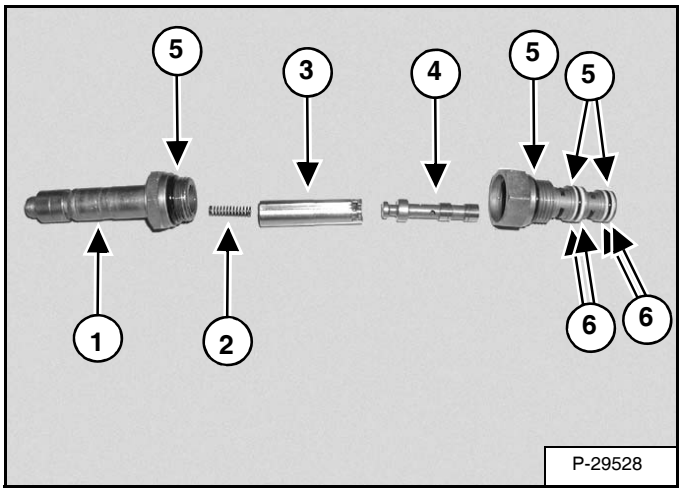


Place the bottom of the solenoid (Item 1) **[Figure 20-60-26]** in a vise equipped with padded jaws.

Loosen the top of the solenoid (Item 2) **[Figure 20-60-26]**.

Remove the solenoid from the vise.

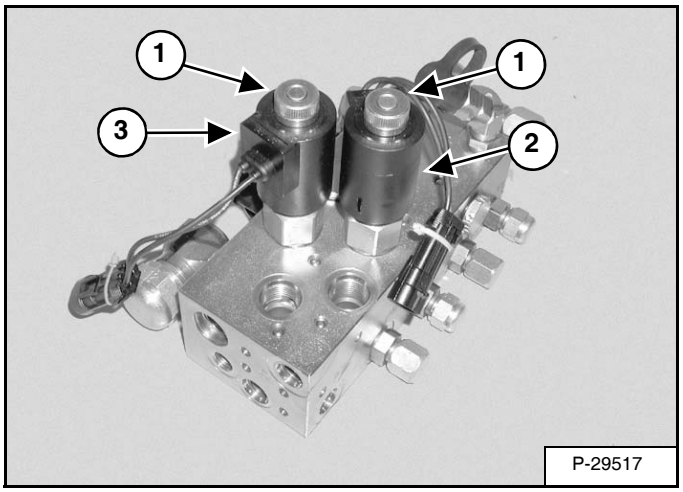
Figure 20-60-27



Remove the top of the solenoid (Item 1), spring (Item 2), spring seat (Item 3) and spool (Item 4) **[Figure 20-60-27]** from the bottom of the solenoid.

Remove the O-rings (Item 5) and back-up rings (Item 6) **[Figure 20-60-27]**.

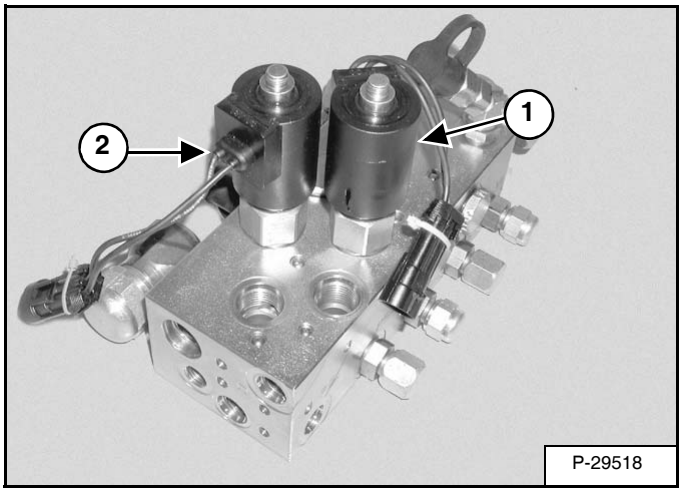
Figure 20-60-28



Remove the nut (Item 1) from the two speed solenoid (Item 2) and system bypass solenoid (Item 3) **[Figure 20-60-28]**.

The 320L is not equipped with the two speed solenoid.

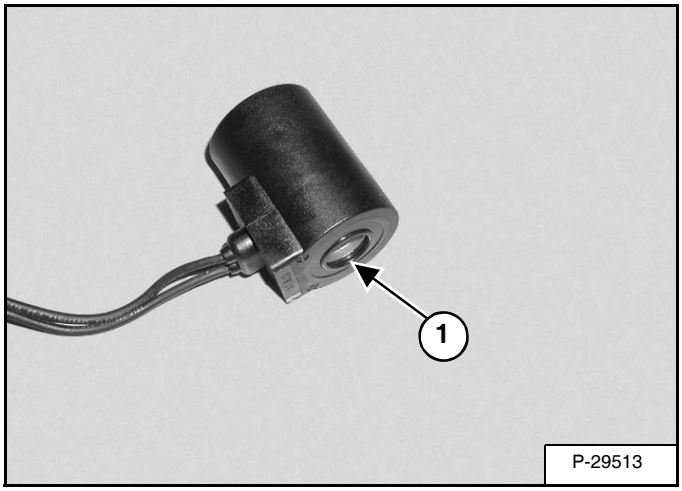
Figure 20-60-29



Remove the coil with the yellow tie strap (Item 1) and the coil with the orange tie strap (Item 2) **[Figure 20-60-29]** from the solenoids.

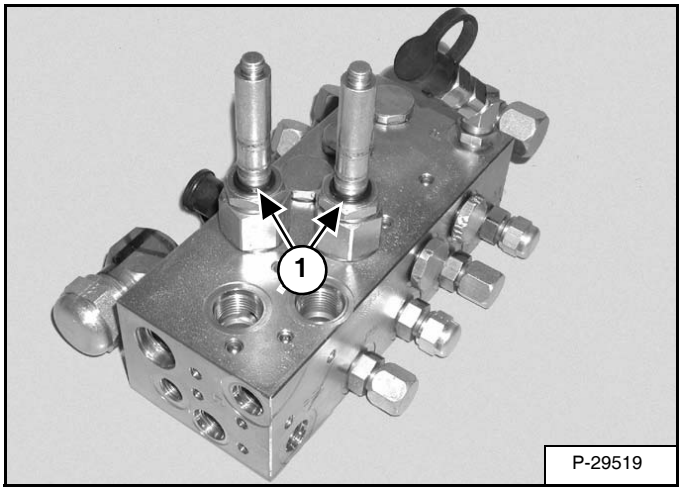
Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-30



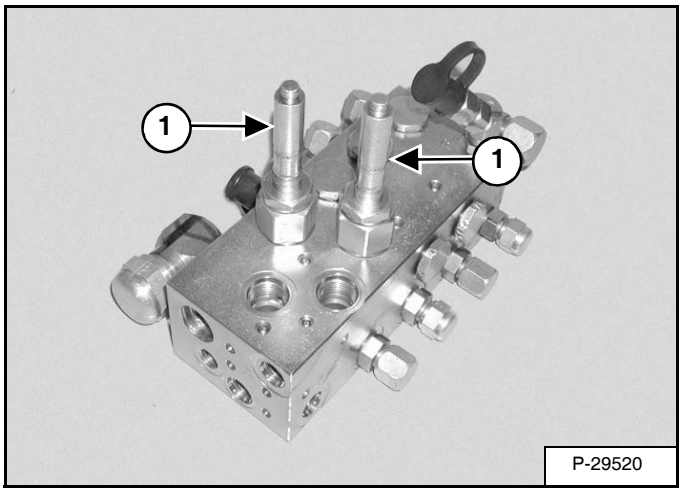
Remove the O-ring (Item 1) **[Figure 20-60-30]** from both coils.

Figure 20-60-31



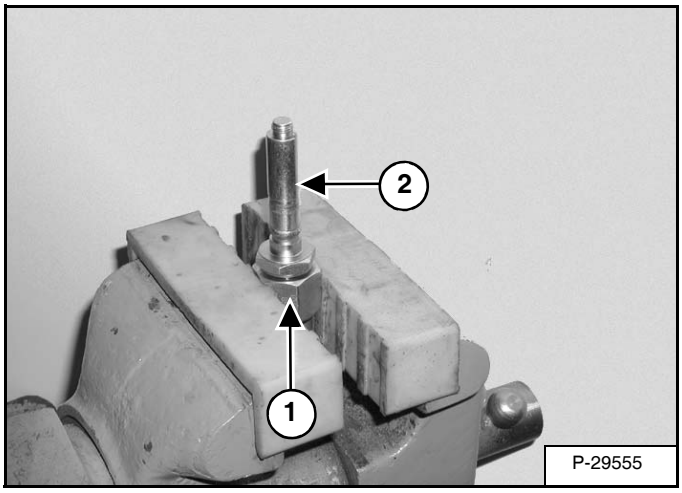
Remove the O-ring (Item 1) **[Figure 20-60-31]** from both solenoids.

Figure 20-60-32



Remove the solenoids (Item 1) **[Figure 20-60-32]**.

Figure 20-60-33



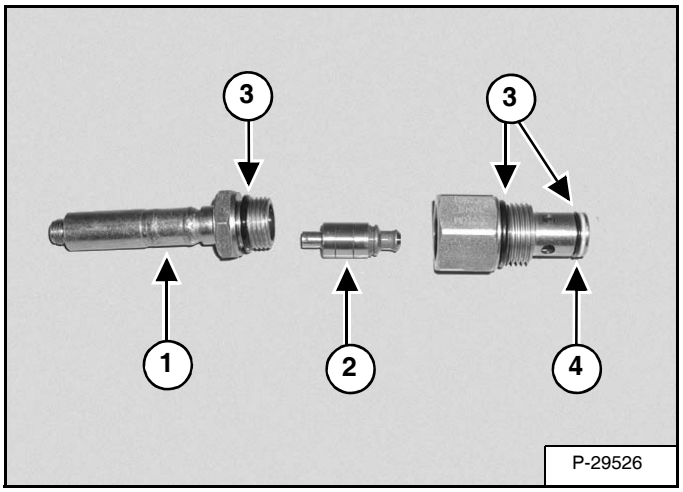
Place the bottom of the solenoid (Item 1) **[Figure 20-60-33]** in a vise equipped with padded jaws.

Loosen the top of the solenoid (Item 2) **[Figure 20-60-33]**.

Remove the solenoid from the vise.

Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

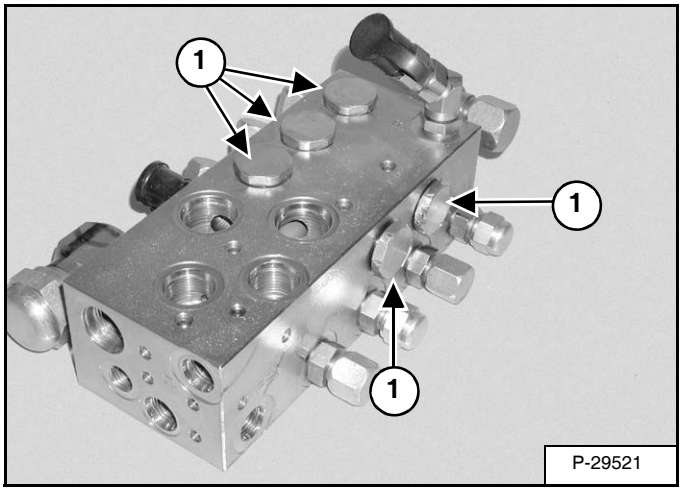
Figure 20-60-34



Remove the top of the solenoid (Item 1) and the spool (Item 2) **[Figure 20-60-34]** from the bottom of the solenoid.

Remove the O-rings (Item 3) and back-up ring (Item 4) **[Figure 20-60-34]**.

Figure 20-60-35



Remove the plugs (Item 1) **[Figure 20-60-35]** from the top and side of the manifold.

Figure 20-60-36

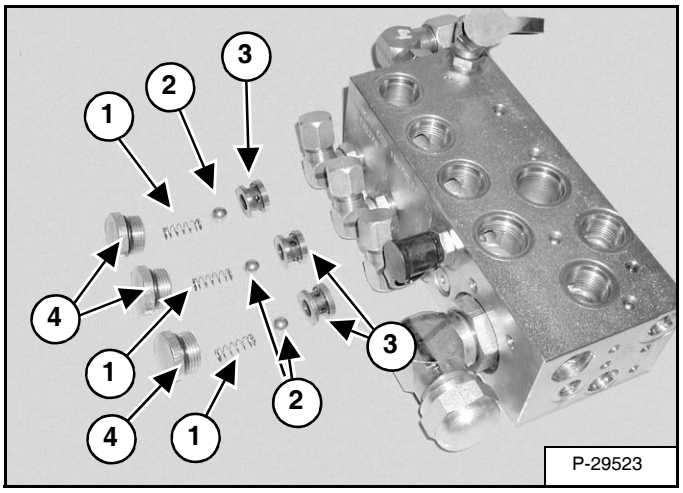
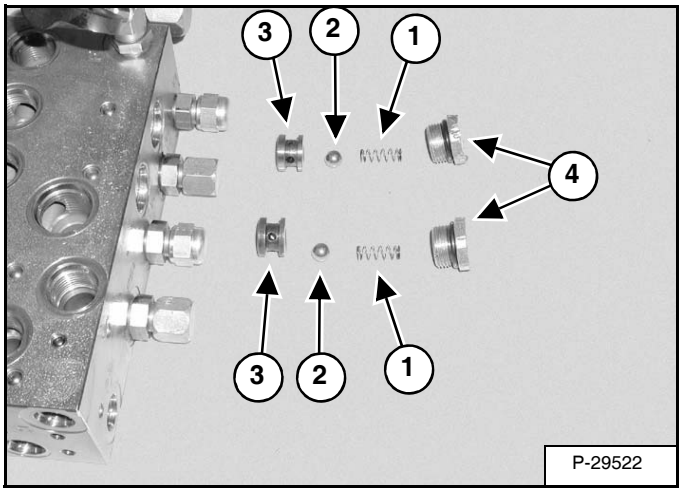


Figure 20-60-37

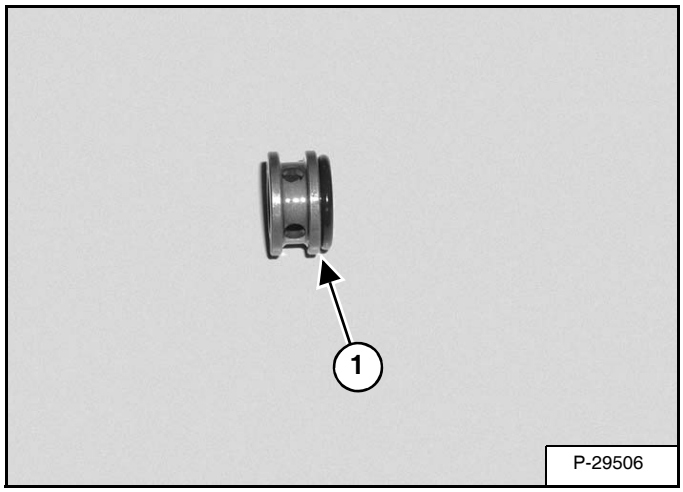


Remove the springs (Item 1), check balls (Item 2) and seats (Item 3) **[Figure 20-60-36]** & **[Figure 20-60-37]**.

Remove the O-rings (Item 4) **[Figure 20-60-36]** & **[Figure 20-60-37]** from the plugs.

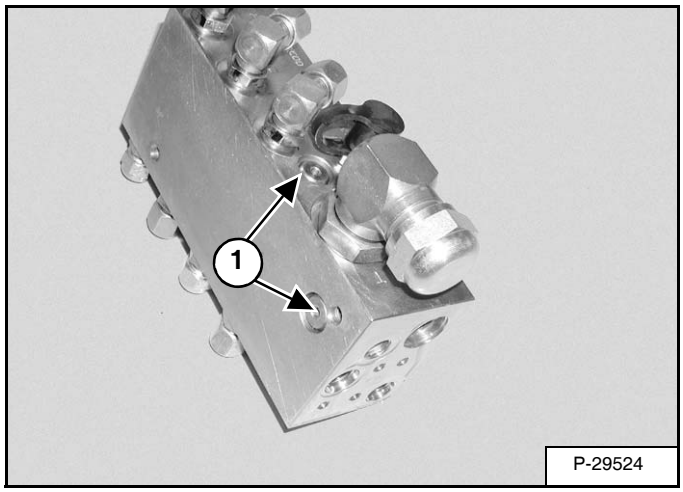
Disassembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-38



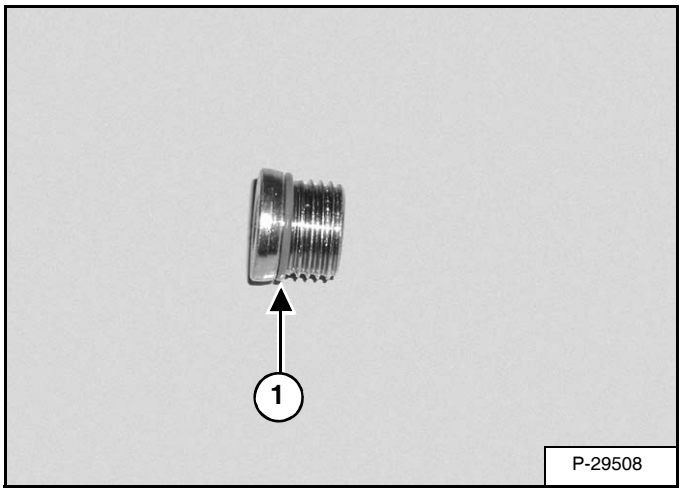
Remove the O-rings (Item 1) **[Figure 20-60-38]** from the seats.

Figure 20-60-39



Remove the plugs (Item 1) **[Figure 20-60-39]**.

Figure 20-60-40



Remove the O-rings (Item 1) **[Figure 20-60-40]** from the plugs.

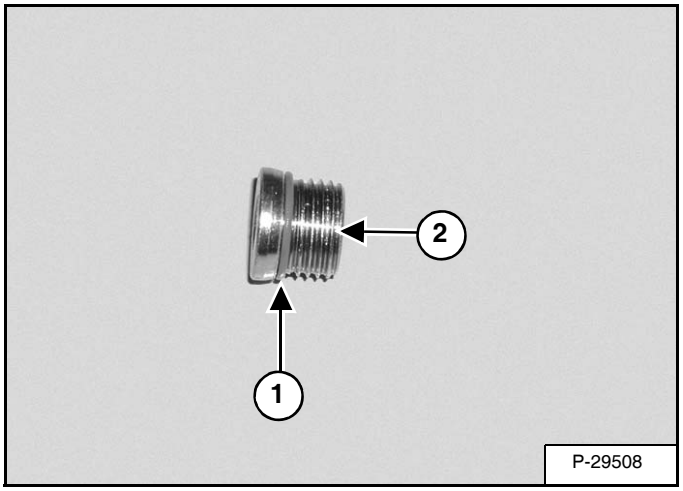
Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293)

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

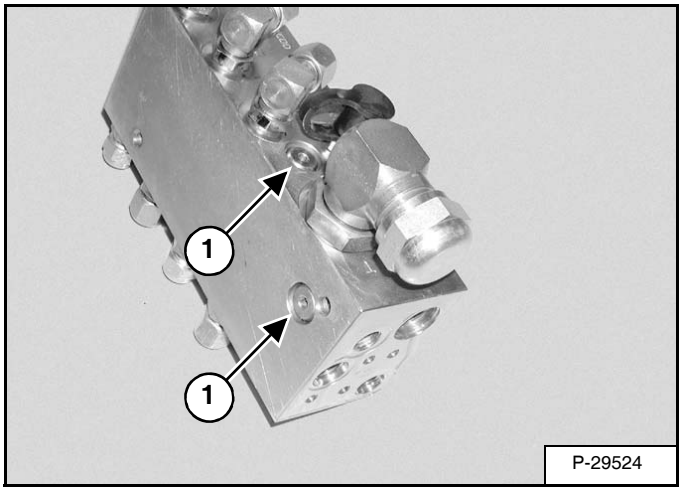
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-60-41



Install the O-rings (Item 1) on the plugs (Item 2) **[Figure 20-60-41]**.

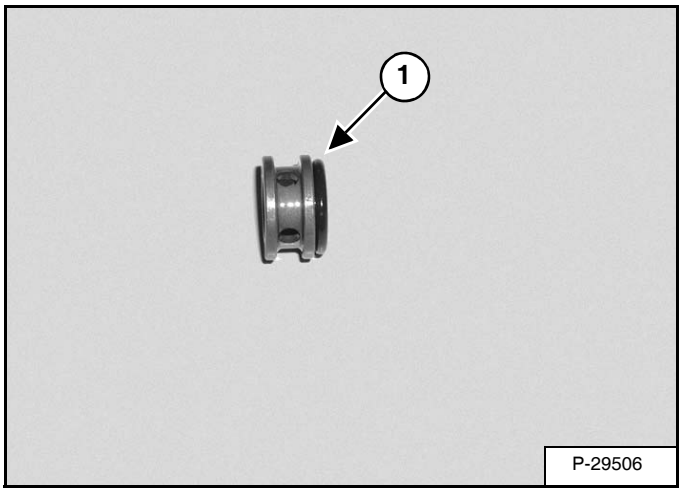
Figure 20-60-42



Install the plugs (Item 1) **[Figure 20-60-42]**.

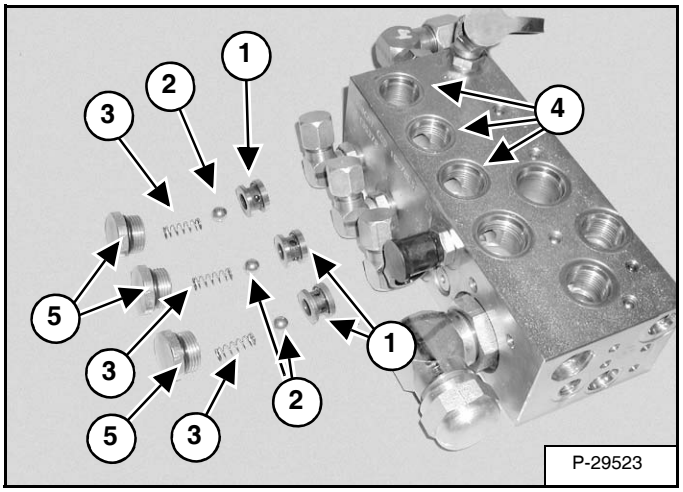
Tighten the plugs to 8-10 ft.-lb. (11-14 N•m) torque.

Figure 20-60-43



Install the O-rings (Item 1) **[Figure 20-60-43]** on the seats.

Figure 20-60-44

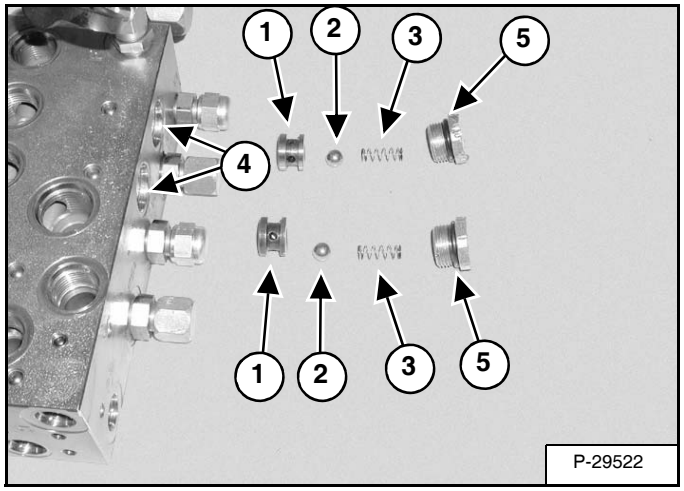


Install the seats (Item 1), check balls (Item 2) and springs (Item 3) in the top ports (Item 4) **[Figure 20-60-44]**.

Install the O-rings (Item 5) **[Figure 20-60-44]** on the plugs.

Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

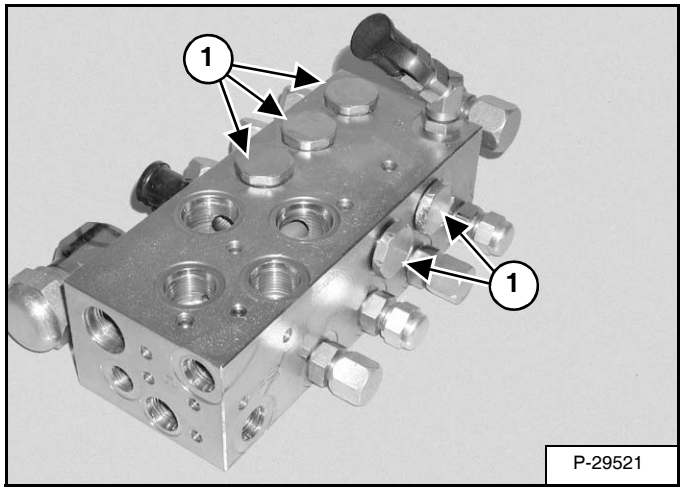
Figure 20-60-45



Install the seats (Item 1), check balls (Item 2) and springs (Item 3) in the side ports (Item 4) **[Figure 20-60-45]**.

Install the O-rings (Item 5) **[Figure 20-60-45]** on the plugs.

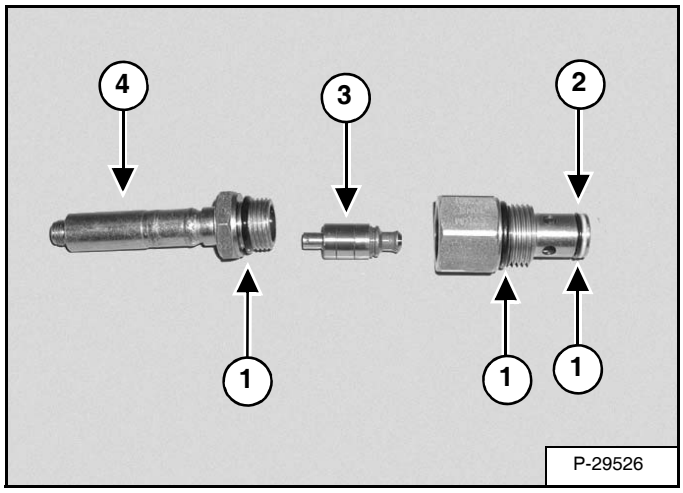
Figure 20-60-46



Install the plugs (Item 1) **[Figure 20-60-46]**.

Tighten the plugs to 44 ft.-lb. (60 N•m) torque.

Figure 20-60-47

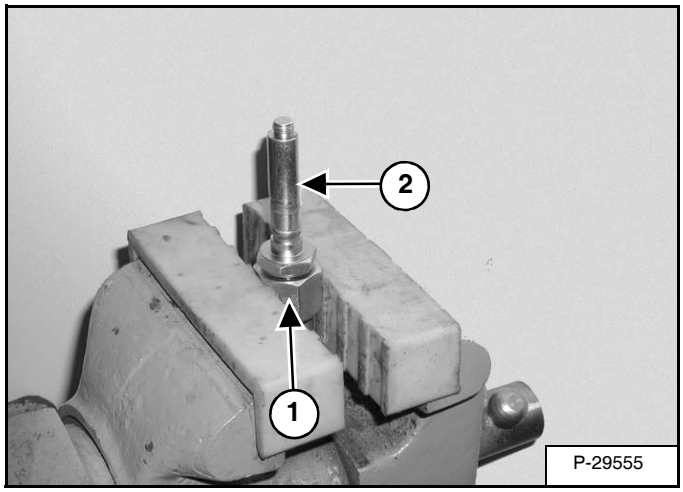


Install the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-60-47]** on the solenoids.

Install the spool (Item 3) **[Figure 20-60-47]** in the bottom of the solenoid.

Install the top of the solenoid (Item 4) **[Figure 20-60-47]** on the bottom of the solenoid.

Figure 20-60-48

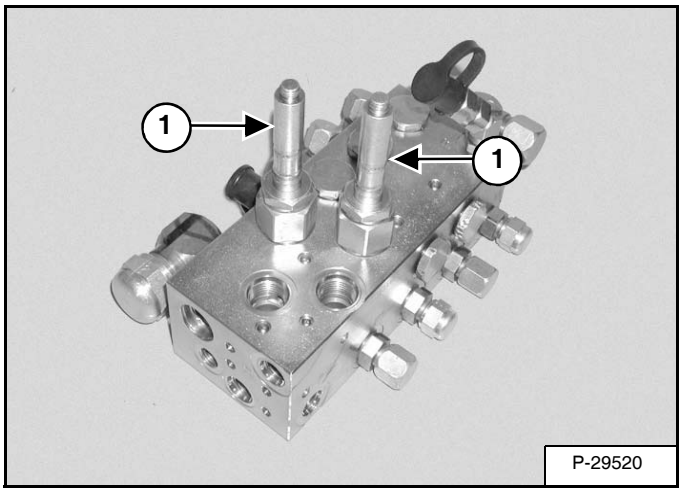


Place the bottom of the solenoid (Item 1) **[Figure 20-60-48]** in a vise equipped with padded jaws.

Tighten the top of the solenoid (Item 2) **[Figure 20-60-48]** to 37 ft.-lb. (50 N•m) torque.

Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

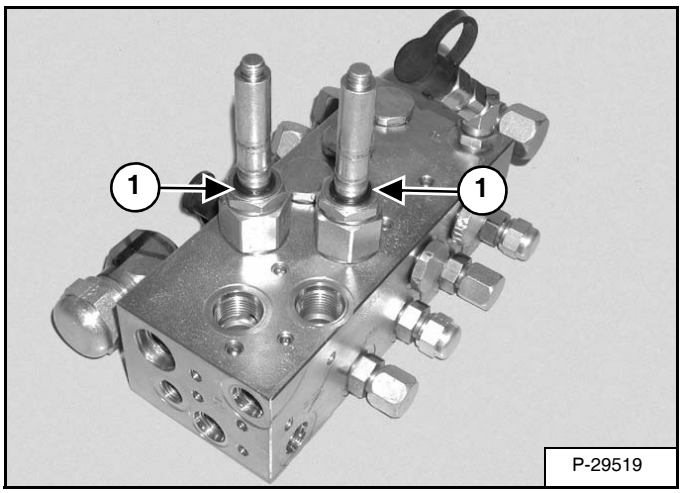
Figure 20-60-49



Install the solenoids (Item 1) **[Figure 20-60-49]**.

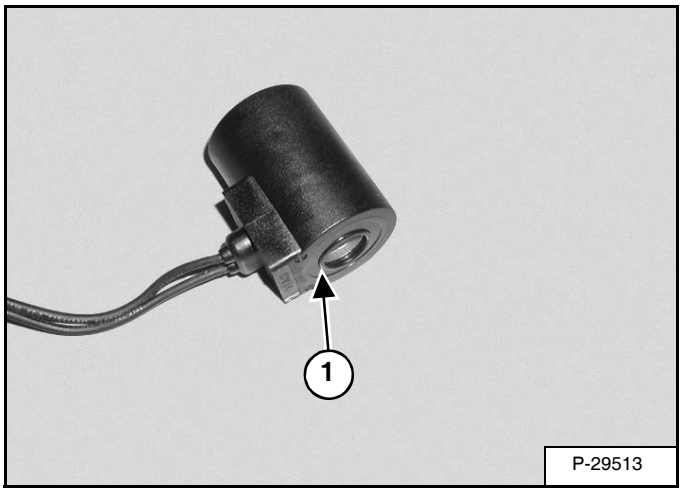
Tighten the solenoids to 37 ft.-lb. (50 N•m) torque.

Figure 20-60-50



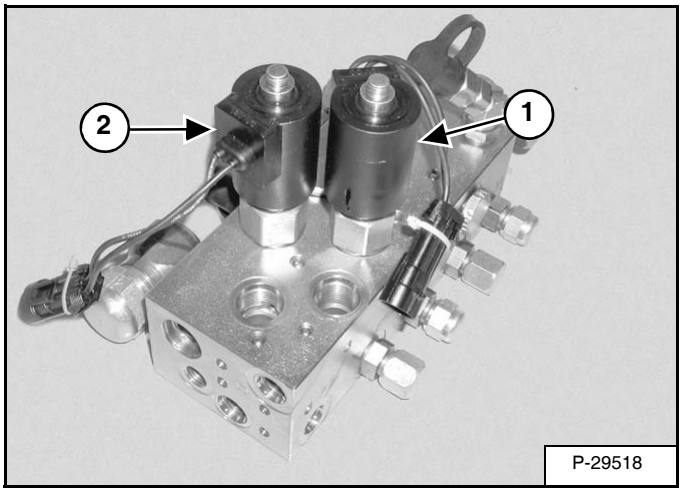
Install the O-rings (Item 1) **[Figure 20-60-50]** on the solenoids.

Figure 20-60-51



Install the O-rings (Item 1) **[Figure 20-60-51]** on both coils.

Figure 20-60-52

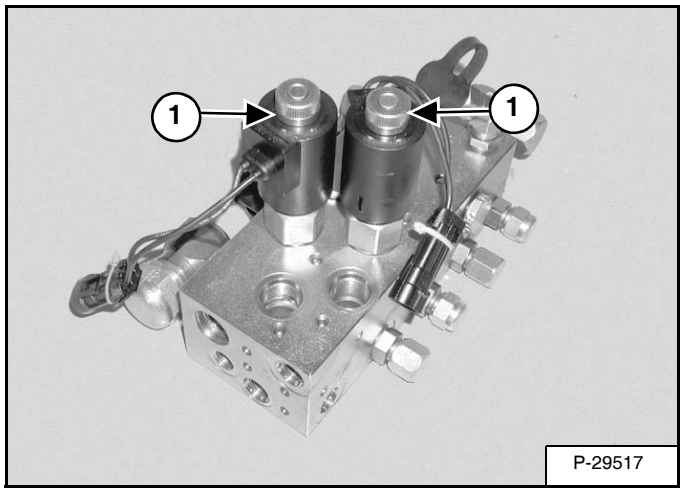


Install the coil with the yellow tie strap (Item 1) **[Figure 20-60-52]** on the two speed solenoid.

Install the coil with the orange tie strap (Item 2) **[Figure 20-60-52]** on the system bypass solenoid.

Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-53

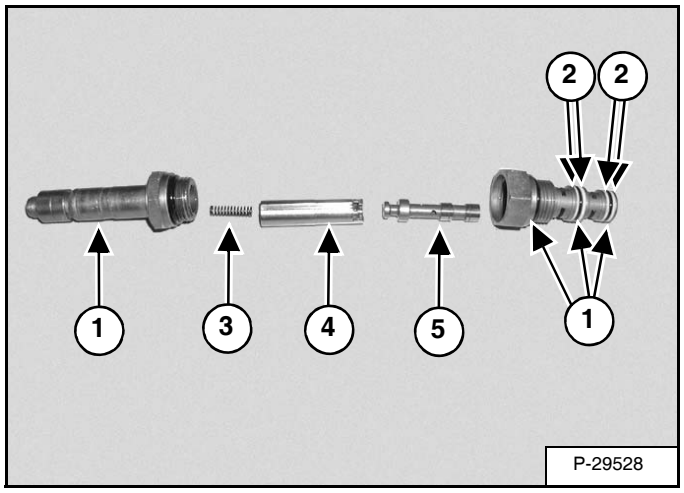


Install the nuts (Item 1) **[Figure 20-60-53]** on the solenoids.

Tighten the nuts to 3-4.5 ft.-lb. (4,1 - 6,1 N•m) torque.

NOTE: Overtightening the nut (Item 1) [Figure 20-60-53] may cause solenoid or coil failure.

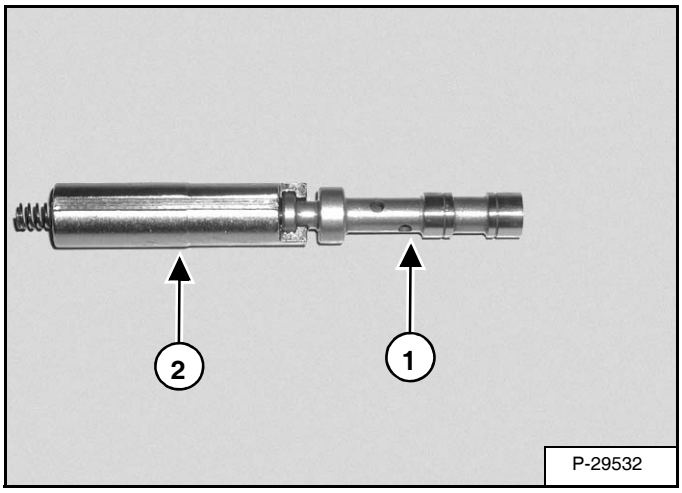
Figure 20-60-54



Install the O-rings (Item 1) and back-up rings (Item 2) **[Figure 20-60-54]** on the solenoid.

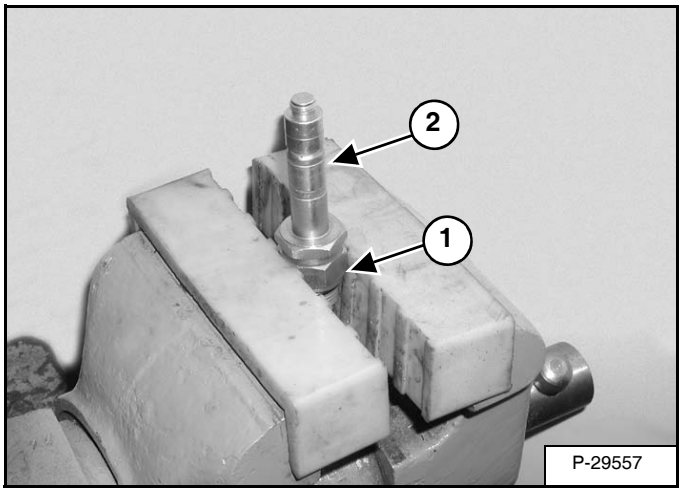
Install the spring (Item 3), spring seat (Item 4) and spool (Item 5) **[Figure 20-60-54]** in the bottom of the solenoid.

Figure 20-60-55



NOTE: Make sure the spool (Item 1) is installed in the spring seat (Item 2) [Figure 20-60-55] before installing the spool/spring seat in the bottom of the solenoid.

Figure 20-60-56



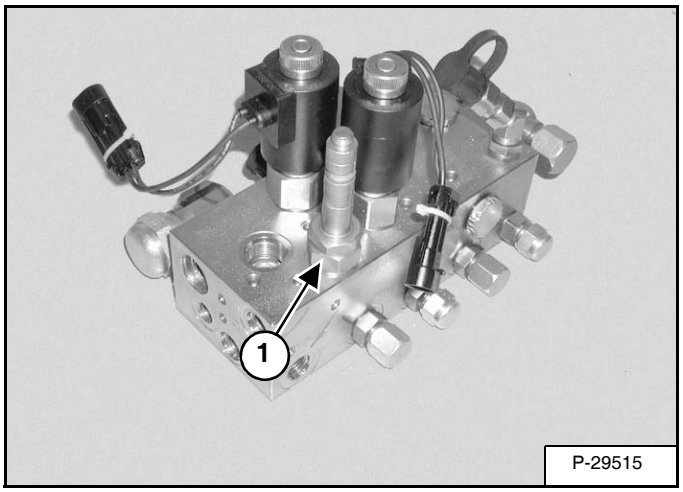
Place the bottom of the solenoid (Item 1) **[Figure 20-60-56]** in a vise equipped with padded jaws.

Install the top of the solenoid (Item 2) **[Figure 20-60-56]** on the bottom of the solenoid.

Tighten the top of the solenoid (Item 2) **[Figure 20-60-56]** to 22 ft.-lb. (30 N•m) torque.

Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

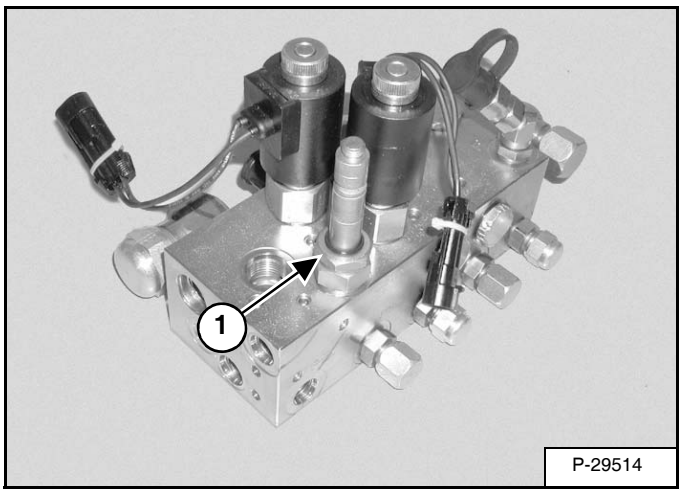
Figure 20-60-57



Install the solenoid (Item 1) **[Figure 20-60-57]**.

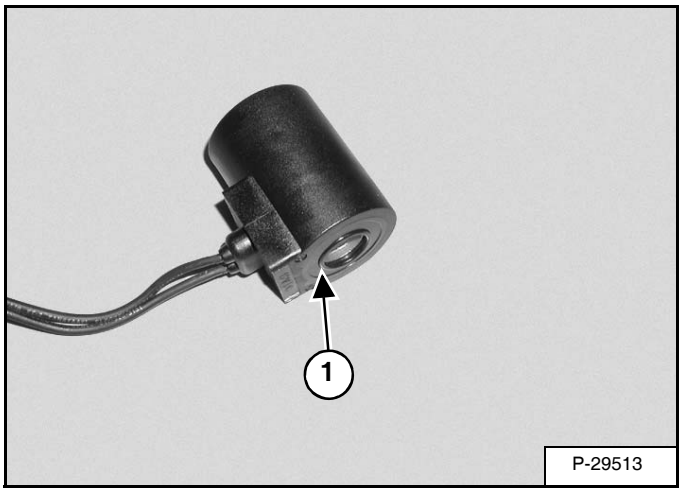
Tighten the solenoid to 22 ft.-lb. (30 N•m) torque.

Figure 20-60-58



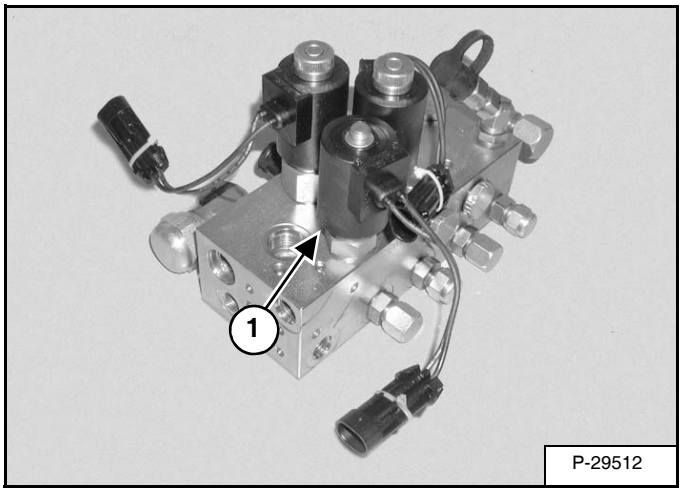
Install the O-ring (Item 1) **[Figure 20-60-58]** on the solenoid.

Figure 20-60-59



Install the O-ring (Item 1) **[Figure 20-60-59]** on the coil.

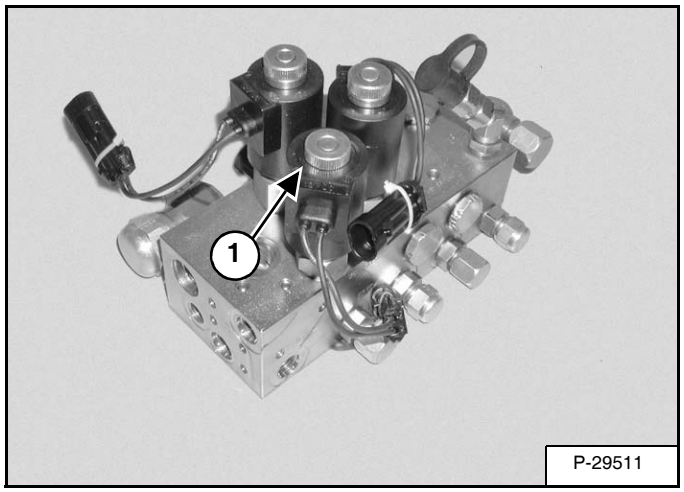
Figure 20-60-60



Install the coil with the green tie strap (Item 1) **[Figure 20-60-60]** on the joystick lockout solenoid.

Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-61

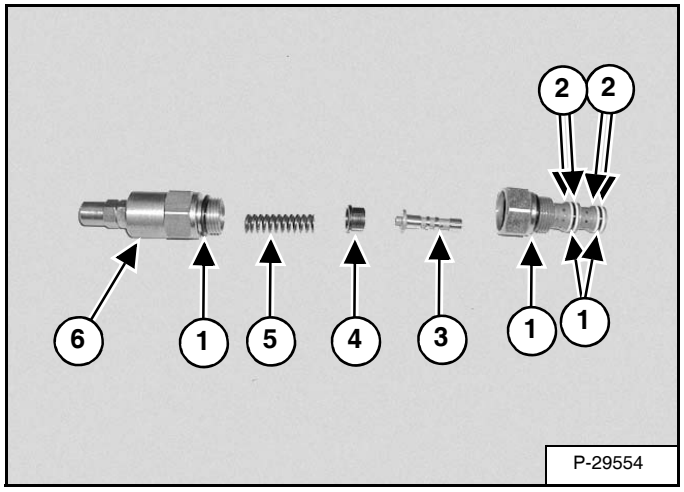


Install the nut (Item 1) **[Figure 20-60-61]** on the solenoid.

Tighten the nut to 3-4.5 ft. -lbs. (4,1 - 6,1 N•m) torque.

NOTE: Overtightening the nut (Item 1) [Figure 20-60-61] may cause solenoid or coil failure.

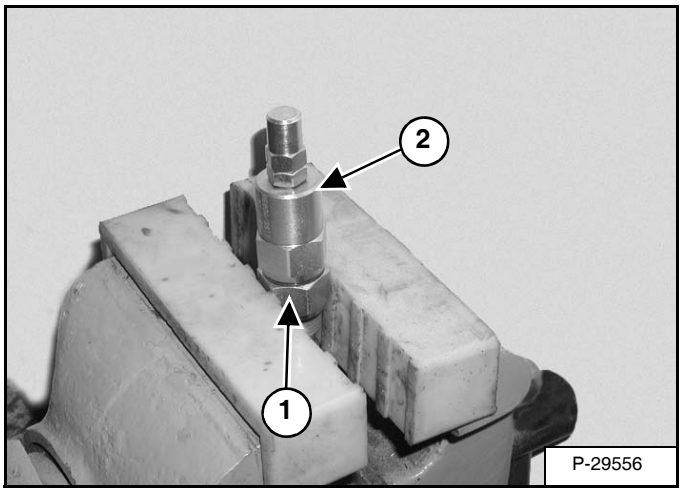
Figure 20-60-62



Install the O-rings (Item 1) and backup rings (Item 2) **[Figure 20-60-62]** on the pressure reducing valve.

Install the spool (Item 3) seat (Item 4) and spring (Item 5) in the bottom of the valve. Install the top of the valve (Item 6) **[Figure 20-60-62]**.

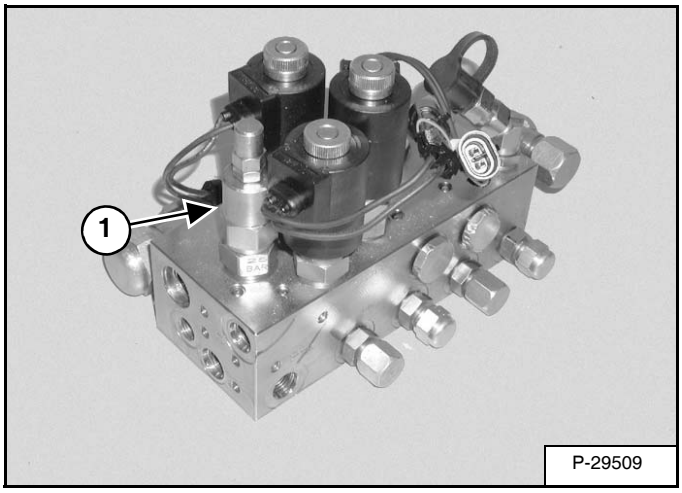
Figure 20-60-63



Place the bottom of the valve (Item 1) **[Figure 20-60-63]** in a vise equipped with padded jaws.

Tighten the top of the valve (Item 2) **[Figure 20-60-63]** to 22 ft.-lb. (30 N•m) torque.

Figure 20-60-64

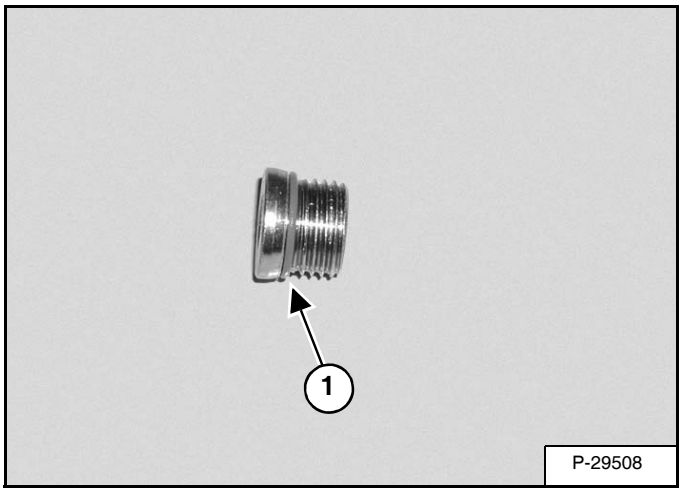


Install the pressure reducing valve (Item 1) **[Figure 20-60-64]** in the manifold.

Tighten the valve to 22 ft.-lb. (30 N•m) torque.

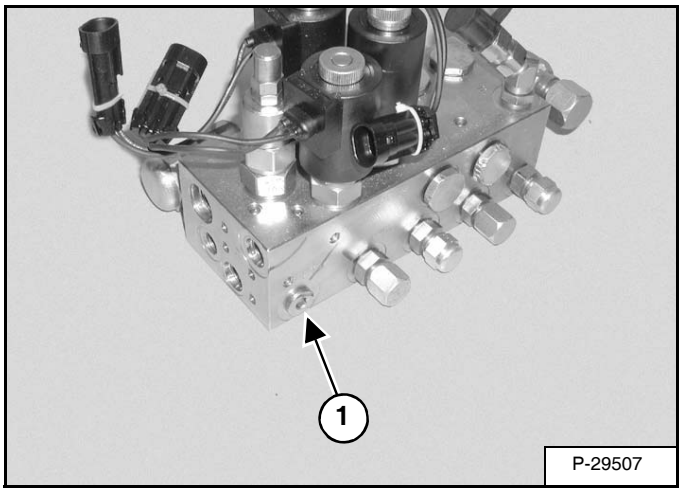
Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-65



Install the O-ring (Item 1) **[Figure 20-60-65]** on the plug.

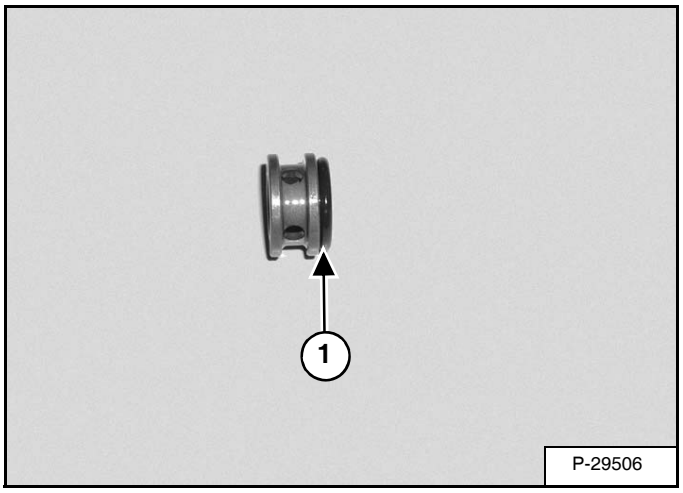
Figure 20-60-66



Install the plug (Item 1) **[Figure 20-60-66]**.

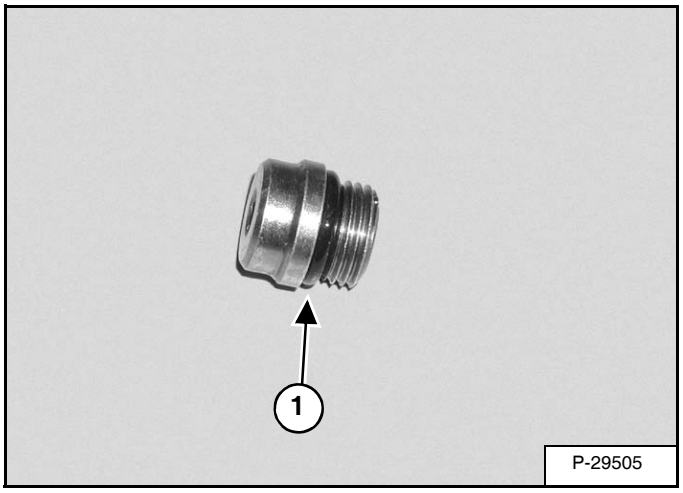
Tighten the plug to 37 ft.-lb. (50 N•m) torque.

Figure 20-60-67



Install the O-ring (Item 1) **[Figure 20-60-67]** on the seat.

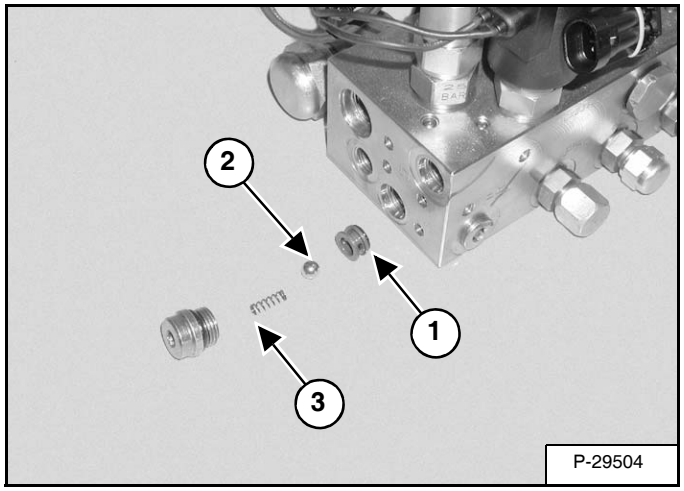
Figure 20-60-68



Install the O-ring (Item 1) **[Figure 20-60-68]** on the plug.

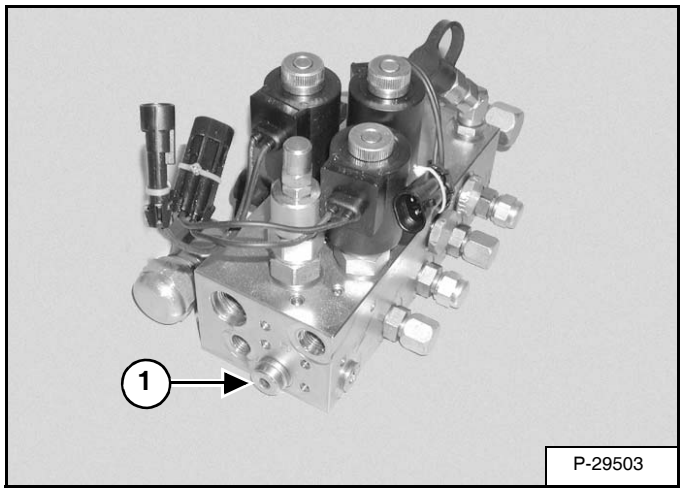
Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

Figure 20-60-69



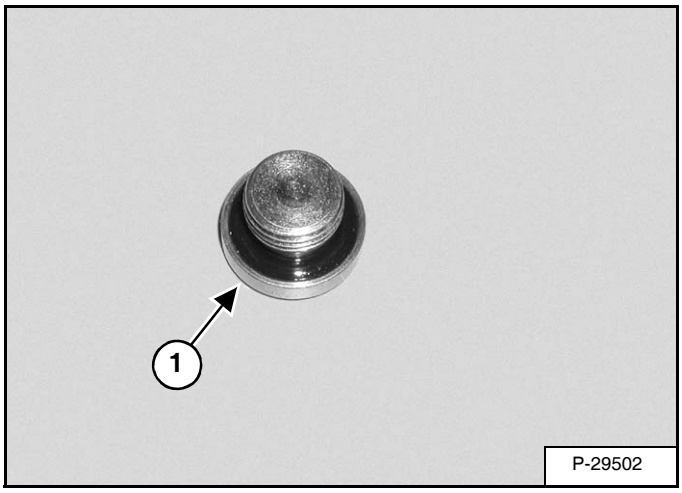
Install the seat (Item 1), check ball (Item 2) and spring (Item 3) **[Figure 20-60-69]**.

Figure 20-60-70



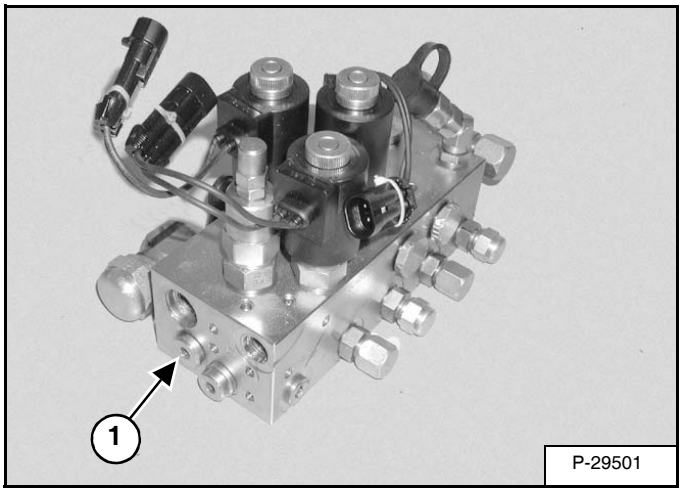
Install the plug (Item 1) **[Figure 20-60-70]** in the manifold.

Figure 20-60-71



Install the O-ring (Item 1) **[Figure 20-60-71]** on the plug.

Figure 20-60-72

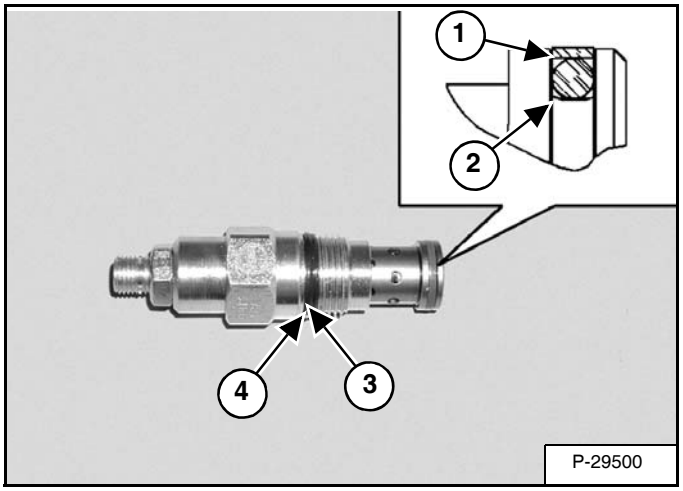


Install the plug (Item 1) **[Figure 20-60-72]** in the manifold.

Tighten the plug to 37 ft.-lb. (50 N•m) torque.

Assembly (S/N 223911001 - 223911247 & S/N 224011001 - 224012293) (Cont'd)

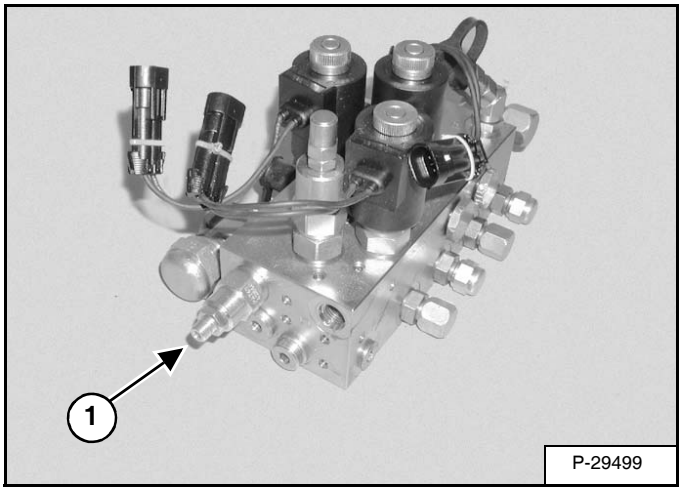
Figure 20-60-73



Install the O-ring (Item 1) and seal (Item 2) **[Figure 20-60-73]** on the relief valve.

Install the O-ring (Item 3) and back-up ring (Item 4) **[Figure 20-60-73]** on the relief valve.

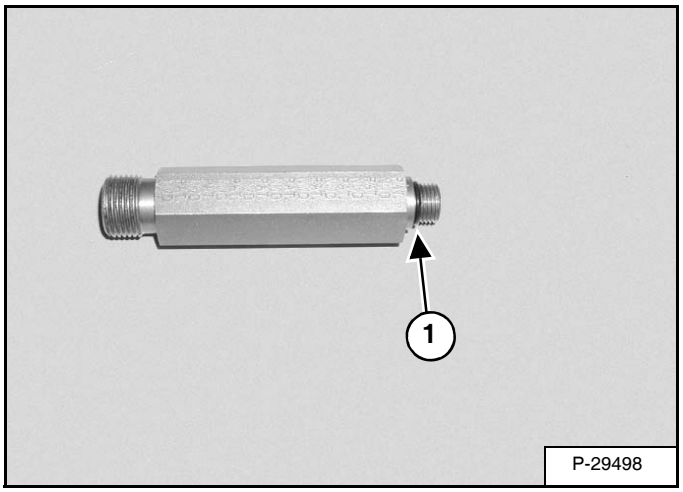
Figure 20-60-74



Install the relief valve (Item 1) **[Figure 20-60-74]** in the manifold.

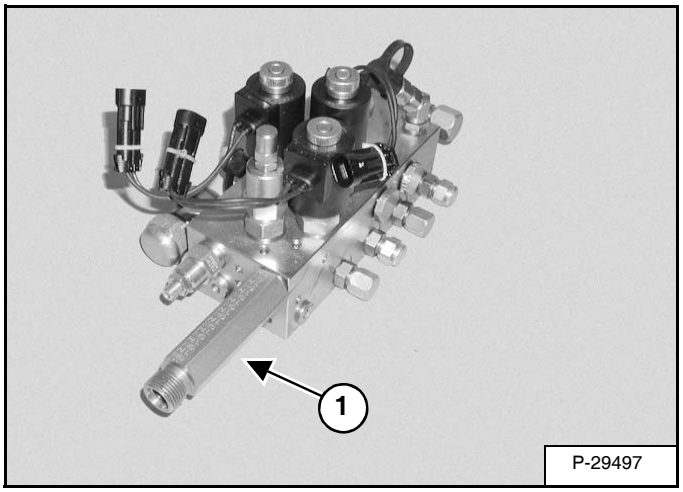
Tighten the valve to 18-22 ft.-lb. (25-30 N•m) torque.

Figure 20-60-75



Install the O-ring (Item 1) **[Figure 20-60-75]** on the accumulator extension.

Figure 20-60-76

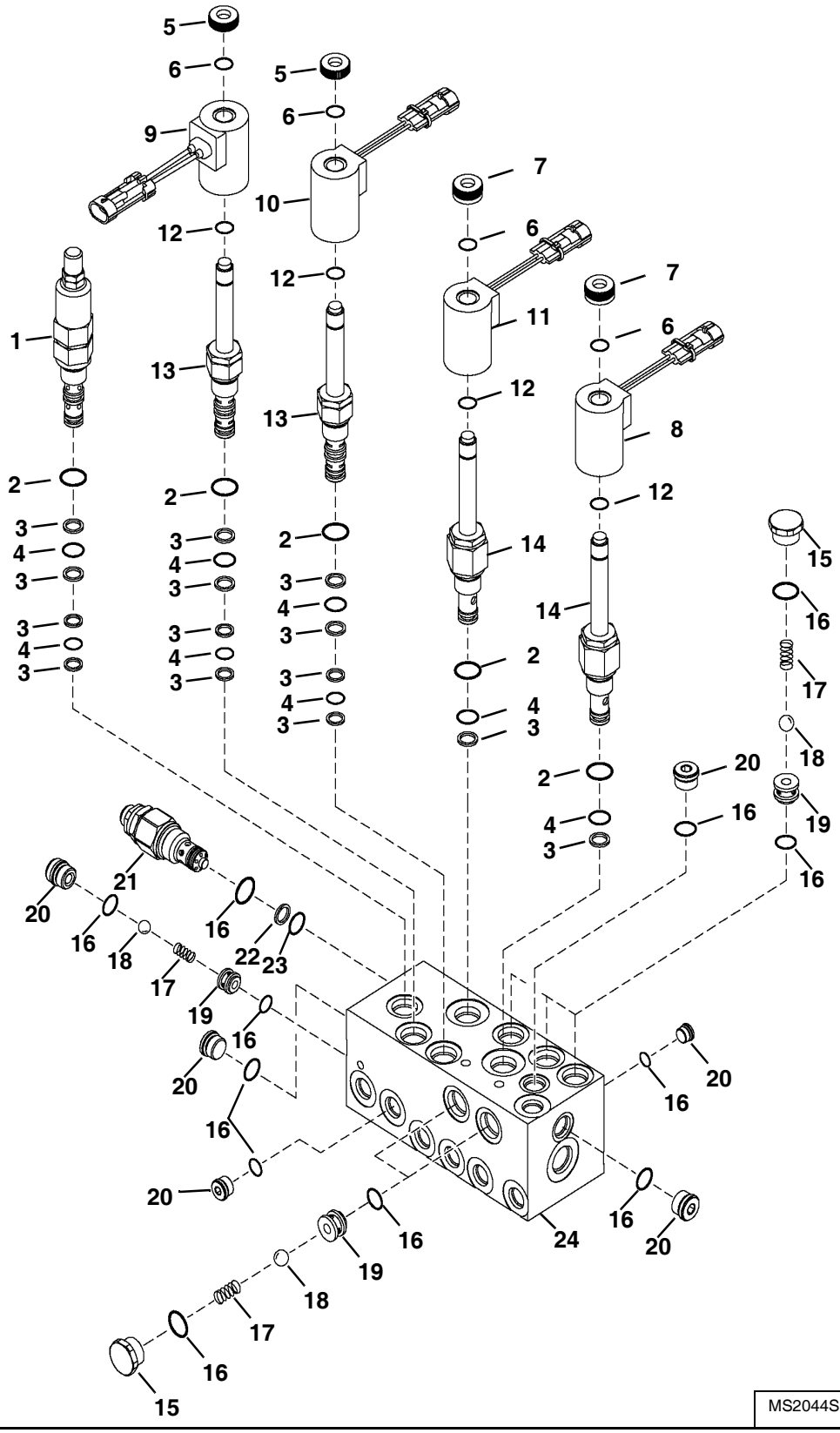


Install the accumulator extension (Item 1) **[Figure 20-60-76]** on the manifold.

Tighten the extension to 22-24 ft.-lb. (29-33 N•m) torque.

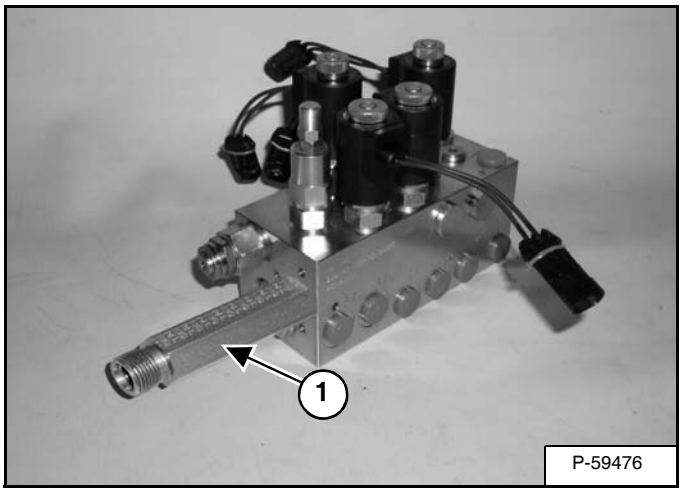
Parts Identification (S/N 223911248 & Above & S/N 224012294 & Above)

1. Pressure Reducing Valve
2. O-Ring
3. Backup Ring
4. O-Ring
5. Nut
6. O-Ring
7. Nut
8. Coil without tie strap
9. Coil with green tie strap
10. Coil with yellow tie strap
11. Coil with orange tie strap
12. O-Ring
13. Solenoid Stem
14. Solenoid Stem
15. Plug
16. O-Ring
17. Spring
18. Check Ball
19. Seat
20. Plug
21. Relief Valve
22. Backup Ring
23. O-Ring
24. Valve Body



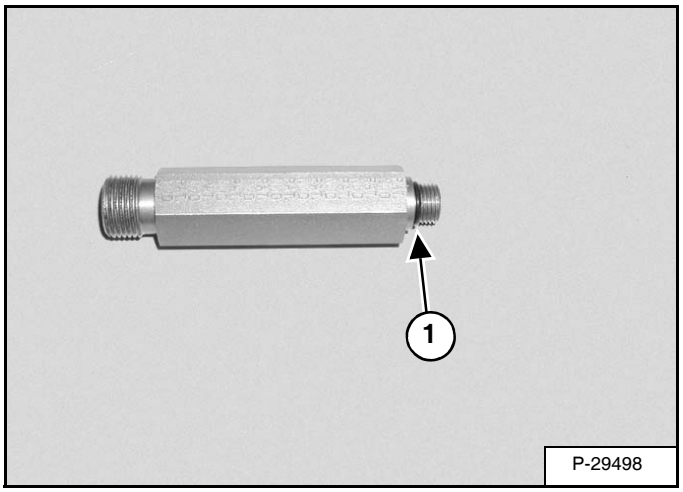
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above)

Figure 20-60-77



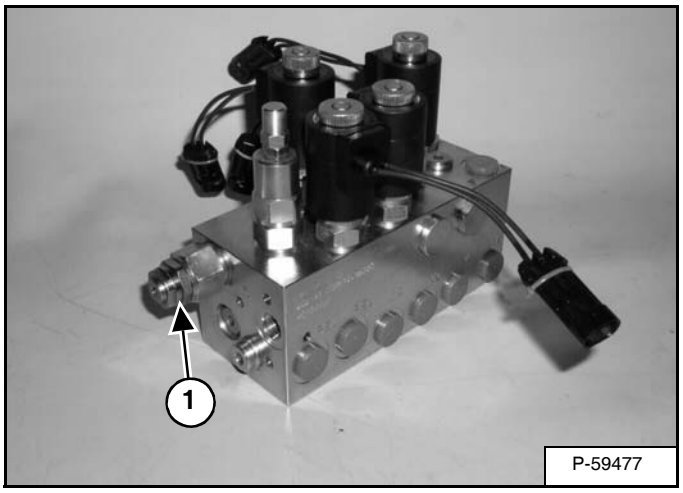
Remove the accumulator extension (Item 1) **[Figure 20-60-77]** from the manifold.

Figure 20-60-78



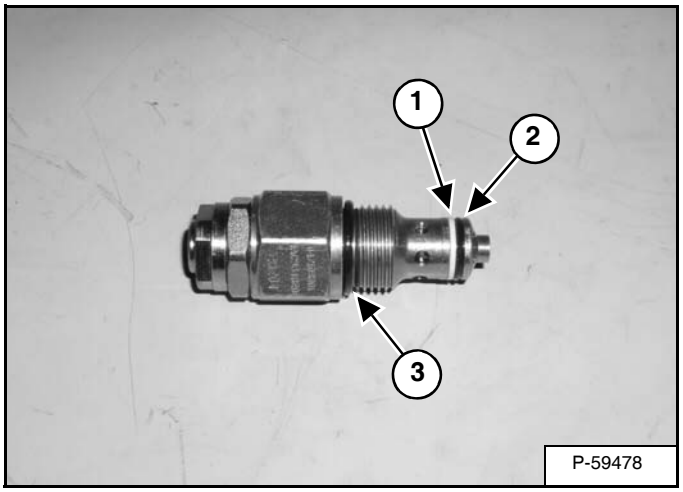
Remove the O-ring (Item 1) **[Figure 20-60-78]** from the accumulator extension.

Figure 20-60-79



Remove the relief valve (Item 1) **[Figure 20-60-79]** from the manifold.

Figure 20-60-80

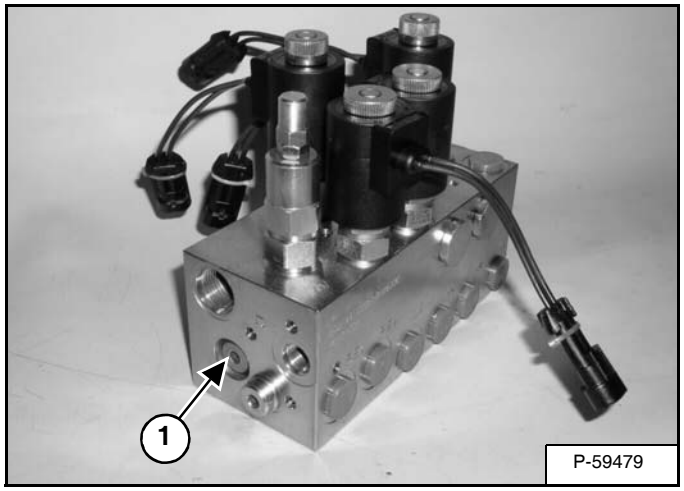


Remove the backup ring (Item 1) O-ring (Item 2) **[Figure 20-60-80]** from the relief valve.

Remove the O-ring (Item 3) **[Figure 20-60-80]** from the relief valve.

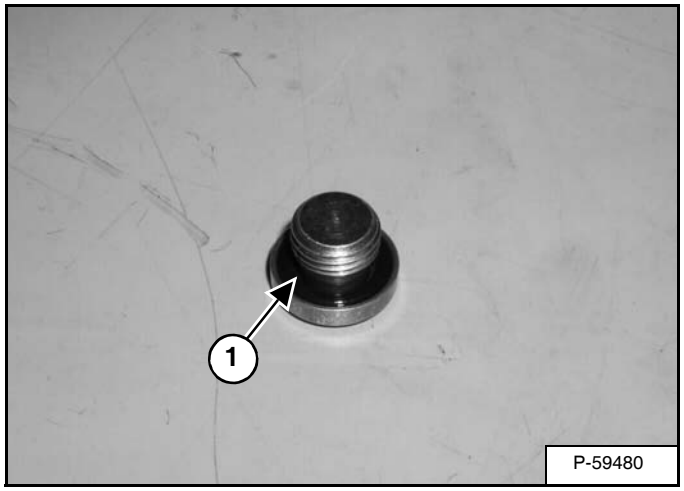
Disassembly (S/N 223911248 And Above & S/N 224012294 And Above) (Cont'd)

Figure 20-60-81



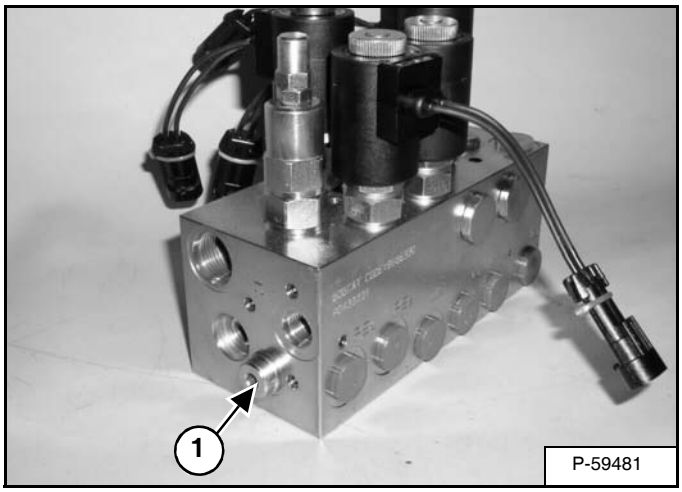
Remove the plug (Item 1) **[Figure 20-60-81]** from the manifold.

Figure 20-60-82



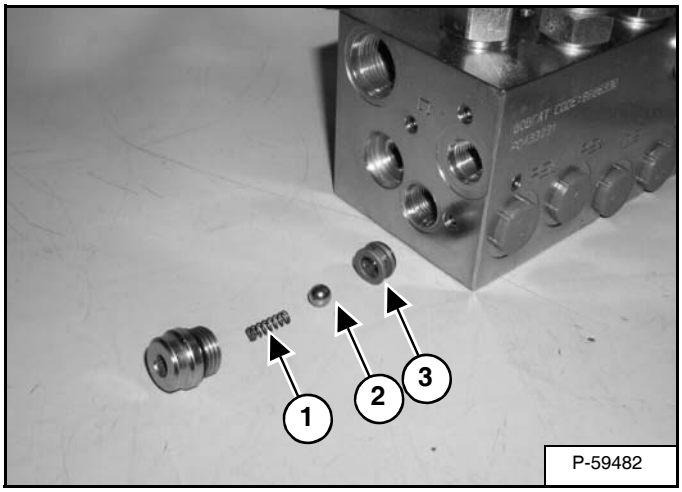
Remove the O-ring (Item 1) **[Figure 20-60-82]** from the plug.

Figure 20-60-83



Remove the plug (Item 1) **[Figure 20-60-83]** from the manifold.

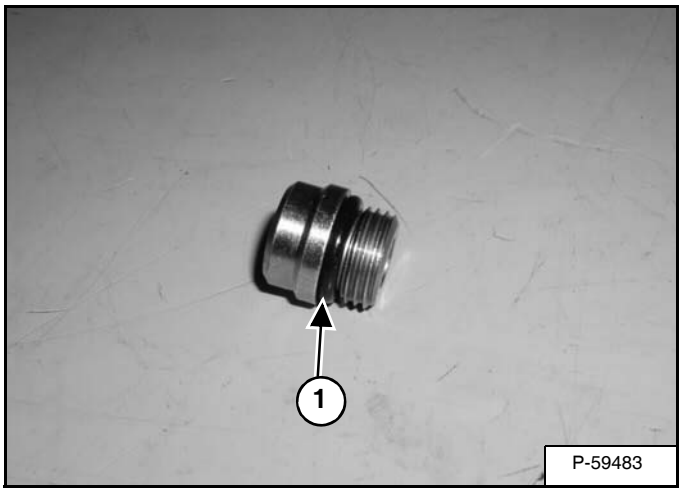
Figure 20-60-84



Remove the spring (Item 1), check ball (Item 2) and seat (Item 3) **[Figure 20-60-84]**.

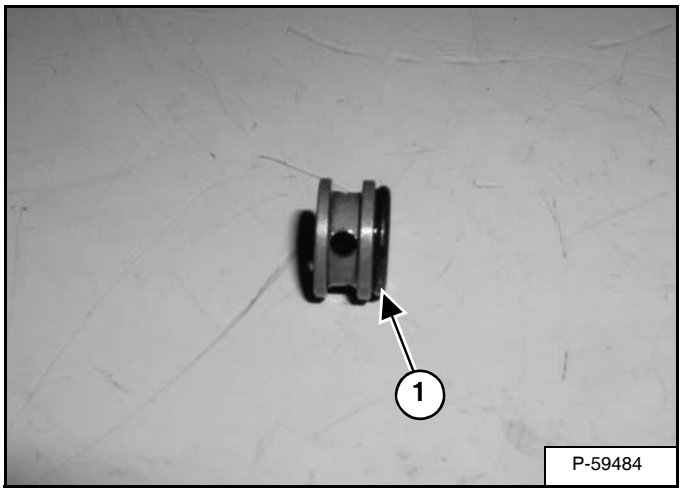
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-85



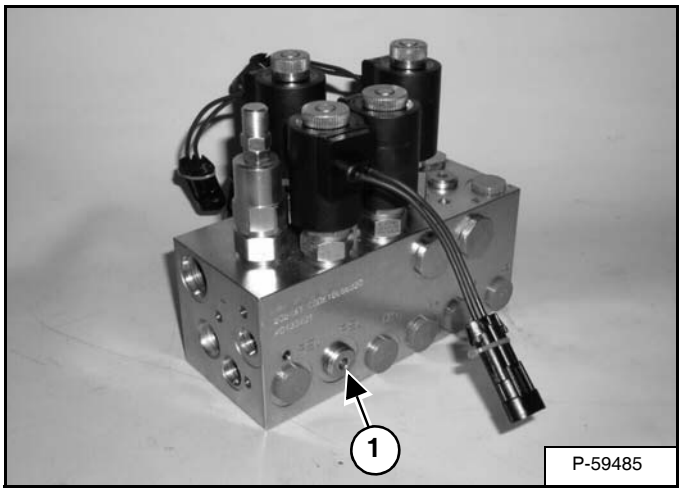
Remove the O-ring (Item 1) **[Figure 20-60-85]** from the plug.

Figure 20-60-86



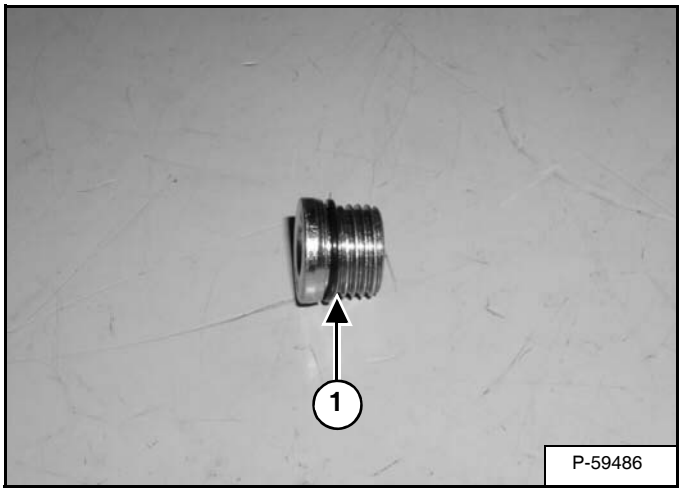
Remove the O-ring (Item 1) **[Figure 20-60-86]** from the seat.

Figure 20-60-87



Remove the plug (Item 1) **[Figure 20-60-87]**.

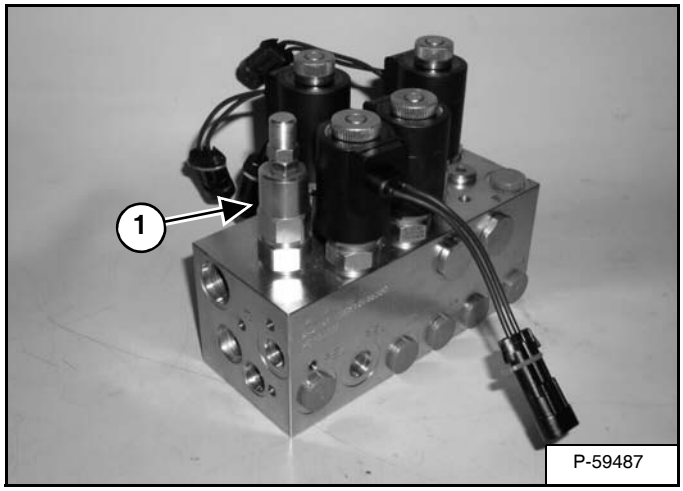
Figure 20-60-88



Remove the O-ring (Item 1) **[Figure 20-60-88]** from the plug.

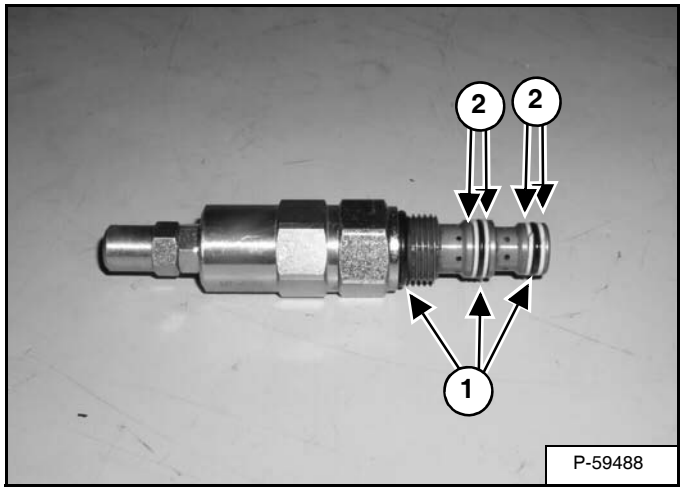
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-89



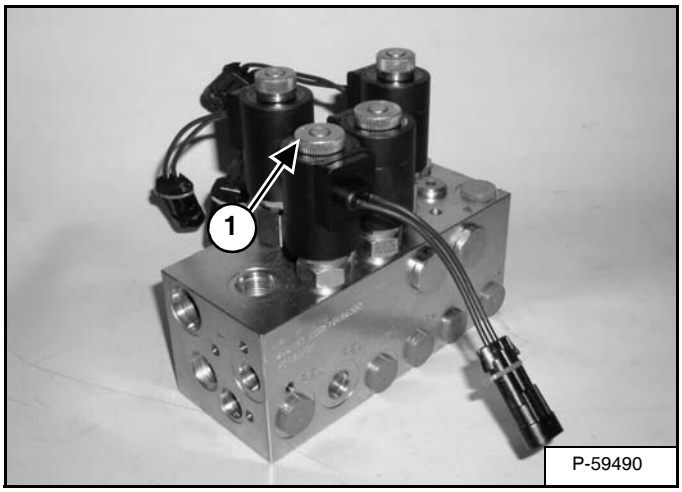
Remove the pressure reducing valve (Item 1) **[Figure 20-60-89]** from the manifold.

Figure 20-60-90



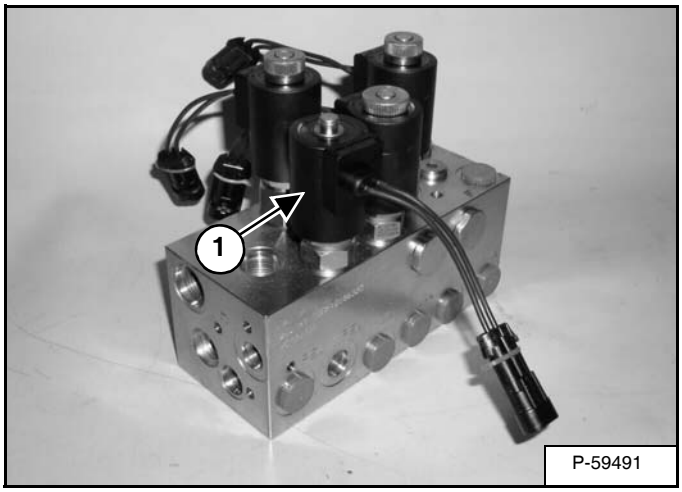
Remove the O-rings (Item 1) and backup rings (Item 2) **[Figure 20-60-90]**.

Figure 20-60-91



Remove the nut (Item 1) **[Figure 20-60-91]** from the console (joystick) lockout solenoid.

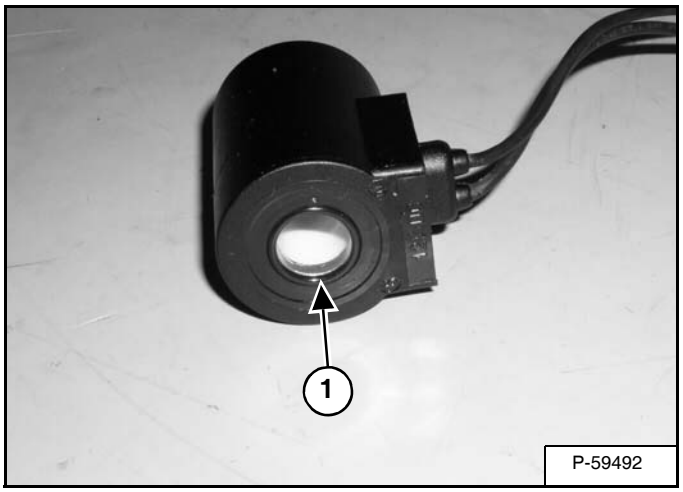
Figure 20-60-92



Remove the coil with the green tie strap (Item 1) **[Figure 20-60-92]** from the solenoid stem.

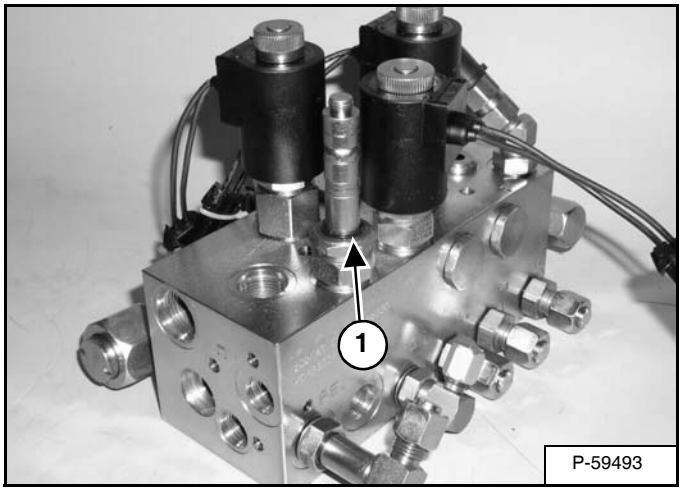
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-93



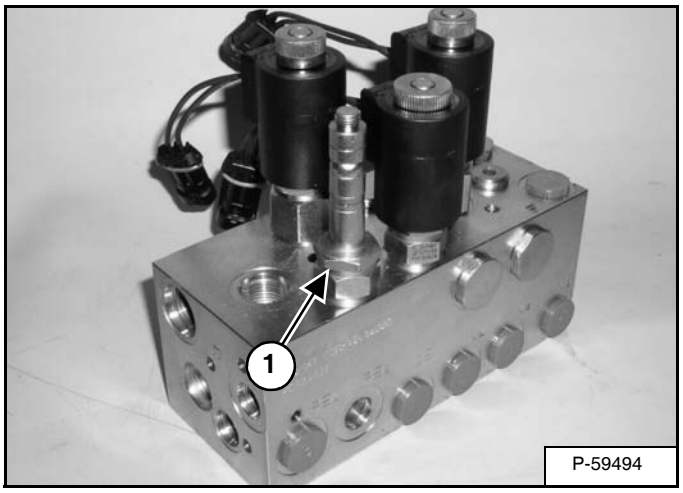
Remove the O-ring (Item 1) **[Figure 20-60-93]** from the coil.

Figure 20-60-94



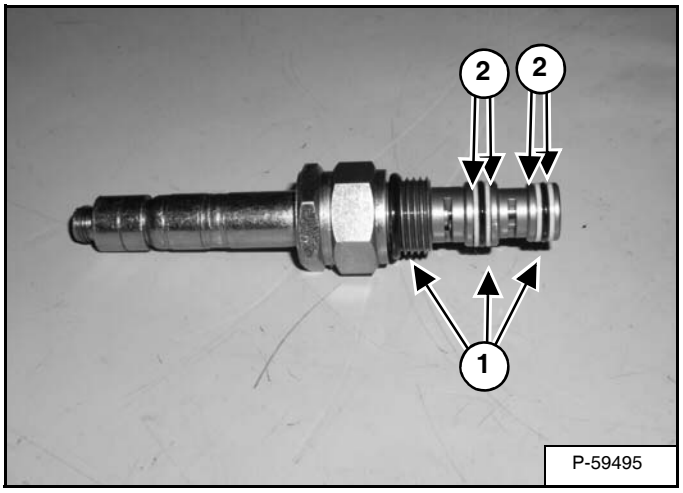
Remove the O-ring (Item 1) **[Figure 20-60-94]** from the solenoid stem.

Figure 20-60-95



Remove the solenoid stem (Item 1) **[Figure 20-60-95]**.

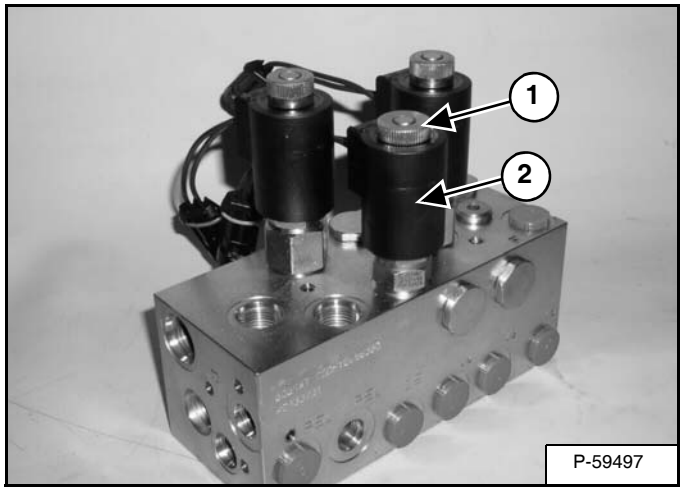
Figure 20-60-96



Remove the O-rings (Item 1) and backup rings (Item 2) **[Figure 20-60-96]**.

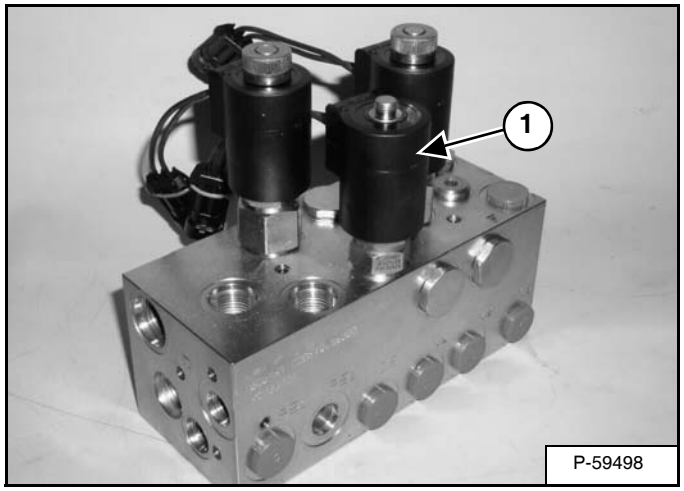
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-97



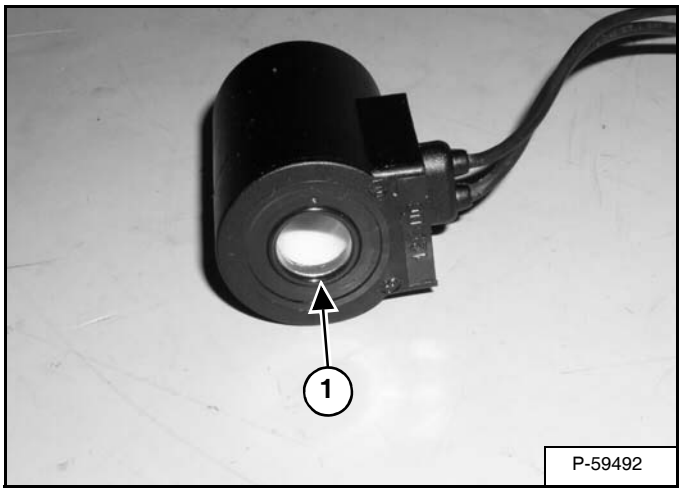
Remove the nut (Item 1) from the two speed boost solenoid (Item 2) **[Figure 20-60-97]**.

Figure 20-60-98



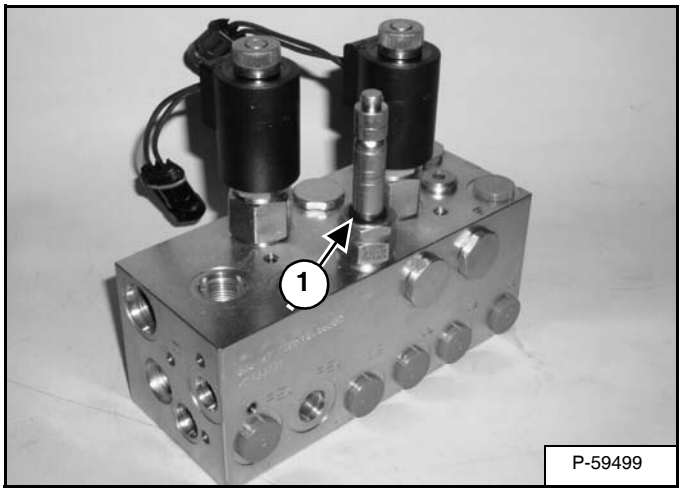
Remove the coil with yellow tie strap (Item 1) **[Figure 20-60-98]** from the solenoid stem.

Figure 20-60-99



Remove the O-ring (Item 1) **[Figure 20-60-99]** from the coil.

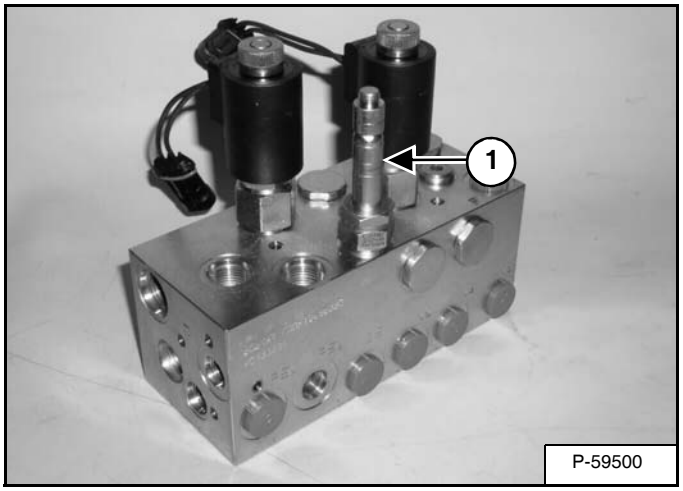
Figure 20-60-100



Remove the O-ring (Item 1) **[Figure 20-60-100]** from the solenoid stem.

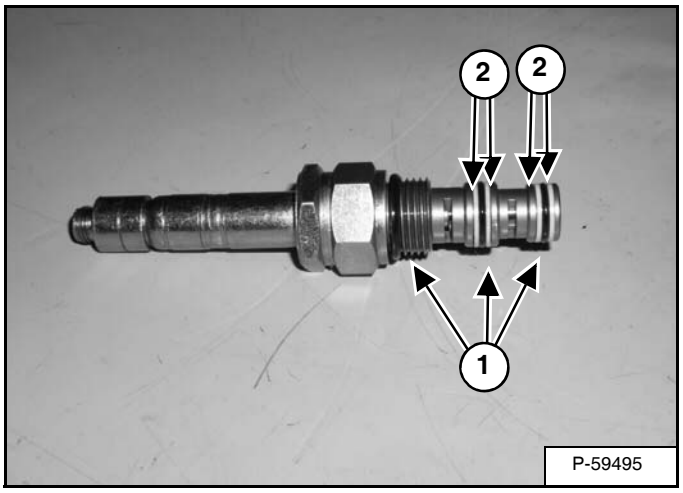
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-101



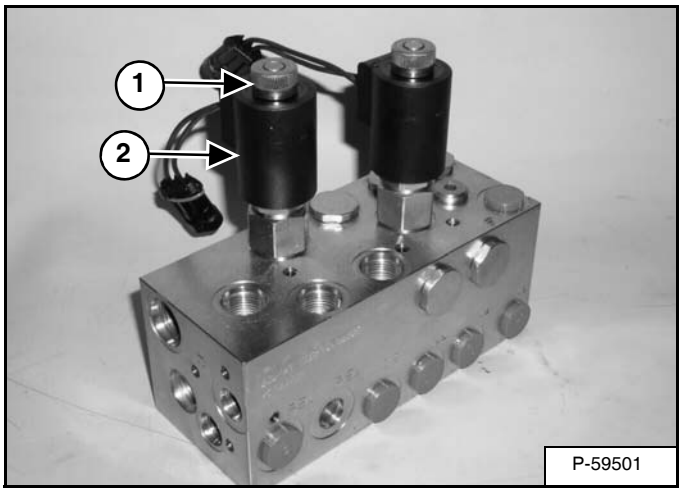
Remove the solenoid stem (Item 1) **[Figure 20-60-101]**.

Figure 20-60-102



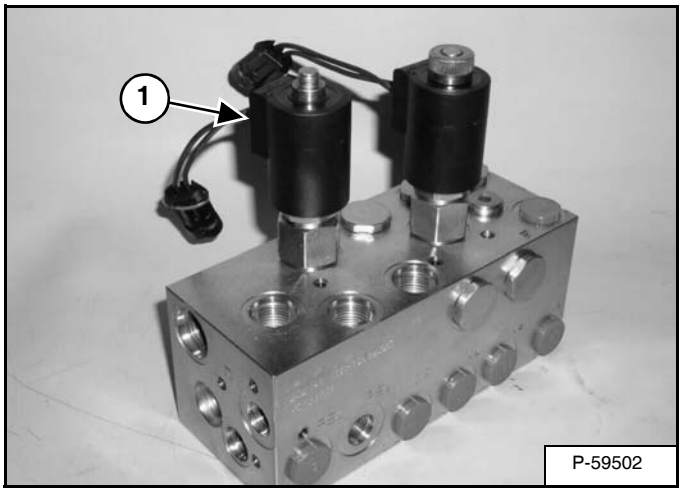
Remove the O-rings (Item 1) and back-up rings (Item 2) **[Figure 20-60-102]**.

Figure 20-60-103



Remove the nut (Item 1) from the system by-pass solenoid (Item 2) **[Figure 20-60-103]**.

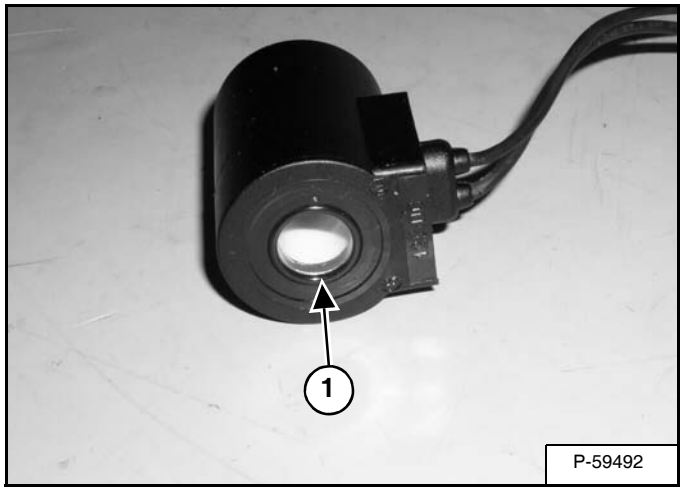
Figure 20-60-104



Remove the coil with orange strap (Item 1) **[Figure 20-60-104]** from the solenoid stem.

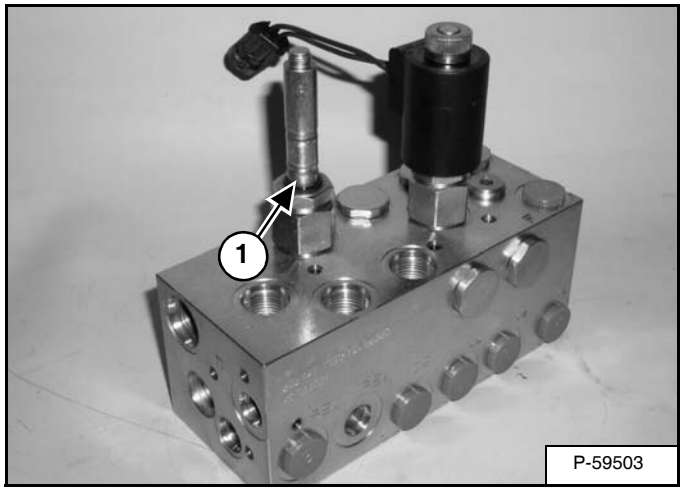
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-105



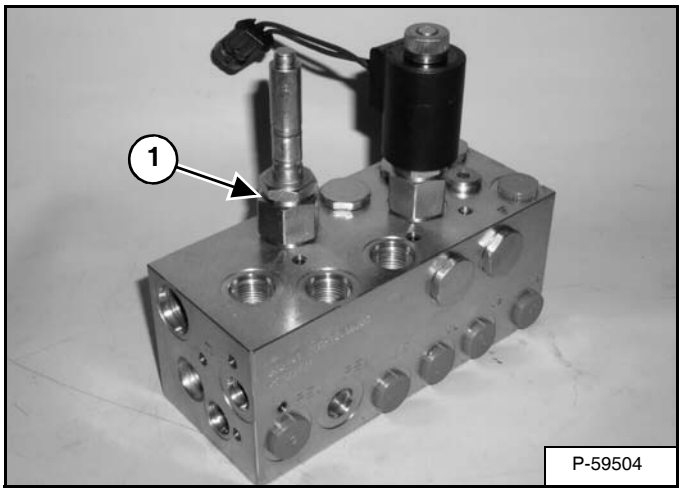
Remove the O-ring (Item 1) **[Figure 20-60-105]** from the coil.

Figure 20-60-106



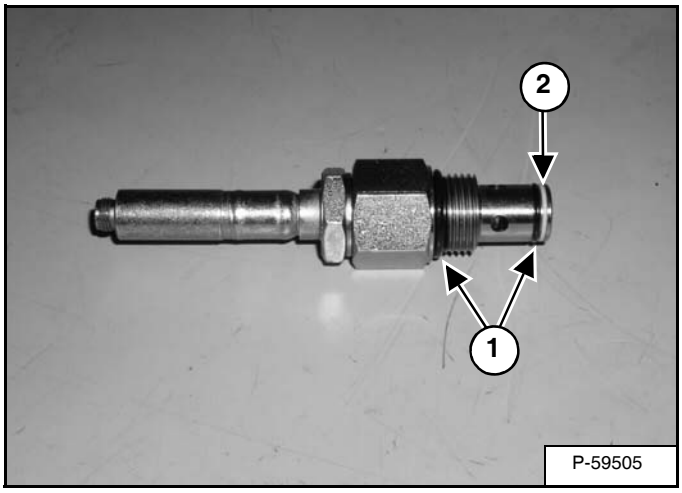
Remove the O-ring (Item 1) **[Figure 20-60-106]** from the solenoid stem.

Figure 20-60-107



Remove the solenoid stem (Item 1) **[Figure 20-60-107]**.

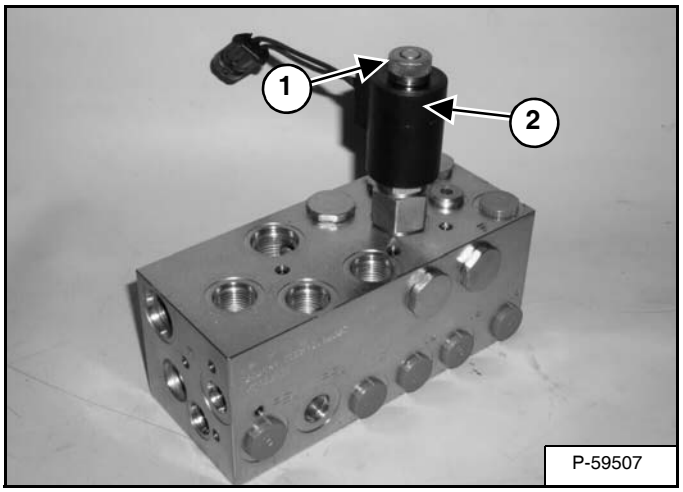
Figure 20-60-108



Remove the O-rings (Item 1) and back-up ring (Item 2) **[Figure 20-60-108]**.

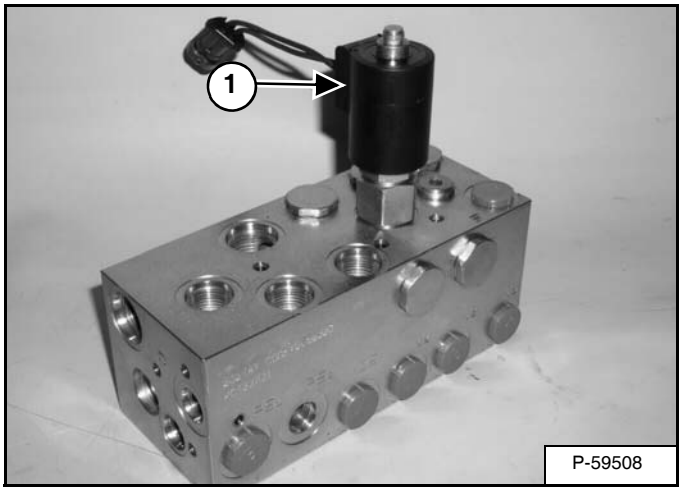
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-109



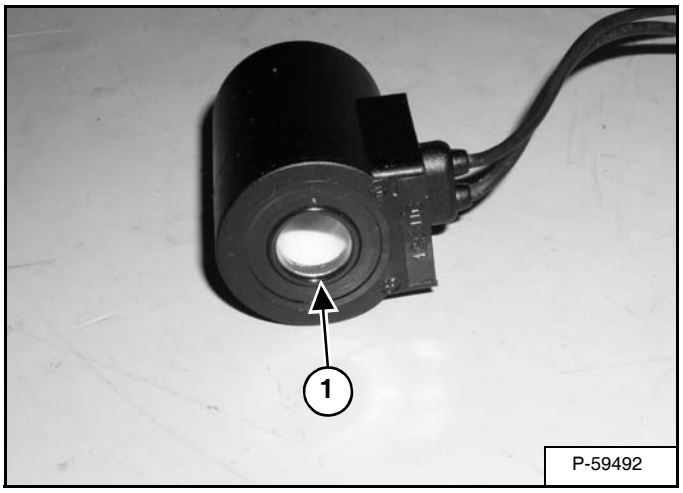
Remove the nut (Item 1) from the two speed solenoid (Item 2) **[Figure 20-60-109]**.

Figure 20-60-110



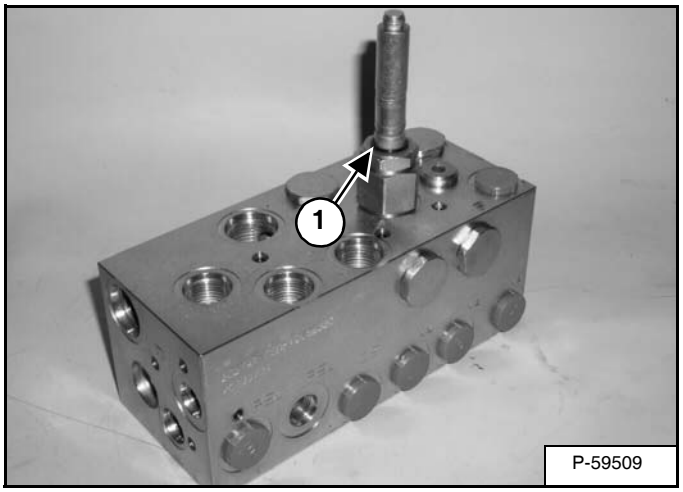
Remove the coil with no strap (Item 1) **[Figure 20-60-110]** from the solenoid stem.

Figure 20-60-111



Remove the O-ring (Item 1) **[Figure 20-60-111]** from the coil.

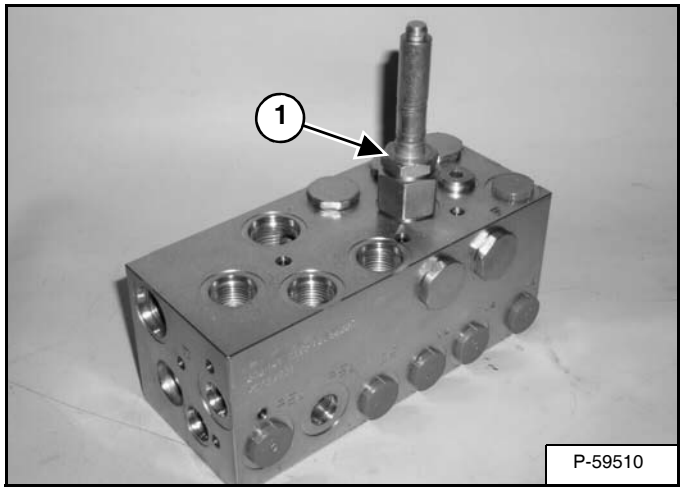
Figure 20-60-112



Remove the O-ring (Item 1) **[Figure 20-60-112]** from the solenoid stem.

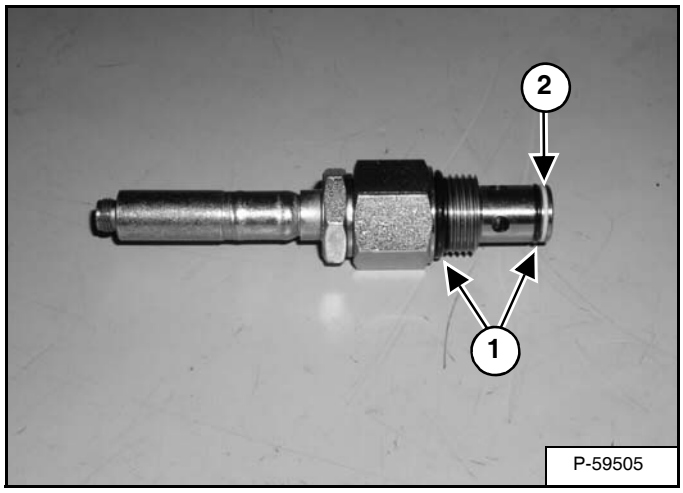
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-113



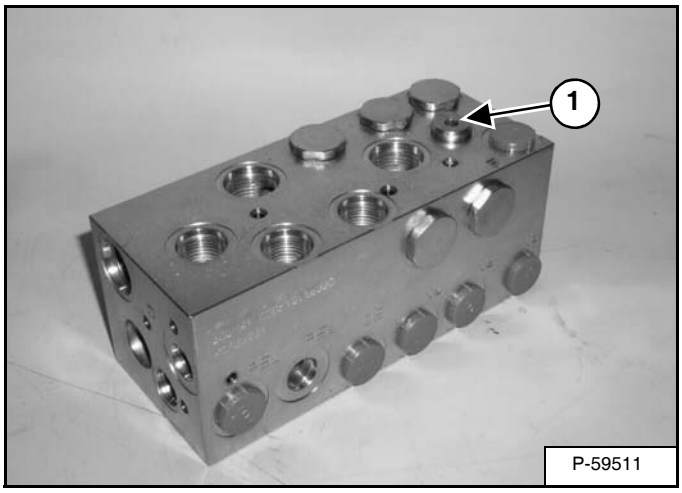
Remove the solenoid stem (Item 1) **[Figure 20-60-113]**.

Figure 20-60-114



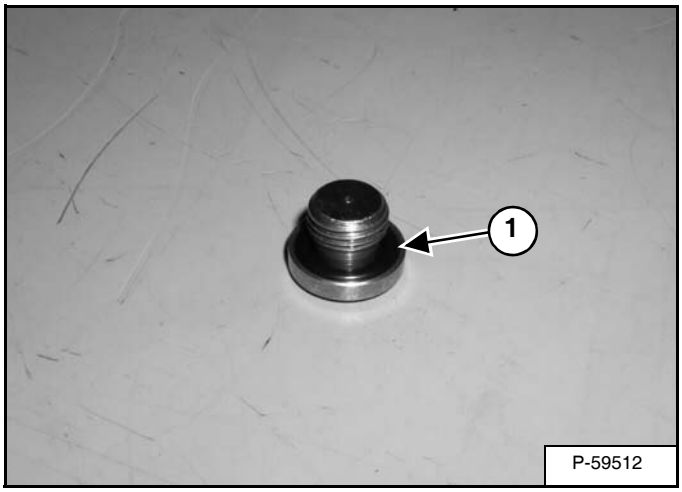
Remove the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-60-114]**.

Figure 20-60-115



Remove the plug (Item 1) **[Figure 20-60-115]** from the top of the manifold.

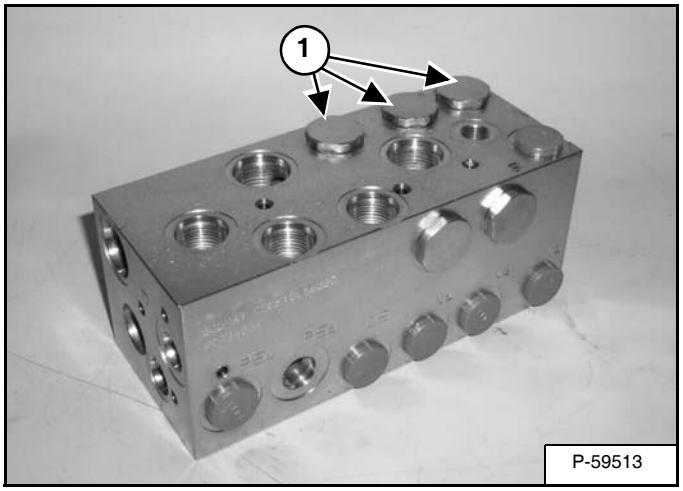
Figure 20-60-116



Remove the O-ring (Item 1) **[Figure 20-60-116]** from the coil.

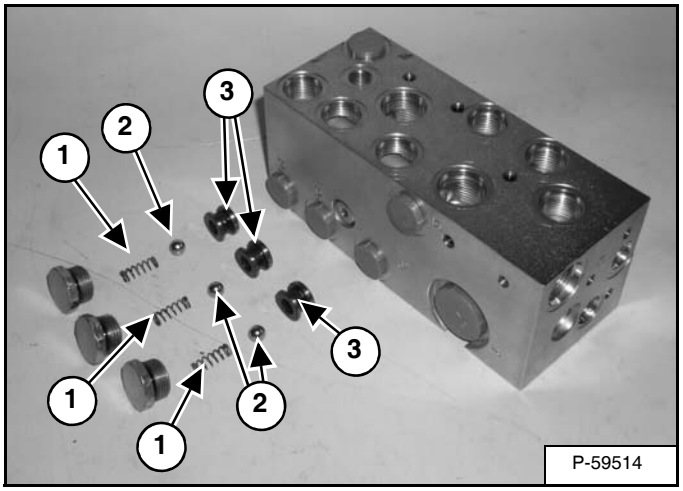
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-117



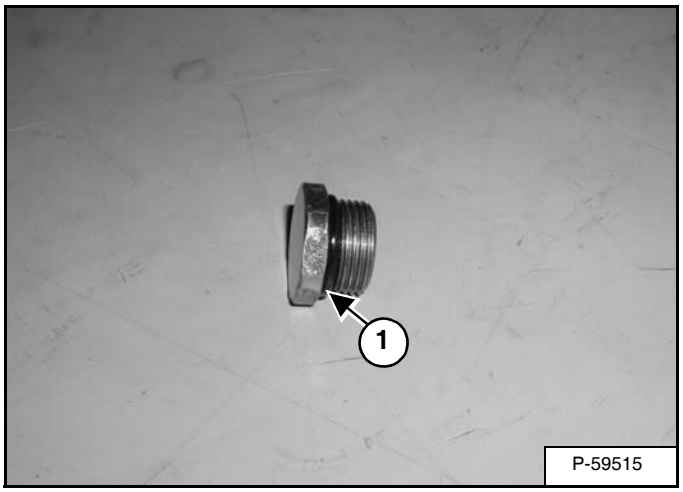
Remove the plugs (Item 1) **[Figure 20-60-117]** from the top of the manifold.

Figure 20-60-118



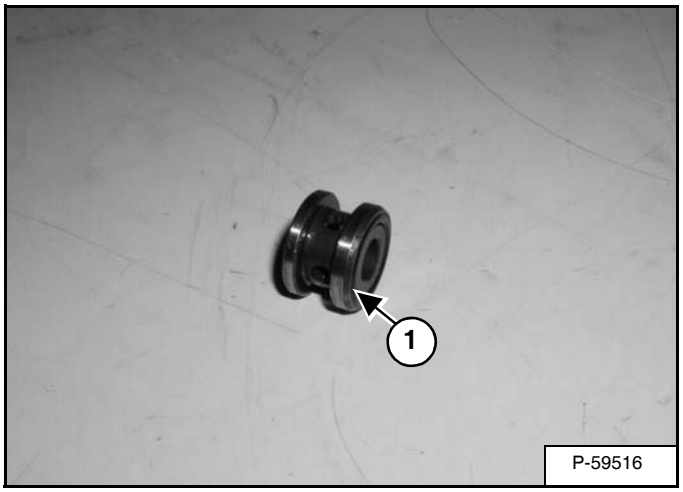
Remove the springs (Item 1), check balls (Item 2) and seats (Item 3) **[Figure 20-60-118]**.

Figure 20-60-119



Remove the O-ring (Item 1) **[Figure 20-60-119]** from the plugs.

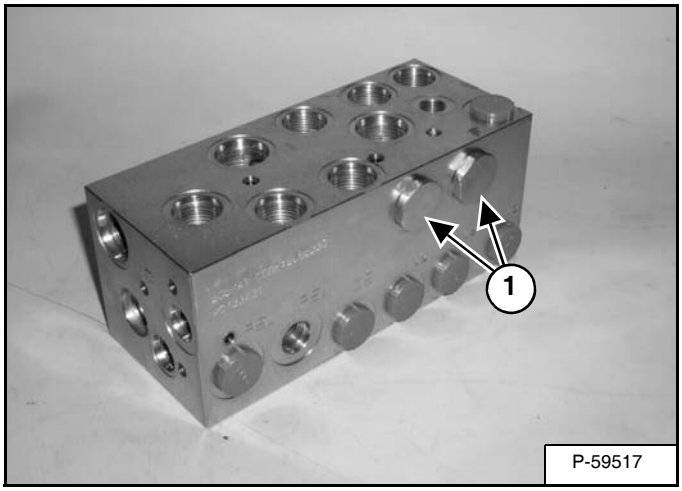
Figure 20-60-120



Remove the O-ring (Item 1) **[Figure 20-60-120]** from the seats.

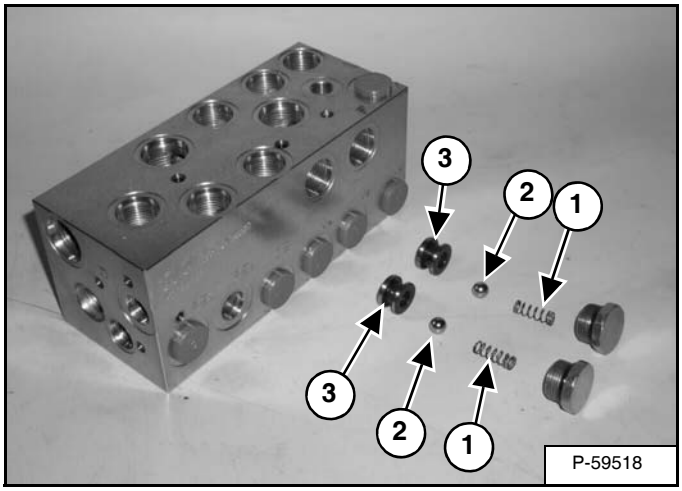
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-121



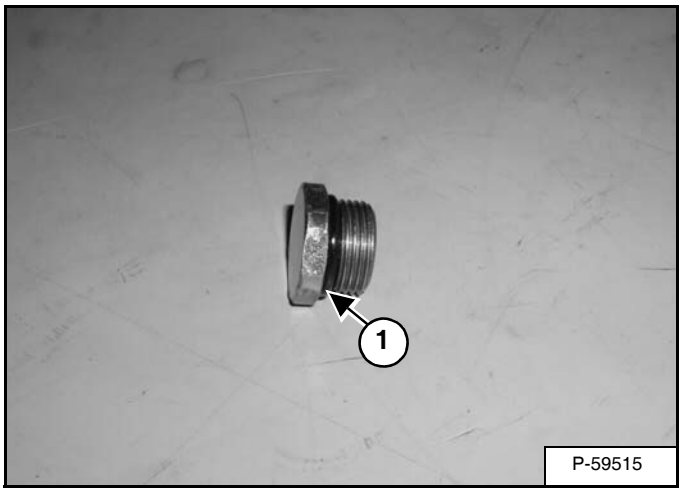
Remove the plugs (Item 1) **[Figure 20-60-121]** from the side of the manifold.

Figure 20-60-122



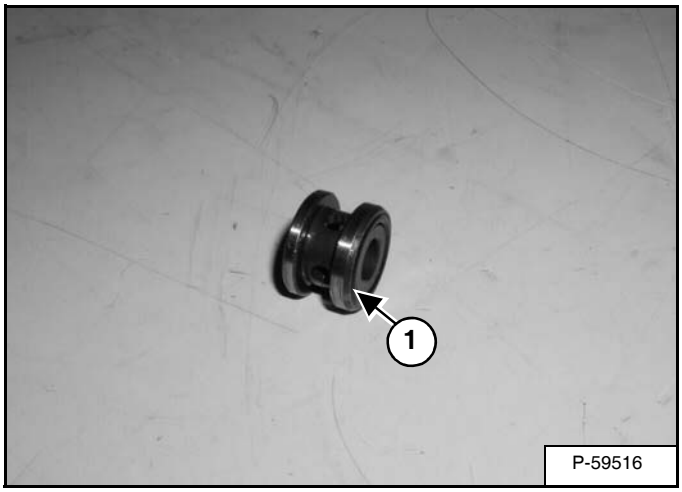
Remove the springs (Item 1), check balls (Item 2) and seats (Item 3) **[Figure 20-60-122]**.

Figure 20-60-123



Remove the O-ring (Item 1) **[Figure 20-60-123]** from the plugs.

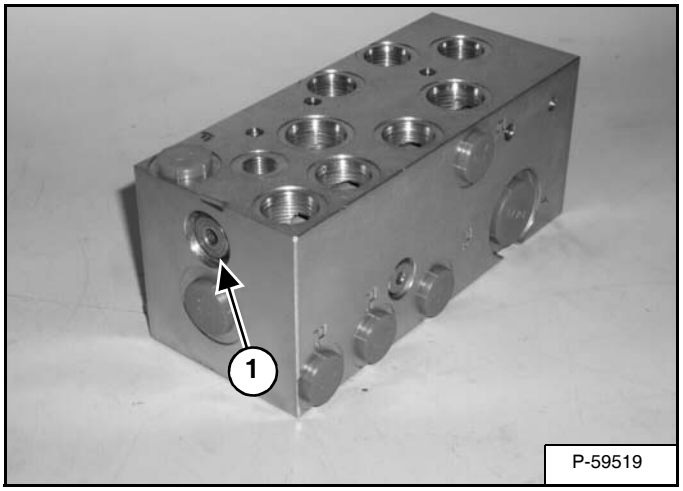
Figure 20-60-124



Remove the O-ring (Item 1) **[Figure 20-60-124]** from the seats.

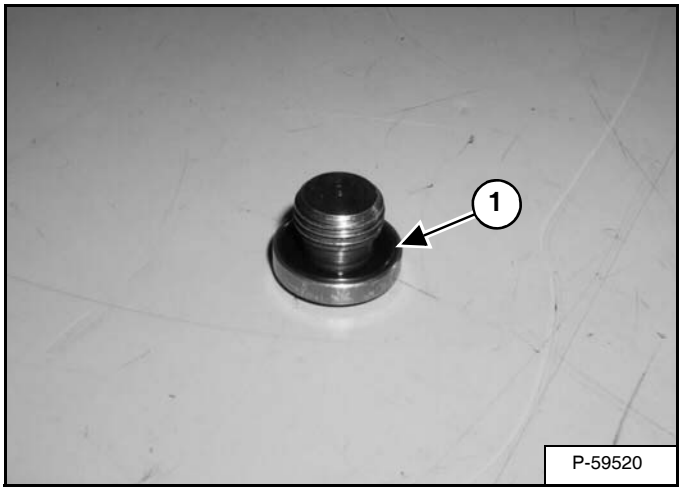
Disassembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-125



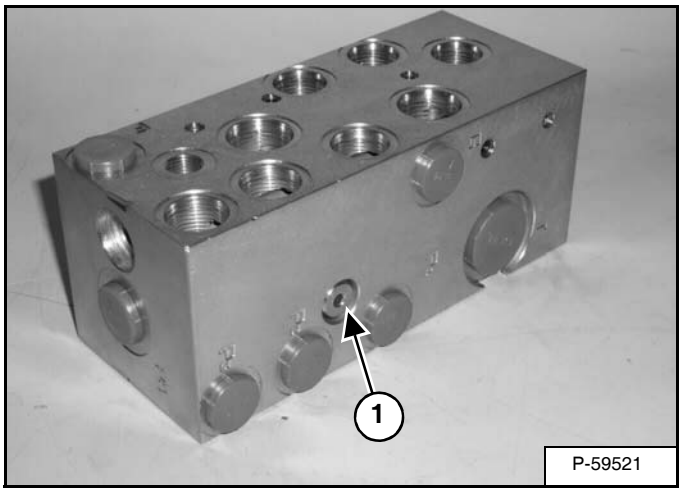
Remove the plug (Item 1) **[Figure 20-60-125]**.

Figure 20-60-126



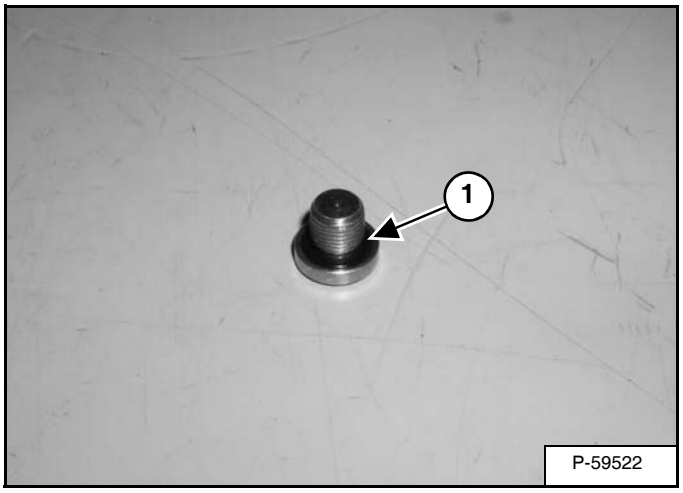
Remove the O-ring (Item 1) **[Figure 20-60-126]** from the plug.

Figure 20-60-127



Remove the plug (Item 1) **[Figure 20-60-127]**.

Figure 20-60-128



Remove the O-ring (Item 1) **[Figure 20-60-128]** from the plug.

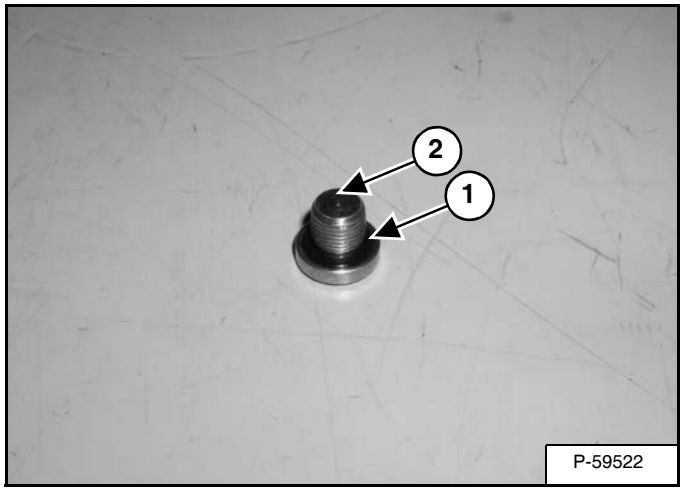
Assembly (S/N 223911248 & Above & S/N 224012294 & Above)

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

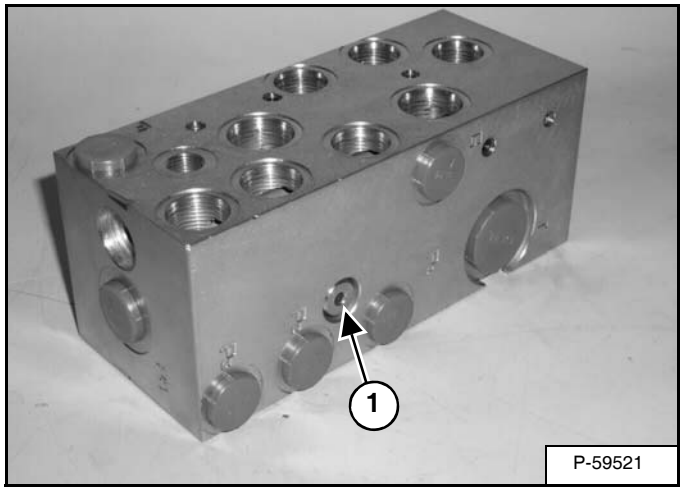
Always install new backup rings and O-rings. Lubricate all backup rings and O-rings with clean hydraulic fluid before installation.

Figure 20-60-129



Install the O-ring (Item 1) on the plug (Item 2) **[Figure 20-60-129]**.

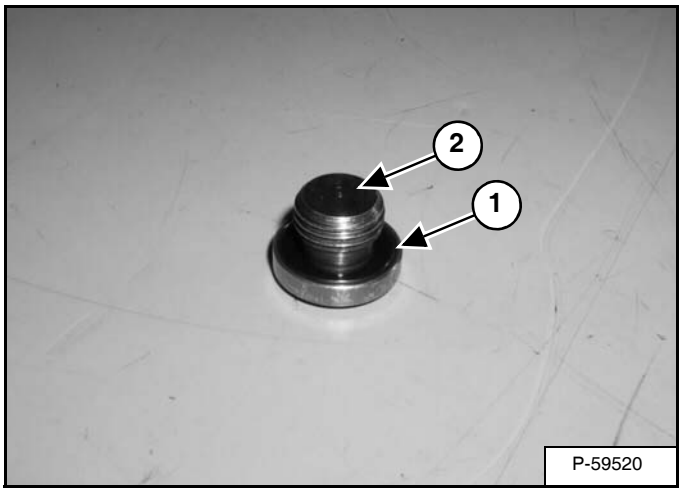
Figure 20-60-130



Install the plug (Item 1) **[Figure 20-60-130]**.

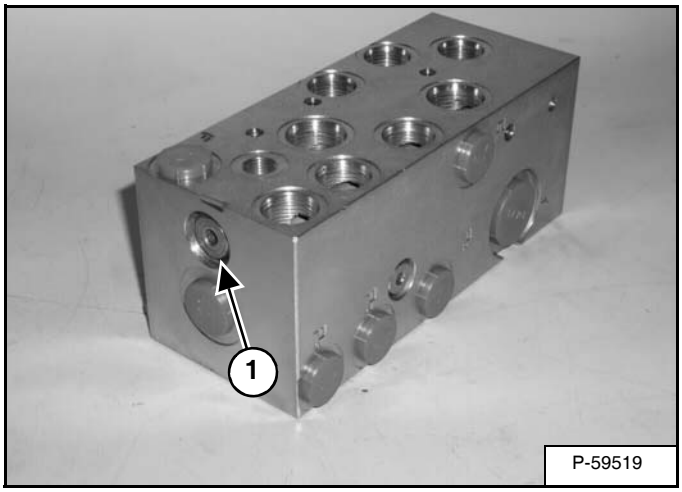
Tighten the plug to 11 ft.-lb. (15 N•m) torque.

Figure 20-60-131



Install the O-ring (Item 1) on the plug (Item 2) **[Figure 20-60-131]**.

Figure 20-60-132

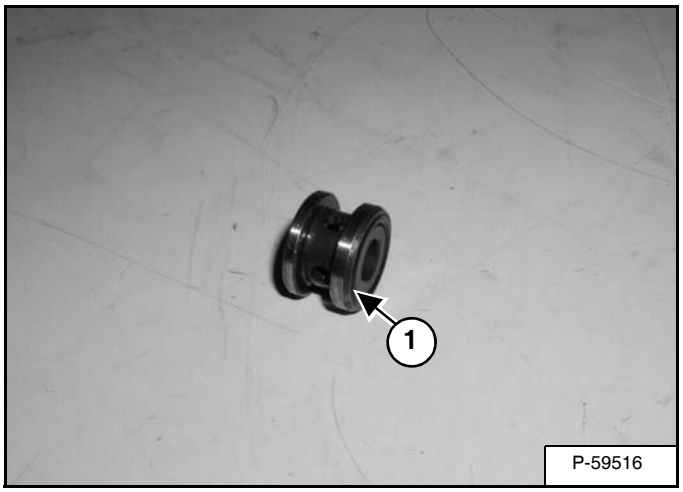


Install the plug (Item 1) **[Figure 20-60-132]**.

Tighten the plug to 22 ft.-lb. (30 N•m) torque.

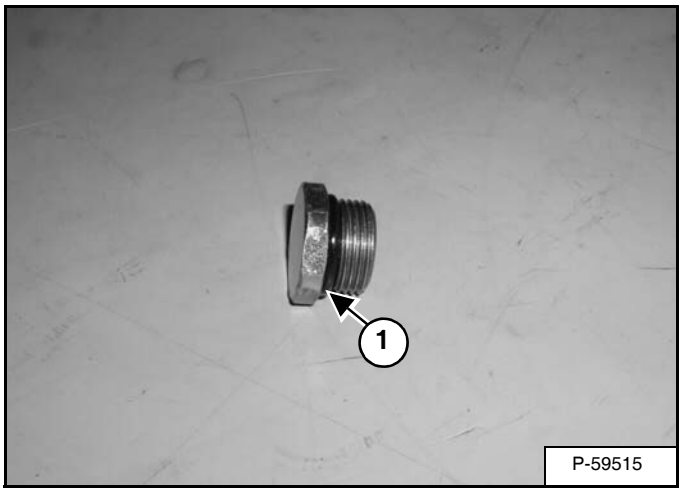
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-133



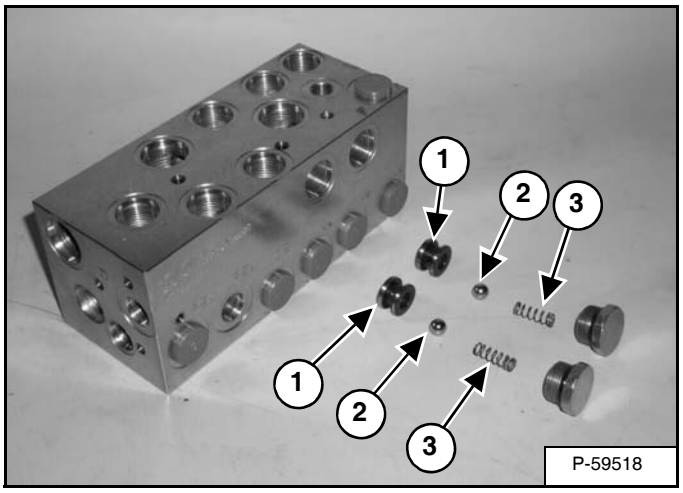
Install the O-rings (Item 1) **[Figure 20-60-133]** on the seats.

Figure 20-60-134



Install the O-rings (Item 1) **[Figure 20-60-134]** on the plugs.

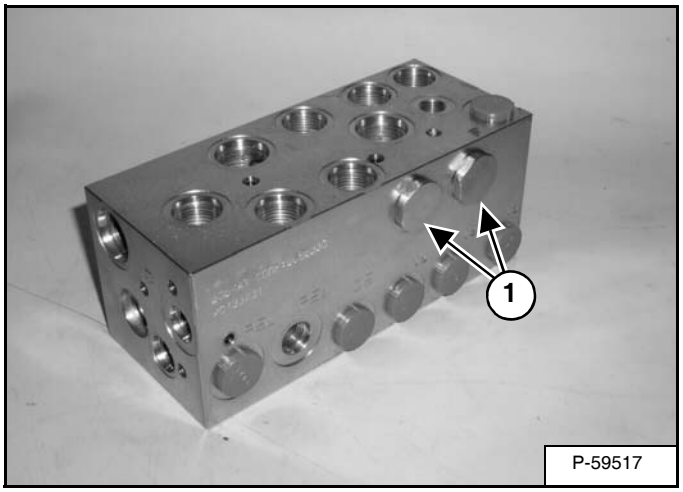
Figure 20-60-135



Install the seats (Item 1), check balls (Item 2) and springs (Item 3) **[Figure 20-60-135]** in the side of the manifold.

NOTE: Install O-ring face on seat towards the center of the manifold.

Figure 20-60-136

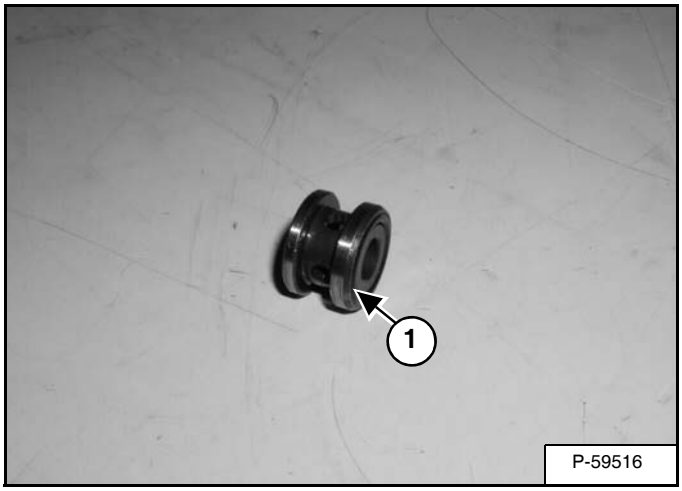


Install the plugs (Item 1) **[Figure 20-60-136]**.

Tighten the plugs to 44 ft.-lb. (60 N•m) torque.

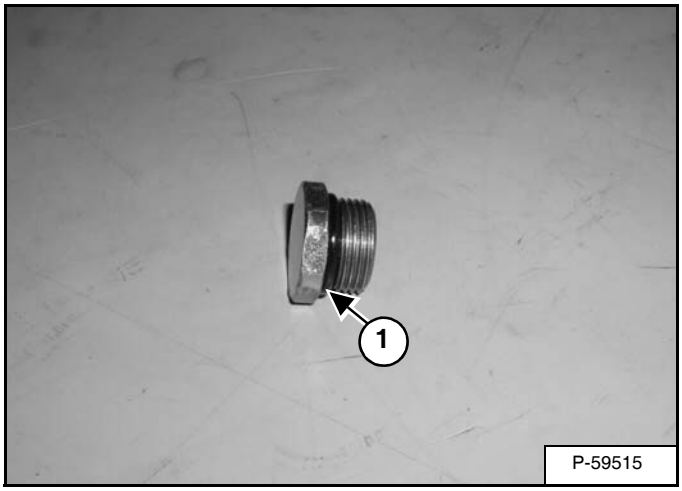
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-137



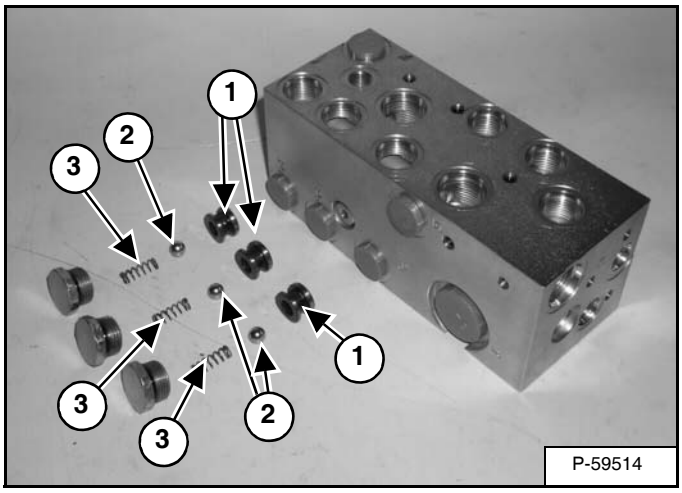
Install the O-rings (Item 1) **[Figure 20-60-137]** on the seats.

Figure 20-60-138



Install the O-rings (Item 1) **[Figure 20-60-138]** on the plugs.

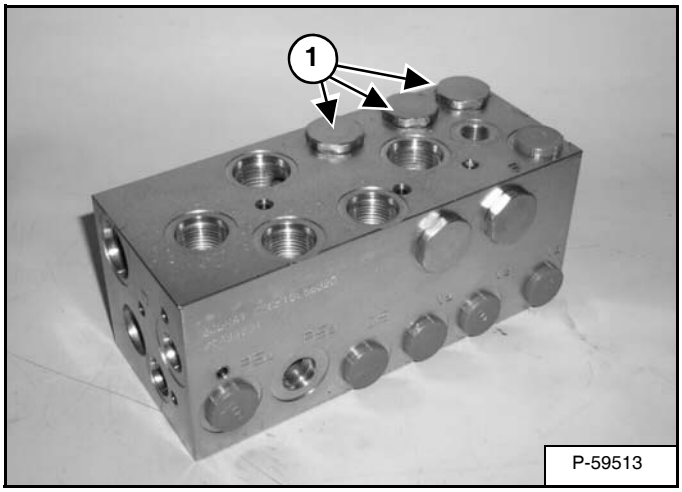
Figure 20-60-139



Install the seats (Item 1), check balls (Item 2) and springs (Item 3) **[Figure 20-60-139]** in the top of the manifold.

NOTE: Install O-ring face on seat towards the center of the manifold.

Figure 20-60-140

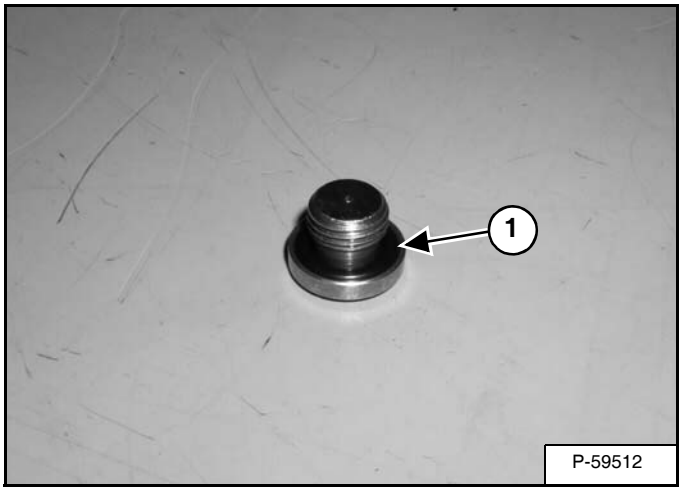


Install the plugs (Item 1) **[Figure 20-60-140]**.

Tighten the plugs to 44 ft.-lb. (60 N•m) torque.

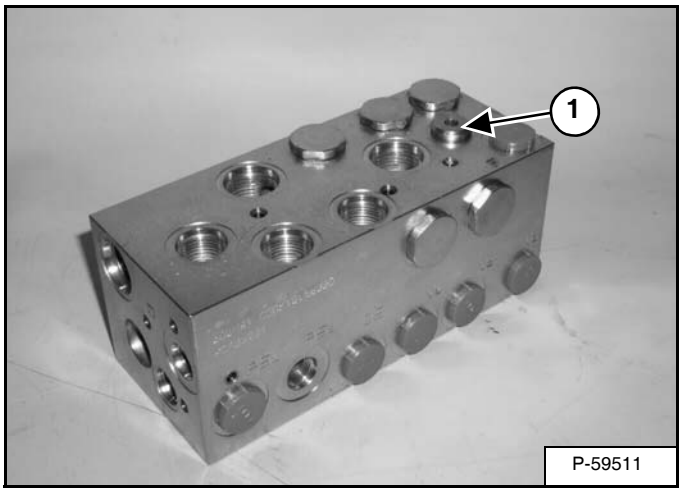
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-141



Install the O-ring (Item 1) **[Figure 20-60-141]** on the plug.

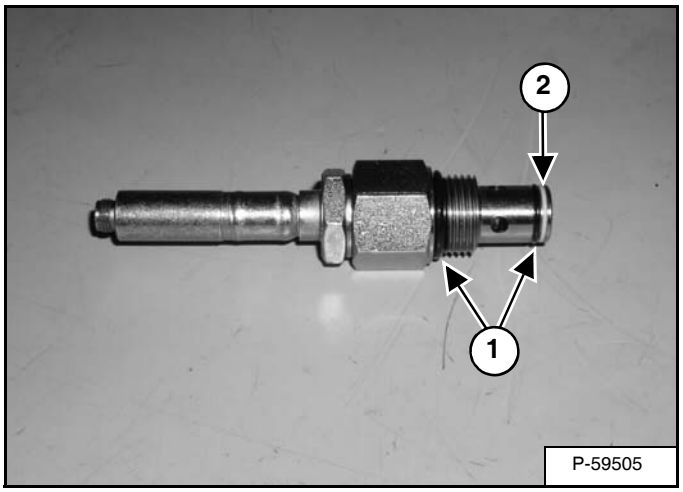
Figure 20-60-142



Install the plug (Item 1) **[Figure 20-60-142]**.

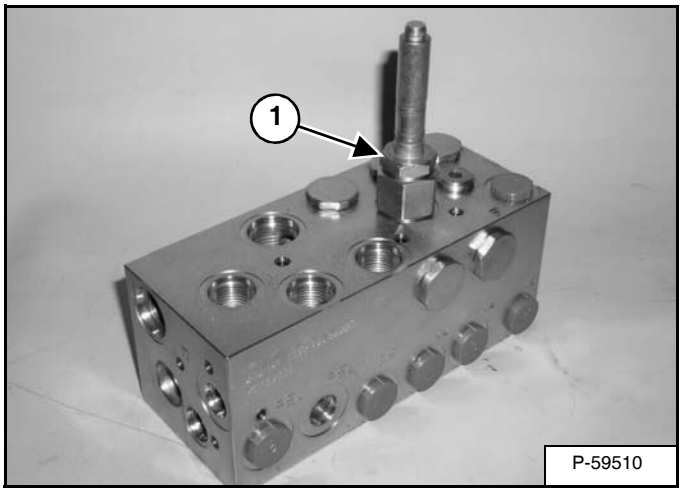
Tighten the plug to 22 ft.-lb. (30 N•m) torque.

Figure 20-60-143



Install the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-60-143]**.

Figure 20-60-144

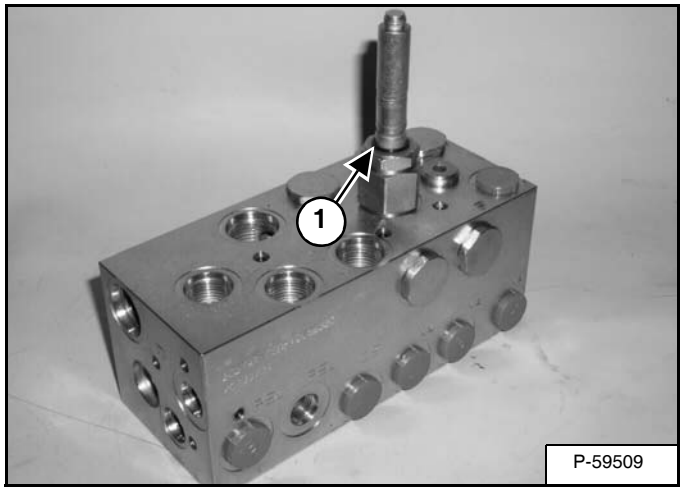


Install the solenoid stem (Item 1) **[Figure 20-60-144]**.

Tighten the solenoid stem to 37 ft.-lb. (50 N•m) torque.

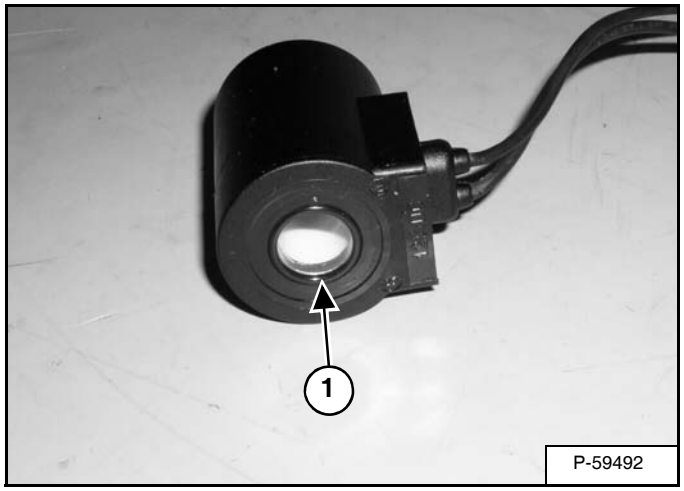
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-145



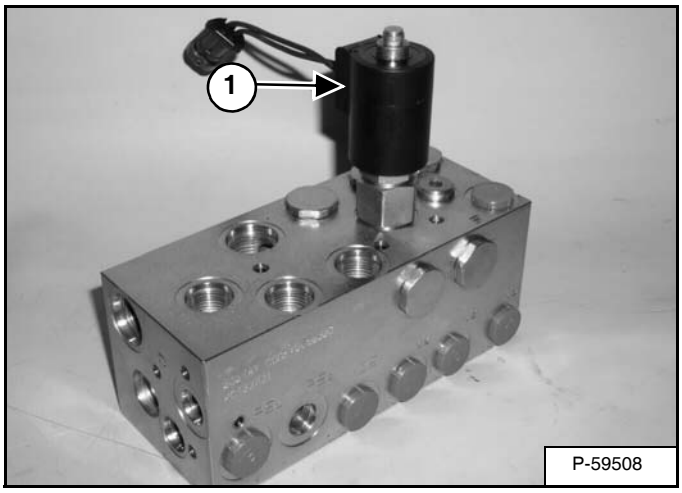
Install the O-ring (Item 1) **[Figure 20-60-145]** on the solenoid stem.

Figure 20-60-146



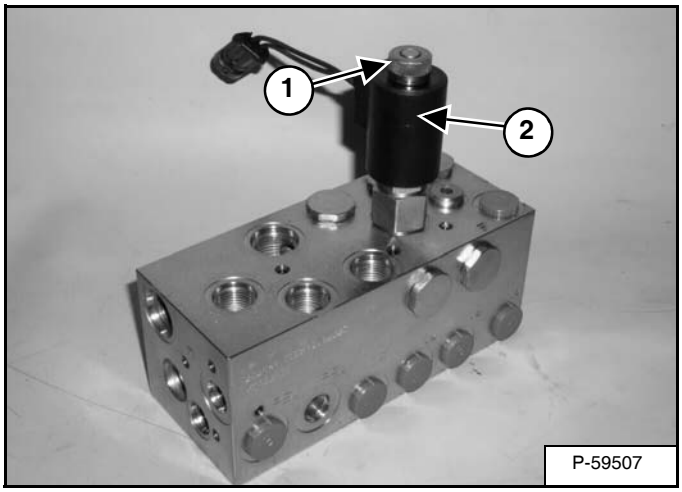
Install the O-ring (Item 1) **[Figure 20-60-146]** on the coil.

Figure 20-60-147



Install the coil with no strap (Item 1) **[Figure 20-60-147]** on the solenoid stem.

Figure 20-60-148



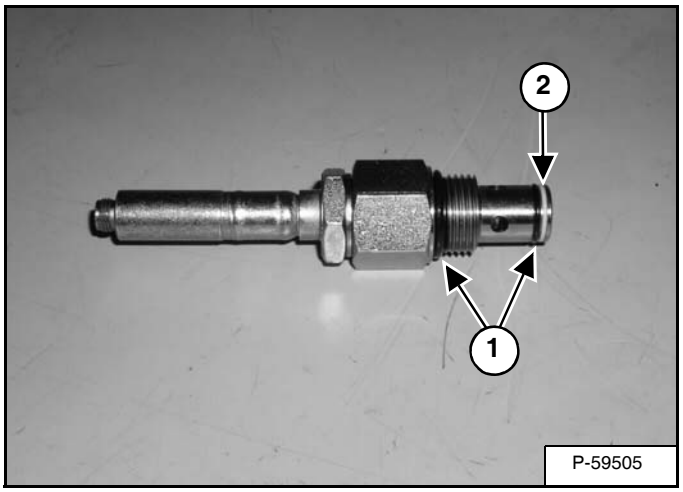
Install the nut (Item 1) on the two speed solenoid (Item 2) **[Figure 20-60-148]**.

Tighten the nuts to 4.4 ft.-lb. (6 N•m) torque.

NOTE: Overtightening the nut (Item 1) [Figure 20-60-148] may cause solenoid or coil failure.

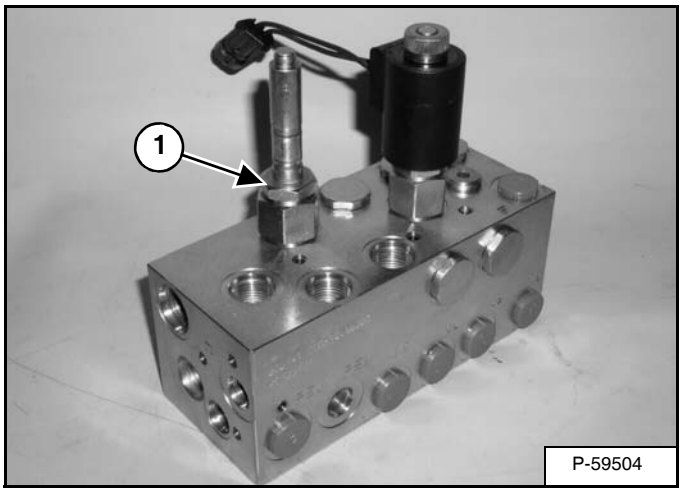
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-149



Install the O-rings (Item 1) and backup ring (Item 2) **[Figure 20-60-149]**.

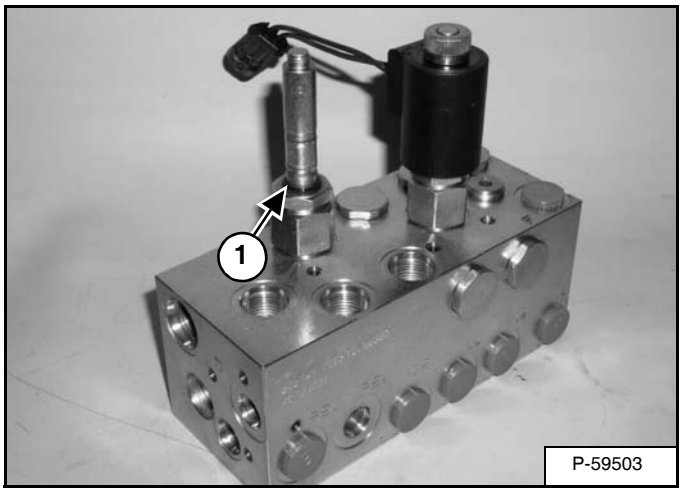
Figure 20-60-150



Install the solenoid stem (Item 1) **[Figure 20-60-150]**.

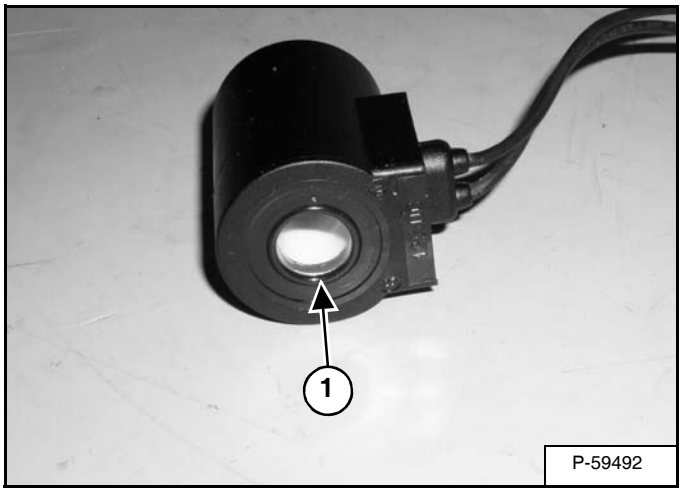
Tighten the solenoid stem to 37 ft.-lb. (50 N•m) torque.

Figure 20-60-151



Install the O-ring (Item 1) **[Figure 20-60-151]** on the solenoid stem.

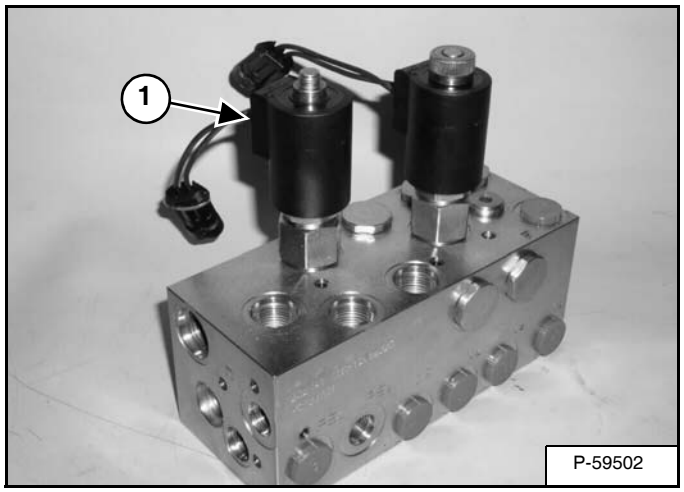
Figure 20-60-152



Install the O-ring (Item 1) **[Figure 20-60-152]** on the coil.

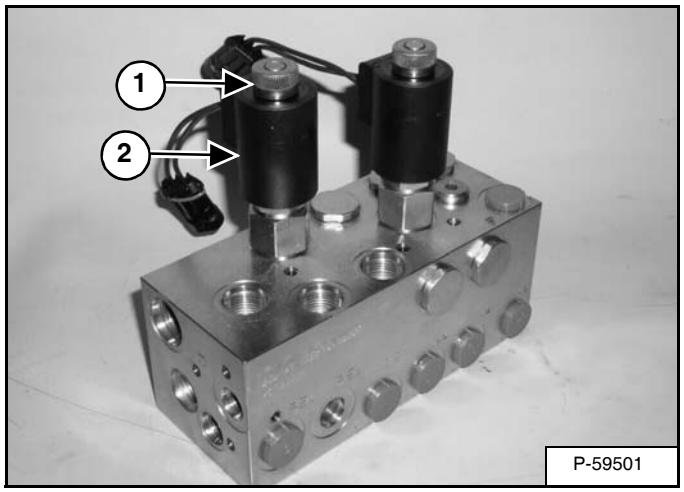
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-153



Install the coil with the orange tie strap (Item 1) **[Figure 20-60-153]** on the system by-pass solenoid stem.

Figure 20-60-154

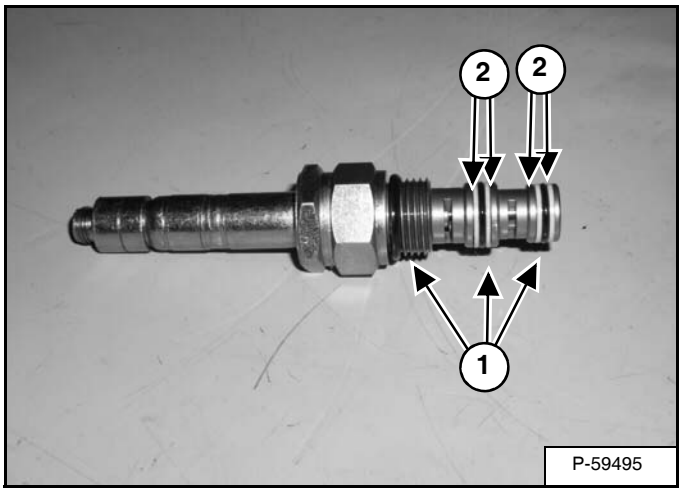


Install the nut (Item 1) on the system by-pass solenoid (Item 2) **[Figure 20-60-154]**.

Tighten the nuts to 4.4 ft.-lb. (6 N•m) torque.

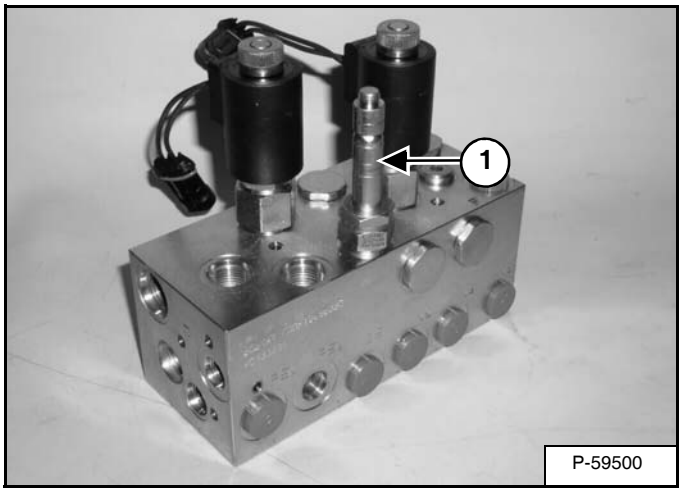
NOTE: Overtightening the nut (Item 1) [Figure 20-60-154] may cause solenoid or coil failure.

Figure 20-60-155



Install the O-rings (Item 1) and backup rings (Item 2) **[Figure 20-60-155]**.

Figure 20-60-156

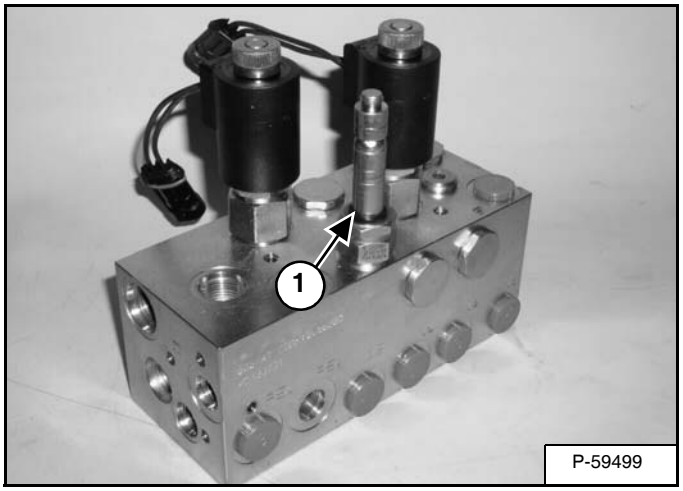


Install the solenoid stem (Item 1) **[Figure 20-60-156]**.

Tighten the solenoid stem to 22 ft.-lb. (30 N•m) torque.

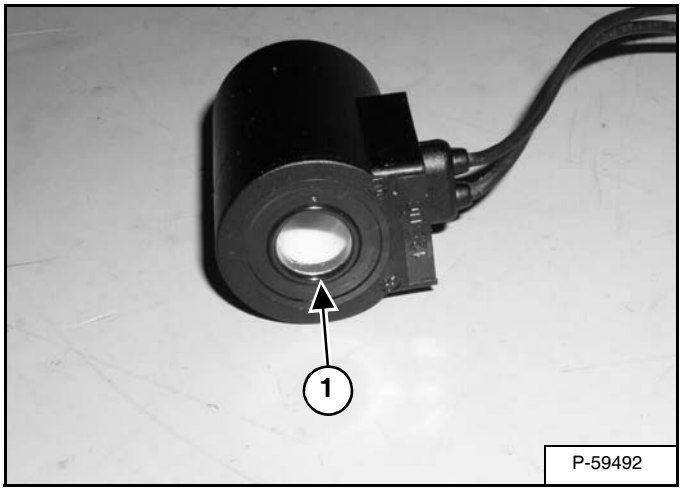
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-157



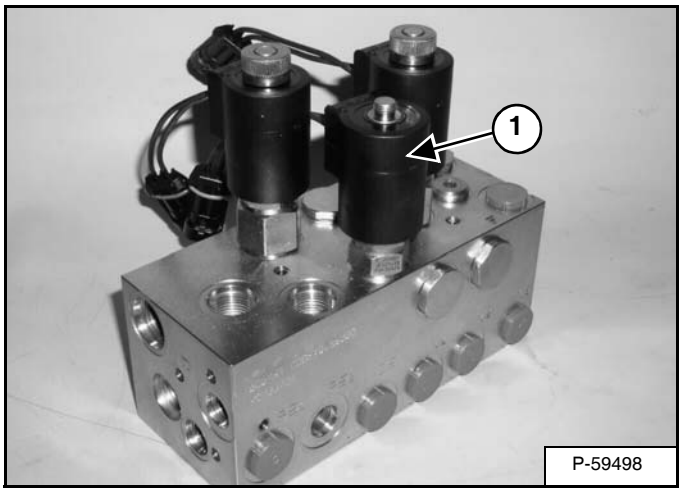
Install the O-ring (Item 1) **[Figure 20-60-157]** on the solenoid stem.

Figure 20-60-158



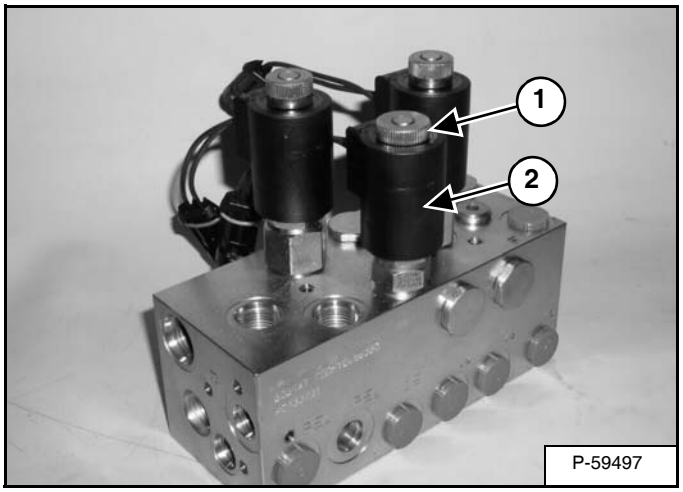
Install the O-ring (Item 1) **[Figure 20-60-158]** on the coil.

Figure 20-60-159



Install the coil with yellow tie strap (Item 1) **[Figure 20-60-159]** on the two speed boost solenoid stem.

Figure 20-60-160



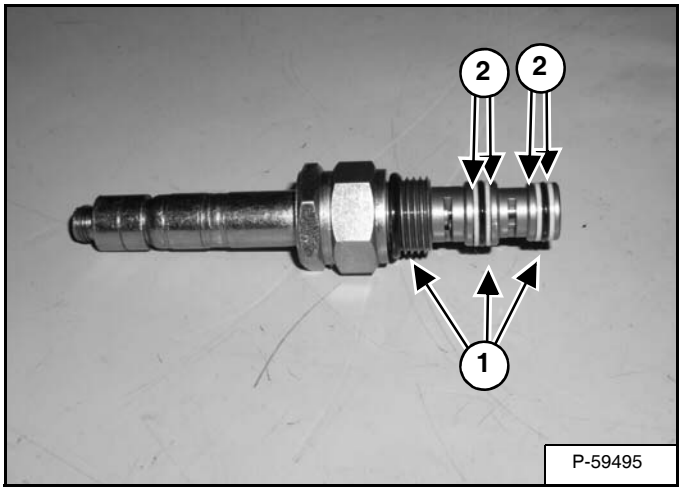
Install the nut (Item 1) on the two speed boost solenoid (Item 2) **[Figure 20-60-160]**.

Tighten the nuts to 4.4 ft.-lb. (6 N•m) torque.

NOTE: Overtightening the nut (Item 1) [Figure 20-60-160] may cause solenoid or coil failure.

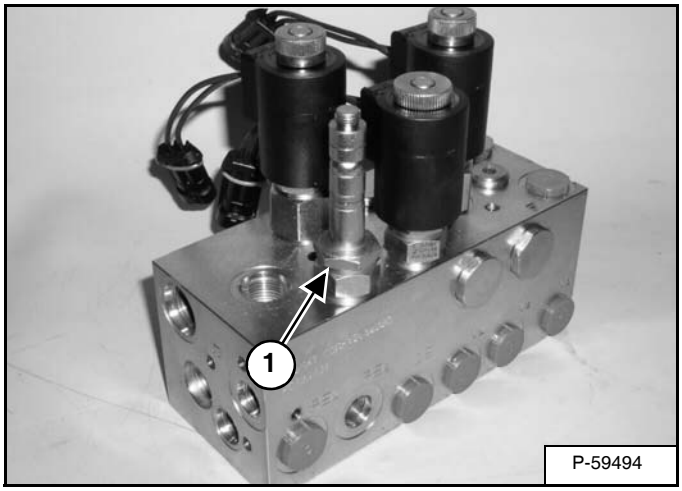
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-161



Install the O-rings (Item 1) and backup rings (Item 2) **[Figure 20-60-161]**.

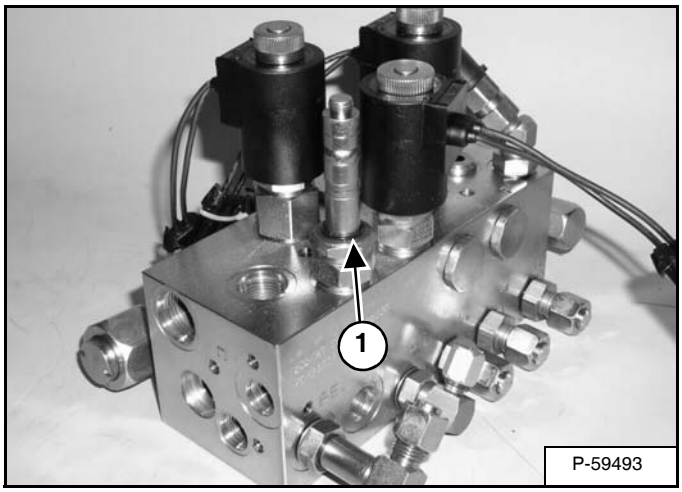
Figure 20-60-162



Install the solenoid stem (Item 1) **[Figure 20-60-162]**.

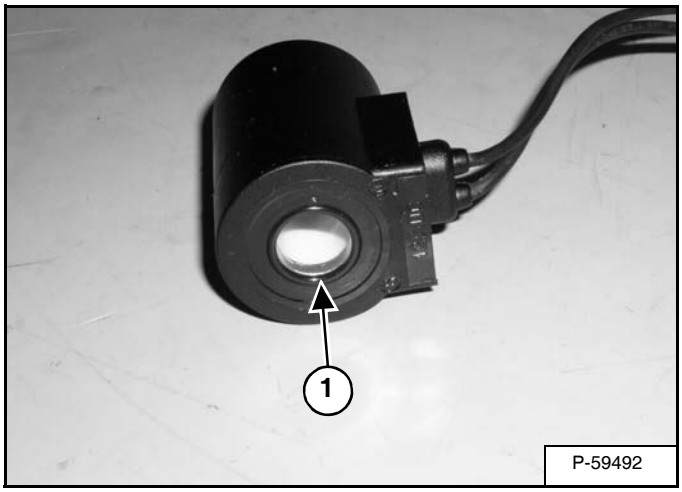
Tighten the solenoid stem to 22 ft.-lb. (30 N•m) torque.

Figure 20-60-163



Install the O-ring (Item 1) **[Figure 20-60-163]** on the solenoid stem.

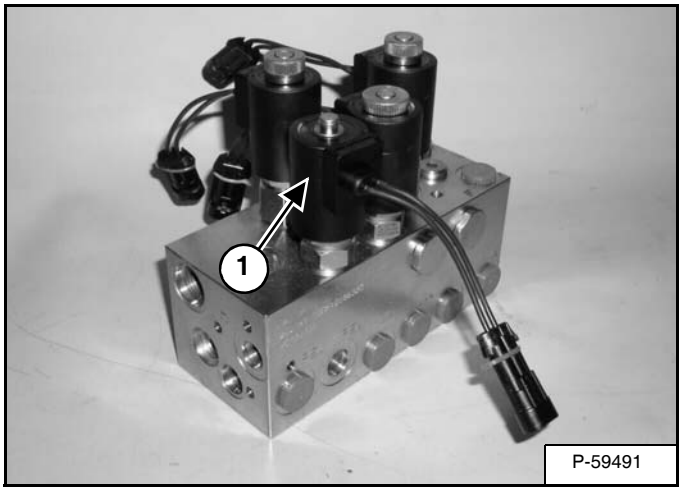
Figure 20-60-164



Install the O-ring (Item 1) **[Figure 20-60-164]** on the coil.

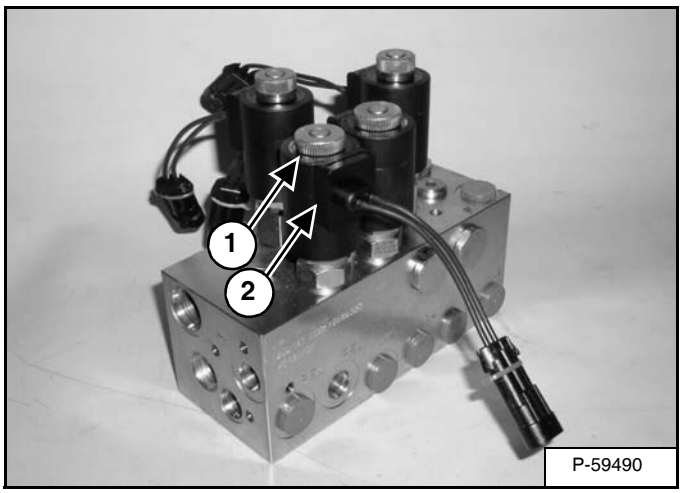
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-165



Install the coil with the green tie strap (Item 1) **[Figure 20-60-165]** on the console (joystick) lockout solenoid stem.

Figure 20-60-166

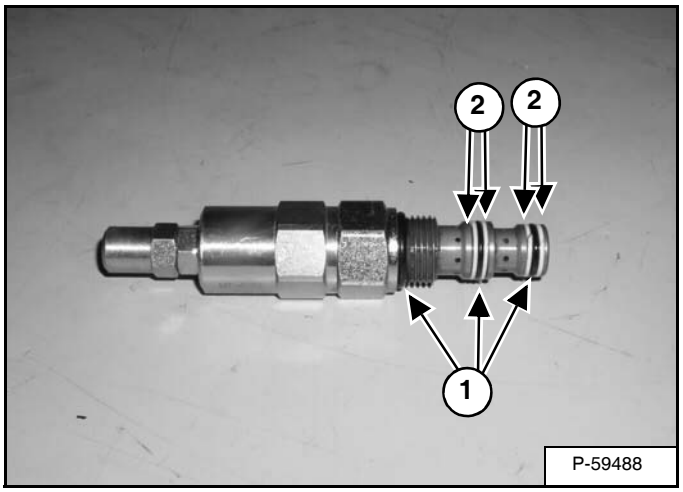


Install the nut (Item 1) on the console (joystick) lockout solenoid (Item 2) **[Figure 20-60-166]**.

Tighten the nuts to 4.4 ft.-lb. (6 N•m) torque.

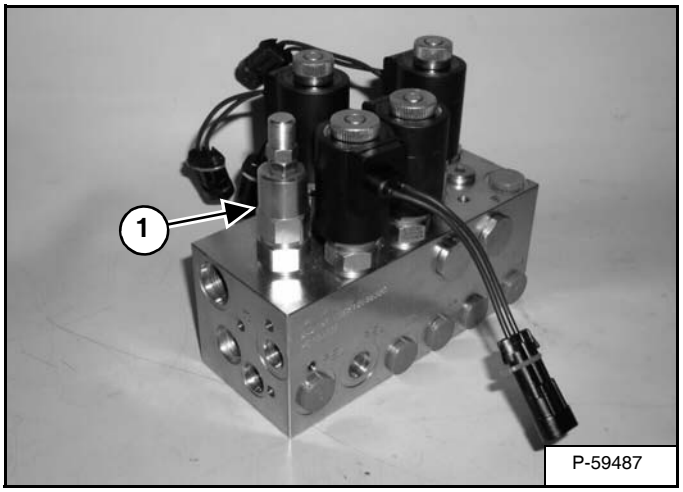
NOTE: Overtightening the nut (Item 1) [Figure 20-60-166] may cause solenoid or coil failure.

Figure 20-60-167



Remove the O-rings (Item 1) and backup rings (Item 2) **[Figure 20-60-167]**.

Figure 20-60-168

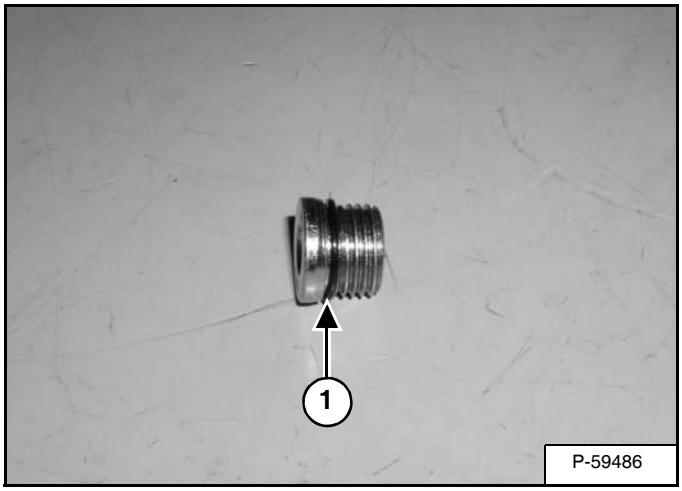


Install the pressure reducing valve (Item 1) **[Figure 20-60-168]** from the manifold.

Tighten the valve to 22 ft.-lb. (30 N•m) torque.

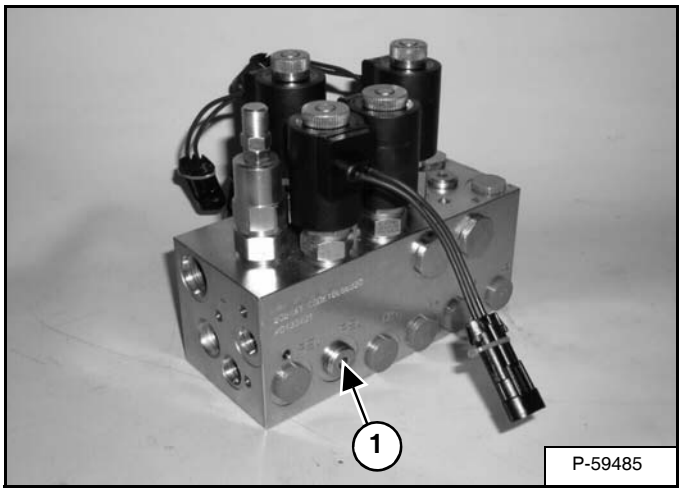
Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

Figure 20-60-169



Install the O-ring (Item 1) **[Figure 20-60-169]** on the plug.

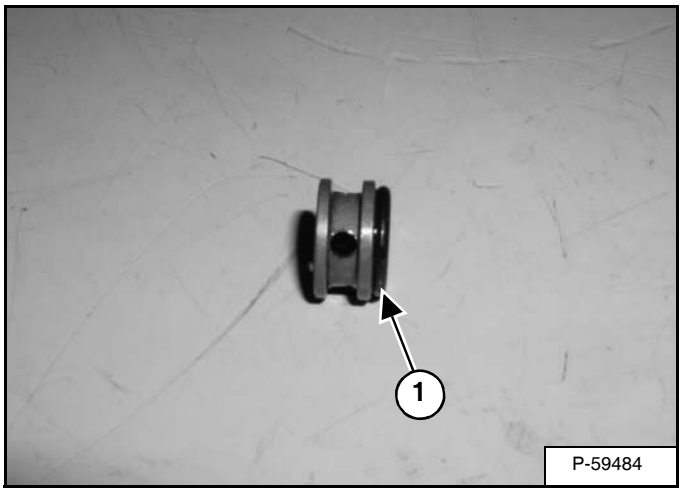
Figure 20-60-170



Install the plug (Item 1) **[Figure 20-60-170]**.

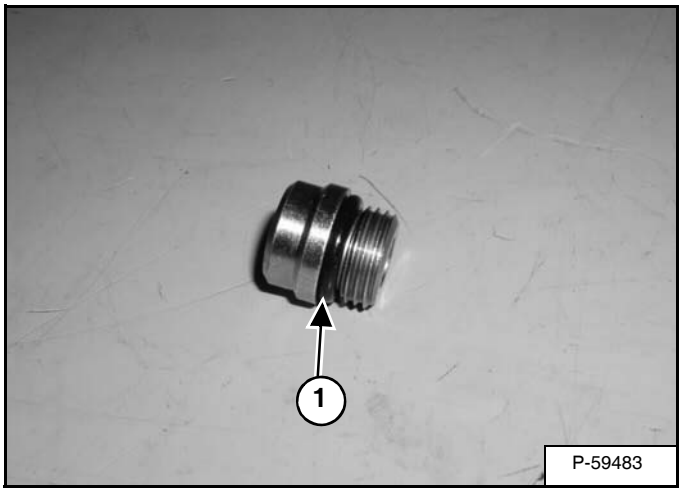
Tighten the plug to 22 ft.-lb. (30 N•m) torque.

Figure 20-60-171



Install the O-ring (Item 1) **[Figure 20-60-171]** on the seat.

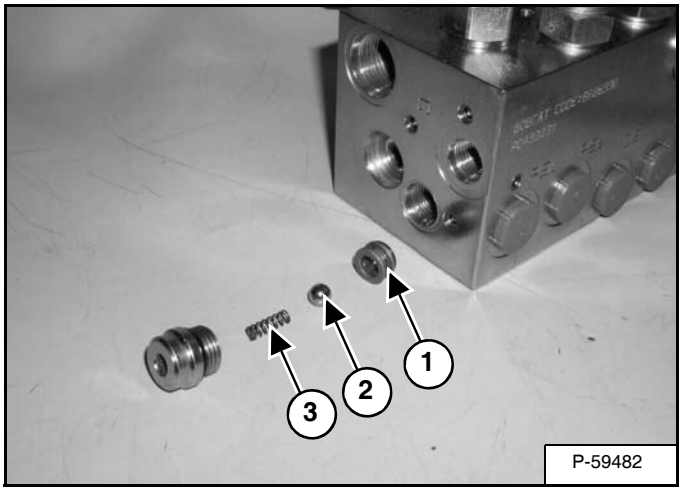
Figure 20-60-172



Install the O-ring (Item 1) **[Figure 20-60-172]** on the plug.

Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

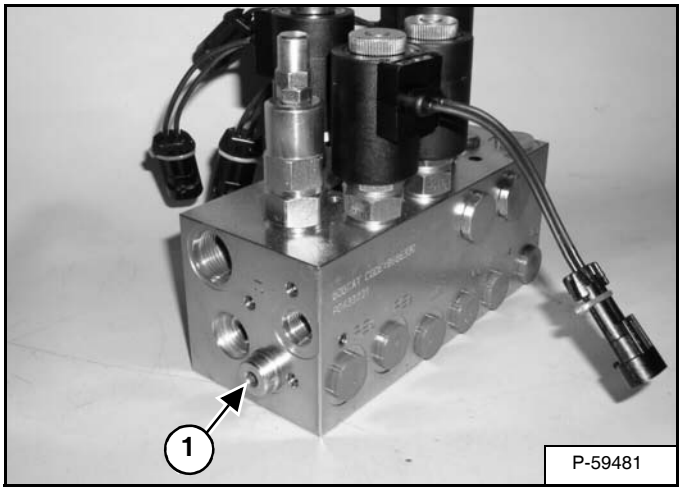
Figure 20-60-173



Install the seat (Item 1), check ball (Item 2) and spring (Item 3) **[Figure 20-60-173]**.

NOTE: Install O-ring face on seat towards the center of the manifold.

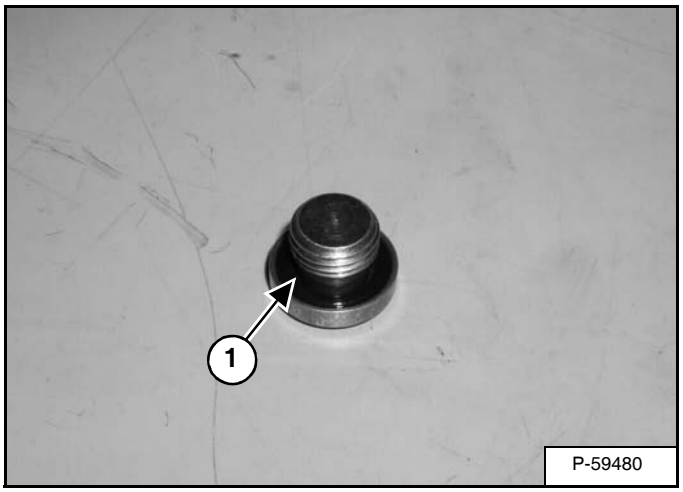
Figure 20-60-174



Install the plug (Item 1) **[Figure 20-60-174]** in the manifold.

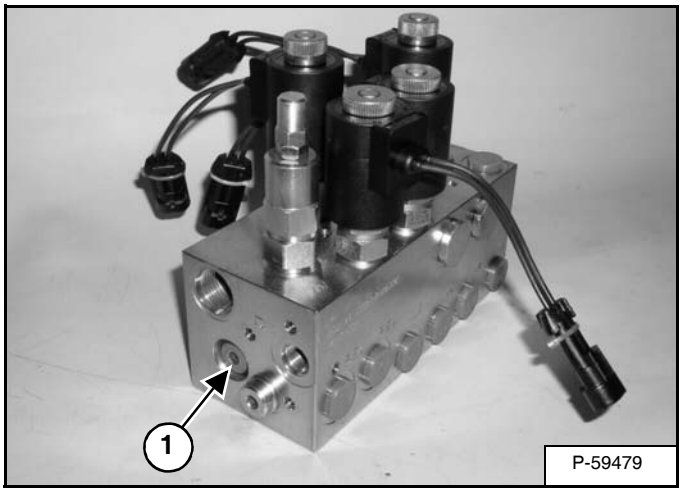
Tighten the plug to 30 ft.-lb. (40 N•m) torque.

Figure 20-60-175



Install the O-ring (Item 1) **[Figure 20-60-175]** on the plug.

Figure 20-60-176

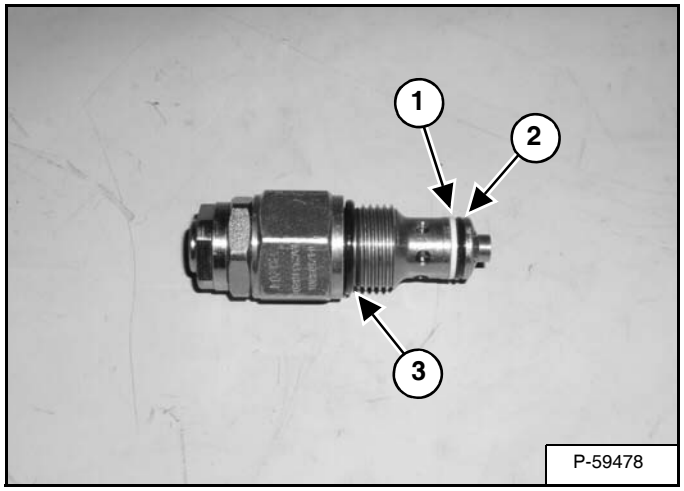


Install the plug (Item 1) **[Figure 20-60-176]** in the manifold.

Tighten the plug to 22 ft.-lb. (30 N•m) torque.

Assembly (S/N 223911248 & Above & S/N 224012294 & Above) (Cont'd)

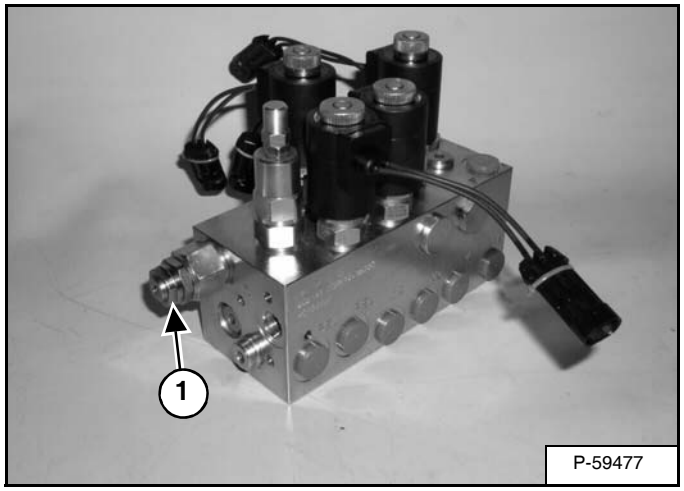
Figure 20-60-177



Install the back-up ring (Item 1) O-ring (Item 2) **[Figure 20-60-177]** on the relief valve.

Install the O-ring (Item 3) **[Figure 20-60-177]** on the relief valve.

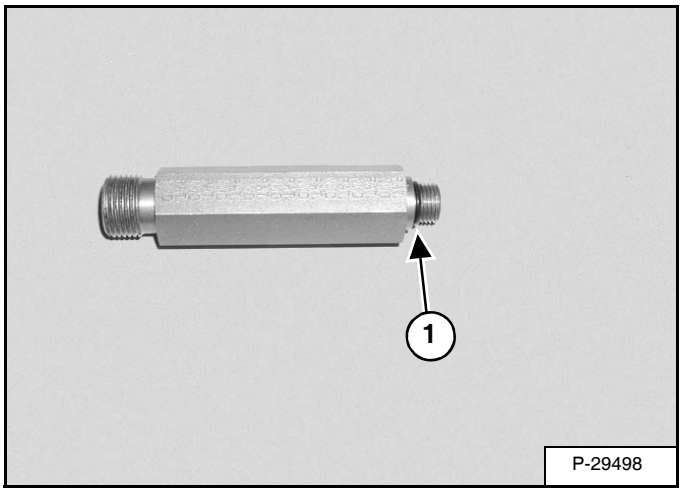
Figure 20-60-178



Install the relief valve (Item 1) **[Figure 20-60-178]** in the manifold.

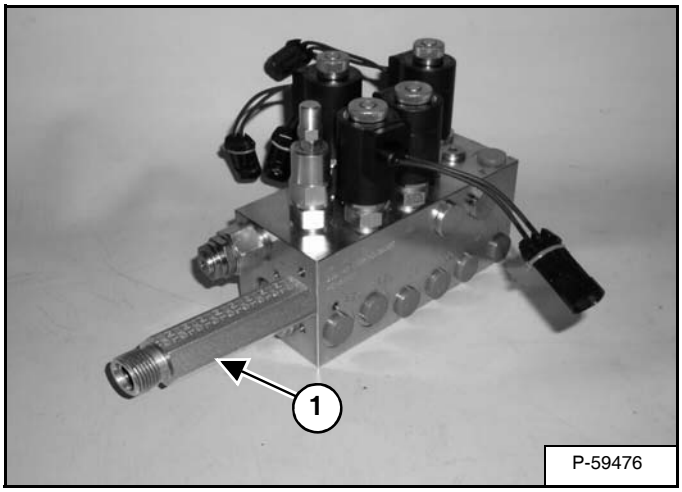
Tighten the valve to 44 ft.-lb. (60 N•m) torque.

Figure 20-60-179



Install the O-ring (Item 1) **[Figure 20-60-179]** on the accumulator extension.

Figure 20-60-180



Install the accumulator extension (Item 1) **[Figure 20-60-180]** on the manifold.

Tighten the extension to 21-24 ft.-lb. (29-33 N•m) torque.

TRAVEL MOTOR

Removal and Installation

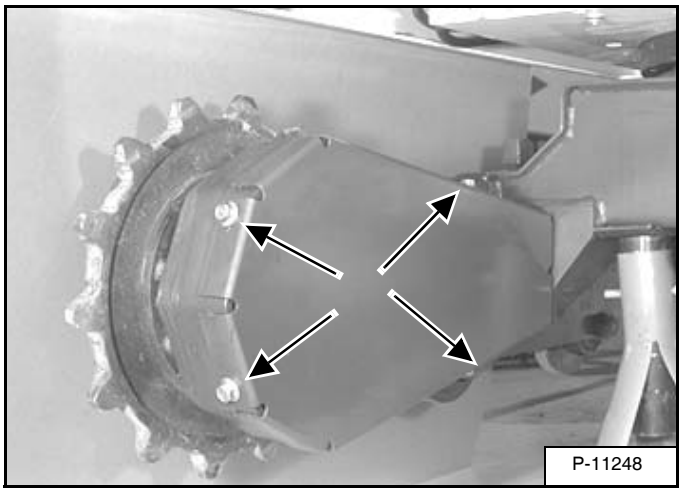
Remove the track. (See Removal And Installation on Page 30-20-4.)

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

Figure 20-70-1



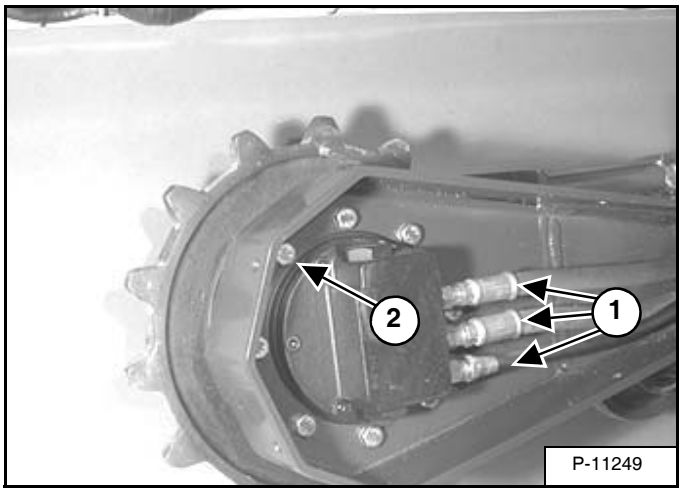
Remove the bolts from the track frame cover **[Figure 20-70-1]**.

Installation: Tighten the bolts to 15-18 ft.-lbs. (20-25 Nm) torque.

Remove the cover.

Mark the hoses for correct installation.

Figure 20-70-2



Remove the hoses (Item 1) **[Figure 20-70-2]** from the travel motor.

Remove the travel motor mounting bolts (Item 2) **[Figure 20-70-2]**.

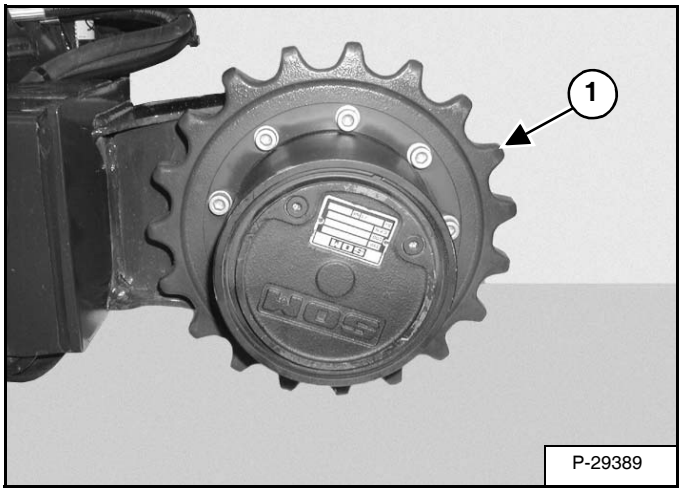
Installation: Tighten the bolts to 29-37 ft.-lbs. (40-50 Nm) torque.

Remove the travel motor.

The drive sprocket can be removed without removing the travel motor.

If removing the sprocket from a travel motor that has been removed from the track frame, clamp the motor in a vise.

Figure 20-70-3

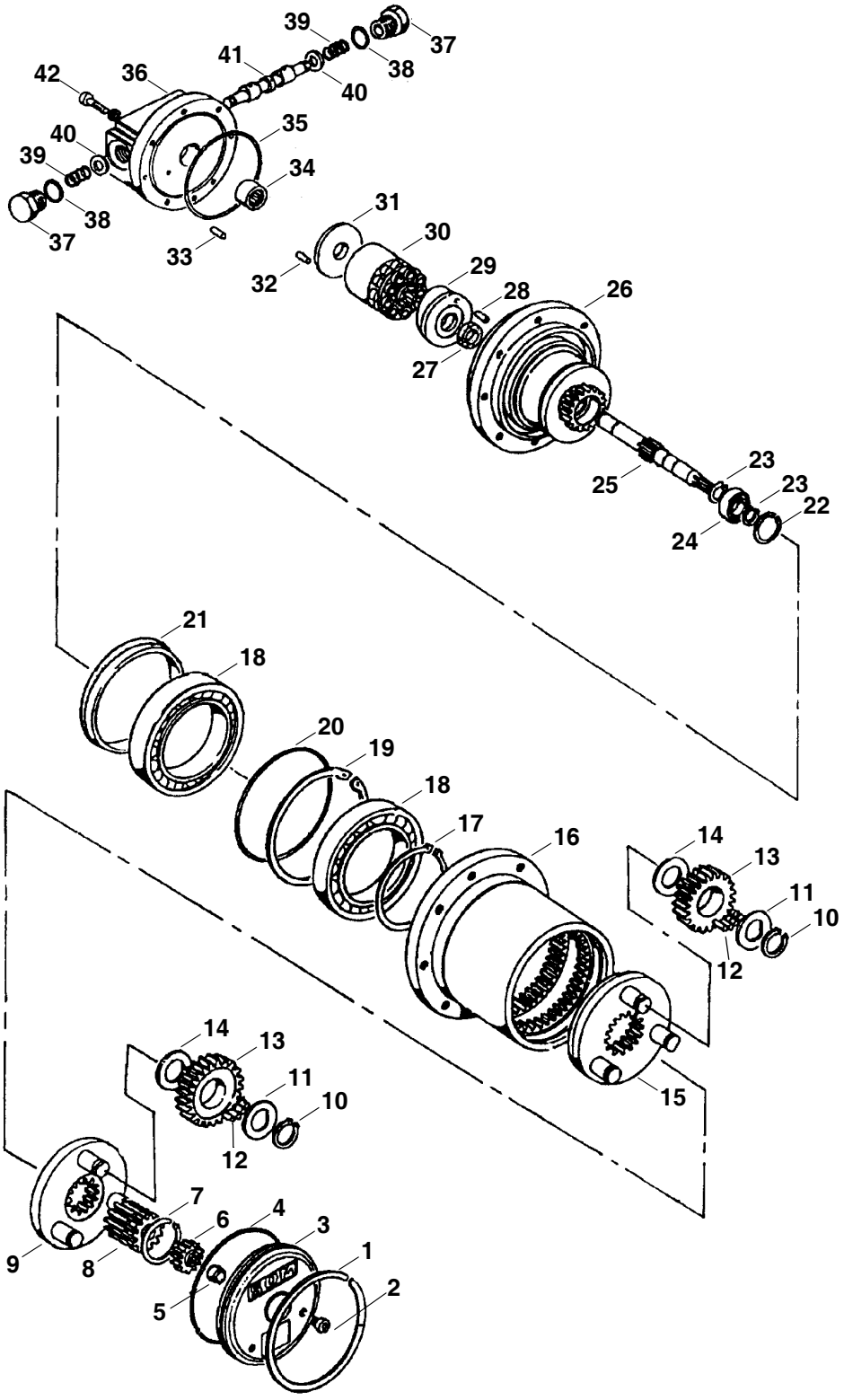


Remove the sprocket bolts. Remove the sprocket (Item 1) **[Figure 20-70-3]**.

Installation: Tighten the bolts to 48-55 ft.-lbs. (65-75 Nm) torque.

Parts Identification

1. Snap Ring
2. Plug
3. Cover
4. O-ring
5. Bushing
6. Sun Gear
7. Snap Ring
8. Sun Gear
9. Planetary Carrier
10. Snap Ring
11. Anti-rotation Washers
12. Bearings
13. Planetary Gear
14. Thrust Washer
15. Planetary Carrier
16. Ring Gear
17. Snap Ring
18. Bearing
19. Snap Ring
20. O-ring
21. Seal Ring
22. Snap Ring
23. Snap Ring
24. Bearing
25. Drive Shaft
26. Hub
27. Seal
28. Alignment Pin
29. Swash Plate
30. Rotating Block
31. Motor Plate
32. Alignment Pin
33. Alignment Pin
34. Bearing
35. O-ring
36. Motor Cover
37. Plug
38. O-ring
39. Spring
40. Washer
41. Spool
42. Bolt



B-14478

Disassembly

IMPORTANT

hen 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.

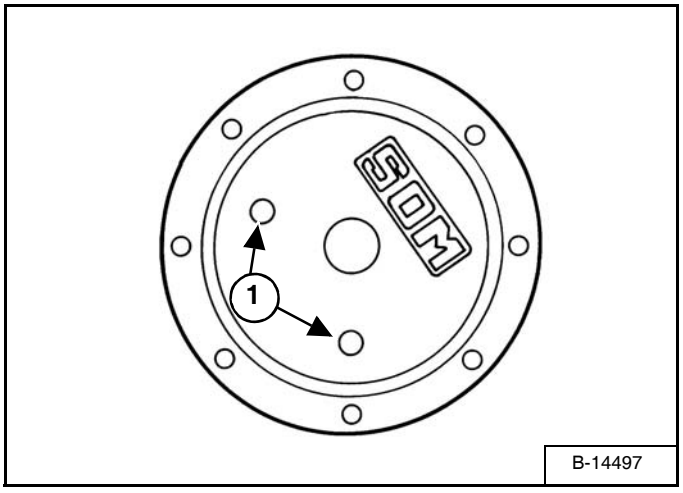
I-2003-0888

Clean the outside of the travel motor before disassembly.

The following tool will need to be ordered from OTC tool to reassemble the travel motor:

MEL1468 for torque ring and seal ring assembly.

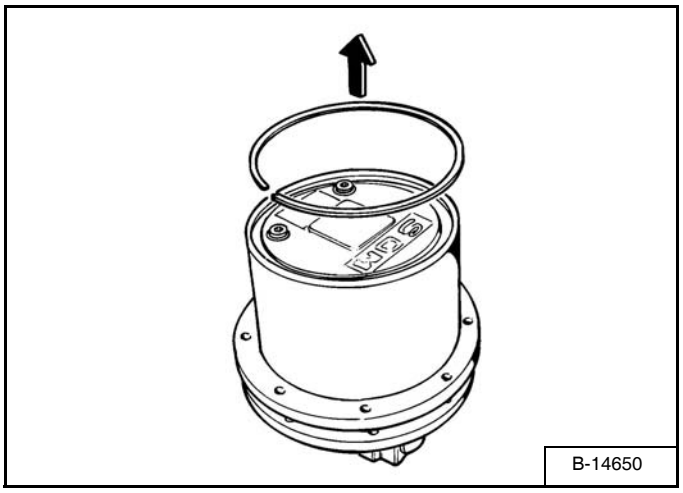
Figure 20-70-4



Remove the drain plugs (Item 1) **[Figure 20-70-4]** from the end cover.

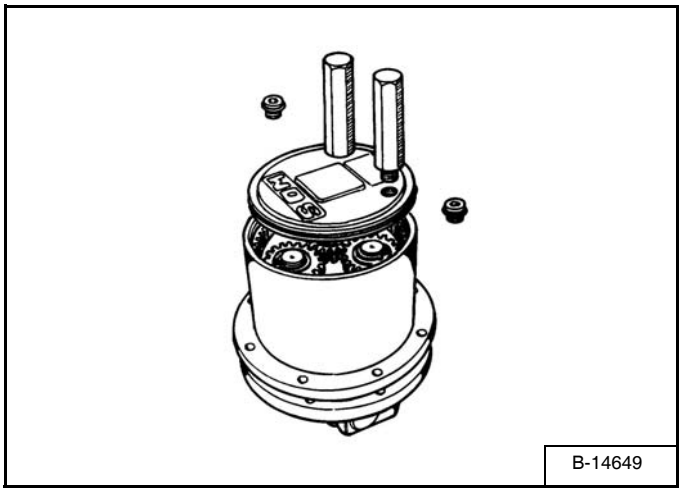
Drain the oil into a container.

Figure 20-70-5



Remove the internal snap ring from the travel motor case **[Figure 20-70-5]**.

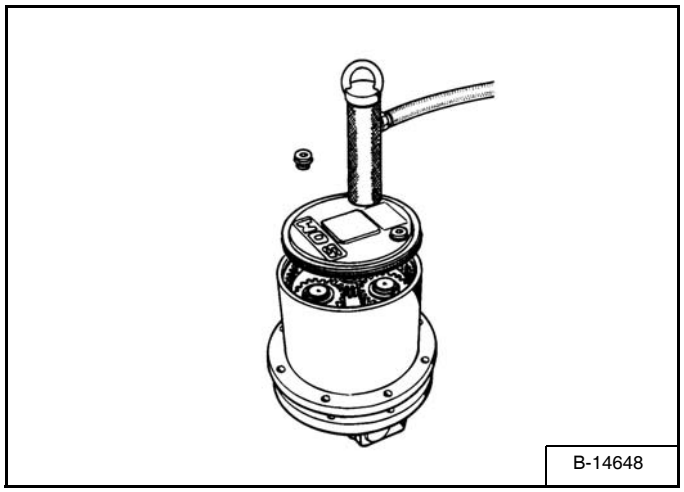
Figure 20-70-6



To remove the cover, install two threaded pins in the drain holes and lift the cover off **[Figure 20-70-6]**.

Disassembly (Cont'd)

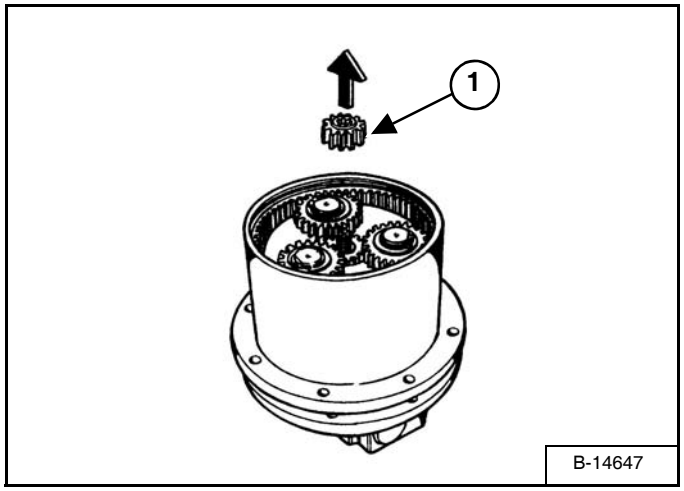
Figure 20-70-7



Air pressure may also be used to remove the cover, screw the adapter in a drain hole and apply 8-11 PSI **[Figure 20-70-7]**.

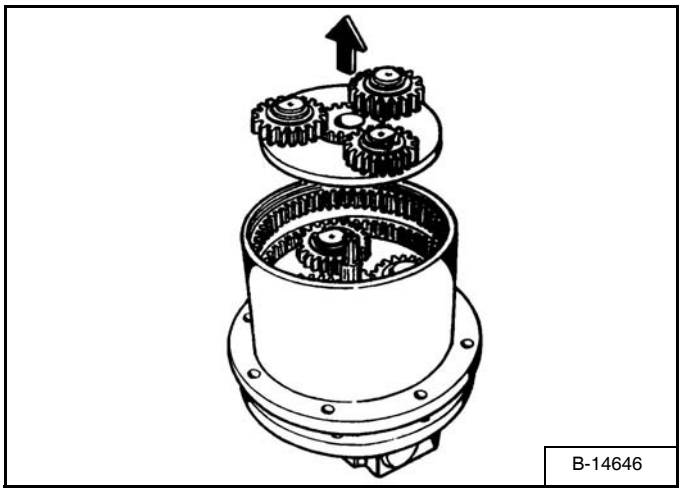
NOTE: Do not use excess pressure or seal damage may result.

Figure 20-70-8



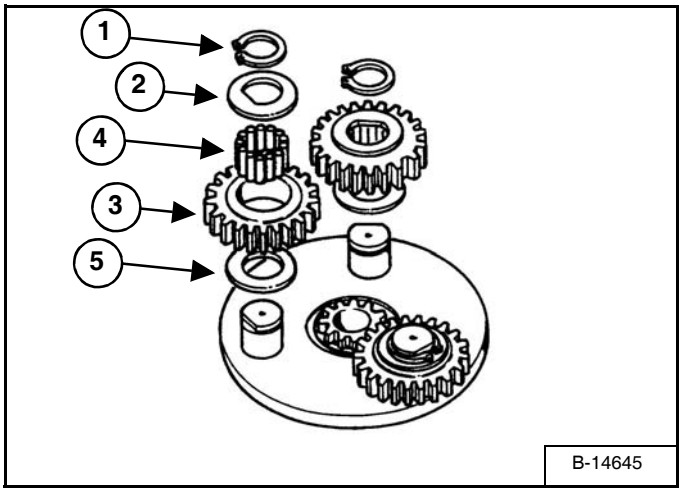
Remove the outer sun gear (Item 1) **[Figure 20-70-8]** by using two levers and prying on the bottom of the gear.

Figure 20-70-9



Remove the planetary carrier **[Figure 20-70-9]**.

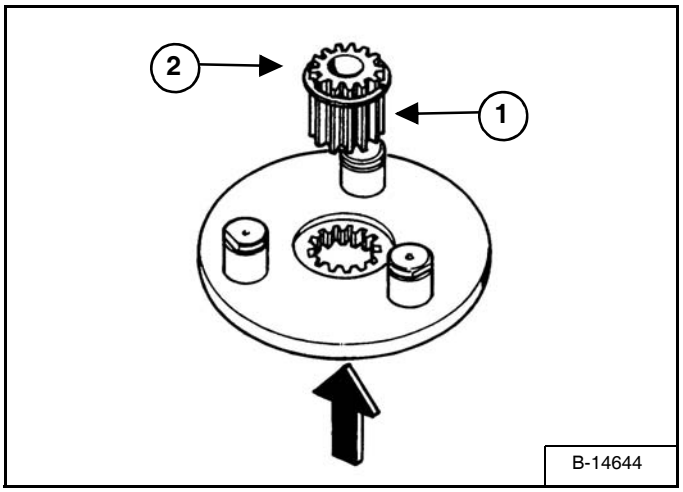
Figure 20-70-10



Remove the snap rings (Item 1) anti-rotation washers (Item 2), gears (Item 3), bearings (Item 4) and the bottom thrust washers (Item 5) **[Figure 20-70-10]** from the planetary carrier assembly.

Disassembly (Cont'd)

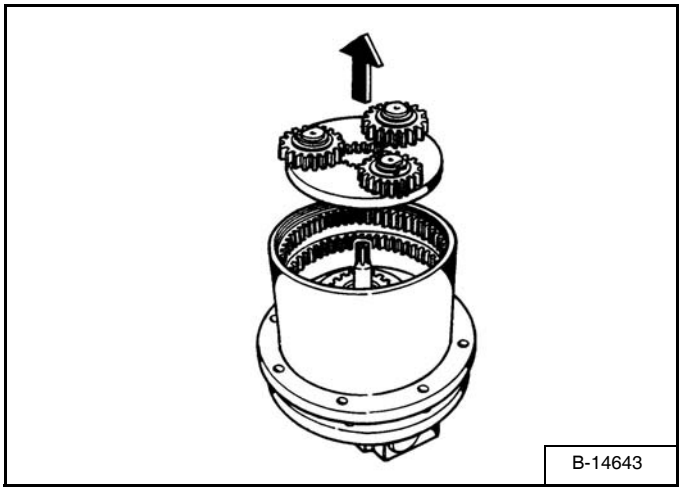
Figure 20-70-11



Remove the inner sun gear (Item 1) **[Figure 20-70-11]**, from the first stage planetary carrier.

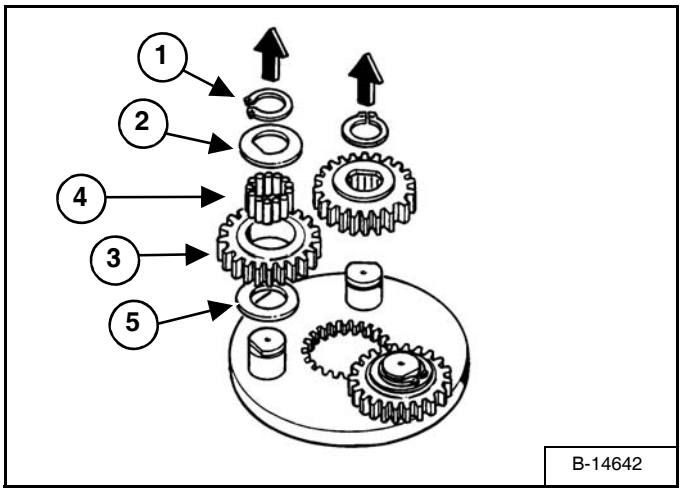
Removal of the sun gear snap ring (Item 2) **[Figure 20-70-11]** is not necessary.

Figure 20-70-12



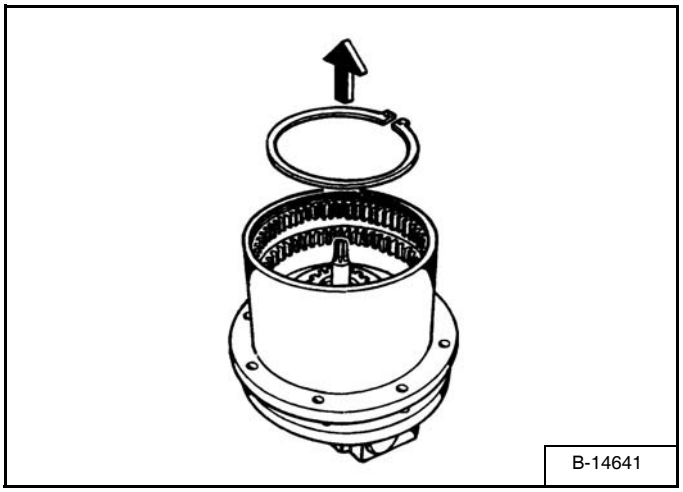
Remove the planetary carrier **[Figure 20-70-12]**.

Figure 20-70-13



Remove the snap rings (Item 1), anti-rotation washers (Item 2), gears (Item 3), bearings (Item 4) and bottom thrust washers (Item 5) **[Figure 20-70-13]** from the planetary carrier assembly.

Figure 20-70-14

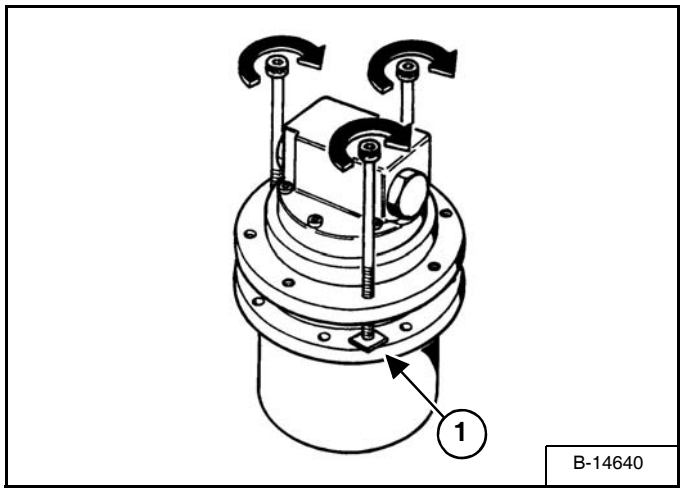


Remove the external snap ring from the hub to free the two bearings, ring gear and motor **[Figure 20-70-14]**.

Install three 10 mm bolts through the hub mounts, and tighten to separate the hub and ring gear assembly.

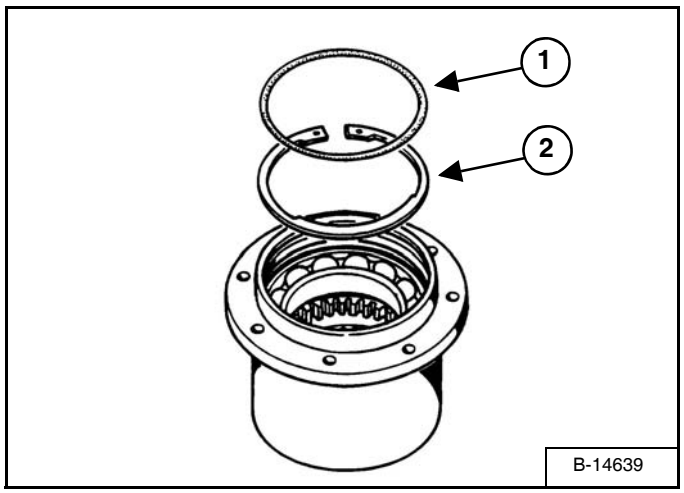
Disassembly (Cont'd)

Figure 20-70-15



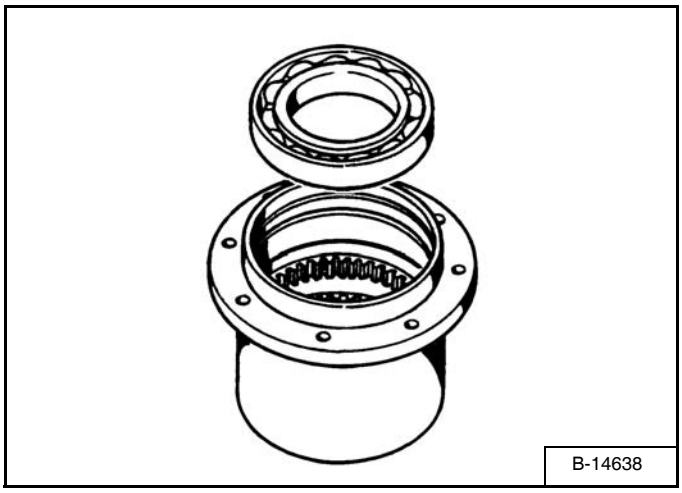
NOTE: Place a piece of scrap metal (Item 1) [Figure 20-70-15] in between the bolt and ring gear flange to prevent damage to the flange when tightening the bolts.

Figure 20-70-16



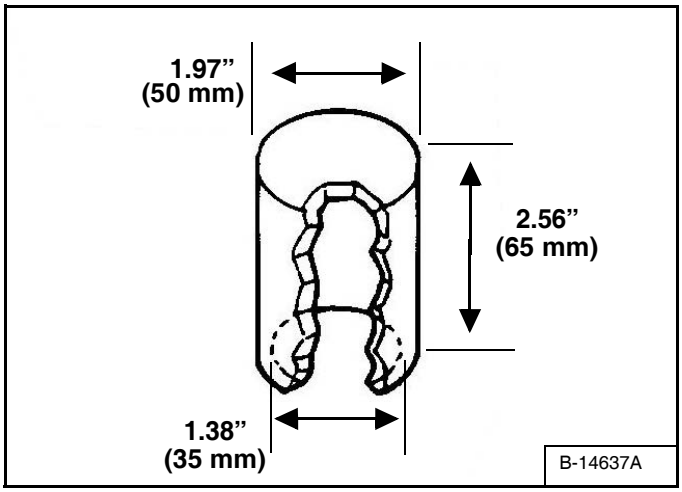
Remove the O-ring (Item 1) and internal snap ring (Item 2) **[Figure 20-70-16]** from the ring gear.

Figure 20-70-17



Remove the bearing from the carrier by pressing it out the flanged side of the carrier **[Figure 20-70-17]**.

Figure 20-70-18



Install a support cap **[Figure 20-70-18]**, over the drive shaft and gear, to protect the splines from damage.

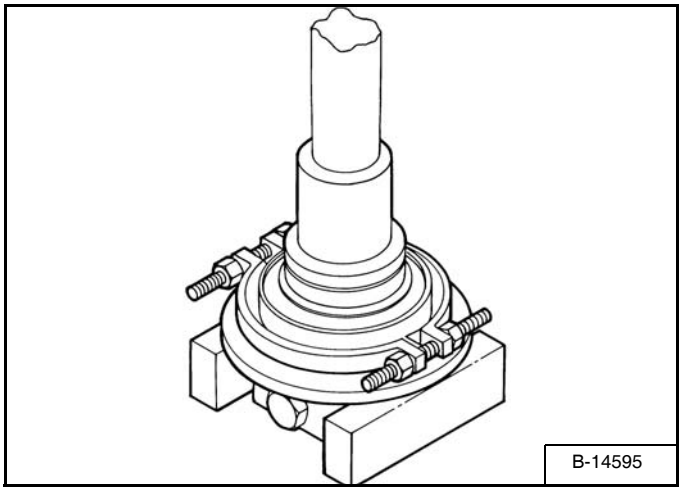
Obtain the support cap locally.

The dimensions of the support cap are as follows:

Height	2.56 inch (65 mm)
I.D.	1.38 inch (35 mm)
O.D.	1.97 inch (50 mm)

Disassembly (Cont'd)

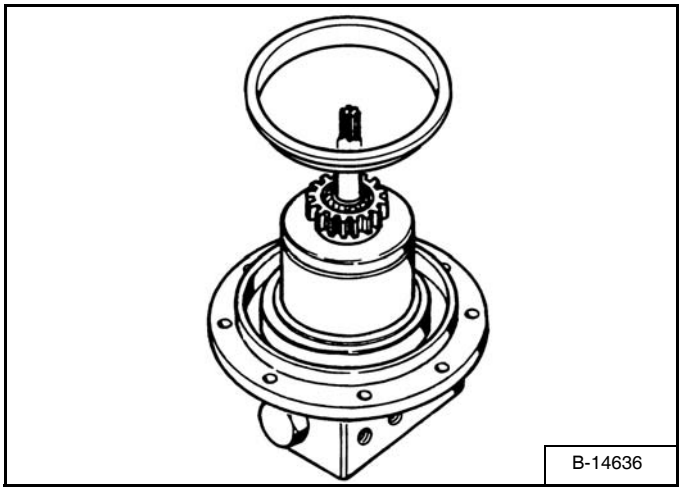
Figure 20-70-19



Press the bearing off the motor hub **[Figure 20-70-19]**.

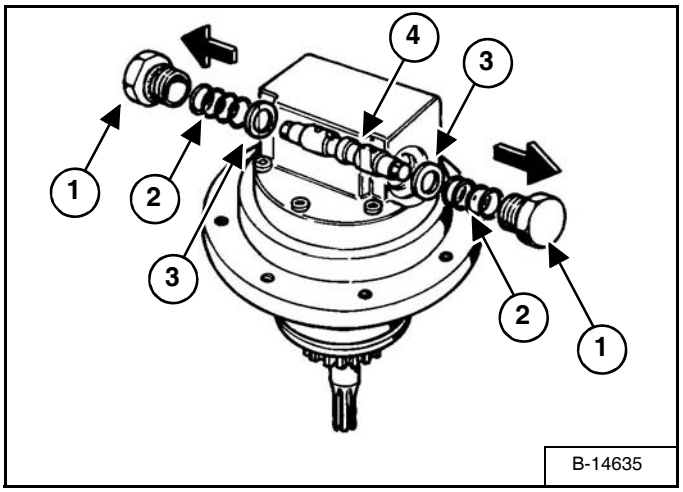
NOTE: Do not damage the bottom surface of the bearing as it is lapped (polished) to mate with the front seal ring.

Figure 20-70-20



Remove the front seal ring from the motor hub **[Figure 20-70-20]**.

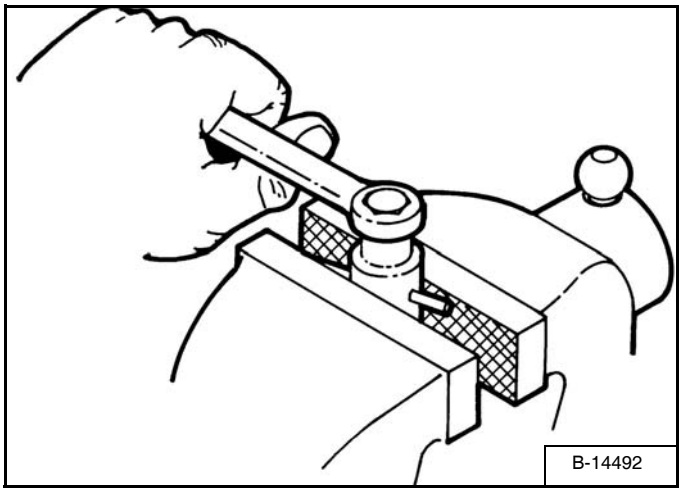
Figure 20-70-21



Remove the two plugs (Item 1), springs (Item 2), and washers (Item 3) **[Figure 20-70-21]** from each end of the housing.

Remove the spool (Item 4) **[Figure 20-70-21]**.

Figure 20-70-22



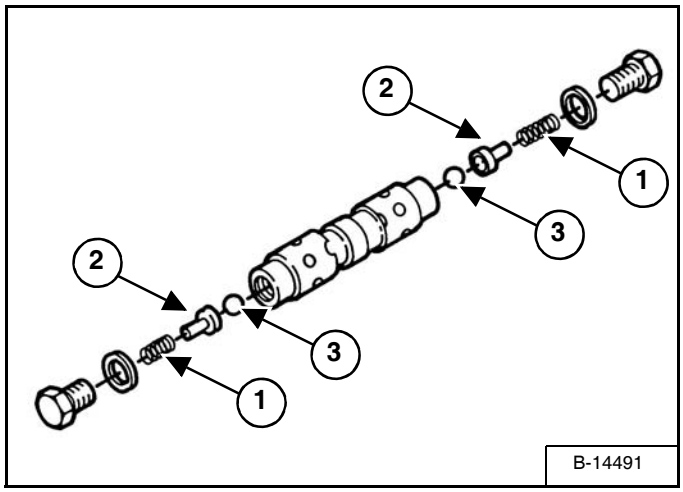
To disassemble the spool, insert a hardened pin through the hole in the spool and use a vise with protective jaws to hold the spool **[Figure 20-70-22]**.

NOTE: Do not use any type of tool to grip the spool or damage to the spool will result.

Remove the two end plugs from the end of the spool **[Figure 20-70-22]**.

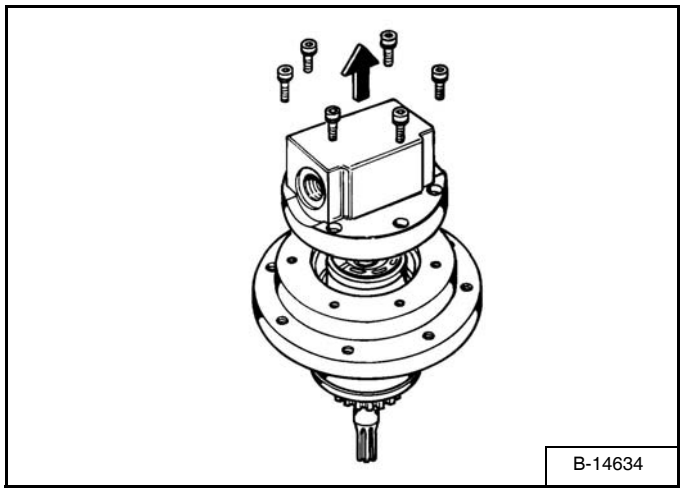
Disassembly (Cont'd)

Figure 20-70-23



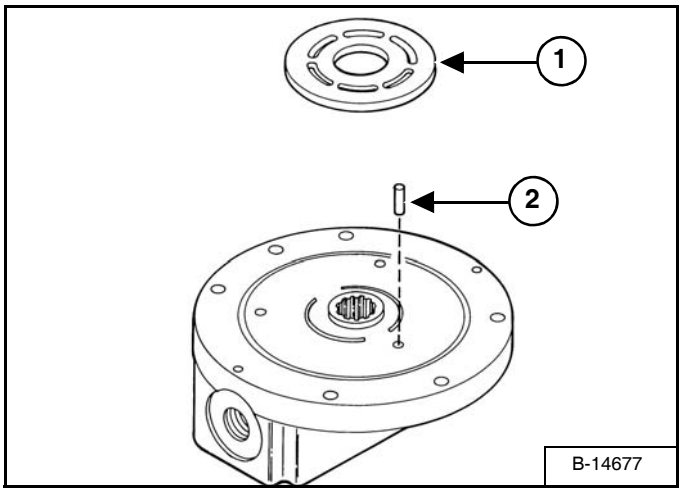
Remove the spring (Item 1) poppet (Item 2) and check ball (Item 3) **[Figure 20-70-23]** from the ends of the spool.

Figure 20-70-24



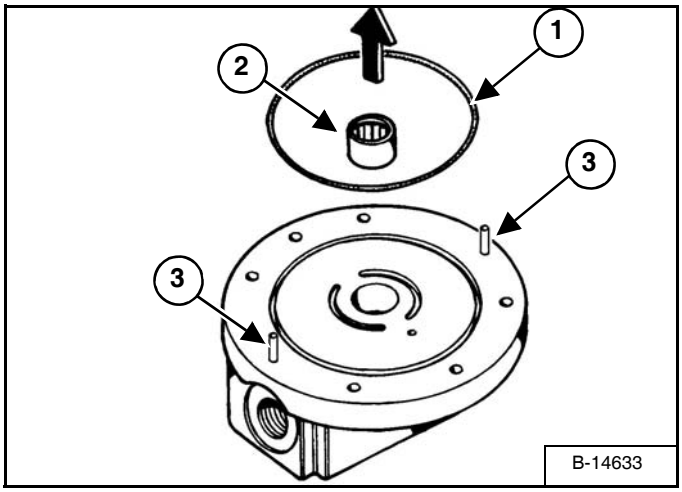
Remove the six bolts and remove the motor cover **[Figure 20-70-24]**.

Figure 20-70-25



Remove the bronze motor plate (Item 1) and dowel pin (Item 2) **[Figure 20-70-25]**.

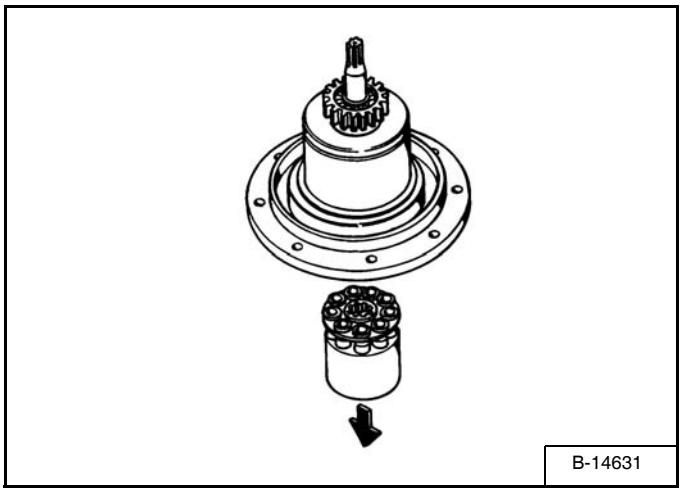
Figure 20-70-26



Remove the O-ring (Item 1) bearing (Item 2) and the two alignment pins (Item 3) remove the bearing (Item 2) **[Figure 20-70-26]** with a bearing puller.

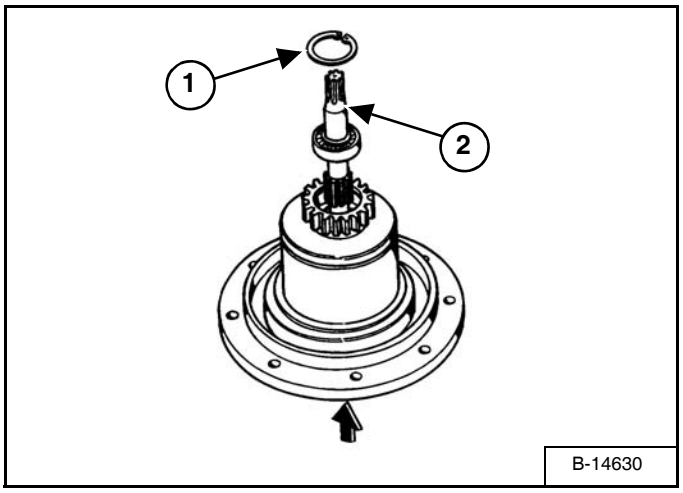
Disassembly (Cont'd)

Figure 20-70-27



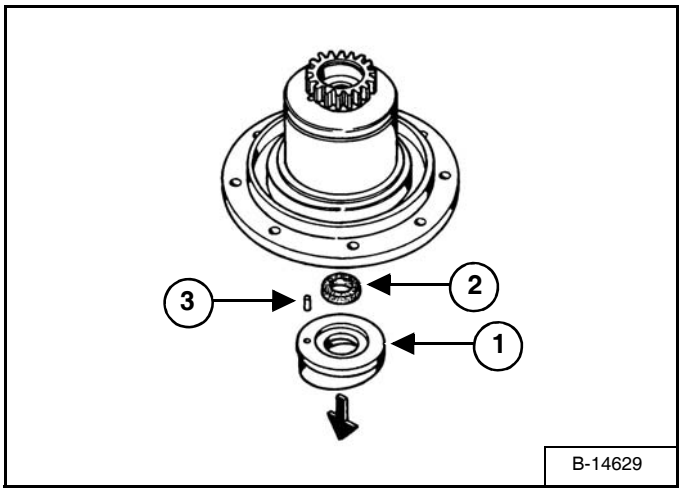
Invert the hub and the rotating block will slide out **[Figure 20-70-27]**.

Figure 20-70-28



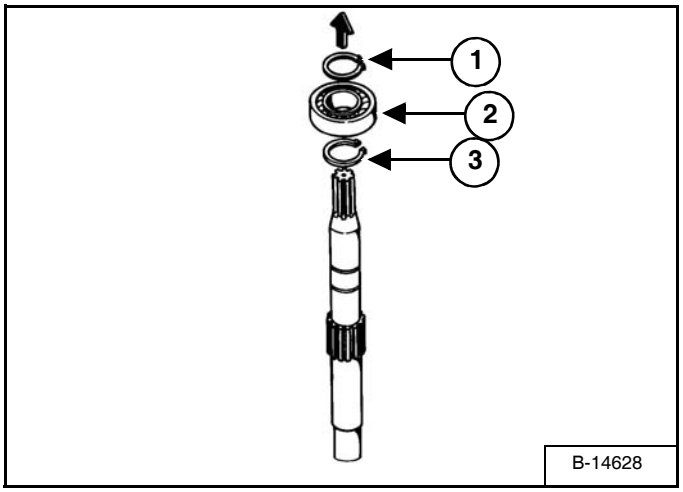
Remove the internal snap ring (Item 1) retaining the bearing/drive shaft to the hub and press the drive shaft (Item 2) **[Figure 20-70-28]** out of the hub.

Figure 20-70-29



Remove the swash plate (Item 1), seal (Item 2) and alignment pin (Item 3) **[Figure 20-70-29]**.

Figure 20-70-30

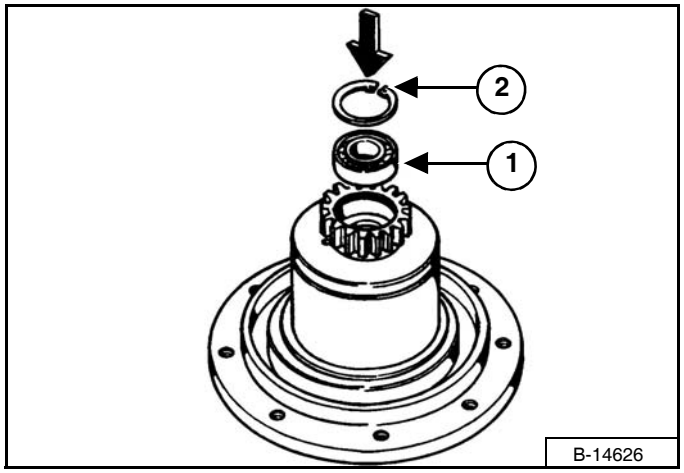


Remove the snap ring (Item 1), bearing (Item 2) and second snap ring (Item 3) **[Figure 20-70-30]** from the drive shaft.

Assembly

Clean all parts in solvent and dry with compressed air. Inspect all parts and replace any that are damaged. If any of the planetary gears are damaged, replace all the planetary gears and sun gear from the stage (first or second) that the damaged gear is from. One damaged gear can cause microscopic fatigue crack in mating teeth and cause premature failure after servicing. Apply oil to all O-rings (do not oil the rubber torque ring) and light grease to the ball and roller bearings before installation.

Figure 20-70-31

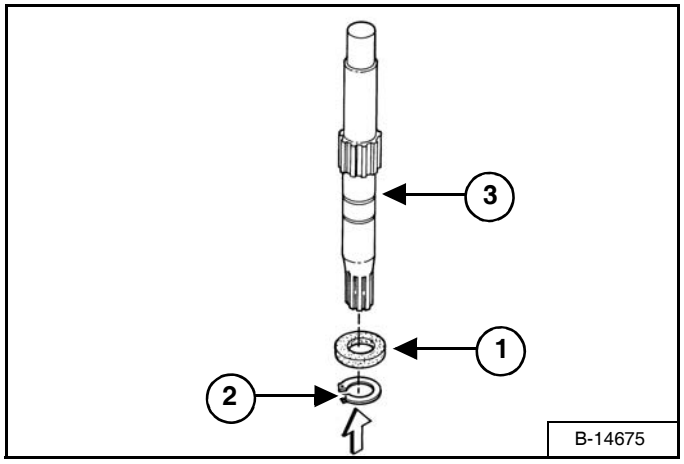


Press the bearing (Item 1) **[Figure 20-70-31]** in the motor hub.

Install the internal snap ring (Item 2) **[Figure 20-70-31]** in the motor hub.

Wrap glossy paper around the snap ring grooves to prevent damage to the seal.

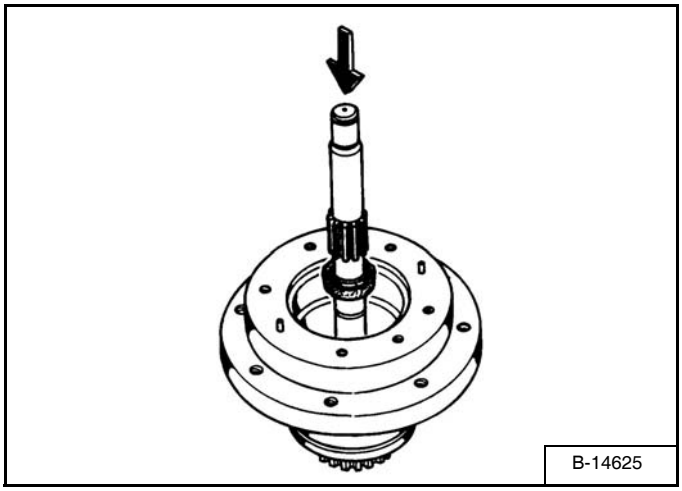
Figure 20-70-32



Lubricate with oil, and install the seal (Item 1) **[Figure 20-70-32]** on the drive shaft.

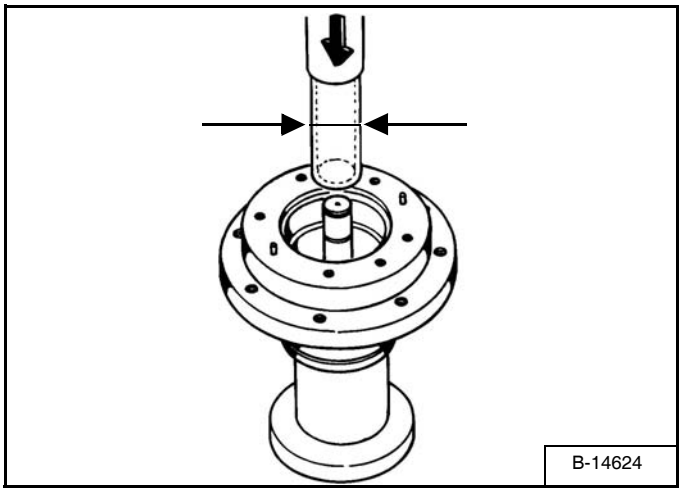
Install the snap ring (Item 2) on the drive shaft in the second groove (Item 3) **[Figure 20-70-32]**.

Figure 20-70-33



Invert the hub and press the drive shaft into the hub and bearing assembly. **[Figure 20-70-33]**

Figure 20-70-34

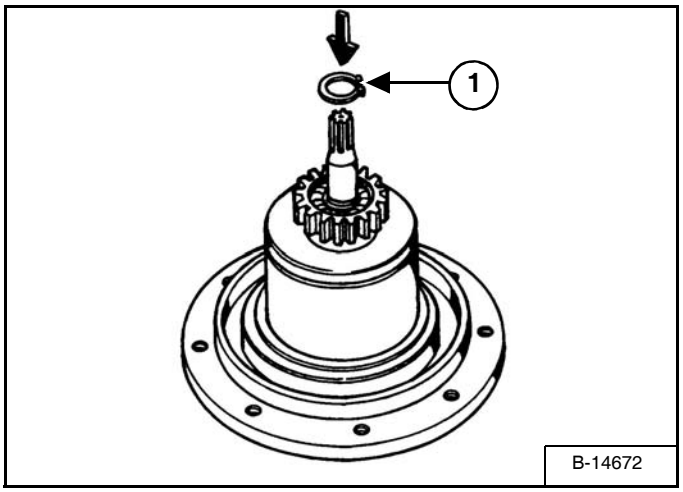


Install the new seal into the seal seat in the motor hub using the seal seating tool **[Figure 20-70-34]**. Obtain the seal seating tool locally. The dimensions of the seal seating tool are as follows:

Height	2.75 inch (70 mm)
I.D.	.677 inch (17, 2 mm)
O.D.	.708 inch (18 mm)

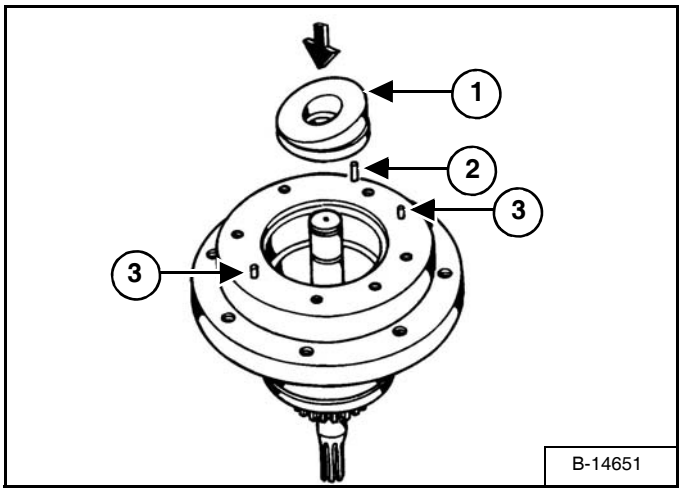
Assembly (Cont'd)

Figure 20-70-35



Invert the motor hub and install the external snap ring (Item 1) **[Figure 20-70-35]**.

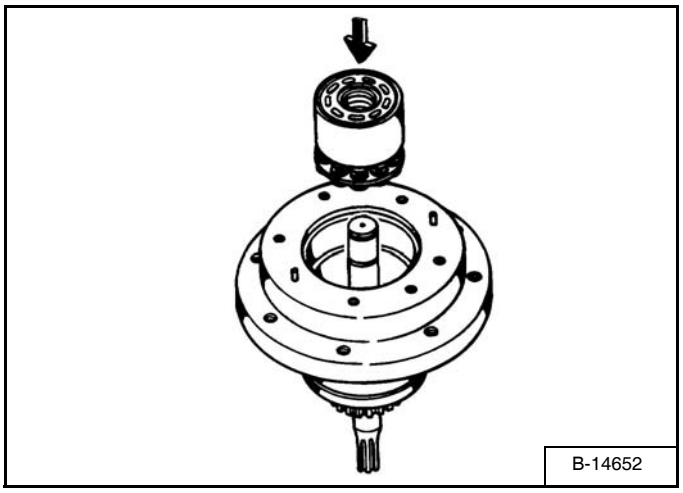
Figure 20-70-36



Install the swash plate (Item 1) and alignment pin (Item 2) **[Figure 20-70-36]** in the motor hub.

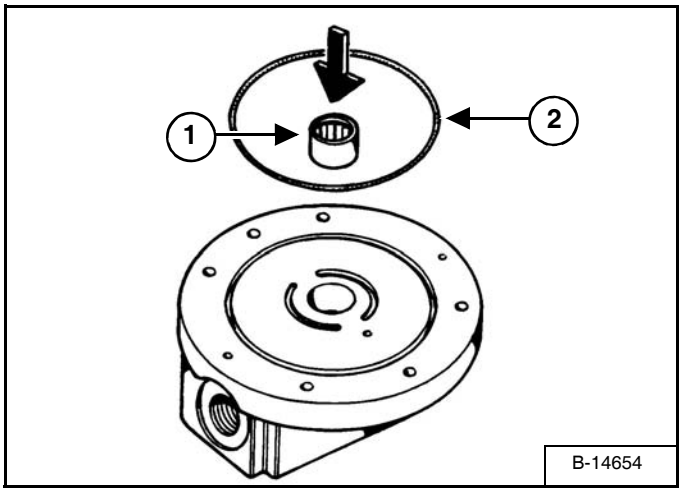
Install the two alignment pins (Item 3) **[Figure 20-70-36]** in the motor hub.

Figure 20-70-37



Lubricate with oil, and install the rotating block in the motor hub **[Figure 20-70-37]**.

Figure 20-70-38

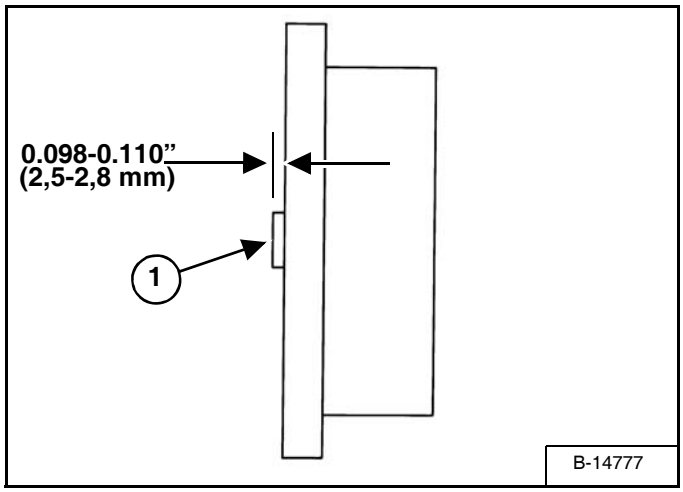


Press the bearing (Item 1) **[Figure 20-70-38]** into the motor cover.

Apply oil and install the O-ring (Item 2) **[Figure 20-70-38]**.

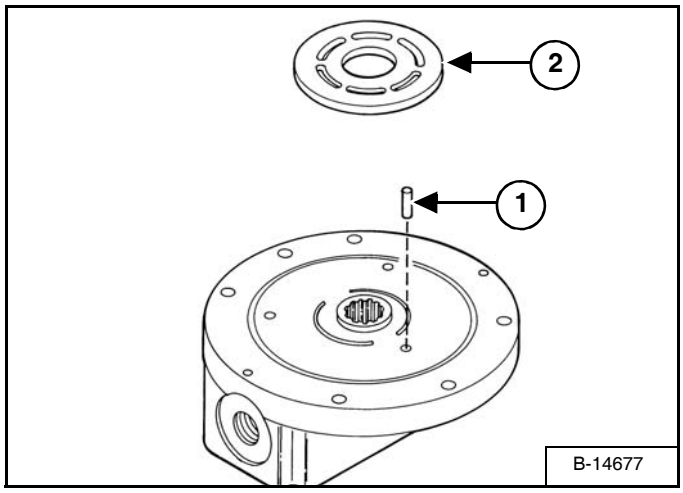
Assembly (Cont'd)

Figure 20-70-39



The bearing (Item 1) **[Figure 20-70-39]** must extend from the face of the cover 0.098-0.110 inch (2,5-2,8 mm).

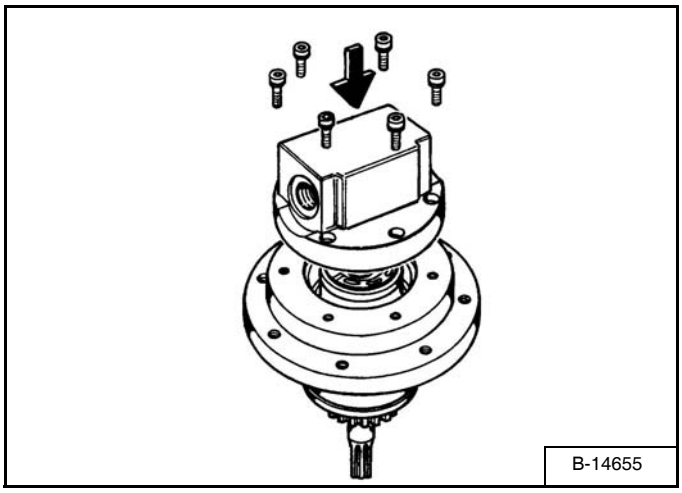
Figure 20-70-40



Install the alignment pin (Item 1) **[Figure 20-70-40]** on the motor cover.

Install the valve plate (Item 2) on the motor cover, with the alignment notch, in the valve plate (Item 2) sliding over the alignment pin (Item 1) **[Figure 20-70-40]**.

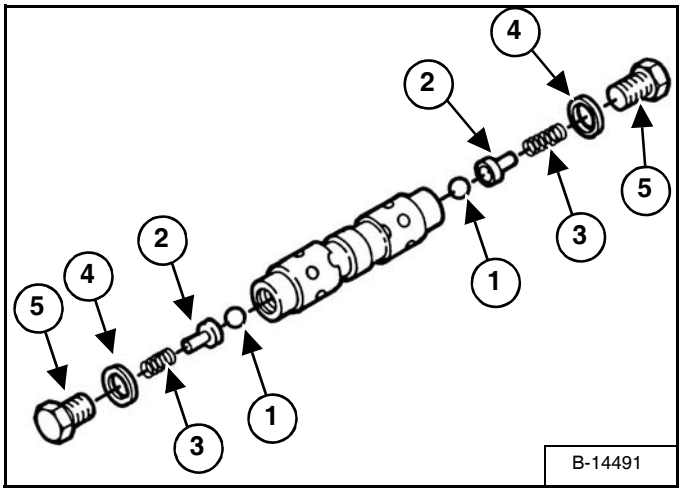
Figure 20-70-41



Lubricate the bearing with oil and install the motor cover onto the hub with six bolts **[Figure 20-70-41]**.

Tighten the bolts in a crisscross manner to 18-22 ft. lbs. (25-30 Nm) torque.

Figure 20-70-42

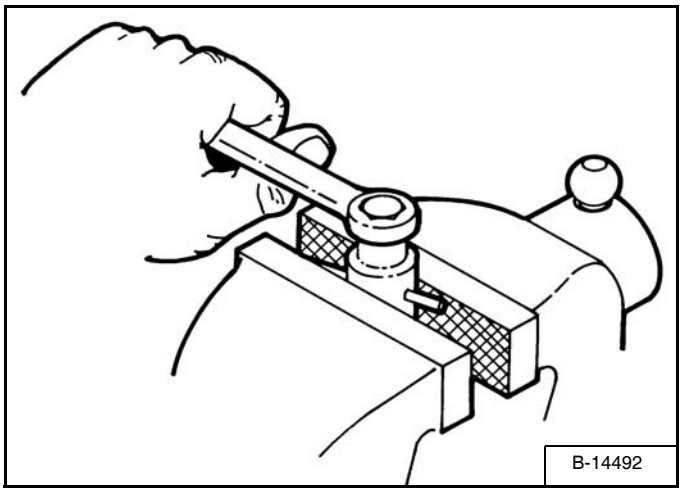


Install the check ball (Item 1), poppet (Item 2) and spring (Item 3) **[Figure 20-70-42]** into both ends of the spool.

Apply oil and install the new O-rings (Item 4) on the plugs (Item 5) **[Figure 20-70-42]**.

Assembly (Cont'd)

Figure 20-70-43



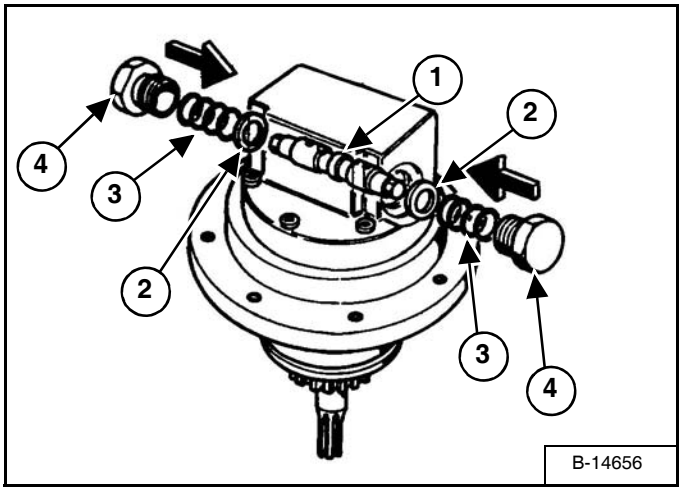
To assemble the spool, insert a hardened pin through the hole in the spool and use a vise with protective jaws to hold the spool **[Figure 20-70-43]**.

NOTE: Do not use any type of tool to grip the spool or damage to the spool will result.

Install the two plugs in both ends of the spool **[Figure 20-70-43]**.

Tighten the plugs to 18-22 ft. lbs. (25-30 Nm) torque.

Figure 20-70-44



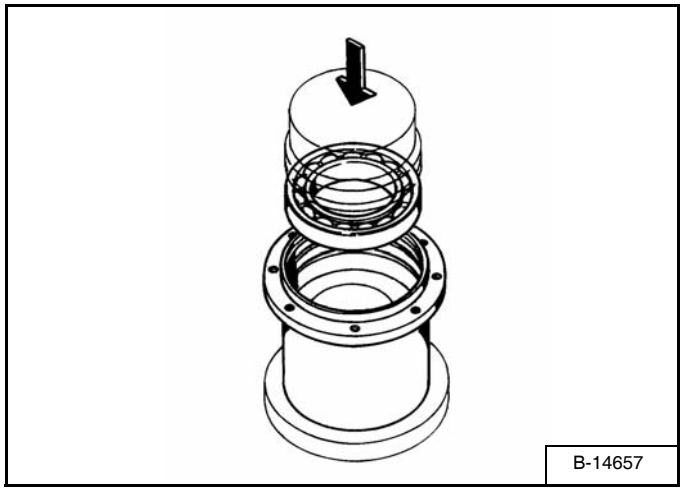
Apply oil to the spool and install the spool (Item 1) **[Figure 20-70-44]** in the motor cover.

Install the washer (Item 2) and spring (Item 3) **[Figure 20-70-44]** in the motor cover.

Apply oil to the O-rings and install the new O-rings on the plugs (Item 4) **[Figure 20-70-44]**.

Install the plugs (Item 4) **[Figure 20-70-44]** in the motor cover.

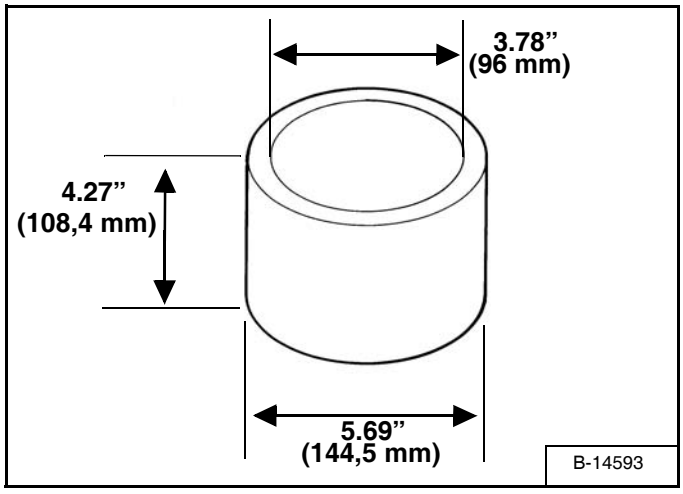
Figure 20-70-45



Apply oil to the outer edge of the bearing and press the bearing in the housing, using the bearing installation tool **[Figure 20-70-45]**.

Obtain the bearing installation tool locally.

Figure 20-70-46

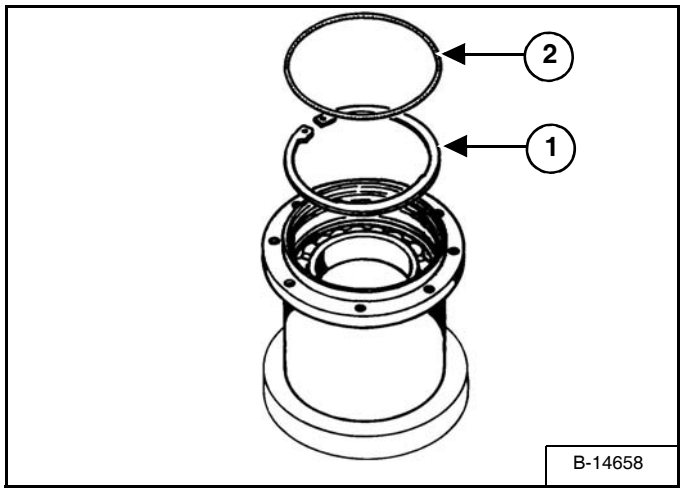


The dimensions of the bearing installation tool **[Figure 20-70-46]** are as follows:

Height	4.27 inch (108, 4 mm)
I.D.	3.78 inch (96 mm)
O.D.	5.69 inch (144,5 mm)

Assembly (Cont'd)

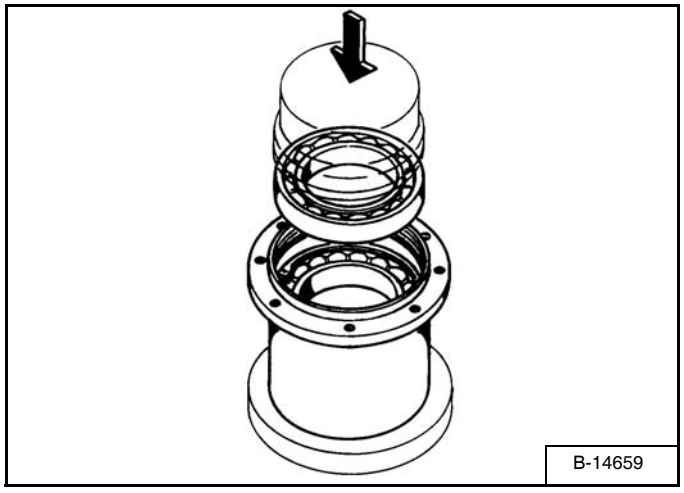
Figure 20-70-47



Install the internal snap ring (item 1) **[Figure 20-70-47]** in the housing.

Apply oil on the O-ring and install the O-ring (Item 2) **[Figure 20-70-47]** in the housing.

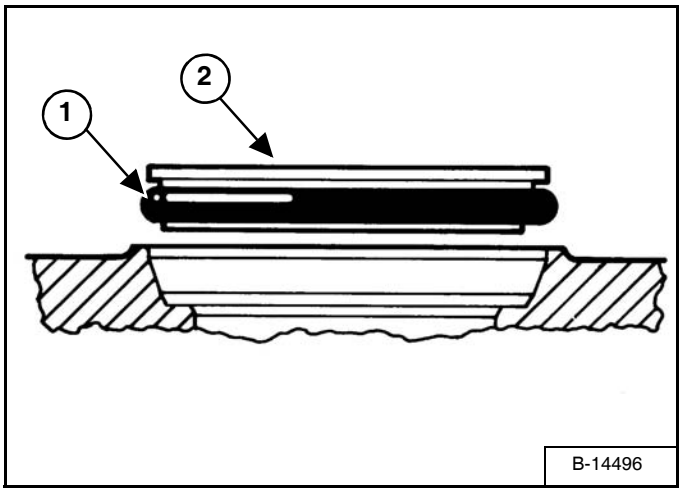
Figure 20-70-48



Apply oil to the outer edge of the second bearing and press the bearing in the housing **[Figure 20-70-48]**.

NOTE: Make sure the O-ring is correctly installed in the housing so it is not damaged when the second bearing is installed.

Figure 20-70-49

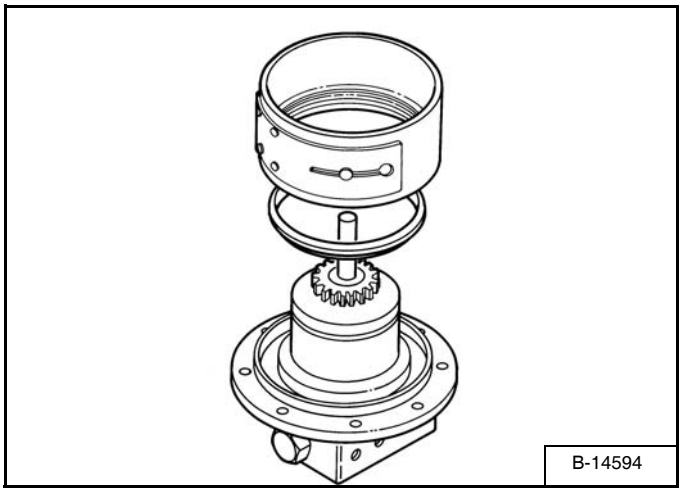


Install the O-ring (Item 1) on the seal ring (Item 2) **[Figure 20-70-49]**.

NOTE: Inspect the seal ring for burrs before installing the O-ring. Install the seal ring making sure it is not twisted. To remove any twists, gently pull a section of the O-ring and let it snap back.

The O-ring, seal ring and motor assembly must be clean and free of any dust, oil film or foreign matter.

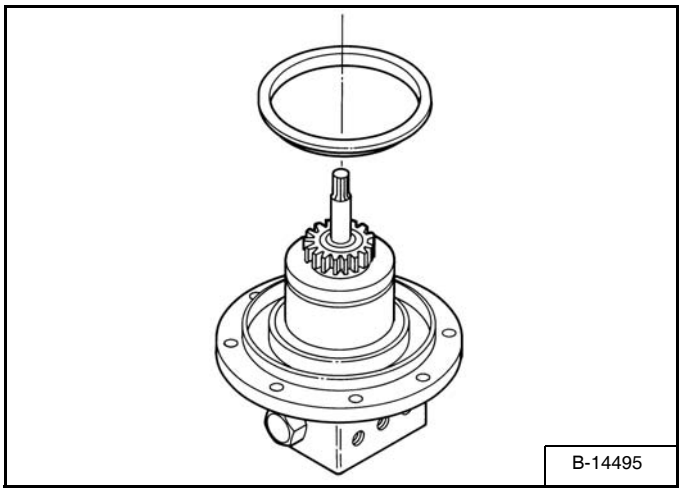
Figure 20-70-50



Install the seal seating tool (MEL1468) on the seal ring **[Figure 20-70-50]**.

Assembly (Cont'd)

Figure 20-70-51



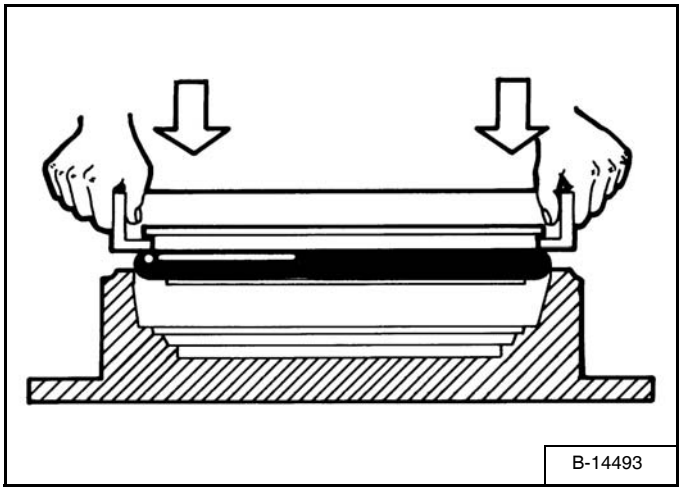
The seal ring assembly must be lubricated with alcohol, so the O-ring will slip past the housing retaining ring and seal uniform in the motor housing radius **[Figure 20-70-51]**.

The O-ring on the seal ring assembly must be lubricated with alcohol.

This will allow the O-ring to slide on the motor housing sealing surface without twisting **[Figure 20-70-51]**.

Dip the O-ring and seal ring assembly in a pan of alcohol.

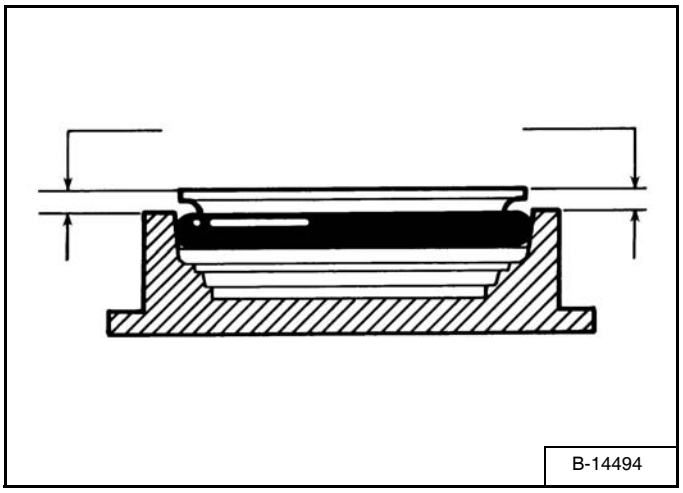
Figure 20-70-52



Shake off the excess alcohol and install the seal ring assembly on the motor **[Figure 20-70-52]**.

Use firm even pressure on the installation tool (MEL1468) to pop the O-ring into the motor housing.

Figure 20-70-53



After the seal ring is installed, check the stand out height **[Figure 20-70-53]** in four places, 90° apart.

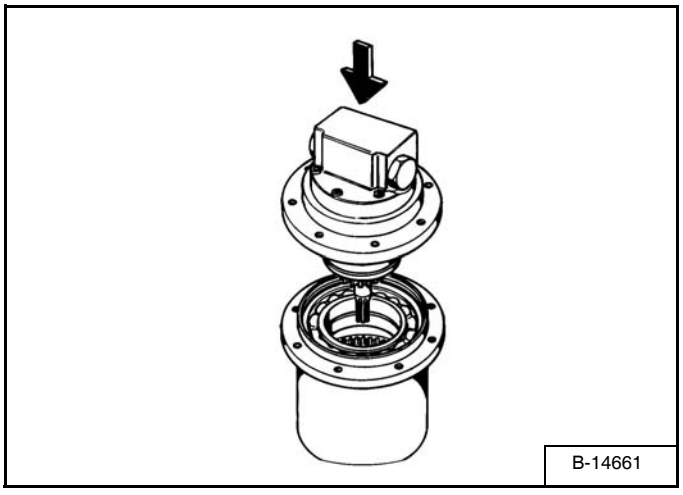
The stand out height is 0.30 ± 0.02 inches (7.7 ± 0,5 mm).

NOTE: If the seal ring does not meet the height specifications inspect the torque ring for twists or obvious bulges.

Apply a light film of oil to the seal ring and lapped face of the bearing.

NOTE: Do not get any oil on the O-ring.

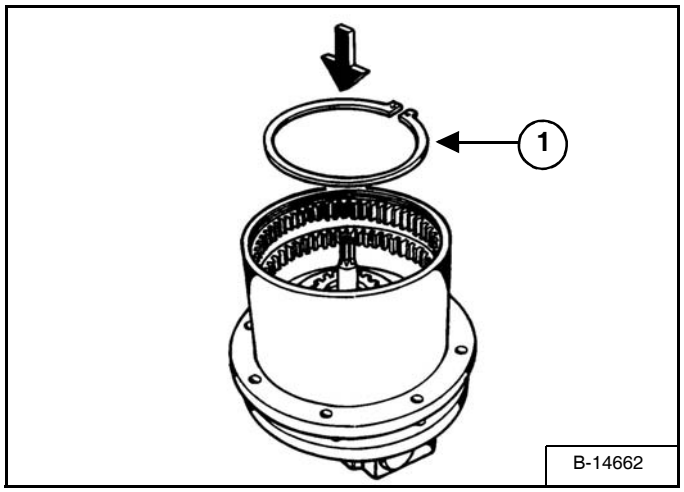
Figure 20-70-54



Press the reduction unit and motor assembly into the seat of the bearings **[Figure 20-70-54]**. The inner bearing may move deeper into the housing as the motor assembly is pressed into the housing. If this happens, press the inner bearing down to its original position.

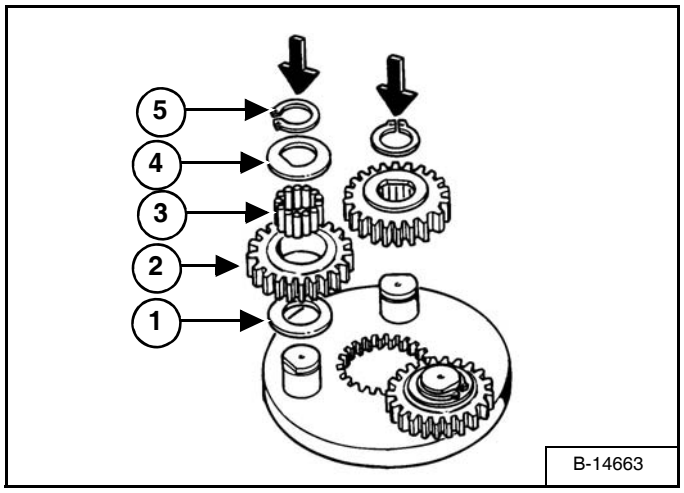
Assembly (Cont'd)

Figure 20-70-55



Install the external snap ring (Item 1) **[Figure 20-70-55]** in the motor reduction unit.

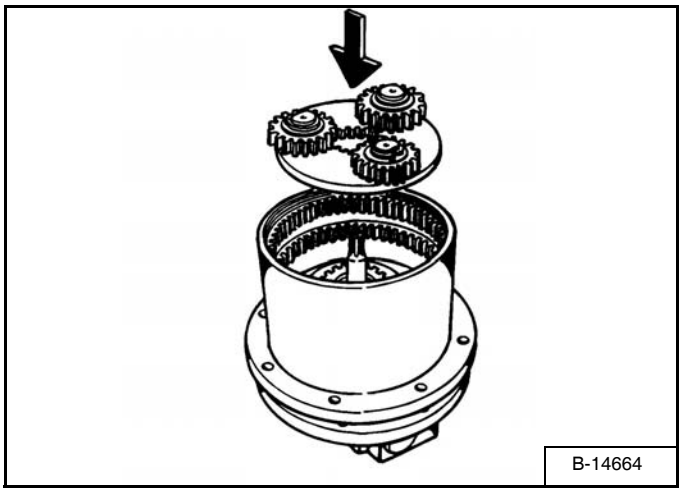
Figure 20-70-56



Install the thrust washers (Item 1), planetary gears (Item 2), bearing (Item 3) anti-rotation washers (Item 4) and external snap rings (Item 5) **[Figure 20-70-56]**.

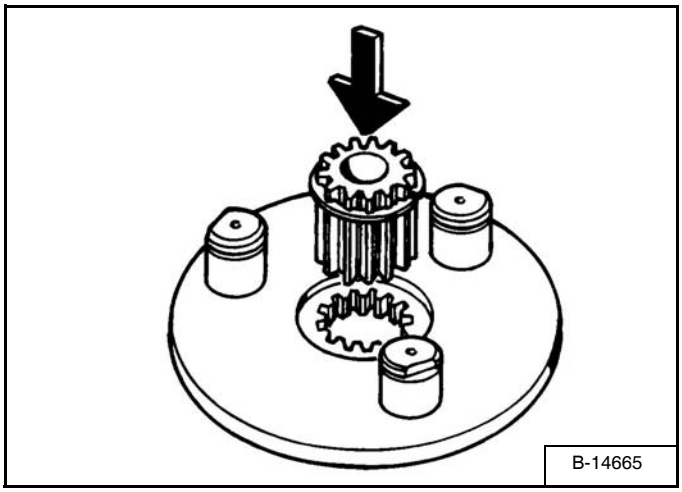
Install the snap rings so the opening of the snap ring is towards the outside.

Figure 20-70-57



Install the planetary assembly in the hub **[Figure 20-70-57]**.

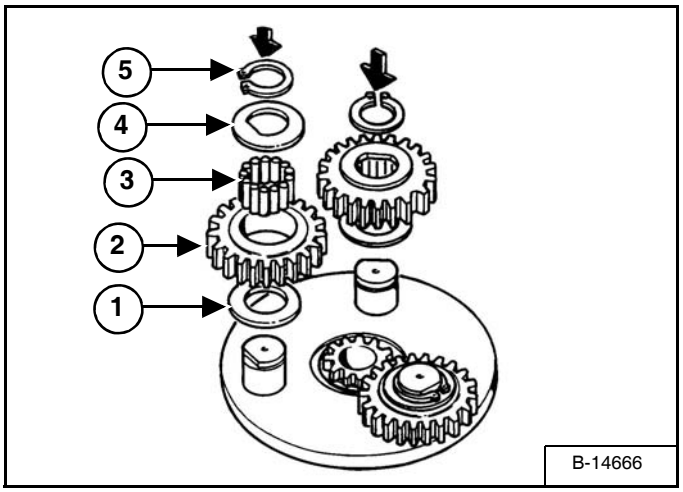
Figure 20-70-58



Install the sun gear into the outer planetary carrier **[Figure 20-70-58]**.

Assembly (Cont'd)

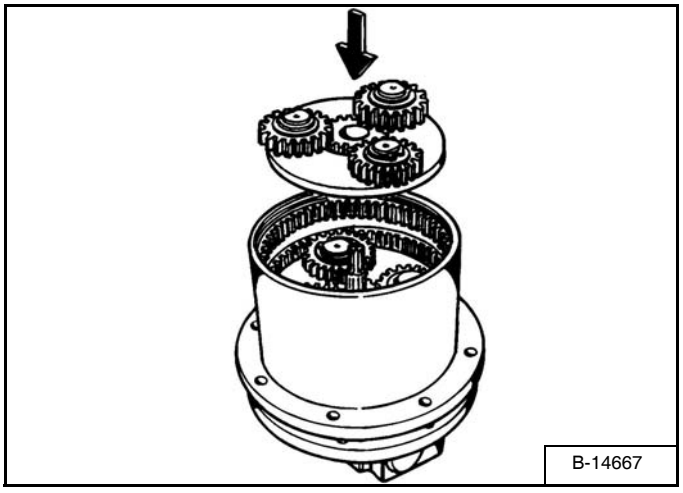
Figure 20-70-59



Install the thrust washers (Item 1) planetary gears (Item 2) bearings (Item 3) anti-rotation washers (Item 4) and external snap rings (Item 5) **[Figure 20-70-59]**.

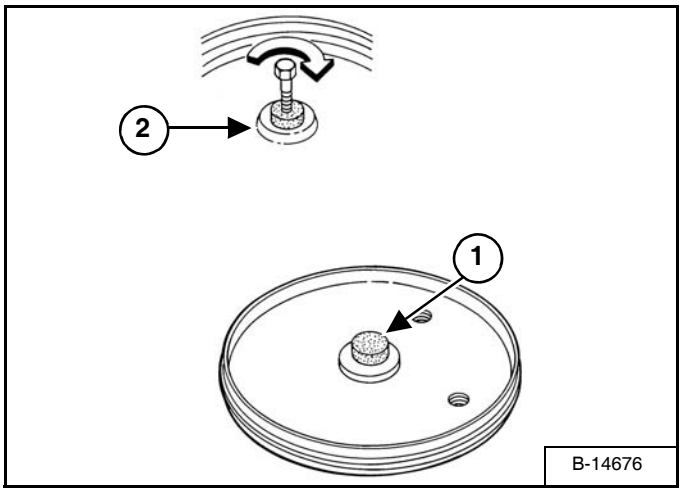
Install the snap rings so the opening of the snap ring is towards the outside.

Figure 20-70-60



Install the outer planetary assembly in the hub **[Figure 20-70-60]**.

Figure 20-70-61



Inspect the cover bushing (Item 1) **[Figure 20-70-61]** for wear.

If the bushing (Item 1) **[Figure 20-70-61]** needs to be replaced, drill a hole in the center of the bushing using a number 3 drill bit.

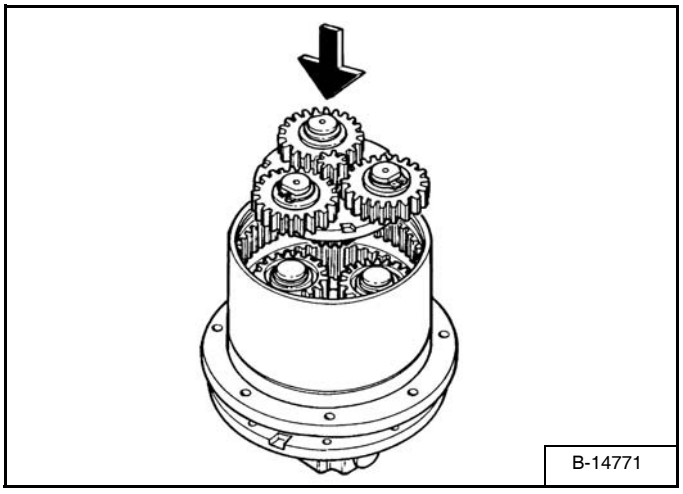
Thread the hole with a 1/4 X 28 inch NF tap.

Install a 1/4 X 28 inch bolt (Item 2) **[Figure 20-70-61]** in the bushing and pull the bushing out of the cover.

Install the new bushing in the cover with the bevel down.

The clearance between the cover bushing and the sun gear must be 0.008-0.031 inch (0,2-0,8 mm).

Figure 20-70-62



Place a 1/2 inch (13 mm) long piece of 1/16 inch (1,5 mm) solder on the sun gear **[Figure 20-70-62]**.

Seat the cover in the hub.

Remove the cover and measure the solder.

Assembly (Cont'd)

If the clearance between the sun gear and cover bushing does not meet specifications, order the bushing shim kit from Bobcat Parts.

Shim Thickness	Part Number
0.020 inch (0,5 mm)	6669597
0.030 inch (0,76 mm)	6669598
0.050 inch (1,27 mm)	6669599

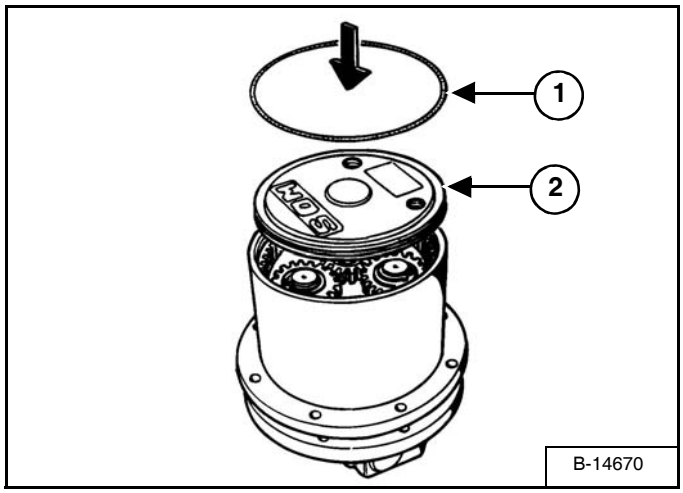
Remove the bushing.

Install the correct shim under the bushing and install the bushing.

NOTE: Make sure there are no burrs on the bushing face from bushing removal.

Repeat the procedure for checking clearance between the sun gear and cover bushing.

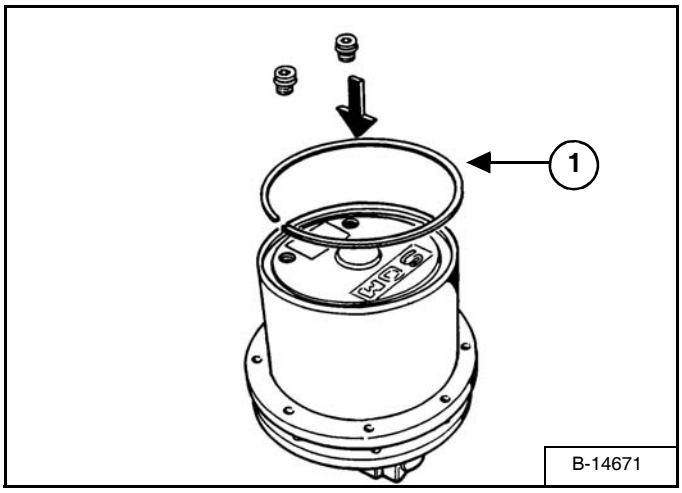
Figure 20-70-63



Lubricate and install the O-ring (Item 1) **[Figure 20-70-63]** on the cover.

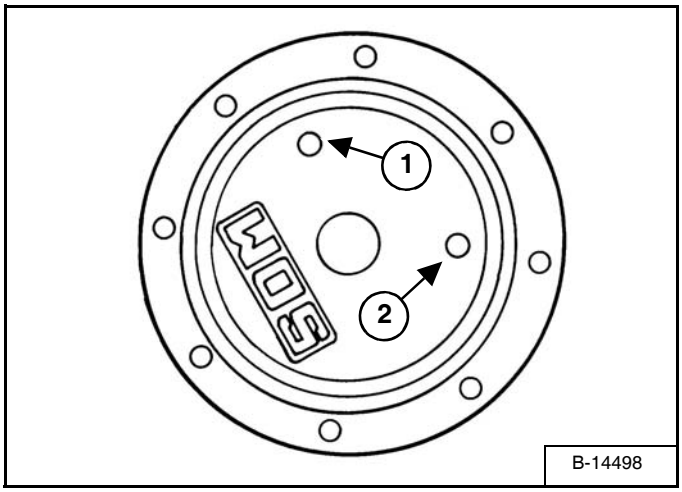
Install the cover (Item 2) **[Figure 20-70-63]** on the hub.

Figure 20-70-64



Install the internal snap ring (Item 1) **[Figure 20-70-64]** securing the cover to the travel motor.

Figure 20-70-65



Add 1.06 qts. (1,0 L) of gear lube 90W to the top plug hole (Item 1) until the gear lube is at the bottom of the plug hole (Item 2) **[Figure 20-70-65]**.

Install and tighten the two plugs.

SWIVEL JOINT

Removal And Installation

Expand the track frame fully.

Figure 20-80-66



Place blocks under the Excavator tracks **[Figure 20-80-66]**.

Lower the boom/bucket and blade to the ground.

Relieve hydraulic pressure.

Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

Drain the hydraulic reservoir. (See Replacing Hydraulic Oil on Page 10-100-2.)

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

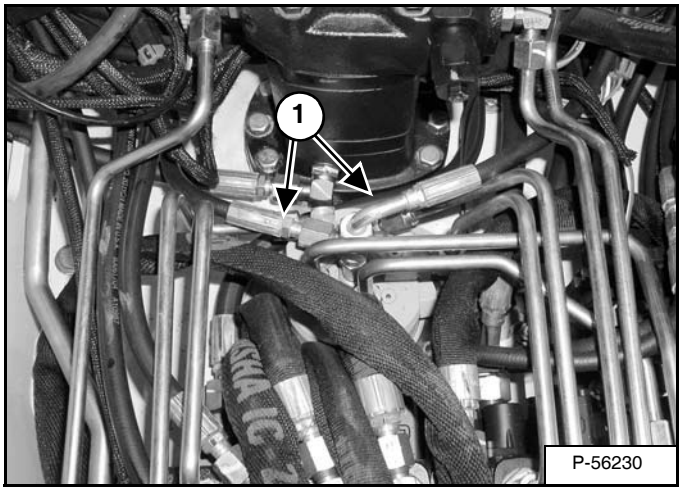
IMPORTANT

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

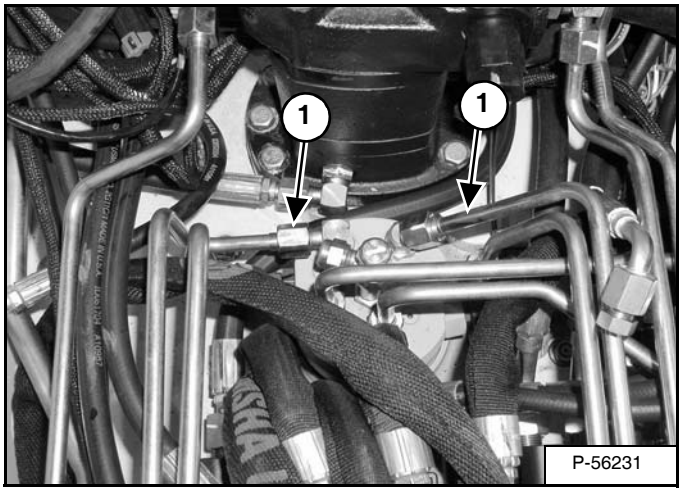
Mark all hoses and tubelines for ease of assembly.

Figure 20-80-67



Remove the hoses (Item 1) **[Figure 20-80-67]** from the top of the swivel joint.

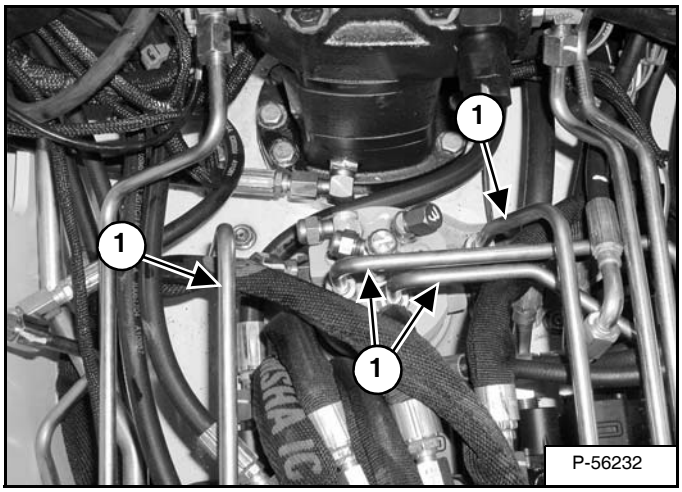
Figure 20-80-68



Remove the tubelines (Item 1) **[Figure 20-80-68]** from the top of the swivel joint and control valve.

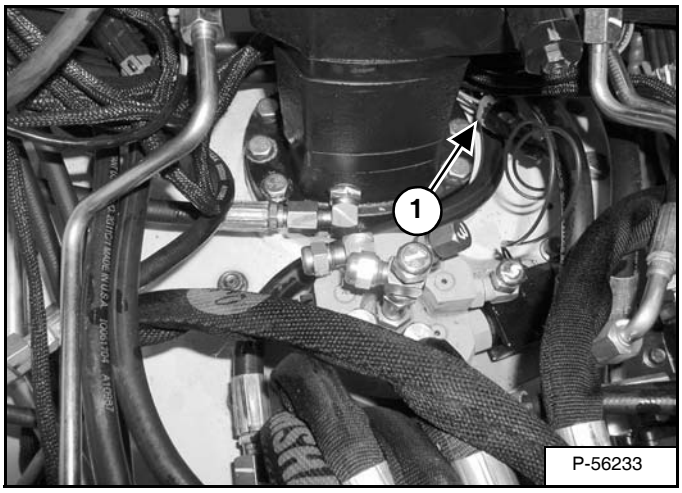
Removal And Installation (Cont'd)

Figure 20-80-69



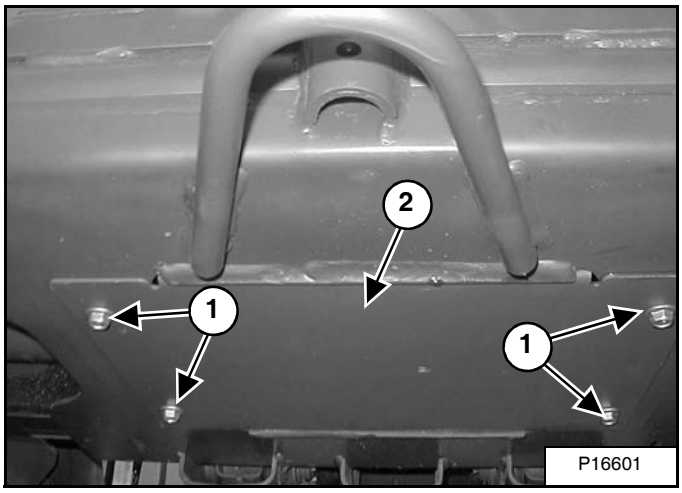
Remove the tubelines (Item 1) **[Figure 20-80-69]**.

Figure 20-80-70



Disconnect the wire harness (Item 1) **[Figure 20-80-70]**.

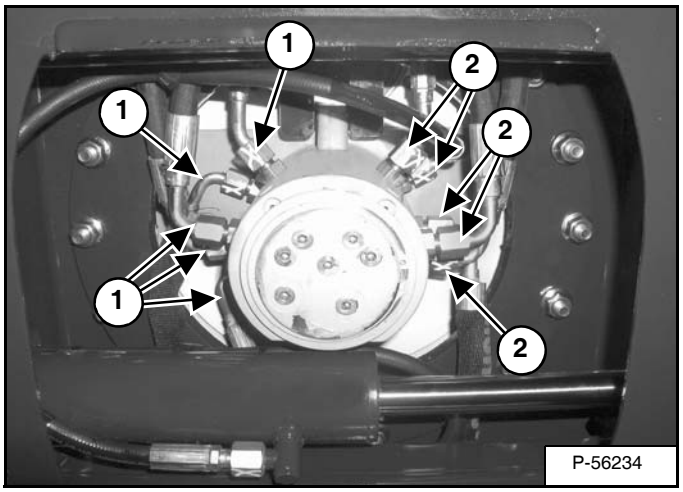
Figure 20-80-71



Remove the bolts (Item 1) and plate (Item 2) **[Figure 20-80-71]** from the underside of the Excavator.

Removal And Installation (Cont'd)

Figure 20-80-72

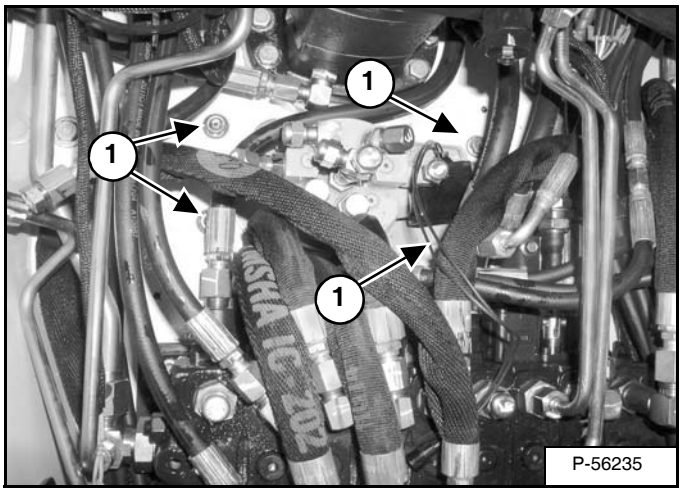


Remove the five hoses (Item 1) **[Figure 20-80-72]** from the left side of the swivel joint.

Remove the five hoses (Item 2) **[Figure 20-80-72]** from the right side of the swivel joint.

NOTE: Support the swivel joint on the underside of the Excavator to prevent the swivel joint from falling when the four nuts are removed.

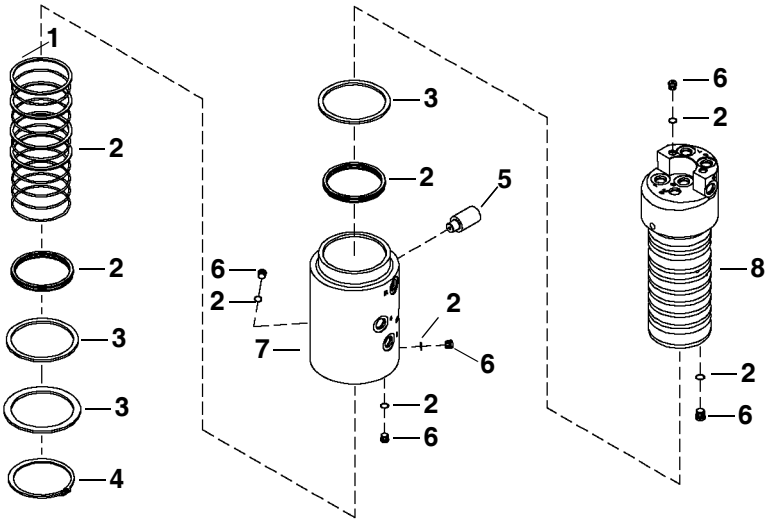
Figure 20-80-73



Remove the four nuts (Item 1) **[Figure 20-80-73]** and slide the swivel joint out from the underside of the Excavator.

Parts Identification 320

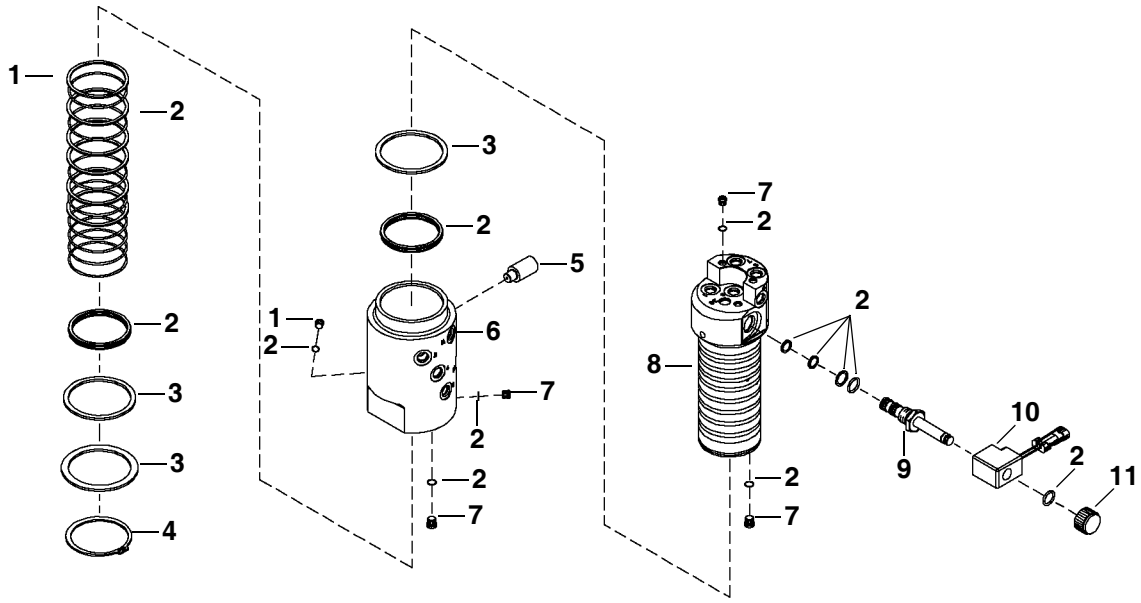
1. Seal
2. O-Ring
3. Washer
4. Snap Ring
5. Stud
6. Plug
7. Housing
8. Rotor



PE-1579

Parts Identification 322

1. Seal
2. O-Ring
3. Washer
4. Snap Ring
5. Stud
6. Housing
7. Plug
8. Rotor
9. Spool
10. Coil
11. Nut



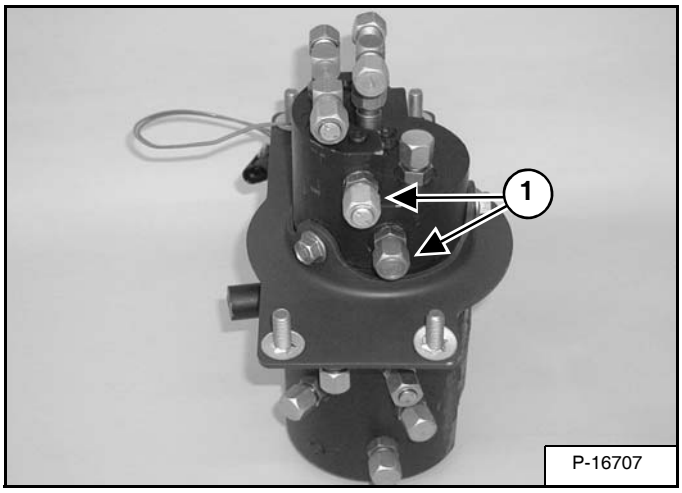
PE-1578

SWIVEL JOINT (CONT'D)

Disassembly

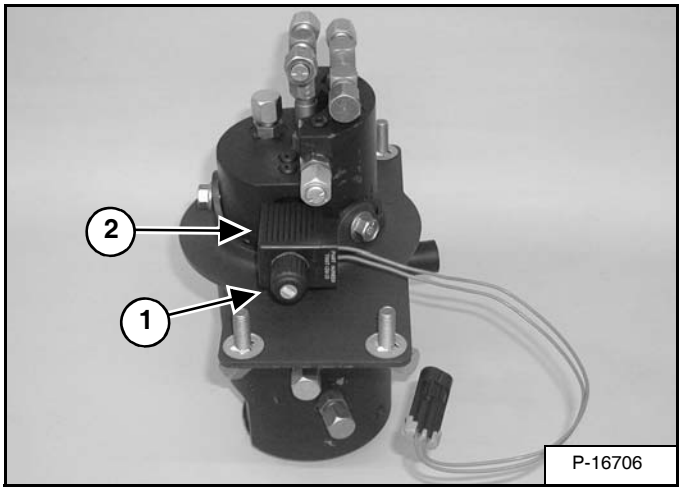
NOTE: The disassembly and assembly of the 322 swivel joint is shown. The procedure for the 320 is the same, except for the coil and spool installed in the track expansion/blade port.

Figure 20-80-74



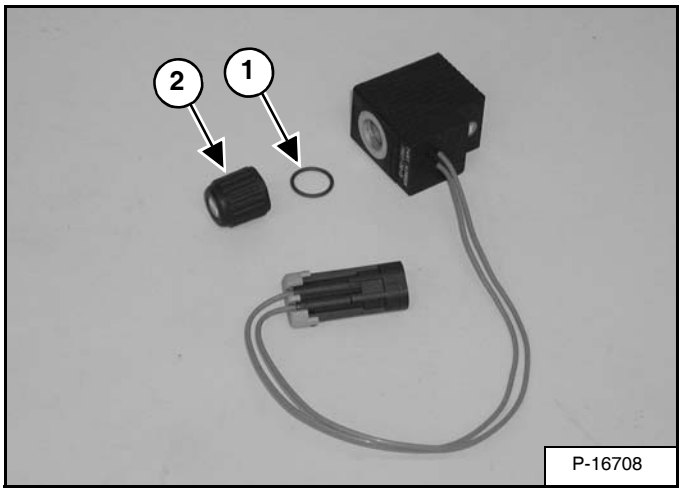
Remove the fittings (Item 1) **[Figure 20-80-74]**.

Figure 20-80-75



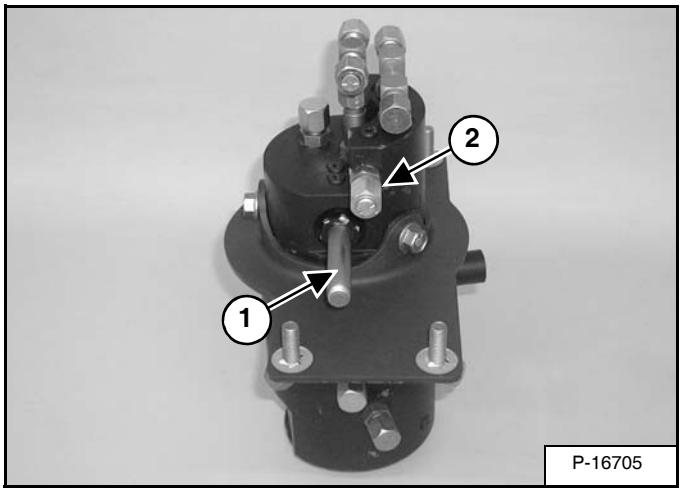
Remove the nut (Item 1) and coil (Item 2) **[Figure 20-80-75]**.

Figure 20-80-76



Remove the O-ring (Item 1) from the nut (Item 2) **[Figure 20-80-76]**.

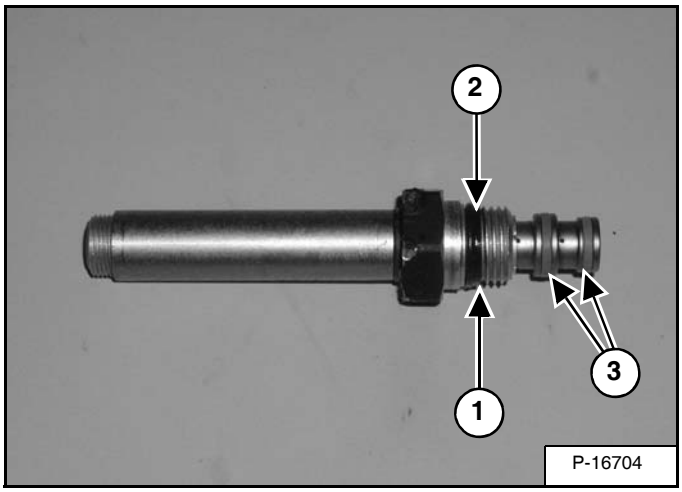
Figure 20-80-77



Remove the spool (Item 1) and fitting (Item 2) **[Figure 20-80-77]**.

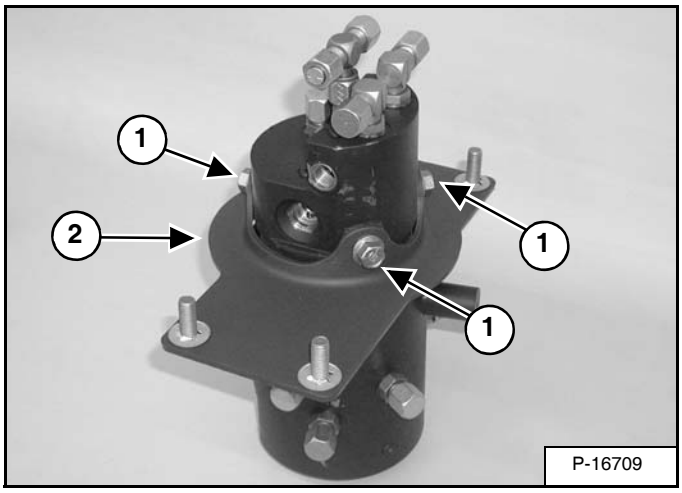
Disassembly (Cont'd)

Figure 20-80-78



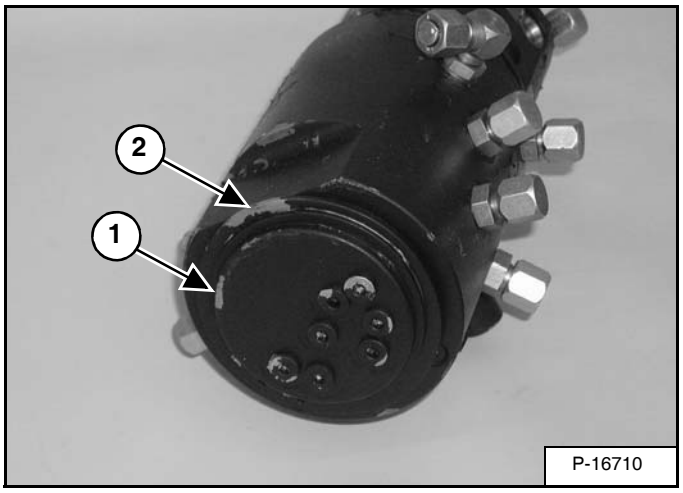
Remove the O-ring (Item 1) back-up ring (Item 2) and seals (Item 3) **[Figure 20-80-78]**.

Figure 20-80-79



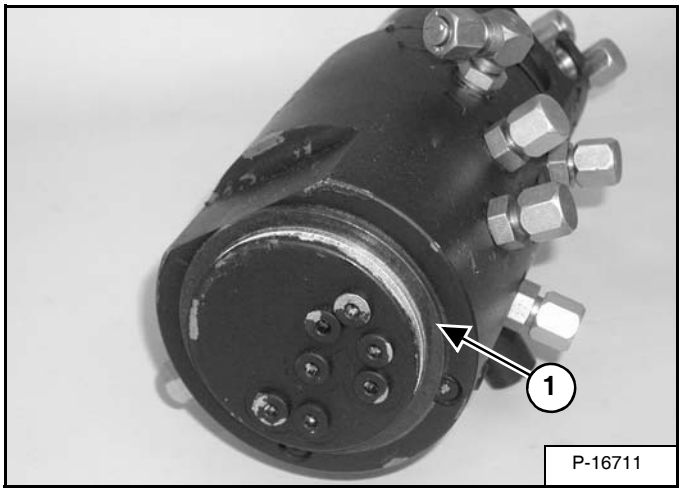
Remove the three bolts (Item 1). Remove the mount (Item 2) **[Figure 20-80-79]**.

Figure 20-80-80



Remove the snap ring (Item 1) and steel washer (Item 2) **[Figure 20-80-80]** from the bottom of the swivel joint.

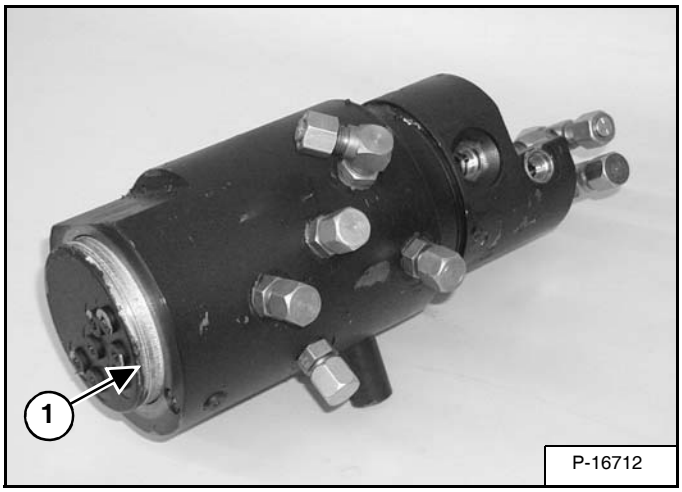
Figure 20-80-81



Remove the nylon washer (Item 1) **[Figure 20-80-81]**.

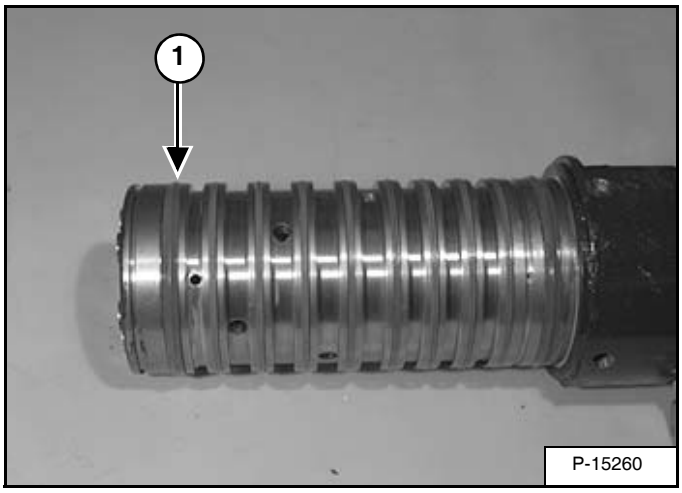
Disassembly (Cont'd)

Figure 20-80-82



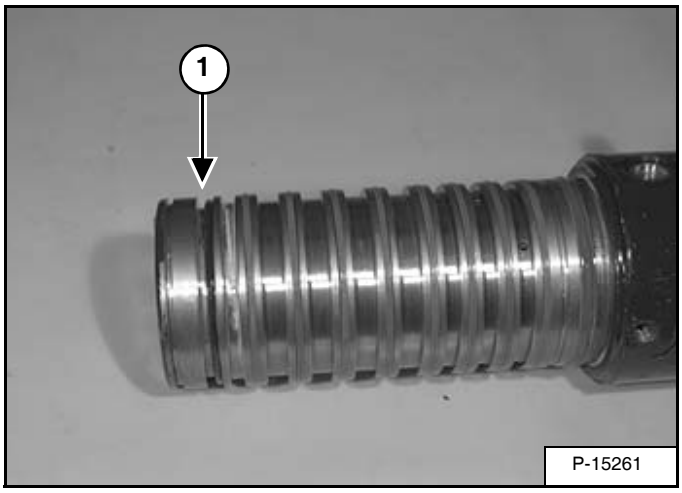
Tap the end of the rotor (Item 1) **[Figure 20-80-82]** with a rubber mallet to drive the rotor out of the housing.

Figure 20-80-83



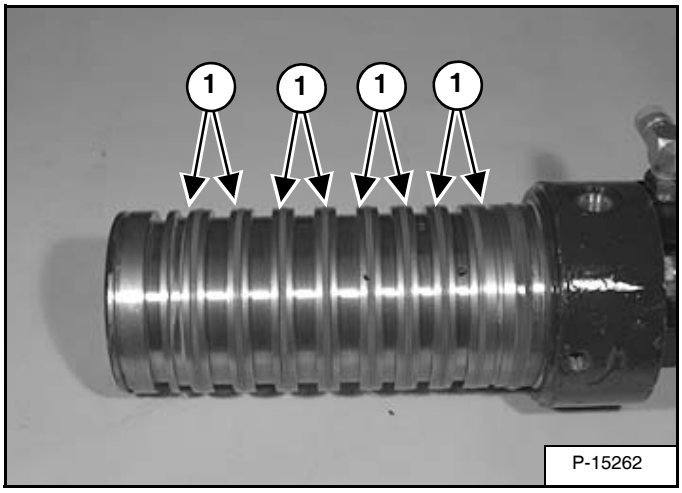
Remove the seal (Item 1) **[Figure 20-80-83]**.

Figure 20-80-84



Remove the O-ring (Item 1) **[Figure 20-80-84]**.

Figure 20-80-85

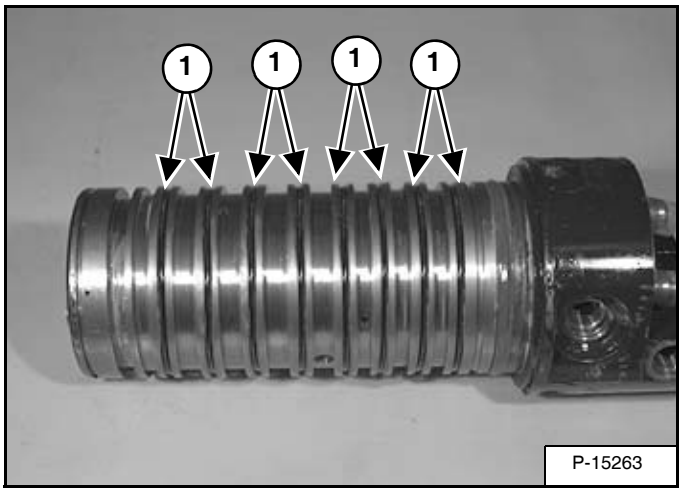


Remove the seals (Item 1) **[Figure 20-80-85]**.

NOTE: The 320 swivel joint is equipped with seven seals and the 322 swivel joint is equipped with eight seals.

Disassembly (Cont'd)

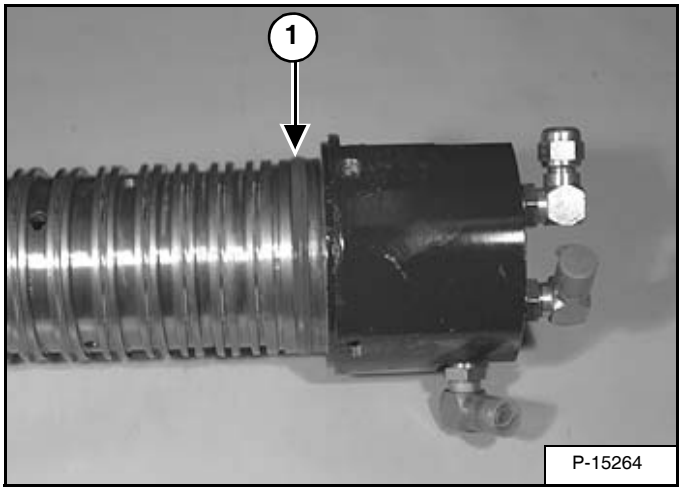
Figure 20-80-86



Remove the O-rings (Item 1) **[Figure 20-80-86]**.

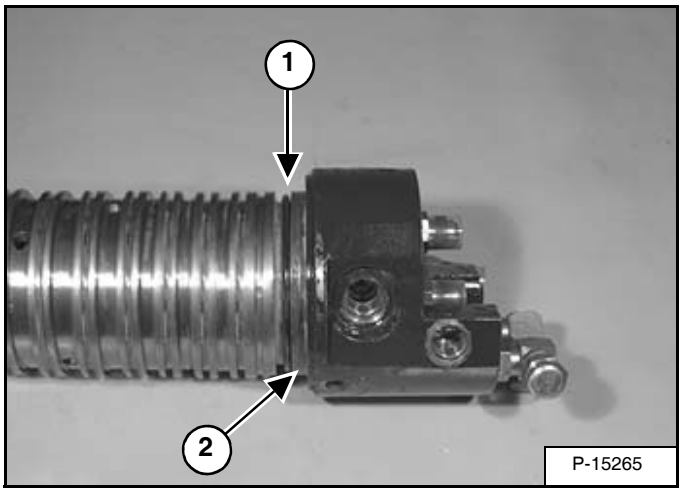
NOTE: The 320 Excavators have seven O-rings installed on the rotor. The 322 Excavators have eight O-rings installed on the rotor.

Figure 20-80-87



Remove the seal (Item 1) **[Figure 20-80-87]**.

Figure 20-80-88



Remove the O-ring (Item 1) **[Figure 20-80-88]**.

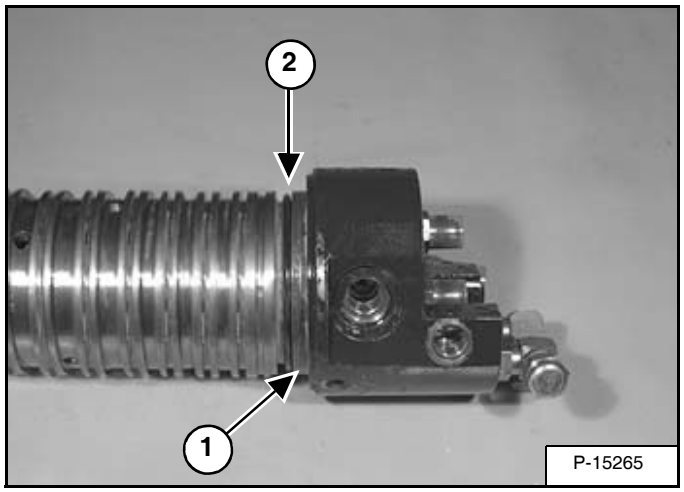
Remove the nylon washer (Item 2) **[Figure 20-80-88]**.

Assembly

Clean all parts in solvent and dry with compressed air.

Inspect the rotor and housing for scratches or wear that could cause internal leakage. Always install new O-rings and seals. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-80-89

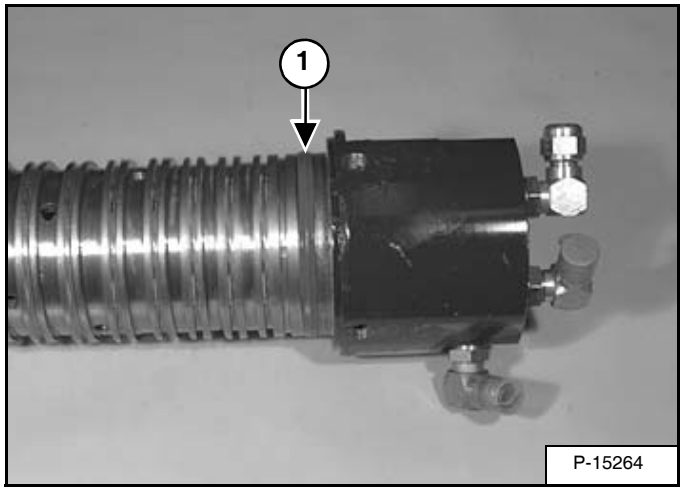


Install the nylon washer (Item 1) **[Figure 20-80-89]**.

Install the O-ring (Item 2) **[Figure 20-80-89]**.

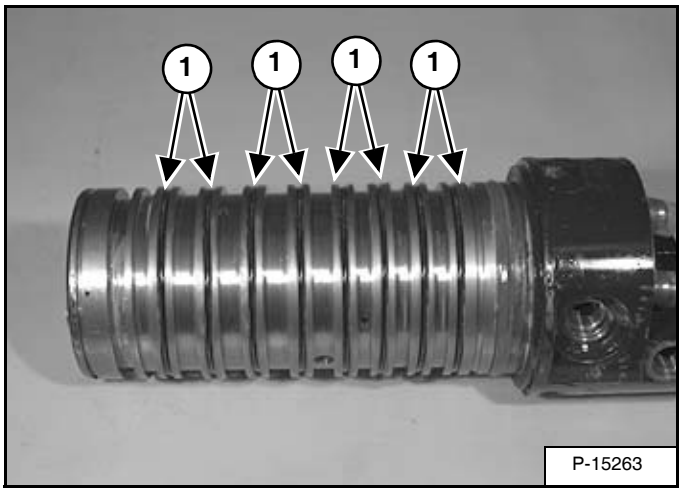
Heat the seal in hydraulic fluid for three minutes at 130°F (54°C).

Figure 20-80-90



Install the seal (Item 1) **[Figure 20-80-90]** on the O-ring.

Figure 20-80-91

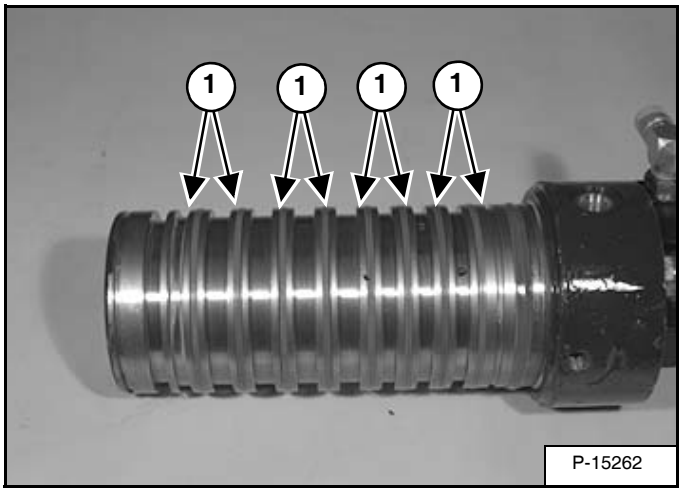


Install the O-rings (Item 1) **[Figure 20-80-91]**.

NOTE: The 320 Excavators have seven O-rings installed on the rotor. The 322 Excavators have eight O-rings installed on the rotor.

Heat the seals in hydraulic fluid for three minutes at 130°F (54°C).

Figure 20-80-92

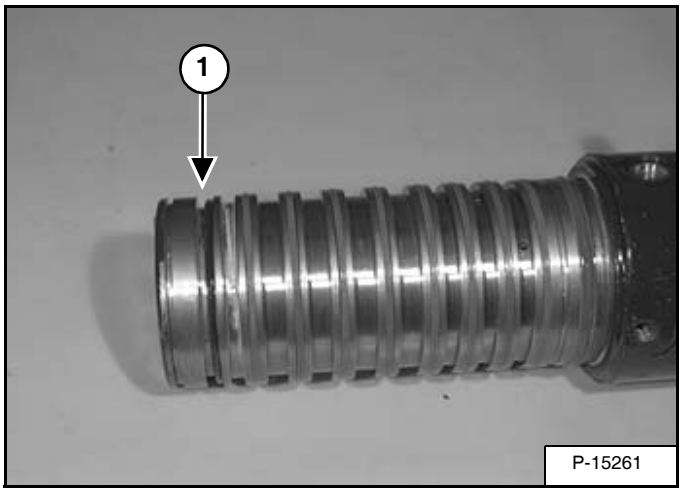


Install the seals (Item 1) **[Figure 20-80-92]**.

NOTE: The 320 Excavators have seven seals installed on the rotor. The 322 Excavators have eight seals installed on the rotor.

Assembly (Cont'd)

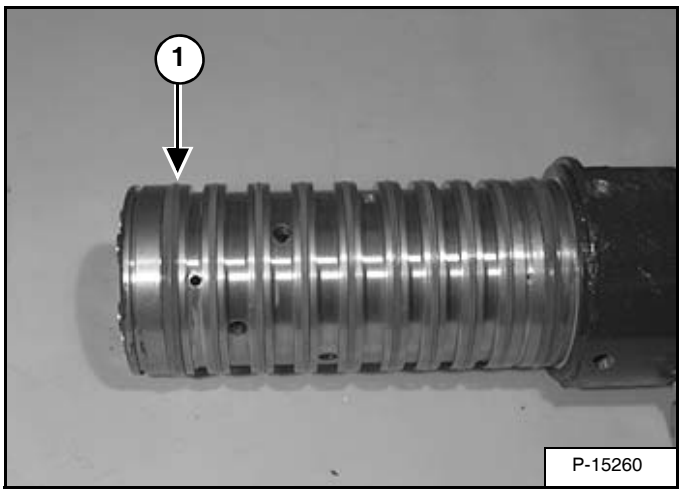
Figure 20-80-93



Install the O-ring (Item 1) **[Figure 20-80-93]**.

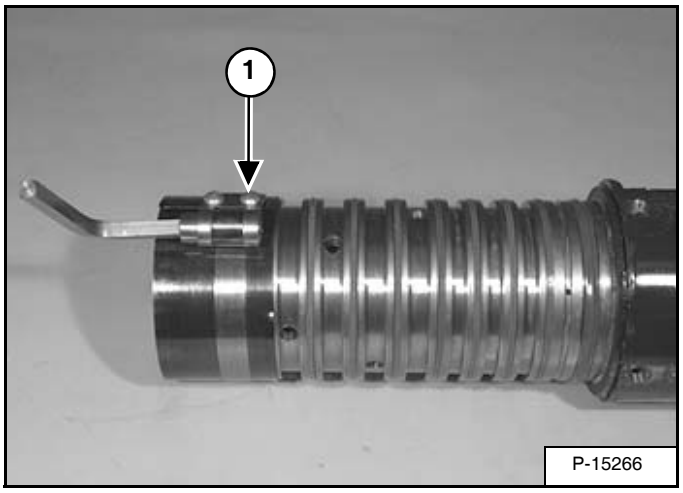
Heat the seal in hydraulic fluid for three minutes at 130°F (54°C).

Figure 20-80-94



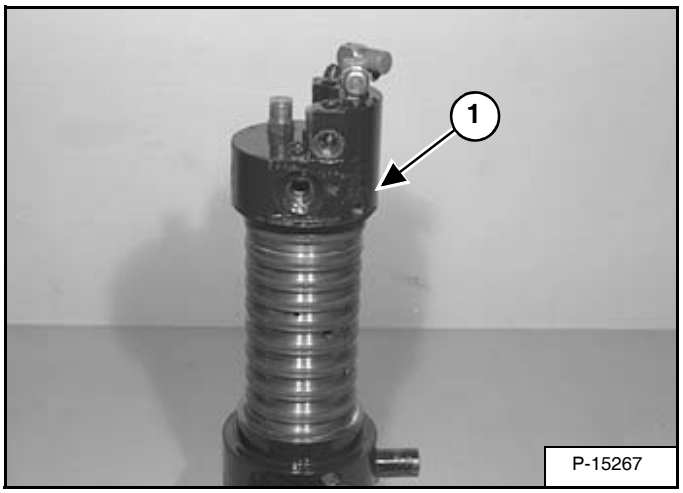
Install the seal (Item 1) **[Figure 20-80-94]**.

Figure 20-80-95



NOTE: A ring compressor (Item 1) may be used to fit the seals into the seal grove [Figure 20-80-95]. Compress the seals for three minutes.

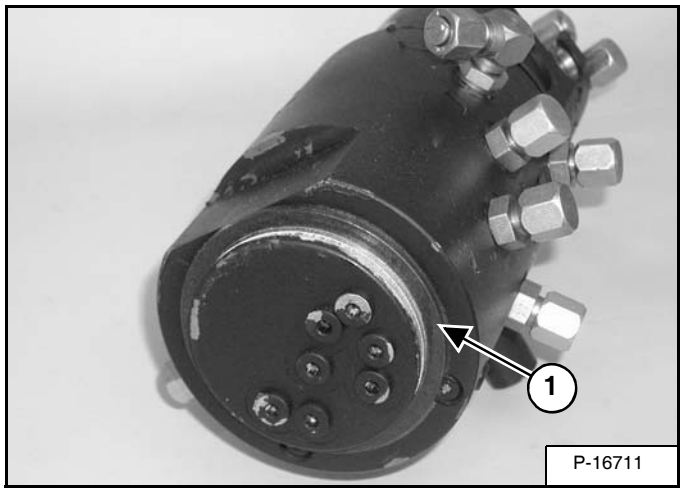
Figure 20-80-96



Apply hydraulic fluid to the rotor. Install the rotor (Item 1) in the housing **[Figure 20-80-96]**.

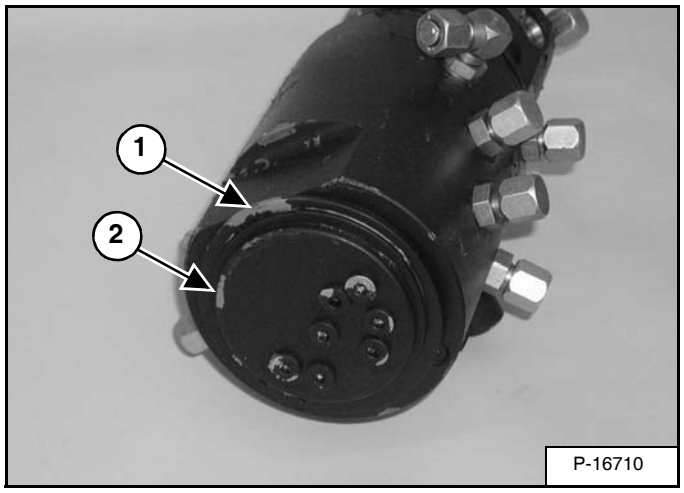
Assembly (Cont'd)

Figure 20-80-97



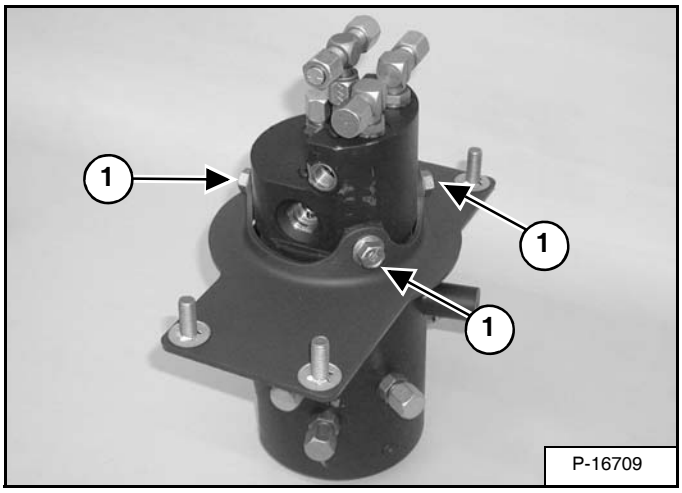
Install the nylon washer (Item 1) **[Figure 20-80-97]**.

Figure 20-80-98



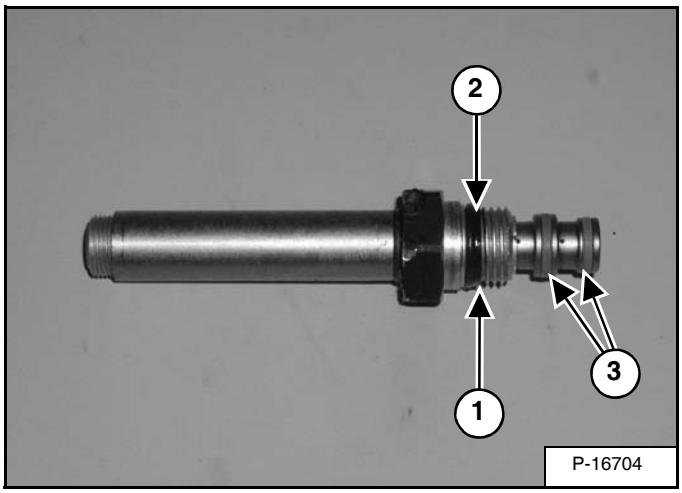
Install the steel washer (Item 1) and snap ring (Item 2) **[Figure 20-80-98]**.

Figure 20-80-99



Install the mount on the swivel joint. Install the bolts (Item 1) **[Figure 20-80-99]**. Tighten the bolts to 32-35 ft.-lbs. (43-47 Nm) torque.

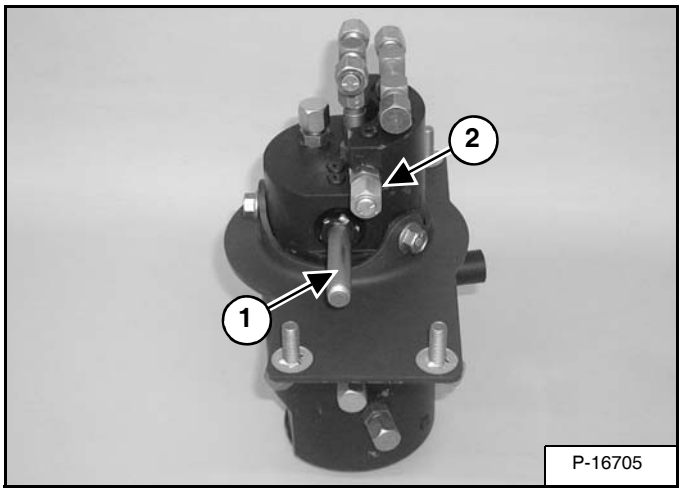
Figure 20-80-100



Install the O-ring (Item 1) back-up ring (Item 2) and seals (Item 3) **[Figure 20-80-100]**.

Assembly (Cont'd)

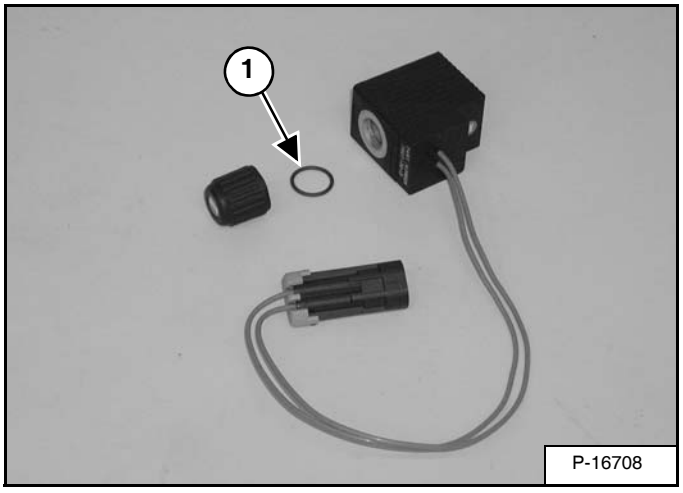
Figure 20-80-101



Install the spool (Item 1) **[Figure 20-80-101]** in the swivel joint. Tighten the spool to 35 ft.-lbs. (47 Nm) torque.

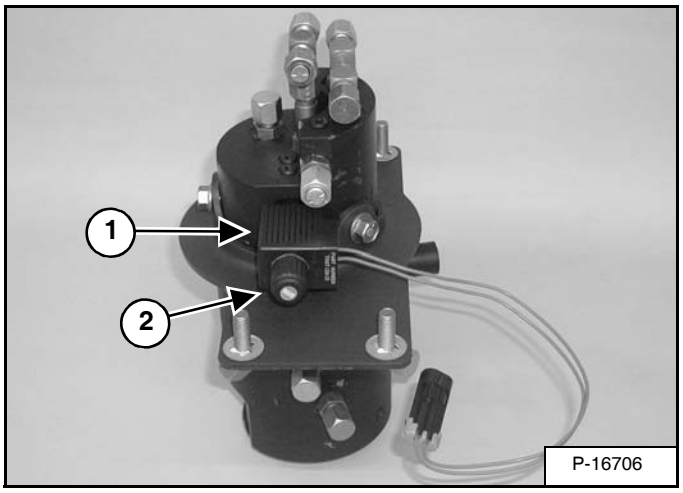
Install the fitting (Item 2) **[Figure 20-80-101]** in the swivel joint.

Figure 20-80-102



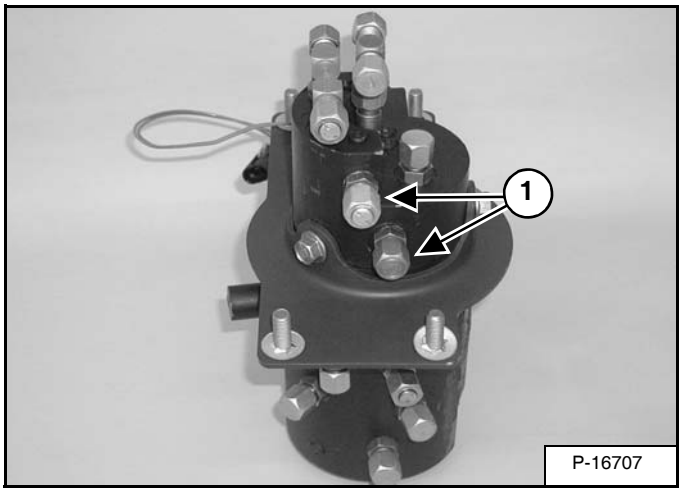
Install the O-ring (Item 1) **[Figure 20-80-102]** in the nut.

Figure 20-80-103



Install the coil (Item 1) and nut (Item 2) **[Figure 20-80-103]** on the spool.

Figure 20-80-104



Install the fittings (Item 1) **[Figure 20-80-104]**.


Bobcat®

SWING MOTOR

Removal and Installation

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.

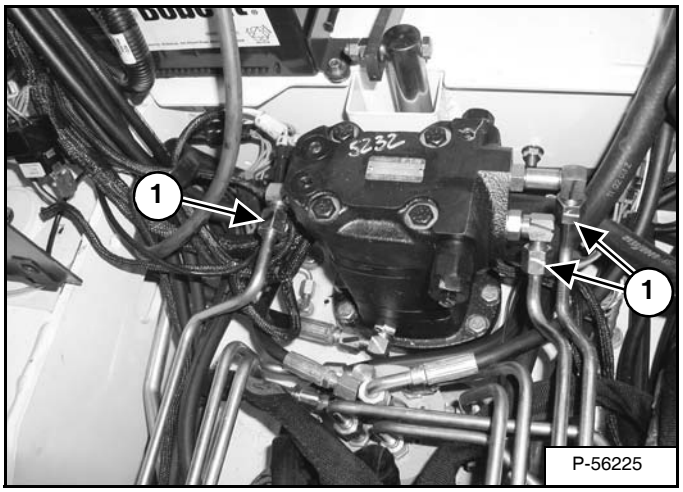
I-2003-0888

Remove the floormat and floorplate. (See Removal and Installation on Page 40-120-1.)

Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Remove blade extension tray. (See Removal And Installation on Page 40-210-1.)

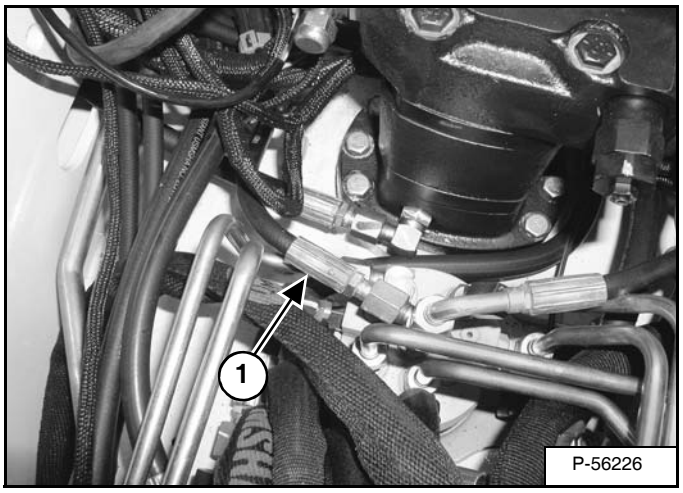
Figure 20-90-1



Mark the hose and tubelines for ease of assembly **[Figure 20-90-1]**.

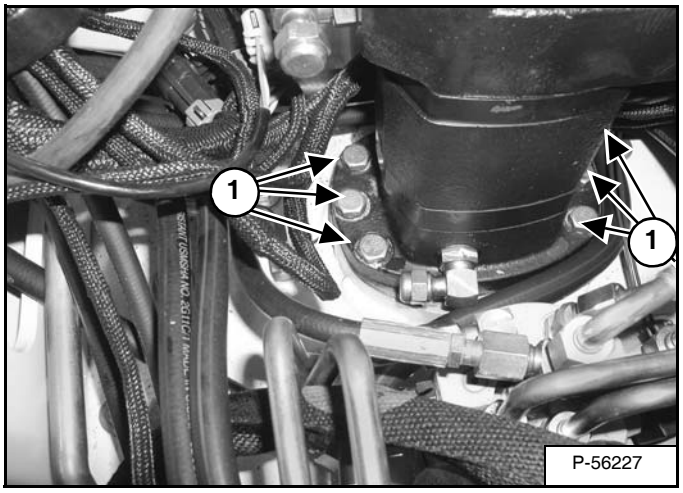
Remove the tubelines (Item 1) **[Figure 20-90-1]**.

Figure 20-90-2



Remove hose (Item 1) **[Figure 20-90-2]**.

Figure 20-90-3



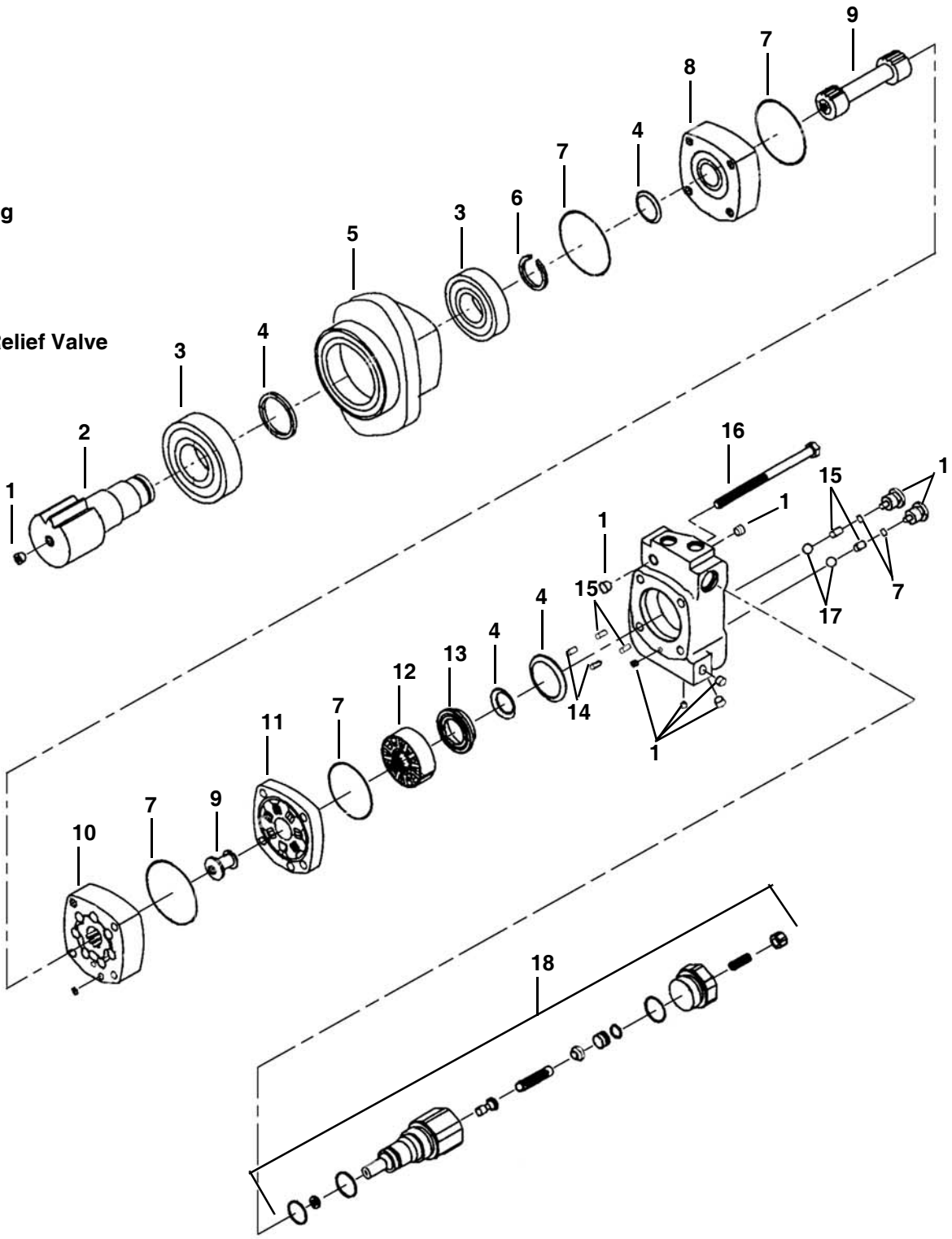
Remove the six bolts (Item 1) **[Figure 20-90-3]** from the swing motor.

Installation: Tighten the bolts to 29-37 ft.-lbs. (40-50 Nm) torque.

Remove the swing motor from the Excavator.

Parts Identification

1. Plug
2. Shaft
3. Bearing
4. Seal
5. Housing
6. Snap Ring
7. O-Ring
8. Plate
9. Drive Shaft
10. Geroler
11. Valve Plate
12. Valve
13. Balance Ring
14. Pin
15. Spring
16. Bolt
17. Ball
18. Crossport Relief Valve

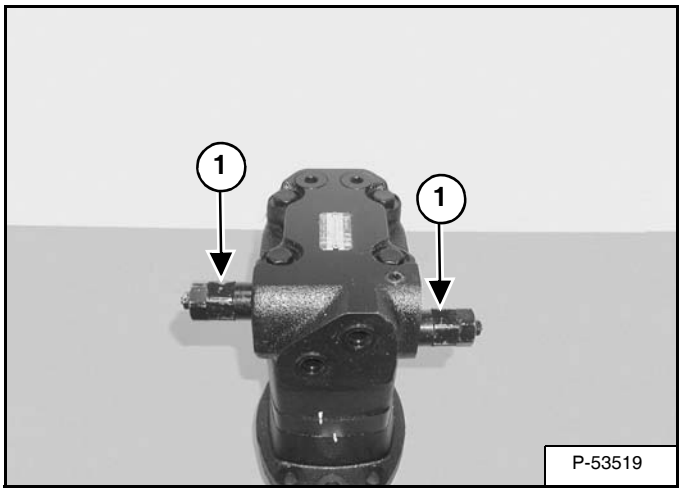


Disassembly

Clean the outside of the swing motor before disassembly.

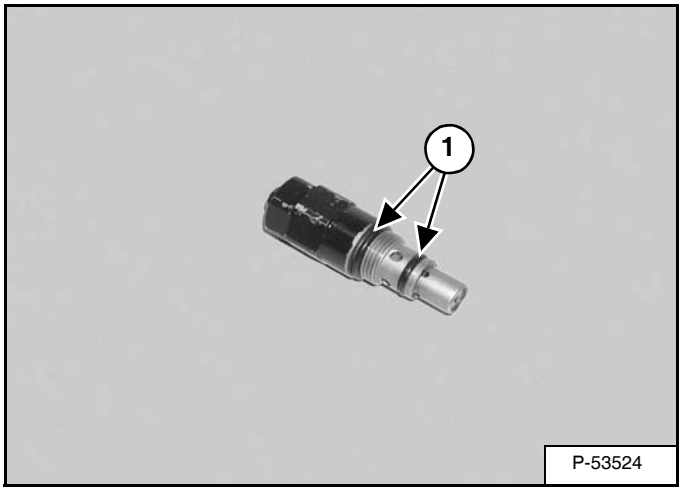
Mark the outside of the swing motor for ease of assembly.

Figure 20-90-4



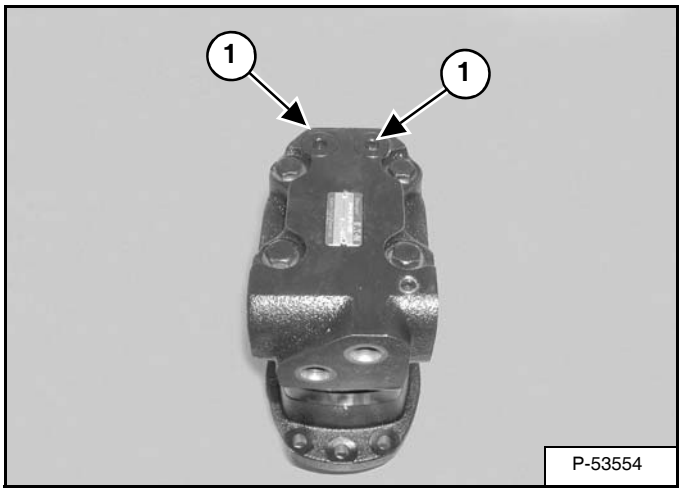
Remove the crossport relief valve (Item 1) **[Figure 20-90-4]**.

Figure 20-90-5



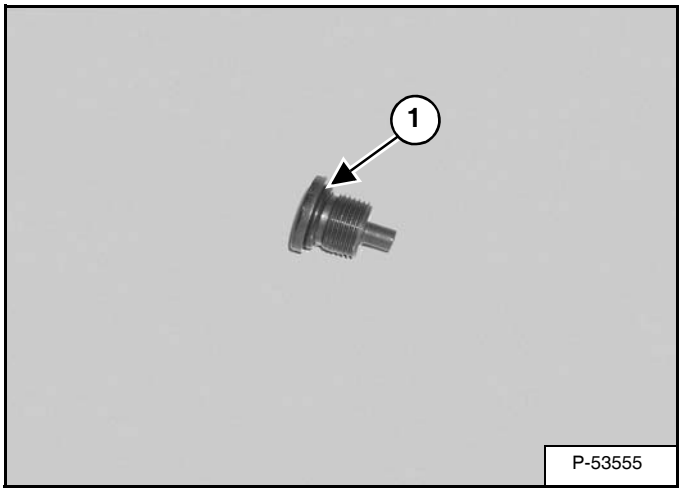
Remove the O-rings (Item 1) **[Figure 20-90-5]** from the crossport relief valves.

Figure 20-90-6



Remove the plugs (Item 1) **[Figure 20-90-6]** from the crossport relief valves.

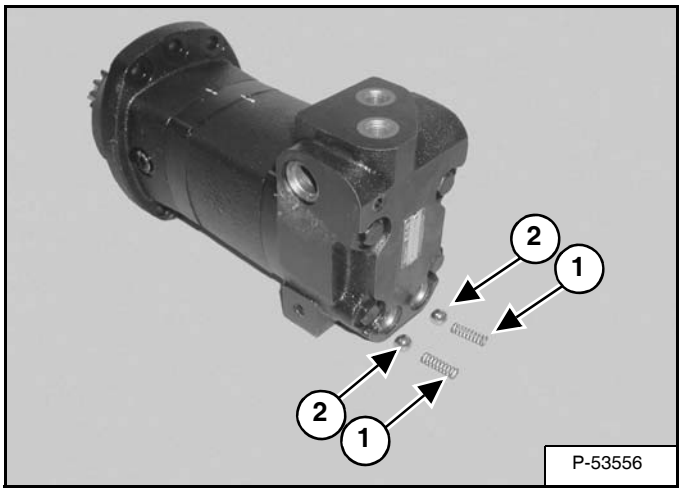
Figure 20-90-7



Remove the O-ring (Item 1) **[Figure 20-90-7]** from the plugs.

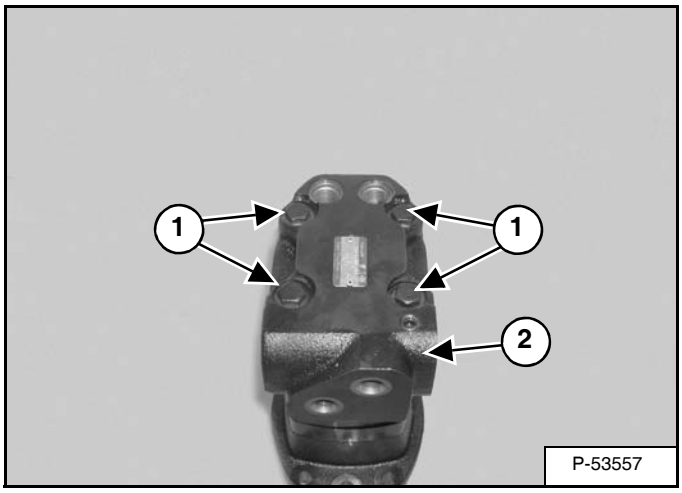
Disassembly (Cont'd)

Figure 20-90-8



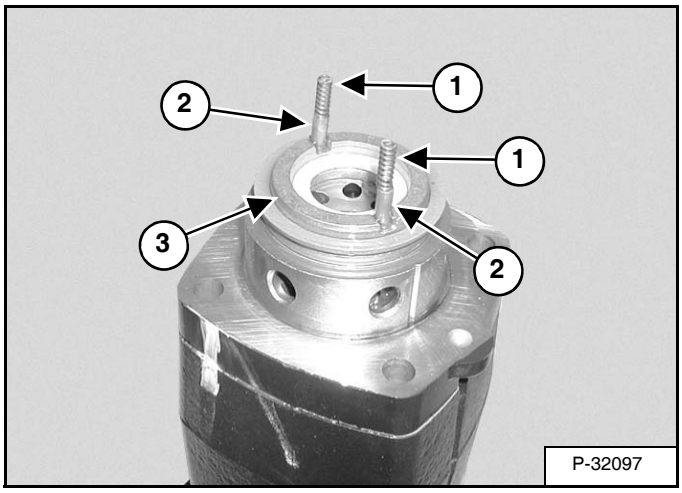
Remove the springs (Item 1) and balls (Item 2) **[Figure 20-90-8]**.

Figure 20-90-9



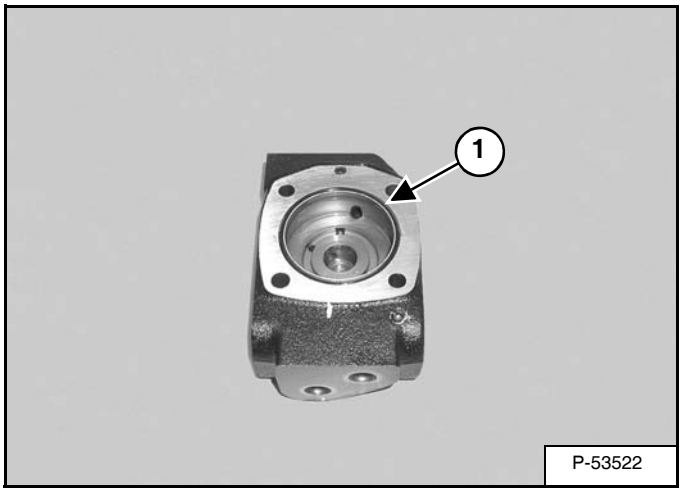
Remove the bolts (Item 1) **[Figure 20-90-9]**.

Figure 20-90-10



Remove the top of the motor (Item 2) **[Figure 20-90-9]** by lifting straight up. If done carefully, the springs (Item 1), pins (Item 2) and balance ring assembly (Item 3) **[Figure 20-90-10]** will remain on the valve for easy removal.

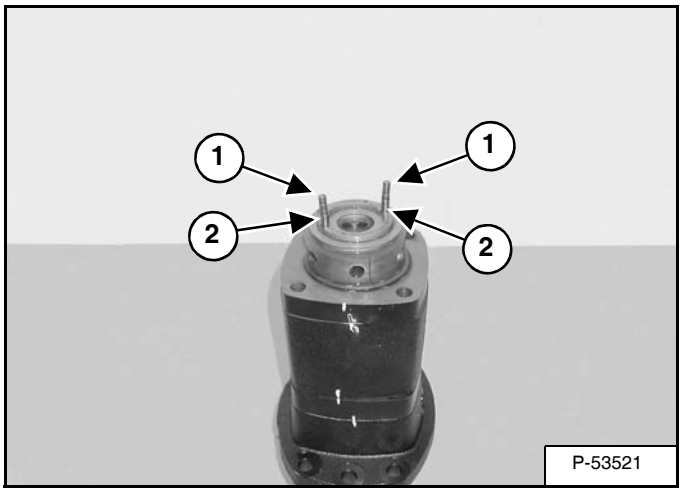
Figure 20-90-11



Remove the O-ring (Item 1) **[Figure 20-90-11]**.

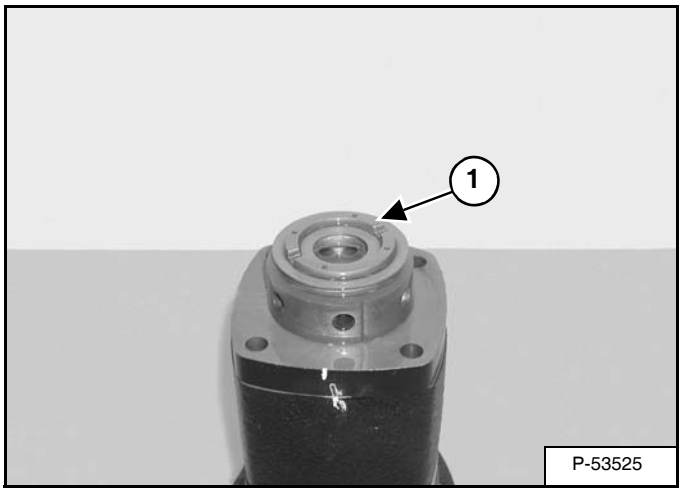
Disassembly (Cont'd)

Figure 20-90-12



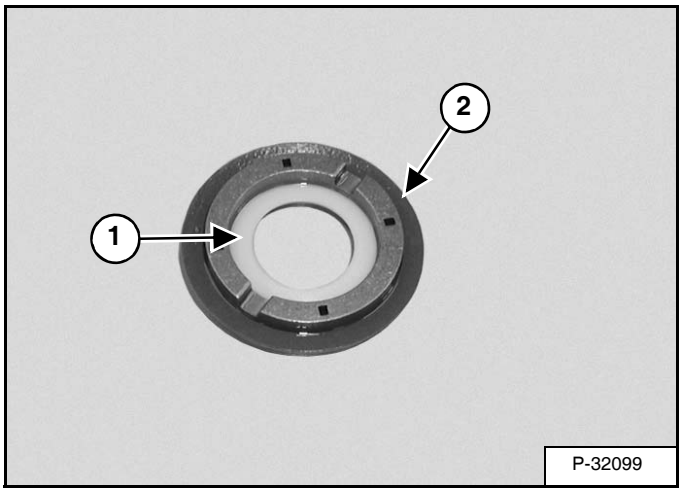
Remove the springs (Item 1) and pins (Item 2) **[Figure 20-90-12]**.

Figure 20-90-13



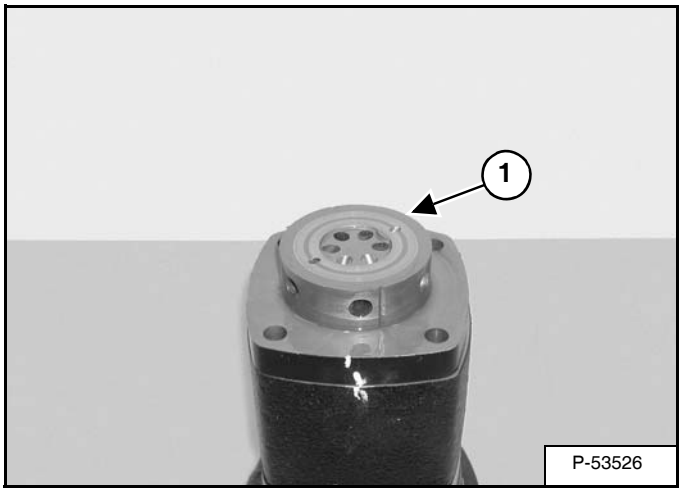
Remove the balance ring (Item 1) **[Figure 20-90-13]**.

Figure 20-90-14



Remove the inner seal (Item 1) and outer seal (Item 2) **[Figure 20-90-14]**.

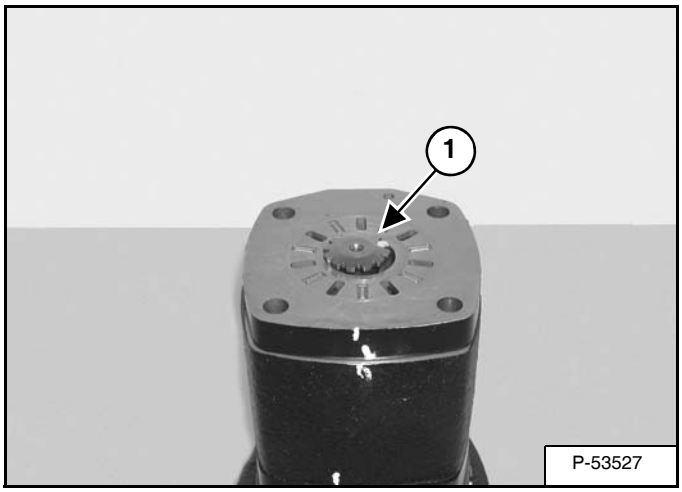
Figure 20-90-15



Remove the valve (Item 1) **[Figure 20-90-15]**.

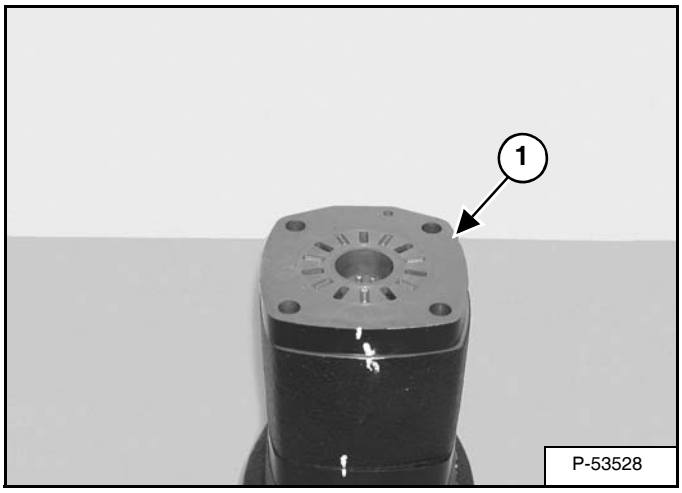
Disassembly (Cont'd)

Figure 20-90-16



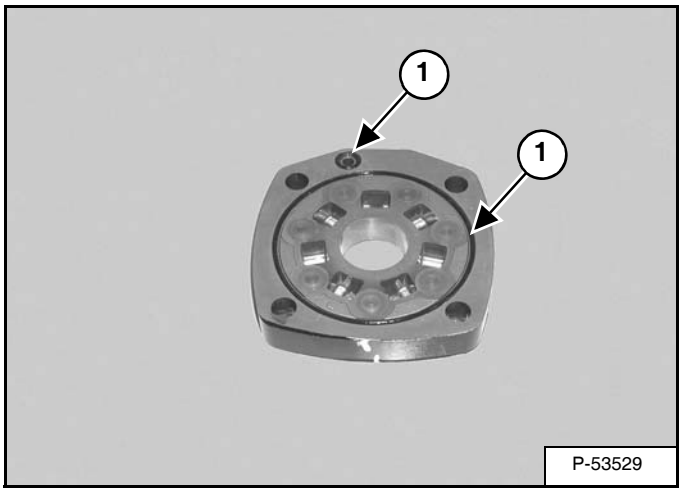
Remove the drive shaft (Item 1) **[Figure 20-90-16]**.

Figure 20-90-17



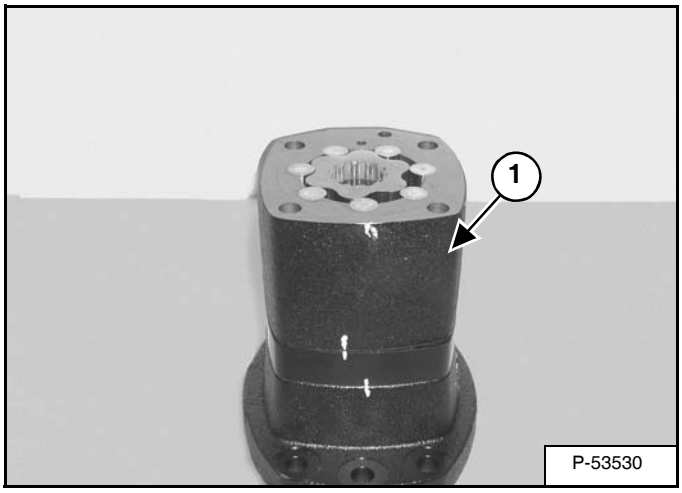
Remove the valve plate (Item 1) **[Figure 20-90-17]**.

Figure 20-90-18



Remove the O-rings (Item 1) **[Figure 20-90-18]**.

Figure 20-90-19

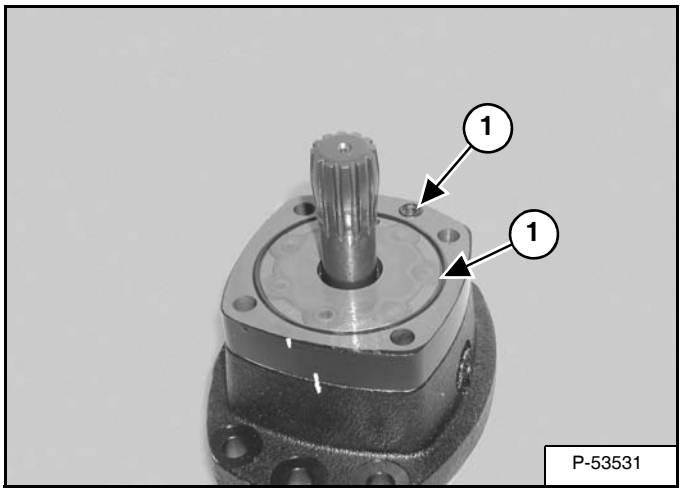


Remove the geroler (Item 1) **[Figure 20-90-19]**.

NOTE: Do not disassemble the geroler.

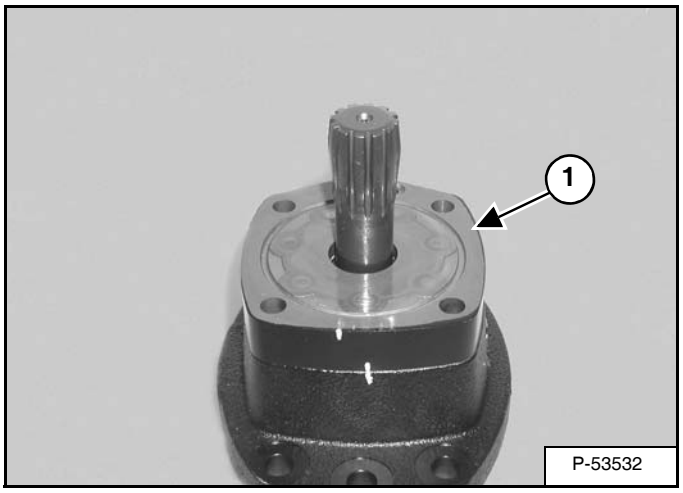
Disassembly (Cont'd)

Figure 20-90-20



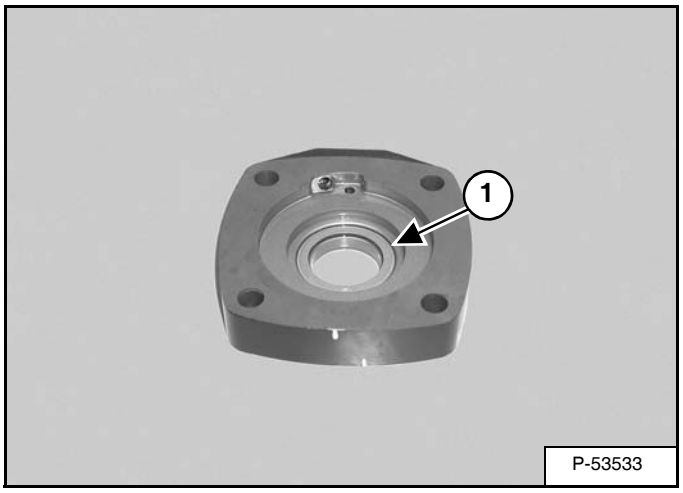
Remove the O-rings (Item 1) **[Figure 20-90-20]**.

Figure 20-90-21



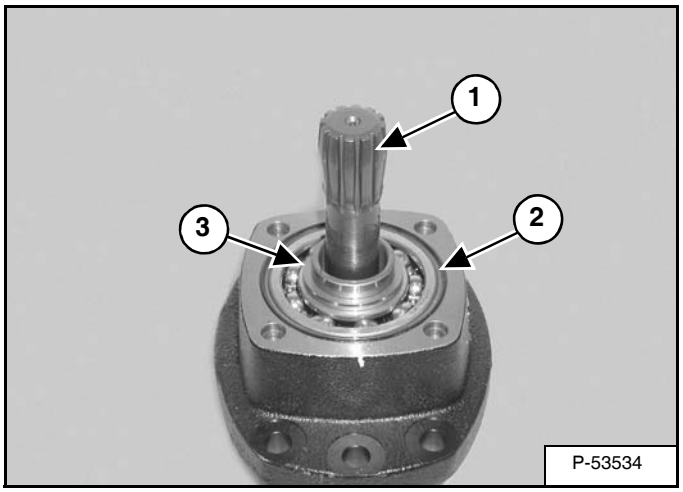
Remove the valve plate (Item 1) **[Figure 20-90-21]**.

Figure 20-90-22



Remove the seal (Item 1) **[Figure 20-90-22]**.

Figure 20-90-23

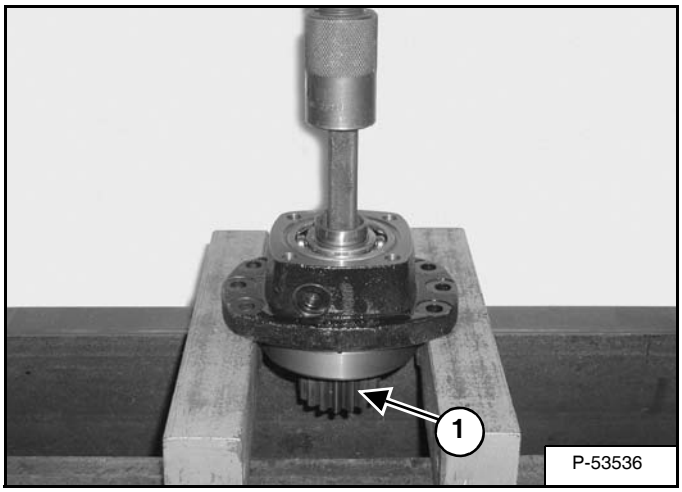


Remove the drive shaft (Item 1). Remove the O-ring (Item 2) **[Figure 20-90-23]**.

Remove the snap ring (Item 3) **[Figure 20-90-23]**.

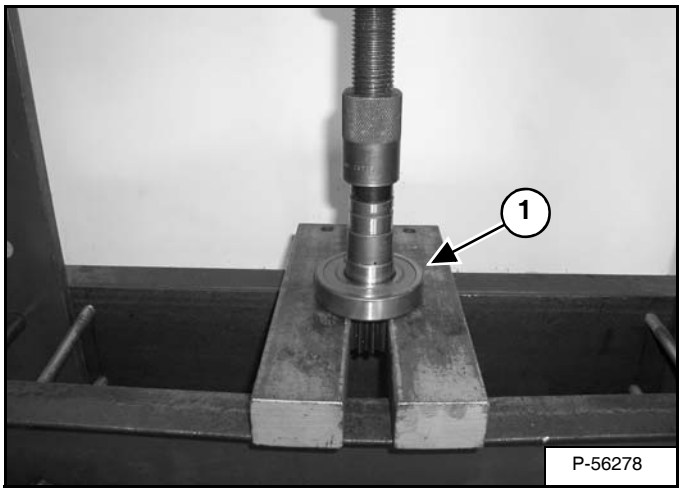
Disassembly (Cont'd)

Figure 20-90-24



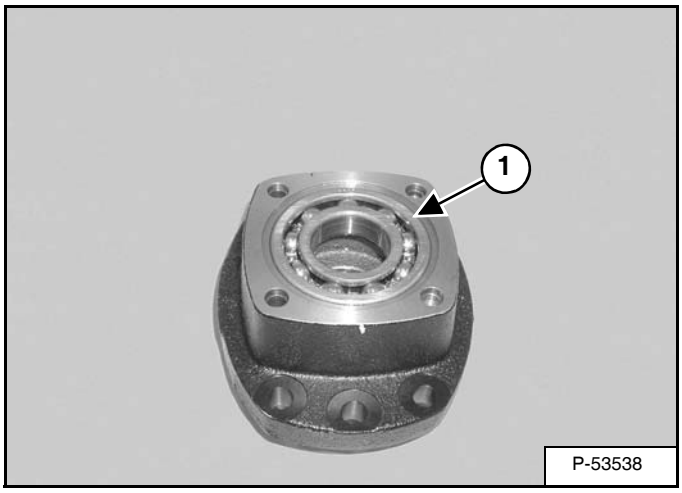
Press the shaft (Item 1) **[Figure 20-90-24]** out of the housing.

Figure 20-90-25



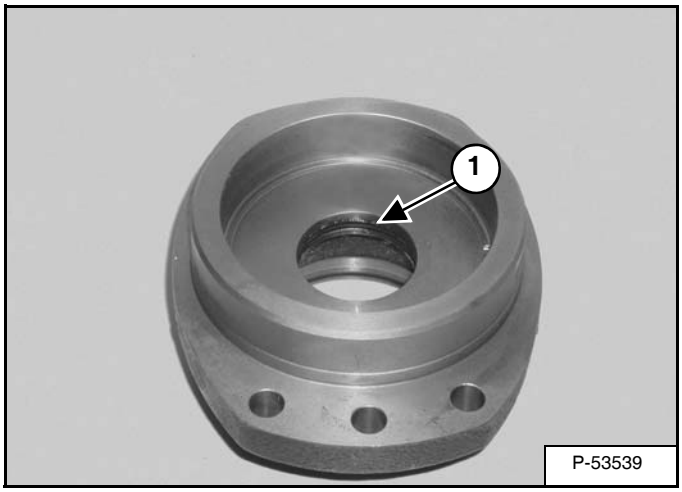
Press the bearing (Item 1) **[Figure 20-90-25]** off of the shaft.

Figure 20-90-26



Remove the bearing (Item 1) **[Figure 20-90-25]** & **[Figure 20-90-26]** from the housing.

Figure 20-90-27



Remove the seal (Item 1) **[Figure 20-90-27]**.

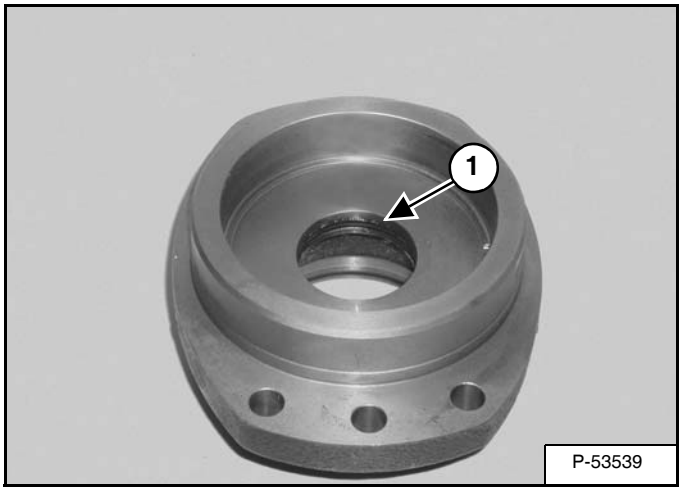
Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

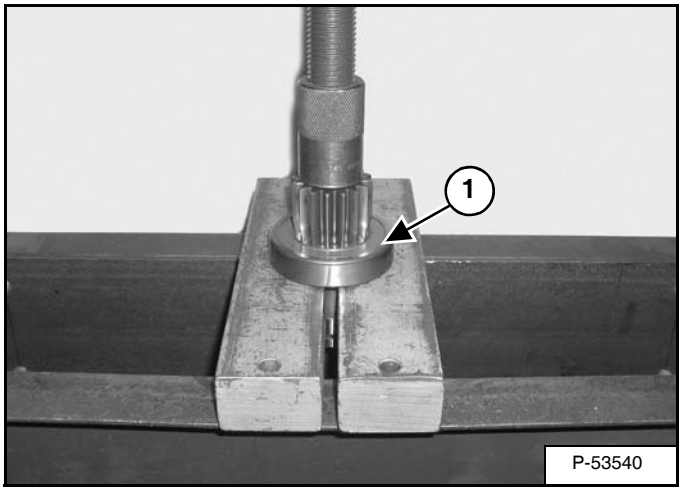
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-90-28



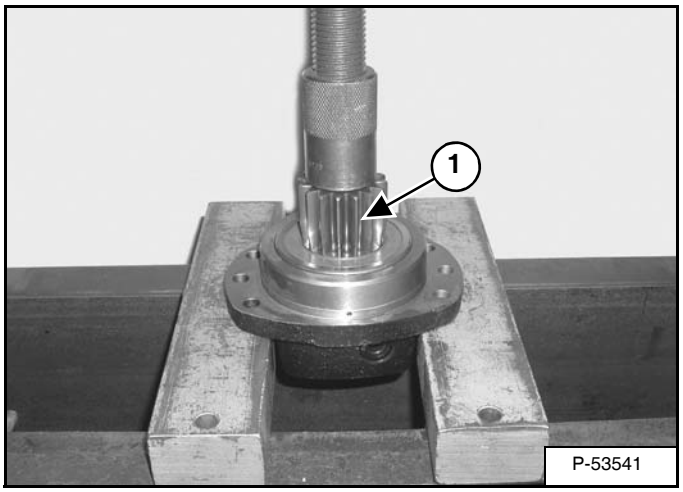
Install the seal (Item 1) **[Figure 20-90-28]** in the housing.

Figure 20-90-29



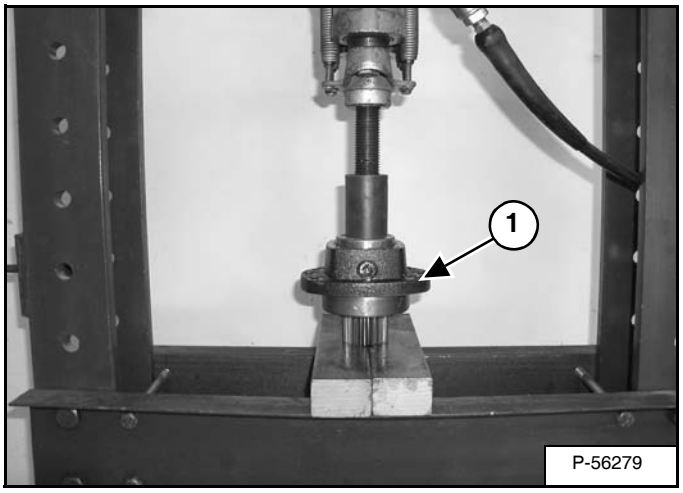
Press the bearing (Item 1) **[Figure 20-90-29]** on the shaft.

Figure 20-90-30



Press the shaft (Item 1) **[Figure 20-90-30]** in the housing.

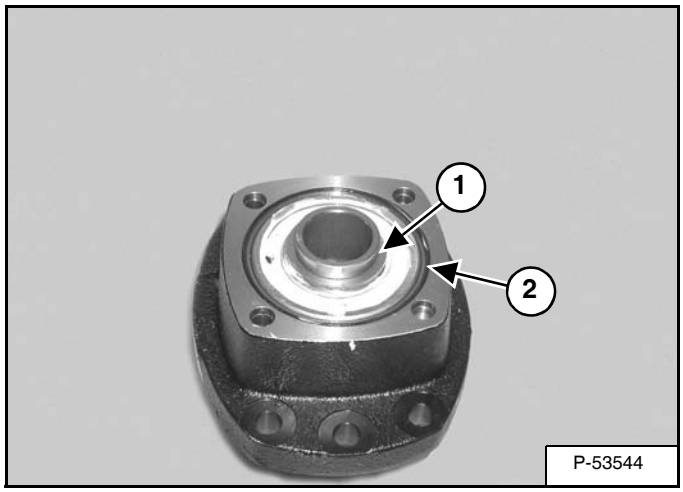
Figure 20-90-31



Apply assembly lube to the bearing and press the bearing (Item 1) **[Figure 20-90-31]** in the housing.

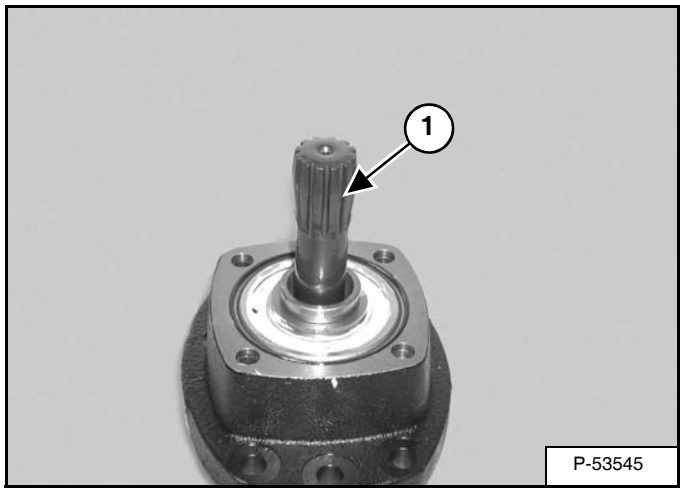
Assembly (Cont'd)

Figure 20-90-32



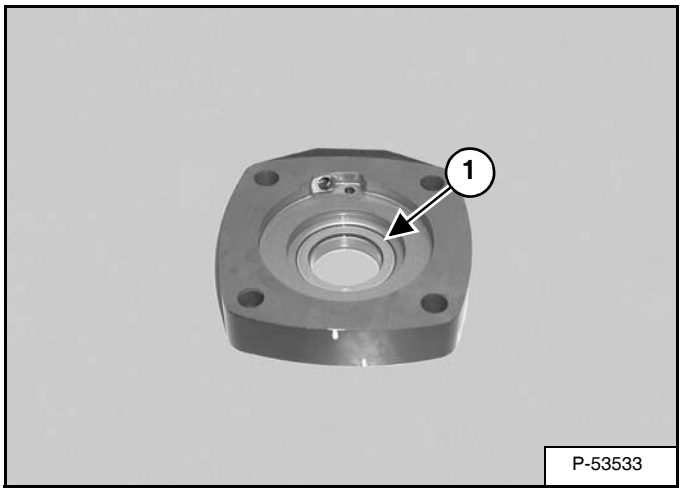
Install the snap ring (Item 1)and O-ring (Item 2) **[Figure 20-90-32]**.

Figure 20-90-33



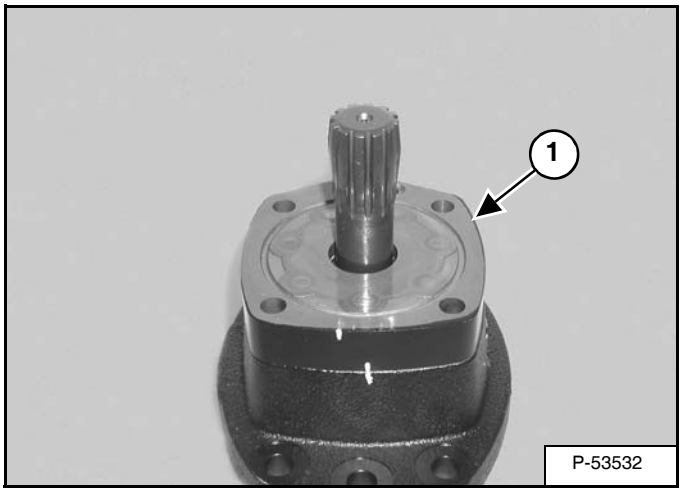
Install the drive shaft (Item 1) **[Figure 20-90-33]**.

Figure 20-90-34



Install the seal (Item 1) **[Figure 20-90-34]** in the plate.

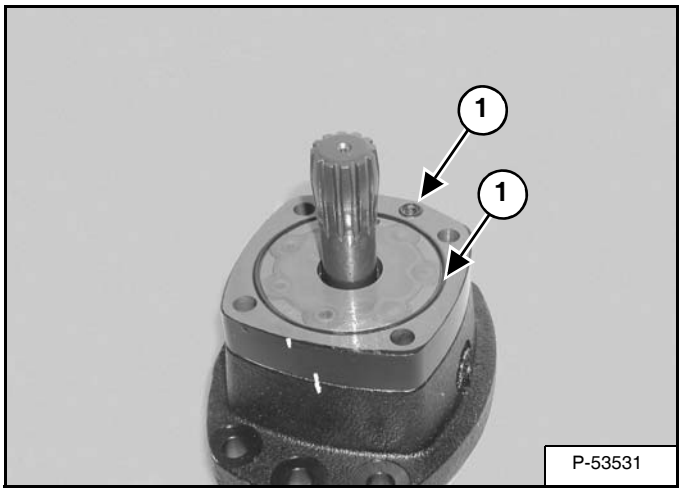
Figure 20-90-35



Install the plate (Item 1) **[Figure 20-90-35]**.

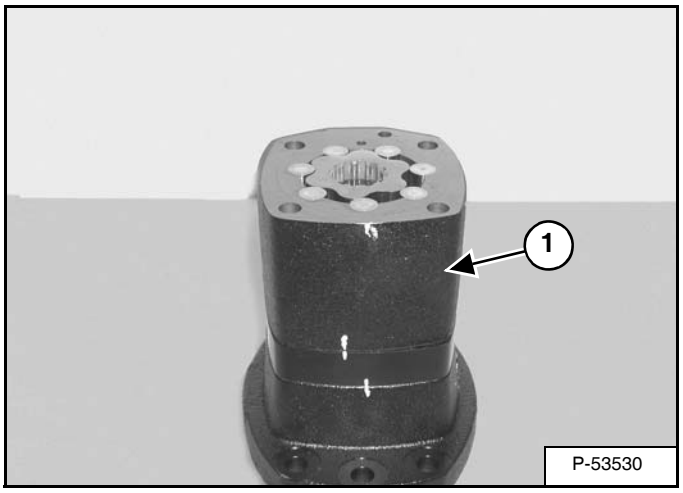
Assembly (Cont'd)

Figure 20-90-36



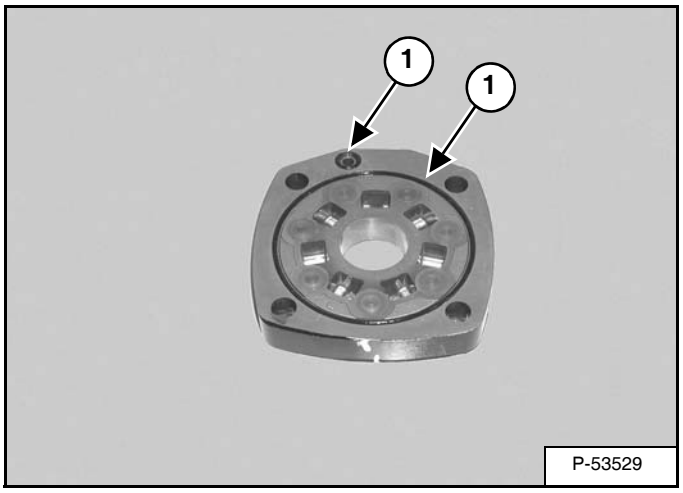
Install the O-rings (Item 1) **[Figure 20-90-36]**.

Figure 20-90-37



Install the geroler (Item 1) **[Figure 20-90-37]**.

Figure 20-90-38

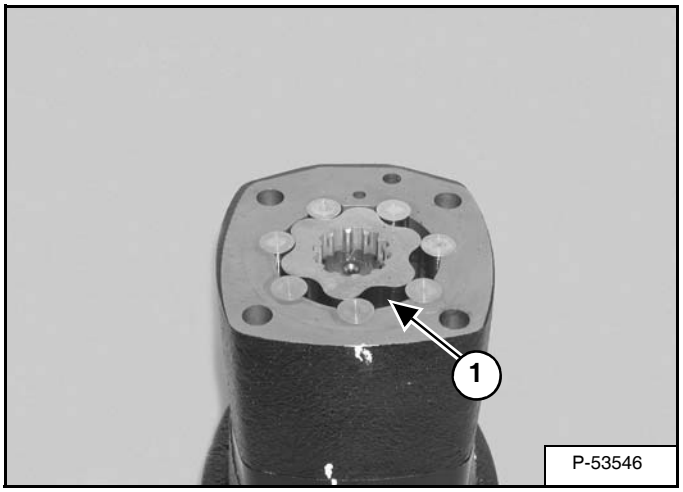


Install the O-rings (Item 1) **[Figure 20-90-38]** on the valve plate.

Motor Timing

The direction that the output shaft rotates is determined by timing. Time the motor as follows:

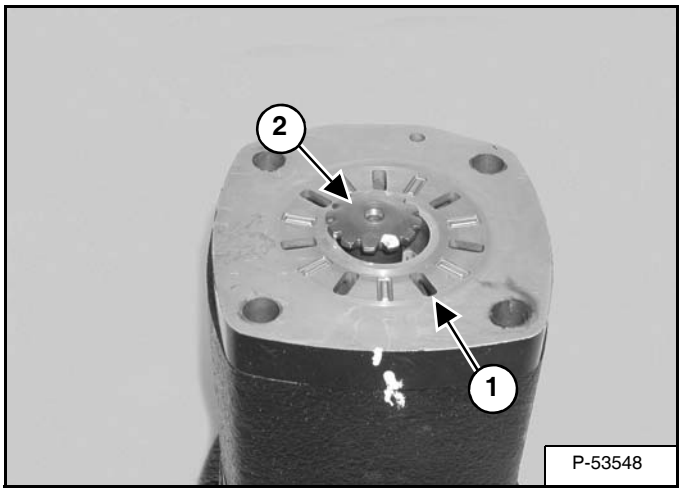
Figure 20-90-39



Locate the largest open pocket in the geroler (Item 1) **[Figure 20-90-39]**.

Assembly (Cont'd)

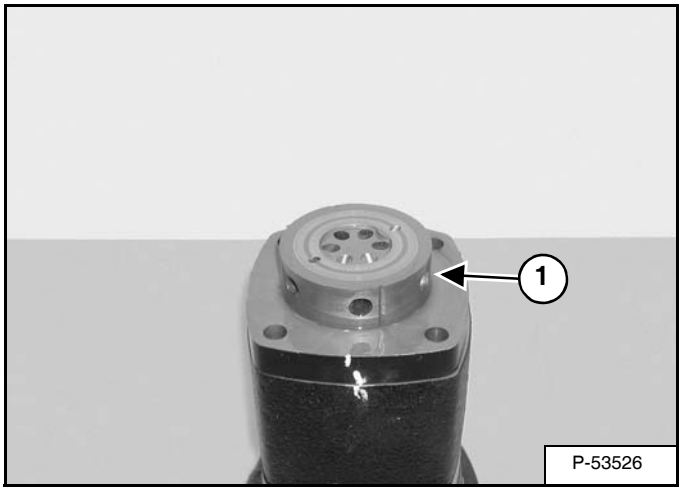
Figure 20-90-40



Install the valve plate and locate the open slot (Item 1) **[Figure 20-90-40]** that is over the largest open Geroler pocket.

Install the drive (Item 2) **[Figure 20-90-40]**.

Figure 20-90-41

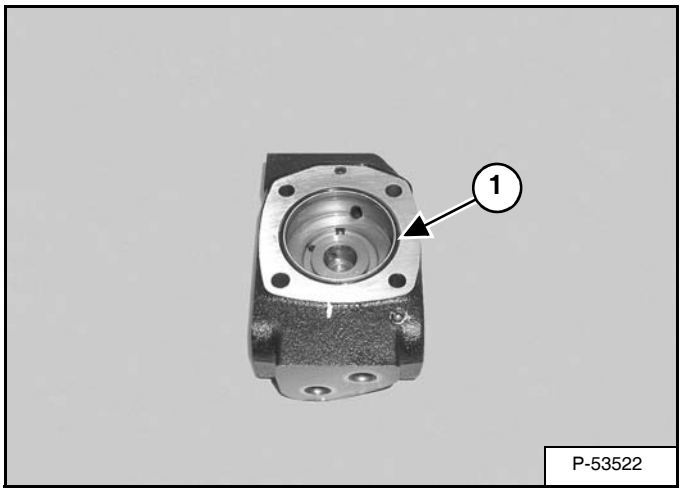


Align one of the side openings (Item 1) **[Figure 20-90-41]** in the valve with the valve plate slot that is over the largest open Geroler pocket.

Engage the valve with the valve drive by rotating it 15° clockwise until the spline teeth mesh.

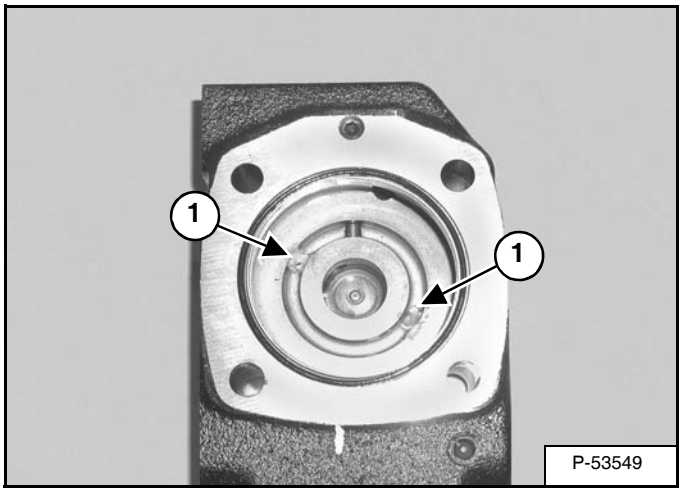
NOTE: If the valve is turned clockwise the motor will rotate in the opposite direction.

Figure 20-90-42



Install the O-ring (Item 1) **[Figure 20-90-42]**.

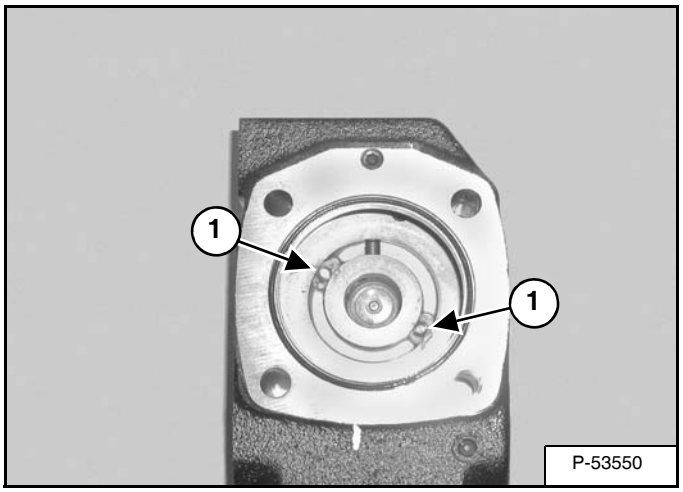
Figure 20-90-43



Apply assembly lube to the springs, and install the springs (Item 1) **[Figure 20-90-43]**.

Assembly (Cont'd)

Figure 20-90-44



Install the pins (Item 1) **[Figure 20-90-44]**.

Figure 20-90-45

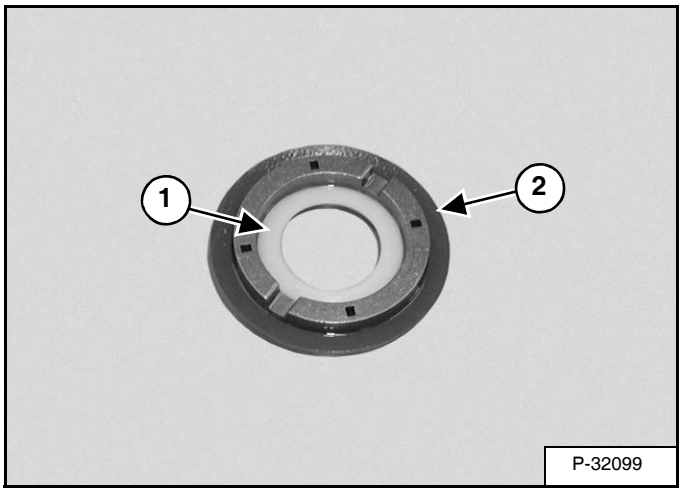
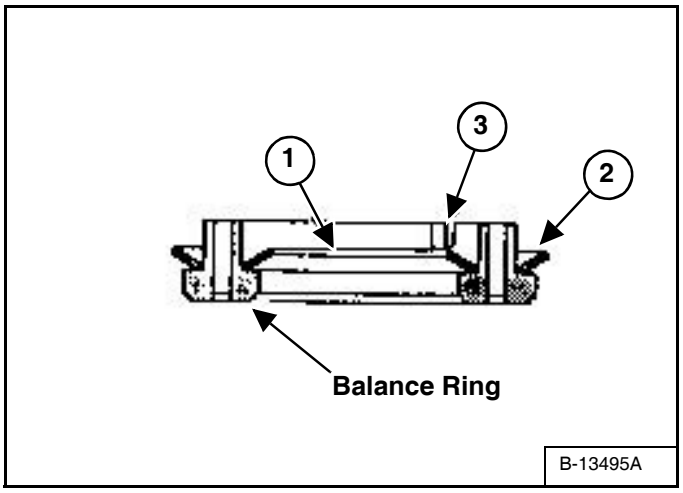
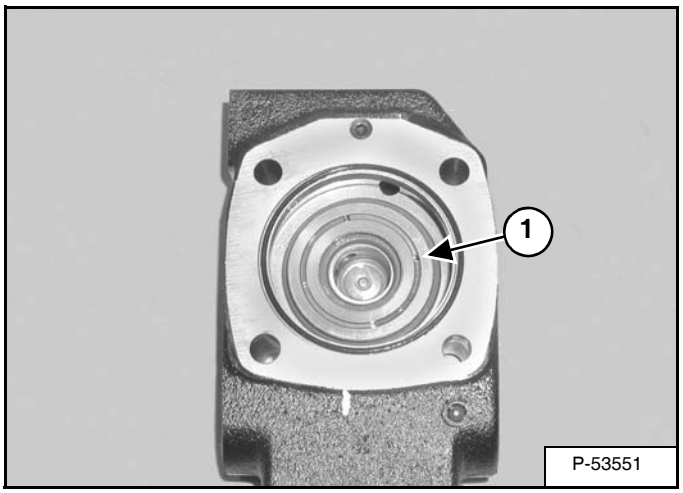


Figure 20-90-46



Install the inner (Item 1) and outer (Item 2) **[Figure 20-90-45]** & **[Figure 20-90-46]** face seals on the balance ring as shown

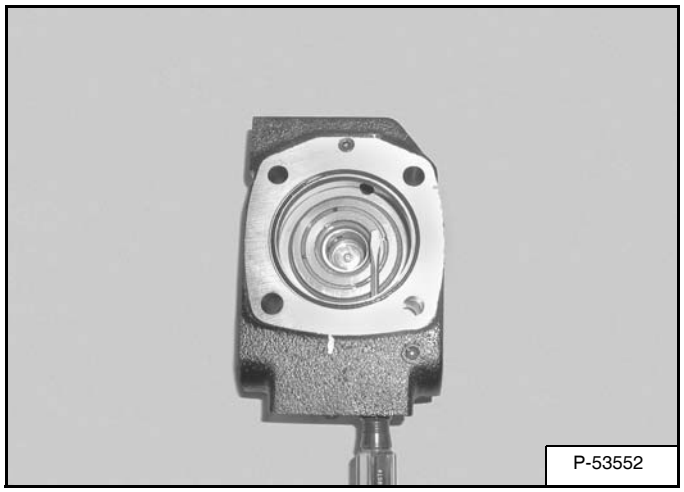
Figure 20-90-47



Install the balance ring (Item 1) **[Figure 20-90-47]**. Make sure the pins engage the pin notches (Item 3) **[Figure 20-90-46]** in the balance ring.

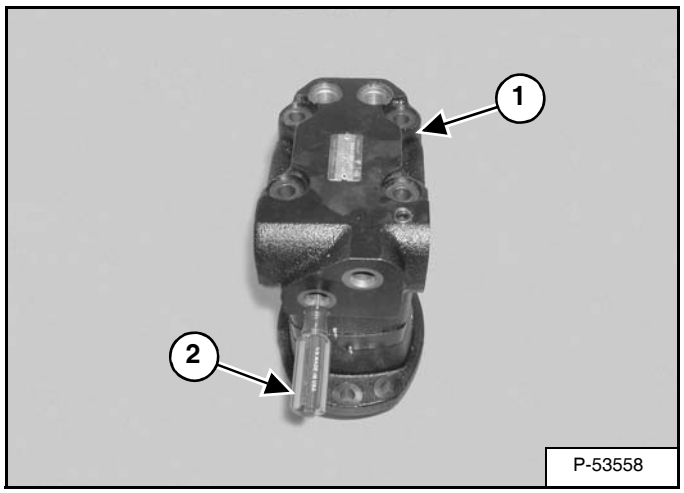
Assembly (Cont'd)

Figure 20-90-48



Insert a small screw driver through the port in the housing. Apply pressure to the side of the balance ring assembly until the valve housing is in place **[Figure 20-90-48]**.

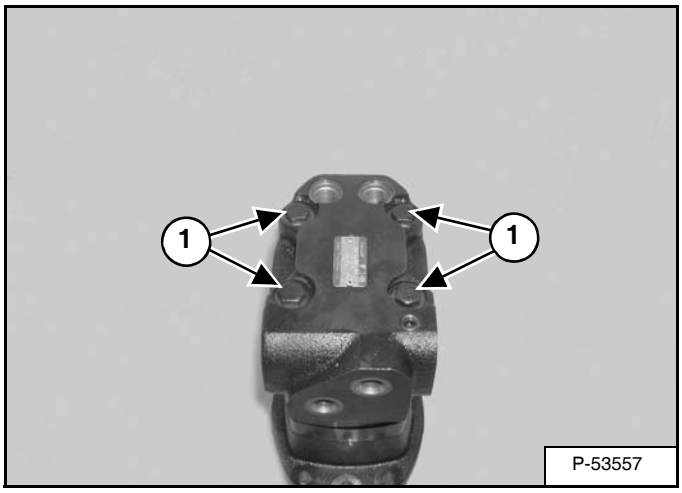
Figure 20-90-49



Install the housing (Item 1) **[Figure 20-90-49]** on the motor.

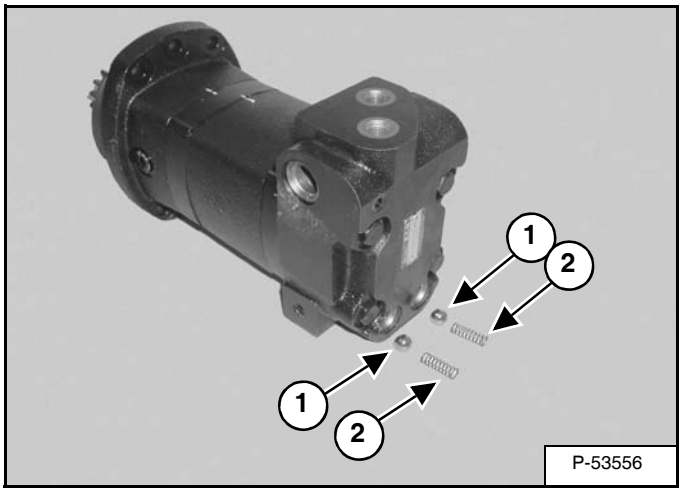
Remove the screwdriver (Item 2) **[Figure 20-90-49]**.

Figure 20-90-50



Install the bolts (Item 1) **[Figure 20-90-50]**. Tighten the bolts to 37 ft.-lbs. (50 Nm) torque in a crisscross pattern.

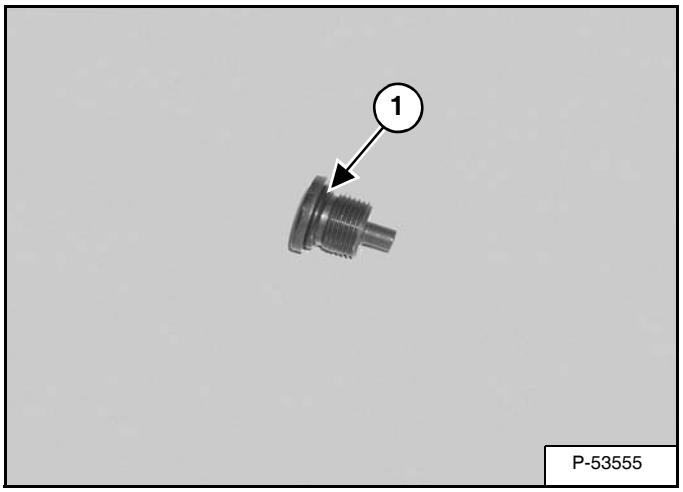
Figure 20-90-51



Install the balls (Item 1) and springs (Item 2) **[Figure 20-90-51]**.

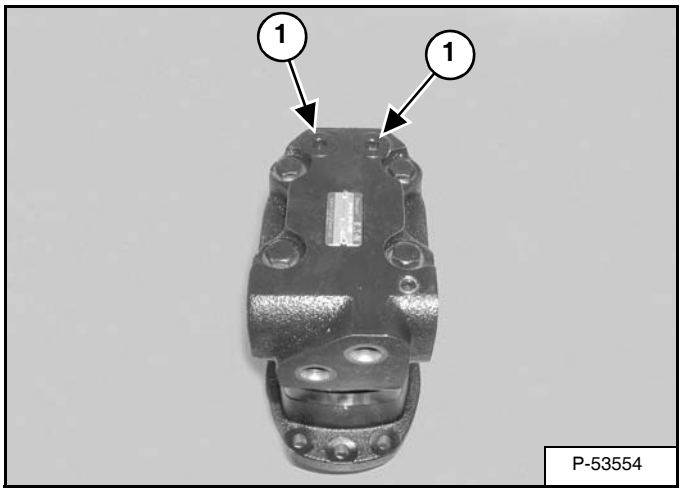
Assembly (Cont'd)

Figure 20-90-52



Install the O-ring (Item 1) **[Figure 20-90-52]** on the plugs.

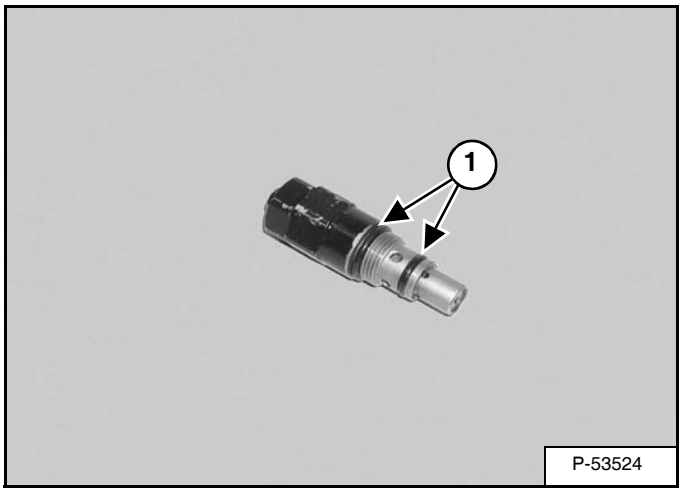
Figure 20-90-53



Install the plugs (Item 1) **[Figure 20-90-53]**.

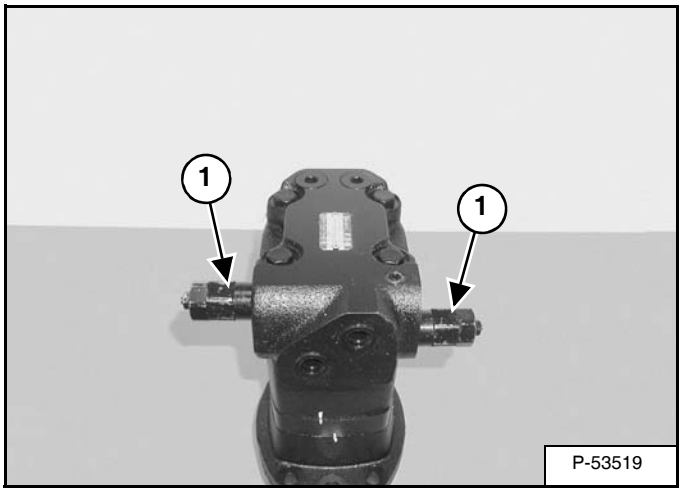
Tighten the plugs to 42 ft.-lbs. (57 Nm) torque.

Figure 20-90-54



Install the O-rings (Item 1) **[Figure 20-90-54]** on the crossport relief valves.

Figure 20-90-55



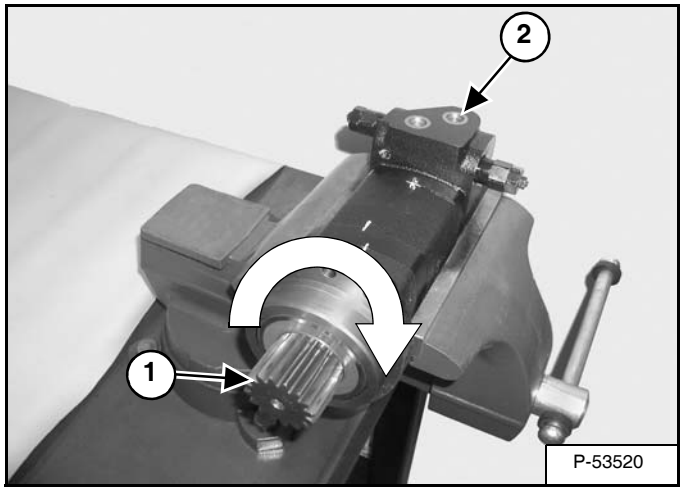
Install the crossport relief valves (Item 1) **[Figure 20-90-55]**.

Tighten the valves to 69 ft.-lbs. (94 Nm) torque.

Assembly (Cont'd)

Clamp the motor in a vise.

Figure 20-90-56



Turn the shaft (Item 1) **[Figure 20-90-56]** in a clockwise direction.

If the motor is correctly timed, there will be suction at the top port (Item 2) **[Figure 20-90-56]**.

CONTROL PATTERN SELECTOR VALVE

Removal And Installation

Figure 20-100-1

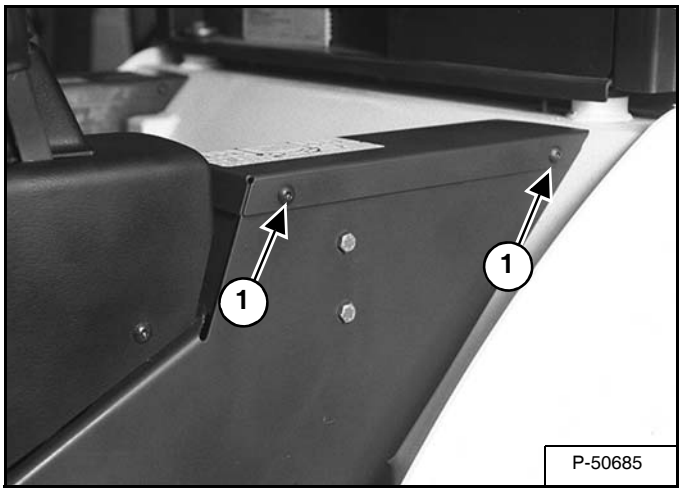
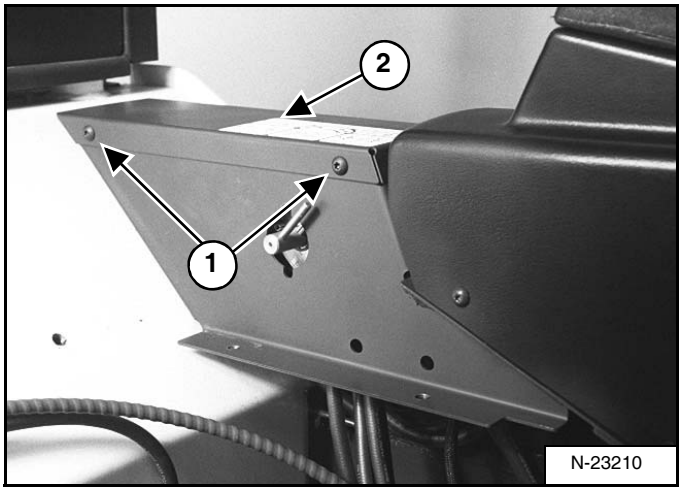


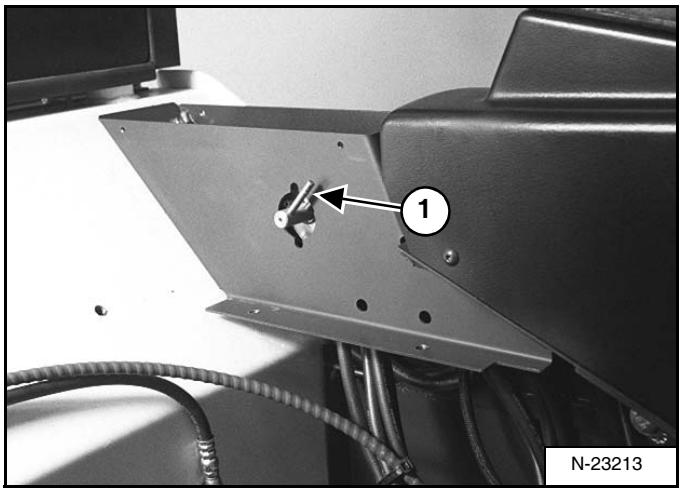
Figure 20-100-2



Remove the four screws (Item 1) **[Figure 20-100-1]** & **[Figure 20-100-2]** from the left console cover.

Remove the left console cover plate (Item 2) **[Figure 20-100-2]**.

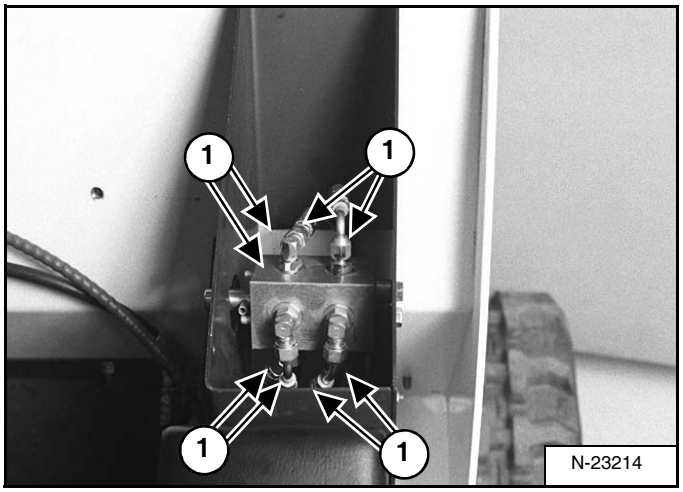
Figure 20-100-3



Remove the control pattern selector valve lever (Item 1) **[Figure 20-100-3]**.

Mark the eight hoses for ease of assembly.

Figure 20-100-4



Remove the eight hoses (Item 1) **[Figure 20-100-4]** from the control pattern selector valve. Cap and plug the fittings and hoses.

Removal And Installation (Cont'd)

Figure 20-100-5

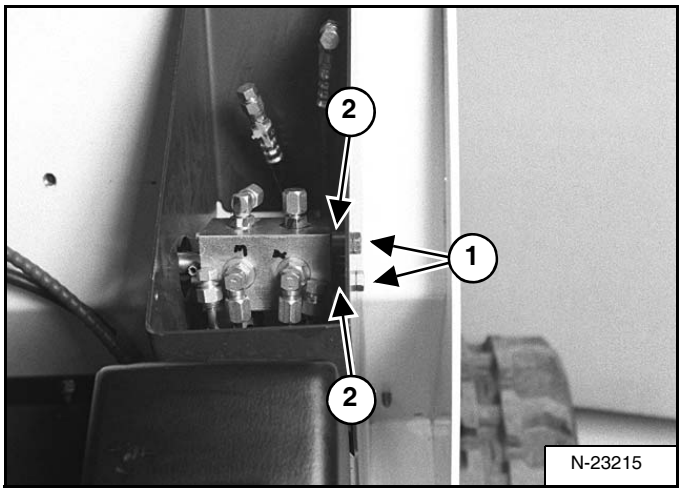
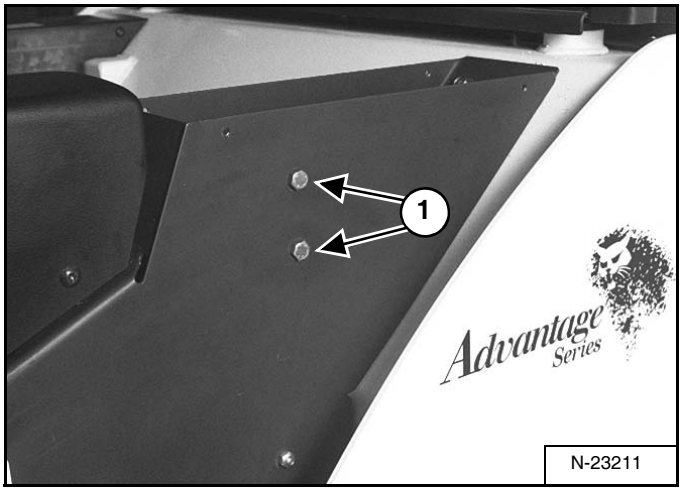


Figure 20-100-6

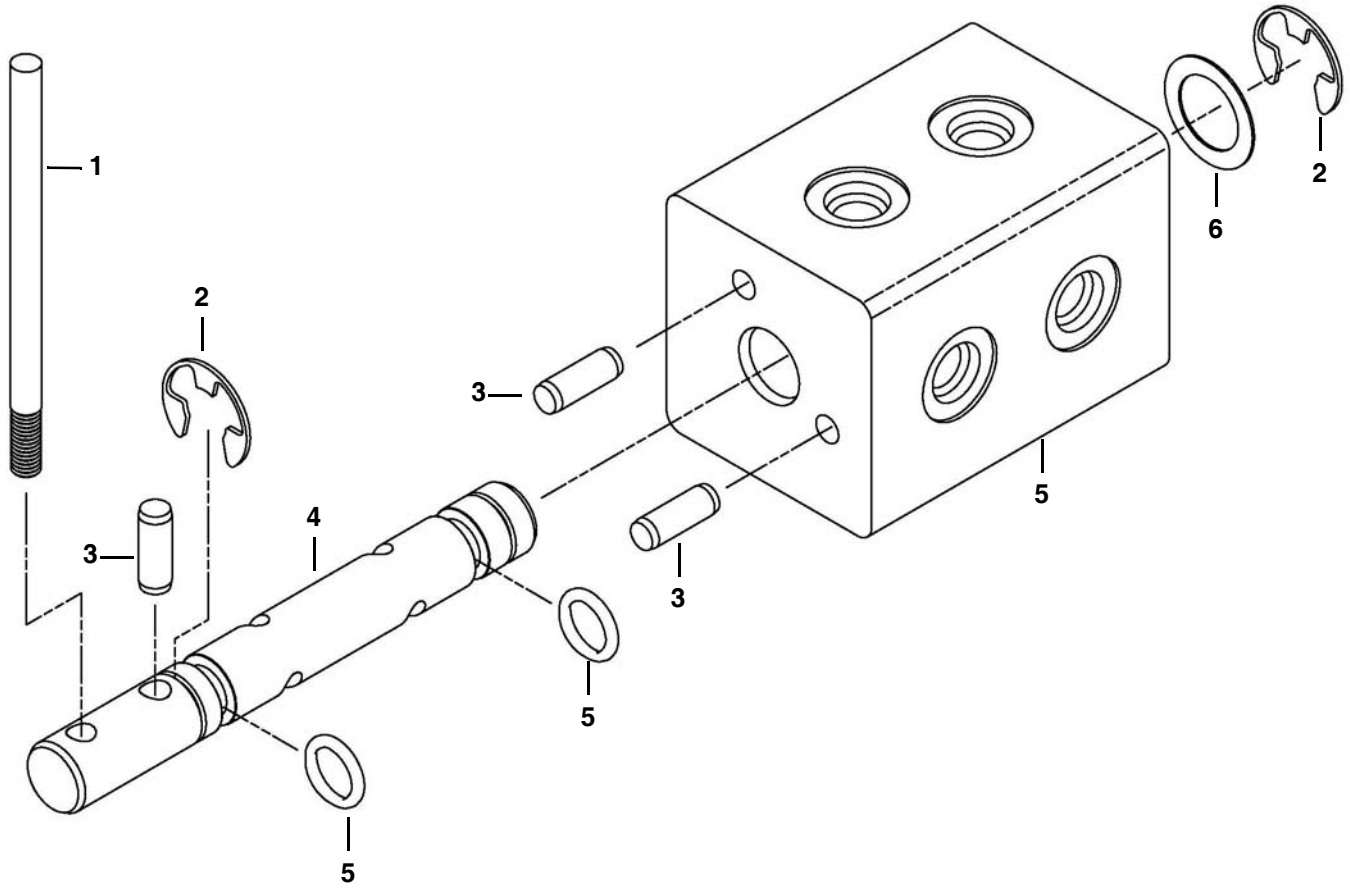


Remove the two bolts (Item 1) **[Figure 20-100-5]** & **[Figure 20-100-6]**.

NOTE: Do not loosen the two spacers (Item 2) [Figure 20-100-5] between the valve and console side plate.

Parts Identification

1. Handle
2. Snap Ring
3. Roll Pin
4. Spool
5. Housing
6. Washer



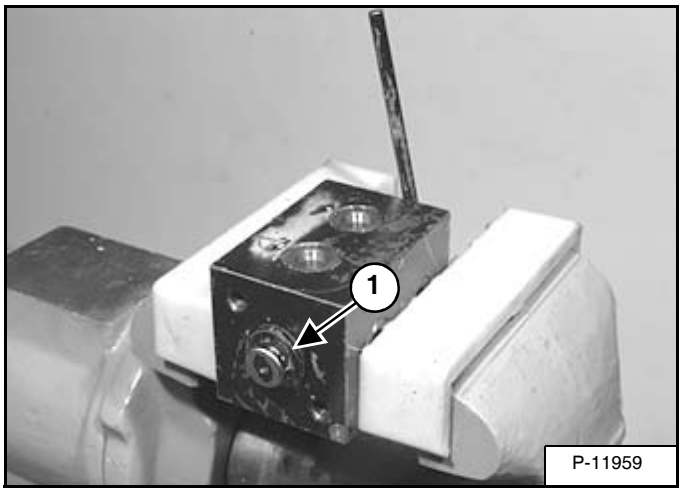
TS-1353

Disassembly

Clean the outside of the control pattern selector valve before disassembly.

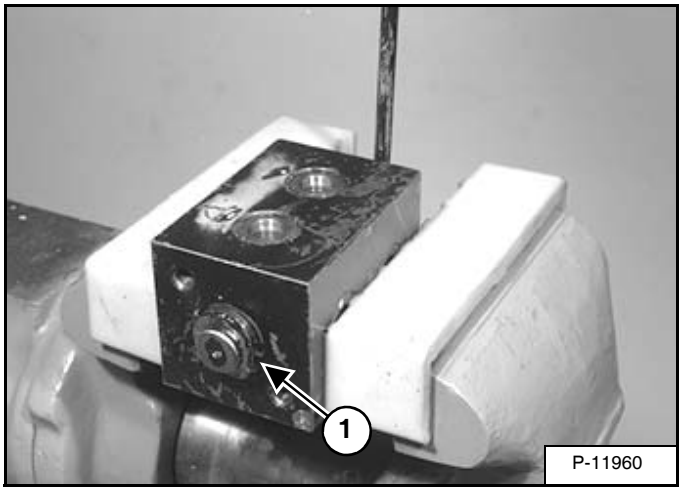
Clamp the valve in a vise equipped with padded jaws.

Figure 20-100-7



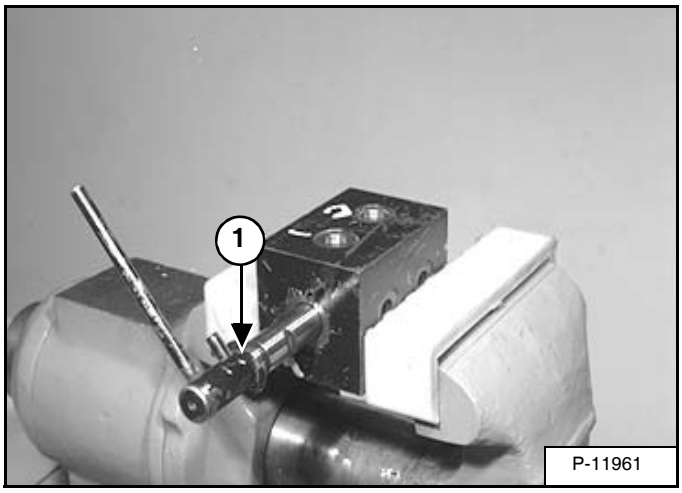
Remove the snap ring (Item 1) **[Figure 20-100-7]**.

Figure 20-100-8



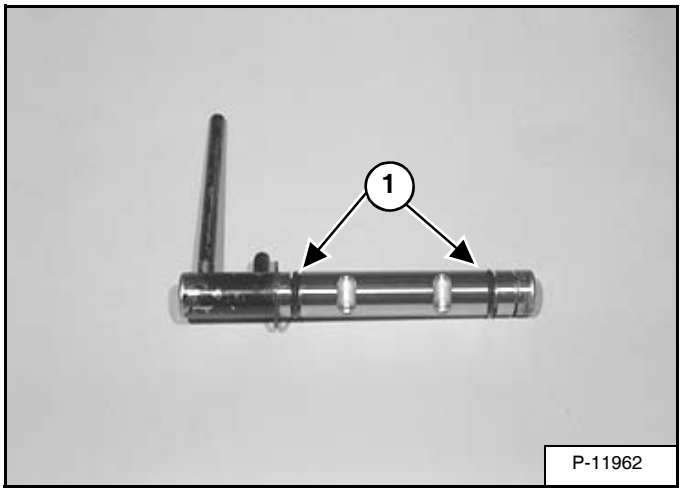
Remove the wave washer (Item 1) **[Figure 20-100-8]**.

Figure 20-100-9



Pull the spool (Item 1) **[Figure 20-100-9]** out of the housing.

Figure 20-100-10



Remove the O-rings (Item 1) **[Figure 20-100-10]** from the spool.

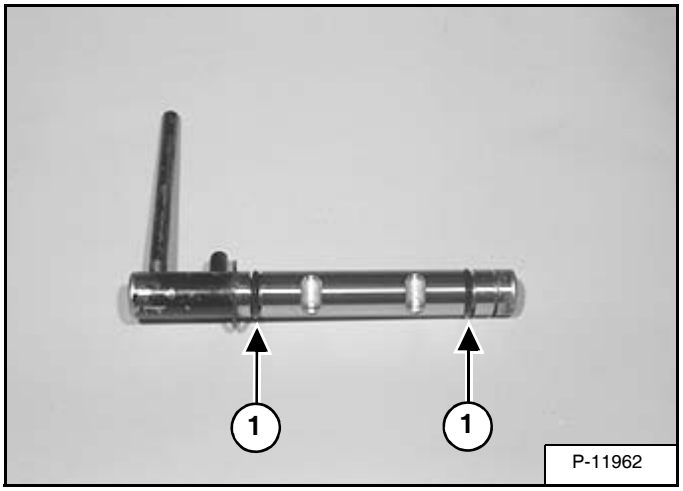
Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new O-rings. Lubricate all O-rings with clean hydraulic fluid before installation.

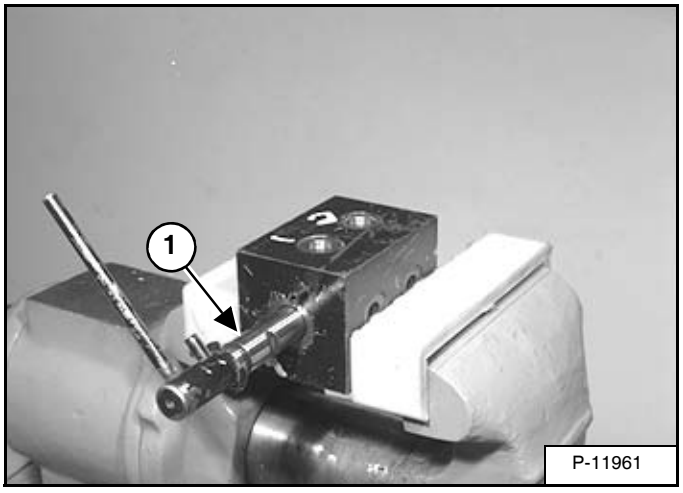
Figure 20-100-11



Clean all parts in solvent and dry with compressed air.

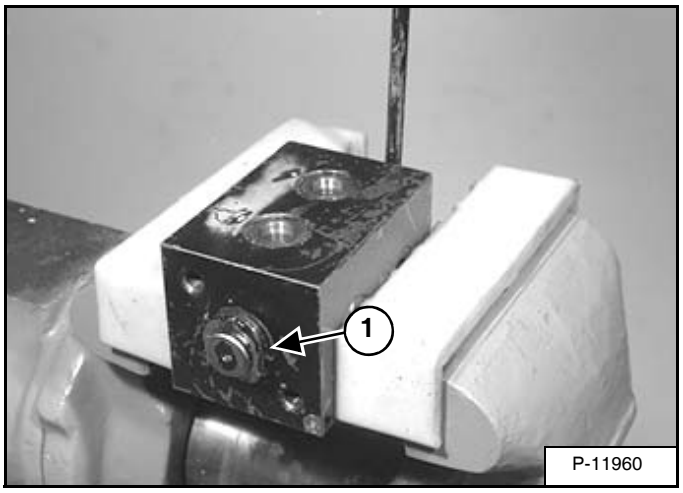
Apply oil to and install new O-rings (Item 1) **[Figure 20-100-11]** on the spool.

Figure 20-100-12



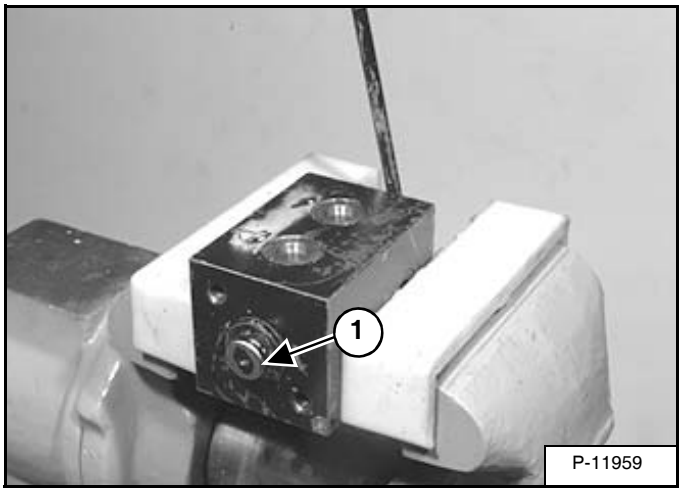
Apply oil to and install the spool (Item 1) **[Figure 20-100-12]** in the housing.

Figure 20-100-13



Install the wave washer (Item 1) **[Figure 20-100-13]** on the end of the spool.

Figure 20-100-14



Install the snap ring (Item 1) **[Figure 20-100-14]** on the spool.


Bobcat®

RIGHT CONTROL LEVER (JOYSTICK)

Testing

Check the pressure reducing valve for the correct pressure. (See Testing And Adjusting The Pressure Reducing Valve on Page 20-33-1.)

The following tools will be needed to do the procedure:

MEL1355 - Hydraulic Test Kit

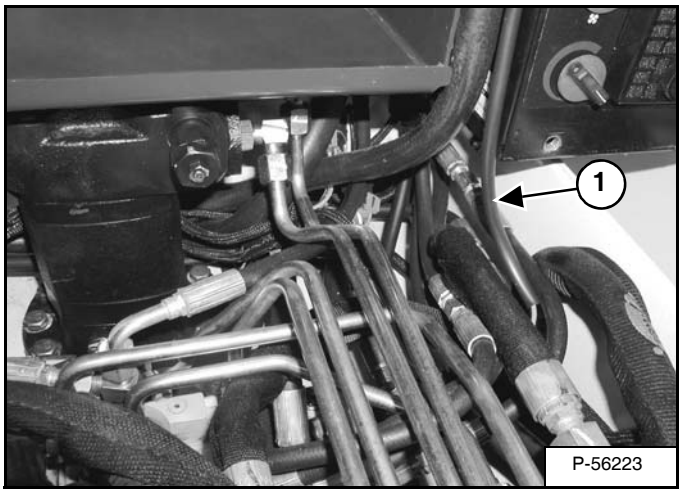
Lower the boom/bucket and blade to the ground.

Relieve hydraulic pressure.

Stop the engine.

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

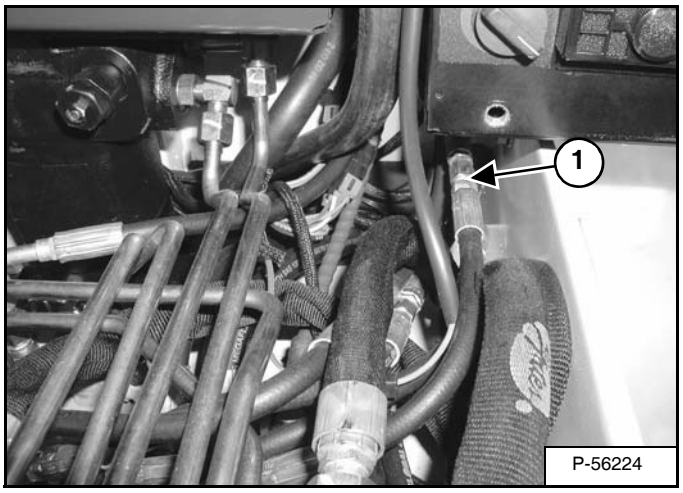
Figure 20-110-1



At the control valve assembly, find the pilot line (Item 1) **[Figure 20-110-1]** of the control lever (joystick) that is to be checked. Arm, Bucket, Boom, and Swing (slew).

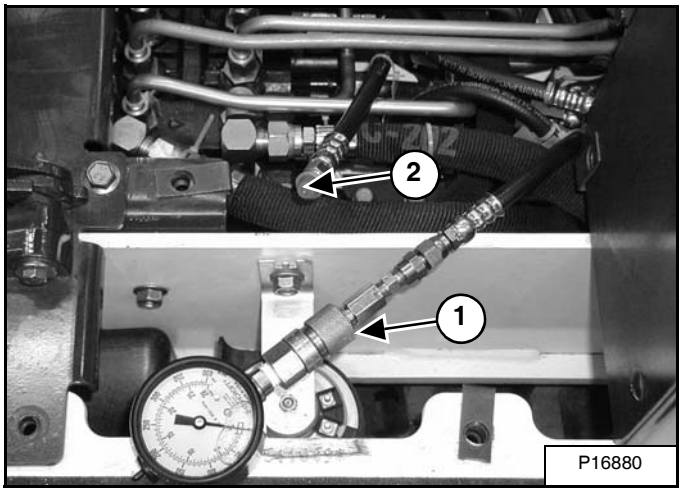
NOTE: These four valves (Arm, Bucket, Boom & Swing (Slew) have short extension hoses with connectors for ease of valve removal and testing.

Figure 20-110-2



Remove the hose (Item 1) **[Figure 20-110-2]** from the short control valve extension hose.

Figure 20-110-3



From the test kit, install a fitting and test port (Item 1) **[Figure 20-110-3]** to the control lever (joystick) hose.

Cap the short control valve extension hose (Item 2) **[Figure 20-110-3]**.

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

Testing (Cont'd)

Install a 1000 PSI (69 Bar) gauge and female coupler on the test port.

Start the engine and warm the hydraulic oil to operating temperature 150°F (66°C).

Check the gauge with the control levers (joystick) in neutral. The hydraulic pressure should be 0 PSI (0 Bar).

Engage the circuit to be tested. Record the operating pressure.

The operating pressure should be as follows:

435 PSI (30 Bar) with an acceptable range of 406-450 PSI (28-31 Bar).

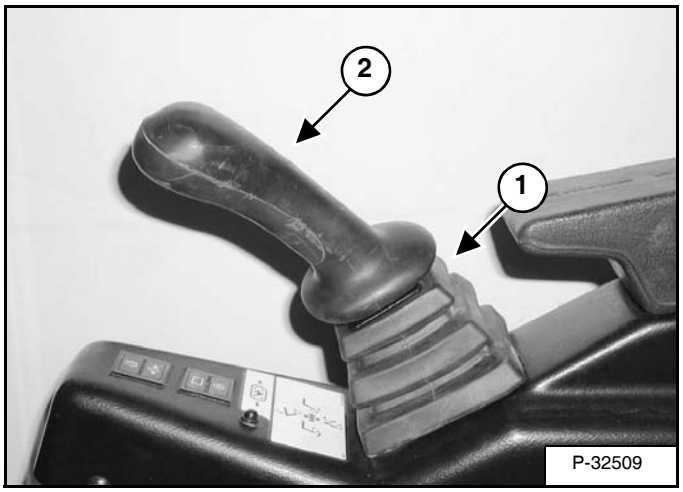
If the operating pressure is correct, check the valve section spool for proper operation.

If the operating pressure is incorrect, remove the pressure reducing valve, clean, install and retest. (See Testing And Adjusting The Pressure Reducing Valve on Page 20-33-1.)

If the pressure is still incorrect replace the pressure reducing valve. (See Testing And Adjusting The Pressure Reducing Valve on Page 20-33-1.)

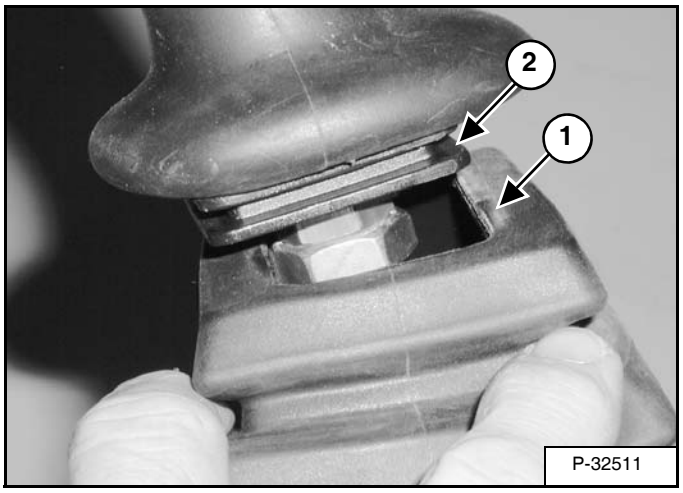
Handle Removal And Installation

Figure 20-110-4



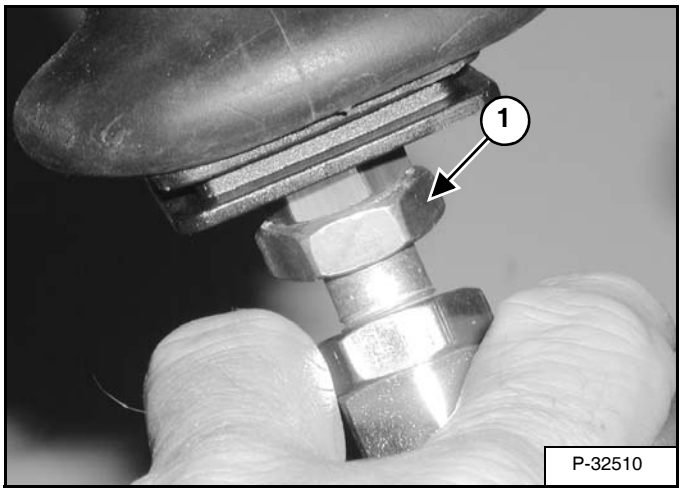
Remove the dust boot (Item 1) from the handle (Item 2) **[Figure 20-110-4]**.

Figure 20-110-5



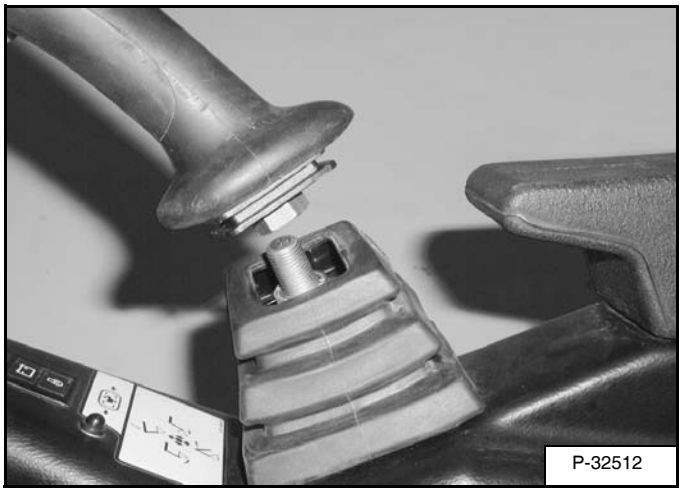
Installation: Align the top of the dust boot (Item 1) with the groove (Item 2) **[Figure 20-110-5]** in the control handle.

Figure 20-110-6



Hold the dust boot (Item 1) down and loosen the jam nut (Item 1) **[Figure 20-110-6]**.

Figure 20-110-7



Remove the handle **[Figure 20-110-7]**.

RIGHT CONTROL LEVER (JOYSTICK) (CONT'D)

Removal And Installation

Lower the boom/bucket and blade to the ground.

Stop the engine.

Relieve hydraulic pressure.

Remove the console cover. (See Console Cover Removal And Installation (Cab Models 320L, 320, 322 & ROPS Canopy Model 320L) on Page 40-50-1 or See Console Cover Removal And Installation (ROPS Canopy Models 320 & 322) on Page 40-50-4)

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.

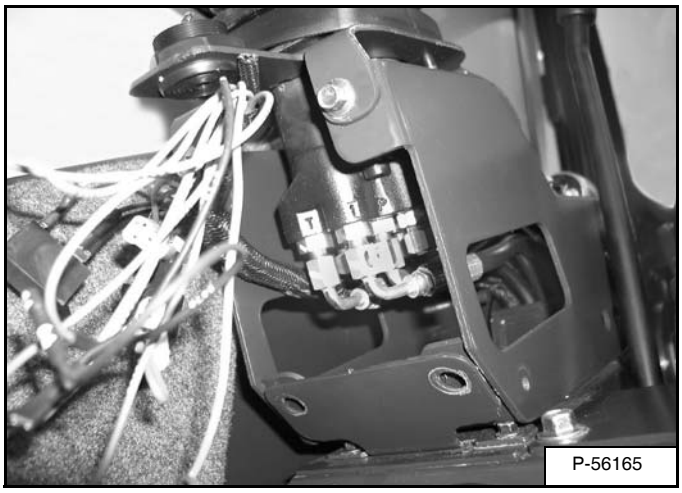
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⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

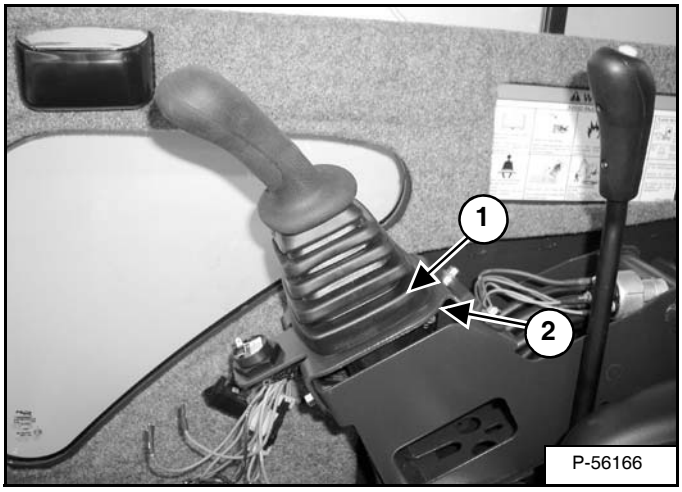
Figure 20-110-8



Mark the hoses for ease of assembly **[Figure 20-110-8]**.

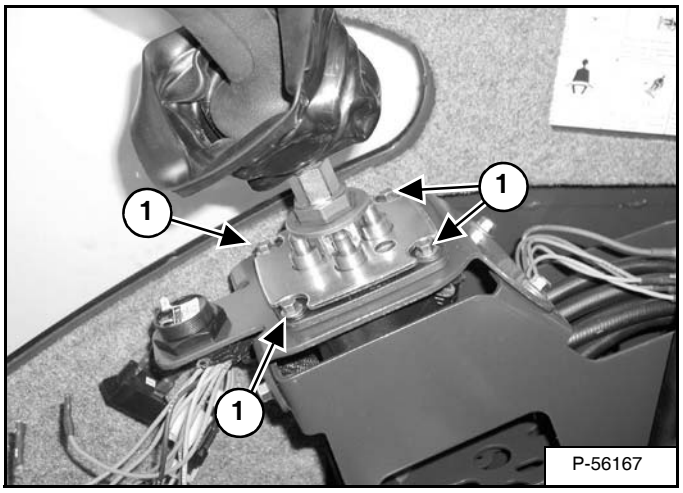
Remove the hoses while the control lever (joystick) is bolted to the console **[Figure 20-110-8]**.

Figure 20-110-9



Raise the dust boot (Item 1) up from the mounting plate (Item 2) **[Figure 20-110-9]**.

Figure 20-110-10

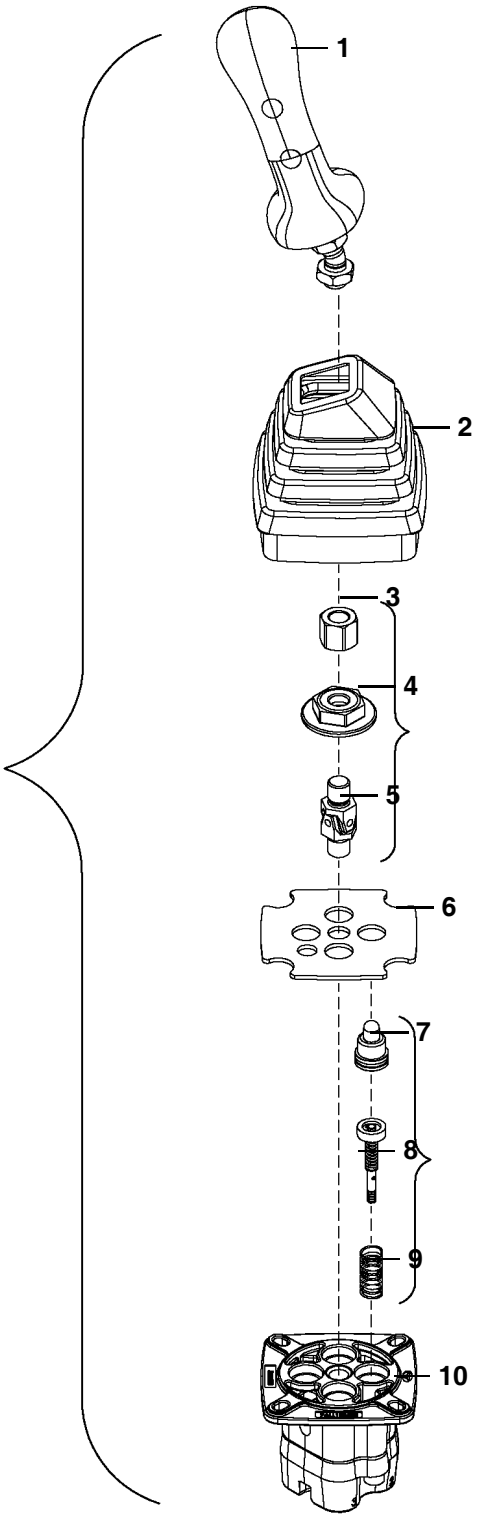


Remove the bolts (Item 1) **[Figure 20-110-10]** from the control lever (joystick) mounting plate.

Remove the control lever (joystick).

Parts Identification

1. Handle
2. Dust Boot
3. Coupler
4. Actuator Control Plate
5. U-Joint
6. Plate
7. Plunger Assembly
8. Spool
9. Spring
10. Housing



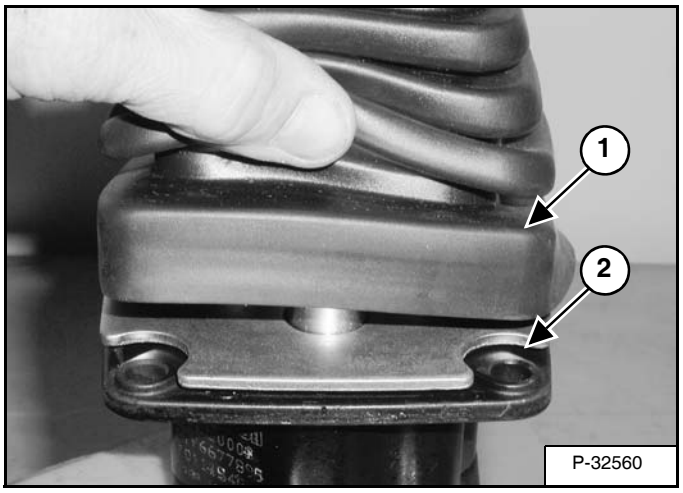
MS1353

Disassembly

Remove the right handle. (See Handle Removal And Installation on Page 20-110-3.)

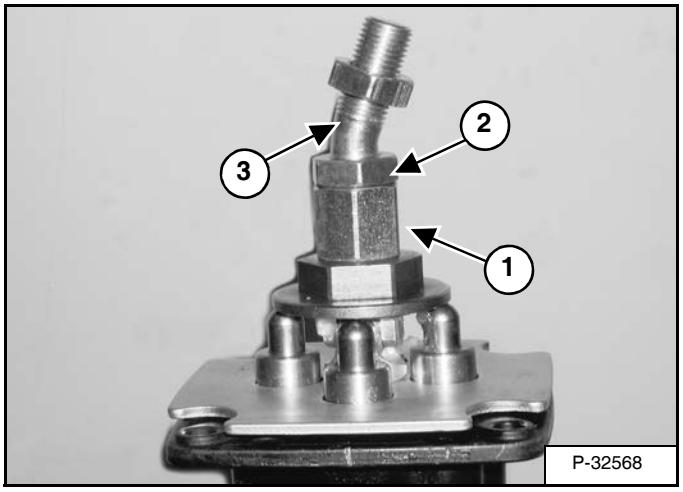
Clean the outside of the control lever before disassembly.

Figure 20-110-11



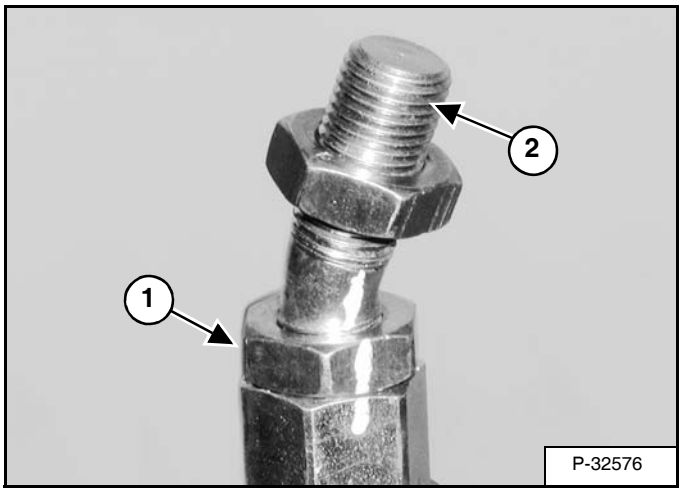
Remove the boot (Item 1) from the control lever (joystick) (Item 2) **[Figure 20-110-11]**.

Figure 20-110-12



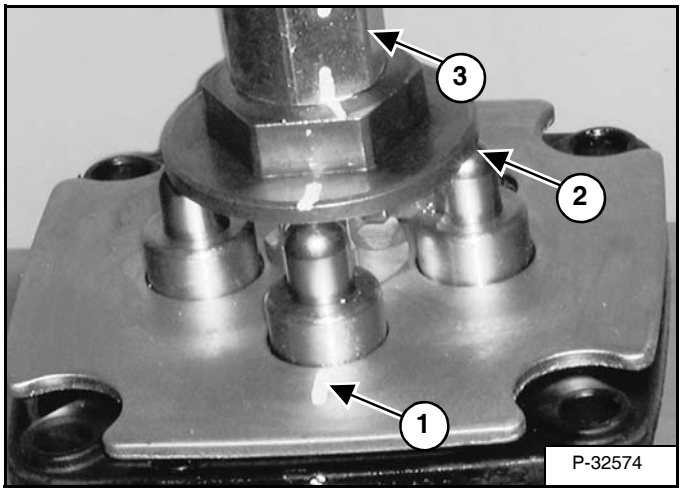
Mark the coupler (Item 1) nut (Item 2), and connector (Item 3) **[Figure 20-110-12]** for correct assembly.

Figure 20-110-13



Loosen the nut (Item 1) and remove the connector (Item 2) **[Figure 20-110-13]**.

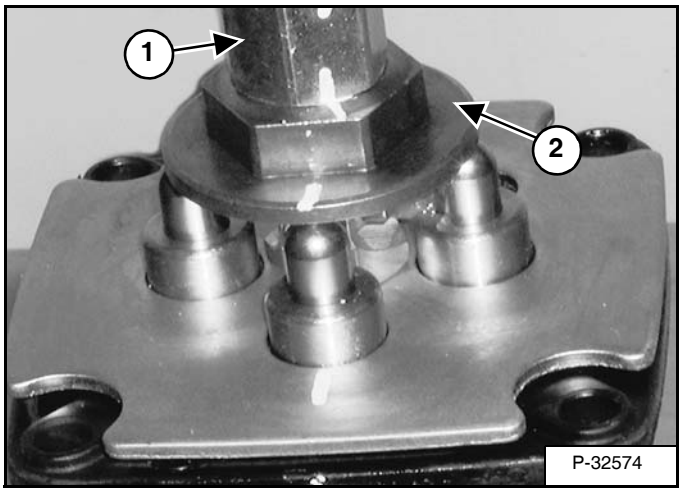
Figure 20-110-14



Mark the coupler (Item 1), control plate (Item 2), and plate (Item 3) **[Figure 20-110-14]** for correct installation.

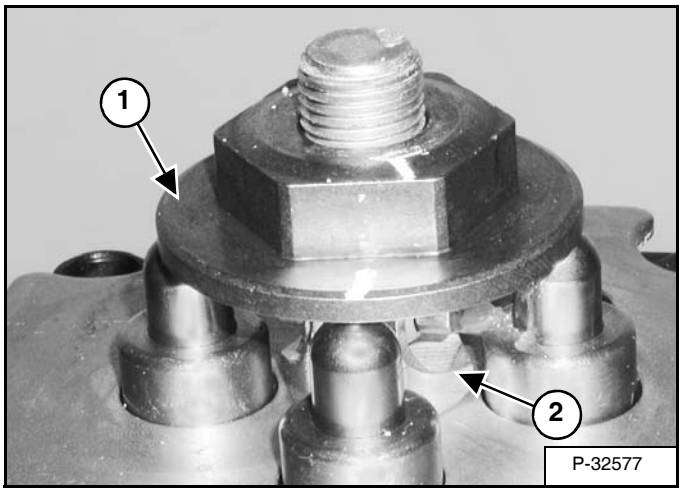
Disassembly (Cont'd)

Figure 20-110-15



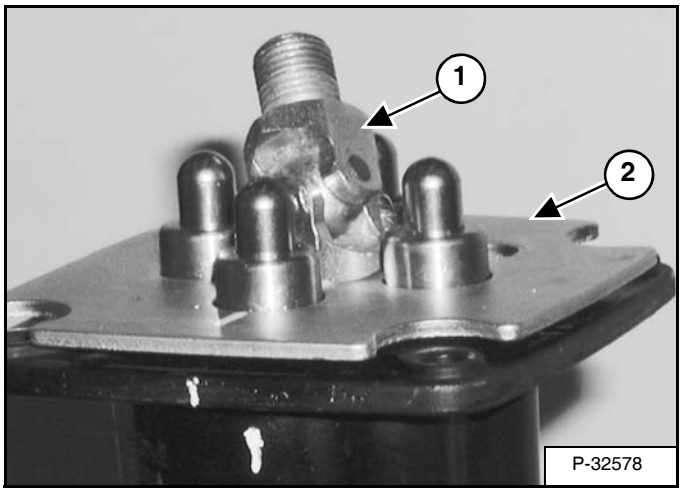
Remove the coupler (Item 1) from the control plate (Item 2) **[Figure 20-110-15]**.

Figure 20-110-16



Remove the control plate (Item 1) from the U-Joint (Item 2) **[Figure 20-110-16]**.

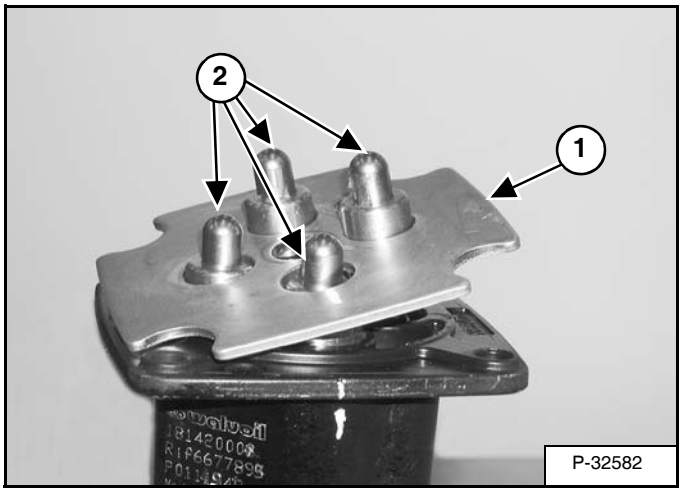
Figure 20-110-17



Mark the plate and housing for correct installation. Remove the U-joint (Item 1) **[Figure 20-110-17]**.

NOTE: The plate (Item 2) [Figure 20-110-17] is spring loaded and will come up as the U-joint is removed.

Figure 20-110-18

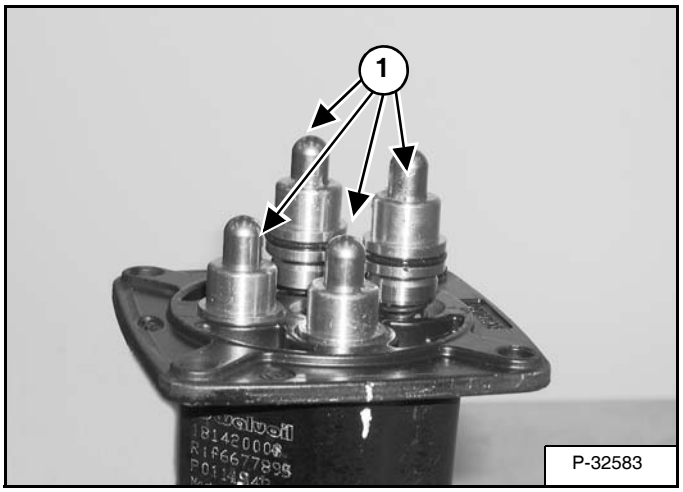


Remove the plate (Item 1) **[Figure 20-110-18]**.

NOTE: Use care while removing the plate. The plungers (Item 2) [Figure 20-110-18] are spring loaded.

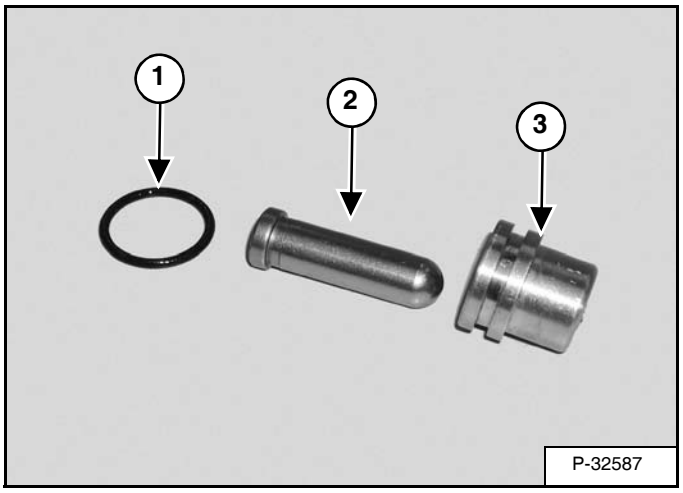
Disassembly (Cont'd)

Figure 20-110-19



Remove the plunger assemblies (Item 1) **[Figure 20-110-19]**.

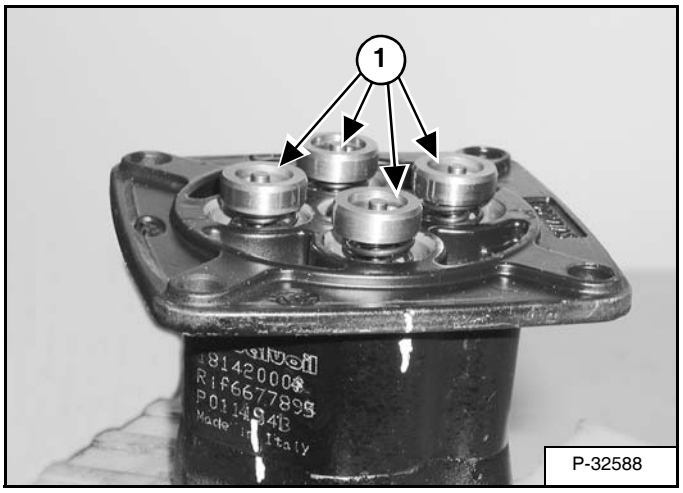
Figure 20-110-20



Remove the O-ring (Item 1) and plunger (Item 2) from the bushing (Item 3) **[Figure 20-110-20]**.

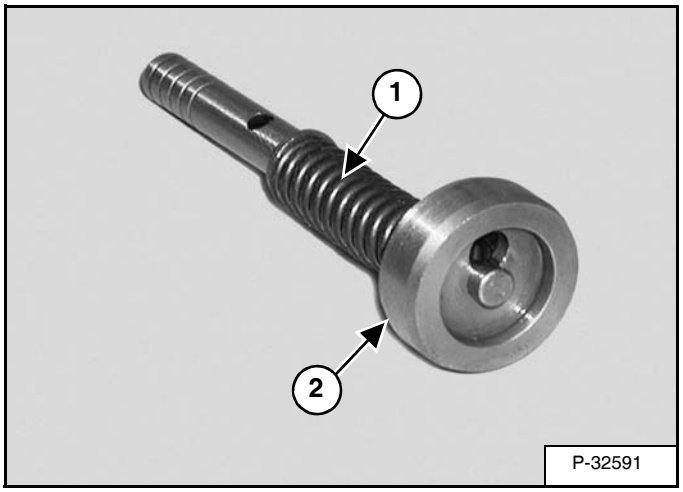
NOTE: Mark the spool assemblies for installation in their original location.

Figure 20-110-21



Remove the spool assemblies (Item 1) **[Figure 20-110-21]**.

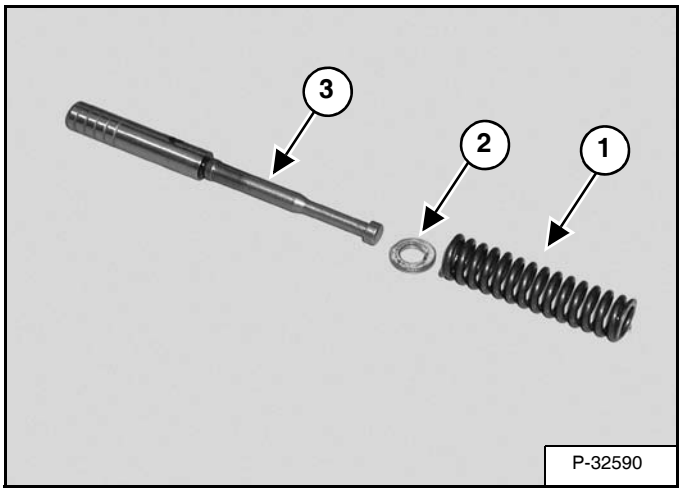
Figure 20-110-22



Compress the spring (Item 1) and remove the seat (Item 2) **[Figure 20-110-22]**.

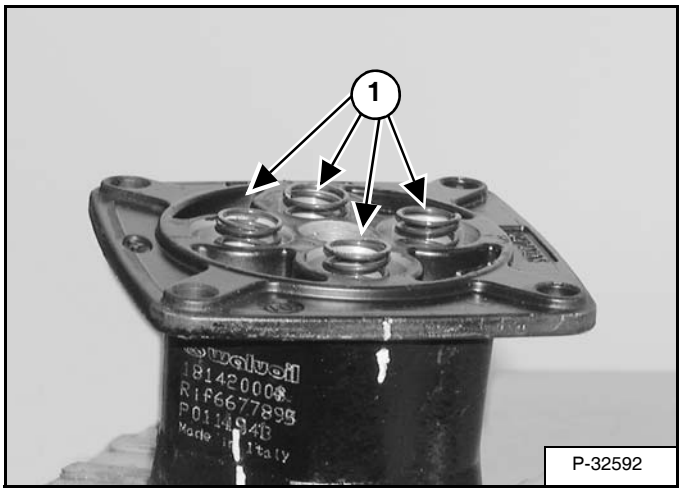
Disassembly (Cont'd)

Figure 20-110-23



Remove the spring (Item 1) and shim (Item 2) from the spool (Item 3) **[Figure 20-110-23]**.

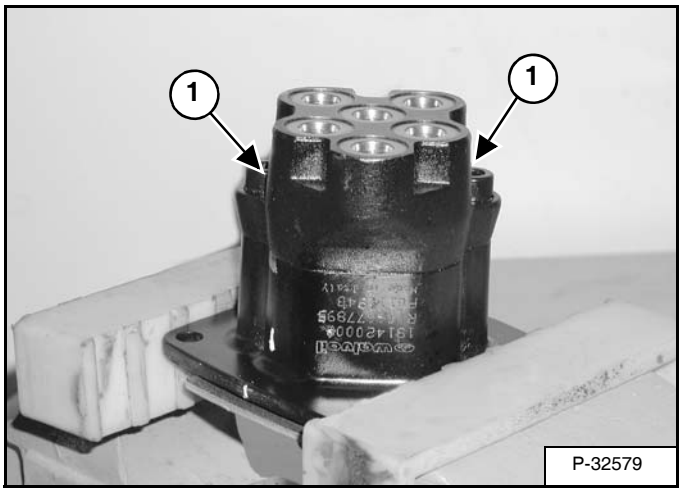
Figure 20-110-24



Remove the springs (Item 1) **[Figure 20-110-24]** from the housing.

Clamp the housing in a vise that is equipped with padded jaws.

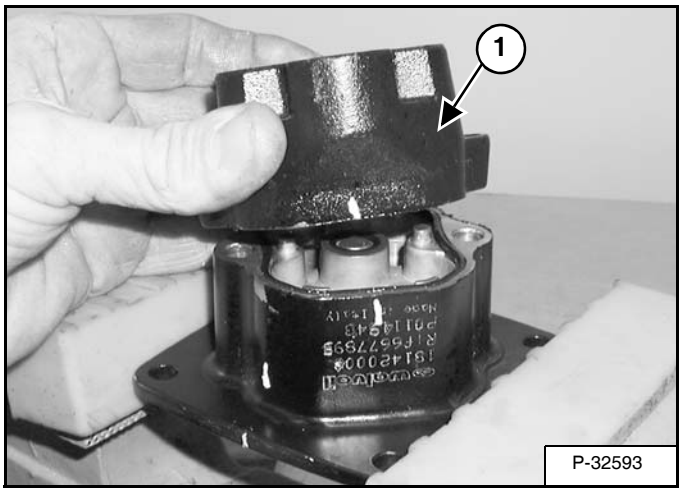
Figure 20-110-25



Remove the bolts (Item 1) **[Figure 20-110-25]**.

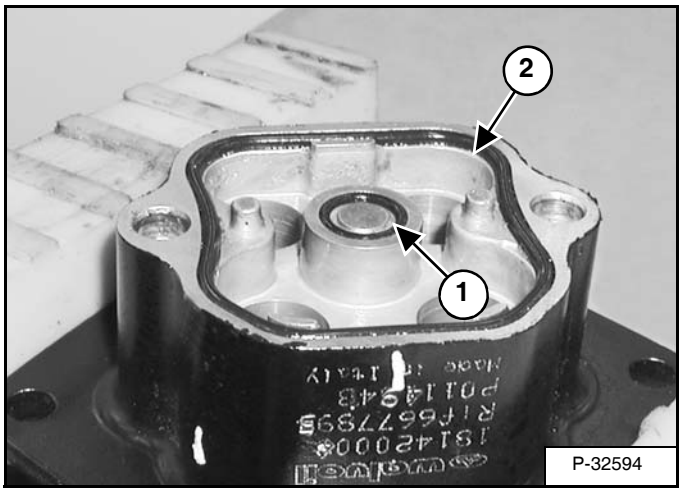
Disassembly (Cont'd)

Figure 20-110-26



Remove the end cap (Item 1) **[Figure 20-110-26]**.

Figure 20-110-27



Remove the O-ring (Item 1) and seal (Item 2) **[Figure 20-110-27]**.

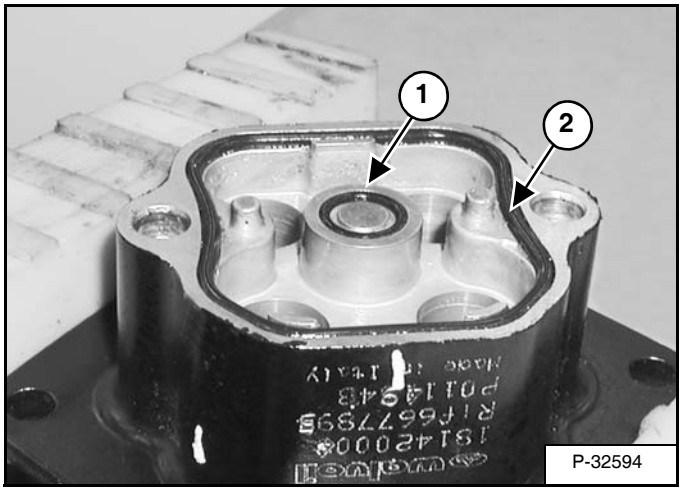
Assembly

Clean all parts in solvent and dry with compressed air.

Inspect all parts for wear or damage. Replace any worn or damaged parts.

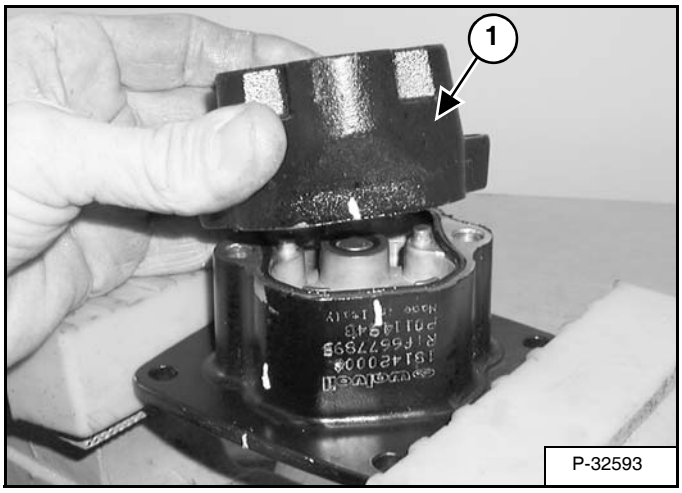
Always install new seals and O-rings. Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-110-28



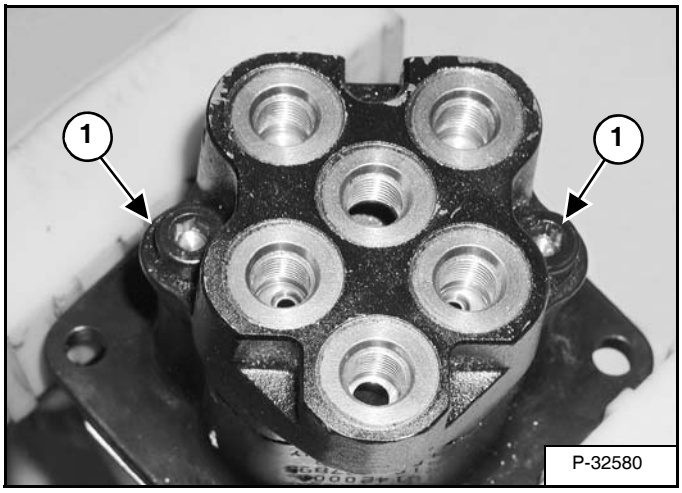
Clamp the housing in a vise equipped with padded jaws. Install the O-ring (Item 1) and seal (Item 2) **[Figure 20-110-28]**.

Figure 20-110-29



Install the end cap (Item 1) **[Figure 20-110-29]**.

Figure 20-110-30

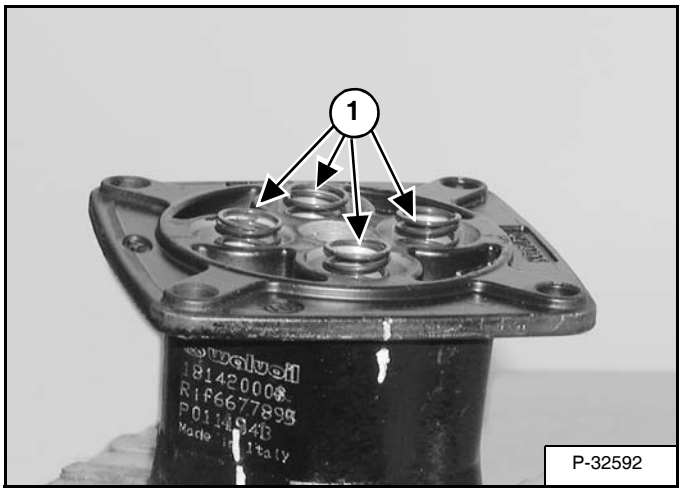


Install the bolts (Item 1) **[Figure 20-110-30]**.

Turn the housing over.

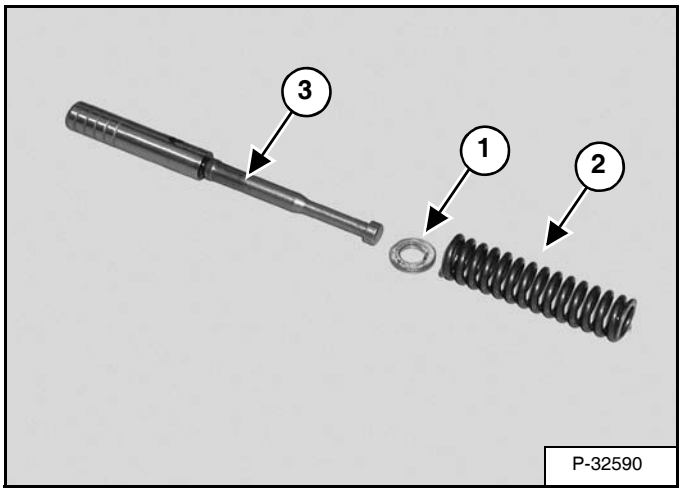
Assembly (Cont'd)

Figure 20-110-31



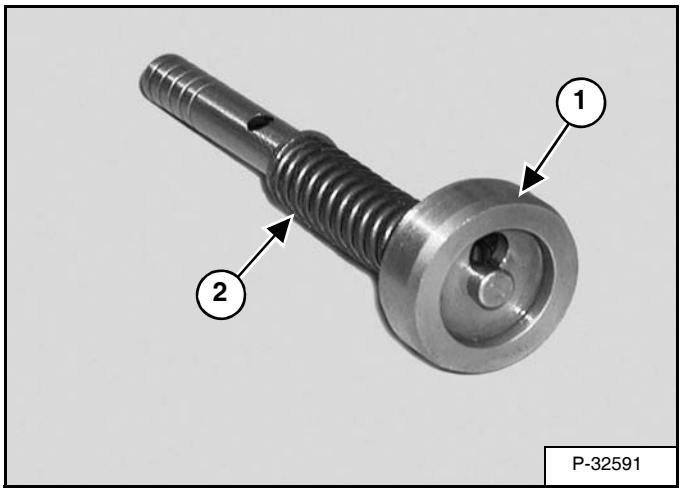
Install the springs (Item 1) **[Figure 20-110-31]**.

Figure 20-110-32



Install the shim (Item 1) and spring (Item 2) on the spool (Item 3) **[Figure 20-110-32]**.

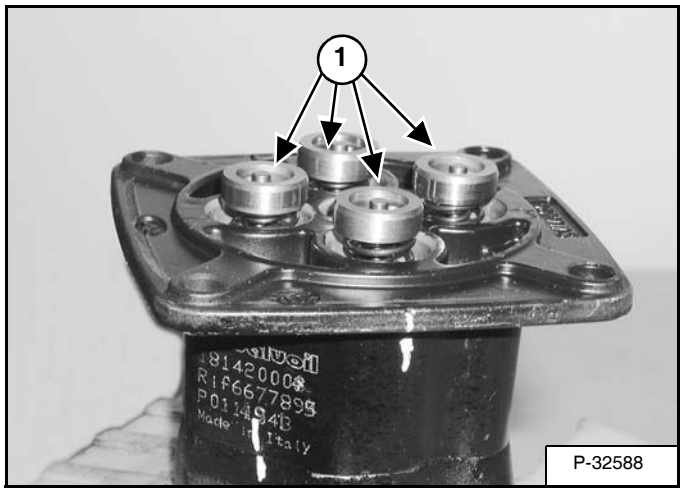
Figure 20-110-33



Compress the spring (Item 1) and install the spring seat (Item 2) **[Figure 20-110-33]**.

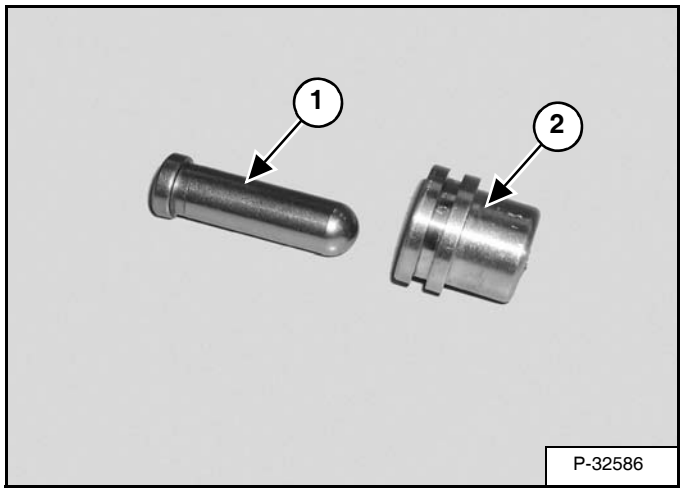
Assembly (Cont'd)

Figure 20-110-34



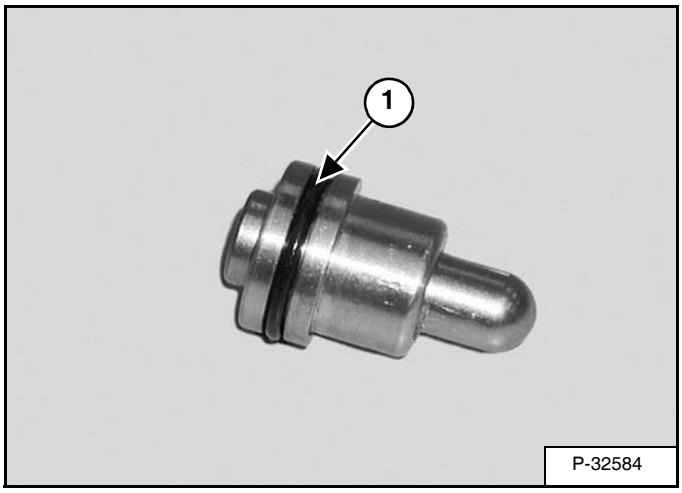
Install the spool assemblies (Item 1) **[Figure 20-110-34]** into the housing.

Figure 20-110-35



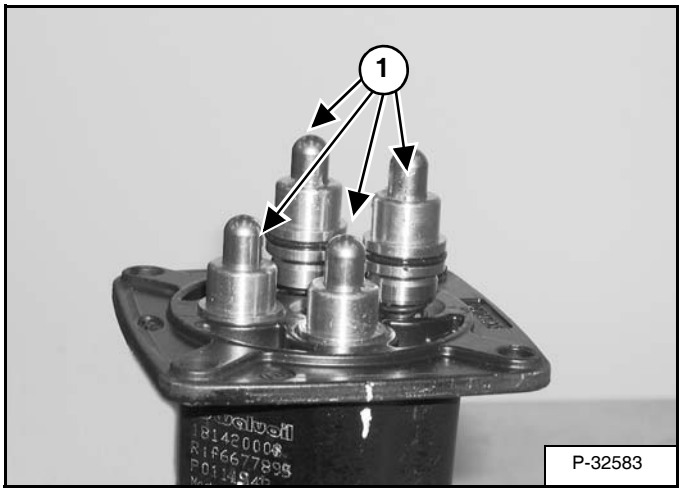
Install the plunger (Item 1) into the bushing (Item 2) **[Figure 20-110-35]**.

Figure 20-110-36



Install the O-ring (Item 1) **[Figure 20-110-36]** on the bushing.

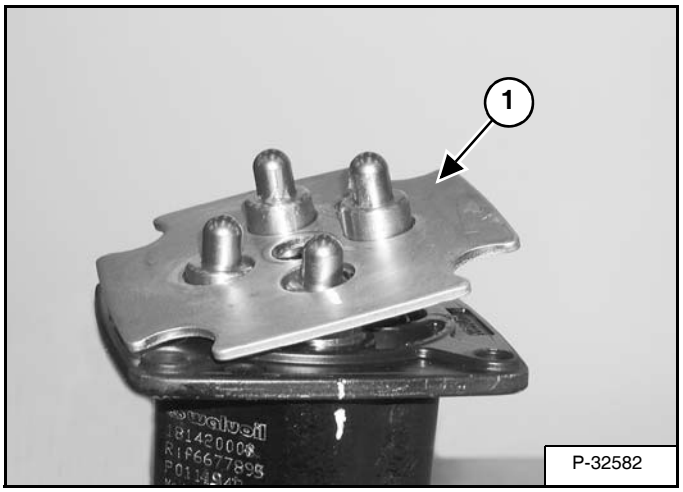
Figure 20-110-37



Install the plunger assemblies (Item 1) **[Figure 20-110-37]** into the housing.

Assembly (Cont'd)

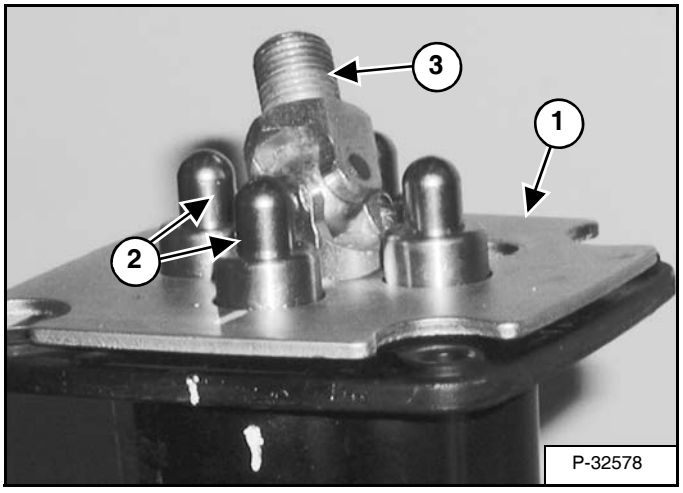
Figure 20-110-38



Install the plate (Item 1) **[Figure 20-110-38]**.

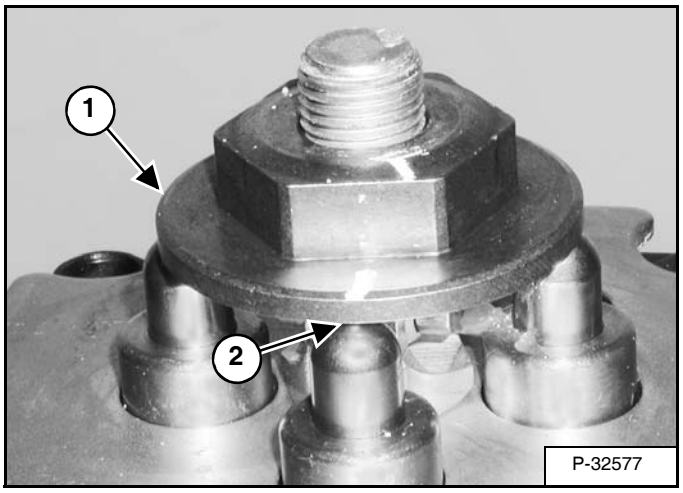
NOTE: Spring pressure can dislodge the plunger assemblies until the plate (Item 1) [Figure 20-110-38] is secured in place.

Figure 20-110-39



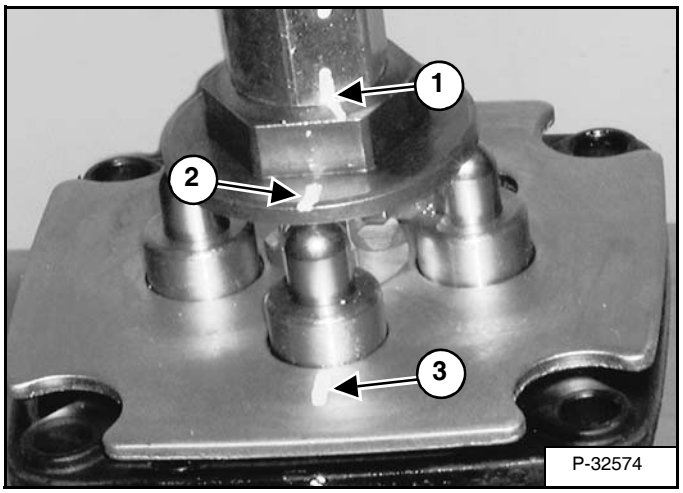
Press down on the plate (Item 1) to seat the plunger assemblies (Item 2). Install the U-joint (Item 3) **[Figure 20-110-39]**.

Figure 20-110-40



Install the control plate (Item 1) until the plate makes light contact with all four plungers (Item 2) **[Figure 20-110-40]**.

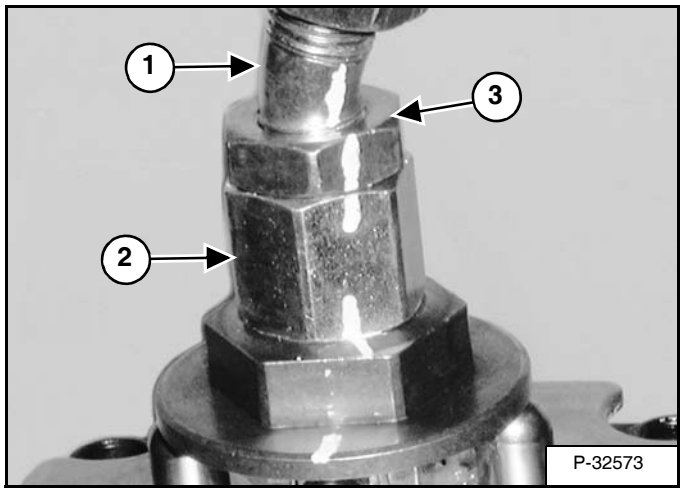
Figure 20-110-41



Align the coupler (Item 1) with the control plate (Item 2) and plate (Item 3) **[Figure 20-110-41]**. Tighten the coupler.

Assembly (Cont'd)

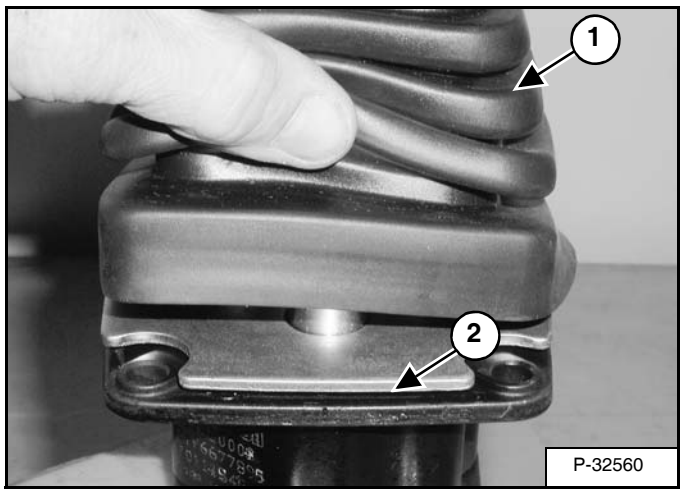
Figure 20-110-42



Install the connector (Item 1) **[Figure 20-110-42]**.

Align the connector with the coupler (Item 2) and tighten the nut (Item 3) **[Figure 20-110-42]**.

Figure 20-110-43



Install the tabs of the boot (Item 1) in between the joystick flange and mounting plate (Item 2) **[Figure 20-110-43]**.

Install the handle. (See Handle Removal And Installation on Page 20-110-3.)


Bobcat®

LEFT CONTROL LEVER (JOYSTICK)

Testing

Check the pressure reducing valve for the correct pressure. (See Testing And Adjusting The Pressure Reducing Valve on Page 20-33-1.)

The following tools will be needed to do the procedure:

MEL1355 - Hydraulic Test Kit

Lower the boom/bucket and blade to the ground.

Stop the engine.

Relieve hydraulic pressure.

⚠ WARNING

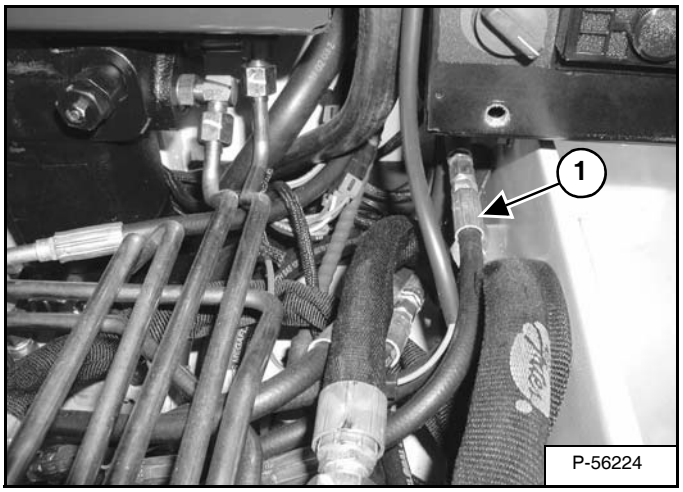
Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

W-2145-0290

Open the tailgate.

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

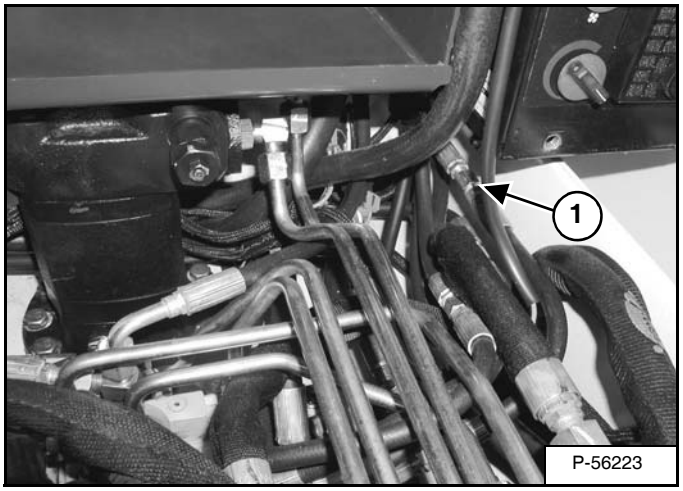
Figure 20-113-1



At the control valve assembly, find the pilot line (Item 1) **[Figure 20-113-1]** of the control lever (joystick) that is to be checked. Arm, Bucket, Boom, and Swing (slew).

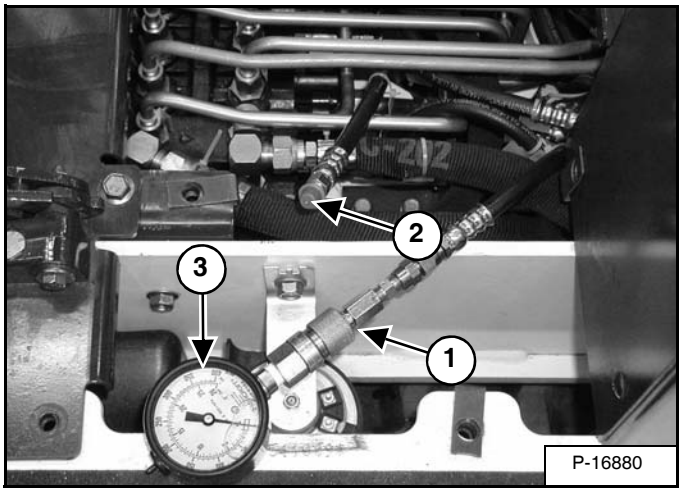
NOTE: These four valves (Arm, Bucket, Boom & Swing (Slew) have short extension hoses with connectors for fast valve removal and testing.

Figure 20-113-2



Disconnect the hydraulic hose (Item 1) **[Figure 20-113-2]** from the short control valve extension hose.

Figure 20-113-3



From the test kit, install a hydraulic fitting and test port (Item 1) **[Figure 20-113-3]** to the control lever (joystick) hydraulic hose.

Cap the short control valve extension hose (Item 2) **[Figure 20-113-3]**.

Install a 1000 PSI (69 Bar) gauge and female coupler (Item 3) **[Figure 20-113-3]** on the test port.

Start the engine and warm the hydraulic oil to operating temperature 150°F (66°C).

Testing (Cont'd)

Check the gauge with the control levers (joystick) in neutral. The hydraulic pressure should be 0 psi (0 Bar).

Engage the circuit to be tested. Record the operating pressure.

The operating pressure should be as follows:

435 PSI (300 Bar) with an acceptable range of (406-450 PSI (28-31 Bar).

If the operating pressure is correct, check the valve section spool for proper operation.

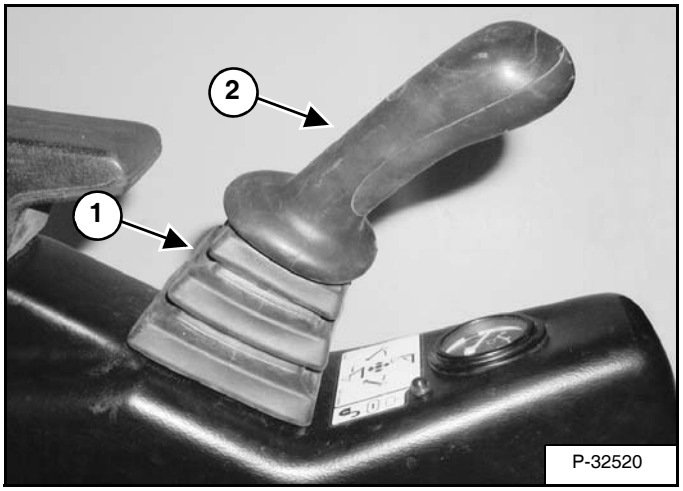
If the operating pressure is incorrect, remove the pressure reducing valve, clean, install and retest. (See Testing And Adjusting The Pressure Reducing Valve on Page 20-33-1.)

If the pressure is still incorrect replace the pressure reducing valve. (See Testing And Adjusting The Pressure Reducing Valve on Page 20-33-1.)

Handle Removal And Installation

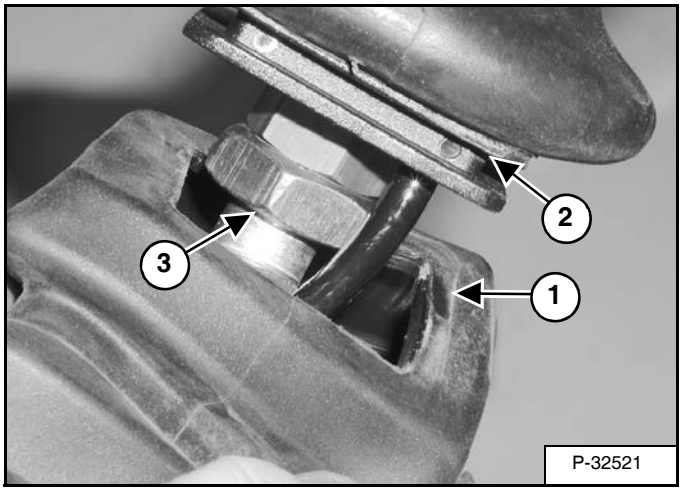
Remove the horn switch connector. (See Removal and Installation on Page 40-140-1.)

Figure 20-113-4



Remove the dust boot (Item 1) from the handle (Item 2) **[Figure 20-113-4]**.

Figure 20-113-5

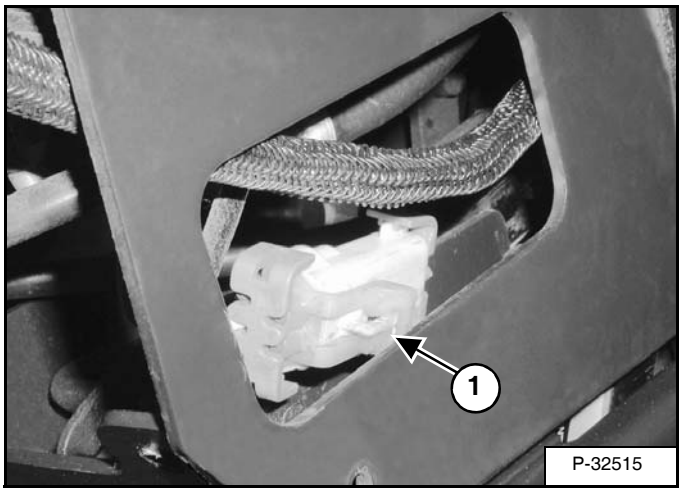


Installation: Align the top of the dust boot (Item 1) with the groove (Item 2) **[Figure 20-113-5]**.

Hold the dust boot (Item 1) down and loosen the nut (Item 3) **[Figure 20-113-5]**.

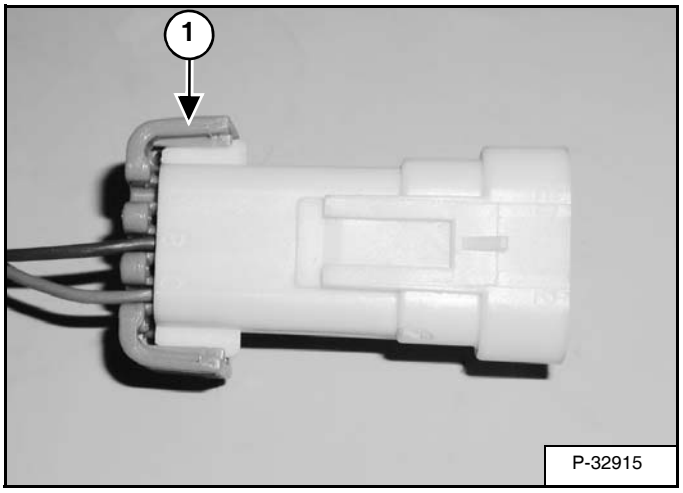
Remove the console cover. (See Console Cover Removal And Installation on Page 40-60-1.)

Figure 20-113-6



Disconnect the wire harness (Item 1) **[Figure 20-113-6]**.

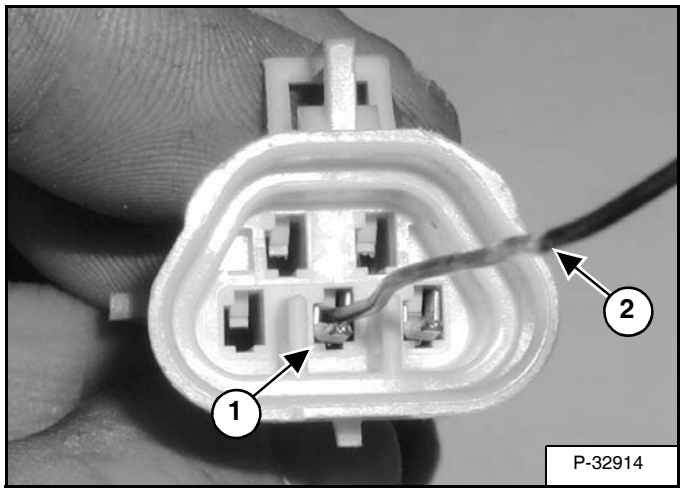
Figure 20-113-7



Remove the lock (Item 1) **[Figure 20-113-7]** from the electrical connector.

Handle Removal And Installation (Cont'd)

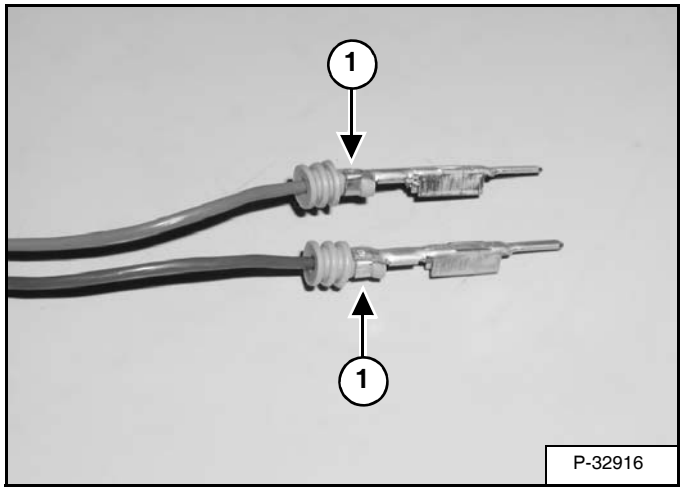
Figure 20-113-8



With a small piece of wire, depress the wire terminal tabs (Item 1) **[Figure 20-113-8]**.

Remove the individual wires from the back of the electrical connector.

Figure 20-113-9



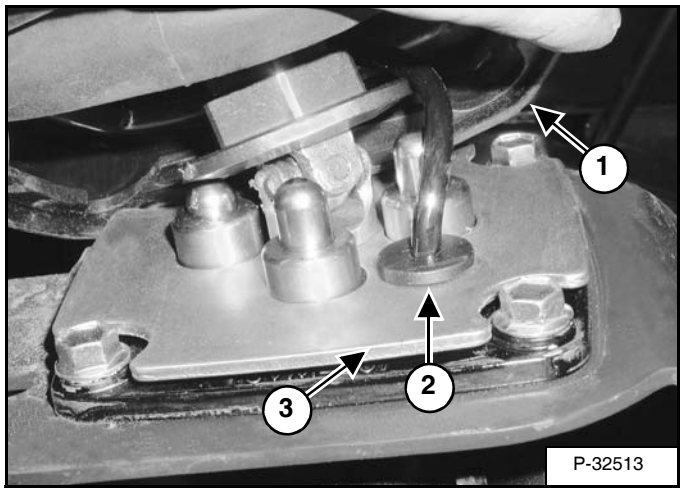
Installation: Use a small piece of wire and rebend the tab (Item 1) **[Figure 20-113-9]** on each wire before installing in the electrical connector.

Installation: The wires must be installed in the proper locations in the wire connector, listed below.

C Red
D Black

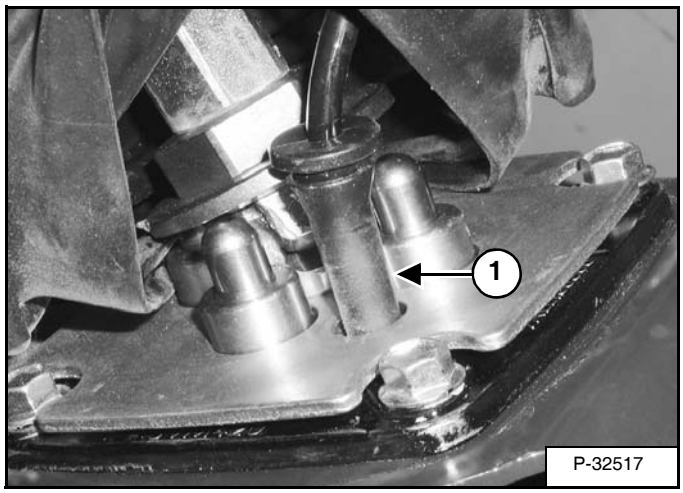
Check each wire to be certain the tab locks into position.

Figure 20-113-10



Raise the dust boot (Item 1) and pull the grommet (Item 2) up through the mount plate (Item 3) **[Figure 20-113-10]**.

Figure 20-113-11



Remove the grommet and wire (Item 1) **[Figure 20-113-11]** from the mount plate and remove the handle.

Removal And Installation

Lower the boom/bucket and blade to the ground.

Stop the engine.

Relieve hydraulic pressure.

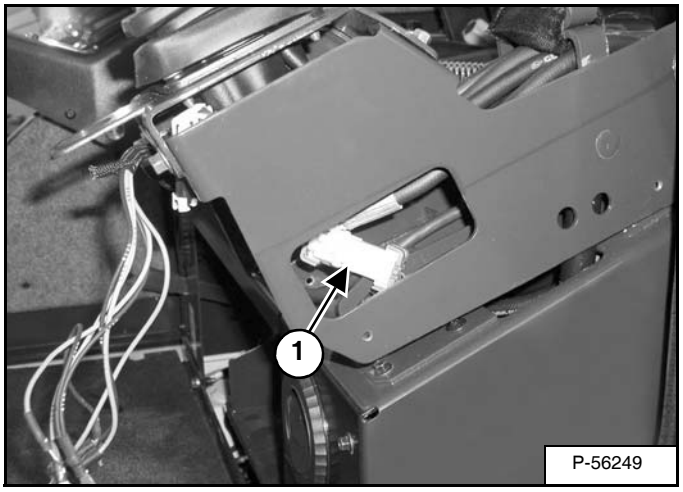
Remove the console cover. (See Console Cover Removal And Installation on Page 40-60-1)

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

Figure 20-113-12



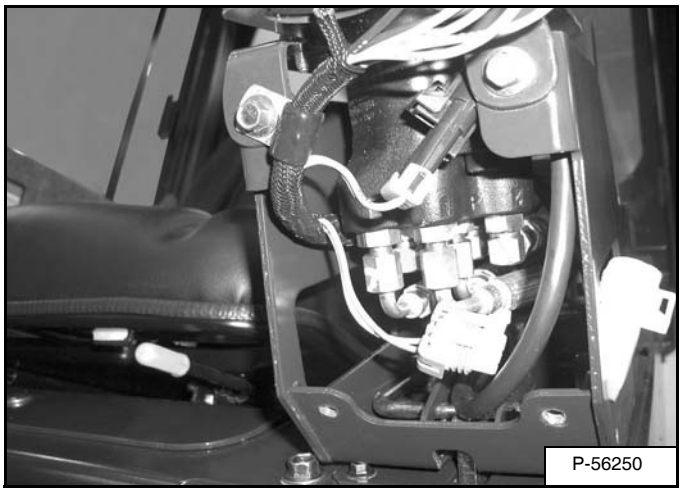
Disconnect the wire connector (Item 1) **[Figure 20-113-12]**.

⚠ WARNING

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin. This can cause serious injury and possible death if proper medical treatment by a physician familiar with this injury is not received immediately.

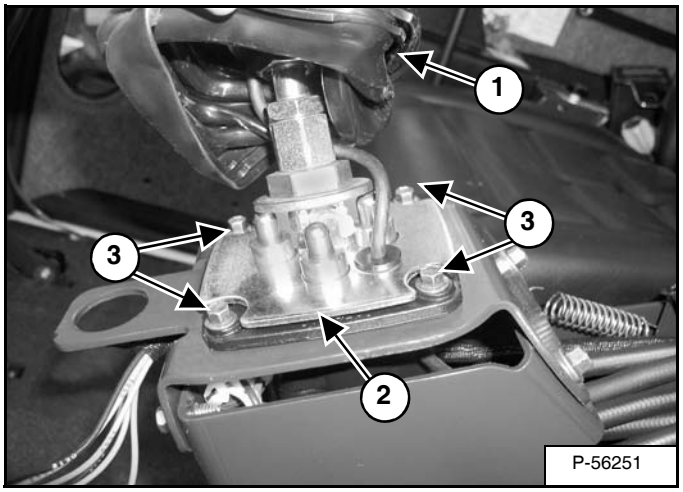
W-2145-0290

Figure 20-113-13



Mark the hoses for ease of assembly. Remove the six hoses from the housing **[Figure 20-113-13]**.

Figure 20-113-14



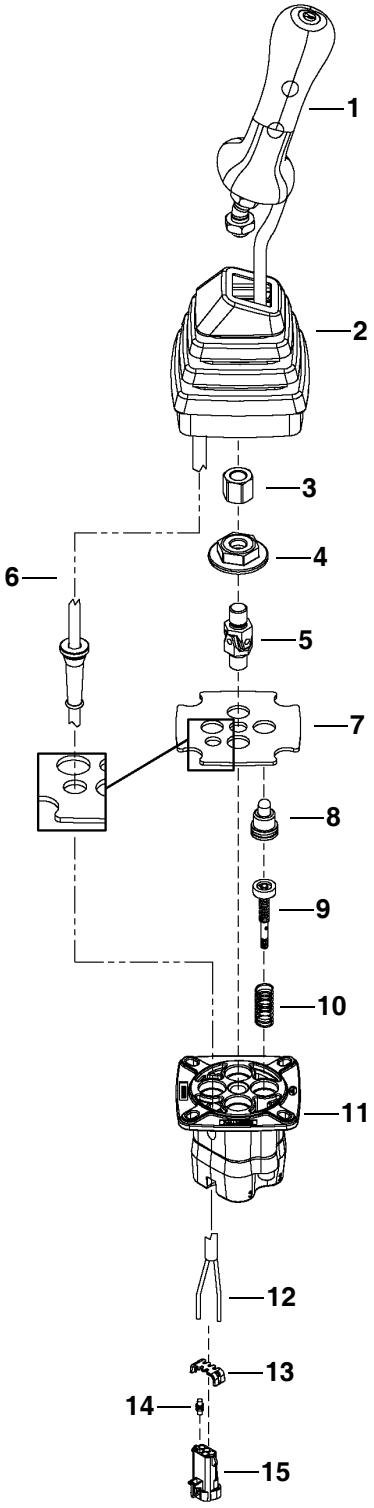
Raise the dust boot (Item 1) up from the plate (Item 2) **[Figure 20-113-14]**.

Remove the bolts (Item 3) **[Figure 20-113-14]** from the joystick plate.

Remove the joystick.

Parts Identification

1. Handle
2. Dust Boot
3. Coupler
4. Actuator Control Plate
5. U-Joint
6. Grommet
7. Plate
8. Plunger Assembly
9. Spool
10. Spring
11. Housing
12. Wire Harness
13. Lock
14. Pin
15. Connector



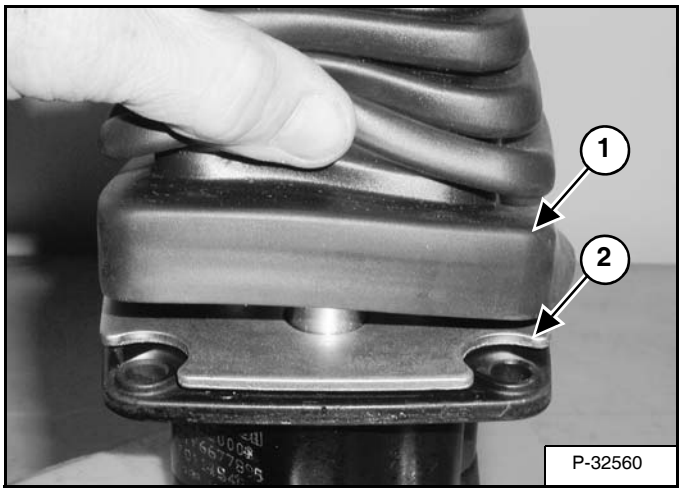
MS-1354

Disassembly

Remove the handle. See Handle Removal And Installation on Page 20-111-3

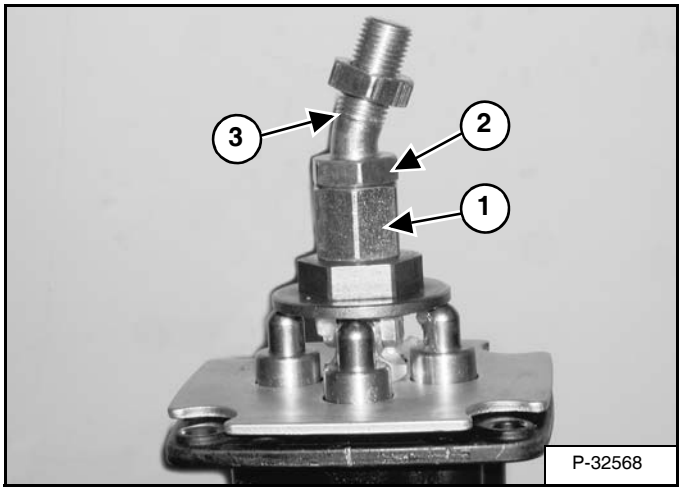
Clean the outside of the control lever before disassembly.

Figure 20-111-15



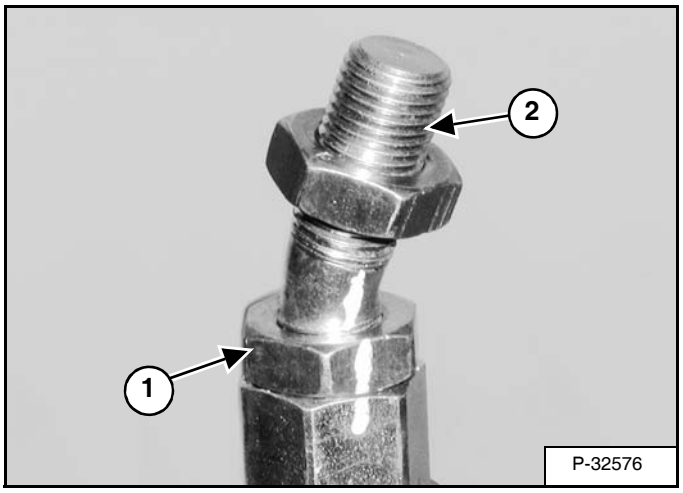
Remove the boot (Item 1) from the control lever (joystick) (Item 2) **[Figure 20-111-15]**.

Figure 20-111-16



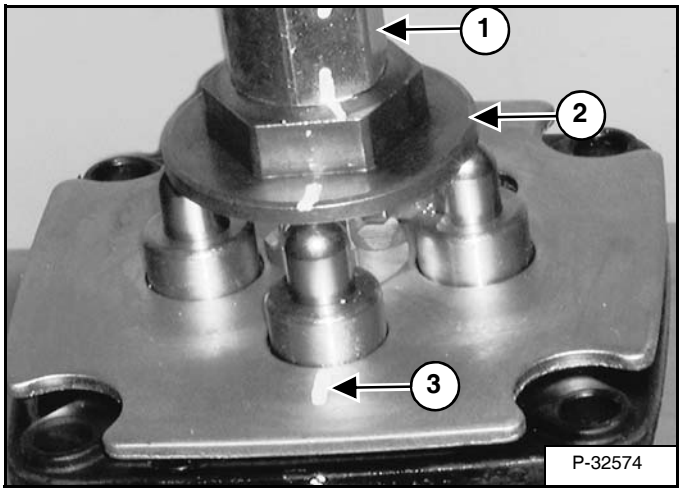
Mark the coupler (Item 1), nut (Item 2), and connector (Item 3) **[Figure 20-111-16]** for correct assembly.

Figure 20-111-17



Loosen the nut (Item 1) and remove the connector (Item 2) **[Figure 20-111-17]**.

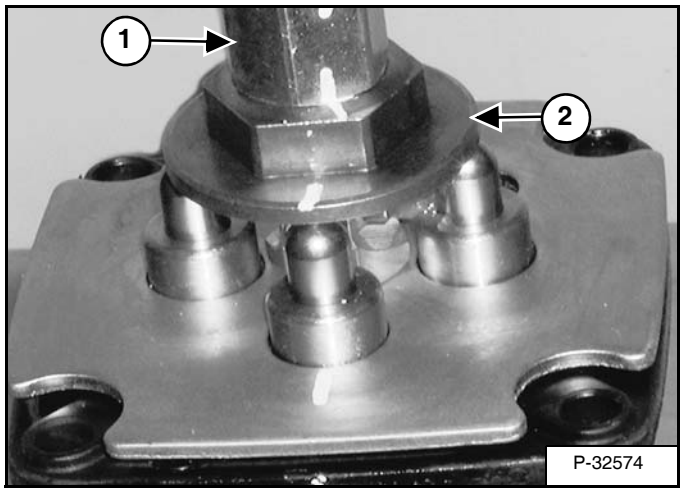
Figure 20-111-18



Mark the coupler (Item 1), control plate (Item 2), and plate (Item 3) **[Figure 20-111-18]** for correct installation.

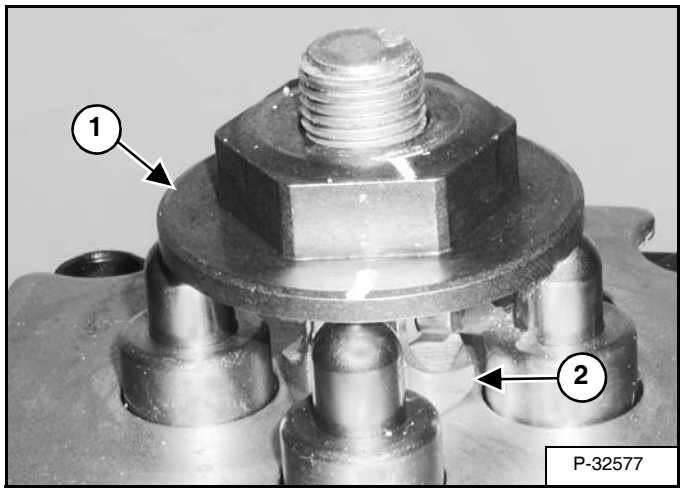
Disassembly (Cont'd)

Figure 20-111-19



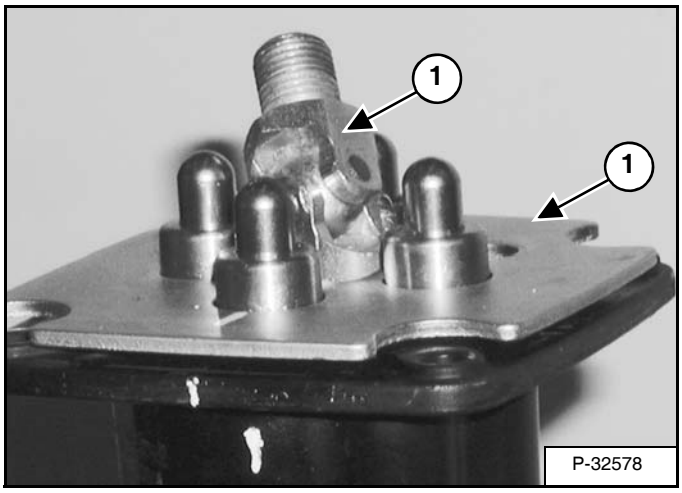
Remove the coupler (Item 1) from the control plate (Item 2) **[Figure 20-111-19]**.

Figure 20-111-20



Remove the control plate (Item 1) from the U-joint (Item 2) **[Figure 20-111-20]**.

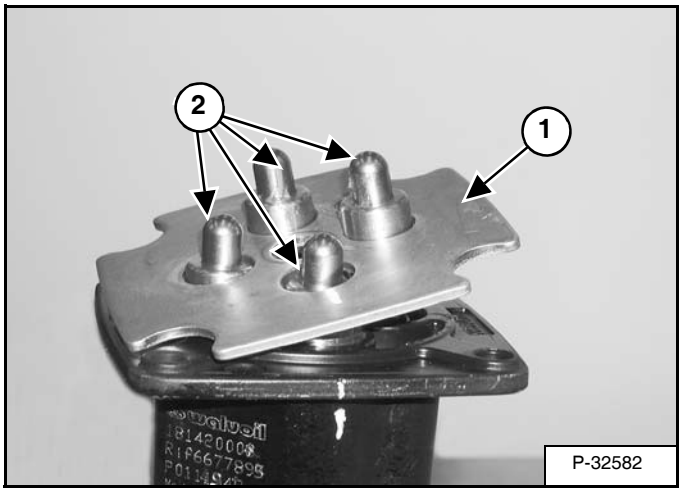
Figure 20-111-21



Mark the plate and housing for correct installation. Remove the U-joint (Item 1) **[Figure 20-111-21]**.

NOTE: The plate (Item 2) [Figure 20-111-21] is spring loaded and will come up as the U-joint is removed.

Figure 20-111-22

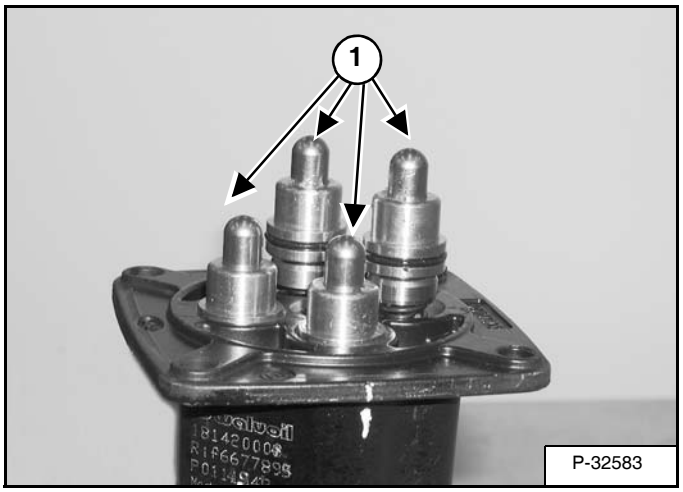


Remove the plate (Item 1) **[Figure 20-111-22]**.

NOTE: Use care while removing the plate. The plungers (Item 2) [Figure 20-111-22] are spring loaded.

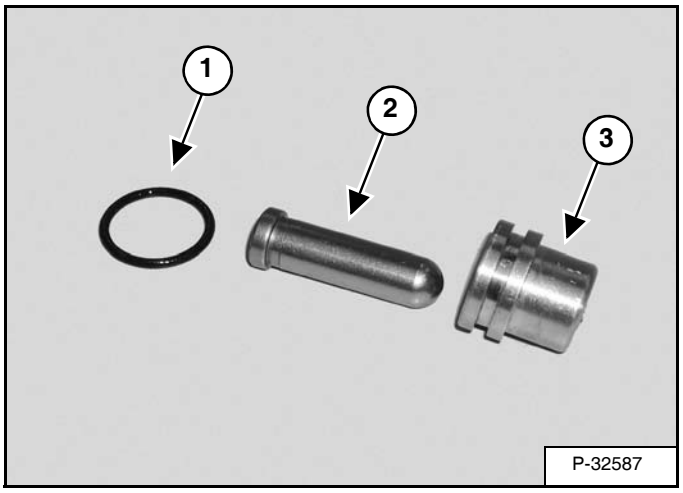
Disassembly (Cont'd)

Figure 20-111-23



Remove the plunger assemblies (Item 1) **[Figure 20-111-23]**.

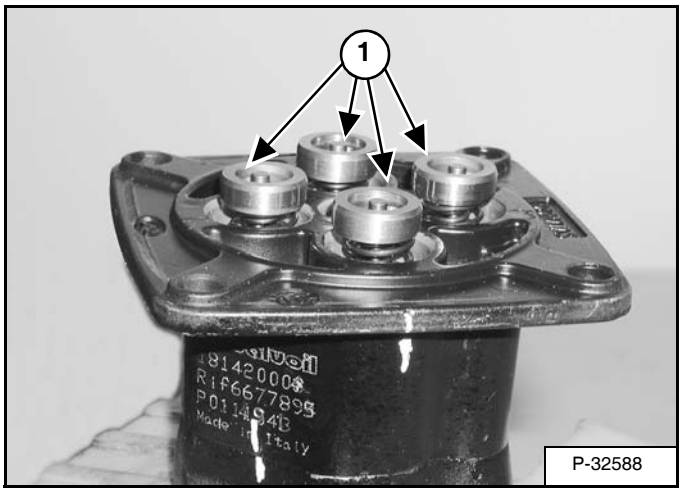
Figure 20-111-24



Remove the O-ring (Item 1) and plunger (Item 2) from the bushing (Item 3) **[Figure 20-111-24]**.

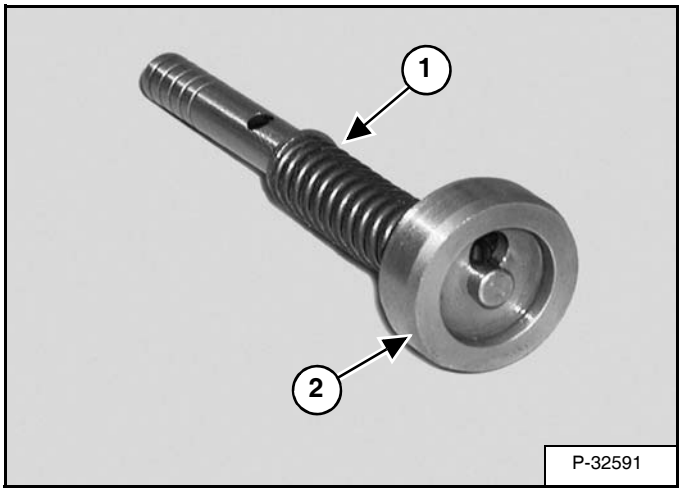
NOTE: Mark the spool assemblies for installation in their original location.

Figure 20-111-25



Remove the spool assemblies (Item 1) **[Figure 20-111-25]**.

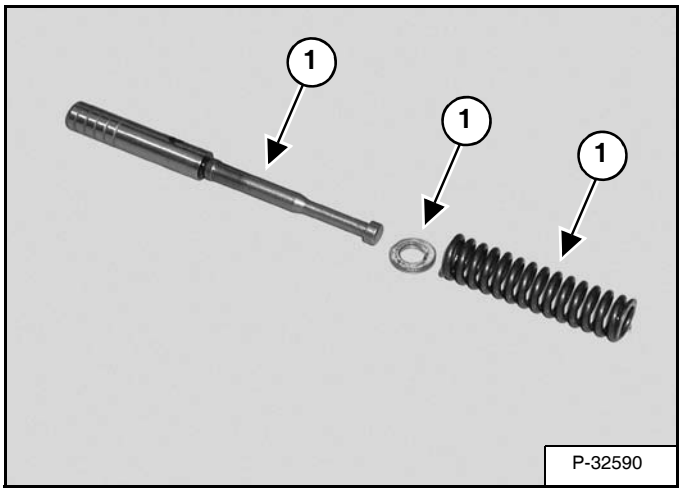
Figure 20-111-26



Compress the spring (Item 1) and remove the seat (Item 2) **[Figure 20-111-26]**.

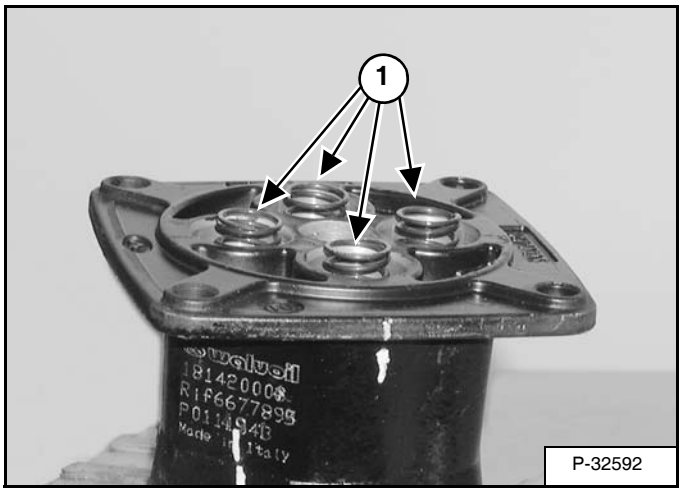
Disassembly (Cont'd)

Figure 20-111-27



Remove the spring (Item 1) and shim (Item 2) from the spool (Item 3) **[Figure 20-111-27]**.

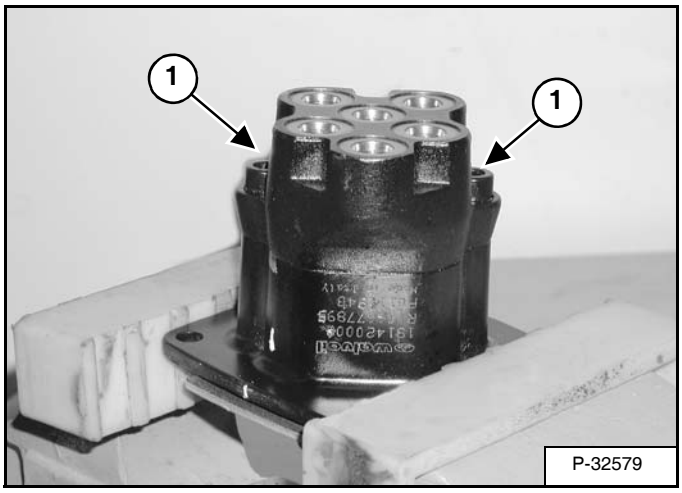
Figure 20-111-28



Remove the springs (Item 1) **[Figure 20-111-28]** from the housing.

Clamp the housing in a vise equipped with padded jaws.

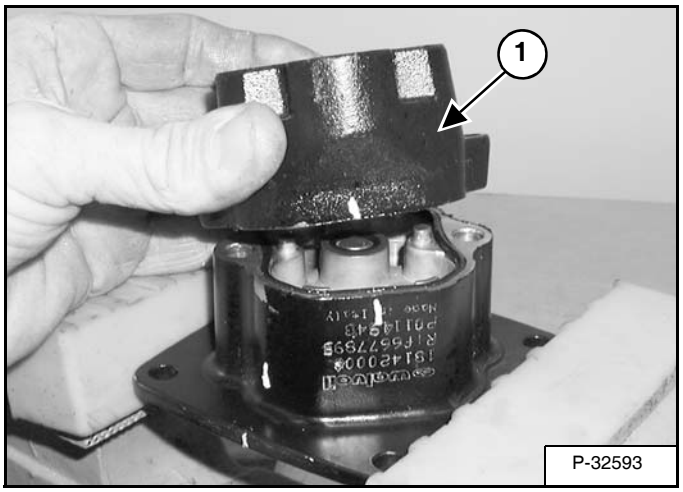
Figure 20-113-29



Remove the bolts (Item 1) **[Figure 20-113-29]**.

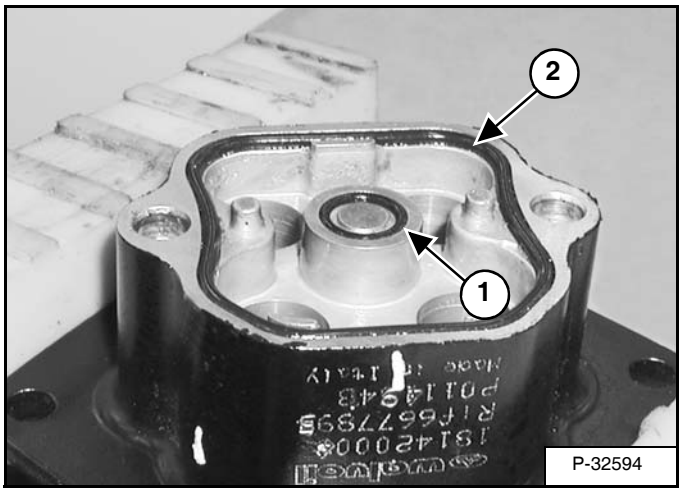
Disassembly (Cont'd)

Figure 20-111-30



Remove the end cap (Item 1) **[Figure 20-111-30]**

Figure 20-113-31



Remove the O-ring (Item 1) and seal (Item 2) **[Figure 20-113-31]**.

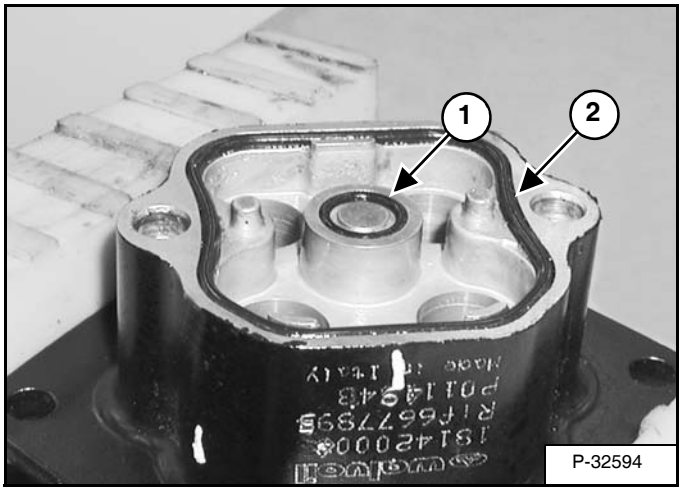
Assembly

Clean all parts in solvent and dry with compressed air. Inspect all parts for wear or damage. Replace any worn or damaged parts.

Always install new seals and o-rings.

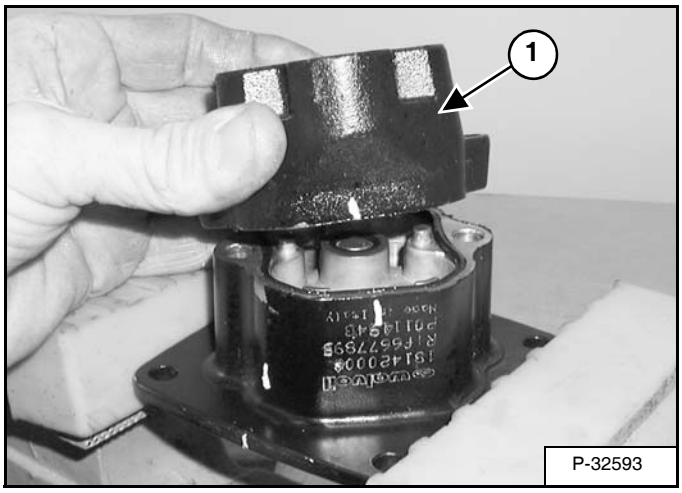
Lubricate all seals and O-rings with clean hydraulic fluid before installation.

Figure 20-113-32



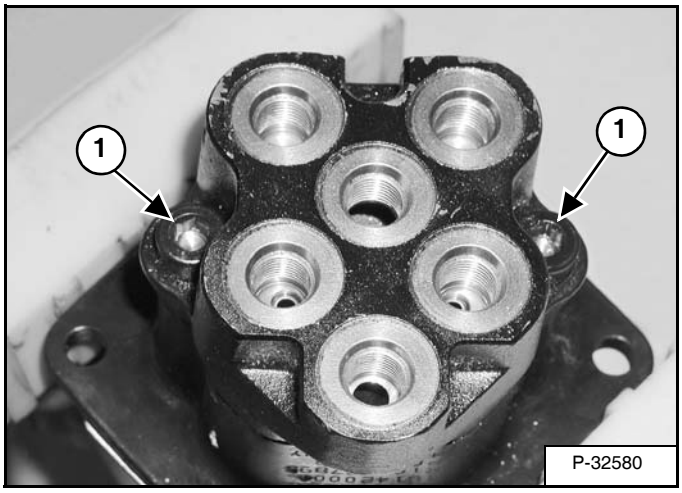
Clamp the housing in a vise equipped with padded jaws. Install the O-ring (Item 1) and seal (Item 2) **[Figure 20-113-32]**.

Figure 20-111-33



Install the end cap (Item 1) **[Figure 20-111-33]**.

Figure 20-111-34

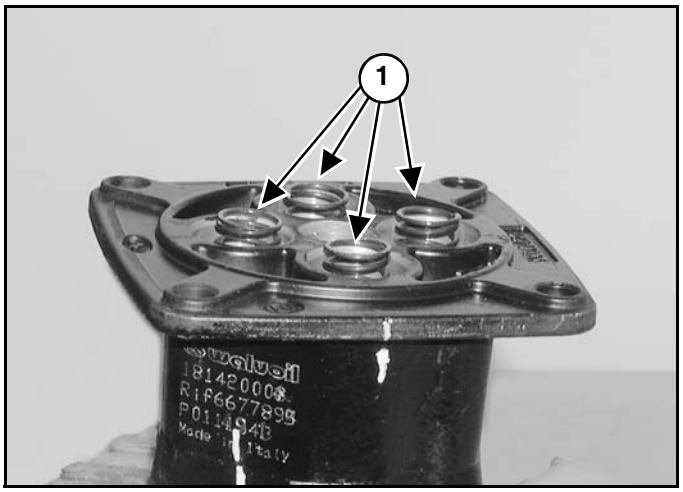


Install the bolts (Item 1) **[Figure 20-111-34]**.

Turn the housing over.

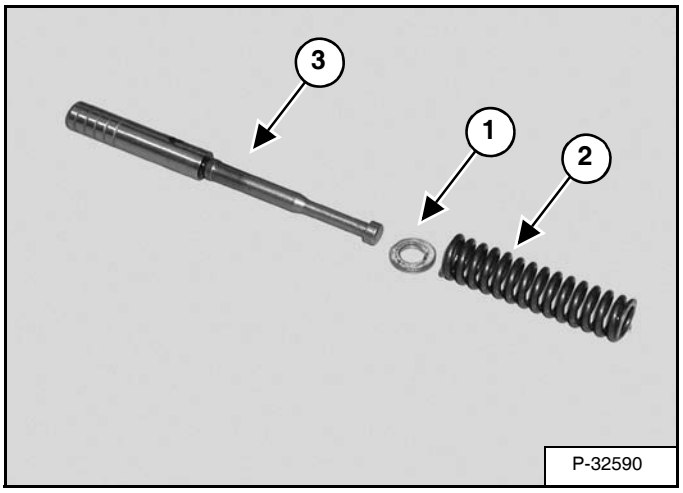
Assembly (Cont'd)

Figure 20-111-35



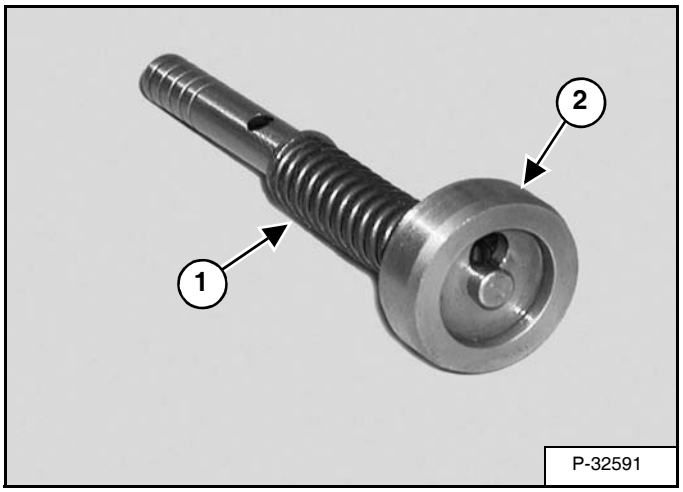
Install the springs (Item 1) **[Figure 20-111-35]**.

Figure 20-111-36



Install the shim (Item 1) and spring (Item 2) on the spool (Item 3) **[Figure 20-111-36]**.

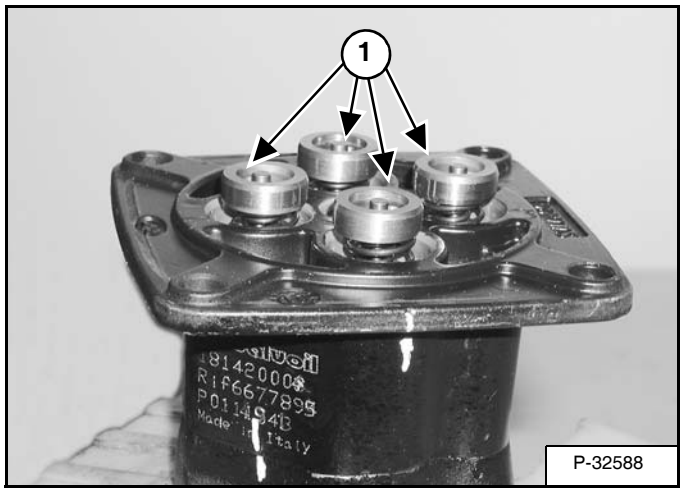
Figure 20-111-37



Compress the spring (Item 1) and install the spring seat (Item 2) **[Figure 20-111-37]**.

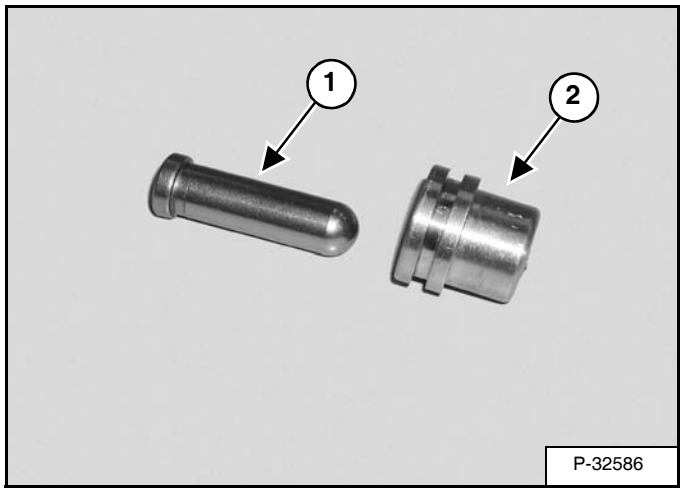
Assembly (Cont'd)

Figure 20-111-38



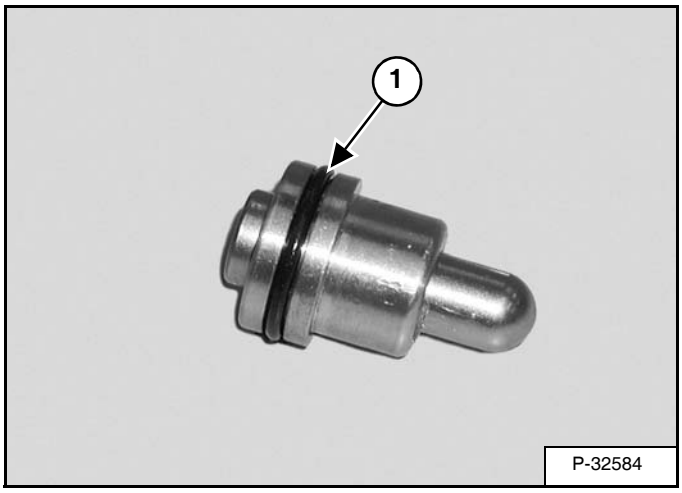
Install the spool assemblies (Item 1) **[Figure 20-111-38]** into the housing.

Figure 20-111-39



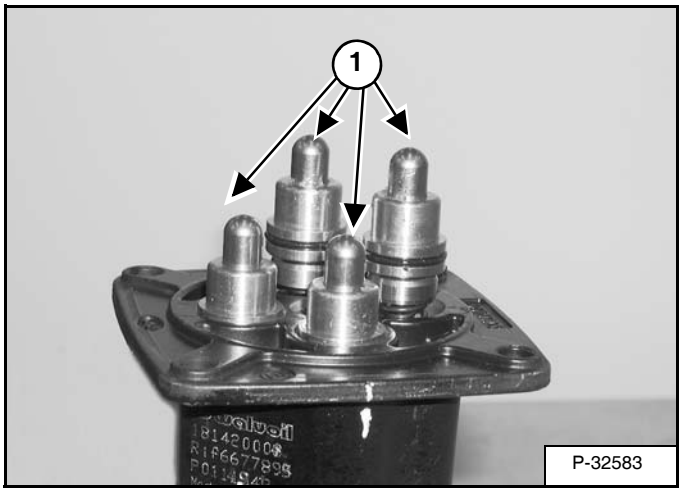
Install the plunger (Item 1) into the bushing (Item 2) **[Figure 20-111-39]**.

Figure 20-111-40



Install the O-ring (Item 1) **[Figure 20-111-40]** on the bushing.

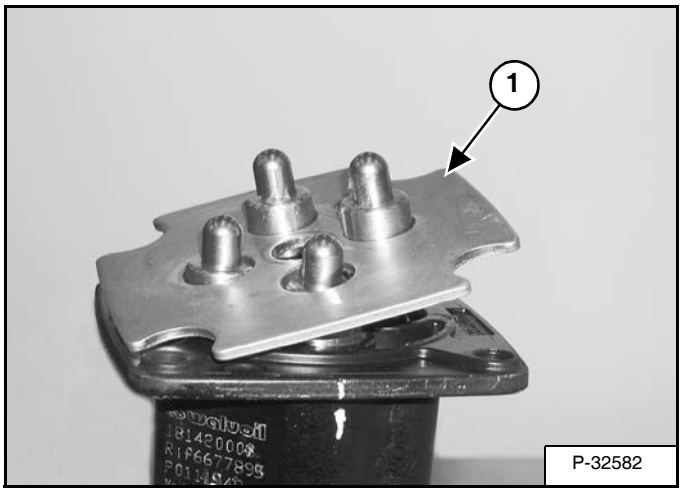
Figure 20-111-41



Install the plunger assemblies (Item 1) **[Figure 20-111-41]** into the housing.

Assembly (Cont'd)

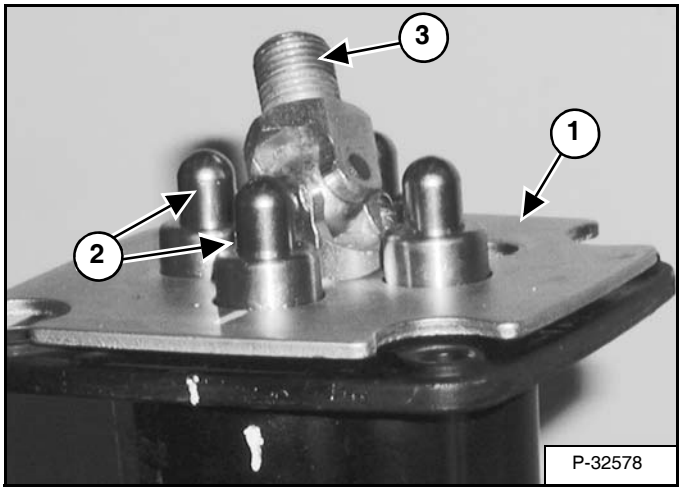
Figure 20-111-42



Install the plate (Item 1) **[Figure 20-111-42]**.

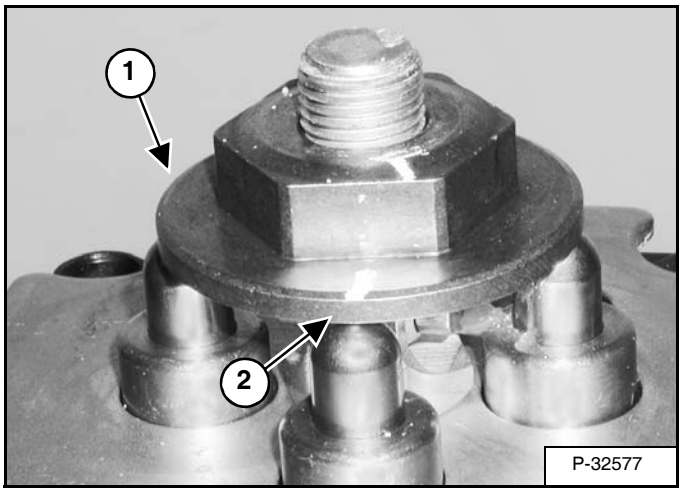
NOTE: Spring pressure can dislodge the plunger assemblies until the plate (Item 1) [Figure 20-111-42] is secured in place.

Figure 20-111-43



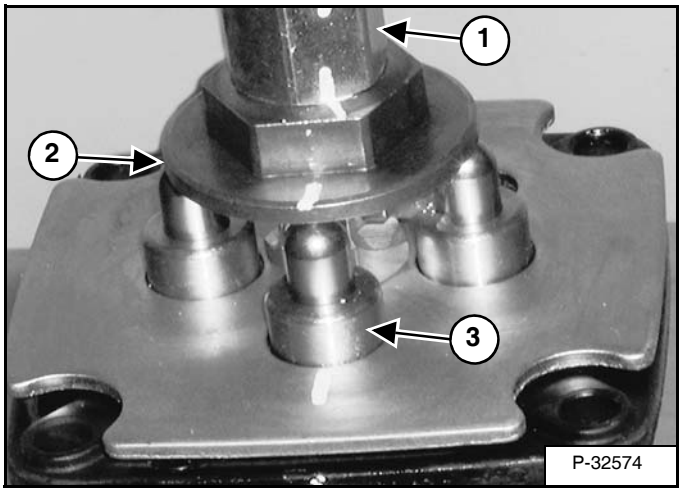
Press down on the plate (Item 1) to seat the four plunger assemblies (Item 2). Install the U-joint (Item 3) **[Figure 20-111-43]**.

Figure 20-111-44



Install the control plate (Item 1) until the plate makes light contact with all four plungers (Item 2) **[Figure 20-111-44]**.

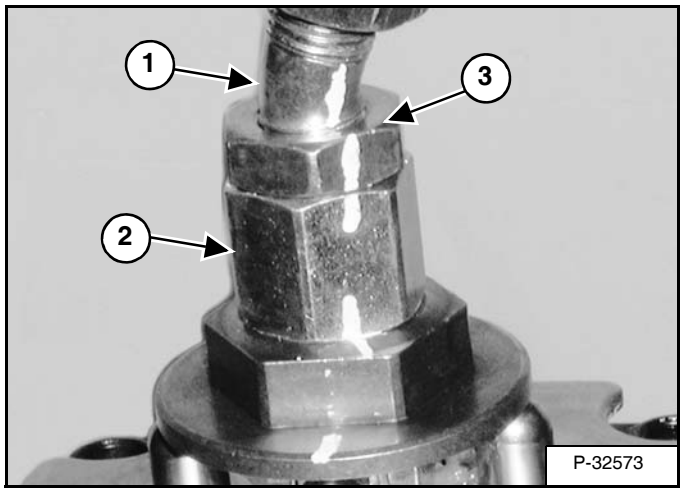
Figure 20-111-45



Align the coupler (Item 1) with the control plate (Item 2) and plunger (Item 3) **[Figure 20-111-45]**. Tighten the coupler.

Assembly (Cont'd)

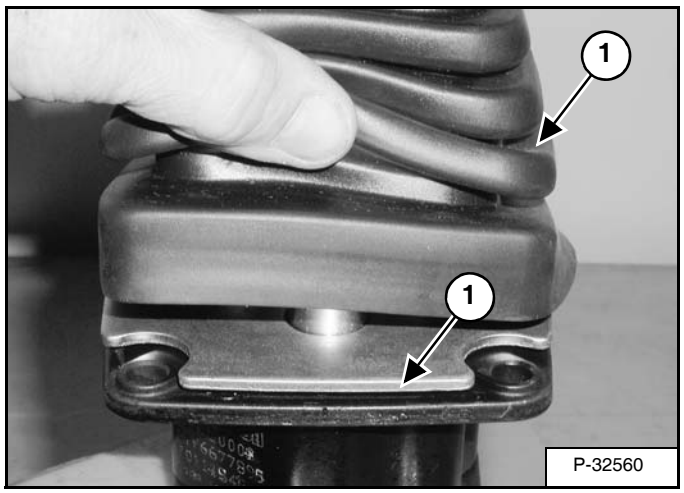
Figure 20-111-46



Install the connector **[Figure 20-111-46]**.

Align the connector with the coupler (Item 2) and tighten the nut (Item 3) **[Figure 20-111-46]**.

Figure 20-111-47



Install the tabs of the boot (Item 1) in between the joystick flange and the mounting plate (Item 2) **[Figure 20-111-47]**.

Install the handle. See Handle Removal And Installation on Page 20-111-3

HYDRAULIC FILTER MOUNT

Removal and Installation

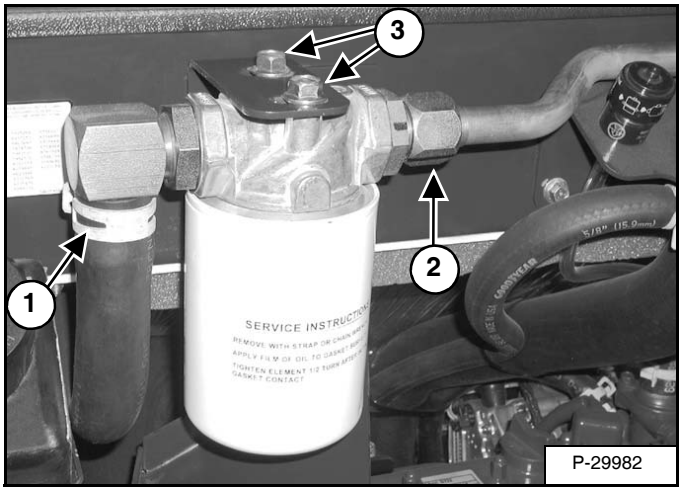
IMPORTANT

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

Open the tailgate.

Figure 20-120-48



Loosen the hose clamp (Item 1) **[Figure 20-120-48]** and remove the hose.

Remove the tube line (Item 2) **[Figure 20-120-48]**.

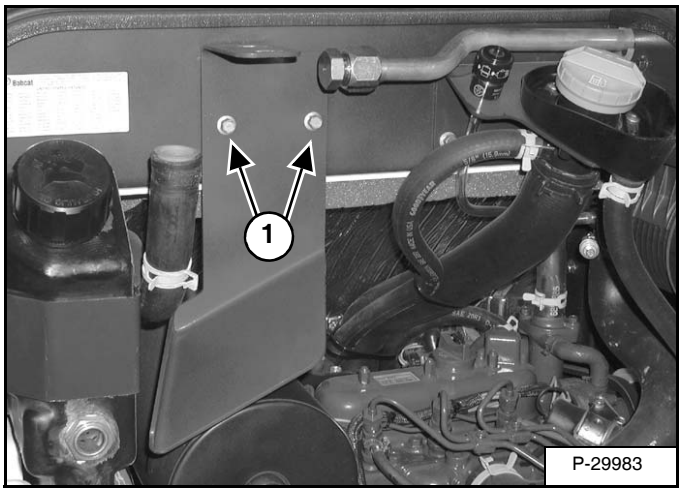
NOTE: Support the hose in approximately the same position as when attached to the filter mount to avoid any hydraulic fluid from draining out of the hydraulic reservoir.

Remove the bolts (Item 3) **[Figure 20-120-48]**.

Remove the filter and filter mount.

Installation: Tighten the bolts to 28 ft.-lbs. (38 Nm) torque.

Figure 20-120-49



Remove the screws (Item 1) **[Figure 20-120-49]** from the filter mount bracket.

Remove the bracket.


Bobcat®

HYDRAULIC RESERVOIR

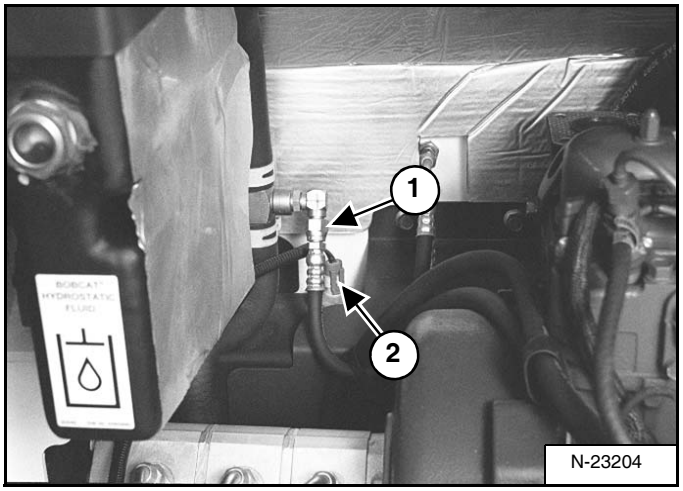
Removal and Installation

Open tailgate.

Drain hydraulic reservoir. (See Replacing Hydraulic Oil on Page 10-100-2.)

Remove the muffler and extension. (See Removal And Installation on Page 60-20-1.)

Figure 20-130-1



Remove the hose (Item 1) **[Figure 20-130-1]** from the hydraulic reservoir tee fitting.

Disconnect the fuel level sender harness (Item 2) **[Figure 20-130-1]** from the fuel level sender.

Figure 20-130-2

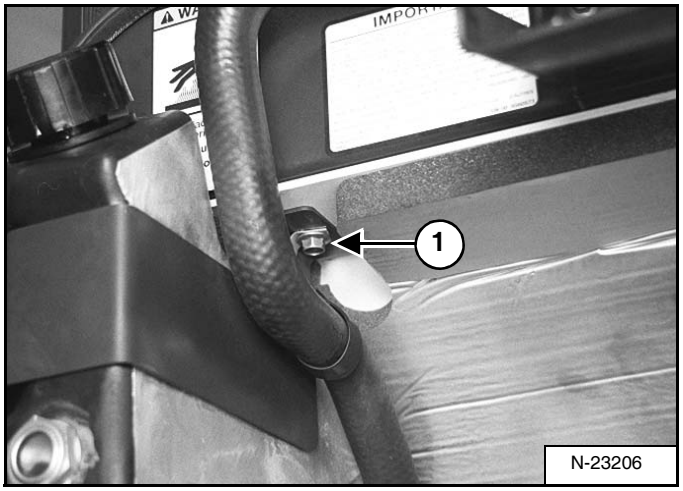
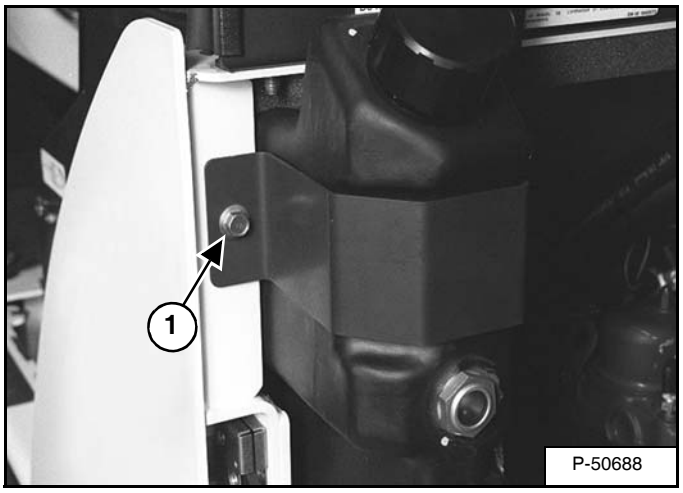
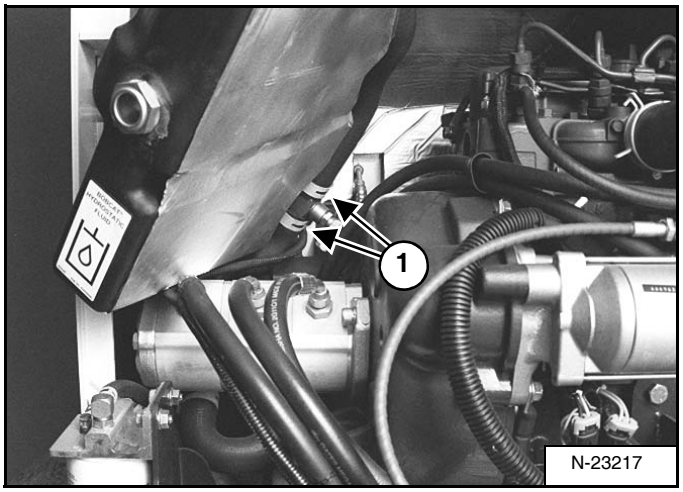


Figure 20-130-3



Remove the two bolts (Item 1) **[Figure 20-130-2]** & **[Figure 20-130-3]** from the hydraulic reservoir bracket.

Figure 20-130-4



Release the hose clamps (Item 1) **[Figure 20-130-4]** and remove hoses from tee fitting on reservoir.

Tilt hydraulic reservoir towards engine and slide reservoir out **[Figure 20-130-4]**.


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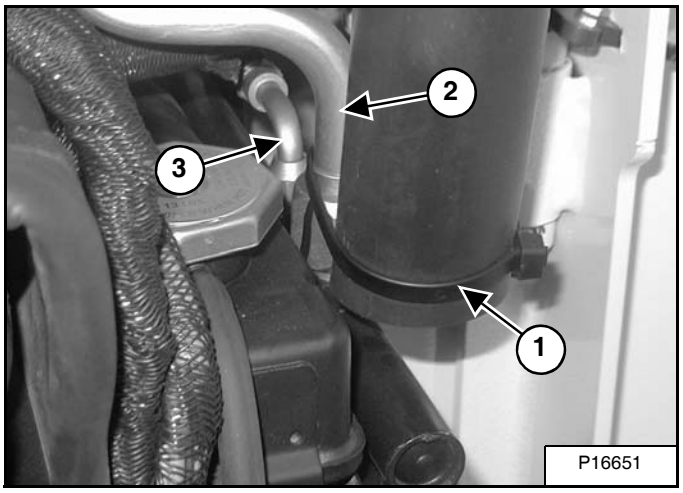
OIL COOLER

Removal And Installation

Open tailgate.

Drain hydraulic reservoir. (See Replacing Hydraulic Oil on Page 10-100-2)

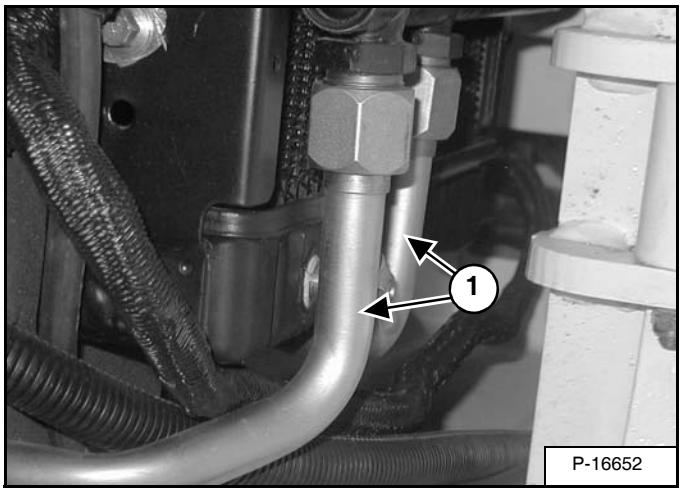
Figure 20-140-1



Remove tie strap (Item 1) **[Figure 20-140-1]**.

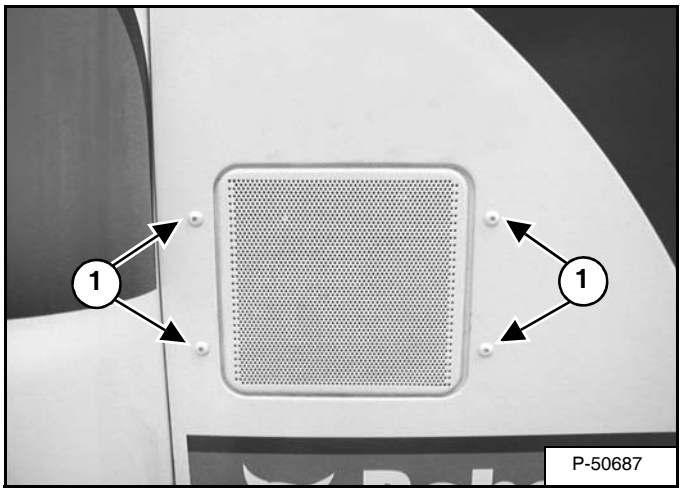
Remove the tubeline (Item 2) and plug hose (Item 3) **[Figure 20-140-1]** from the top of the oil cooler.

Figure 20-140-2



Remove the tubelines (Item 1) **[Figure 20-140-2]** from the bottom of the oil cooler.

Figure 20-140-3



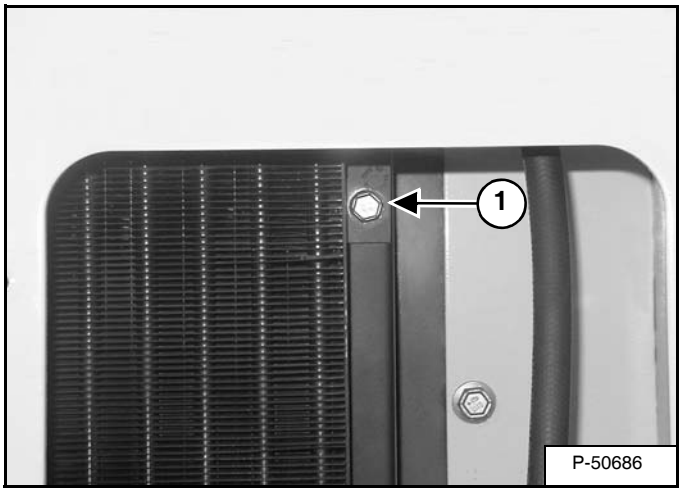
Remove the four bolts (Item 1) **[Figure 20-140-3]** holding the grill to the side frame.

Push the grill in and slide the grill out the back of the Excavator.

NOTE: Use a magnet or hook pick to prevent the grill from dropping and being scratched or damaged.

NOTE: Support the oil cooler before removing the mounting bolts.

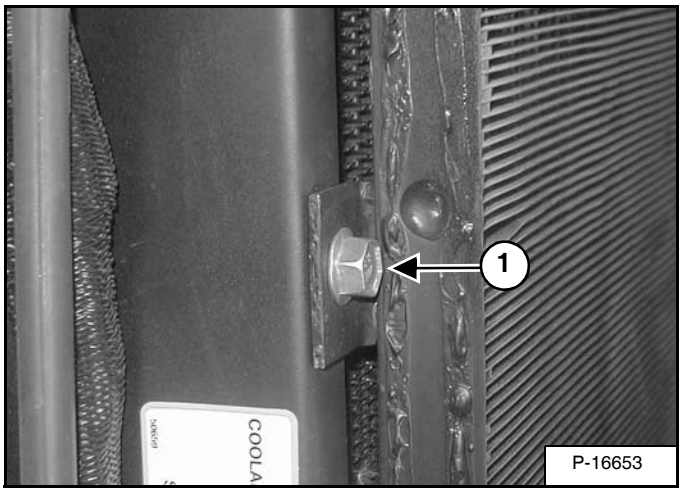
Figure 20-140-4



Remove the bolt (Item 1) **[Figure 20-140-4]** mounting the oil cooler to the radiator.

Removal And Installation (Cont'd)

Figure 20-140-5



Remove the bolt (Item 1) **[Figure 20-140-5]** mounting the oil cooler to the radiator.

Remove the oil cooler from rear of Excavator.

UNDERCARRIAGE

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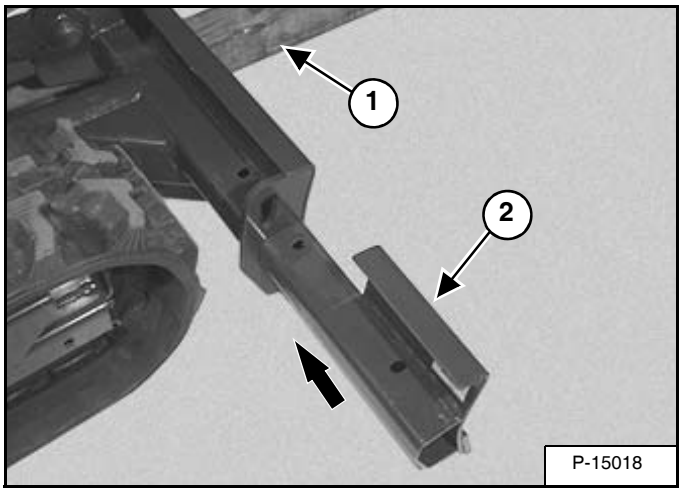
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BLADE

Extension Removal And Installation

Figure 30-10-1



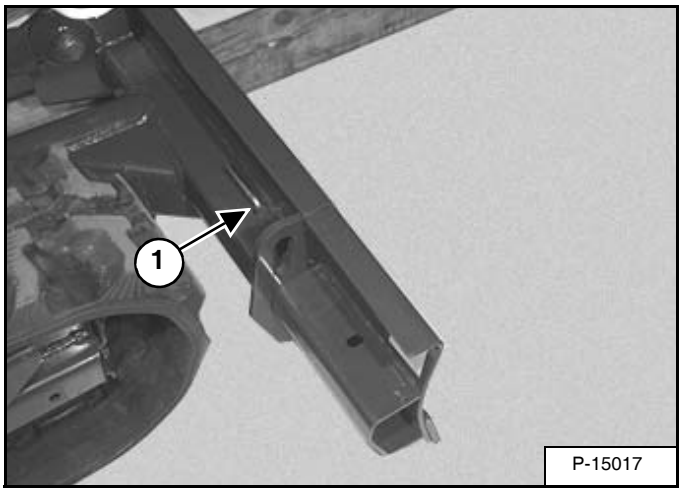
Put a block (Item 1) **[Figure 30-10-1]** under the blade.

Fully lower the blade to the block.

Stop the engine.

Slide the extension (Item 2) **[Figure 30-10-1]** into the blade frame.

Figure 30-10-2



Install the pin (Item 1) **[Figure 30-10-2]**.

Remove the blade extensions when transporting the Excavator, or when a narrow operating width is needed. Under normal operating conditions, the blade width should match the track width.

Blade Removal And Installation

Expand the tracks.

Lower the blade to the ground.

Remove the blade cylinder. (See Removal and Installation on Page 20-24-3)

Figure 30-10-3

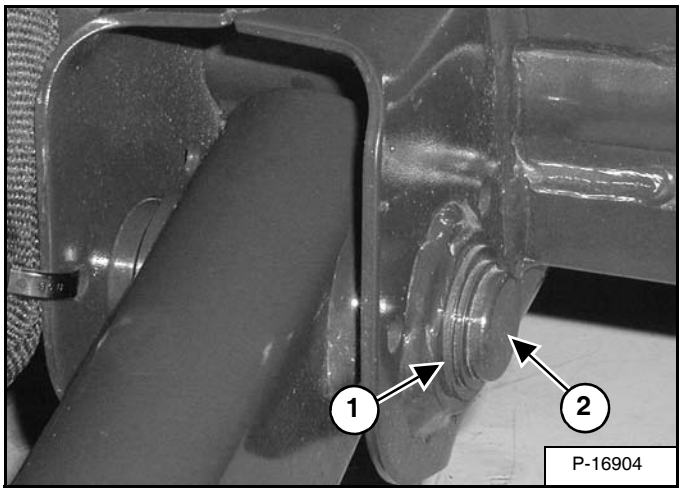
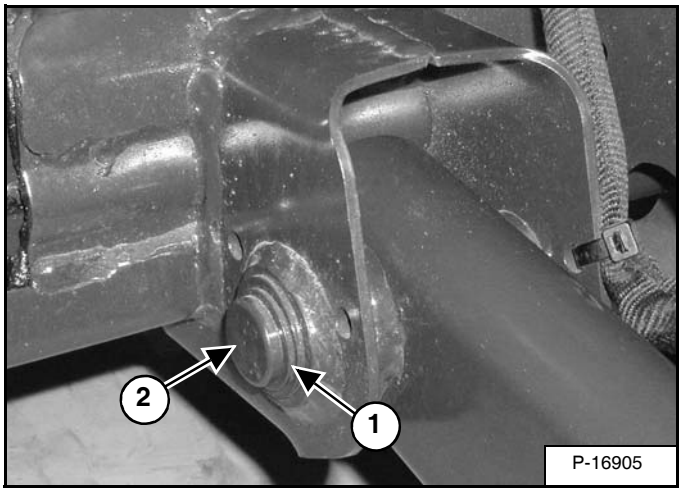


Figure 30-10-4



Remove the snap ring (Item 1) **[Figure 30-10-3]** & **[Figure 30-10-4]** and washer from the blade arm pivot pins (both sides).

Remove the blade arm pivot pins (Item 2) **[Figure 30-10-3]** & **[Figure 30-10-4]**.

Remove blade from Excavator.


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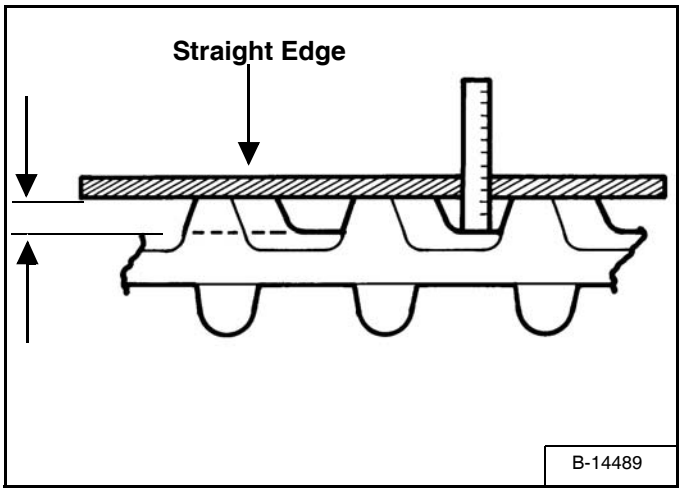
TRACKS

Track Lug Height

Rubber Track

The lug height of a new rubber track is 0.984 inch (25,0 mm).

Figure 30-20-1



To find the percentage of wear on an Excavator track, measure the height of the lug by placing a straight edge across the top of three lugs and measure the distance from the base of the track to the bottom of the straight edge **[Figure 30-20-1]**.

Divide this measurement by the new track height and multiply by 100. This will give the percentage of track lug left.

Example: lug height 0.787 inch (20,0 mm)

$$\frac{0.787}{0.984} \times 100 = 80$$

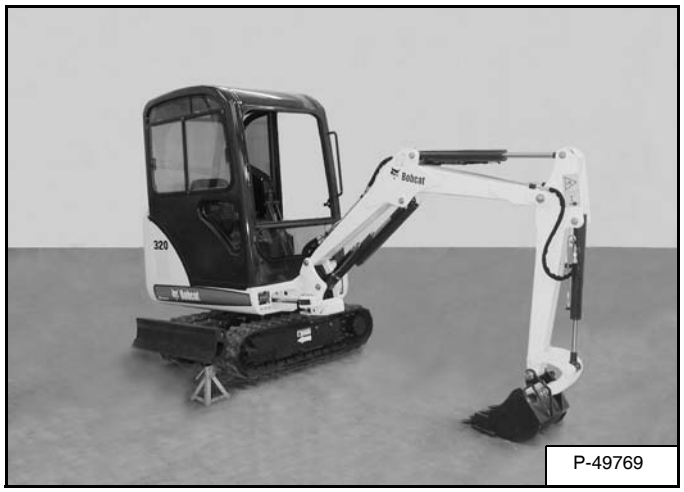
80% of the track lug is remaining with 20% wear on the track lugs.

The rubber track should be replaced when lug height measures .246 inch. (6,25 mm) from the base of the track to the top of the lug.

Adjustment

NOTE: The wear of undercarriage parts vary with working conditions and types of soil conditions. Maintain the correct track tension by inspecting regularly. See Service Schedule for the correct service interval. (See SERVICE SCHEDULE on Page 10-50-1.)

Figure 30-20-2



Raise one side of the machine (approximately four inches [102 mm]) using the boom and arm as shown in **[Figure 30-20-2]**.

Raise the blade fully and install jackstands under the blade and the track frame. Lower the machine until all machine weight is on the jackstands.

Stop the engine.

⚠ WARNING

AVOID INJURY

Keep fingers and hands out of pinch points when checking the track tension.

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Figure 30-20-3

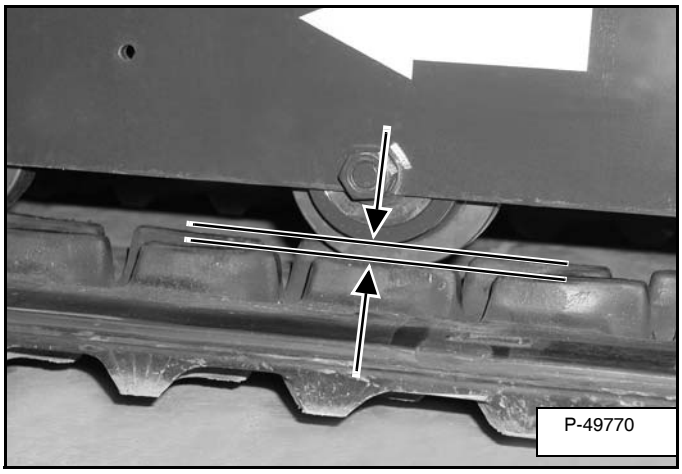


Figure 30-20-4

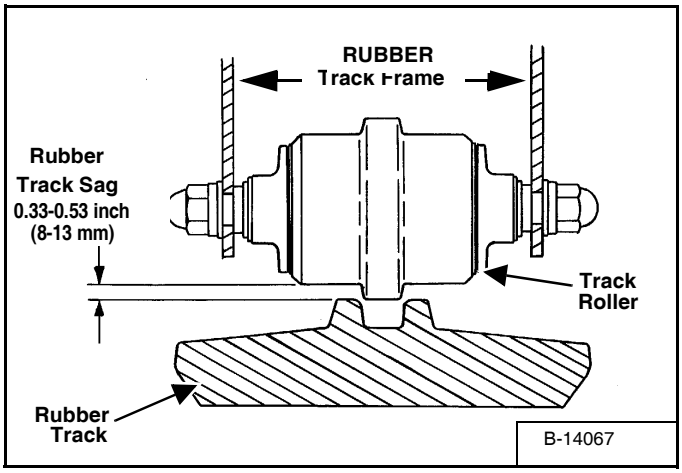
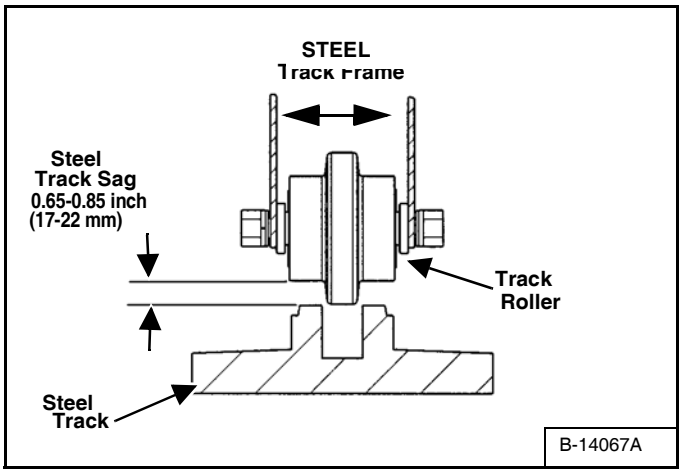


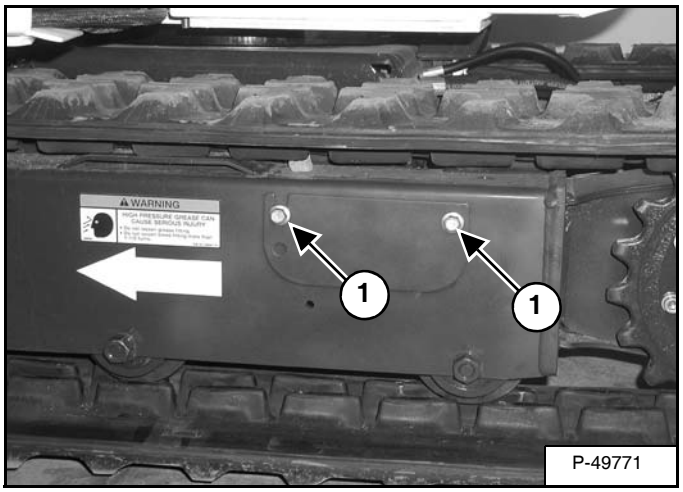
Figure 30-20-5



Measure the rubber or steel track sag at the middle track roller **[Figure 30-20-3]**. Do not get your fingers into pinch points between the track and the track roller. Use material of appropriate size to check the gap between the contact edge of the roller and top edge of the track guide lug **[Figure 30-20-3]**, **[Figure 30-20-4]** & **[Figure 30-20-5]**.

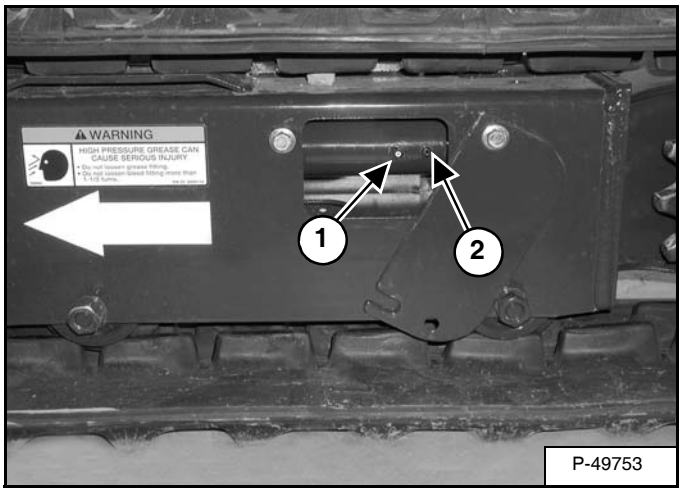
Adjustment (Cont'd)

Figure 30-20-6



Loosen the two bolts (Item 1) **[Figure 30-20-6]** on the cover. Pivot the cover downward.

Figure 30-20-7



Add grease to the fitting (Item 1) **[Figure 30-20-7]** until the track tension is correct.

If tension is too tight, loosen the bleed screw (Item 2) **[Figure 30-20-7]** (1 turn maximum) and let grease flow out of the bleed screw. When tension is correct, tighten the bleed screw.

Repeat the procedure for the other side.

If the track tension is still loose after adjusting to the mentioned limit, it indicates the track is worn.

⚠ WARNING

AVOID INJURY OR DEATH

Do not loosen the grease fitting more than one complete rotation. Also, be careful not to loosen any part other than the grease fitting. If the grease fitting or any part is loosened too much, it can fly off under high pressure. If the grease does not ooze smoothly, try moving the machine back and forth for a short distance.

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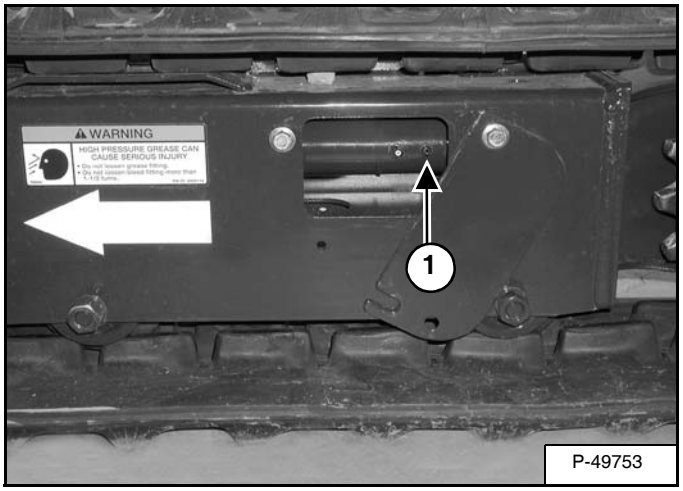


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Removal And Installation

Lift and block the side of the machine where the track will be removed. (See LIFTING AND BLOCKING THE EXCAVATOR on Page 10-10-1.)

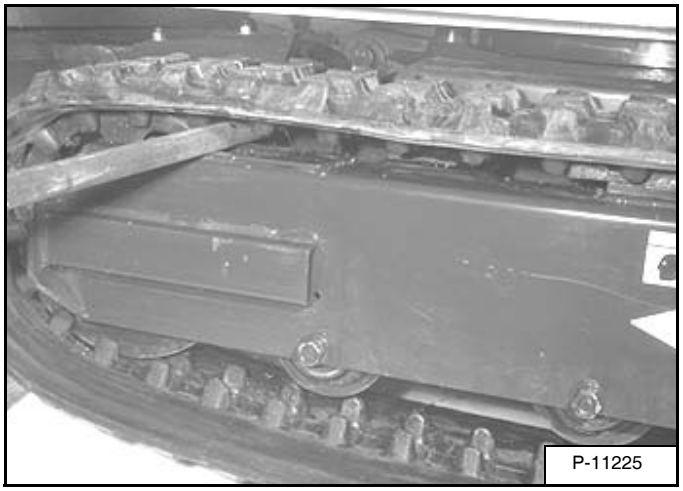
Figure 30-20-8



Slowly loosen the bleed screw fitting (Item 1) **[Figure 30-20-8]** (one turn maximum) to remove track tension.

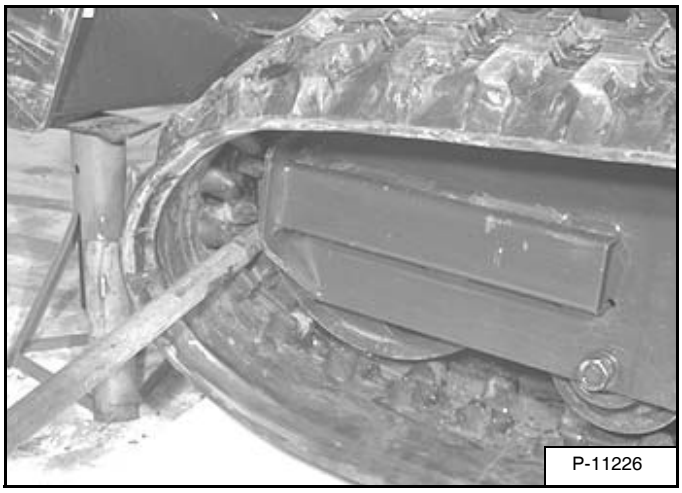
NOTE: Apply additional pressure to the track by standing on the lower track span so all the tension is released from the grease cylinder for easier removal of the track.

Figure 30-20-9



Install a round bar (Approximately 1.25 inch [30 mm] diameter) between the drive lugs **[Figure 30-20-9]**.

Figure 30-20-10



Turn the track until the bar contacts the frame **[Figure 30-20-10]**.

Pry the track off the idler wheel.

Remove the track from the drive sprocket.

To install the rubber track:

Put the track over the rear drive sprocket lugs.

Put the front of the track onto the front idler wheel.

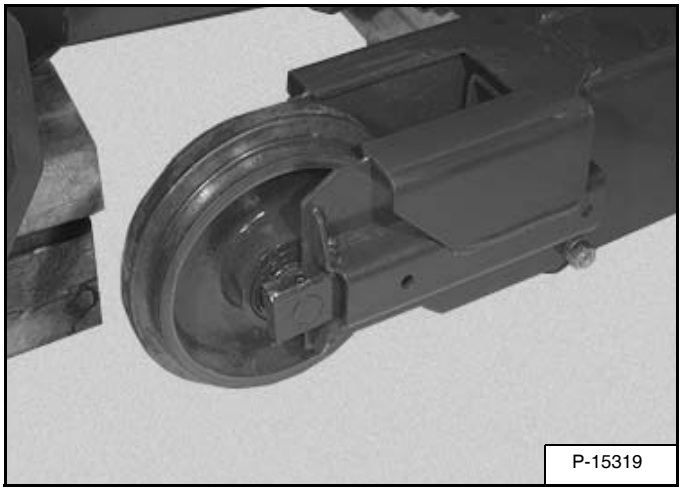
See Adjustment on Page 30-20-2 for adding grease to the grease spring and for checking track tension.

TRACK FRAME

Disassembly And Assembly

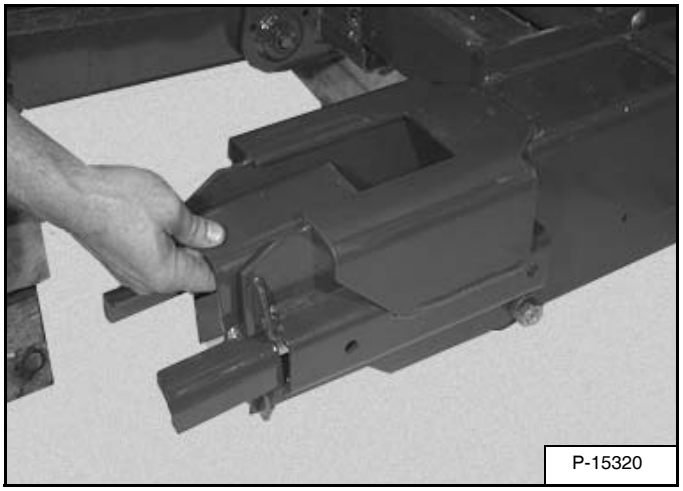
Remove the track. (See Removal And Installation on Page 30-20-4.)

Figure 30-30-11



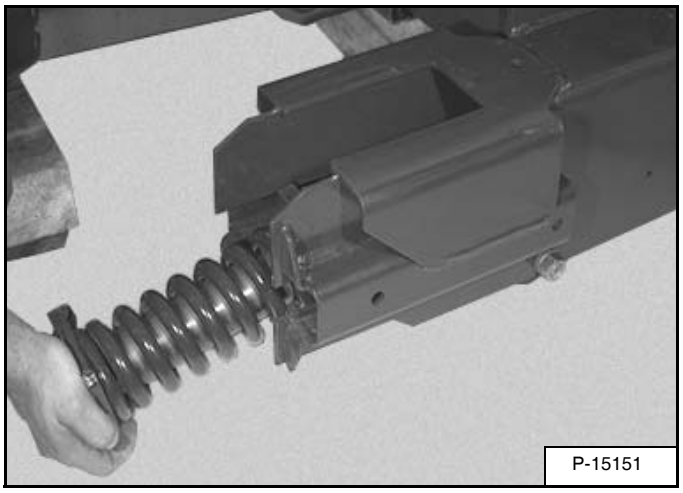
Slide the front track idler out of the track frame to remove it **[Figure 30-30-11]**.

Figure 30-30-12



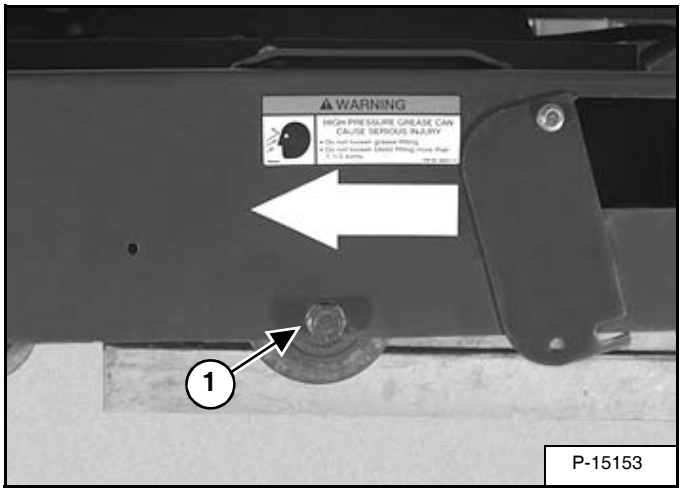
Remove the sliding plate **[Figure 30-30-12]**.

Figure 30-30-13



Slide the recoil spring cylinder forward and remove it from the track frame **[Figure 30-30-13]**.

Figure 30-30-14



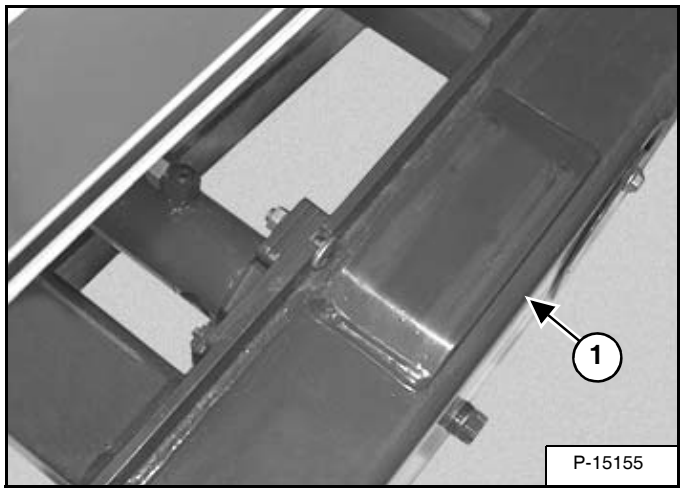
Loosen the nuts from the track roller on both sides of the track frame **[Figure 30-30-14]**.

Installation: Tighten the nuts to 125 - 140 ft.-lb. (170-190 N•m) torque.

Remove the track roller (Item 1) **[Figure 30-30-14]**.

Disassembly And Assembly (Cont'd)

Figure 30-30-15



Inspect the track guide (Item 1) **[Figure 30-30-15]** for wear or damage.

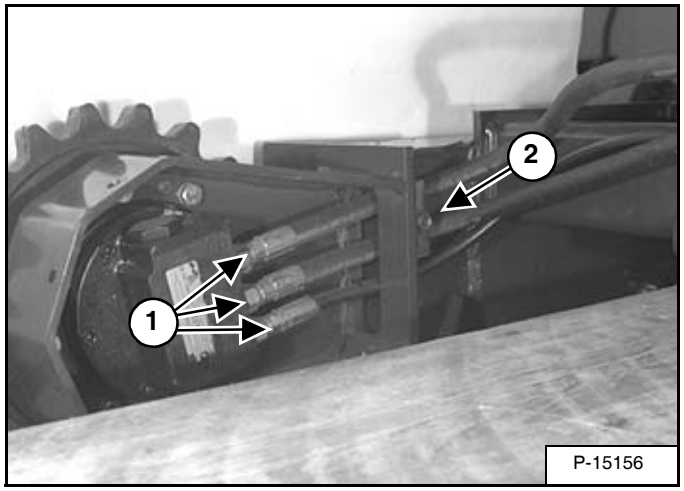
Removal And Installation Of Expandable Track Frame (322 Only)

Remove the track expansion cylinder. (See Removal And Installation on Page 20-25-2.)

Lift and block the track frame.

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

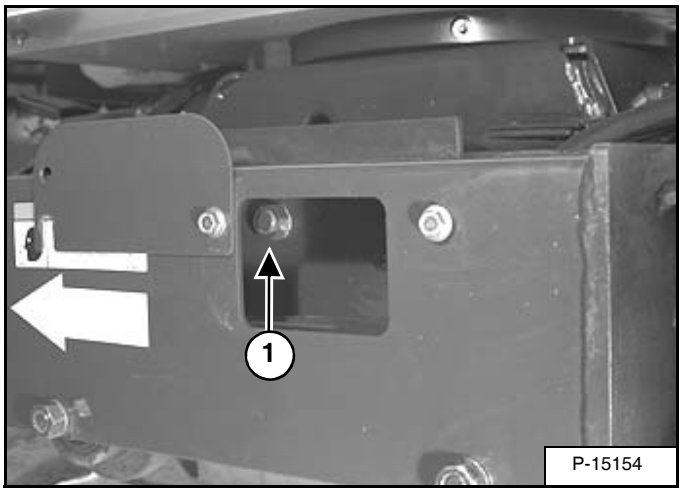
Figure 30-30-16



Remove the travel motor cover. Remove the hoses (Item 1) **[Figure 30-30-16]** from the travel motor.

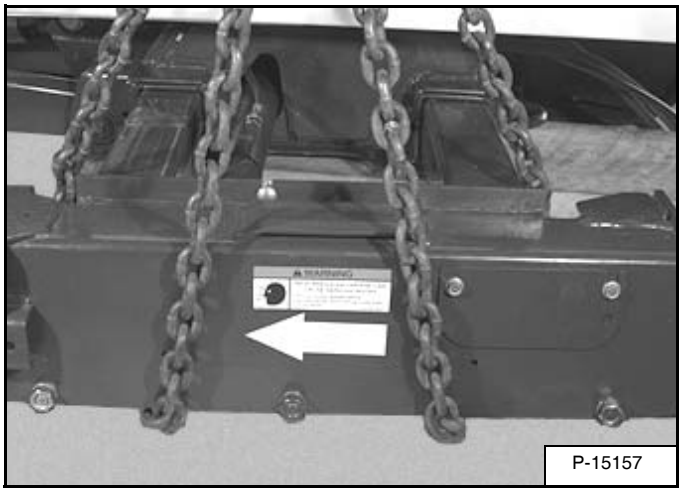
Remove the hose clamp (Item 2) **[Figure 30-30-16]** from the track frame.

Figure 30-30-17



Remove the nut (Item 1) **[Figure 30-30-17]** from the track expansion stop rod.

Figure 30-30-18



Install a chain hoist on the track frame **[Figure 30-30-18]**. Lift the frame a small amount while pulling the frame away from the Excavator.

Using a 10 X 1.5 mm tap, clean the track frame bolt holes to remove the old thread locking compound.

Recoil Spring Disassembly And Assembly

DO NOT DISASSEMBLE OR REPAIR THE COIL SPRING ASSEMBLY (Item 2) [Figure 30-30-19].

⚠ WARNING



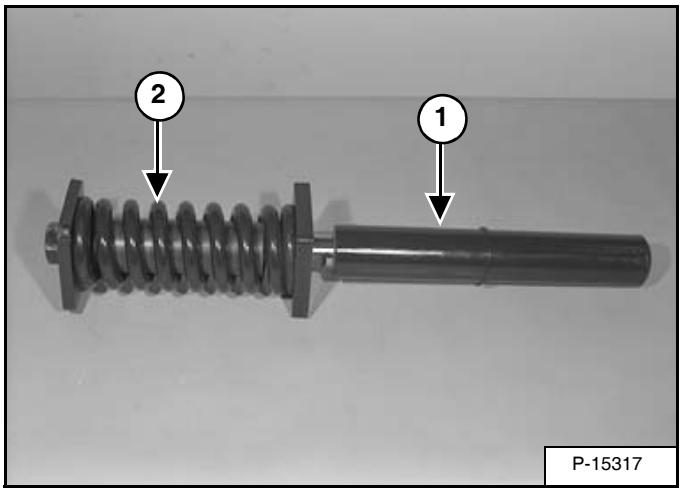
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AVOID INJURY OR DEATH

- **Spring loaded components under pressure can cause serious injury or death.**
- **Do not disassemble the coil spring assembly.**

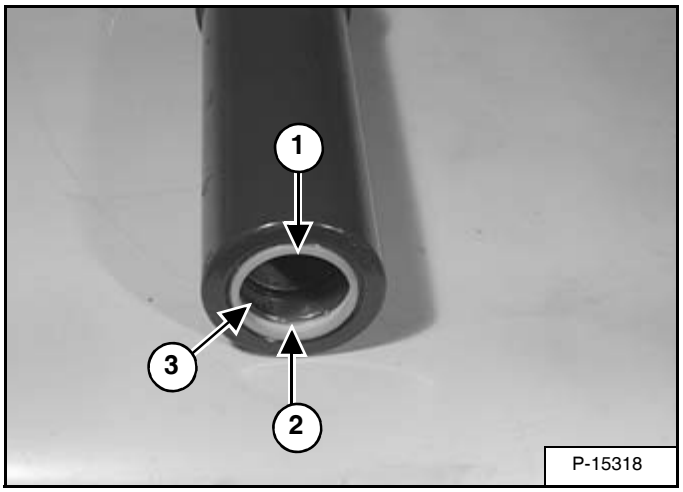
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Figure 30-30-19



Remove the cylinder (Item 1) from the coil spring assembly (Item 2) **[Figure 30-30-19]**.

Figure 30-30-20



Remove the seal (Item 1), back-up ring (Item 2) and O-ring (Item 3) **[Figure 30-30-20]** from the cylinder.


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TRACK DAMAGE IDENTIFICATION

Cutting Of The Steel Cords

Damage:

Figure 30-40-22

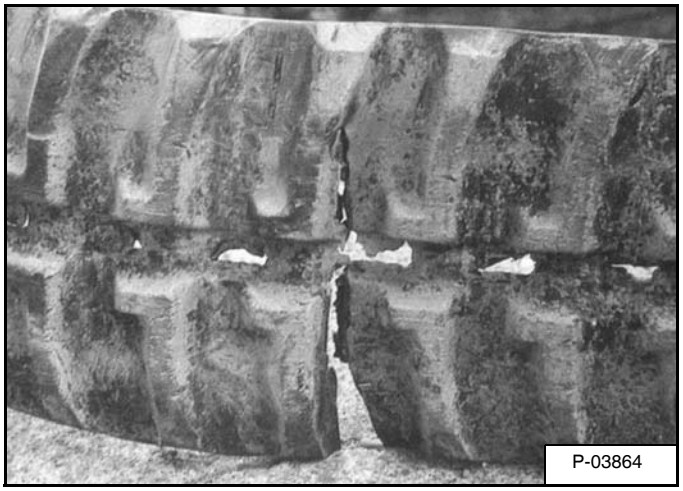
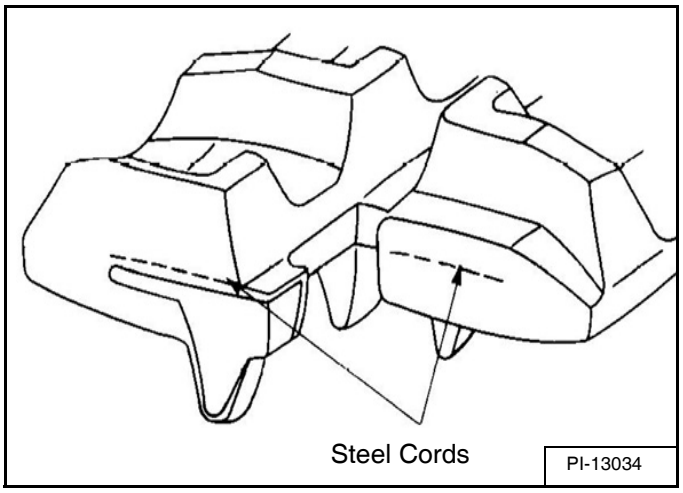


Figure 30-40-23



Embedded steel cords are cut off **[Figure 30-40-22]** & **[Figure 30-40-23]**.

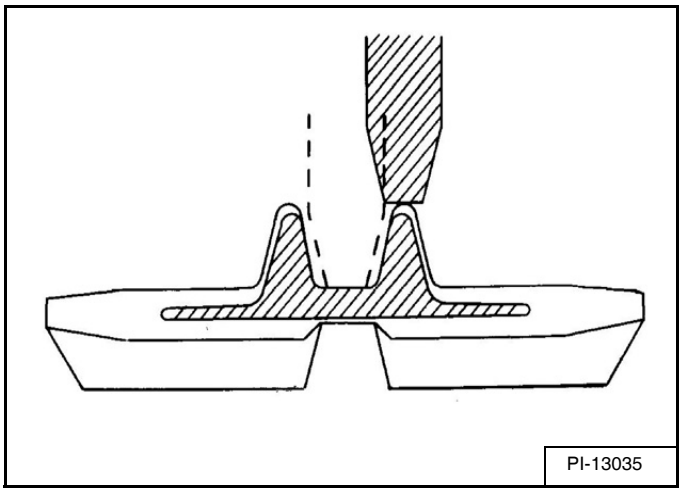
Replacement:

Replacement is required **[Figure 30-40-22]** & **[Figure 30-40-23]**.

Causes Of The Damage

When applied to rubber tracks under the following circumstances, tension in excess of the breaking strength of the embedded steel cords causes steel cords to be cut:

Figure 30-40-24



When the rubber track is detracking, the idler or sprocket rides on the projections of the embedded metal **[Figure 30-40-24]**.

When the rubber track is detracted, projections of rubber tracks get stuck between the frame of the undercarriage.

The rubber track is clogged with stones or foreign obstacles.

When moisture penetrates through a cut on the lug side rubber surface, the embedded steel cords will corrode. The deterioration of the design strength may lead to the breaking off of the steel cords.

Prevention

The following preventions should be taken to minimize the risk of this damage:

Periodically check on site, recommended track tension. (See Adjustment on Page 30-20-2.)

Avoid quick turns on bumpy and rocky fields.

Drive carefully to avoid having stones and other articles clog the rubber tracks.

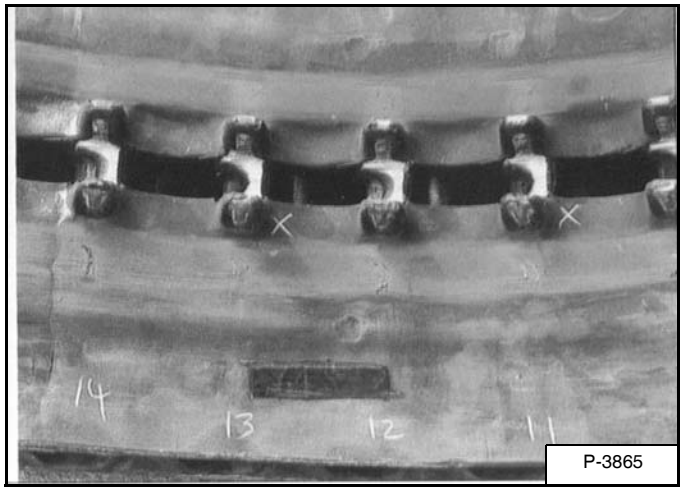
Avoid driving over sharp objects. If this is impossible, do not make turns while driving over sharp objects.

TRACK DAMAGE IDENTIFICATION (CONT'D)

Abrasion Of Embedded Metals

Damage:

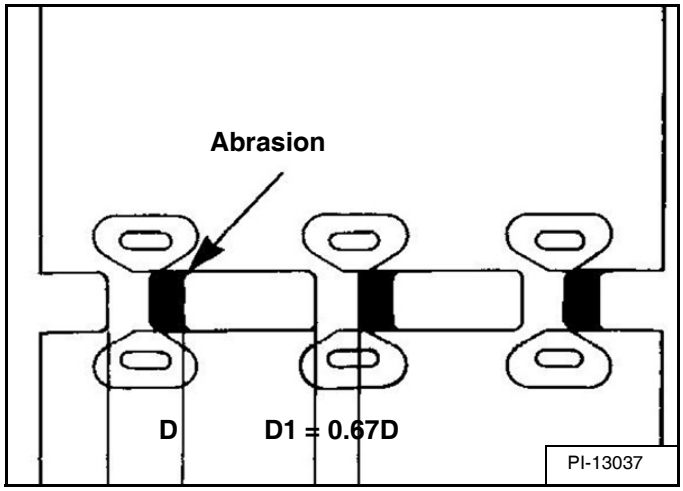
Figure 30-40-25



In proportion to the service time, embedded metals will gradually wear away by friction **[Figure 30-40-25]**.

Replacement:

Figure 30-40-26



Replacement is required when the width of the embedded metals (D1) becomes 67% of their original width (D) **[Figure 30-40-26]**.

Causes Of The Damage

When the track rollers, sprockets and idler gears roll over the embedded metals, abrasion of embedded metals is inevitable. The following cases sometimes accelerate rubber track abrasion:

Rubber tracks are driven with an extraordinary heavy load on them.

Rubber tracks are used on sandy fields.

Prevention

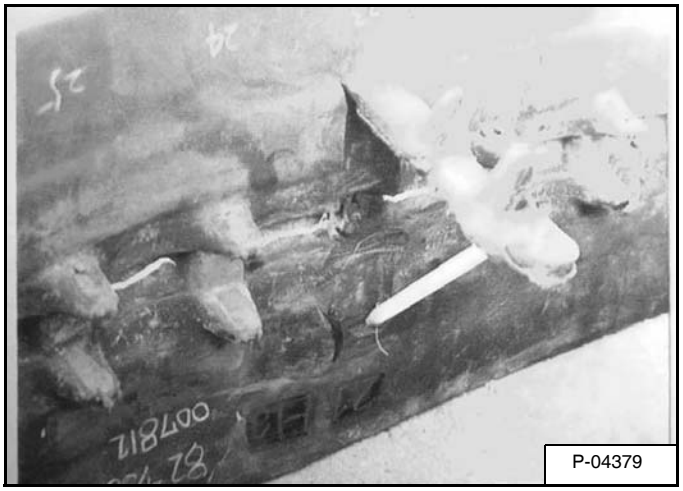
As long as rubber tracks are used under normal operating conditions, abnormal abrasion is unlikely to occur. The level of abrasion should be carefully checked when the machines are used for dozing which generate a heavy load for rubber tracks, and when they are operated under a sandy field condition for a long time.

TRACK DAMAGE IDENTIFICATION (CONT'D)

Separation Of Embedded Metals

Damage:

Figure 30-40-27



Extraordinary outer forces applied to embedded metals cause their separation from the rubber track's body **[Figure 30-40-27]**.

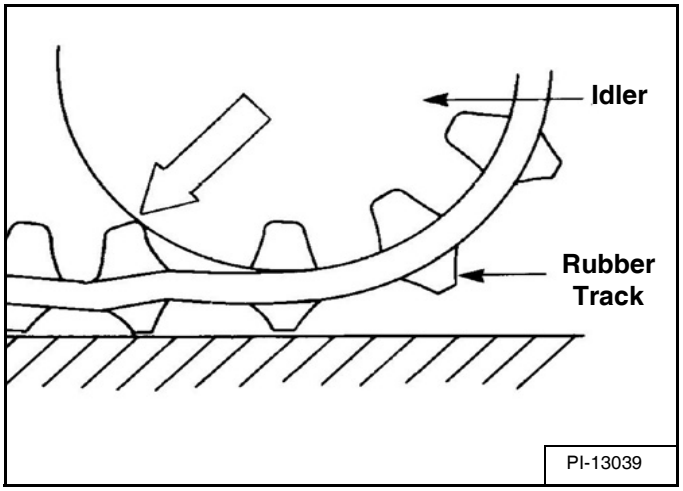
Replacement:

Even a partial separation of embedded metals requires replacement of the track.

Causes Of The Damage:

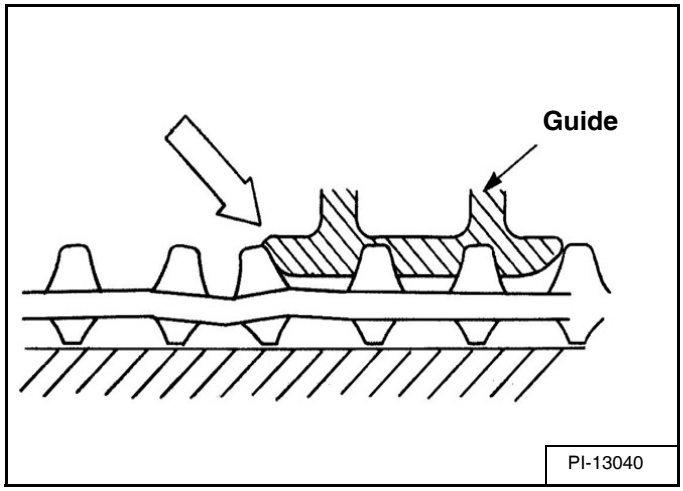
Embedded metals adhere between the steel cords and the rubber body. The following cases generate external forces greater than the adhesion strength, causing separation of the embedded metals:

Figure 30-40-28



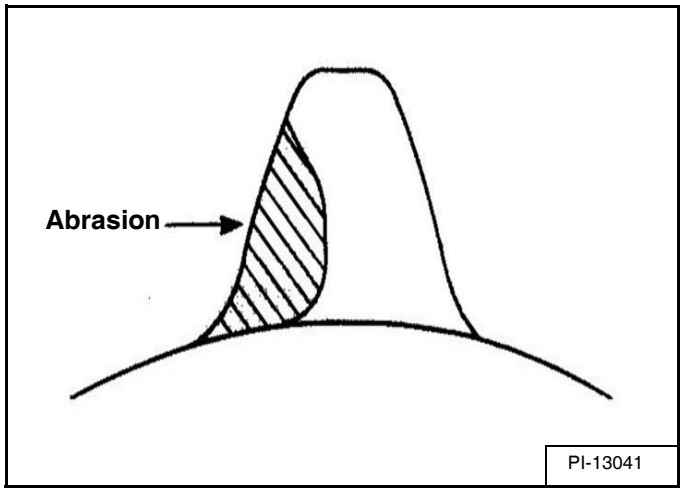
When the idler continually rides on the projections of embedded metals, the embedded metals will eventually peel off **[Figure 30-40-28]**.

Figure 30-40-29



When a rubber track is detracted, it becomes stuck between the guide or the undercarriage frame, causing the separation of embedded metals **[Figure 30-40-29]**.

Figure 30-40-30



Abnormally worn sprockets as shown will pull embedded metals out **[Figure 30-40-30]**.

Prevention:

Similar to the prevention against the cutting of the steel cords:

Periodically check on site, recommended track tension. (See Adjustment on Page 30-20-2.)

Separation Of Embedded Metals (Cont'd)

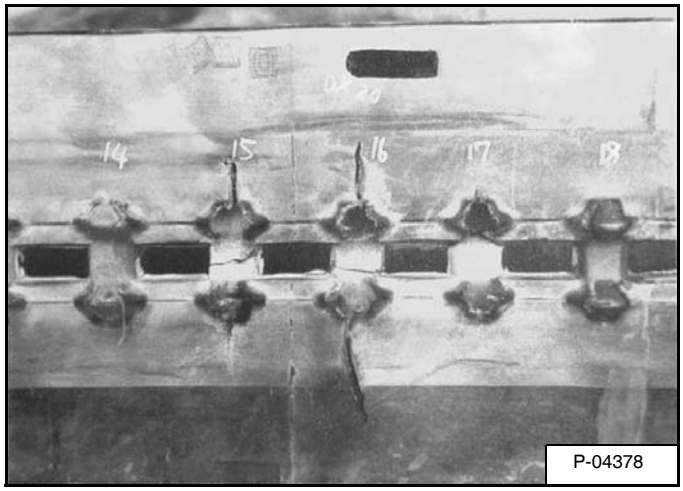
Quick turns on bumpy and rocky fields should be avoided.

If abnormal wear of sprockets is observed, they should be immediately replaced.

Separation Of Embedded Metals Due To Corrosion

Damage:

Figure 30-40-31



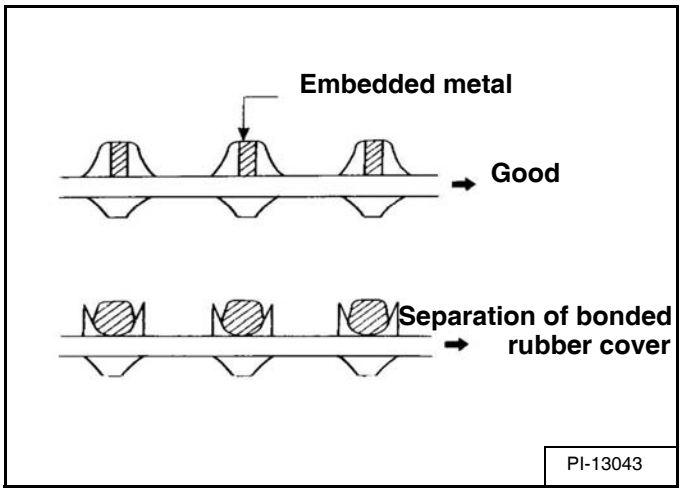
Due to corrosion of embedded metals, the adhesion to the rubber body deteriorates, resulting in complete separation **[Figure 30-40-31]**.

Replacement:

Even a partial separation of embedded metals requires a rubber track replacement.

Causes Of The Damage

Figure 30-40-32



Embedded metals are bonded to the rubber body. The following operating conditions cause embedded metals to corrode, causing deterioration of the bonding, and finally resulting in separation of the embedded metals from the rubber body **[Figure 30-40-32]**.

Excessively salty fields, like the sea shore.

Strong acidic or alkali soil conditions

Compost spread grounds

On tracks that are out of adjustment, the track rollers, idlers and sprockets will gradually wear the rubber surface at track roller side, causing exposure of the embedded metals. Consequently the embedded metals will corrode resulting in their separation from the rubber body.

Prevention:

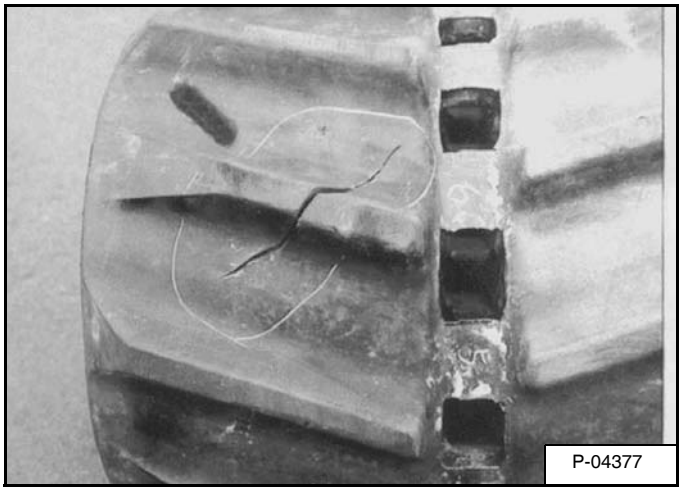
If rubber tracks are used under such field conditions as described under (Causes Of The Damage), they should be washed with plenty of water. After being completely dried, they should be stored correctly.

When the bonded rubber cover is separated from the embedded metal projections and the metals in the rubber body become loose, it is time to consider replacement of the rubber track.

Cuts On The Lug Side Rubber

Damage:

Figure 30-40-33



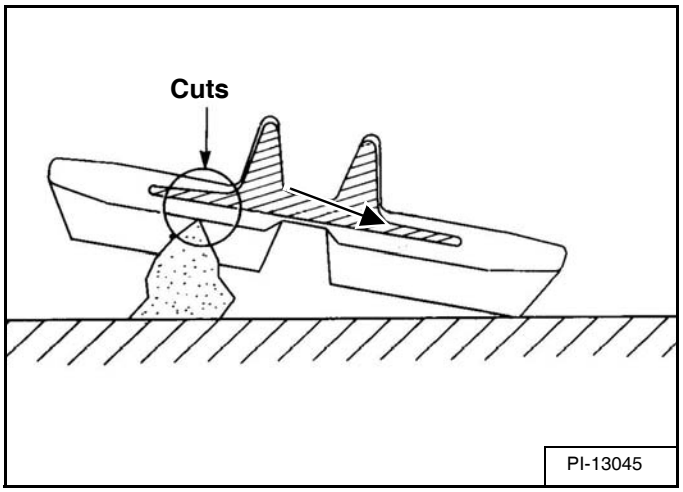
Cuts on the lug side rubber often occurs as one of the most typical failure modes **[Figure 30-40-33]**

Replacement:

When a cut on the lug side rubber reaches the embedded steel cords, it should be immediately repaired with cold vulcanization rubber.

Causes Of The Damage:

Figure 30-40-34



When rubber tracks drive over projections or sharp stones in the fields, the concentrated forces applied cause cuts on the lug side rubber surface. In case of making turns on projections, the lug side rubber surface will have an even higher chance to be cut. If the cuts run through the embedded steel cords, it might result in the breakage of steel cords due to corrosion. It is highly recommended to repair the cuts with cold vulcanization rubber as soon as they are observed **[Figure 30-40-34]**.

Prevention:

Machine operators should drive with great attention to the ground surface, especially in terrains of the following type:

Construction sites

Demolition sites

Paths covered with rocks and wood

Concrete ridges

Stumpy fields

When operating on terrains as mentioned above, quick high speed turns and overloading should be avoided.

Cracks On The Lug Side Rubber Due To Fatigue

Damage:

Figure 30-40-35

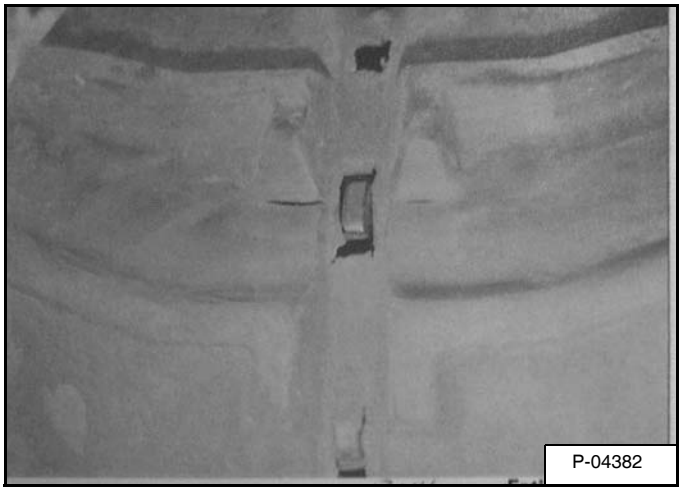
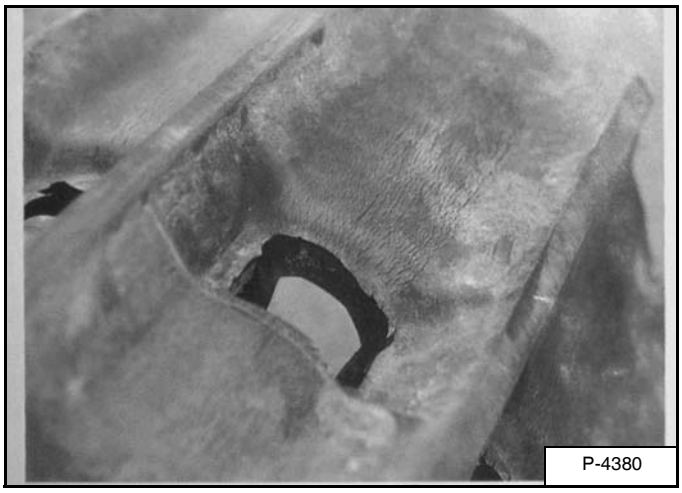


Figure 30-40-36



Small cracks around the root of the lug are a result from operation fatigue **[Figure 30-40-35]** & **[Figure 30-40-36]**

Replacement:

When the cracks become deep enough to expose the steel cords, track replacement is required.

Causes Of The Damage:

Because of wound stress applied to rubber tracks around the undercarriage parts during operation, the fatigue especially causes cracks on the lug side rubber surface. Once the cracks occur, they gradually deteriorate with even small external cracks.

Also when operating near seashores or under cold temperatures, rubber tracks are more likely to suffer from ozone cracks.

Prevention:

Rubber tracks are designed with special rubber compounds to prevent cracks due to fatigue. However, external damage on the lug side rubber, increases the possibility of cracking. Machine operators should observe soil conditions when driving, to prevent external damage to the lug side rubber. In order to minimize the occurrence of ozone cracks, follow these maintenance instructions:

Avoid exposing stored tracks to direct sun light.

Avoid exposing stored tracks to direct rain and snowfall.

Store tracks in well ventilated warehouses.

Use the tracks at least once a month.

Lug Abrasion

Damage:

Figure 30-40-37

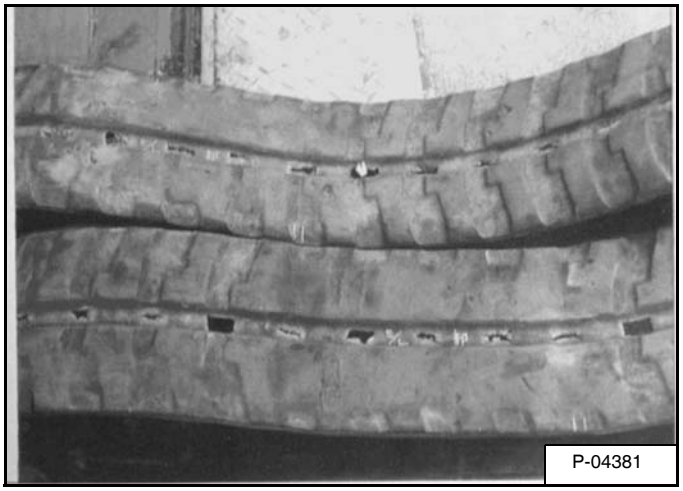
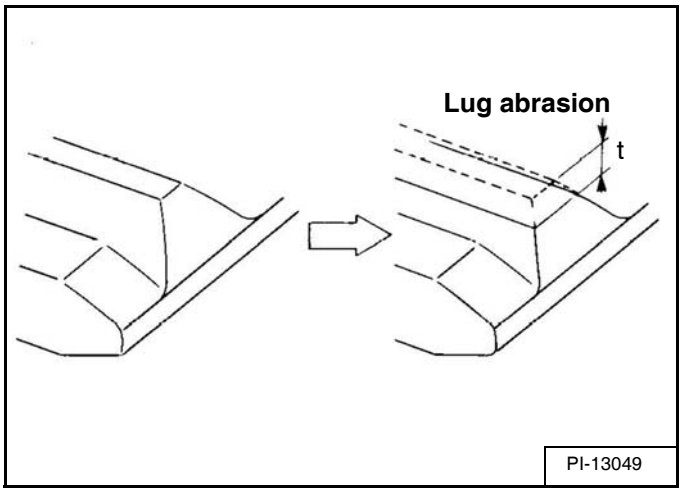


Figure 30-40-38



As operation time increases, the lug side undergoes abrasion **[Figure 30-40-37]** & **[Figure 30-40-38]**.

Replacement:

No replacement is required.

Causes Of The Damage:

Lug abrasion will occur as operation time increases. Even as lug abrasion increases, the rubber track can be used. However, as the traction performance deteriorates, it is highly recommended to replace the abraded tracks with new ones when the lug height becomes less than 5 mm.

Prevention:

In order to prevent the rubber track from abnormal or premature abrasion, the following operating conditions should be avoided:

Making quick and repeated turns on concrete and asphalt roads.

Driving up and down hilly paths with slippage.

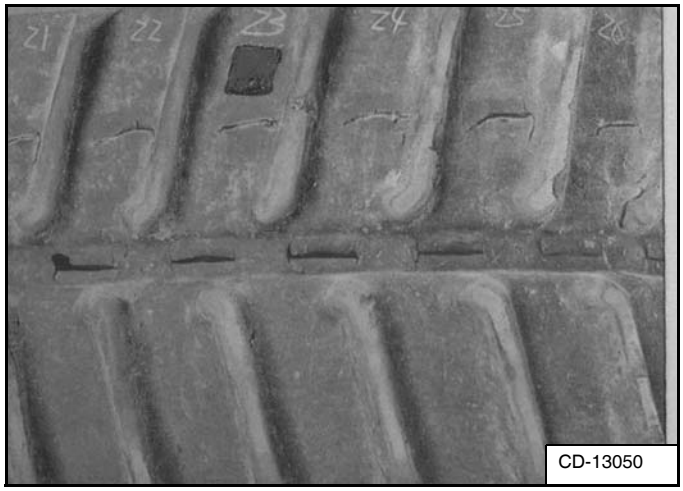
Making frequent turns on paths covered with rocks and wood.

TRACK DAMAGE IDENTIFICATION (CONT'D)

Cracks And Cuts On The Lug Side Rubber

Damage:

Figure 30-40-39



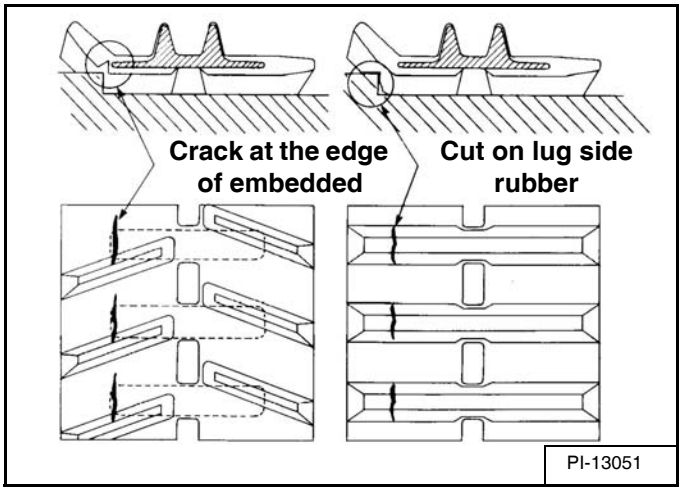
Sometimes cracks and cuts on the lug side rubber at the edges of the embedded metals can be observed **[Figure 30-40-39]**.

Replacement:

Basically, no replacement is required unless the cuts on the lug side rubber are discovered all around the edges of the embedded metals, as this will result in a complete cut off.

Causes Of The Damage:

Figure 30-40-40



When rubber tracks drive over sharp projections, intensive stress is applied to the lug side rubber surface, especially at the edges of embedded metals, causing cracks and cuts in the area around the embedded metals **[Figure 30-40-40]**.

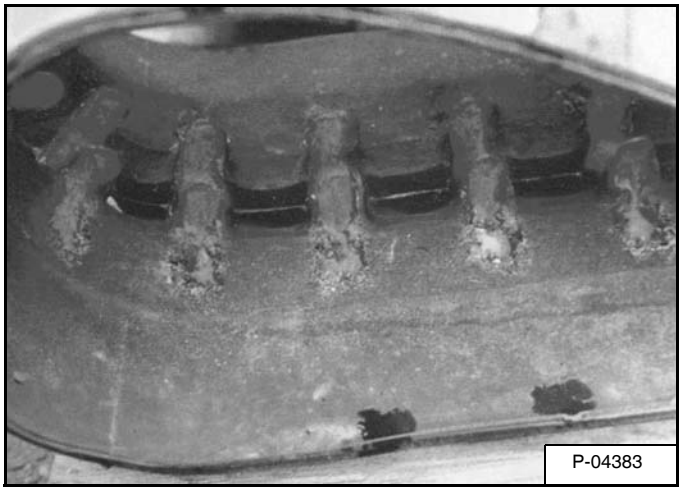
Prevention:

To avoid extensive stress applied to the lug root where metals are embedded, machine operators should avoid driving over stumps and ridges.

Abrasion Of The Track Roller Side

Damage:

Figure 30-40-41



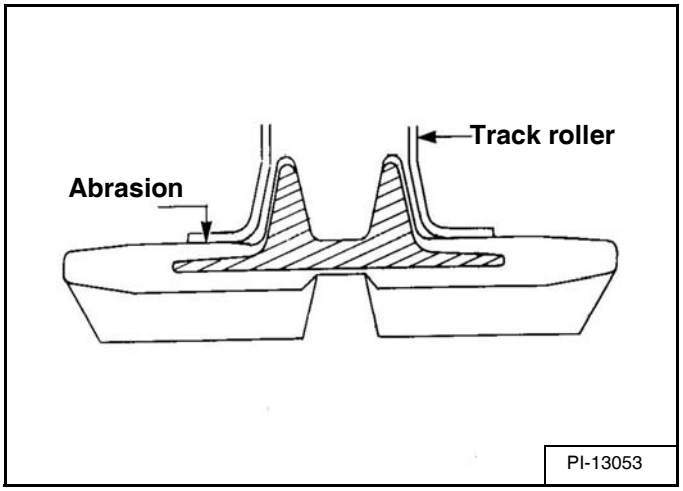
The rubber surface on which track rollers run is gradually abraded. It will result in the exposure of the embedded metals **[Figure 30-40-41]**.

Replacement:

It is recommended to replace the rubber track when more than half of the embedded metals are completely exposed.

Causes Of The Damage:

Figure 30-40-42



The abrasion of the track roller side rubber surface occurs because of sand and gravel being clogged between the rubber and the outside surface of the track rollers. The stress pushes the sand and gravel against the side of the rubber track to cause the abrasion **[Figure 30-40-42]**.

The level of abrasion is highly dependent on terrain conditions. A higher level of abrasion will occur when the rubber tracks are operated in fields covered with many stones and gravel. Small stones hardened with mud, stuck to the track rollers increase the abrasion level. After an extended period of abrasion, it will be more likely for exposed embedded metals to catch moisture through the inside steel cords, which can cause breakage of steel cords and separation of the metals from the rubber body.

Prevention:

After operation in wet fields containing many small stones, wash off the mud that is stuck to the track rollers completely. When operating on gravel paths and stony grounds, machines should be driven slowly and the turning radius should be big enough to prevent stones and gravel from getting stuck to the track roller side rubber.

TRACK DAMAGE IDENTIFICATION (CONT'D)

Cuts On The Edges Of The Track Roller Side

Damage:

Figure 30-40-43

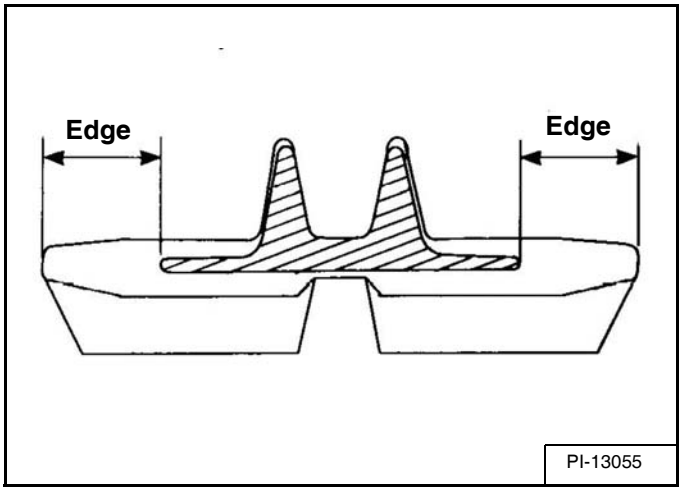


Figure 30-40-44

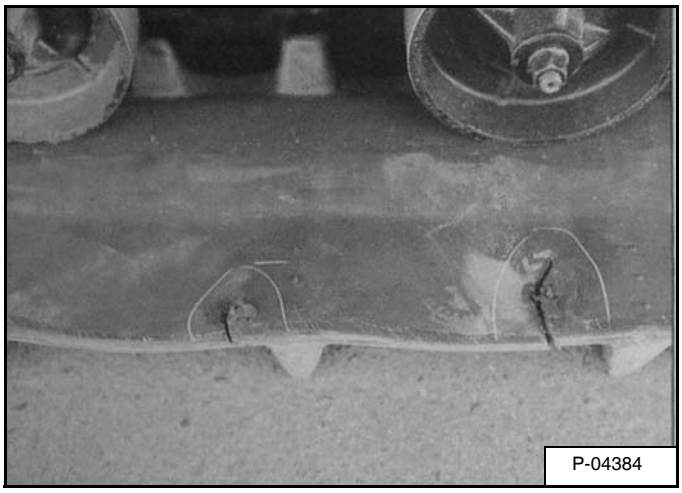
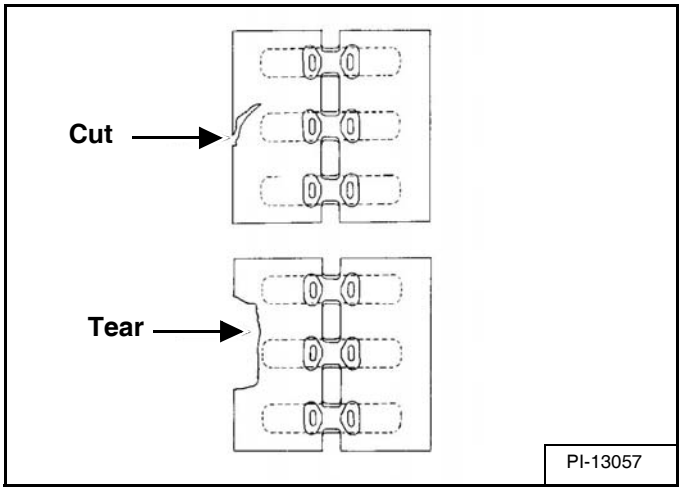


Figure 30-40-45



Both edges of a rubber track **[Figure 30-40-43]** have no special reinforcement. During operation the edges may become cut or torn off **[Figure 30-40-44]** & **[Figure 30-40-45]**.

Replacement:

In such case, the rubber track does not have to be replaced.

Causes Of The Damage:

This damage is caused by objects on the ground or by interference with the machine frame.

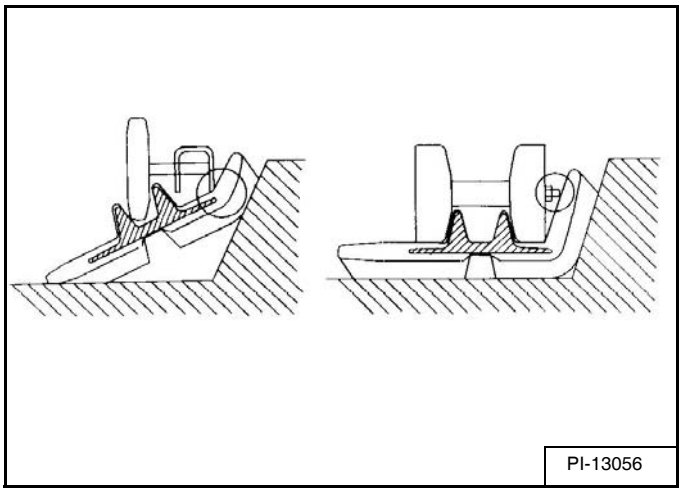
In case of damage by objects on the operating ground:

The edges of rubber track are often deformed largely due to a bumpy ground surface, stones and other objects. This causes extensive stress on the edges resulting in the damage.

When driving a machine over concrete ridges, this type of damage easily occurs.

In case of damage by interference with the machine frame.

Figure 30-40-46



If a machine continues operating with rubber tracks being detracked, the rubber tracks may get caught up in the machine frame or undercarriage parts resulting in damage. Furthermore, when a machine travels along side slopes, the rubber tracks are deformed so much that they come into contact with the machine frame and undercarriage parts, which causes cutting, gouging and rubbing of rubber tracks in the end **[Figure 30-40-46]**.

Cuts On The Edges Of The Track Roller Side (Cont'd)

Prevention:

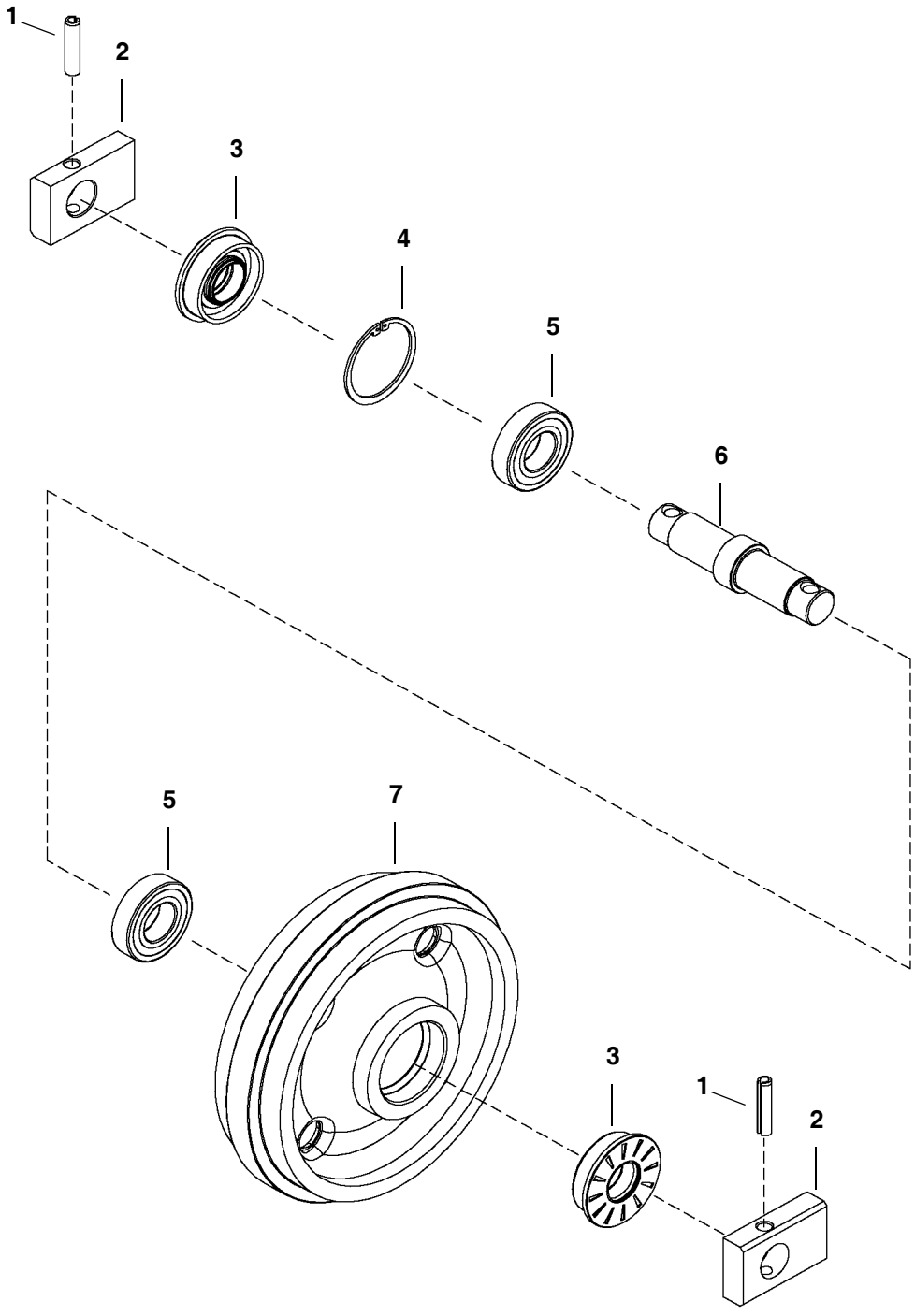
When traveling, a machine operator should be careful not to drive over any projections on the ground. He should also prevent rubber tracks from coming into contact with concrete walls, ditches and ridges. If rubber tracks are detracked, the machine should be stopped immediately for retracking.


Bobcat®

TRACK IDLER

Parts Identification

1. Roll Pin
2. Block
3. Seal
4. Snap Ring
5. Bearing
6. Shaft
7. Idler

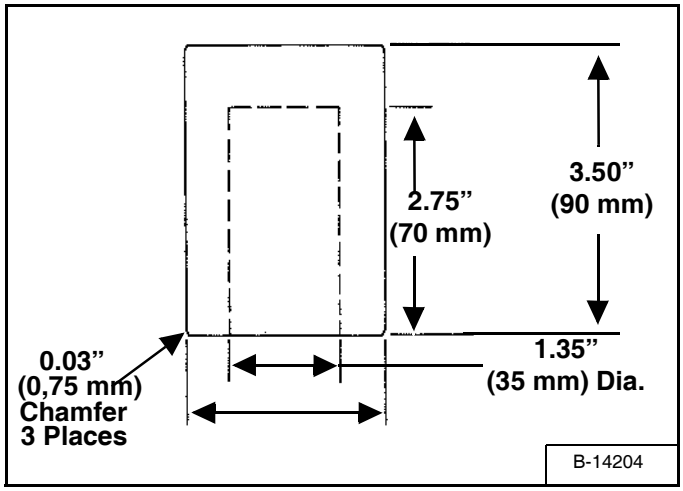


PE2202S

Disassembly

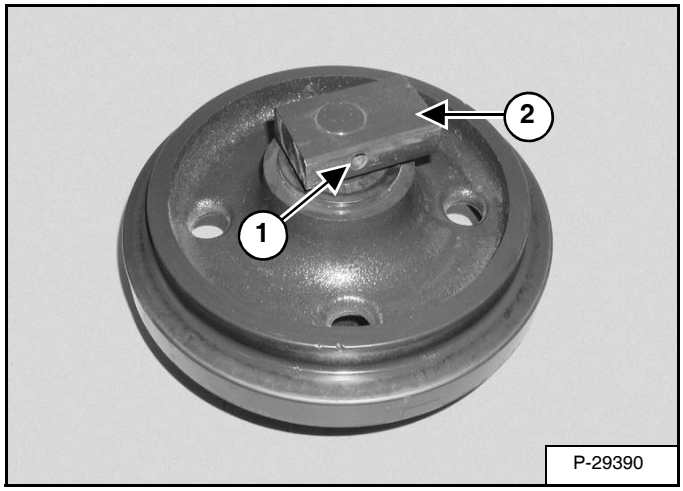
The following tools must be fabricated for this procedure:

Figure 30-50-47



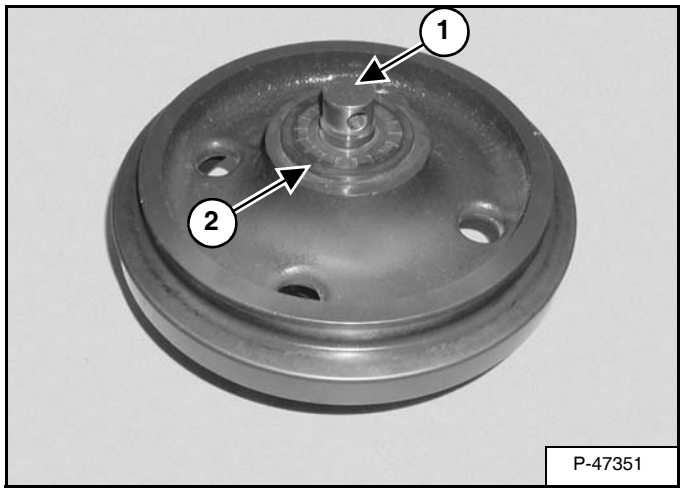
1. Driver Tool - see figure **[Figure 30-50-47]**.
2. Support Fixture - Tube, 3.0 inches ID x 0.250 inch wall x 6.0 inches long.

Figure 30-50-48



Remove the roll pin (Item 1) and block (Item 2) **[Figure 30-50-48]** from each end of the shaft.

Figure 30-50-49

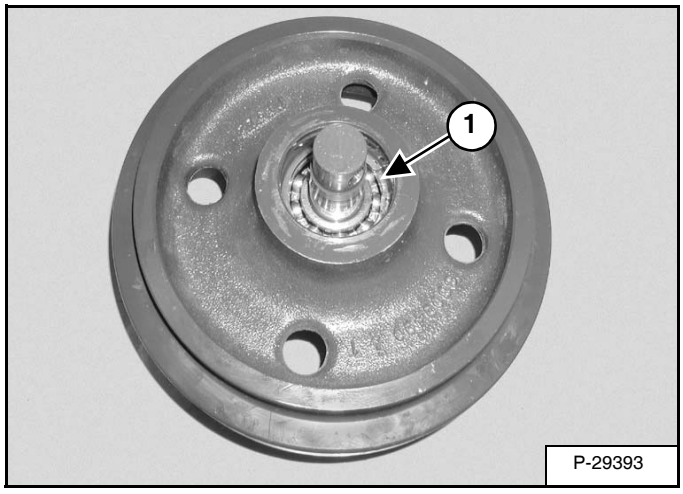


Remove any corrosion or paint from both ends of the exposed shaft (Item 1) **[Figure 30-50-49]** that could affect seal removal or damage the new seal during installation.

Apply penetrating oil to both ends of the exposed shaft to ease removal of the seal.

Remove the seal (Item 2) **[Figure 30-50-49]** from both sides of the idler.

Figure 30-50-50

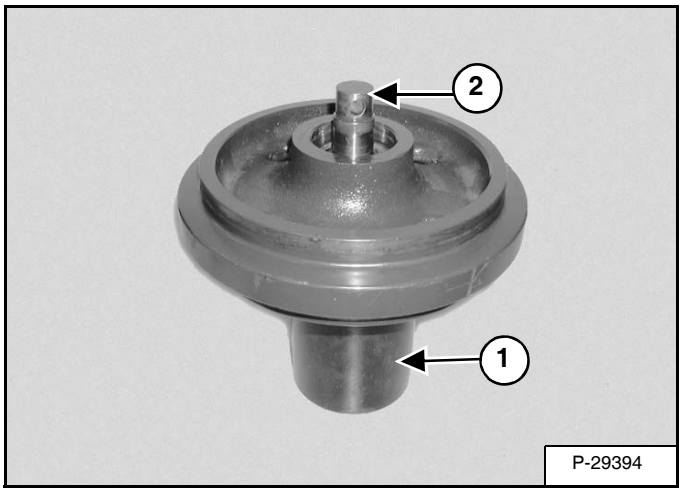


Remove the snap ring (Item 1) **[Figure 30-50-50]**.

NOTE: The snap ring is installed on one side of the idler. The other side is stepped to retain the bearing.

Disassembly (Cont'd)

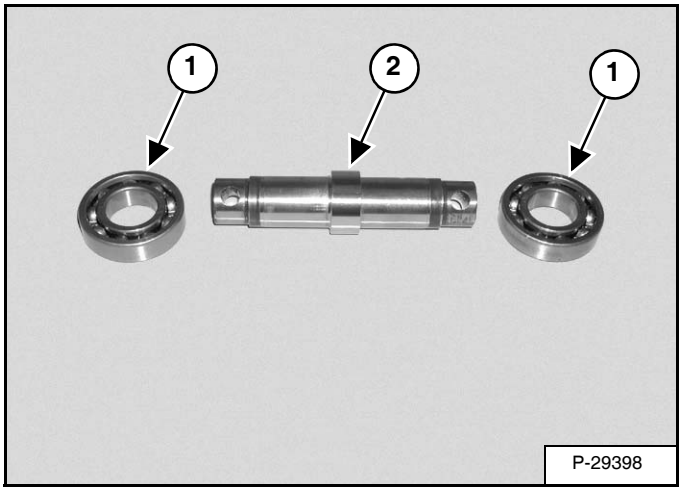
Figure 30-50-51



Place the idler on the support fixture (Item 1) **[Figure 30-50-51]**.

Using a soft faced hammer, tap the shaft (Item 2) **[Figure 30-50-51]** and bearing out the bottom of the idler.

Figure 30-50-52

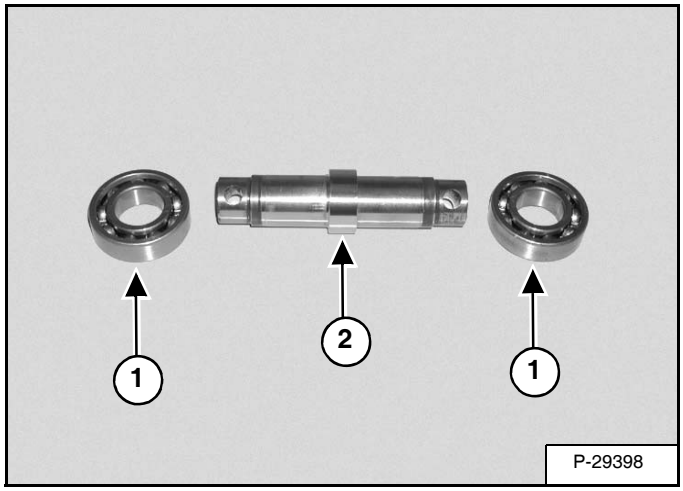


Slide the bearings (Item 1) off of the shaft (Item 2) **[Figure 30-50-52]**.

Assembly

Clean all parts in solvent and dry with compressed air.

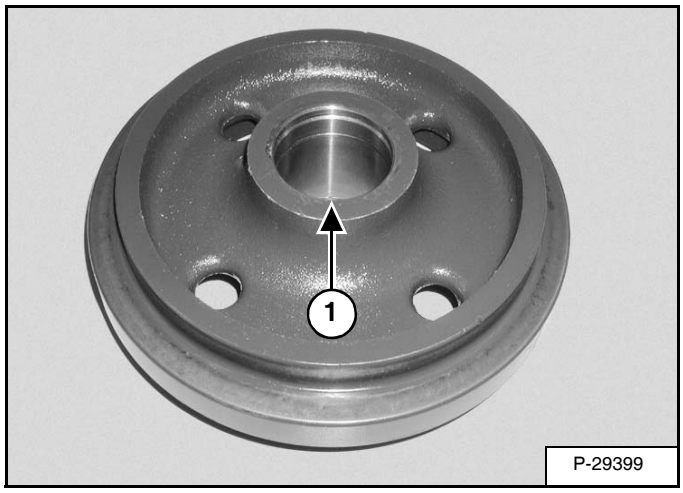
Figure 30-50-53



Inspect the bearings (Item 1) and shaft (Item 2) **[Figure 30-50-53]** for wear or damage. Replace any worn or damaged parts.

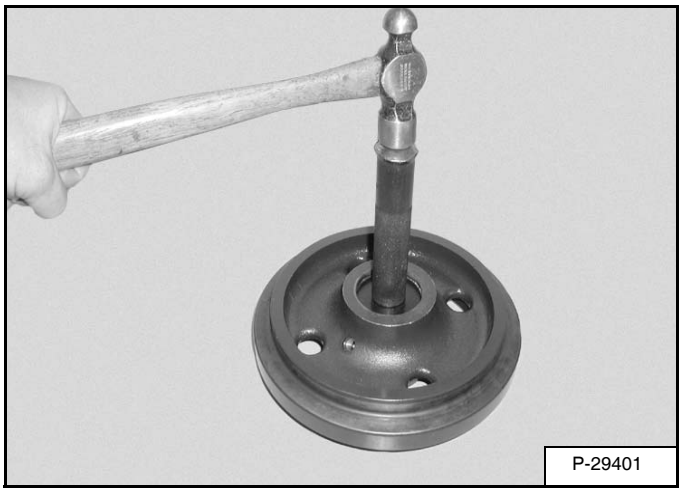
The bearings are sealed. If the bearings do not roll smoothly, or if the seals are damaged, replace the bearings.

Figure 30-50-54



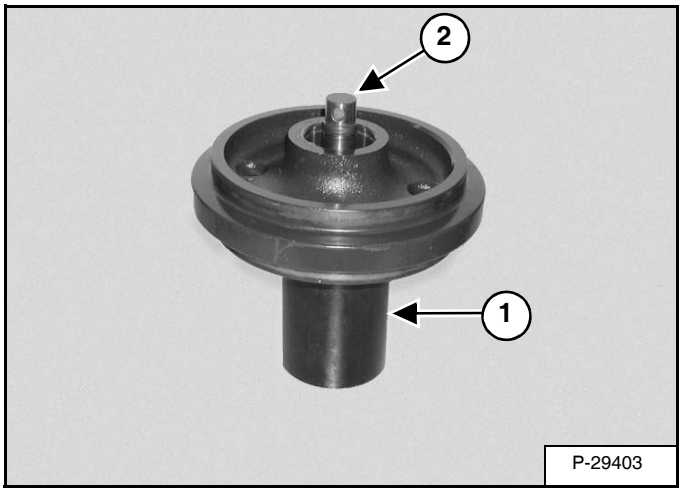
Remove all paint and corrosion from the seal surface (Item 1) **[Figure 30-50-54]** on both sides of the idler.

Figure 30-50-55



Using a bearing driver, install the bearing in the idler **[Figure 30-50-55]**.

Figure 30-50-56

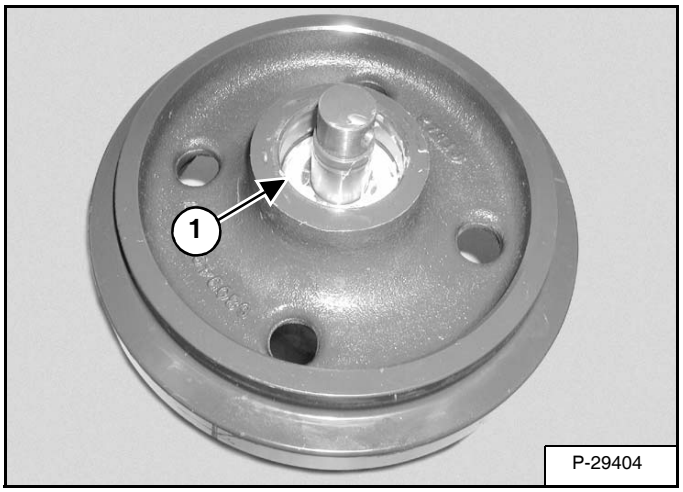


Place the idler on the support fixture (Item 1) **[Figure 30-50-56]**.

Install the shaft (Item 2) **[Figure 30-50-56]**.

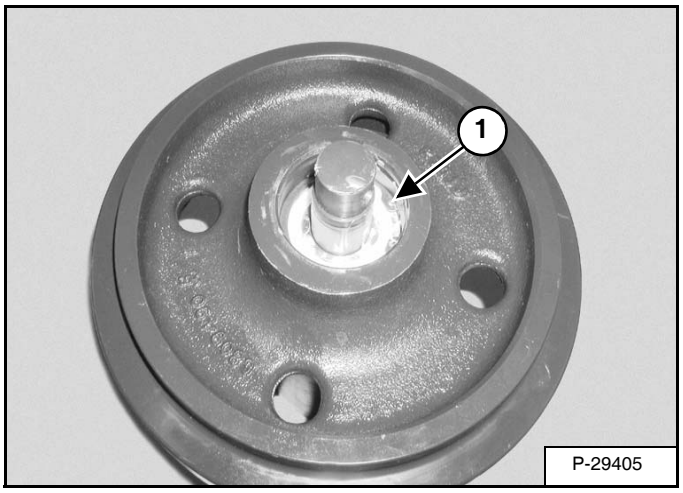
Assembly (Cont'd)

Figure 30-50-57



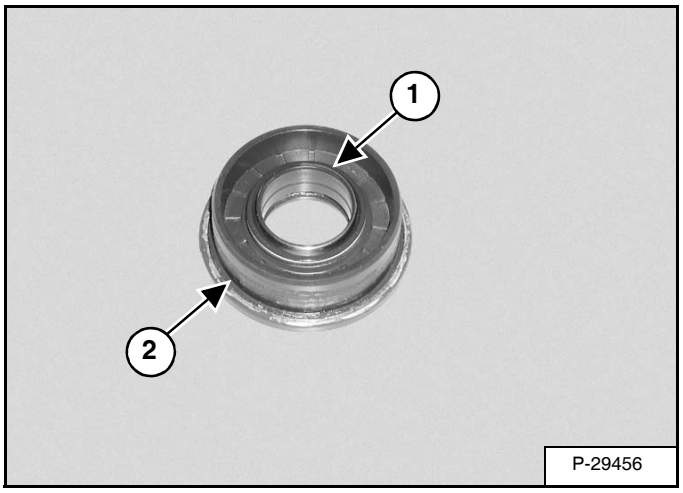
Install the bearing (Item 1) **[Figure 30-50-57]**. Use a brass drift to seat the bearing.

Figure 30-50-58



Install the snap ring (Item 1) **[Figure 30-50-58]**.

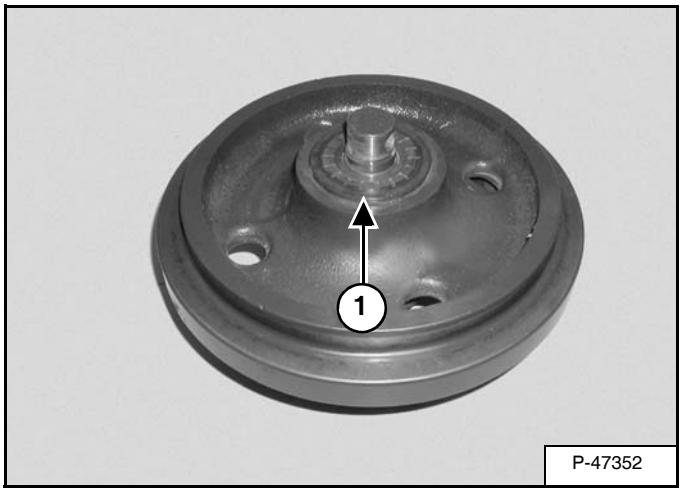
Figure 30-50-59



Apply assembly lube to the inside diameter (Item 1) **[Figure 30-50-59]** of the seal.

Apply a small bead of high temperature silicone sealant around the flange surface (Item 2) **[Figure 30-50-59]** of the seal.

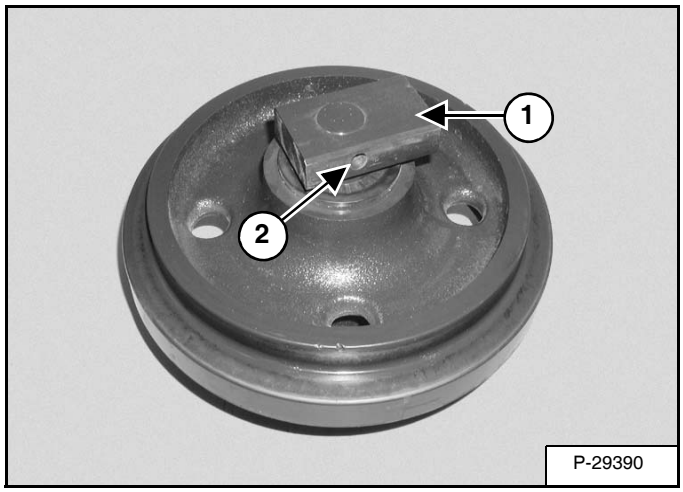
Figure 30-50-60



Using the driving tool, install the seal (Item 1) **[Figure 30-50-60]** on both sides of the idler.

Assembly (Cont'd)

Figure 30-50-61

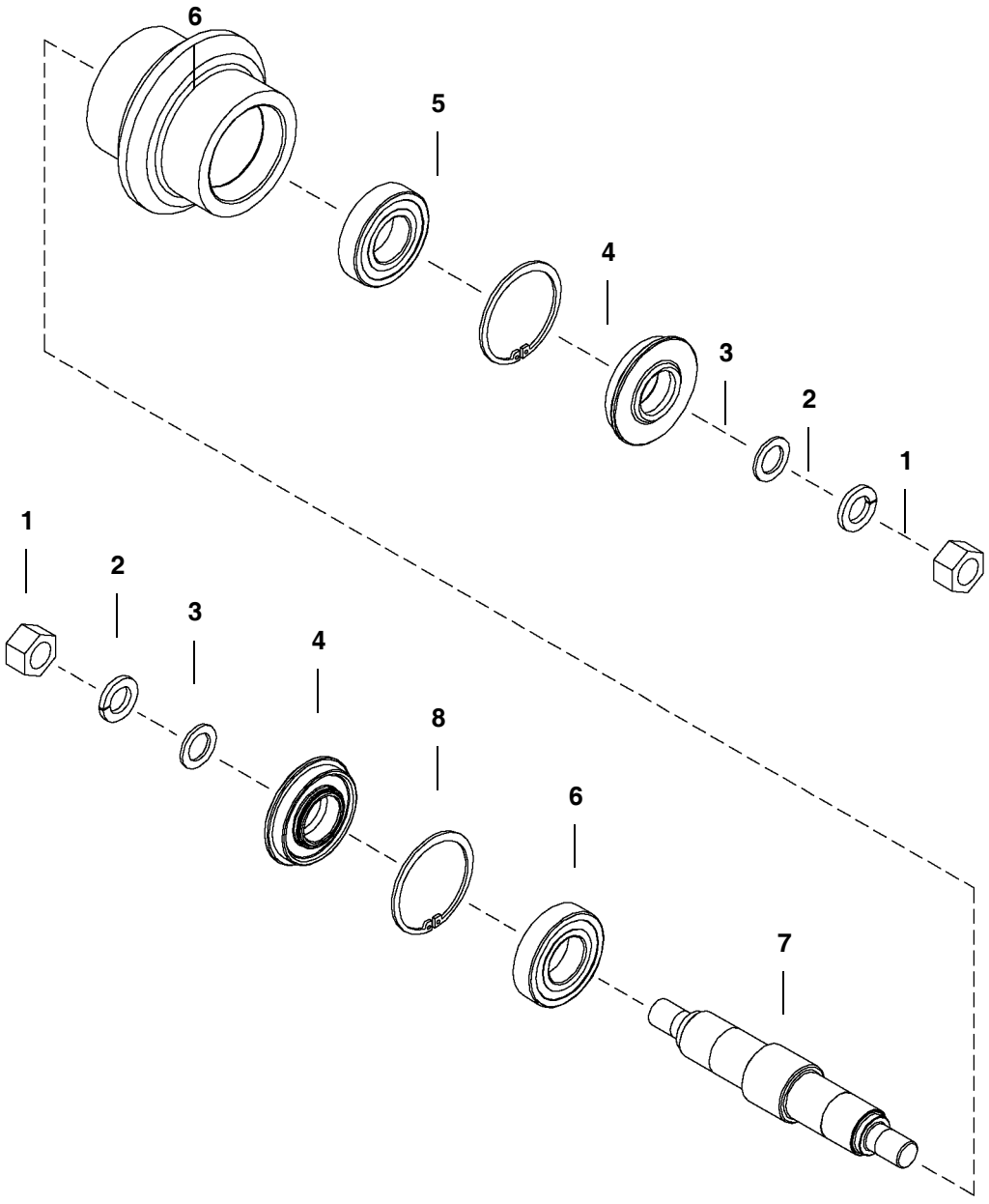


Install the block (Item 1) and roll pin (Item 2) **[Figure 30-50-61]** on both sides of the shaft.

TRACK ROLLER

Parts Identification

1. Nut
2. Lock Washer
3. Washer
4. Seal
5. Roller
6. Bearing
7. Shaft
8. Snapring

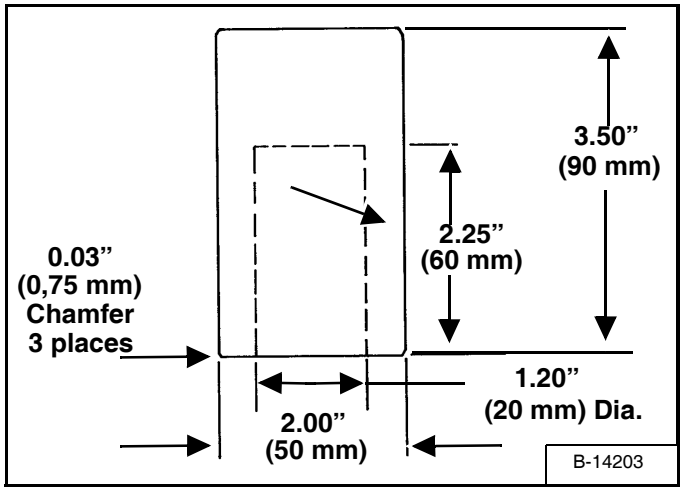


PE1914S

Disassembly

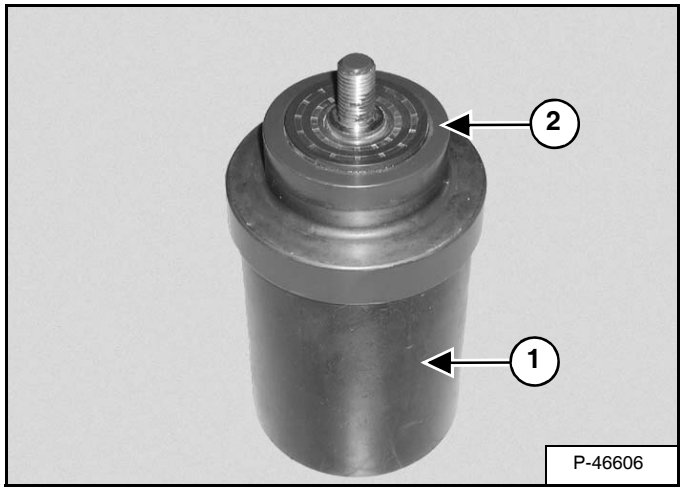
The following tools must be fabricated for this procedure:

Figure 30-60-62



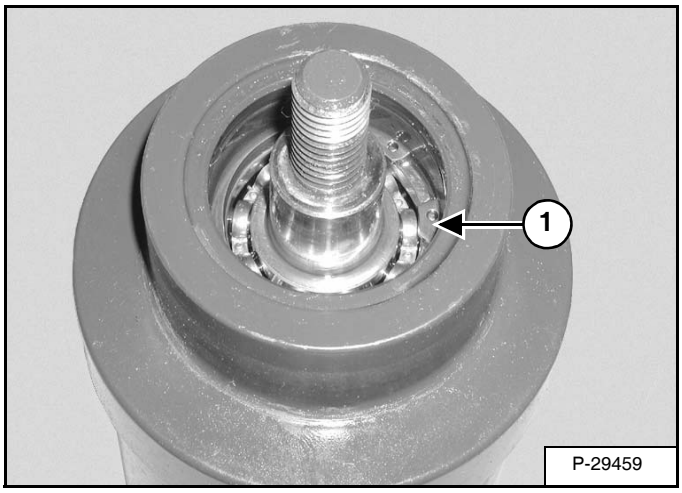
1. Driver Tool - see **[Figure 30-60-62]**.
2. Support Fixture - Tube, 3" ID x 1/4" wall x 6 inches long.

Figure 30-60-63



Support the roller in the support fixture (Item 1). Remove the seal (Item 2) **[Figure 30-60-63]** from both sides of the roller.

Figure 30-60-64

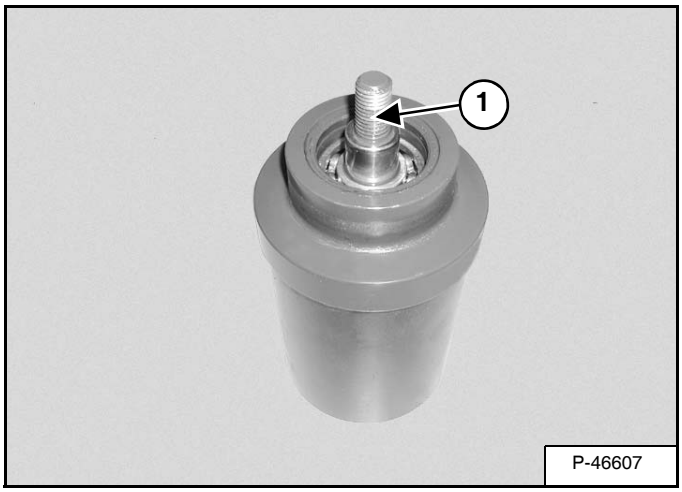


Remove the snap ring (Item 1) **[Figure 30-60-64]**.

NOTE: The snapring is installed on one side of the roller. The other side is stepped to retain the bearing.

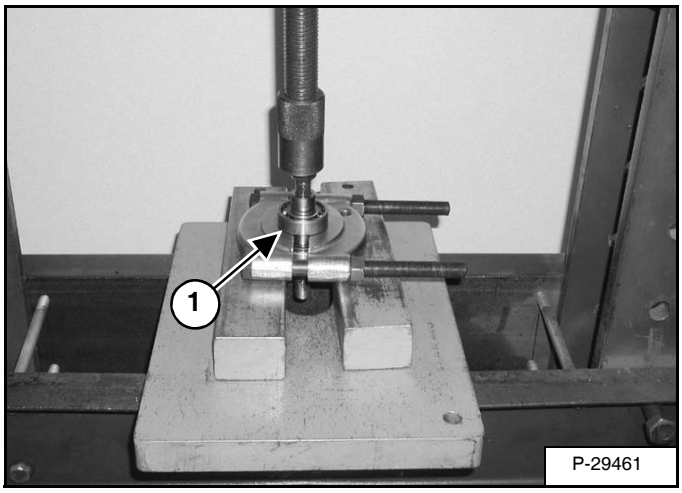
Disassembly (Cont'd)

Figure 30-60-65



Turn the roller over and tap the shaft (Item 1) **[Figure 30-60-65]** and bearings out the bottom of the roller.

Figure 30-60-66

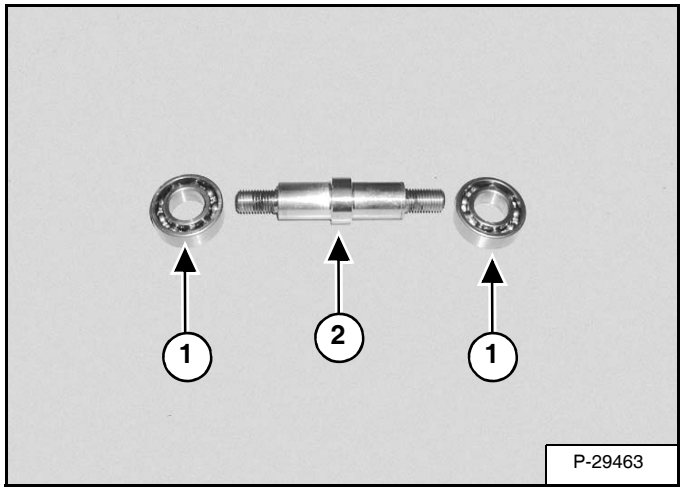


Press the bearings (Item 1) **[Figure 30-60-66]** off the shaft.

Assembly

Clean all parts in solvent and dry with compressed air.

Figure 30-60-67

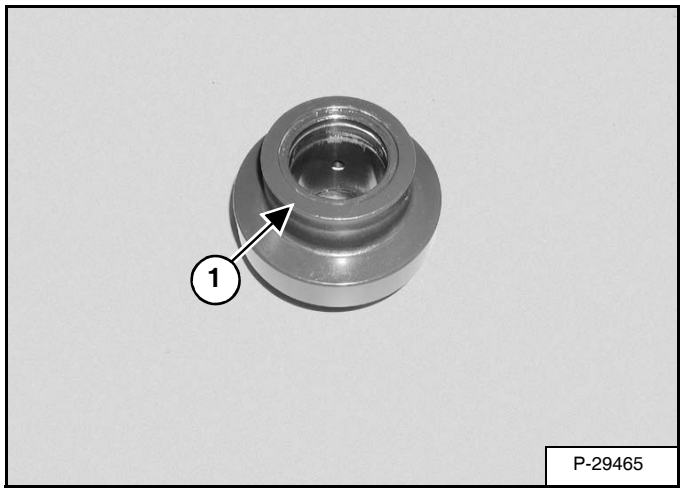


Inspect the bearings (Item 1) and shaft (Item 2) **[Figure 30-60-67]** for wear or damage.

The bearings are sealed. If the bearings do not roll smoothly or if the seals are damaged, replace the bearings.

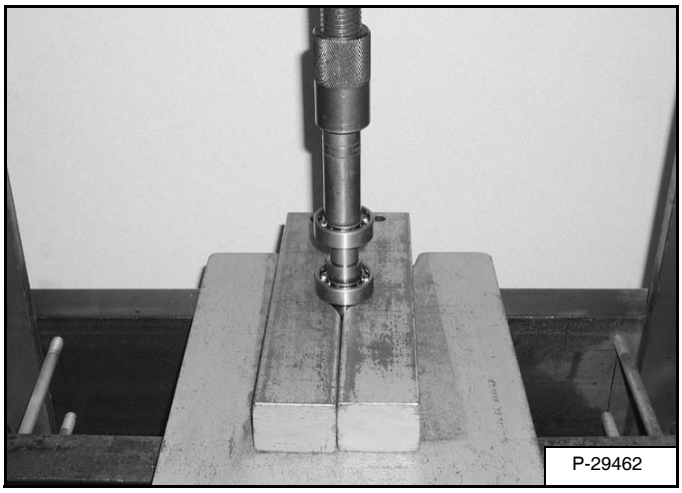
Replace any worn or damaged parts.

Figure 30-60-68



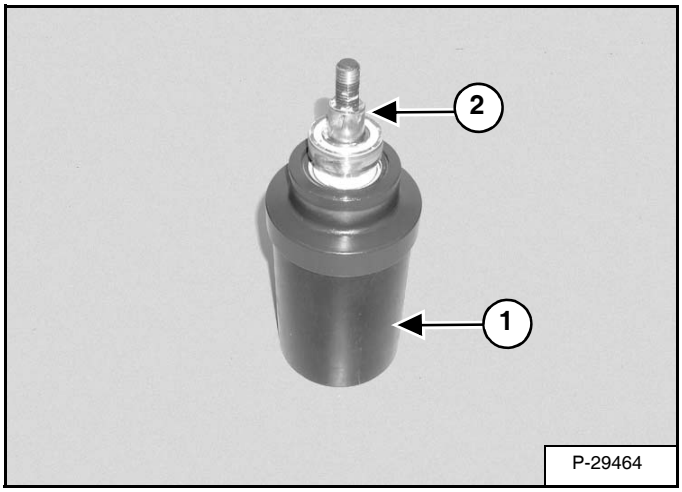
Remove all paint and corrosion from the seal surface (Item 1) **[Figure 30-60-68]** on both sides of the roller.

Figure 30-60-69



Press the bearings (Item 1) **[Figure 30-60-69]** on the shaft.

Figure 30-60-70

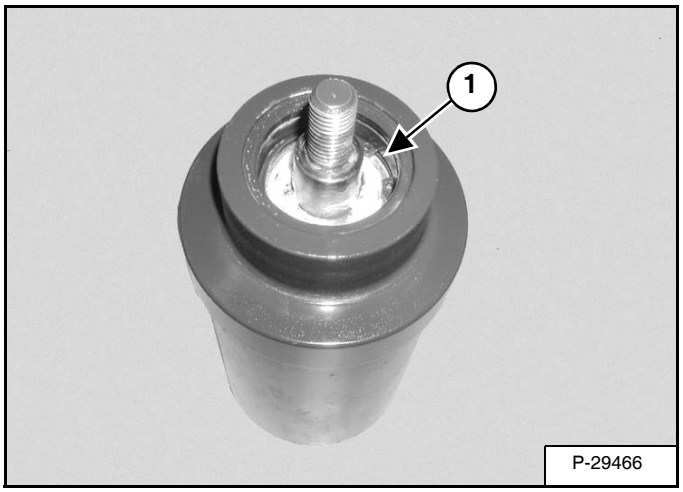


Place the roller on the support fixture (Item 1) **[Figure 30-60-70]**.

Tap the shaft and bearing assembly (Item 2) **[Figure 30-60-70]** into the roller.

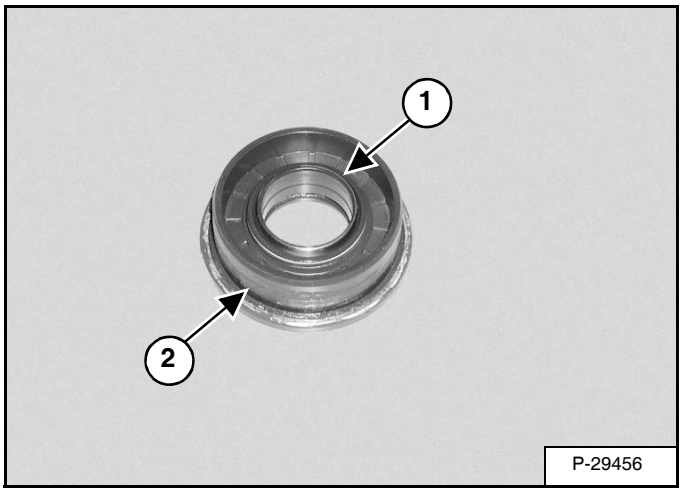
Assembly (Cont'd)

Figure 30-60-71



Install the snap ring (Item 1) **[Figure 30-60-71]**.

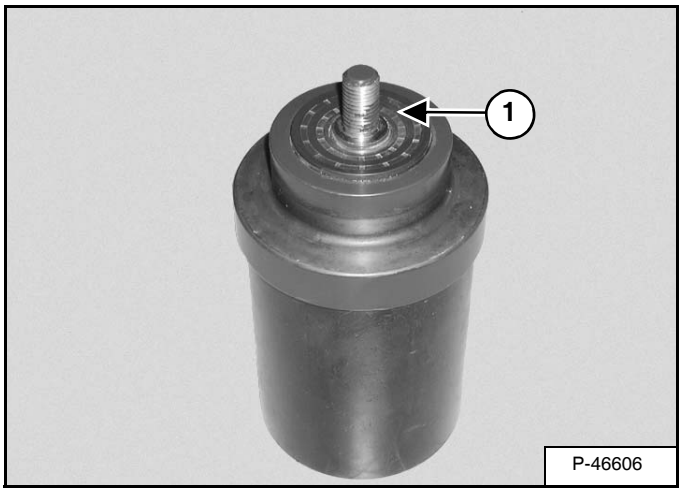
Figure 30-60-72



Apply assembly lube to the inside diameter (Item 1) **[Figure 30-60-72]** of the seal.

Apply a small bead of high temperature silicone sealant around the flange surface (Item 2) **[Figure 30-60-72]** of the seal.

Figure 30-60-73



Using the driving tool, install the seal (Item 1) **[Figure 30-60-73]** on both sides of the roller.


Bobcat®

SWING CIRCLE GEAR

Removal and Installation

Remove the upperstructure from the swing circle gear. (See Removal on Page 40-10-1.)

Figure 30-70-1

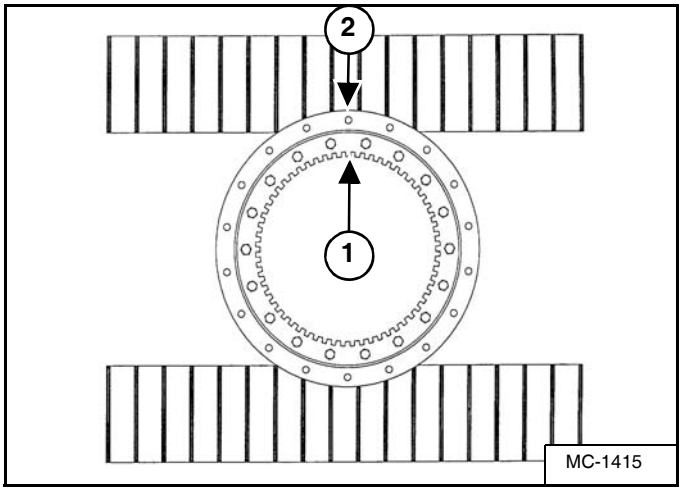
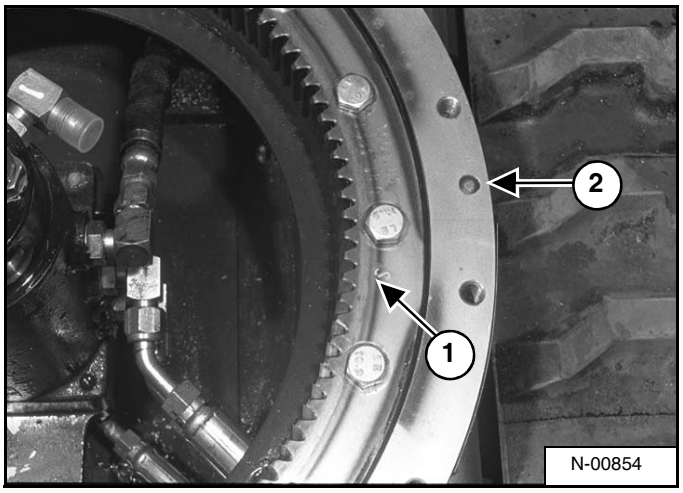


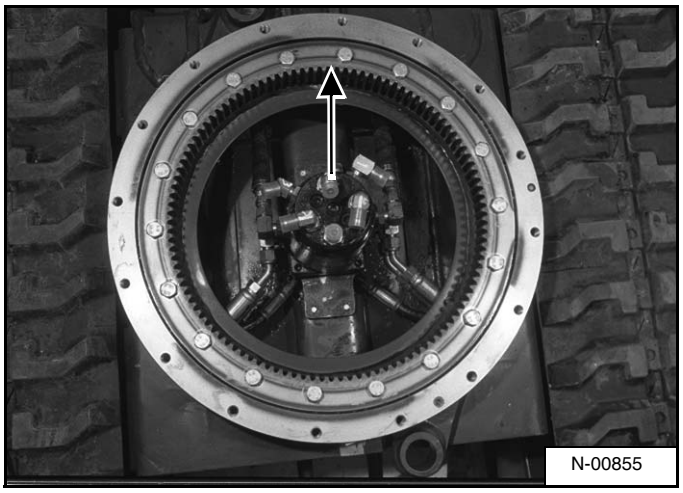
Figure 30-70-2



The swing gear and outer ring both have a soft zone. The swing gear soft zone is identified with an S (Item 1) stamped in the swing gear. The outer ring soft zone is identified by a filler plug (Item 2) **[Figure 30-70-1]** & **[Figure 30-70-2]** pressed into the outer ring.

The soft zones of both the swing gear and outer ring must be positioned to the right side of the center line of the Excavator.

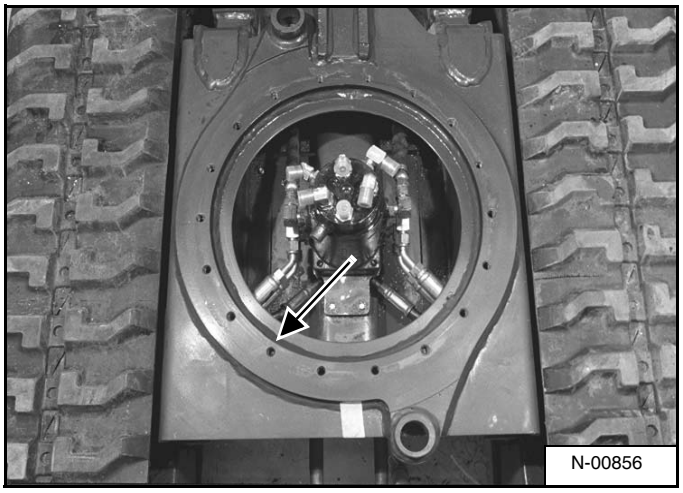
Figure 30-70-3



Remove the bolts from the swing circle gear **[Figure 30-70-3]**.

Installation: Apply thread lock adhesive (LOCTITE #242) to the bolt threads and tighten to 78 - 85 ft.-lb. (105 - 115 Nm) torque.

Figure 30-70-4



Using a 10 X 1.5 mm tap, clean the track frame bolt holes to remove the old thread lock adhesive.


Bobcat®

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Installation 40-10-3
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Bobcat®

UPPERSTRUCTURE

Removal

Fully extend the cylinders of the bucket, arm & boom.

Lower the blade to the ground.

Disconnect the battery negative (-) cable. (See Removing And Installing The Battery on Page 50-20-2.)

Remove the cab or canopy. (See Removal And Installation on Page 40-30-1.)

Drain the hydraulic reservoir. (See Replacing Hydraulic Oil on Page 10-100-2.)

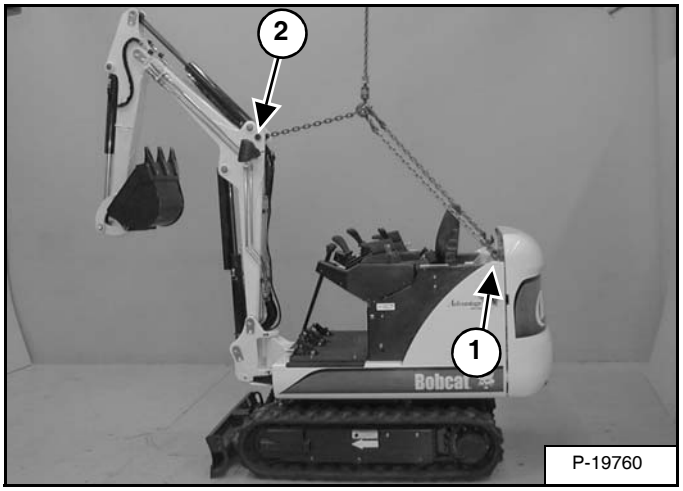
Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

Remove the hydraulic control valve. (See Removal And Installation on Page 20-40-1.)

Remove the swing motor. (See Removal and Installation on Page 20-90-1.)

Figure 40-10-1



Install eye bolts (Item 1) **[Figure 40-10-1]** in the rear cab/ canopy mounts.

Fasten chains to the eyebolts and up to the chain hoist.

Install a 1 inch (.25 mm) bolt (Grade 5) (Item 2) **[Figure 40-10-1]** through the hole at the top of the boom. Fasten a chain from the bolt to the chain hoist.

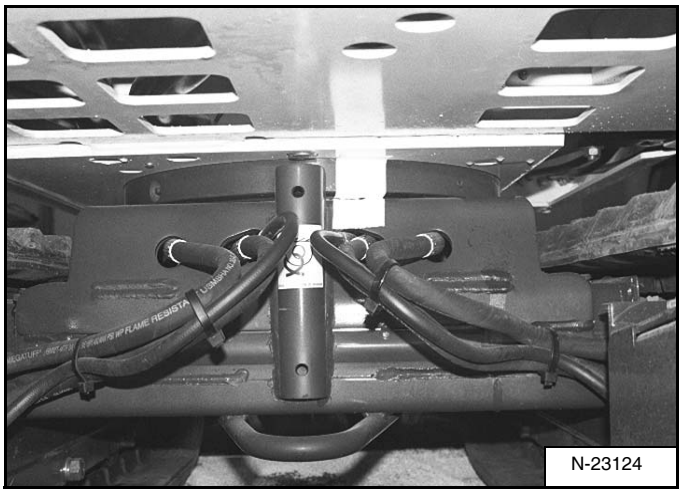
⚠ WARNING

AVOID INJURY OR DEATH

- **Use a lifting fixture with sufficient capacity for the weight of the excavator plus any added attachments.**
- **Maintain center of gravity and balance when lifting.**
- **Do not swing boom or upperstructure. Engage the swing locking lever.**
- **Never lift with operator on machine.**

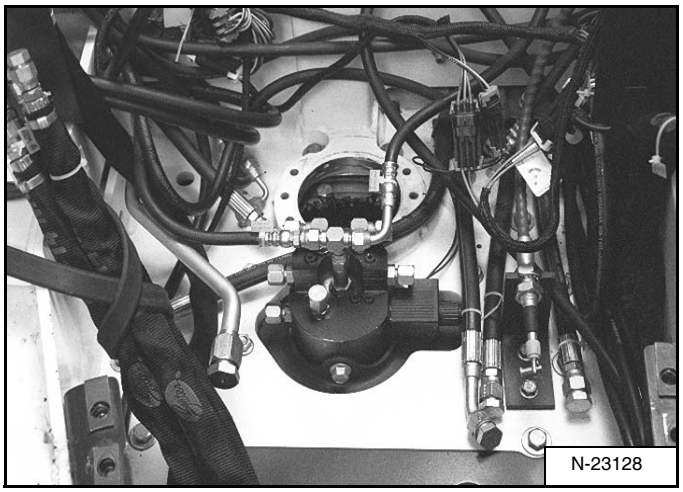
W-2202-0595

Figure 40-10-2



Mark the upperstructure to the swing bearing and to the track frame for assembly **[Figure 40-10-2]**.

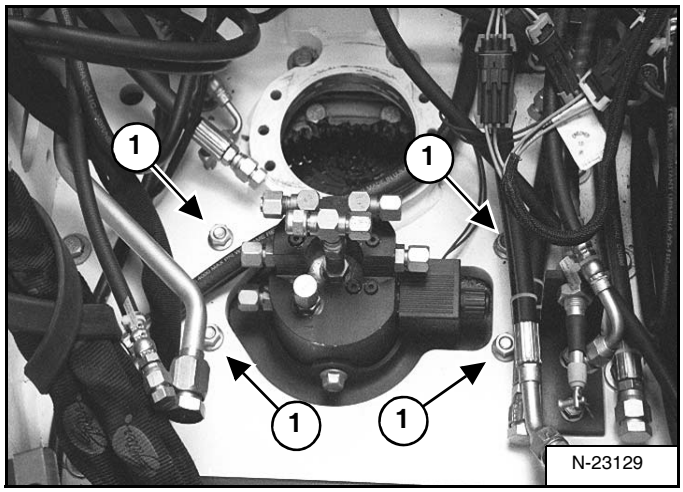
Figure 40-10-3



Mark and remove the remaining hoses from the swivel joint **[Figure 40-10-3]**.

Removal (Cont'd)

Figure 40-10-4



Remove the swivel joint nuts (Item 1) **[Figure 40-10-4]**.

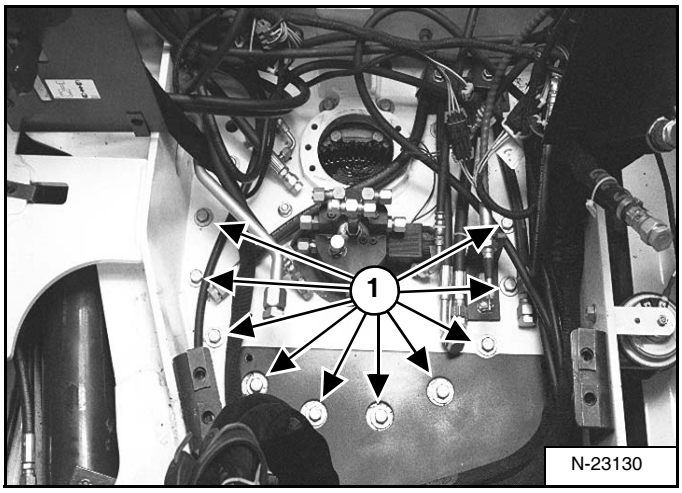
IMPORTANT

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.

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Apply a small amount of lifting pressure to the upperstructure with the chain hoist.

Figure 40-10-5



Remove the sixteen bolts (Item 1) **[Figure 40-10-5]** from the upperstructure.

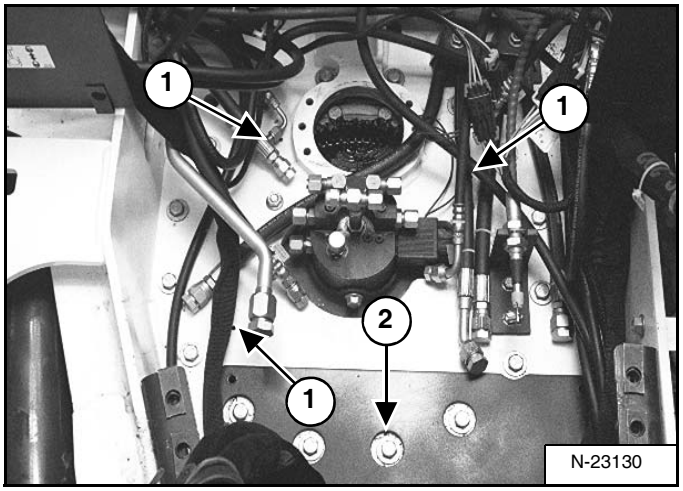
Lift the upperstructure off the swing bearing. Position the upperstructure onto supporting stands or blocks.

NOTE: Keep tension on the chain hoist to support the boom and arm when the upperstructure is supported on stands or blocks.

Installation

Lower the frame onto the swing bearing. Maintain a slight amount of weight on the hoist.

Figure 40-10-6



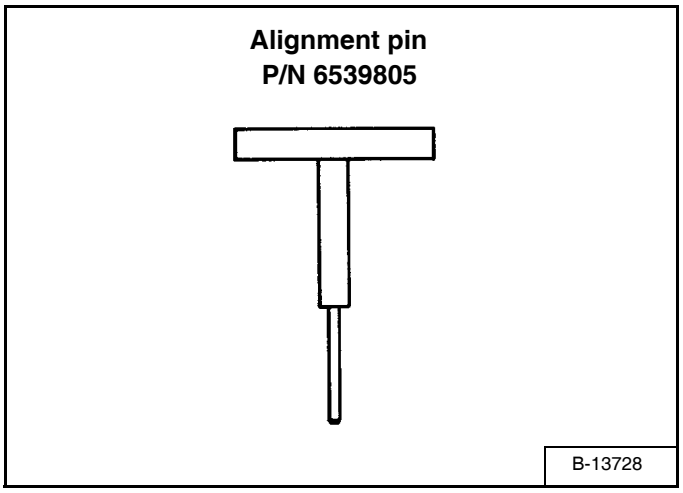
Remove any paint from the three alignment pin holes (Item 1) **[Figure 40-10-6]** in the frame.

Apply thread lock adhesive (LOCTITE #242) to the threads of the bolts.

Install the sixteen bolts and washers (Item 2) **[Figure 40-10-6]** through the frame and into the swing bearing.

DO NOT tighten the bolts at this time.

Figure 40-10-7



Insert the three alignment pins (P/N 639805) **[Figure 40-10-7]** & (Item 1) **[Figure 40-10-6]** into the alignment holes.

Reposition the frame as necessary until the alignment pins will slide through the frame and into the teeth of the swing bearing.

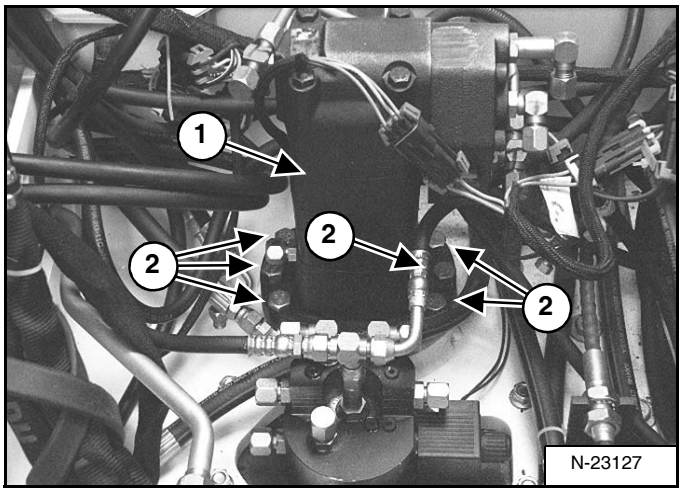
With the pins installed, lower the upperstructure onto the swing bearing and remove the hoist.

Tighten the bolts to 44-47 ft.-lbs. (60-65 Nm) torque.

Remove the alignment pins.

Installation (Cont'd)

Figure 40-10-8



Install the swing motor (Item 1) **[Figure 40-10-8]**.

Apply thread lock adhesive (LOCTITE #242) to the threads of the six bolts (Item 2) **[Figure 40-10-8]** and install.

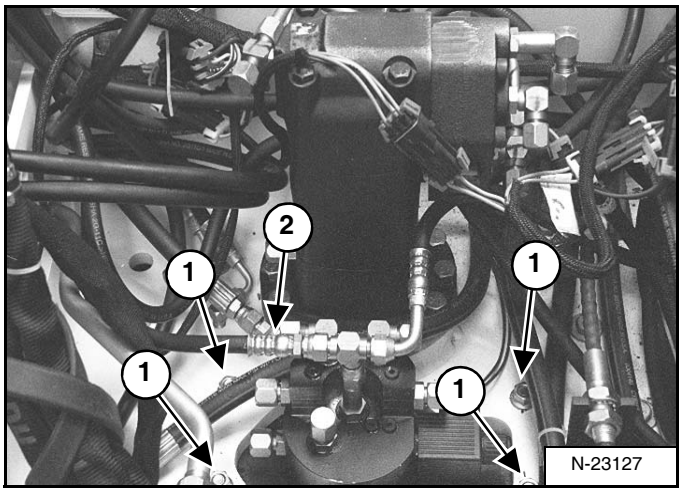
Tighten the bolts to 29-37 ft.-lbs. (40-50 Nm) torque.

Remove the caps and/or plugs from the swing motor. Do not install any hoses.

The swing motor gear to the swing bearing gear engagement must be checked for back lash between the gears through 360° of frame rotation.

Check for back lash by moving the frame back and forth at several points throughout the frames rotation. There must be some backlash present.

Figure 40-10-9



Install the swivel joint nuts (Item 1) **[Figure 40-10-9]**.

Install the hoses (Item 2) **[Figure 40-10-9]** on the swivel joint.

Install the hydraulic control valve. (See Removal And Installation on Page 20-40-1.)

Install the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

Install the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Fill the hydraulic reservoir. (See Replacing Hydraulic Oil on Page 10-100-2.)

Install the cab or canopy. (See Removal And Installation on Page 40-30-1.)

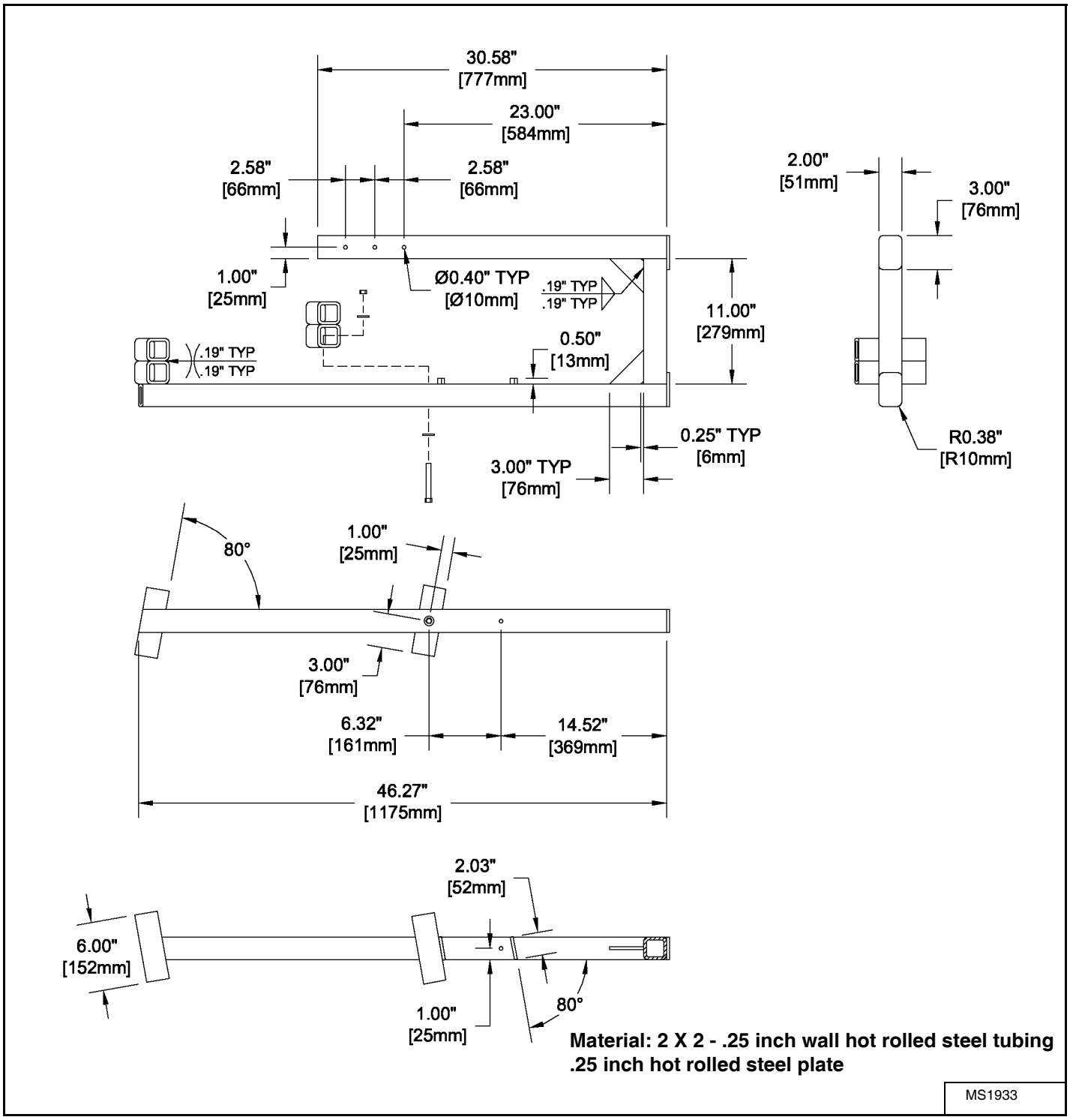
Connect the negative (-) battery cable. (See Removing And Installing The Battery on Page 50-20-2.)

ROPS CANOPY

Removal And Installation

Build the service lifting bracket used to remove and install the ROPS canopy. Use the dimensions shown **[Figure 40-20-10]** to build the service lifting bracket.

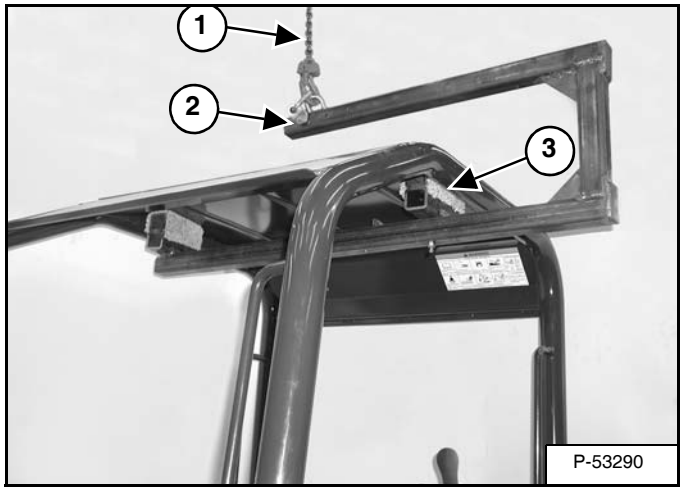
Figure 40-20-10



Removal And Installation (Cont'd)

Remove the upperstructure light. (See Upper Structure Light Removal And Installation on Page 50-50-1.)

Figure 40-20-11



Install the chain hoist (Item 1) in the end hole of the lifting bracket (Item 2) **[Figure 40-20-11]**.

Install the cab/canopy service lifting bracket on the cab (Item 2) **[Figure 40-20-11]**.

NOTE: Use a lifting device of sufficient capacity.

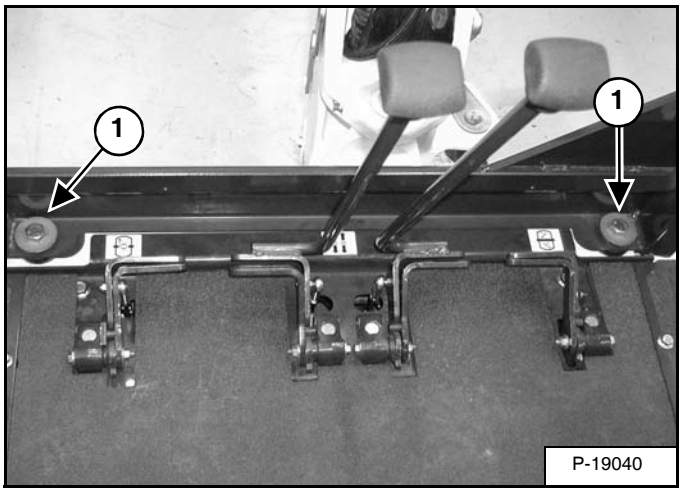
Adjust the lifting bracket to the proper width by moving the bracket (Item 3) **[Figure 40-20-11]**.

⚠ WARNING

Never use the cab/canopy service lifting bracket to lift the excavator. The bracket is not strong enough and can fail causing serious injury or death.

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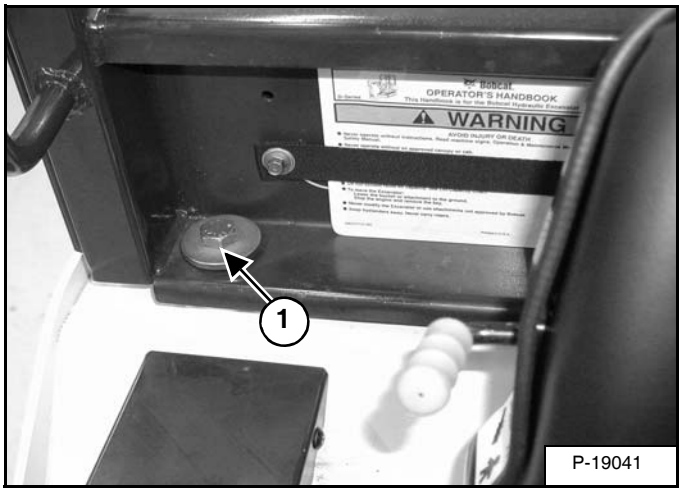
Figure 40-20-12



Remove the bolts, nuts and washers (Item 1) **[Figure 40-20-12]** from the front of the canopy.

Installation: Tighten the bolts to 118-133 ft.-lbs. (160-180 Nm) torque.

Figure 40-20-13

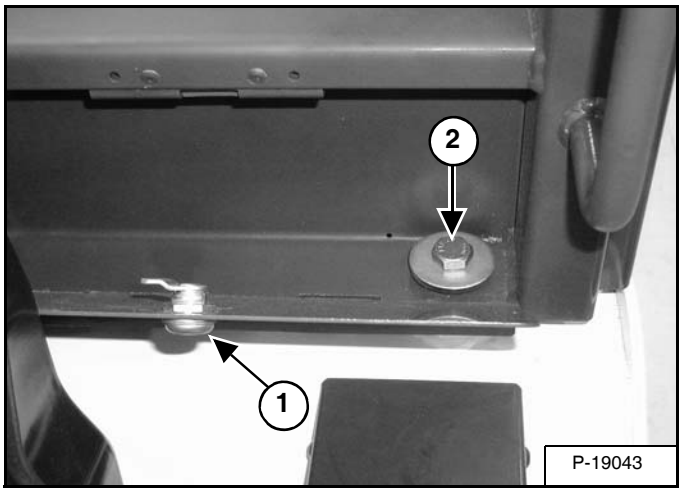


Remove the bolt and washer (Item 1) **[Figure 40-20-13]** from the right rear of the canopy.

Installation: Tighten the bolt to 118-133 ft.-lbs. (160-180 Nm) torque.

Removal And Installation (Cont'd)

Figure 40-20-14



Open and remove the Operation & Maintenance Manual storage door (Item 1) **[Figure 40-20-14]** with the start key.

NOTE: Later models are not equipped with the storage door.

Remove the bolt and washer (Item 2) **[Figure 40-20-14]** from the left rear of the canopy.

Installation: Tighten the bolt to 118-133 ft.-lbs. (160-180 Nm) torque.

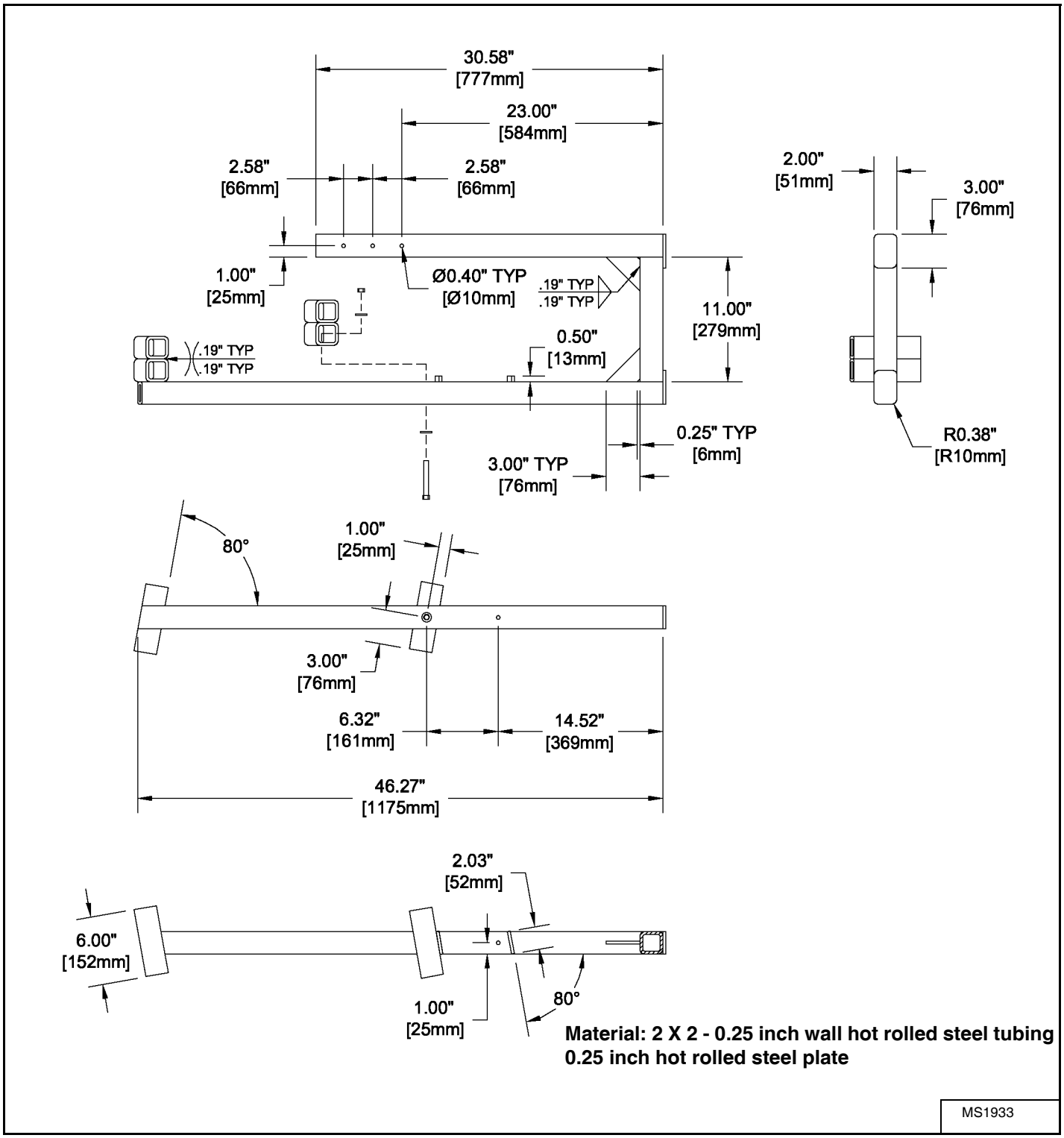
Remove the canopy from the upperstructure.


Bobcat

Removal And Installation

Build the service lifting bracket used to remove and install the cab. Use the dimensions shown **[Figure 40-30-15]** to build the service lifting bracket.

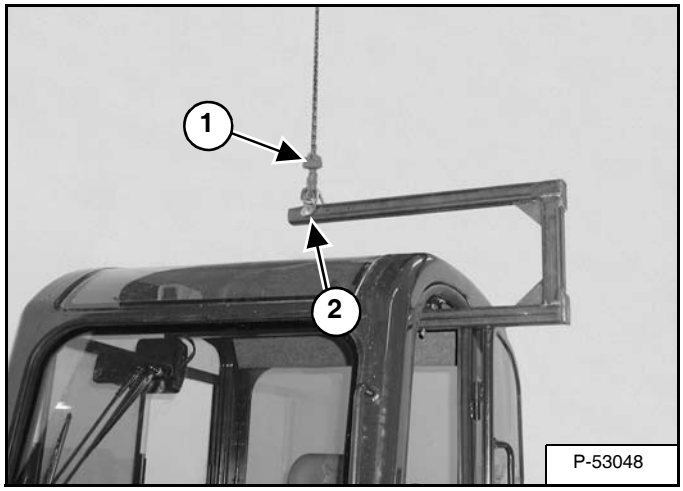
Figure 40-30-15



Removal And Installation (Cont'd)

Remove the upperstructure light. (See Upper Structure Light Removal And Installation on Page 50-50-1.)

Figure 40-30-16



Install the chain hoist (Item 1) in the end hole of the lifting bracket (Item 2) **[Figure 40-30-16]**.

Install the cab/canopy service lifting bracket on the cab **[Figure 40-30-16]**.

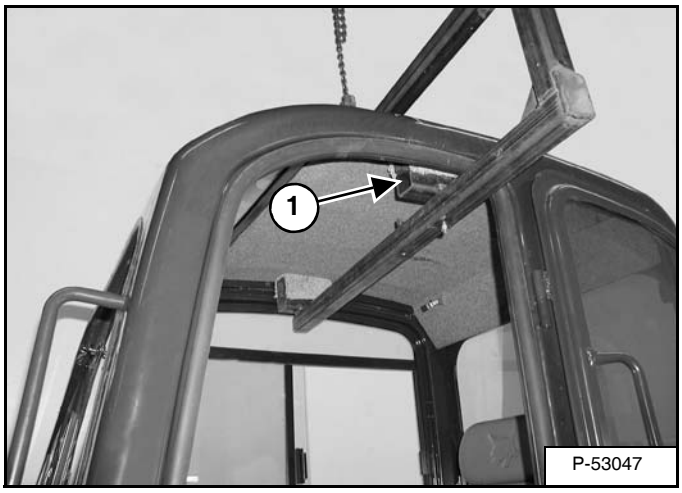
NOTE: Use a chain hoist of sufficient capacity.

⚠ WARNING

Never use the cab/canopy service lifting bracket to lift the Excavator. The bracket is not strong enough and can fail causing serious injury or death.

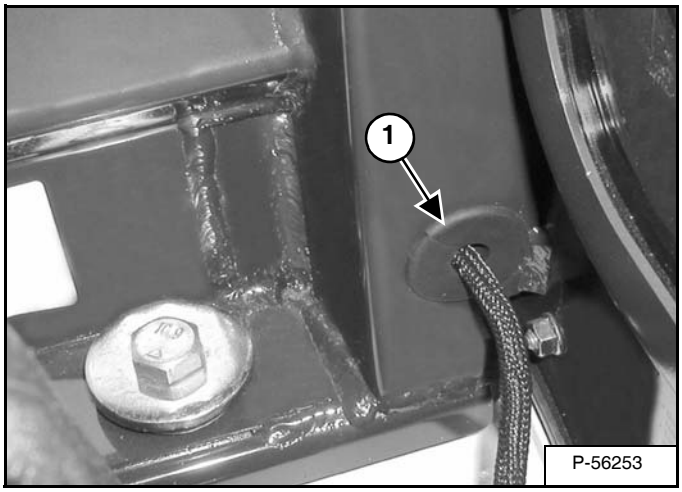
W-2384-1000

Figure 40-30-17



Adjust the lifting bracket to the proper width by moving the bracket (Item 1) **[Figure 40-30-17]**.

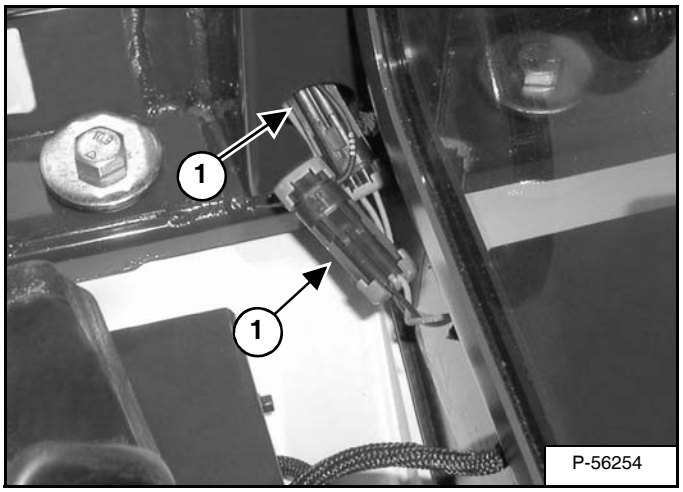
Figure 40-30-18



Remove the grommet (Item 1) **[Figure 40-30-18]** located in the left rear corner of the cab.

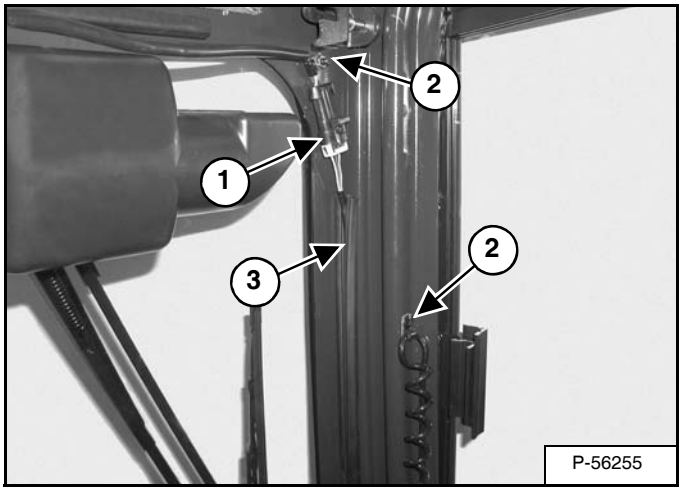
Removal And Installation (Cont'd)

Figure 40-30-19



Remove the wire harness from the cab frame and disconnect the wire connectors (Item 1) **[Figure 40-30-19]**.

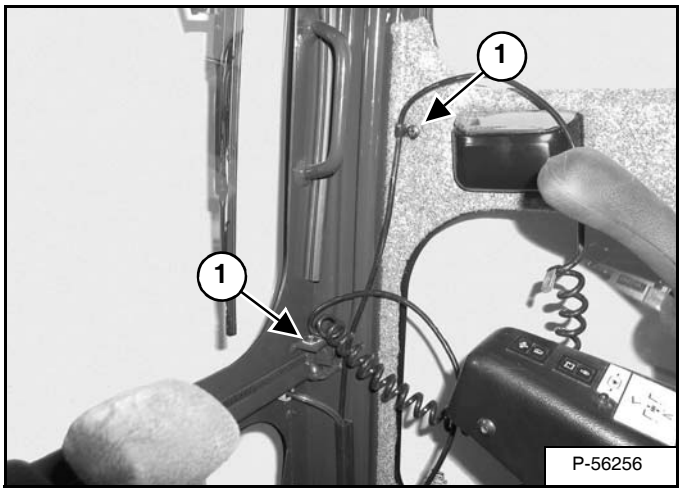
Figure 40-30-20



Disconnect the wire harness (Item 1) and remove the screws (Item 2) **[Figure 40-30-20]**.

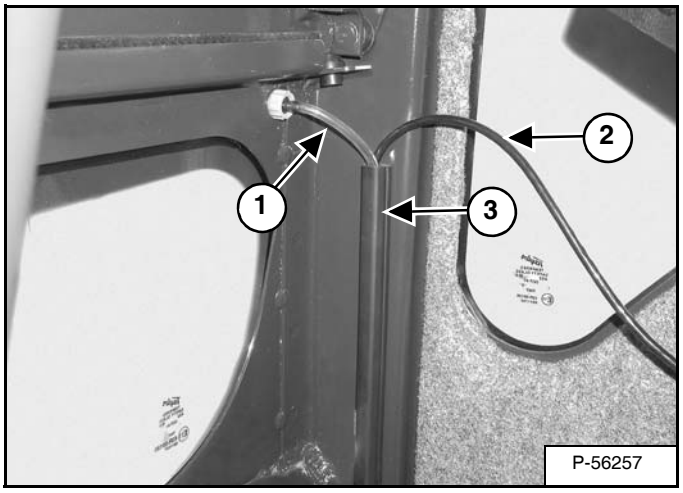
Remove the wire harness from the channel (Item 3) **[Figure 40-30-20]**.

Figure 40-30-21



Remove the screws (Item 1) **[Figure 40-30-21]**.

Figure 40-30-22

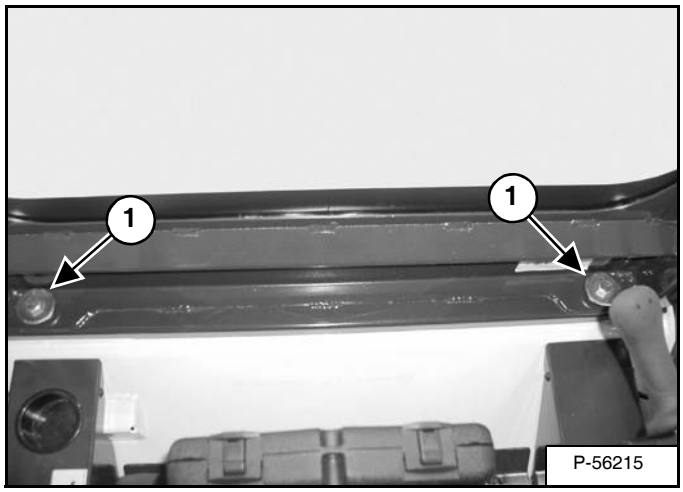


Remove the windshield washer hose (Item 1) **[Figure 40-30-22]** from the nozzle.

Remove the wire harness (Item 2) and washer hose from the channel (Item 3) **[Figure 40-30-22]**.

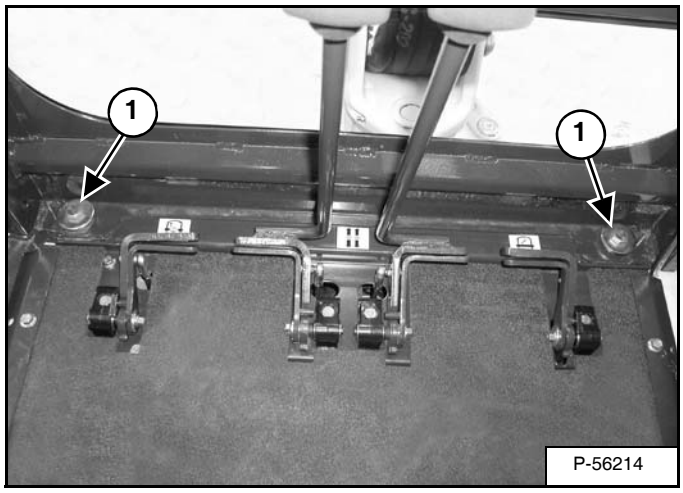
Removal And Installation (Cont'd)

Figure 40-30-23



Remove the bolts and washers (Item 1) **[Figure 40-30-23]** from the rear of the cab.

Figure 40-30-24

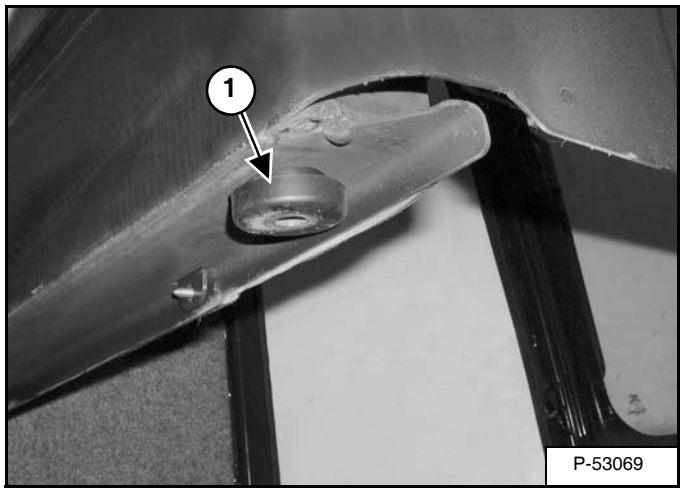


Remove the bolts and washers (Item 1) **[Figure 40-30-24]** from the front of the cab.

Installation: Tighten the bolts to 118-133 ft.-lbs. (160-180 Nm) torque.

Raise the hoist and remove the cab.

Figure 40-30-25



Installation: Install the cab mounts (Item 1) **[Figure 40-30-25]** on the four corners of the cab.

Door Removal And Installation

Figure 40-30-26

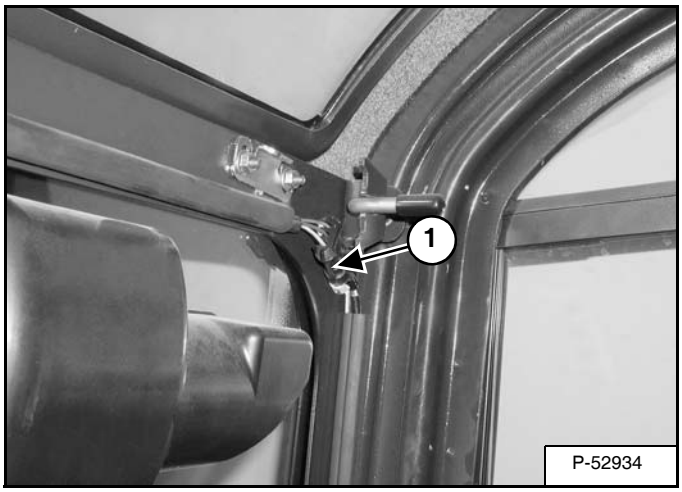


The door can be removed from the cab by slowly swinging the door back and forth while lifting up on the door **[Figure 40-30-26]**.

Installation: Align the hinges and swing the door back and forth until the door weight settles the hinges to full engagement.

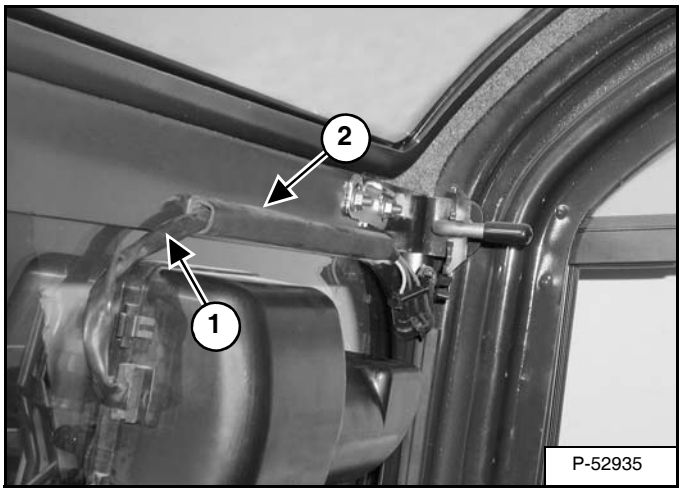
Front Window Removal And Installation

Figure 40-30-27



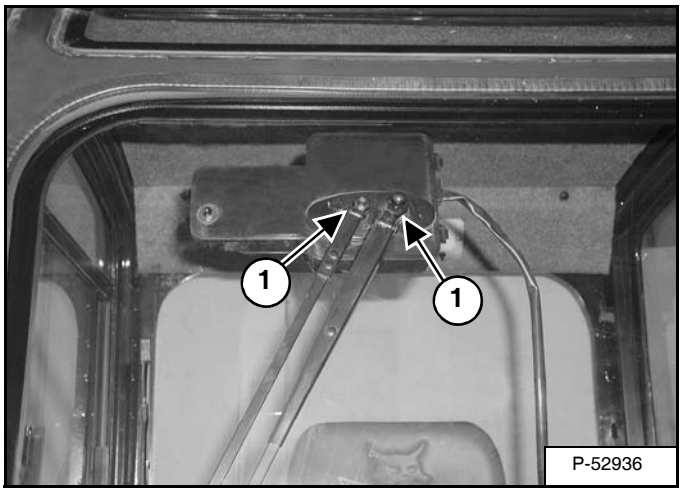
Disconnect the wire harness (Item 1) **[Figure 40-30-27]**.

Figure 40-30-28



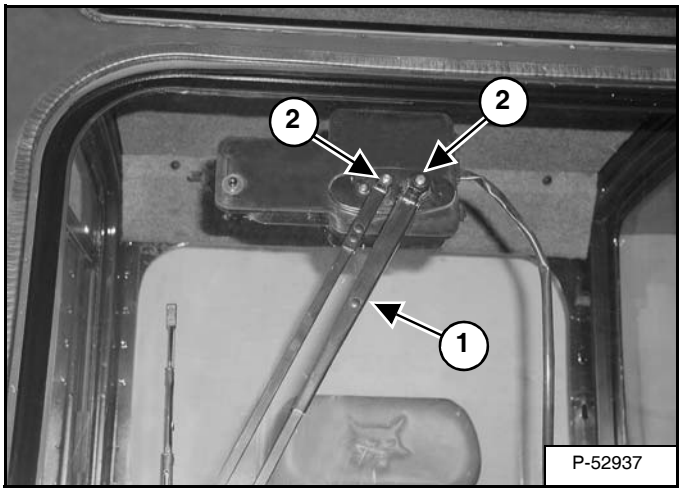
Remove the wire harness (Item 1) from the channel (Item 2) **[Figure 40-30-28]**.

Figure 40-30-29



Remove the nuts (Item 1) **[Figure 40-30-29]**.

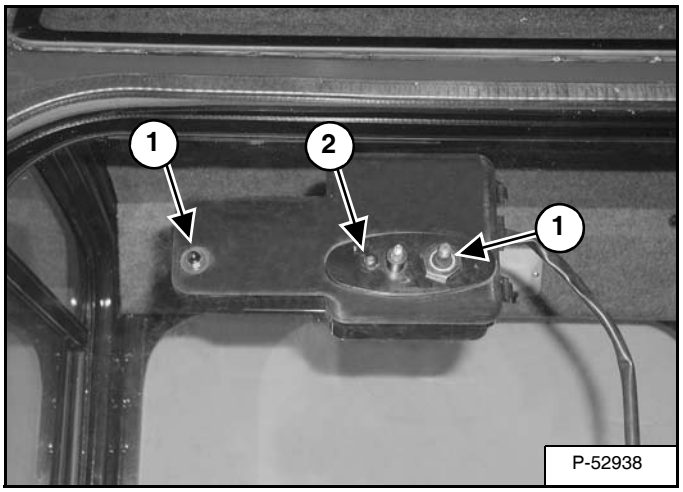
Figure 40-30-30



Remove the wiper assembly (Item 1) from the pivot mounts (Item 2) **[Figure 40-30-30]**.

Front Window Removal And Installation (Cont'd)

Figure 40-30-31

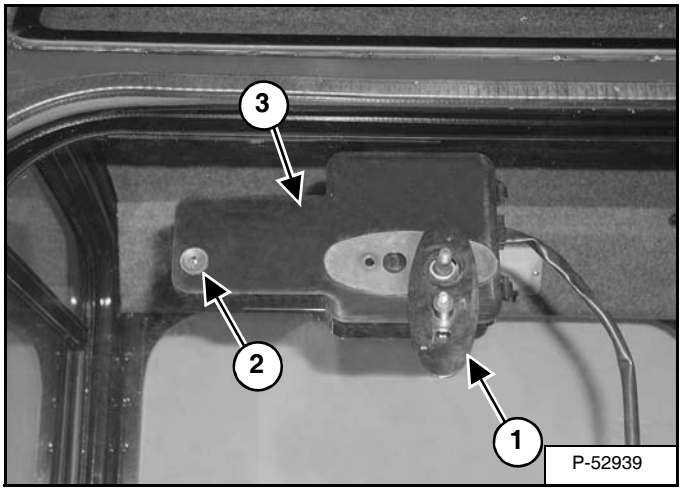


Remove the nuts and washers (Item 1) **[Figure 40-30-31]**.

Remove the bolt (Item 2) **[Figure 40-30-31]**.

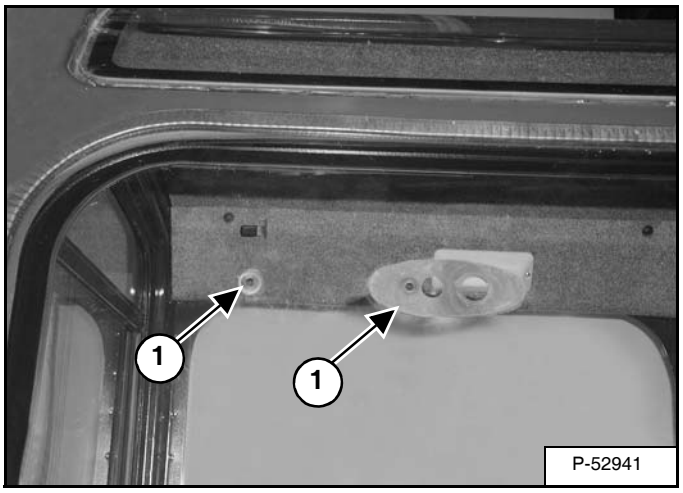
NOTE: Support the wiper motor before removing the bolts.

Figure 40-30-32



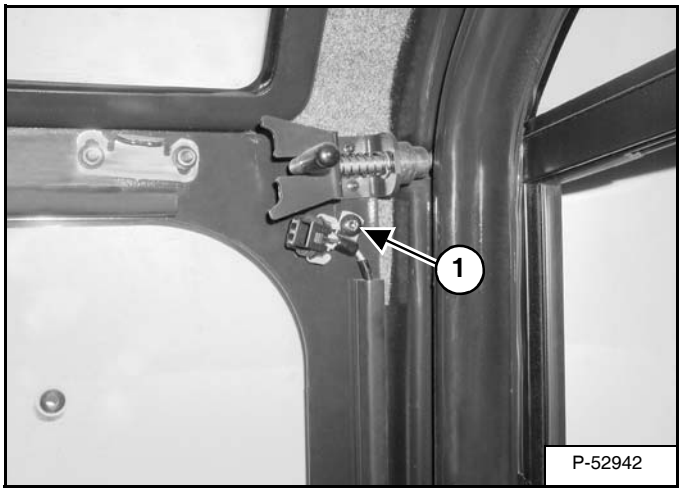
Remove the plate (Item 1), washer (Item 2), and wiper motor (Item 3) **[Figure 40-30-32]**.

Figure 40-30-33



Remove the seals (Item 1) and bushings **[Figure 40-30-33]**.

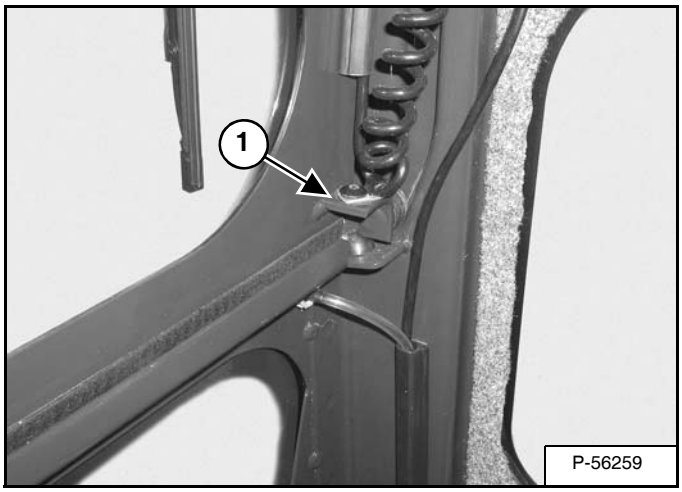
Figure 40-30-34



Remove the screw (Item 1) **[Figure 40-30-34]** holding the wire harness clamp to the top of the front window.

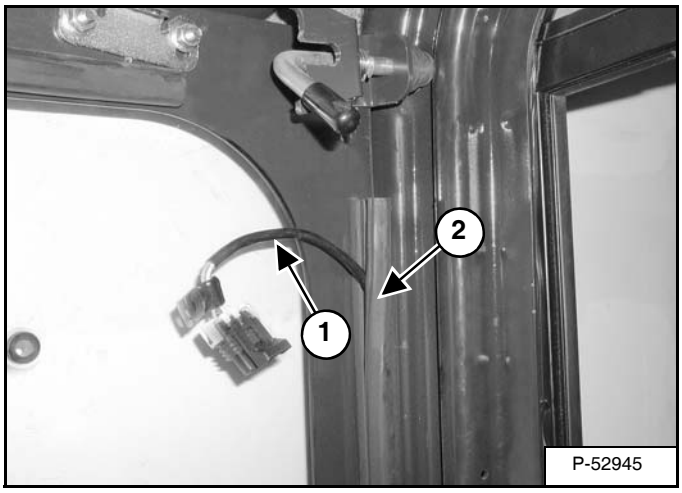
Front Window Removal And Installation (Cont'd)

Figure 40-30-35



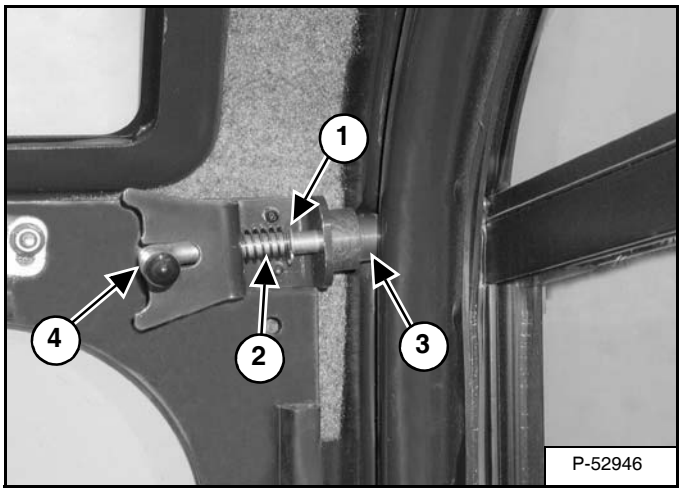
Remove the screw (Item 1) **[Figure 40-30-35]** holding the wire harness clamp to the bottom of the front window.

Figure 40-30-36



Remove the wire harness (Item 1) from the channel (Item 2) **[Figure 40-30-36]**.

Figure 40-30-37



With the help of a second person holding the front window, remove the retainer (Item 1), spring (Item 2), roller (Item 3), and handle (Item 4) **[Figure 40-30-37]** from both sides of the front window.

Figure 40-30-38

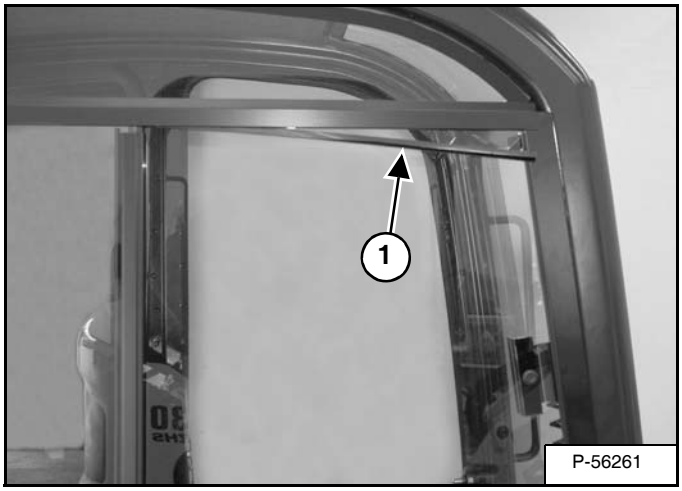


Tilt the front window (Item 1) **[Figure 40-30-38]**. Remove the front window from the cab.

Right Side Rear Sliding Window Removal And Installation

Close and latch the front and rear sliding windows.

Figure 40-30-39



Use a pick to pull the felt (Item 1) **[Figure 40-30-39]** from the top window channel.

Unlatch the rear sliding window and slide the window open until it stops.

Figure 40-30-40



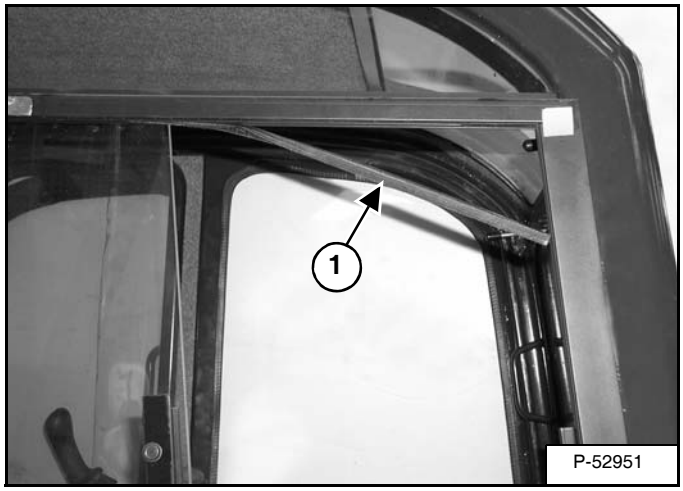
Lift the window up into the top channel and tilt the bottom edge out **[Figure 40-30-40]**. Remove the window from the cab.

Right Side Front Sliding Window Removal And Installation

NOTE: The rear sliding window must be removed before the front sliding window can be removed.

Unlatch the front sliding window and slide the window open until it stops.

Figure 40-30-41



Use a pick to pull the felt (Item 1) **[Figure 40-30-41]** from the inside top window channel.

Figure 40-30-42

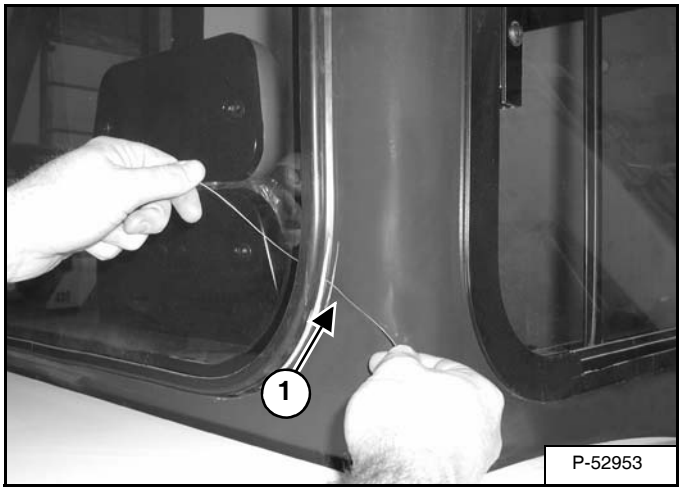


Lift the window up into the channel and tilt the bottom edge out **[Figure 40-30-42]**. Remove the window from the cab.

Glass Removal

Use the following procedure to remove the glass from the rear of the cab and right side window assembly.

Figure 40-30-43



Push a small diameter wire (Item 1) **[Figure 40-30-43]** through the adhesive. Pull the wire around the perimeter of the glass to cut the adhesive.

Remove the glass.

NOTE: The right side window frame is aluminum and will be destroyed when removed.

Glass Installation

Rear and front lower glass

Remove the majority of the old urethane adhesive from the perimeter of the cab.

NOTE: Leave a thin film of the old urethane on the cab frame, fresh urethane will bond to the remaining film.

Prime and paint any bare metal or scratches.

Clean the metal surfaces with general purposes adhesive cleaner. Clean the glass surface with glass cleaner.

Figure 40-30-44

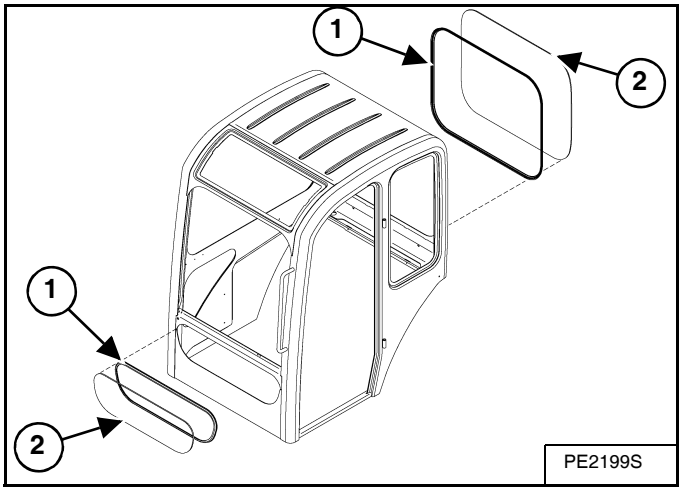
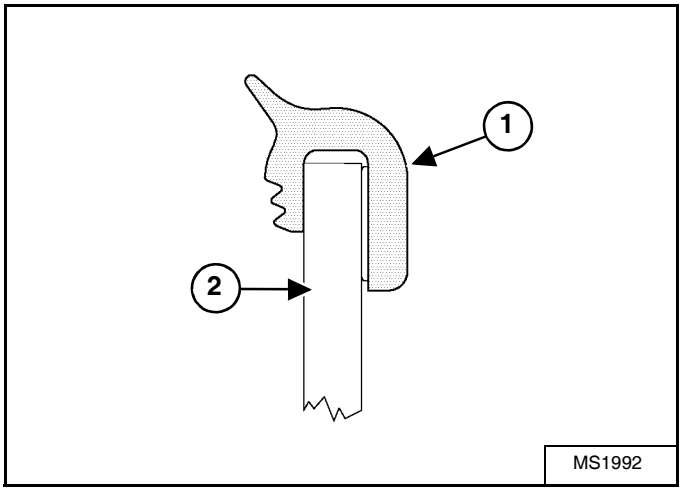


Figure 40-30-45



Install the seal (Item 1) on the glass (Item 2) **[Figure 40-30-44]** & **[Figure 40-30-45]**.

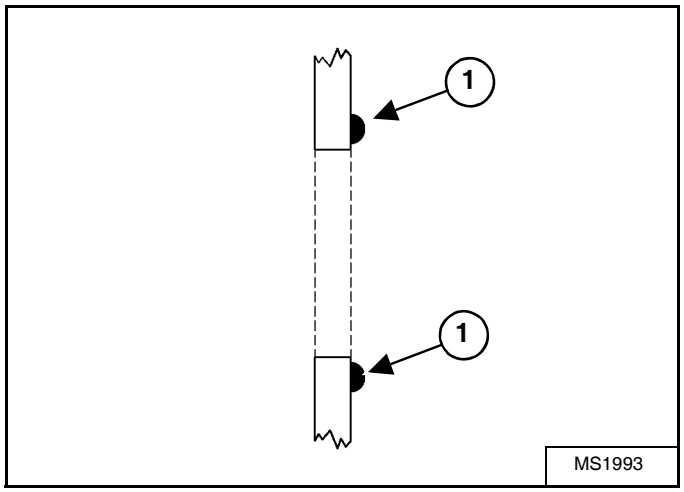
Shake the combo primer for one minute.

Apply the combo primer to the perimeter of the cab and glass (Item 2) **[Figure 40-30-45]**. Apply the primer in one direction only, using a dauber. Do not dip the dauber in the primer more than once. Use multiple daubers if needed.

Allow the combo primer to dry for five minutes. Dry time doubles if the primer is applied in two coats.

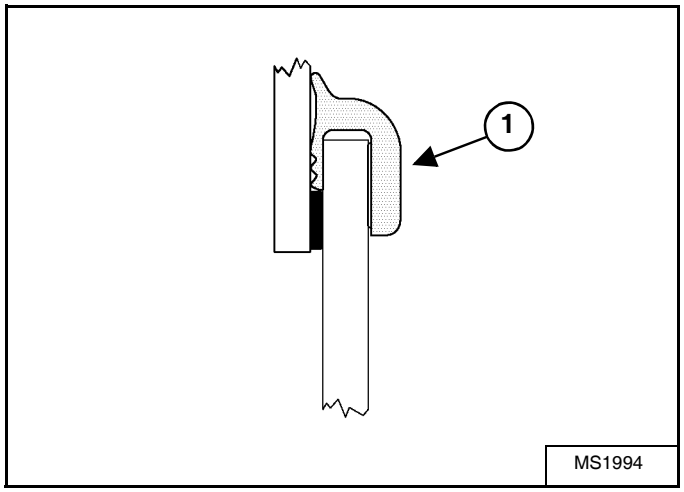
Cut the tip of the adhesive tube to the desired shape and size to provide a bead height sufficient to give good contact with the glass around the entire perimeter.

Figure 40-30-46



Apply a 0.3 x 0.25 inch bead of urethane adhesive (Item 1) **[Figure 40-30-46]** to the perimeter of the cab.

Figure 40-30-47



Install the glass and seal assembly (Item 1) **[Figure 40-30-47]**. Press the glass into the cab to make complete contact with the adhesive. Tape the glass in place.

CAB (CONT'D)

Glass Installation (Cont'd)

Allow 2 hours for curing at normal conditions (65° F, 75% relative humidity).

Remove the tape after the adhesive is cured.

Top, right side and left side glass

Remove the majority of the old urethane adhesive from the perimeter of the cab.

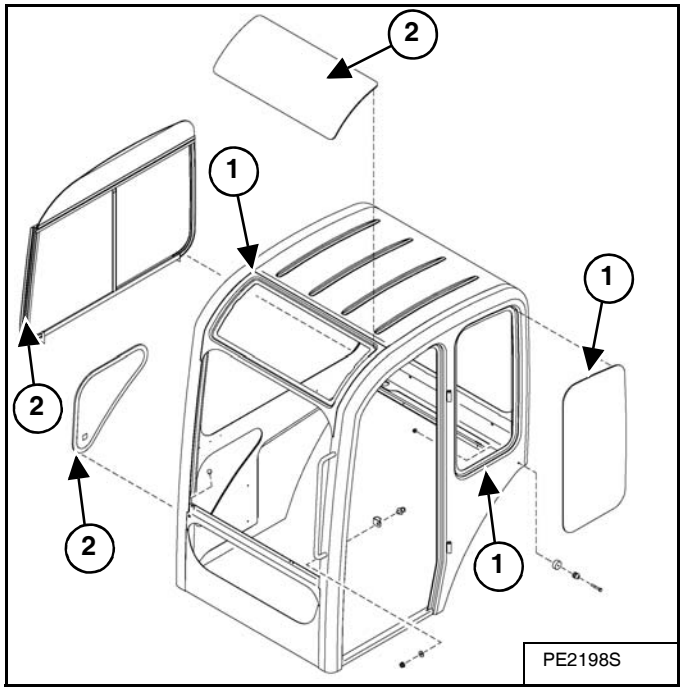
NOTE: Leave a thin film of the old urethane on the cab frame, fresh urethane will bond to the remaining film.

Prime and paint any bare metal or scratches.

Clean the metal surfaces with general purposes adhesive cleaner. Clean the glass surface with glass cleaner.

Shake the combo primer for one minute.

Figure 40-30-48

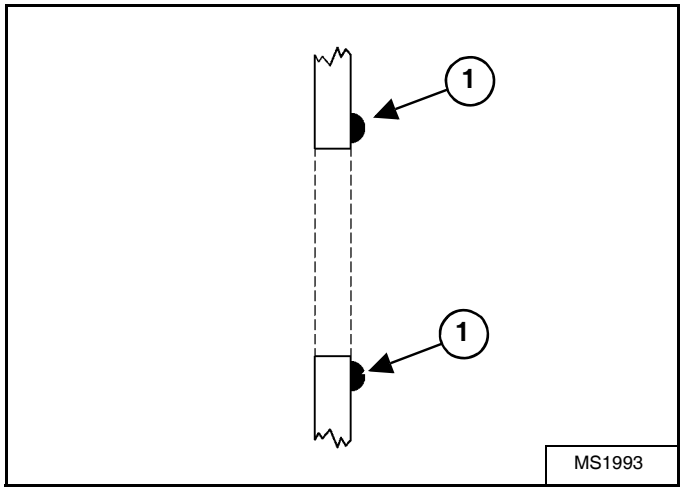


Apply combo primer to the perimeter of the cab (Item 1) and glass (Item 2) **[Figure 40-30-48]**. Apply the primer in one direction only, using a dauber. Do not dip the dauber in the primer more than once. Use multiple daubers if needed.

Allow the combo primer to dry for five minutes. Dry time doubles if the primer is applied in two coats.

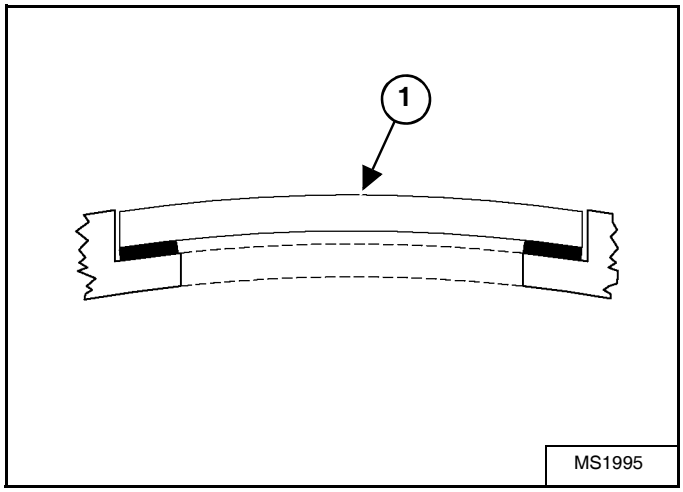
Cut the tip of the adhesive tube to the desired shape and size to provide a bead height sufficient to give good contact with the glass around the entire perimeter.

Figure 40-30-49



Apply a 0.3 x 0.25 inch bead of urethane adhesive (Item 1) **[Figure 40-30-49]** to the perimeter of the cab.

Figure 40-30-50



Install the glass (Item 1) **[Figure 40-30-50]**. Press the glass into the cab to make complete contact with the adhesive. Tape the glass in place.

Allow 2 hours for curing at normal conditions (65° F, 75% relative humidity).

Remove the tape after the adhesive is cured.

Door and front window glass

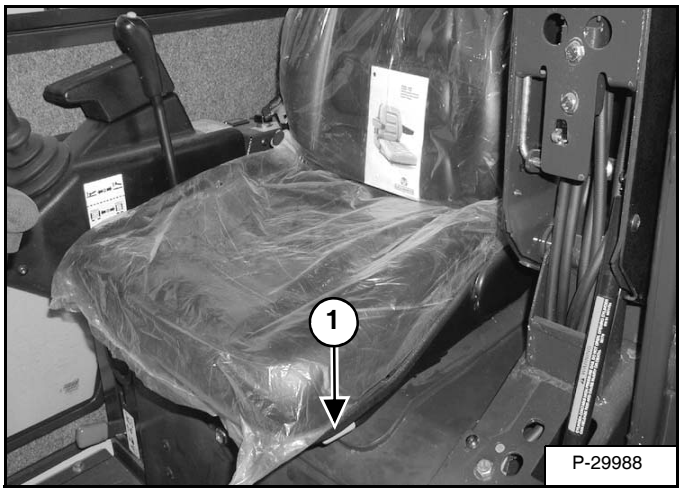
The door and front window glass are not available separately.

Order and install the door or front window frame and glass assembly.

SEAT AND SEAT MOUNT

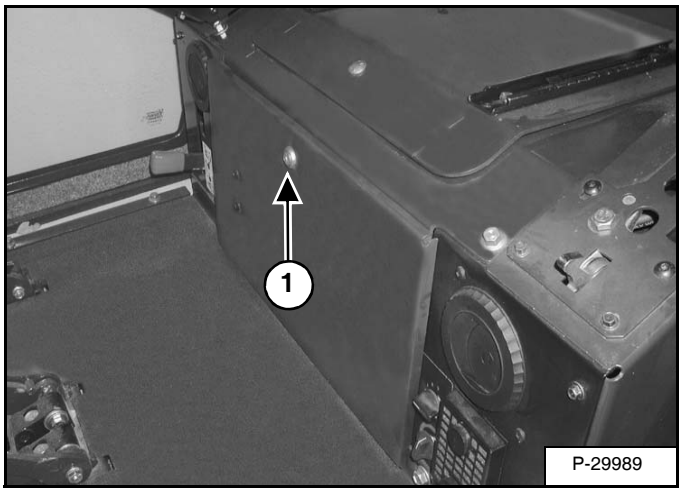
Removal And Installation

Figure 40-40-51



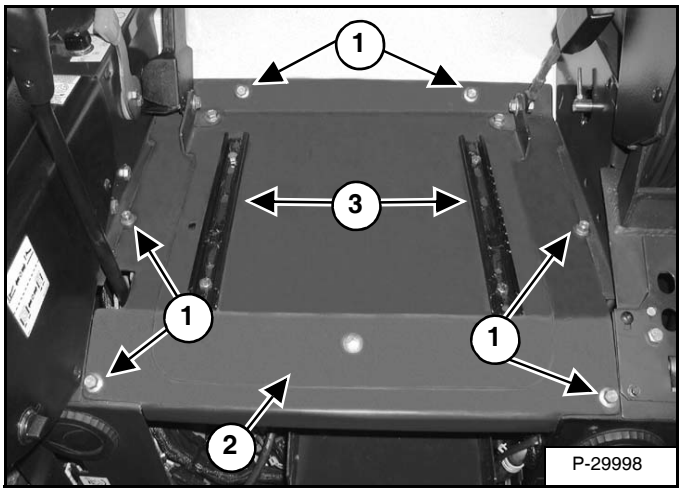
Pull the slide handle (Item 1) **[Figure 40-40-51]** out and slide the seat forward and remove.

Figure 40-40-52



Using the start key, unlock and remove the front cover (Item 1) **[Figure 40-40-52]**.

Figure 40-40-53



Remove the bolts (Item 1) **[Figure 40-40-53]**.

Remove the seat mount (Item 2) **[Figure 40-40-53]**

NOTE: If the lower seat slide rails (Item 3) [Figure 40-40-53] are removed from the seat pan, the lower rails must be realigned with the seat rails for proper fit. With the seat and the pan removed from the Excavator, install the lower seat rails onto the main seat rails. Install the seat to the seat pan and tighten the bolts.


Bobcat®

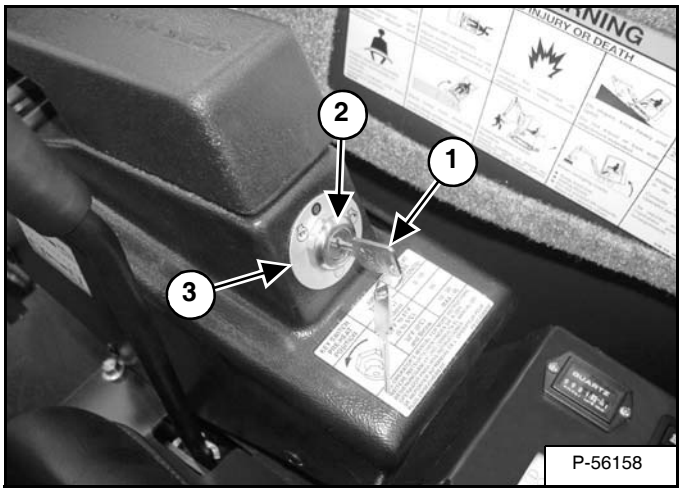
RIGHT CONSOLE

Console Cover Removal And Installation (Cab Models 320L, 320, 322 & ROPS Canopy Model 320L)

Lower the boom/bucket and blade to the ground.

Disconnect the battery negative (-) cable. (See Removing And Installing The Battery on Page 50-20-2)

Figure 40-50-1

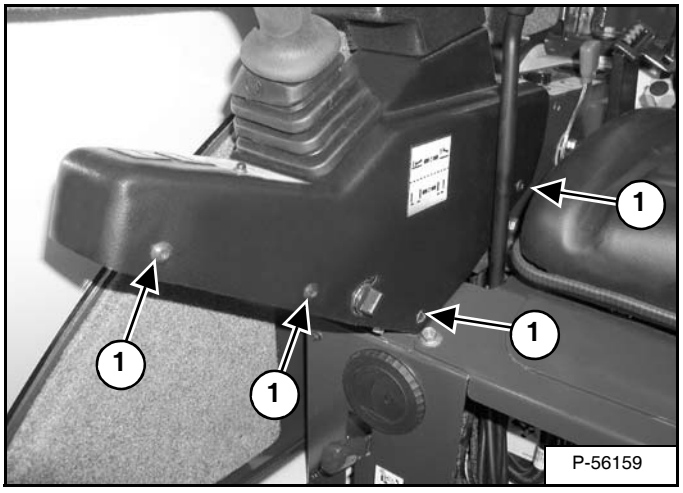


Remove the key (Item 1) **[Figure 40-50-1]**.

Remove the nut (Item 2) and the decal plate (Item 3) **[Figure 40-50-1]** from the ignition switch.

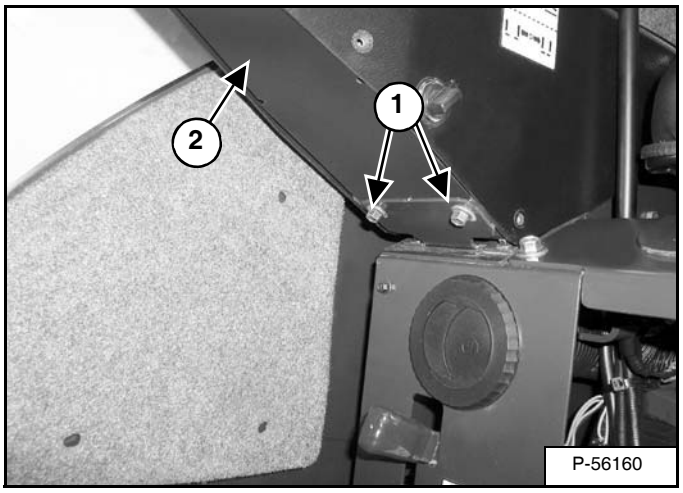
Push the key switch inside the console cover.

Figure 40-50-2



Remove the four screws (Item 1) **[Figure 40-50-2]** from the console cover. (Both sides)

Figure 40-50-3

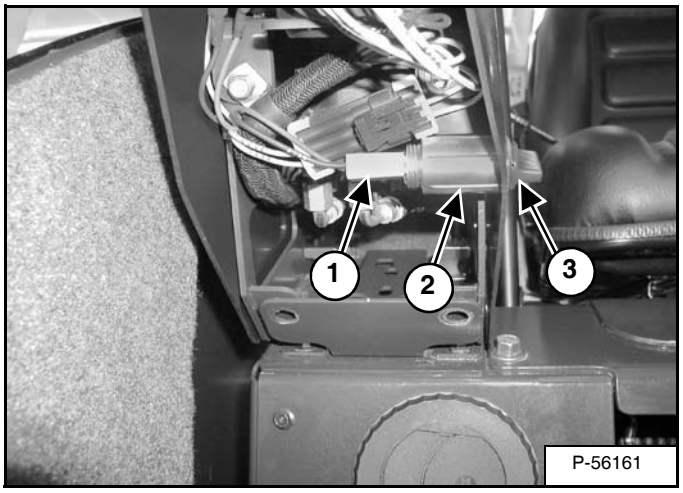


Remove the bolts (Item 1) from the access plate (Item 2) **[Figure 40-50-3]**.

Remove the access plate.

Mark the electrical wires for ease of assembly.

Figure 40-50-4



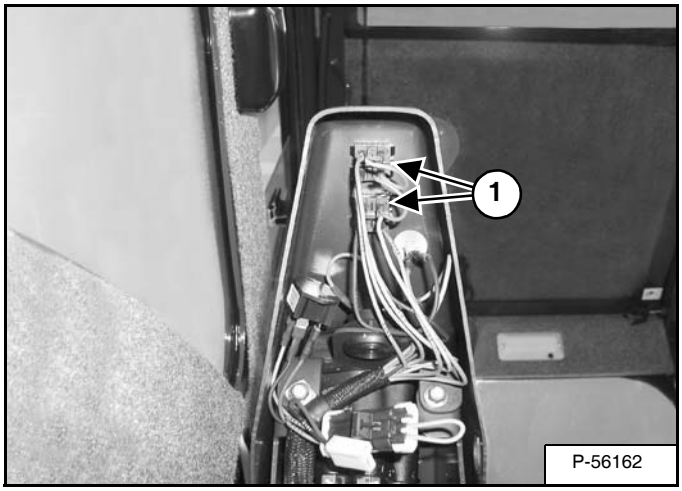
Remove the wire harness from the auxiliary power plug (Item 1) **[Figure 40-50-4]**.

Turn the inner auxiliary power plug housing (Item 2) **[Figure 40-50-4]** and remove it from the housing.

Remove the outer auxiliary power plug (Item 3) **[Figure 40-50-4]**.

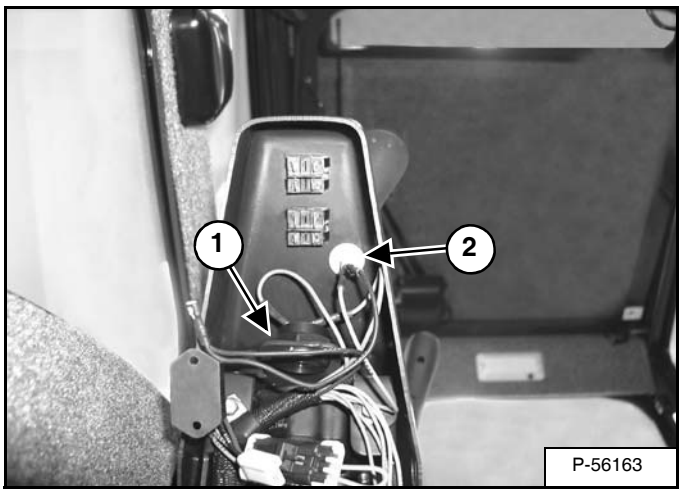
Console Cover Removal And Installation (Cab Models 320L, 320, 322 & ROPS Canopy Model 320L) (Cont'd)

Figure 40-50-5



Mark and remove the wires from the indicator lamps (Item 1) **[Figure 40-50-5]**.

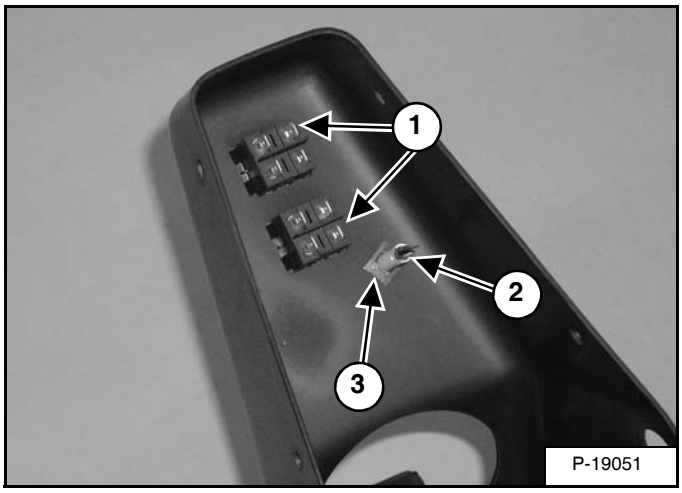
Figure 40-50-6



Mark and remove the wires from the horn (Item 1) and two speed indicator (Item 2) **[Figure 40-50-6]**. (If equipped)

Lift the console cover over the control lever (joystick) handle.

Figure 40-50-7

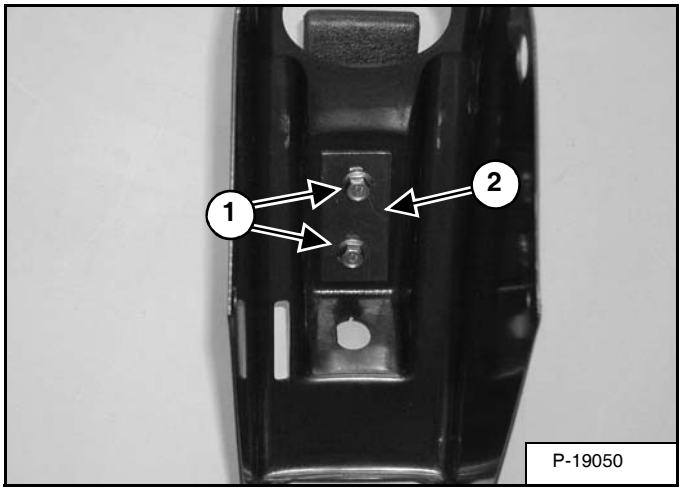


Remove the indicator lights (Item 1) **[Figure 40-50-7]** by squeezing together the mounting tabs on the indicator light and pushing the indicator out of the top of the console cover.

Remove the two speed indicator (Item 2) by removing the retaining clip (Item 3) **[Figure 40-50-7]** and pushing the indicator out of the top of the console cover. (If equipped)

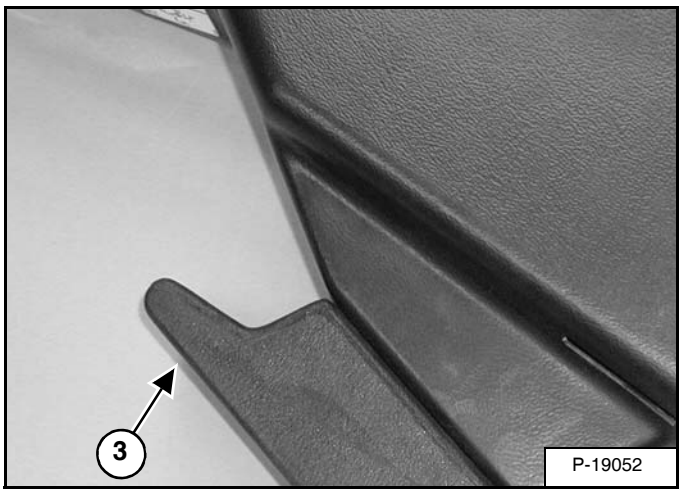
Console Cover Removal And Installation (Cab Models 320L, 320, 322 & ROPS Canopy Model 320L) (Cont'd)

Figure 40-50-8



Remove the bolts (Item 1) and retainer plate (Item 2) **[Figure 40-50-8]** from the console cover.

Figure 40-50-9



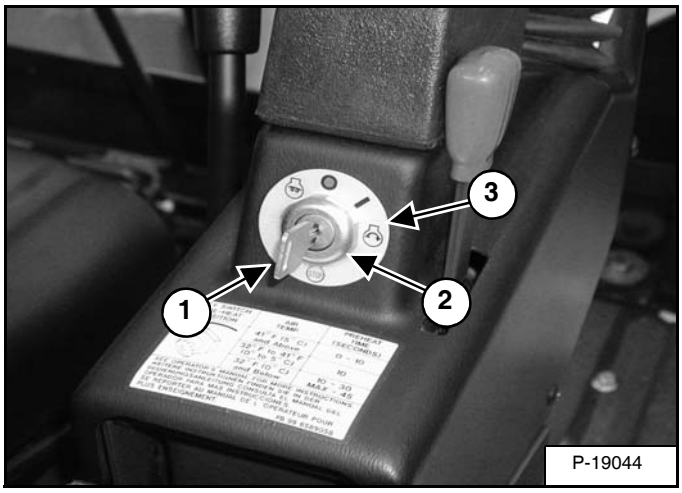
Remove the armrest (Item 3) **[Figure 40-50-9]**.

Console Cover Removal And Installation (ROPS Canopy Models 320 & 322)

Lower the boom/bucket and blade to the ground.

Disconnect the battery negative (-) cable. (See Removing And Installing The Battery on Page 50-20-2.)

Figure 40-50-10



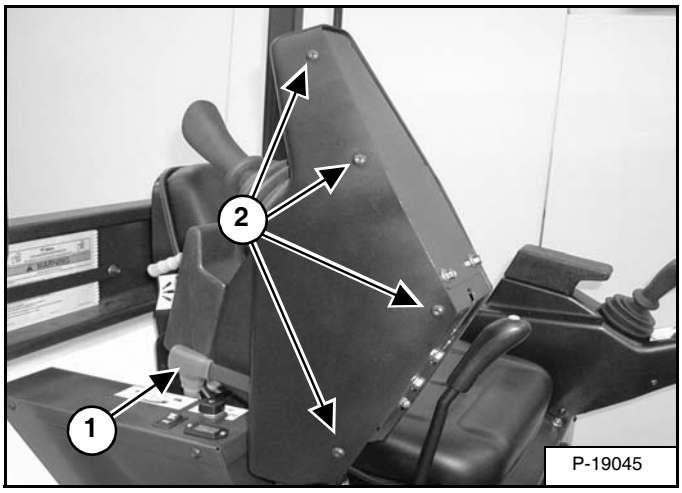
Remove the key (Item 1) **[Figure 40-50-10]**.

Remove the nut (Item 2) and the decal plate (Item 3) **[Figure 40-50-10]** from the key switch.

Push the key switch inside the console cover.

Raise the console.

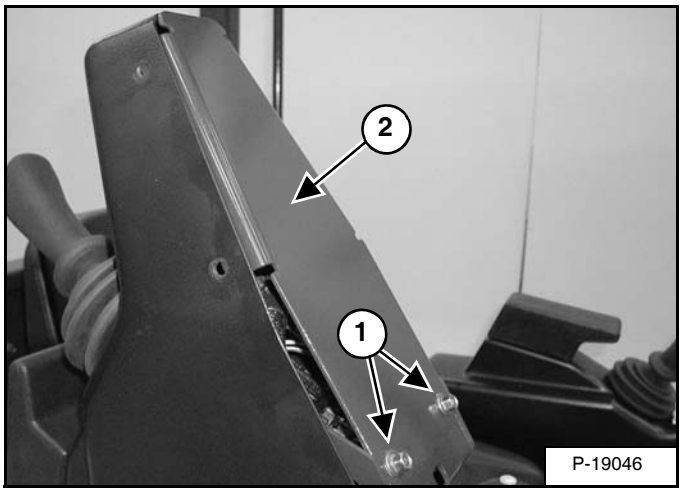
Figure 40-50-11



Remove the latch lever knob (Item 1) **[Figure 40-50-11]**.

Remove the four screws (Item 2) **[Figure 40-50-11]** from the console cover. (Both sides)

Figure 40-50-12

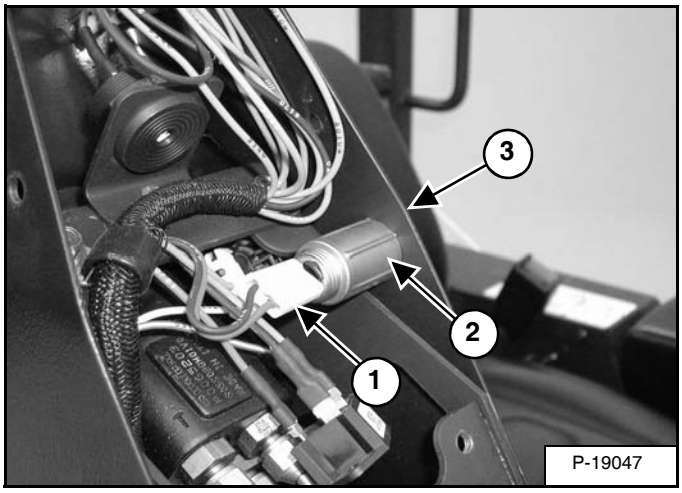


Remove the bolts (Item 1) from the access plate (Item 2) **[Figure 40-50-12]**.

Remove the access plate.

Mark the electrical wires for ease of assembly.

Figure 40-50-13



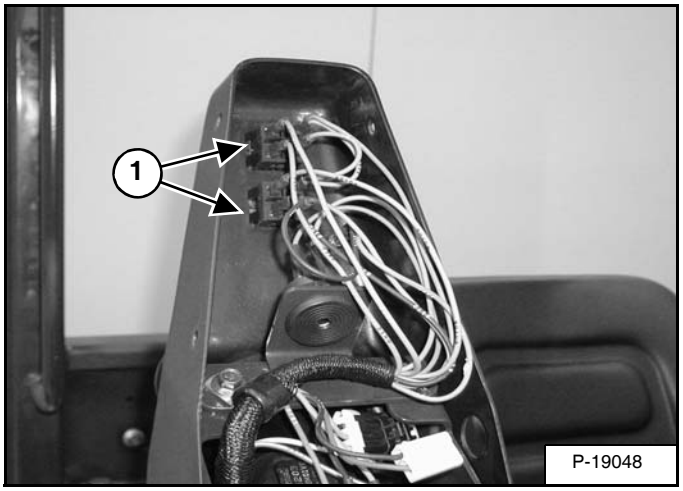
Remove the wires from the auxiliary power plug (Item 1) **[Figure 40-50-13]**.

Turn the inner auxiliary power plug housing (Item 2) **[Figure 40-50-13]** and remove it from the housing.

Remove the outer auxiliary power plug (Item 3) **[Figure 40-50-13]**.

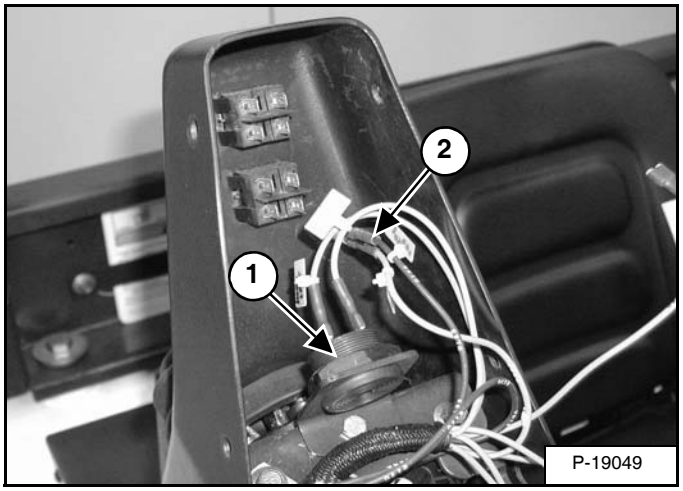
Console Cover Removal And Installation (ROPS Canopy Models 320 & 322) (Cont'd)

Figure 40-50-14



Mark and remove the wires from the indicator lamps (Item 1) **[Figure 40-50-14]**.

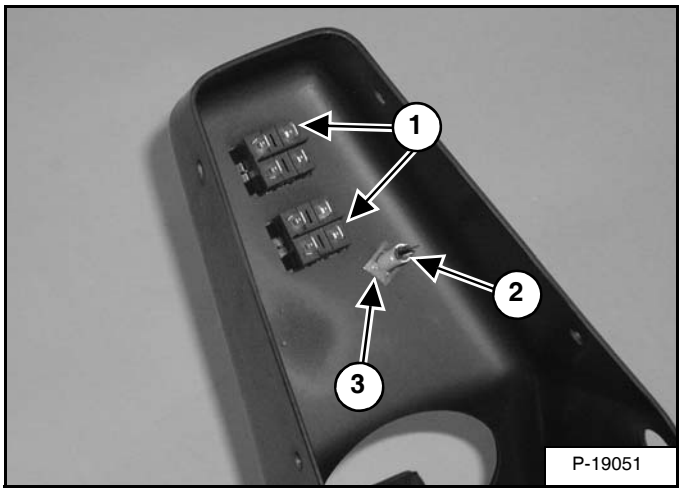
Figure 40-50-15



Mark and remove the wires from the horn (Item 1) and two speed indicator (Item 2) **[Figure 40-50-15]**.

Lift the console cover over the control lever (joystick) handle.

Figure 40-50-16

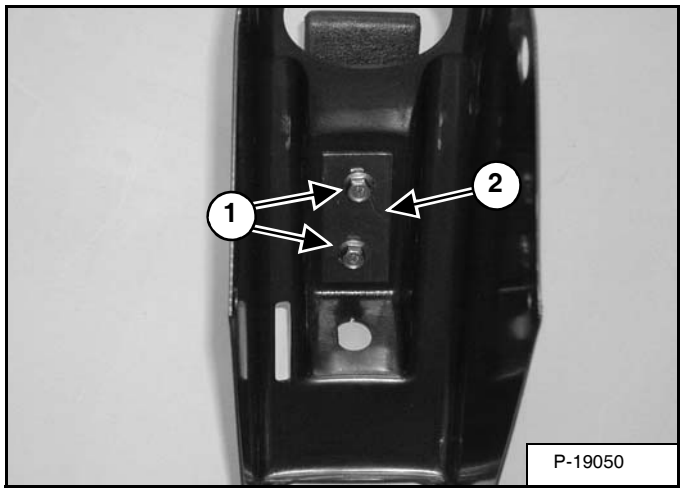


Remove the indicator lights (Item 1) **[Figure 40-50-16]** by squeezing together the mounting tabs on the indicator light and pushing the indicator out of the top of the console cover.

Remove the two speed indicator (Item 2) by removing the retaining clip (Item 3) **[Figure 40-50-16]** and pushing the indicator out of the top of the console cover.

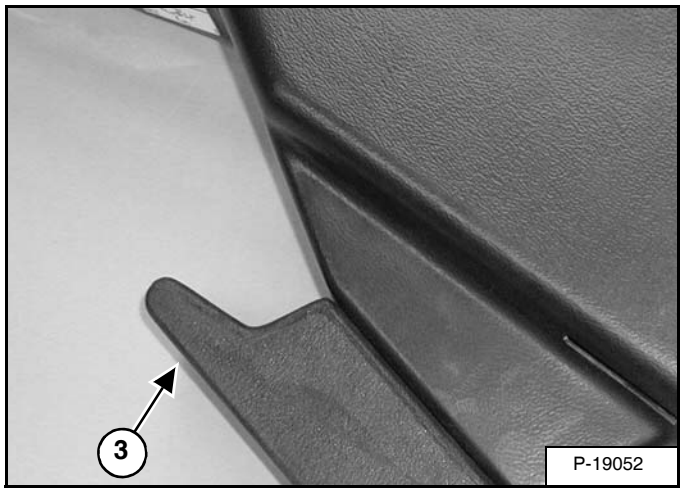
Console Cover Removal And Installation (ROPS Canopy Models 320 & 322) (Cont'd)

Figure 40-50-17



Remove the bolts (Item 1) and retainer plate (Item 2) from the console cover **[Figure 40-50-17]**.

Figure 40-50-18



Remove the armrest (Item 3) **[Figure 40-50-18]**.

Gas Spring Removal And Installation (ROPS Canopy Models 320 & 322)

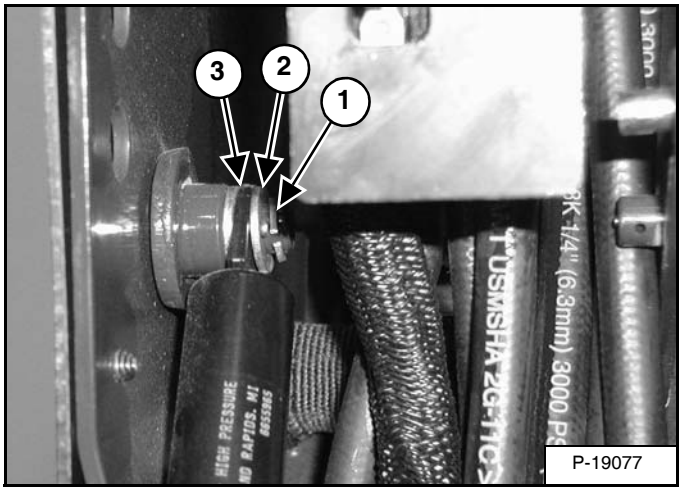
⚠ WARNING

Cylinder contains high pressure gas. Do not open. Opening cylinder can release rod and cause injury or death.

W-2113-0288

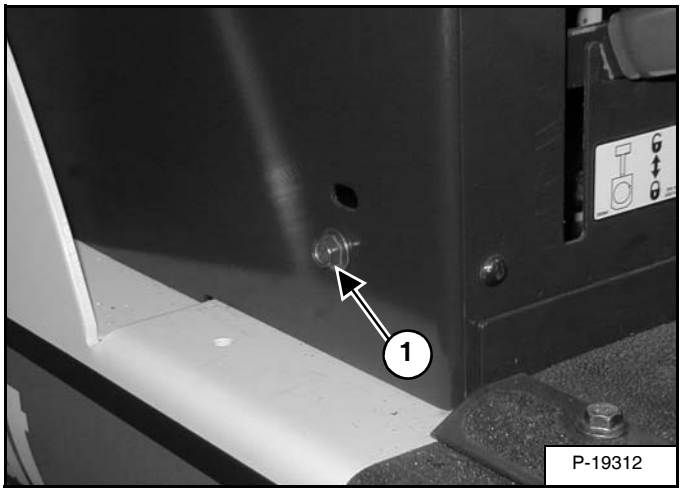
Raise the console.

Figure 40-50-19



Remove the cotter pin (Item 1) and the washer (Item 2) **[Figure 40-50-19]** from the mount.

Figure 40-50-20



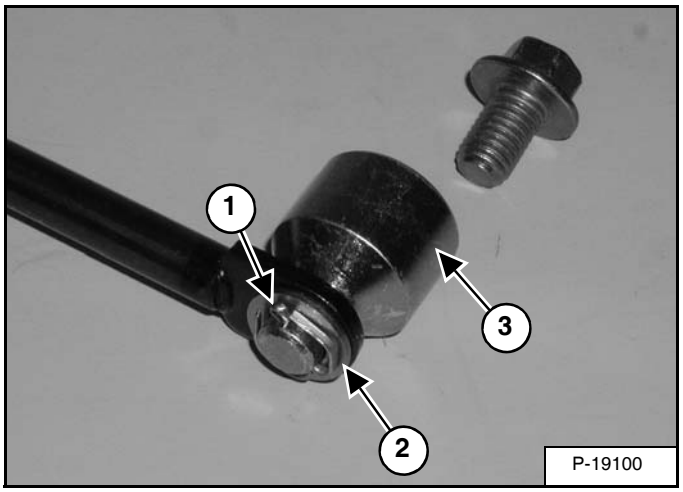
Remove the bolt (Item 1) **[Figure 40-50-20]** from the bottom of the console.

NOTE: Support the console before removing the gas spring.

Remove the top of the gas spring from the mount **[Figure 40-50-19]** and remove the gas spring from the console.

Remove the washer (Item 3) **[Figure 40-50-19]**.

Figure 40-50-21



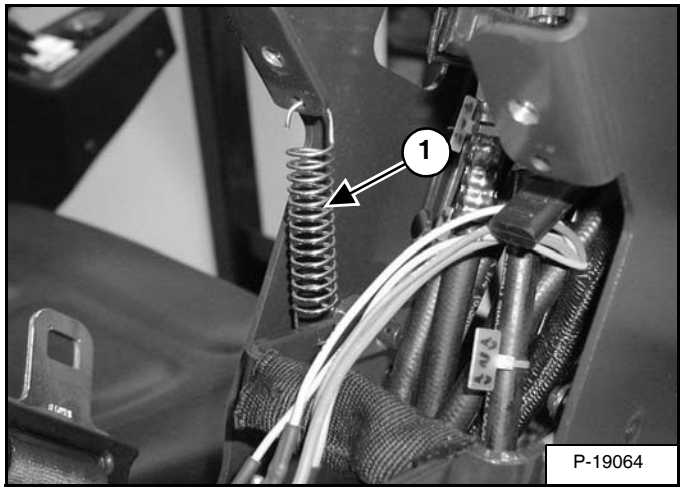
Remove the cotter pin (Item 1) and washer (Item 2) from the lower mount and remove the mount (Item 3) **[Figure 40-50-21]**.

Lock Lever Removal And Installation (ROPS Canopy Models 320 & 322)

Remove the console cover. (See Console Cover Removal And Installation (ROPS Canopy Models 320 & 322) on Page 40-50-4)

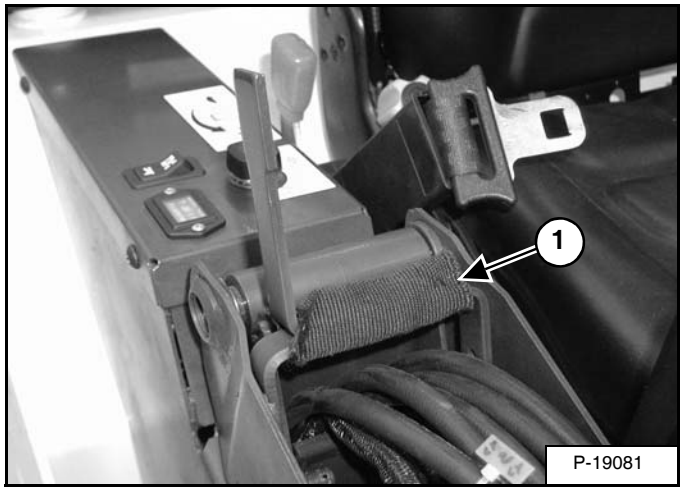
Remove the gas spring. (See Gas Spring Removal And Installation (ROPS Canopy Models 320 & 322) on Page 40-50-7)

Figure 40-50-22



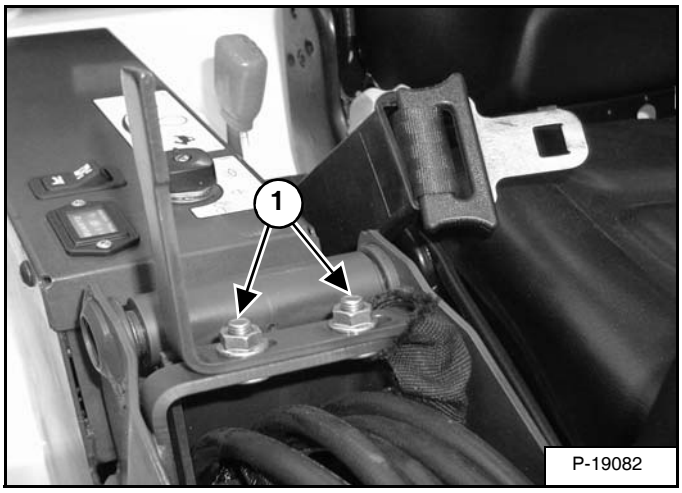
Remove the return spring (Item 1) **[Figure 40-50-22]** from the lock lever.

Figure 40-50-23



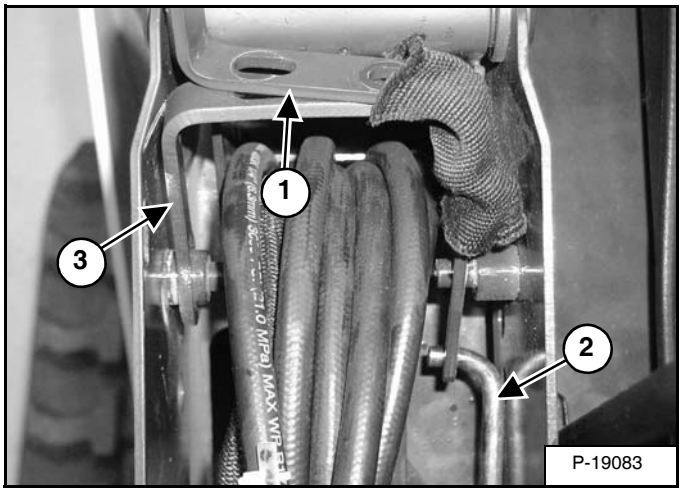
Slide the protective sleeve (Item 1) **[Figure 40-50-23]** to the side.

Figure 40-50-24



Remove the nuts and bolts (Item 1) **[Figure 40-50-24]** from the lock lever assembly.

Figure 40-50-25



Slide the top lever (Item 1) away from the operators seat and remove the release rod (Item 2) **[Figure 40-50-25]**.

Remove the bottom lever (Item 3) **[Figure 40-50-25]**.

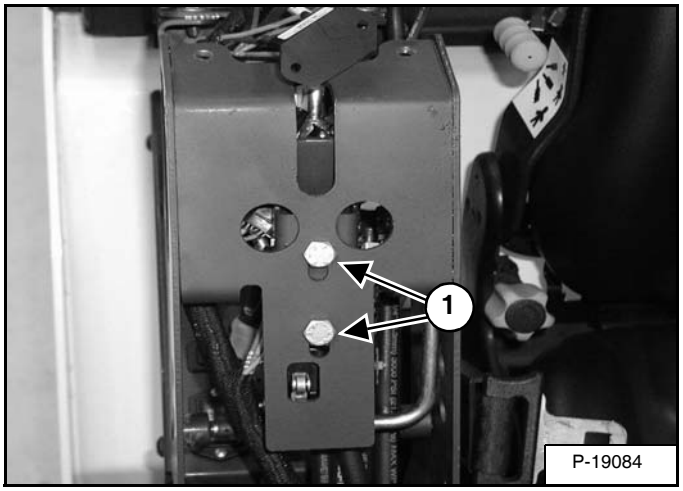
Installation: Install the release rod (Item 2) **[Figure 40-50-25]** through the lever. Position the levers over the lever mounts and spread them so there is no play between the mount and the lever but loose enough so the levers do not bind against the mounts and the spring will return the levers to the latched position without interference.

NOTE: When installing nuts and bolts, the nuts must be to the top side of the lock levers so the bolt threads do not rub against the hoses.

Pull the actuating rod forward to release the console latch and tilt the console up.

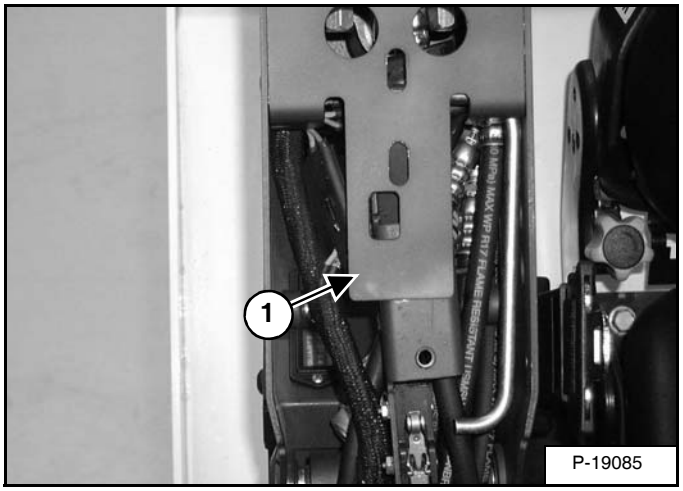
Lock Lever Removal And Installation (ROPS Canopy Models 320 & 322) (Cont'd)

Figure 40-50-26



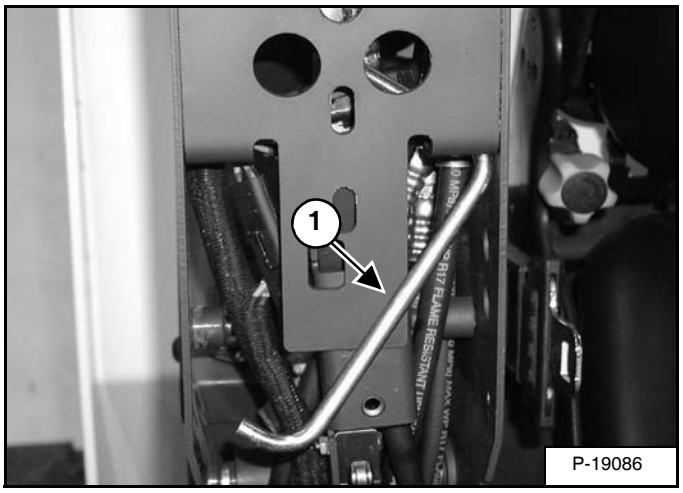
Remove the bolts (Item 1) **[Figure 40-50-26]** holding the console latch bracket.

Figure 40-50-27



Slide the latch bracket (Item 1) **[Figure 40-50-27]** down.

Figure 40-50-28



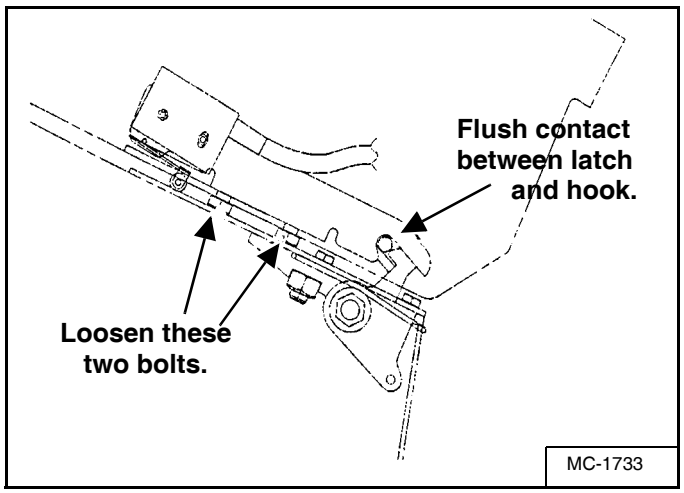
Tilt the pivot release rod (Item 1) **[Figure 40-50-28]** and remove the rod from the upper console.

RIGHT CONSOLE (CONT'D)

Adjustment (ROPS Canopy Models 320 & 322)

NOTE: Before the lock lever adjustments can be made, the microswitch must be moved to the top of the adjustment slots. Switch damage may occur if this is not done prior to the lock lever adjustments. See Microswitch Removal And Testing. (See MICROSWITCH on Page 50-80-1.)

Figure 40-50-29



Loosen the two bolts that hold the latch bracket to the console so the latch bracket will not move when the control console is closed but loose enough so the bolt heads can be tapped with a punch to move the latch for proper adjustment **[Figure 40-50-29]**.

Lower the control console to latched position.

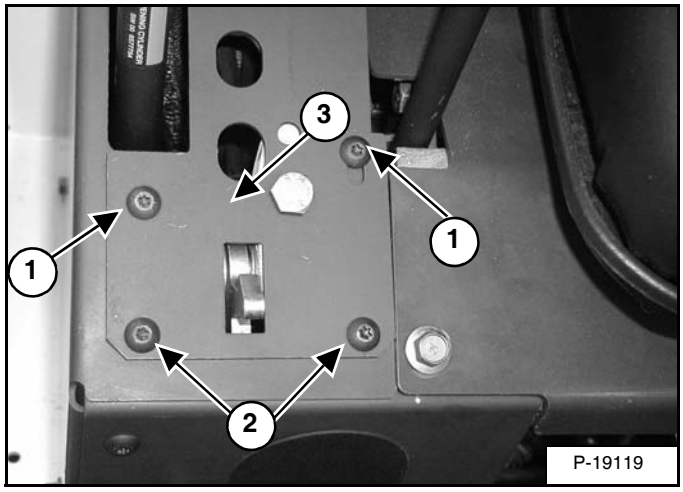
Push down on the console to remove the gas spring pressure.

Adjust the latch until the spring loaded hook will just make contact with the latch bracket when the console is lowered **[Figure 40-50-29]**.

Latch Hook Removal And Installation (ROPS Canopy 320 & 322)

Raise the console.

Figure 40-50-30



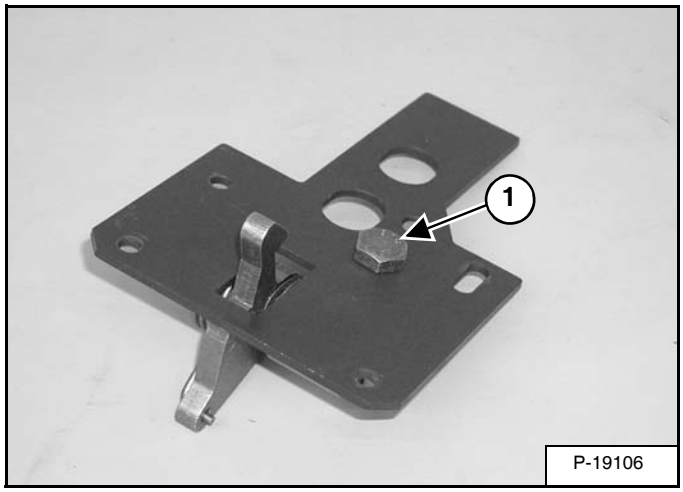
Remove the bolts (Item 1 & 2) **[Figure 40-50-30]** from the plate.

Installation: Tighten the bolts to 6-7 ft.-lbs. (8-10 Nm) torque.

NOTE: Install the long bolts (Item 2) [Figure 40-50-30] in the front of the plate.

Remove the plate (Item 3) **[Figure 40-50-30]**.

Figure 40-50-31

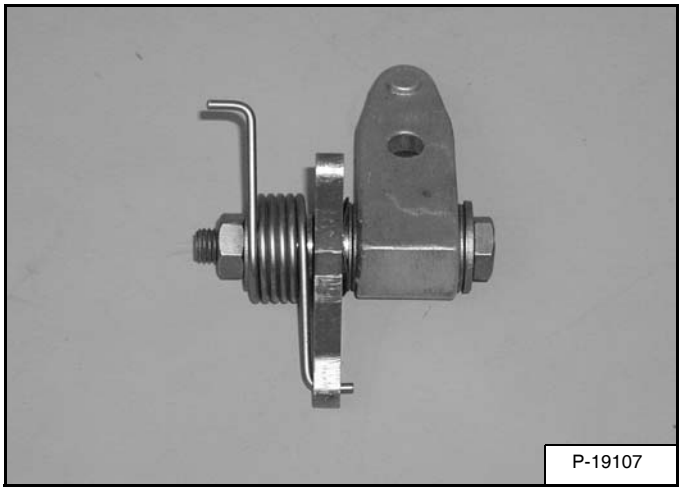


Remove the bolt and the nut (Item 1) **[Figure 40-50-31]** from the latch pivot.

Installation: Tighten the bolt to 29-37 ft.-lbs. (40-50 Nm) torque.

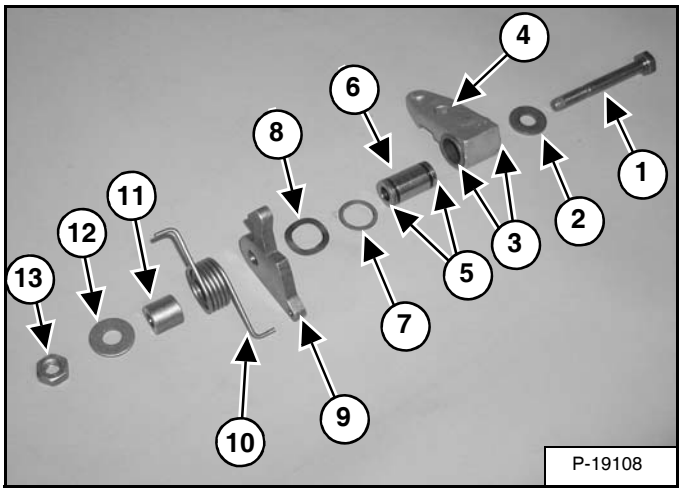
Latch Hook Disassembly And Assembly (ROPS Canopy Models 320 & 322)

Figure 40-50-32



Disassemble the latch pivot **[Figure 40-50-32]**.

Figure 40-50-33



Item No.	Description
1	Bolt
2	Washer
3	Bushing
4	Pivot
5	O-rings
6	Sleeve
7	Shim
8	Wave Washer
9	Latch Hook
10	Spring
11	Spacer
12	Washer
13	Nut **[Figure 40-50-33]**

Installation: Tighten the nut (Item 1) **[Figure 40-50-33]** to 29-37 ft.-lbs. (40-50 Nm) torque.

NOTE: Install the bushings (Item 3) with a pilot shaft to avoid bushing damage. Verify the sleeve (Item 6) [Figure 40-50-33] will pivot freely inside the bushings.

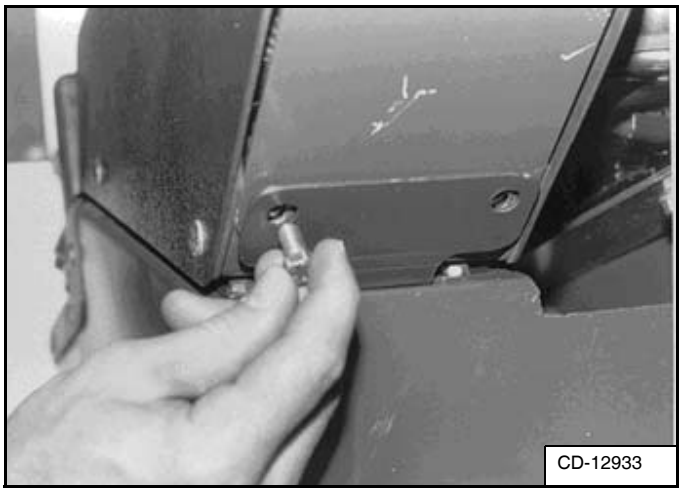
Apply oil to the O-rings (Item 5) before installing the sleeve (Item 6) into the pivot (Item 4) **[Figure 40-50-33]**.

Make sure the shim (Item 7) is properly positioned over the sleeve and after tightening the nut, the hook (Item 9) **[Figure 40-50-33]** pivots freely.

Cab Models (320L, 320 & 322, And ROPS Canopy Model 320L)

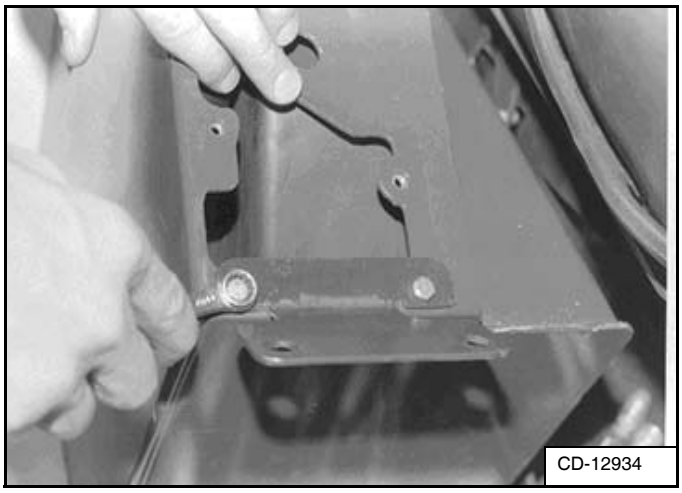
On Excavators 320L, 320 & 322 equipped with a cab and 320L equipped with a ROPS canopy, the right hand control console is stationary (will not raise and lower with a release lever).

Figure 40-50-34



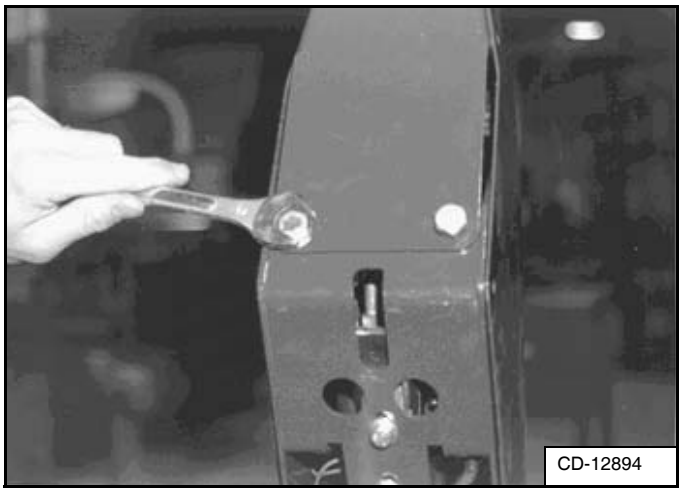
To raise the console, remove the two bolts from the console **[Figure 40-50-34]**.

Figure 40-50-35



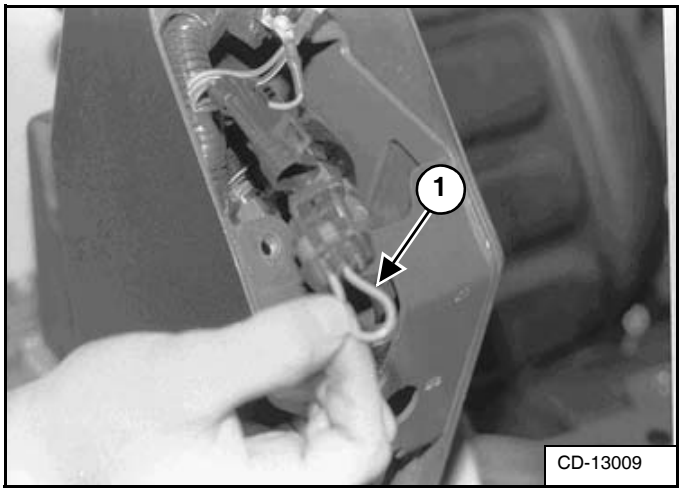
Remove the two bolts from the console plate **[Figure 40-50-35]**.

Figure 40-50-36



Remove the console cover plate **[Figure 40-50-36]**.

Figure 40-50-37



The right hand console harness uses a jumper harness (Item 1) **[Figure 40-50-37]** in place of the microswitch so the control lever (joystick) manifold/accumulator will function properly.

Upper Console Removal And Installation

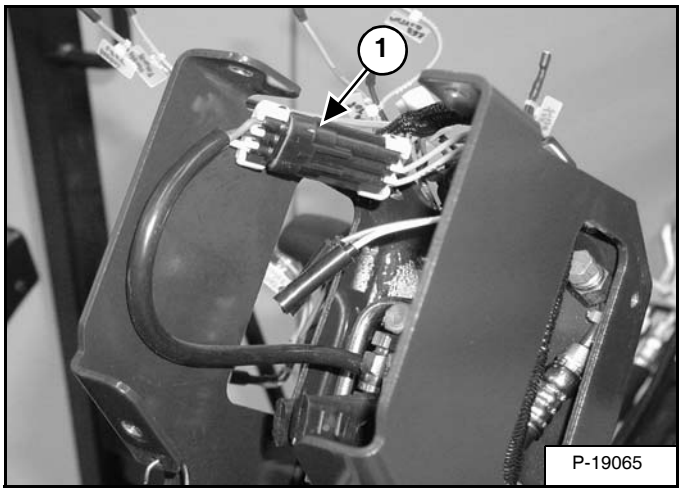
Lower the boom/bucket and blade to the ground.

Remove the console cover. (See Console Cover Removal And Installation (Cab Models 320L, 320, 322 & ROPS Canopy Model 320L) on Page 40-50-1)

Remove the control lever (joystick). (See Removal And Installation on Page 20-110-4.)

Remove the gas spring. (See Gas Spring Removal And Installation (ROPS Canopy Models 320 & 322) on Page 40-50-7) (If equipped)

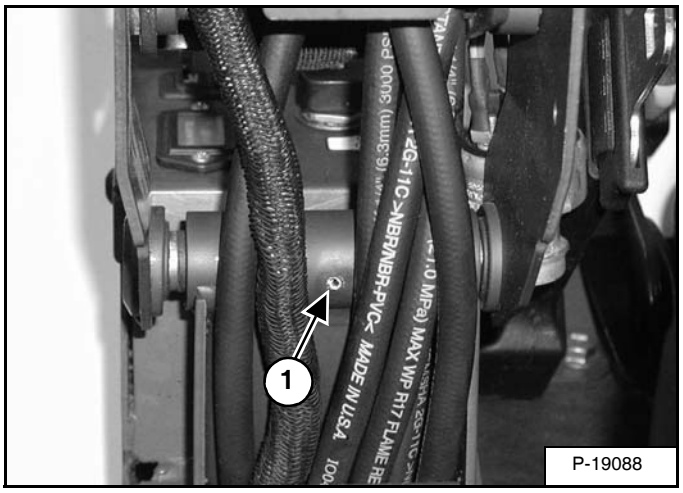
Figure 40-50-38



Disconnect the lock out microswitch harness connector (Item 1) **[Figure 40-50-38]**. (If equipped)

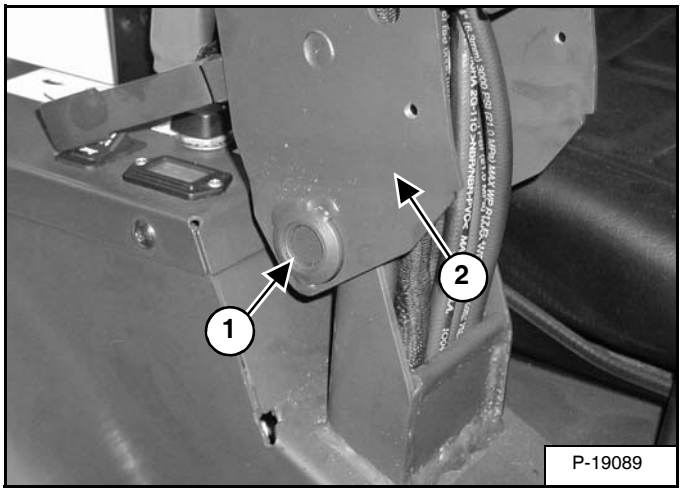
Raise the console.

Figure 40-50-39



Drive the roll pin (Item 1) **[Figure 40-50-39]** through the pivot shaft towards the back of the console base.

Figure 40-50-40



Drive the pivot shaft (Item 1) through and remove the upper console (Item 2) **[Figure 40-50-40]**.

NOTE: Feed the hoses and wire harness through the upper console during removal to avoid hose and harness damage.

Console Base Removal And Installation

Lower the boom/bucket and blade to the ground.

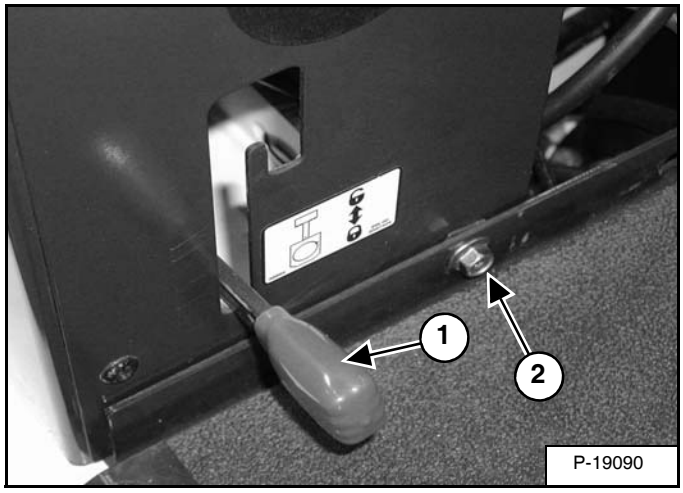
Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Remove the console cover. (See Console Cover Removal And Installation (Cab Models 320L, 320, 322 & ROPS Canopy Model 320L) on Page 40-50-1)

Remove the control lever (joystick). (See Removal And Installation on Page 20-110-4.)

Remove the upper console. (See Upper Console Removal And Installation on Page 40-50-13)

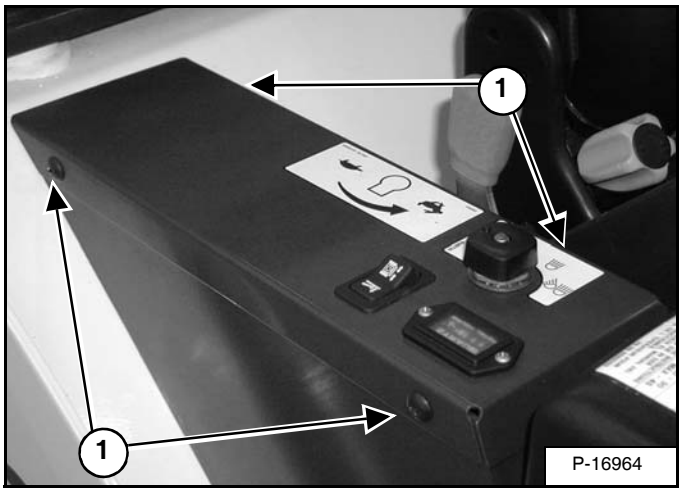
Figure 40-50-41



Remove the lever lock knob (Item 1) **[Figure 40-50-41]**.

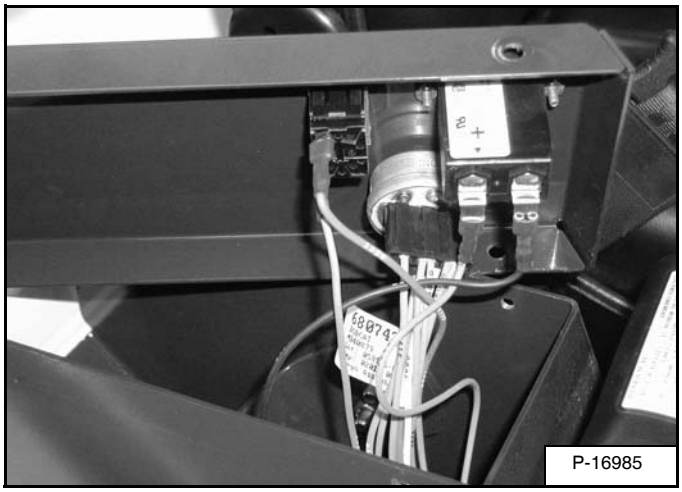
Remove the bolt (Item 2) **[Figure 40-50-41]** from the right console and floorplate.

Figure 40-50-42



Remove the four screws (Item 1) **[Figure 40-50-42]** from the cover panel.

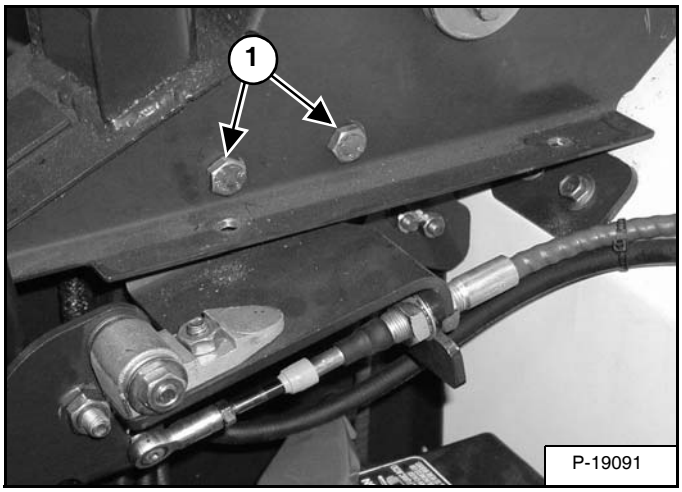
Figure 40-50-43



Mark the wires and disconnect the wires and wire harness from the switches and hourmeter **[Figure 40-50-43]**.

Console Base Removal And Installation (Cont'd)

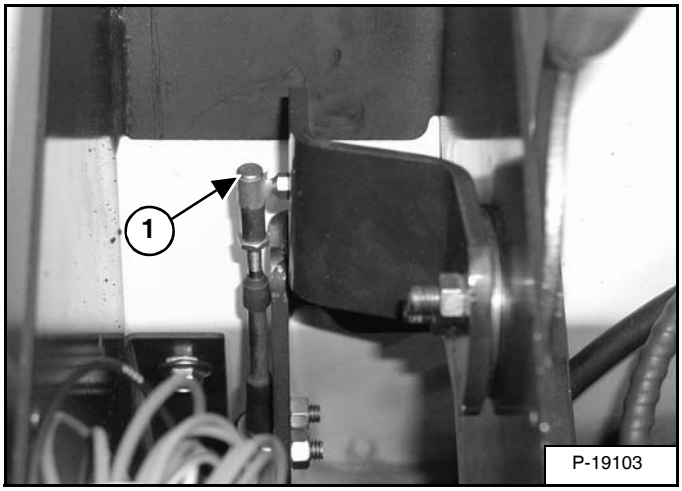
Figure 40-50-44



Remove the bolts and nuts (Item 1) **[Figure 40-50-44]** fastening the blade linkage assembly to the console base.

Remove the blade linkage assembly from the right console.

Figure 40-50-45



Disconnect the speed control cable (Item 1) **[Figure 40-50-45]**.

Figure 40-50-46

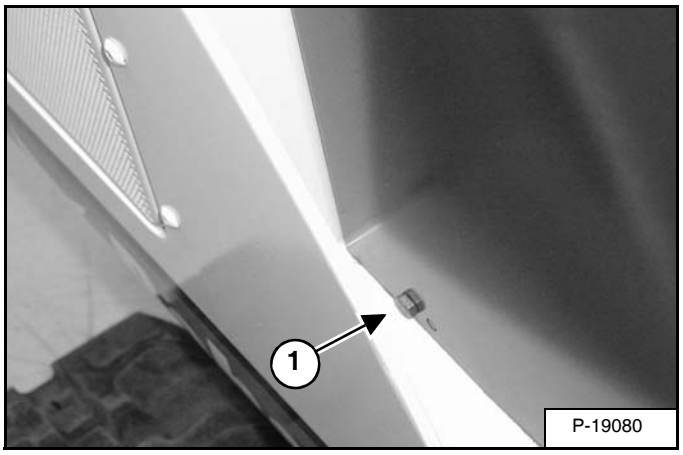
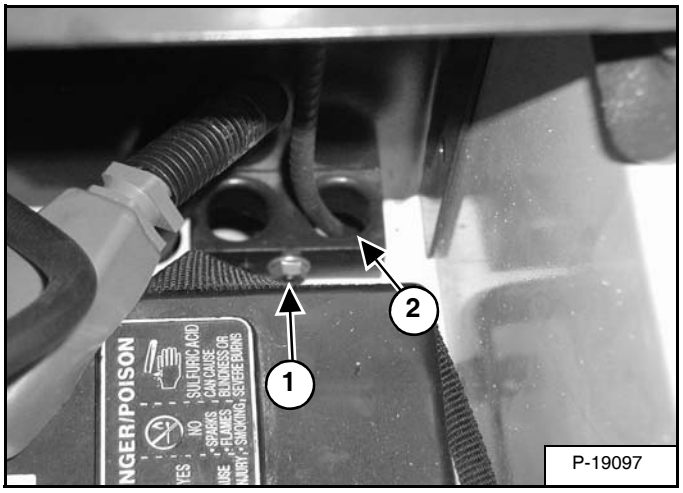


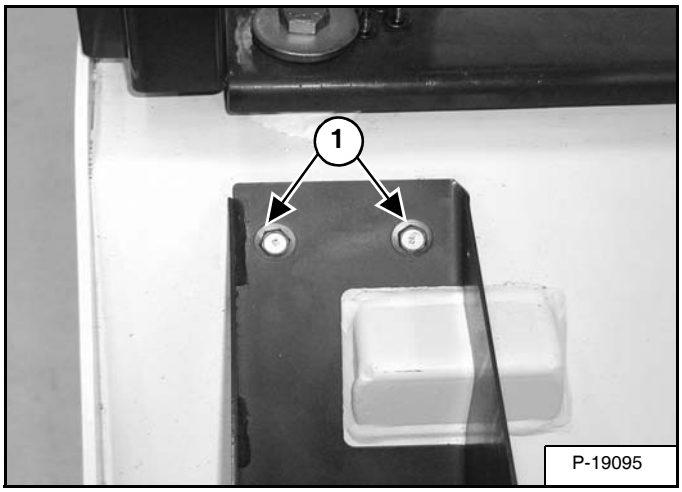
Figure 40-50-47



Remove the bolt and nut (Item 1) **[Figure 40-50-46]** & **[Figure 40-50-47]** holding the plastic block (Item 2) **[Figure 40-50-47]** to the inside console base.

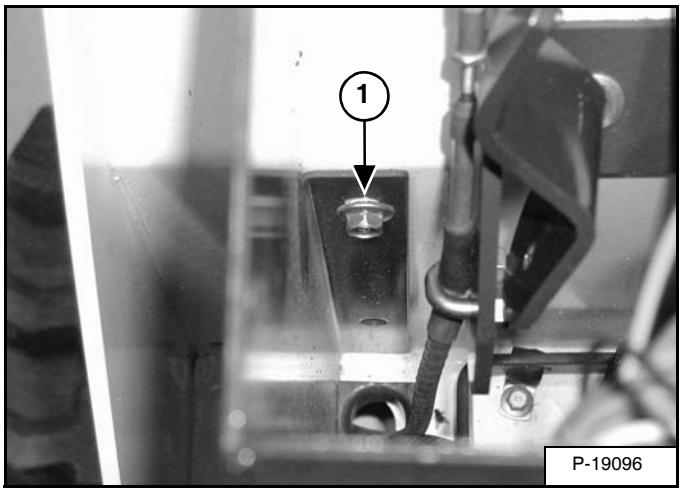
Console Base Removal And Installation (Cont'd)

Figure 40-50-48



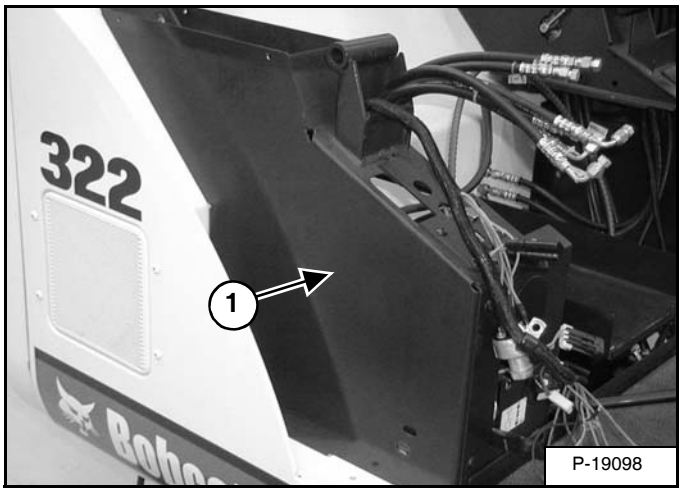
Remove the bolts (Item 1) **[Figure 40-50-48]** holding the console base to the frame.

Figure 40-50-49



Remove the bolt (Item 1) **[Figure 40-50-49]** from the inside of the console base.

Figure 40-50-50



Remove the console base (Item 1) **[Figure 40-50-50]** from the Excavator.

NOTE: Feed the hoses and wire harness through the console base during removal to avoid hose and harness damage.

LEFT CONSOLE

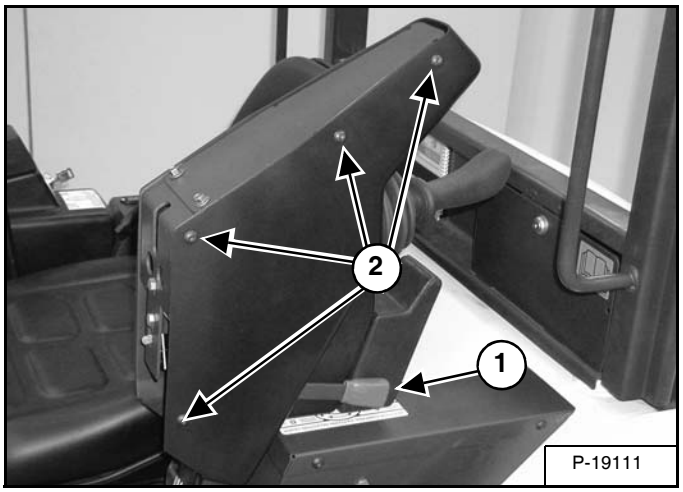
Console Cover Removal And Installation

Lower the boom/bucket and blade to the ground.

Disconnect the battery negative (-) cable. (See Removing And Installing The Battery on Page 50-20-2.)

Raise the console.

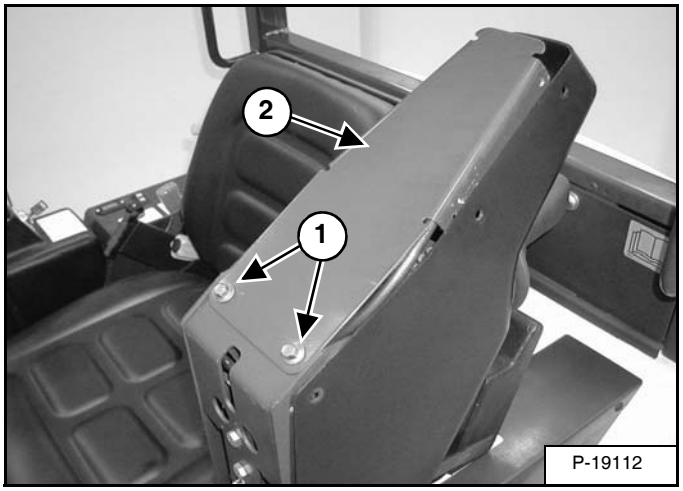
Figure 40-60-1



Remove the latch lever knob (Item 1) **[Figure 40-60-1]**.

Remove the four screws (Item 2) **[Figure 40-60-1]** from both sides of the console cover. (Both sides)

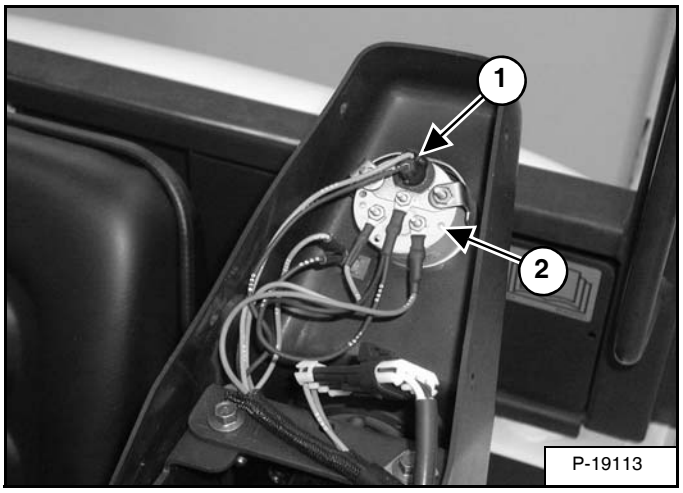
Figure 40-60-2



Remove the bolts (Item 1) from the plate (Item 2) **[Figure 40-60-2]**.

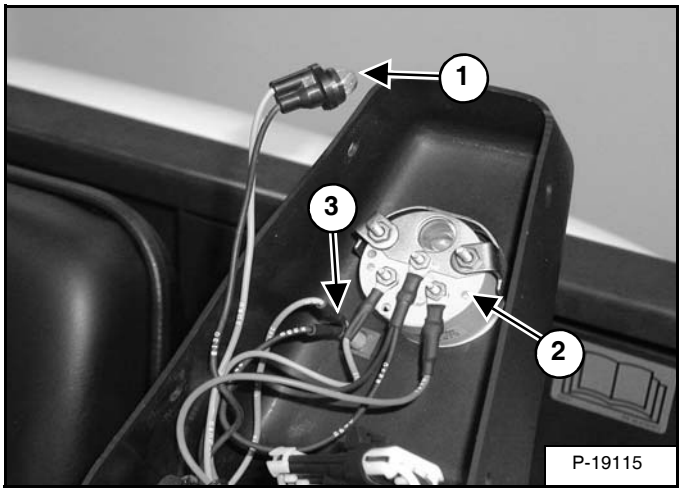
Remove the plate.

Figure 40-60-3



Remove the bulb connector assembly (Item 1) from the fuel gauge (Item 2) **[Figure 40-60-3]**.

Figure 40-60-4



Remove the bulb (Item 1) **[Figure 40-60-4]** for replacement.

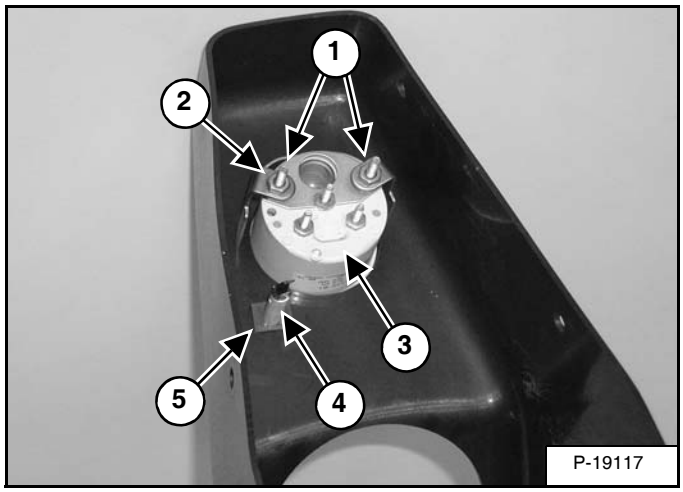
Mark the electrical wires for ease of assembly.

Remove the wires from the fuel gauge (Item 2) and lock out indicator (Item 3) **[Figure 40-60-4]**.

Lift the console cover over the control lever (joystick) handle.

Console Cover Removal And Installation (Cont'd)

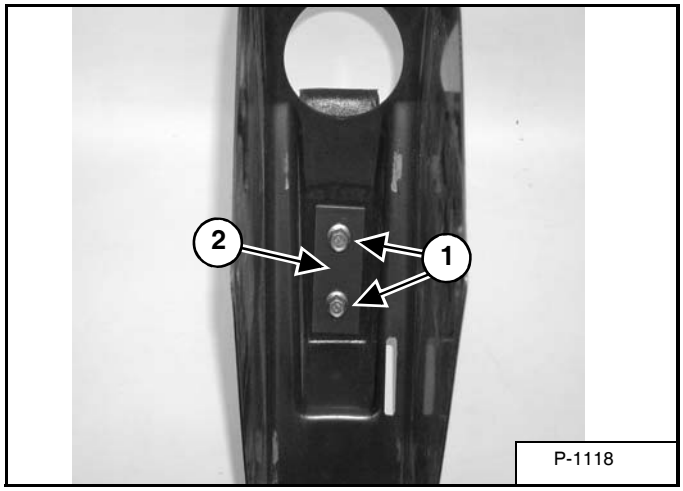
Figure 40-60-5



Remove the nuts (Item 1) and clamp (Item 2) Push the fuel gauge (Item 3) **[Figure 40-60-5]** out the top of the console cover.

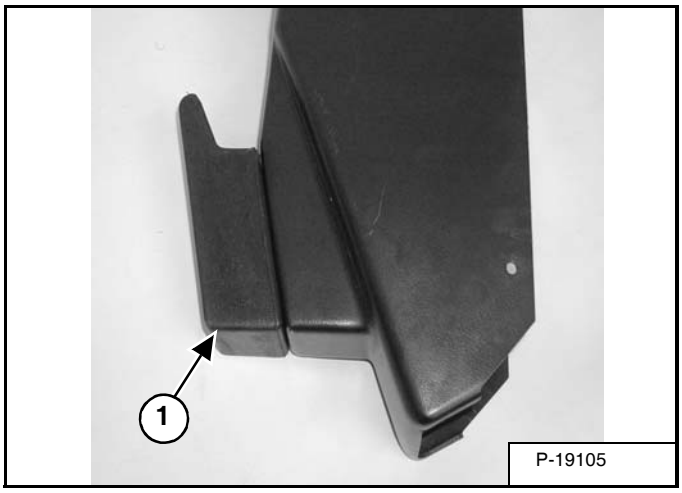
Remove the lock out indicator (Item 4) by removing the retaining clip (Item 5) **[Figure 40-60-5]** and pushing the indicator out of the top of the console cover.

Figure 40-60-6



Remove the bolts (Item 1) and plate (Item 2) **[Figure 40-60-6]** from the console cover.

Figure 40-60-7



Remove the armrest (Item 1) **[Figure 40-60-7]**.

Gas Spring Removal And Installation

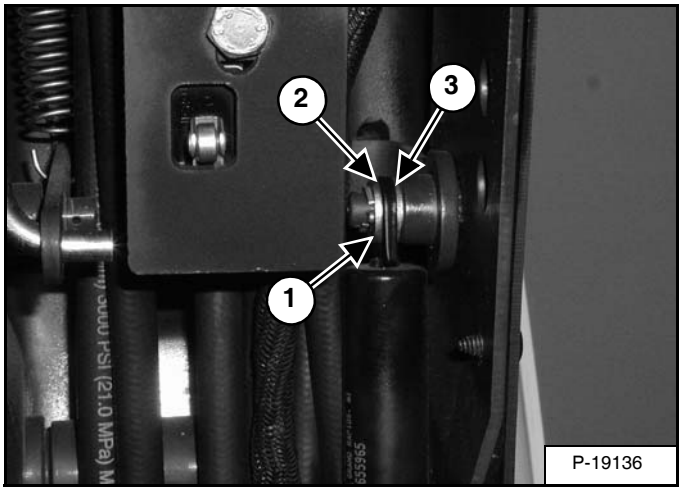
⚠ WARNING

Cylinder contains high pressure gas. Do not open. Opening cylinder can release rod and cause injury or death.

W-2113-0288

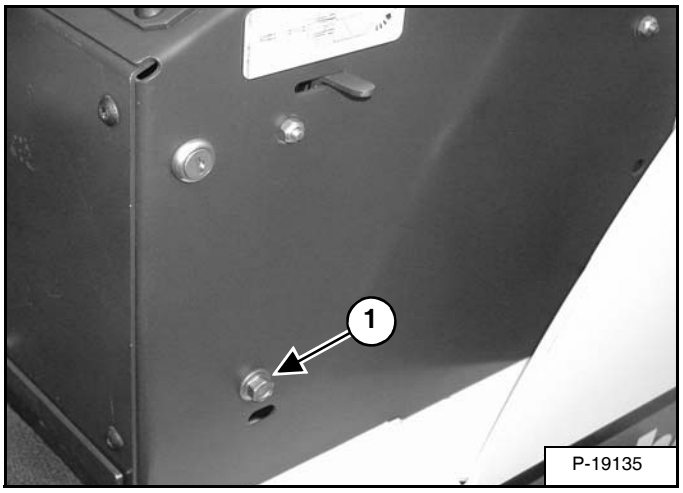
Raise the console.

Figure 40-60-8



Remove the cotter pin (Item 1) and the washer (Item 2) **[Figure 40-60-8]** from the mount.

Figure 40-60-9



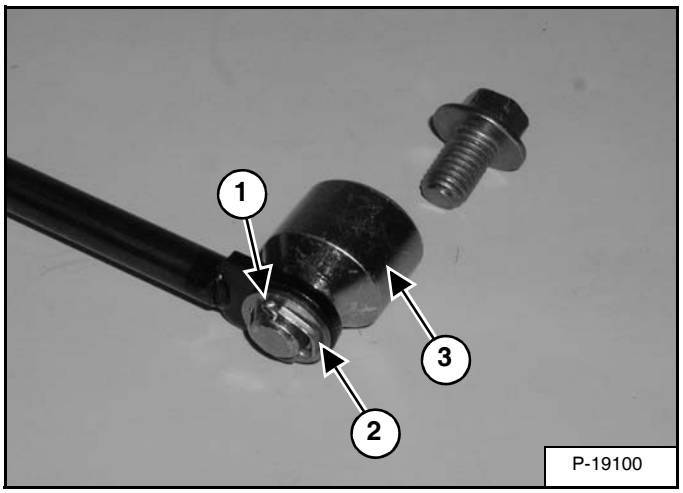
Remove the bolt (Item 1) **[Figure 40-60-9]** from the bottom side of the console.

NOTE: Hold the console up to remove the gas spring.

Remove the top of the gas spring from the mount **[Figure 40-60-8]** and remove the gas spring from the console.

Remove the washer (Item 3) **[Figure 40-60-8]**.

Figure 40-60-10



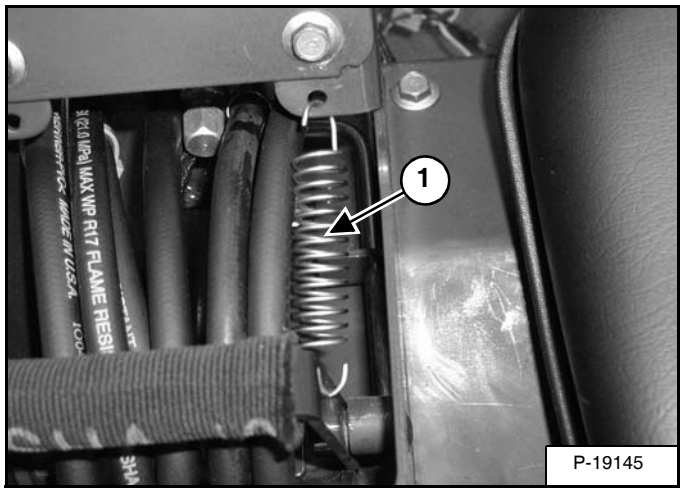
Remove the cotter pin (Item 1) and washer (Item 2) from the lower mount and remove the mount (Item 3) **[Figure 40-60-10]**.

Lock Lever Removal And Installation

Remove the console cover. (See Console Cover Removal And Installation on Page 40-60-1.)

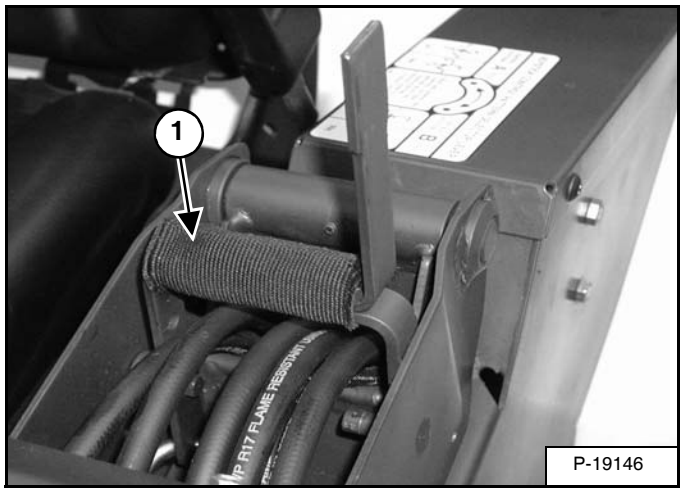
Remove the gas spring. (See Gas Spring Removal And Installation on Page 40-60-3.)

Figure 40-60-11



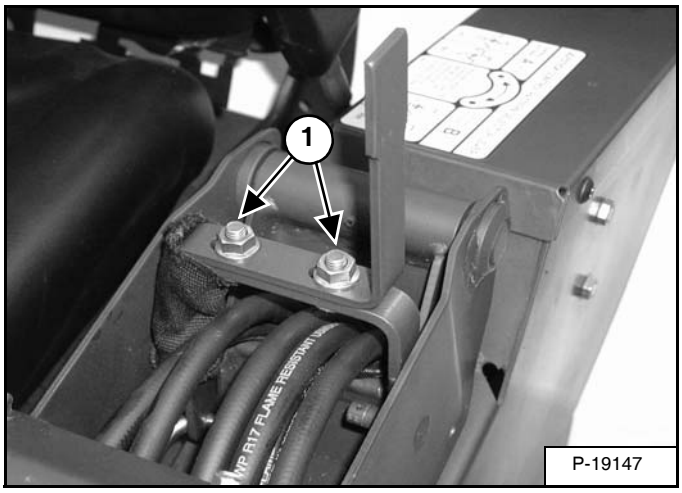
Remove the return spring (Item 1) **[Figure 40-60-11]** from the lock lever.

Figure 40-60-12



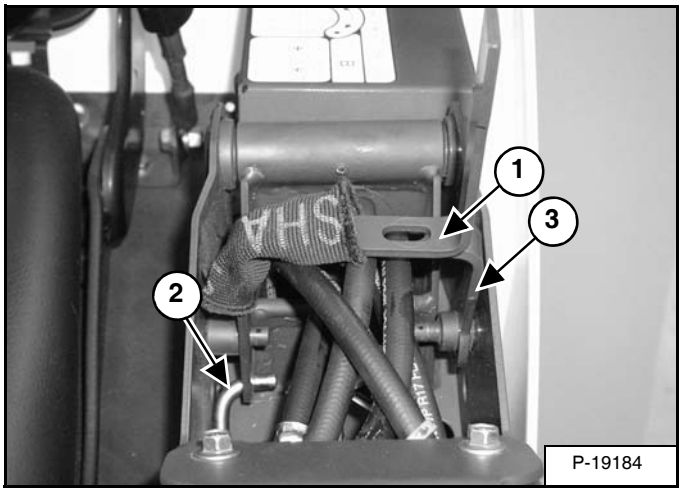
Slide the protective sleeve (Item 1) **[Figure 40-60-12]** to the side.

Figure 40-60-13



Remove the nuts and bolts (Item 1) **[Figure 40-60-13]** from the lock lever assembly.

Figure 40-60-14



Slide the top lever (Item 1) away from the operators seat and remove the release rod (Item 2) **[Figure 40-60-14]**.

Remove the bottom lever (Item 3) **[Figure 40-60-14]**.

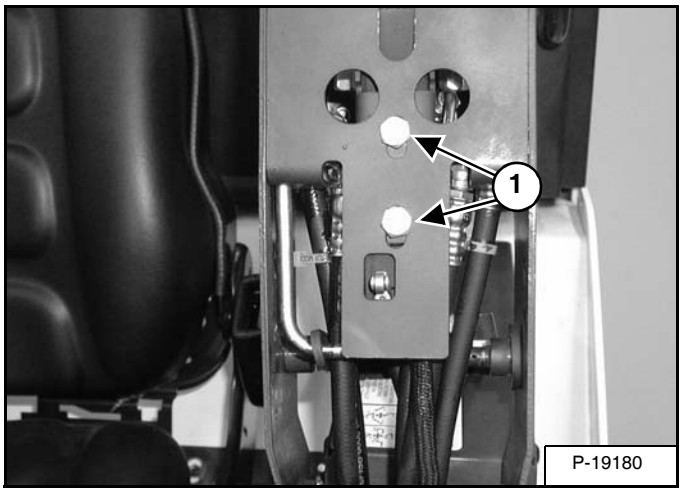
Installation: Install the release rod (Item 2) **[Figure 40-60-14]** through the lever. Position the levers over the lever mounts and spread them so there is no play between the mount and the lever but loose enough so the levers do not bind against the mounts and the spring will return the levers to the latched position without interference.

NOTE: When installing the nuts and bolts, the nuts must be to the top side of the lock levers so the bolt threads do not rub against the hoses.

Pull the actuating rod forward to release the console latch and raise the console.

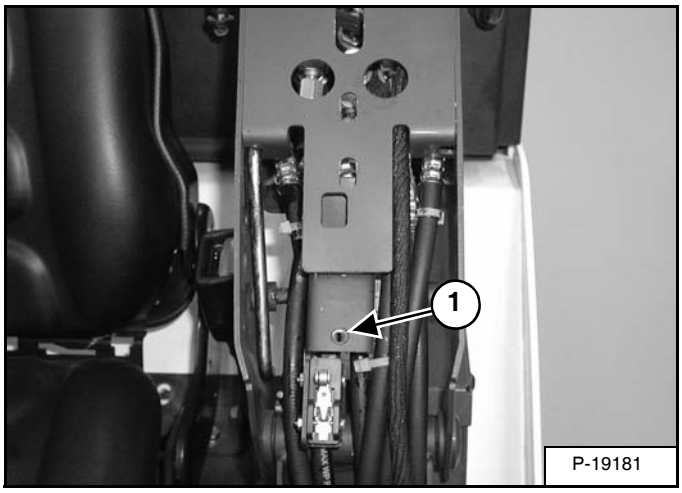
Lock Lever Removal And Installation (Cont'd)

Figure 40-60-15



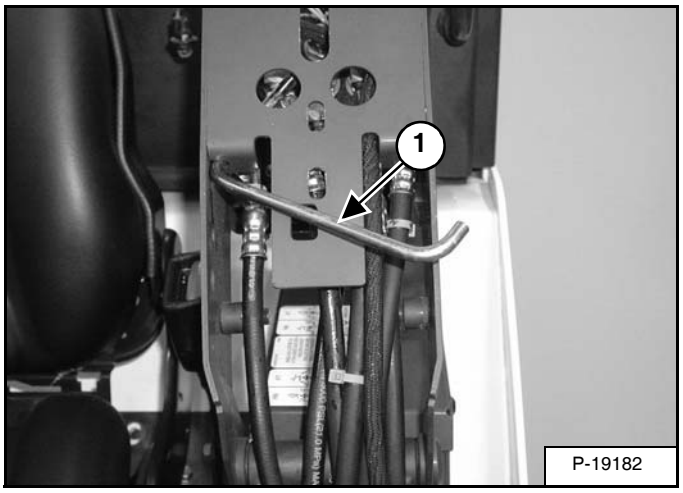
Remove the bolts (Item 1) **[Figure 40-60-15]** holding the console latch bracket.

Figure 40-60-16



Slide the latch bracket (Item 1) **[Figure 40-60-16]** down.

Figure 40-60-17



Tilt the pivot release rod (Item 1) **[Figure 40-60-17]** and remove from the upper console.

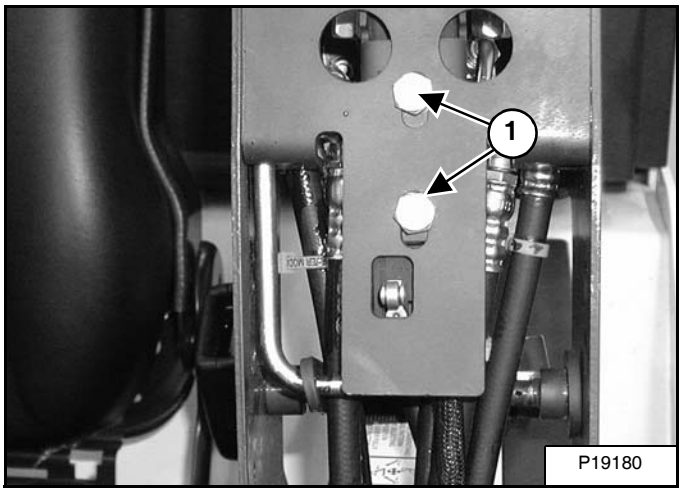
Remove the release rod and the latch bracket with the microswitch **[Figure 40-60-16]**.

NOTE: See Microswitch Removal And Testing. (See MICROSWITCH on Page 50-80-1.)

Adjustment

NOTE: Before the lock lever adjustments can be made, the microswitch must be moved to the top of the adjustment slots. Switch damage may occur if this is not done prior to the lock lever adjustments.

Figure 40-60-18

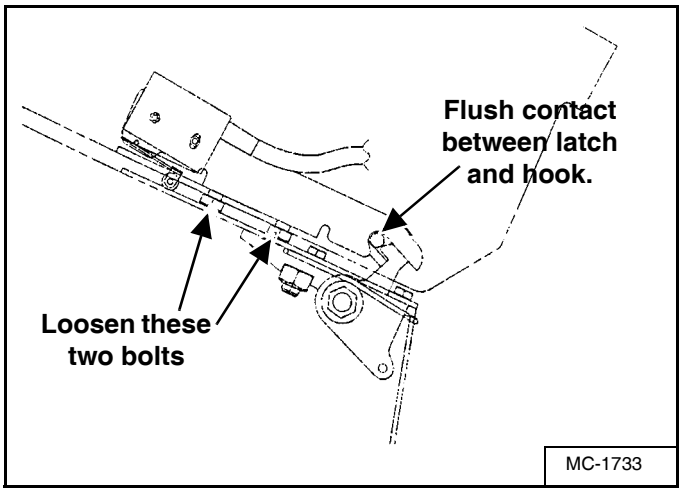


Loosen the two bolts (Item 1) **[Figure 40-60-18]** that hold the latch bracket to the console so the latch bracket will not move when the control console is closed, but loose enough so the bolt heads can be tapped with a punch to move the latch for proper adjustment.

Lower the control console to the latched position.

Push down on the console to remove the gas spring pressure.

Figure 40-60-19

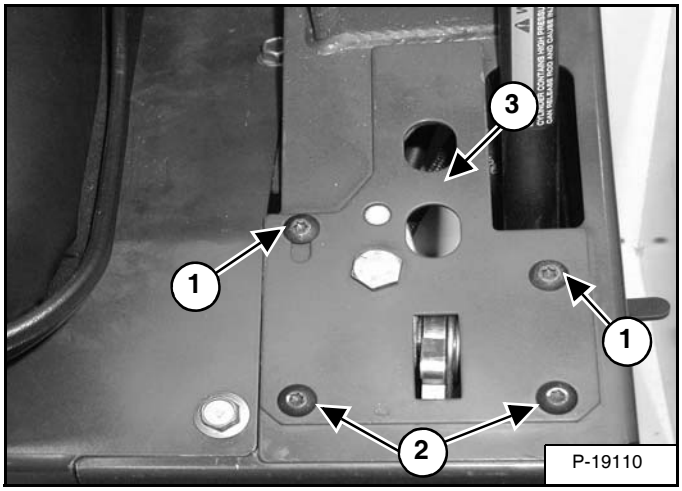


Adjust the latch until the spring loaded hook will just make contact with the latch bracket when the console is lowered **[Figure 40-60-19]**.

Latch Hook Removal And Installation

Raise the console.

Figure 40-60-20



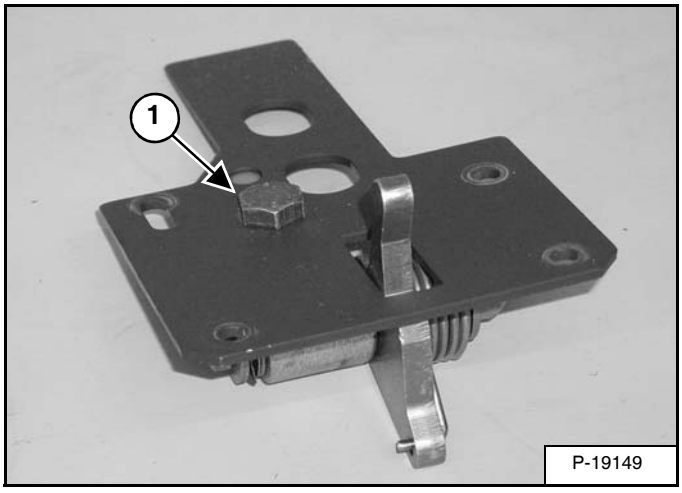
Remove the bolts (Item 1) and (Item 2) **[Figure 40-60-20]** from the plate.

Installation: Tighten the bolts to 6-7 ft.-lbs. (8-10 Nm) torque.

NOTE: Install the long bolts (Item 2) [Figure 40-60-20] in the front of the plate.

Remove the mounting plate (Item 3) **[Figure 40-60-20]**.

Figure 40-60-21



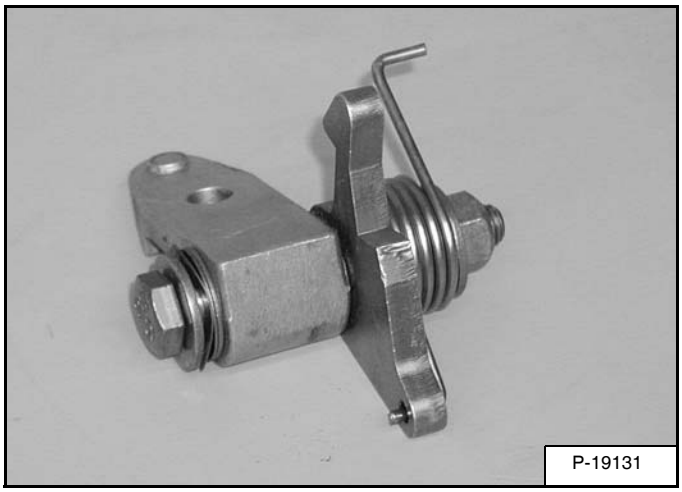
Remove the bolt and the nut (Item 1) **[Figure 40-60-21]** from the latch pivot.

Installation: Tighten the bolt to 29-37 ft.-lbs. (40-50 Nm) torque.

LEFT CONSOLE (CONT'D)

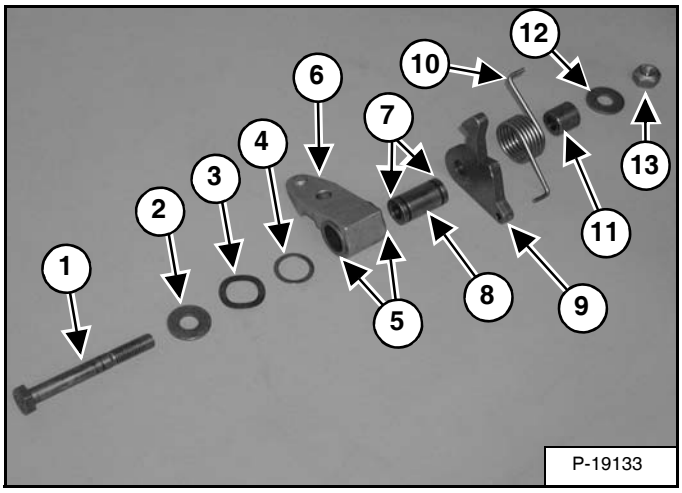
Latch Hook Disassembly And Assembly

Figure 40-60-22



Disassemble the latch pivot **[Figure 40-60-22]**.

Figure 40-60-23



Item No.	Description
1	Bolt
2	Washer
3	Wave Washer
4	Shim
5	Bushing
6	Pivot
7	O-rings
8	Sleeve
9	Latch Hook
10	Spring
11	Spacer
12	Washer
13	Nut **[Figure 40-60-23]**

Installation: Tighten the nut (Item 13) **[Figure 40-60-23]** to 29-37 ft.-lbs. (40-50 Nm) torque.

NOTE: Install the bushings (Item 5) with a pilot shaft to avoid bushing damage. Verify the sleeve (Item 8) [Figure 40-60-23] will pivot freely inside the bushings.

Apply oil to the O-rings (Item 7) before installing the sleeve (Item 8) into the pivot (Item 6) **[Figure 40-60-23]**.

Make sure that the shim (Item 4) is properly positioned over the sleeve and after tightening the nut, the hook (Item 9) **[Figure 40-60-23]** pivots freely.

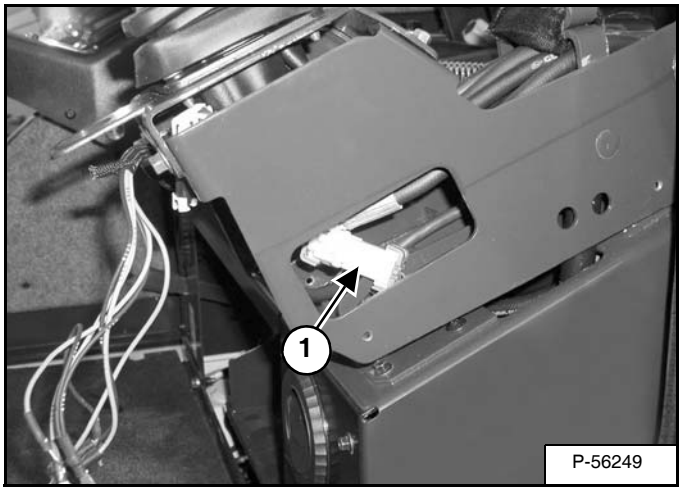
Upper Console Removal And Installation

Lower the boom/bucket and blade to the ground.

Remove the console cover. (See Console Cover Removal And Installation on Page 40-60-1.)

Remove the gas spring. (See Gas Spring Removal And Installation on Page 40-60-3.)

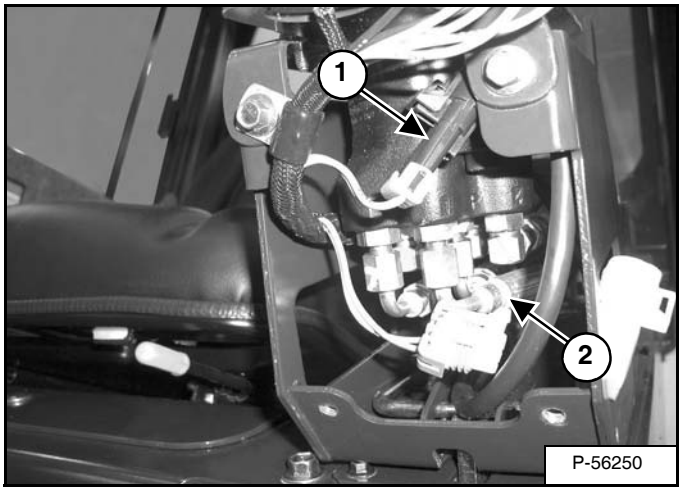
Figure 40-60-24



Disconnect the wire harness (Item 1) **[Figure 40-60-24]**.

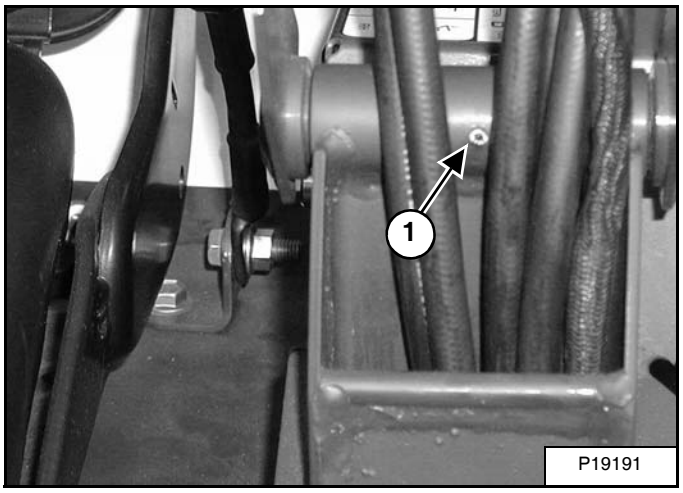
Raise and support the console.

Figure 40-60-25



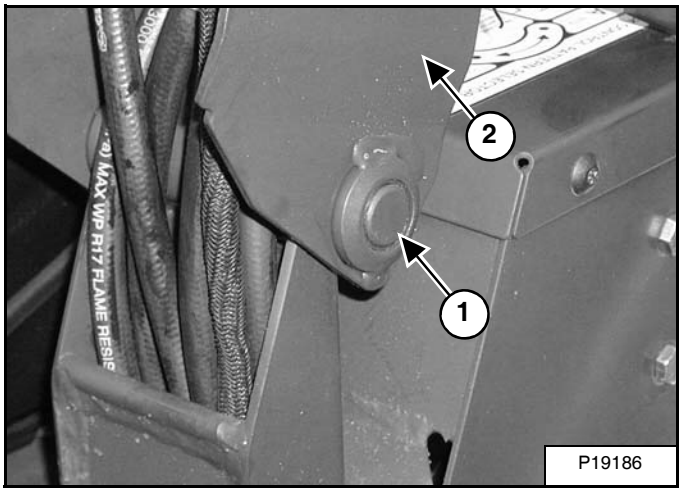
Disconnect the wire harness (Item 1) and remove the hoses (Item 2) **[Figure 40-60-25]** from the control lever (joystick).

Figure 40-60-26



Drive the roll pin (Item 1) **[Figure 40-60-26]** through the pivot shaft towards the back of the console base.

Figure 40-60-27



Drive the pivot shaft (Item 1) through and remove the upper console (Item 2) **[Figure 40-60-27]**.

NOTE: Feed the hoses and wire harness through the upper console during removal to avoid hose and harness damage.

Console Base Removal And Installation

Lower the boom/bucket and blade to the ground.

Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Remove the heater (If equipped). (See Removal And Installation on Page 70-10-1.)

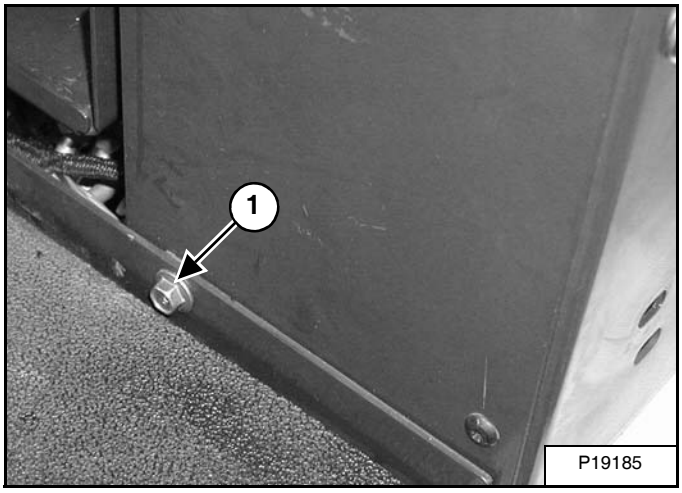
Remove the console cover. (See Console Cover Removal And Installation on Page 40-60-1.)

Remove the control lever (joystick). (See Removal And Installation on Page 20-111-5)

Remove the upper console. (See Upper Console Removal And Installation on Page 40-60-9.)

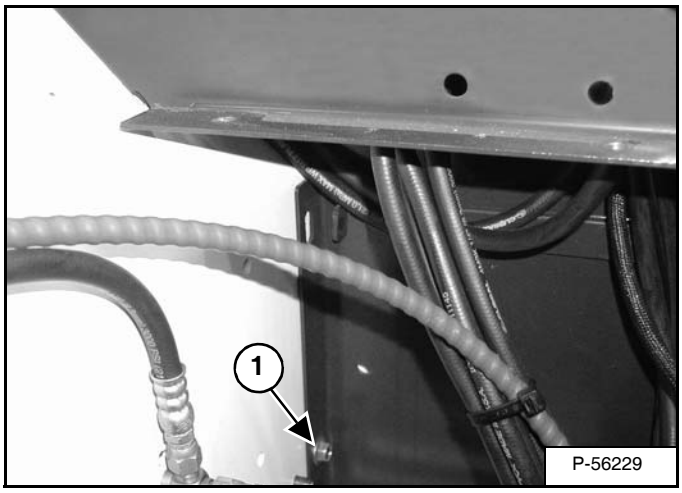
Remove the control pattern selector valve. (See Removal And Installation on Page 20-100-1.)

Figure 40-60-28



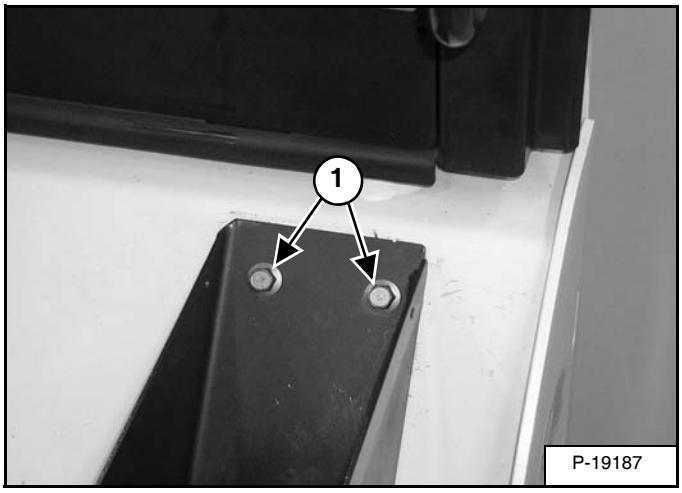
Remove the bolt (Item 1) **[Figure 40-60-28]** from the left console and floorplate.

Figure 40-60-29



Remove the bolt (Item 1) **[Figure 40-60-29]**.

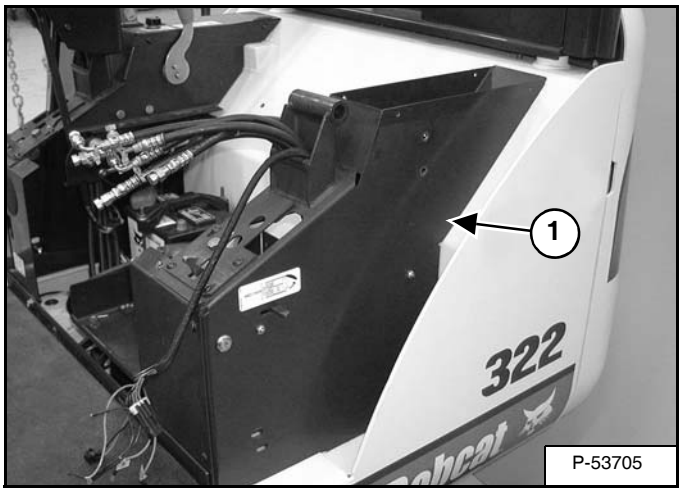
Figure 40-60-30



Remove the bolts (Item 1) **[Figure 40-60-30]** holding the console base to the frame.

Console Base Removal And Installation (Cont'd)

Figure 40-60-31



Remove the console base (Item 1) **[Figure 40-60-31]** from the Excavator.

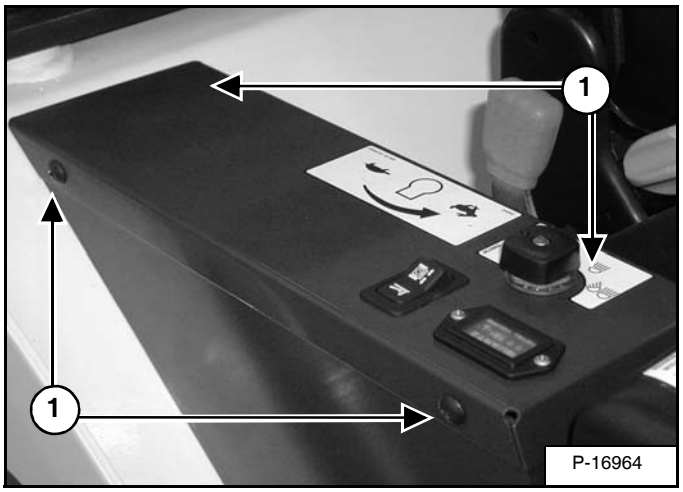
NOTE: Feed the hoses and wire harness through the console base during removal to avoid hose and harness damage.


Bobcat®

ENGINE SPEED CONTROL

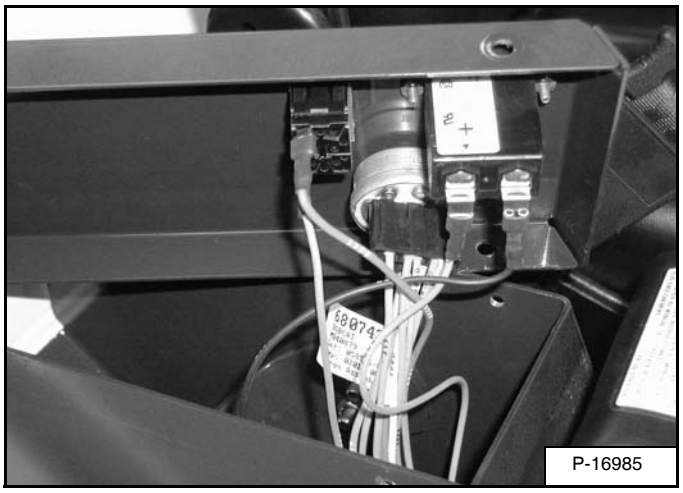
Removal and Installation

Figure 40-70-1



Remove the four screws (Item 1) **[Figure 40-70-1]** from the cover panel.

Figure 40-70-2



Mark the wires for ease of assembly. Disconnect the wires and wire harness from the switches and hourmeter **[Figure 40-70-2]**.

Remove the cover panel.

Figure 40-70-3

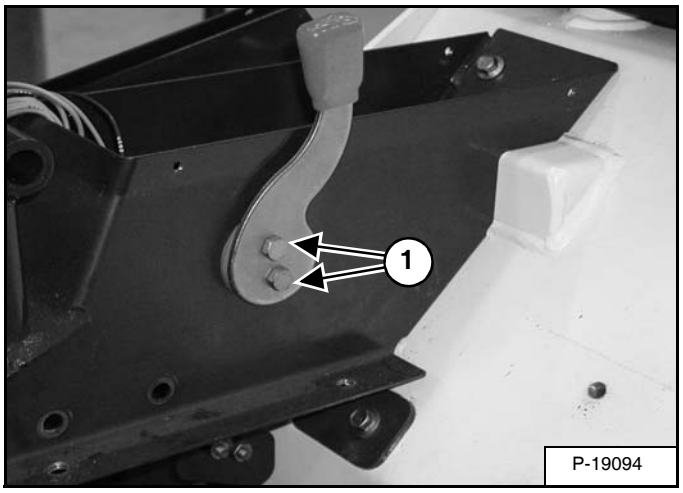
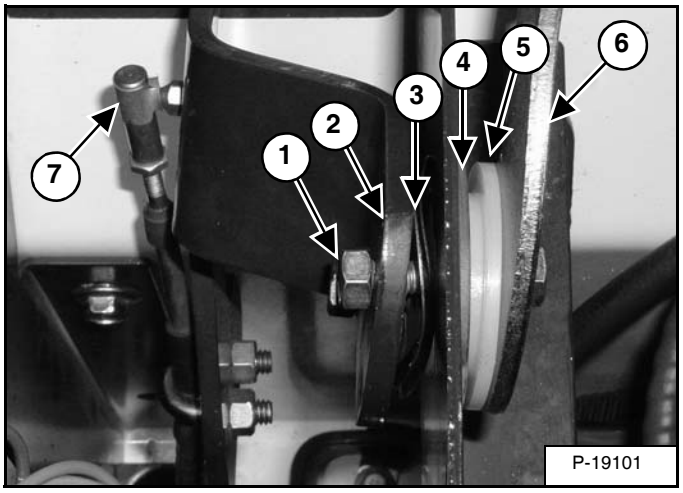


Figure 40-70-4

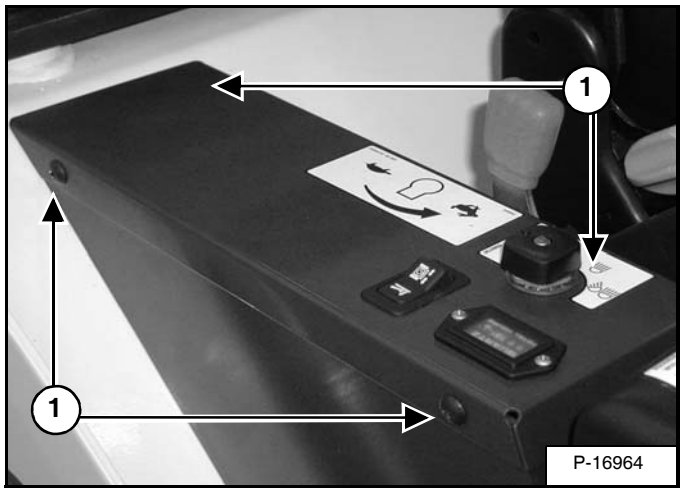


Remove the bolts and nuts (Item 1) **[Figure 40-70-3]** & **[Figure 40-70-4]**, the bracket (Item 2), the two wave washers (Item 3), the friction washer (Item 4), the nylon spacer (Item 5), and the lever (Item 6) **[Figure 40-70-4]**.

Disconnect the engine speed control cable (Item 7) **[Figure 40-70-4]** from the ball joint.

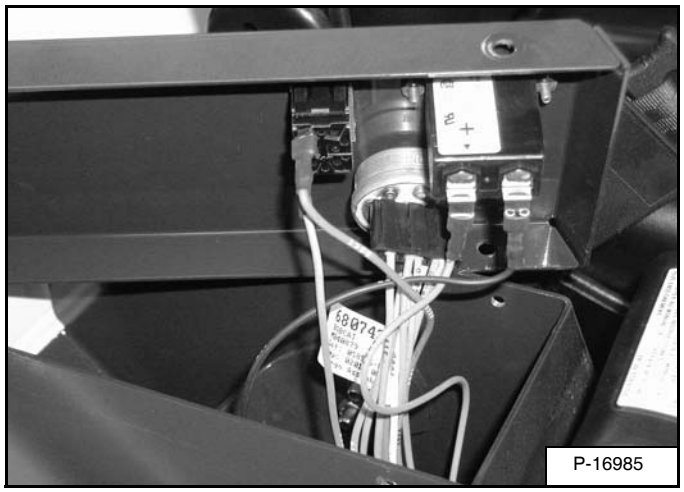
Engine Speed Control Cable Removal and Installation

Figure 40-70-5



Remove the four screws (Item 1) **[Figure 40-70-5]** from the cover panel.

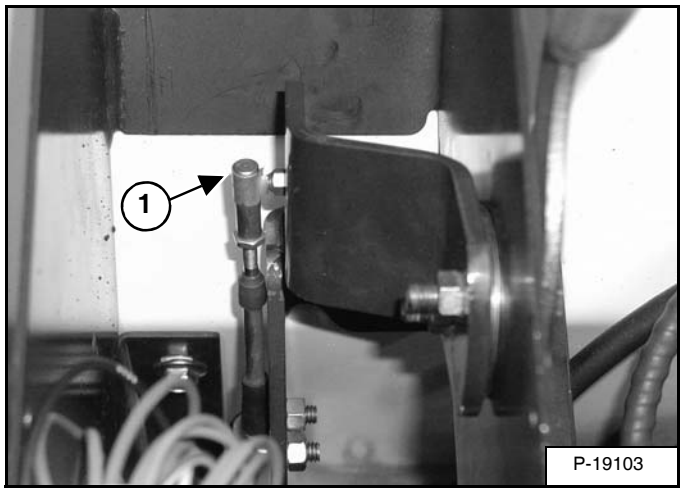
Figure 40-70-6



Mark the wires for ease of assembly. Disconnect the wires and wire harness from the switches and hourmeter **[Figure 40-70-6]**.

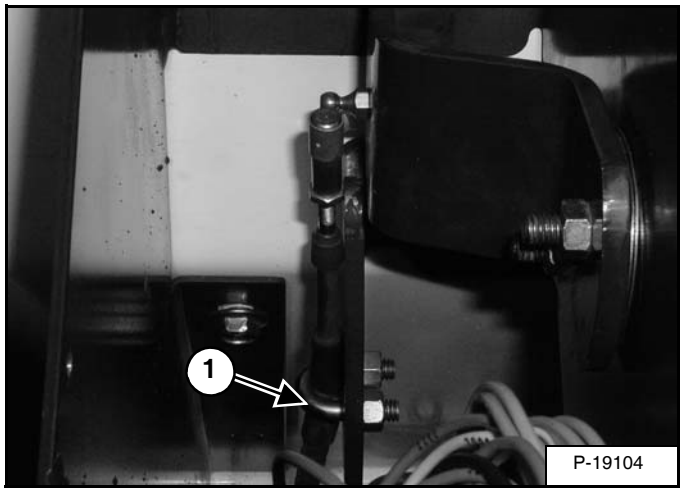
Remove the cover panel.

Figure 40-70-7



Disconnect the engine speed control cable (Item 1) **[Figure 40-70-7]** from the ball joint.

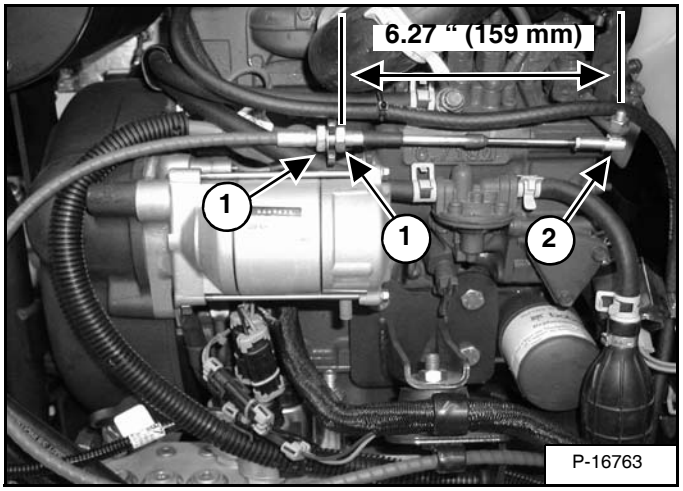
Figure 40-70-8



Loosen the u-bolt (Item 1) **[Figure 40-70-8]** on the cable.

Engine Speed Control Cable Removal and Installation (Cont'd)

Figure 40-70-9

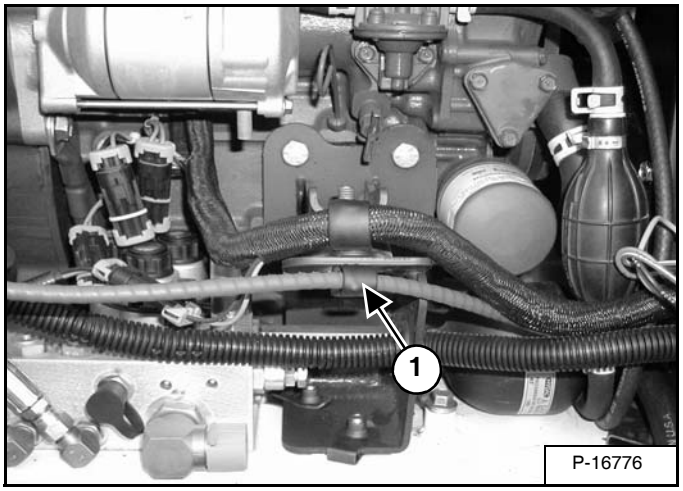


Loosen the nuts (Item 1) **[Figure 40-70-9]** fastening the cable to the bracket.

Disconnect the linkage (Item 2) **[Figure 40-70-9]** from the bracket.

Installation: The cable linkage measurement from bracket to the center of the ball joint is 6.27 inches (159 mm).

Figure 40-70-10



Remove the nut and clamp (Item 1) **[Figure 40-70-10]**.

Move the cable away from the engine.

Pull the cable down from the right console and out the back of the Excavator.

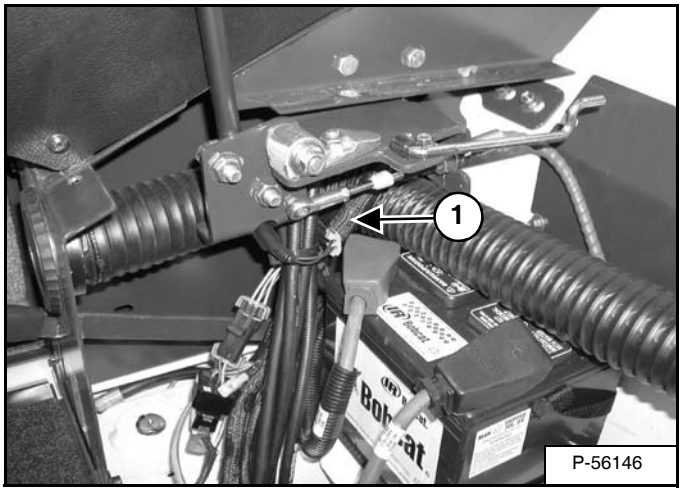

Bobcat®

BLADE CONTROL

Removal and Installation

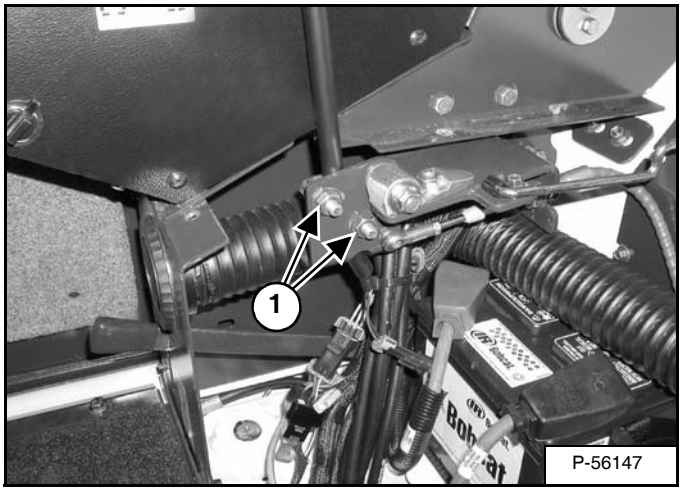
Remove the seat and seat mount. (SSee Removal And Installation on Page 40-40-1.)

Figure 40-80-1



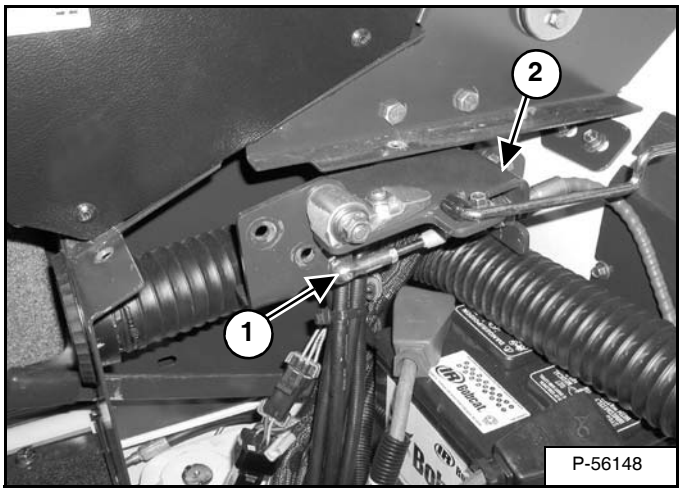
Disconnect the two speed wire harness (Item 1) **[Figure 40-80-1]**. (If Equipped)

Figure 40-80-2



Remove the bolts and clamps (Item 1). Remove the blade/track expansion lever (Item 2) **[Figure 40-80-2]**.

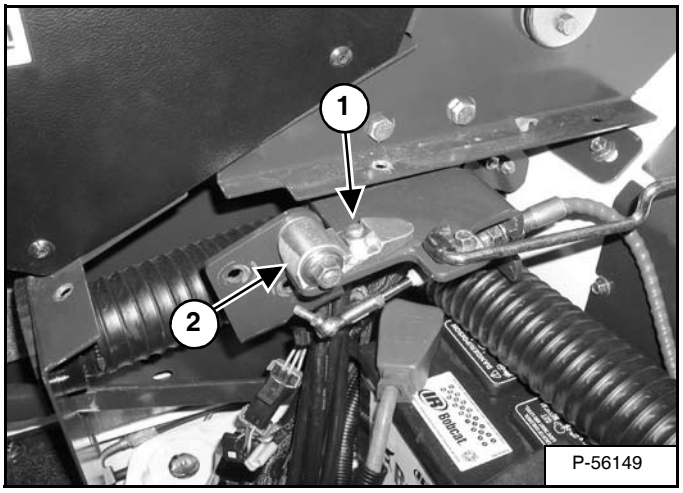
Figure 40-80-3



Remove the nut holding the ball joint of the blade/track expansion cable (Item 1) **[Figure 40-80-3]**.

Loosen the nut (Item 2) **[Figure 40-80-3]** and slide the cable assembly out of the bracket.

Figure 40-80-4



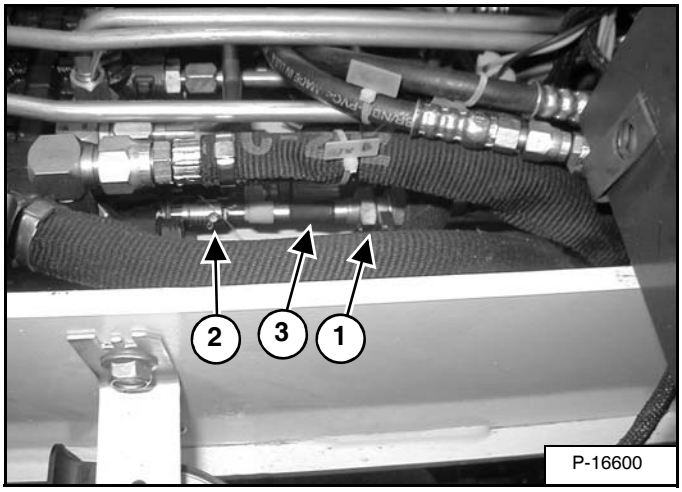
Remove the nut and bolt (Item 1) **[Figure 40-80-4]**.

Remove the bellcrank and pivot mount (Item 2) **[Figure 40-80-4]**.

Removal and Installation (Cont'd)

Remove the floormat and floorplate. (See Removal and Installation on Page 40-120-1.)

Figure 40-80-5

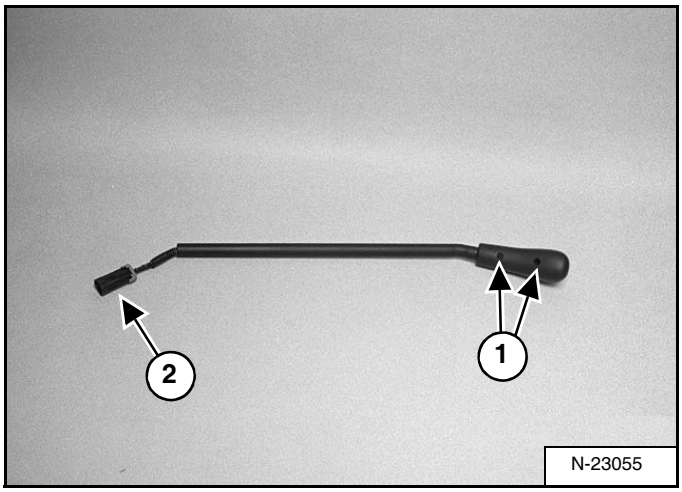


Loosen the nut (Item 1) and remove the clevis pin and cotter pin (Item 2) **[Figure 40-80-5]**.

Remove the cable (Item 3) **[Figure 40-80-5]**.

Disassembly And Assembly

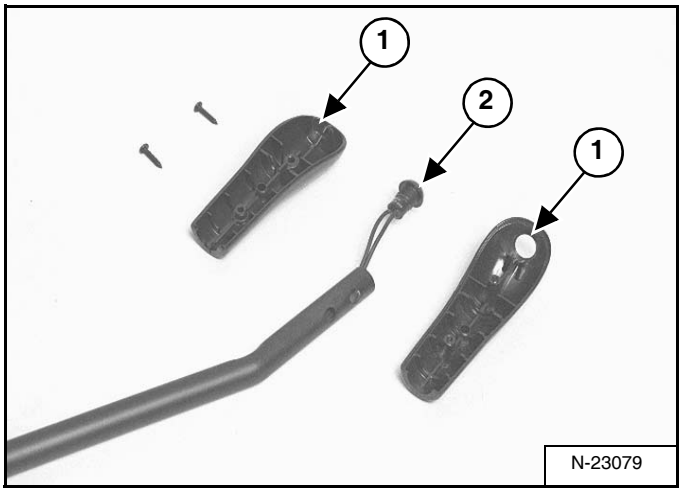
Figure 40-80-6



Remove the screws (Item 1) **[Figure 40-80-6]** from the two piece handle.

Remove the connector (Item 2) **[Figure 40-80-6]** from the wires.

Figure 40-80-7



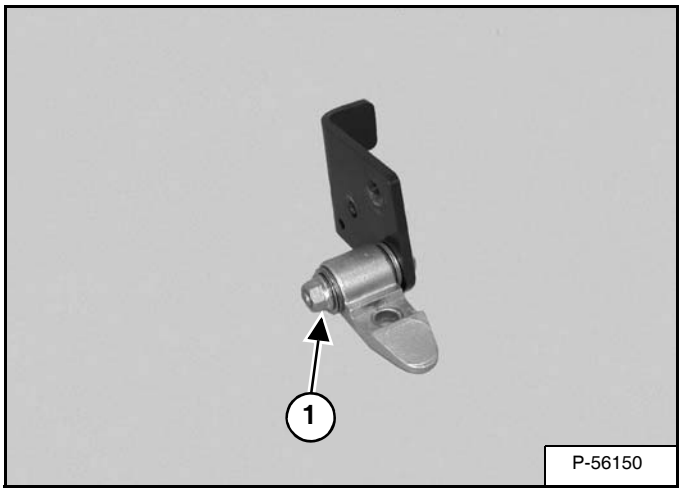
Remove the two halves of the handle (Item 1) **[Figure 40-80-7]**.

Remove the two speed switch and wire assembly (Item 2) **[Figure 40-80-7]** from the tube.

NOTE: The 320L is not equipped with a two speed.

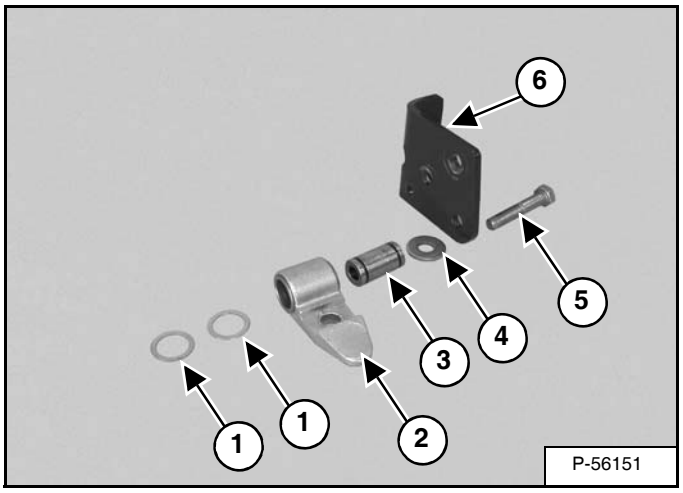
Disassembly And Assembly (Cont'd)

Figure 40-80-8



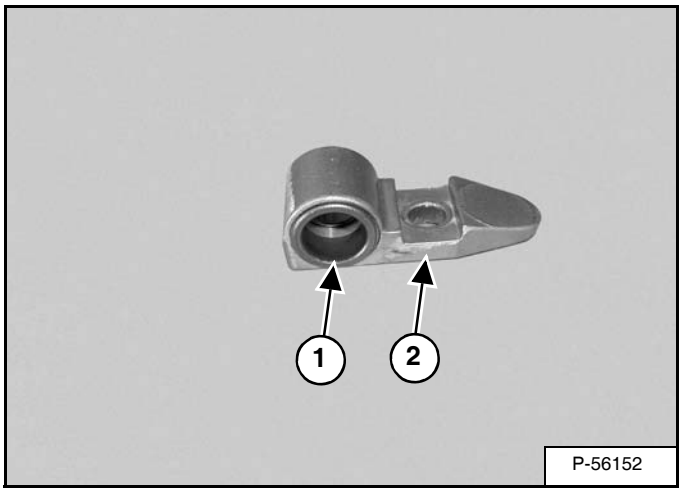
Remove the nut (Item 1) **[Figure 40-80-8]**.

Figure 40-80-9



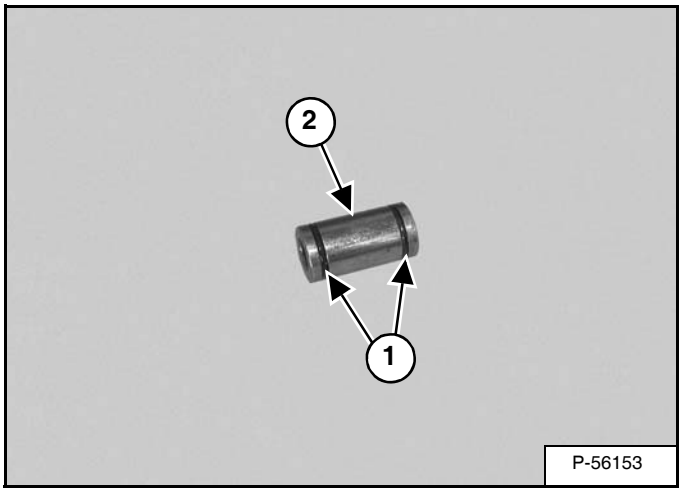
Remove the washers (Item 1), bellcrank (Item 2), sleeve (Item 3), washer (Item 4) and bolt (Item 5) from the pivot mount (Item 6) **[Figure 40-80-9]**.

Figure 40-80-10



Remove the bushing (Item 1) from the bellcrank (Item 2) **[Figure 40-80-10]**. (Both Sides)

Figure 40-80-11



Remove the O-rings (Item 1) from the sleeve (Item 2) **[Figure 40-80-11]**.

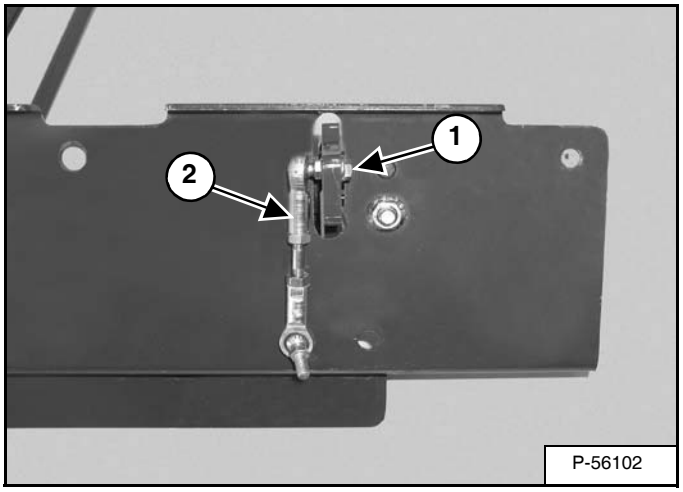

Bobcat®

RIGHT PEDAL

Right Pedal Removal And Installation

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

Figure 40-90-1



Remove the nut (Item 1) and linkage rod (Item 2) **[Figure 40-90-1]**.

Figure 40-90-2

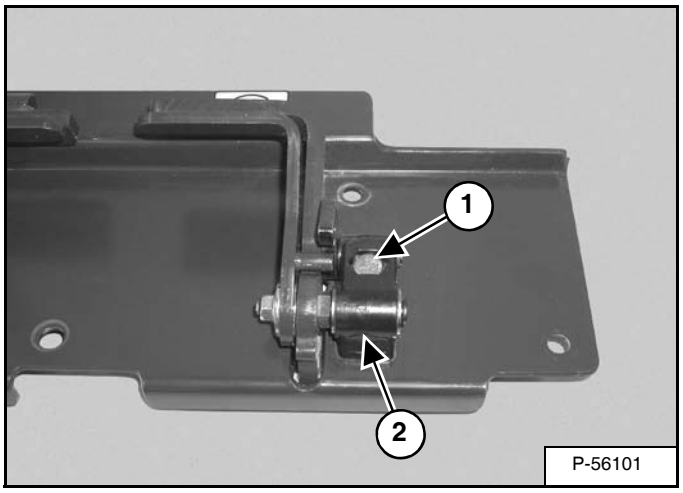
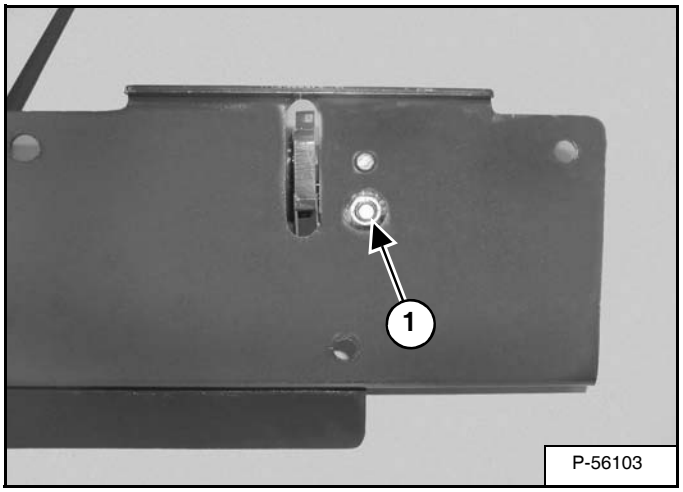


Figure 40-90-3



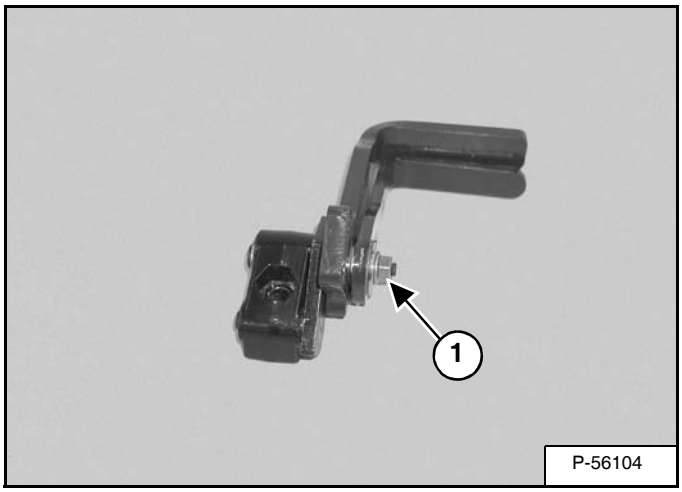
Remove the bolt and nut (Item 1) **[Figure 40-90-2]** & **[Figure 40-90-3]**.

Remove the pedal assembly (Item 2) **[Figure 40-90-2]** from the floorplate.

RIGHT PEDAL (CONT'D)

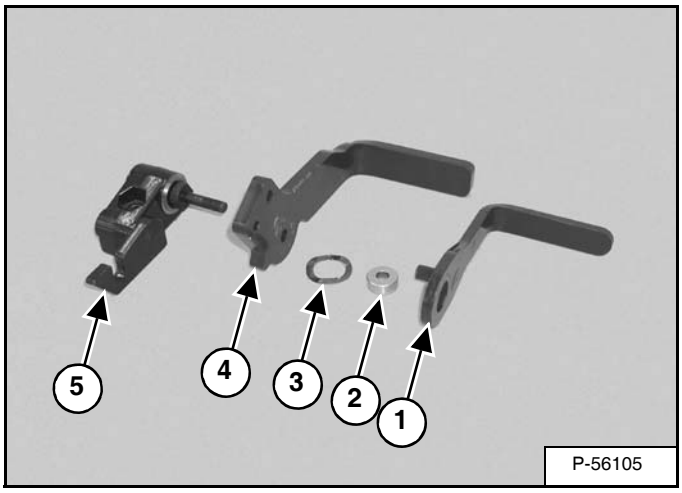
Disassembly And Assembly

Figure 40-90-4



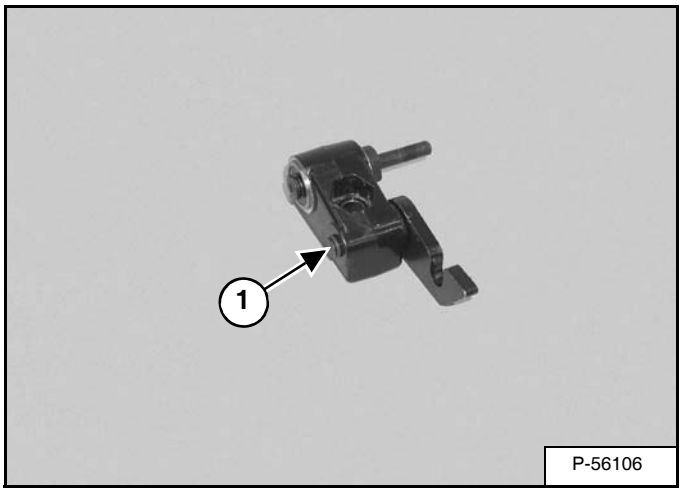
Remove the nut and washer (Item 1) **[Figure 40-90-4]**.

Figure 40-90-5



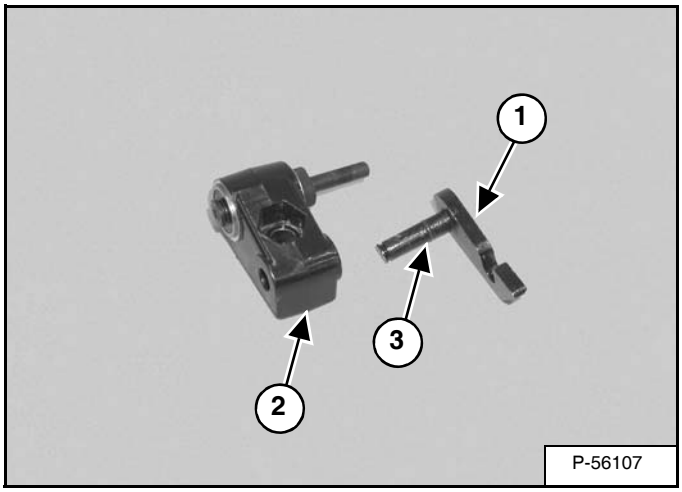
Remove the rear pedal (Item 1), bushing (Item 2), wave washer (Item 3) and front pedal (Item 4) from the mount (Item 5) **[Figure 40-90-5]**.

Figure 40-90-6



Remove the O-ring (Item 1) **[Figure 40-90-6]** from the shaft.

Figure 40-90-7



Remove the lock (Item 1) from the mount (Item 2) **[Figure 40-90-7]**.

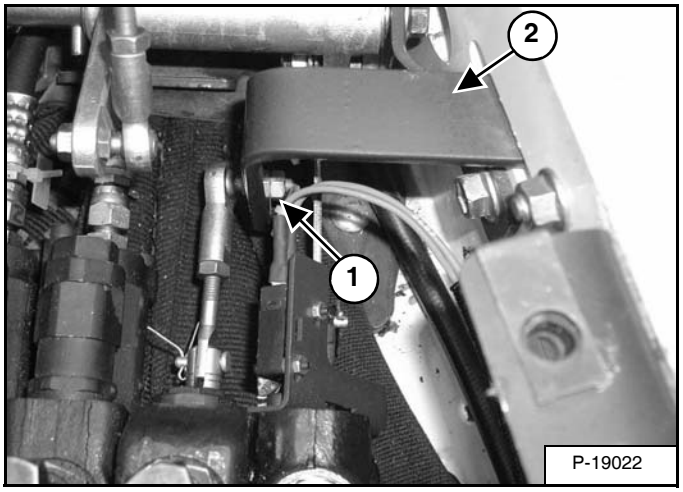
Remove the O-ring (Item 3) **[Figure 40-90-7]** from the shaft.

NOTE: Do not lubricate the O-ring (Item 3) with grease during installation. The O-ring works as a friction lock to prevent the lock (Item 1) [Figure 40-90-7] from pivoting freely.

Linkage Removal And Installation

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

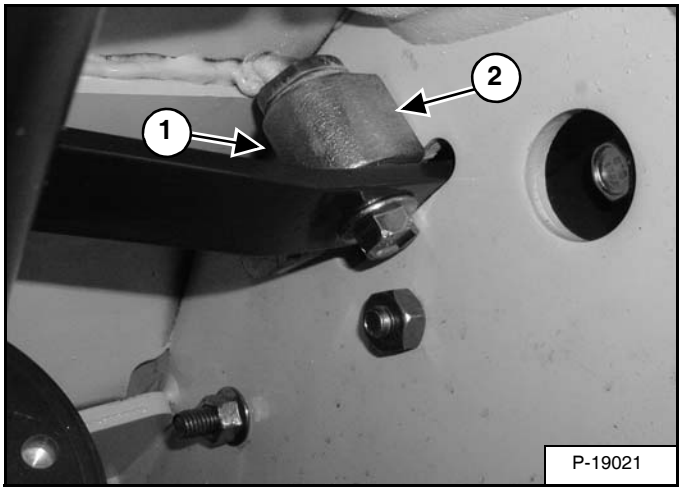
Figure 40-90-8



Remove the nut (Item 1) **[Figure 40-90-8]** from the lower linkage rod ball joint.

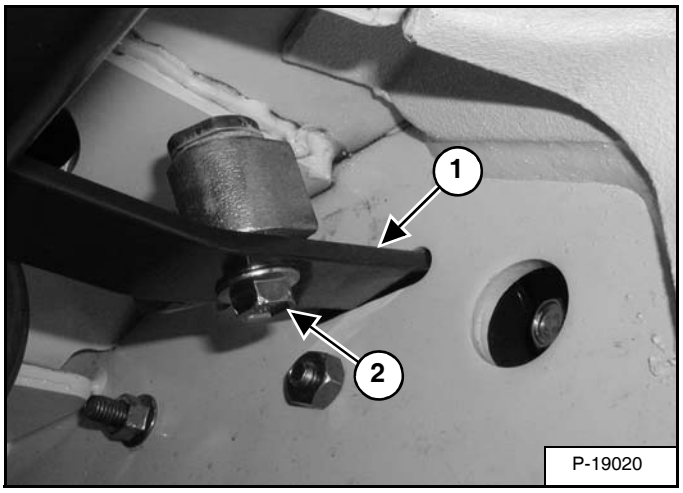
Remove the linkage rod ball joint from the right pedal bracket (Item 2) **[Figure 40-90-8]**.

Figure 40-90-9



Remove the bolt and nut (Item 1) fastening the bellcrank (Item 2) **[Figure 40-90-9]** to the frame.

Figure 40-90-10



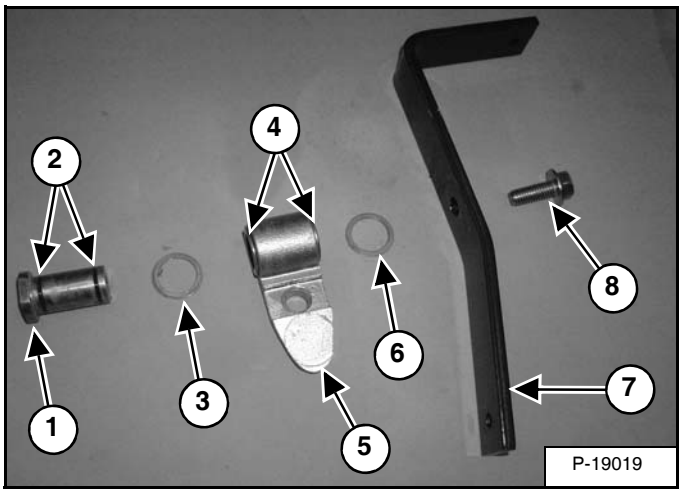
Pull the right pedal bracket (Item 1) **[Figure 40-90-10]** away from the frame.

Remove the bolt (Item 2) **[Figure 40-90-10]** fastening the bellcrank to the right pedal bracket.

Pull the right pedal bracket through the frame towards the control valve assembly.

Linkage Disassembly And Assembly

Figure 40-90-11



Disassemble the bellcrank. Sleeve (Item 1), O-rings (Item 2), washer (Item 3), bushings (Item 4), bellcrank (Item 5), washer (Item 6), bracket (Item 7) and bolt (Item 8) **[Figure 40-90-11]**.

NOTE: Install the bushings (Item 4) with a pilot shaft to avoid bushing damage. Verify sleeve (Item 1) [Figure 40-90-11] will pivot freely inside the bushings.


Bobcat®

LEFT PEDAL

Removal And Installation

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1)

Figure 40-91-1

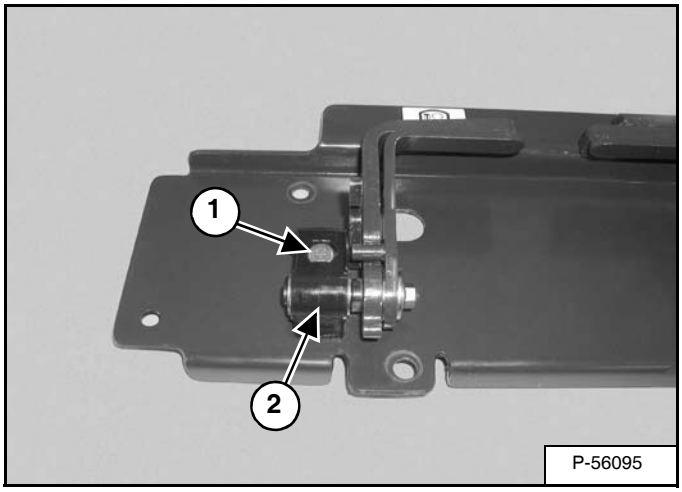
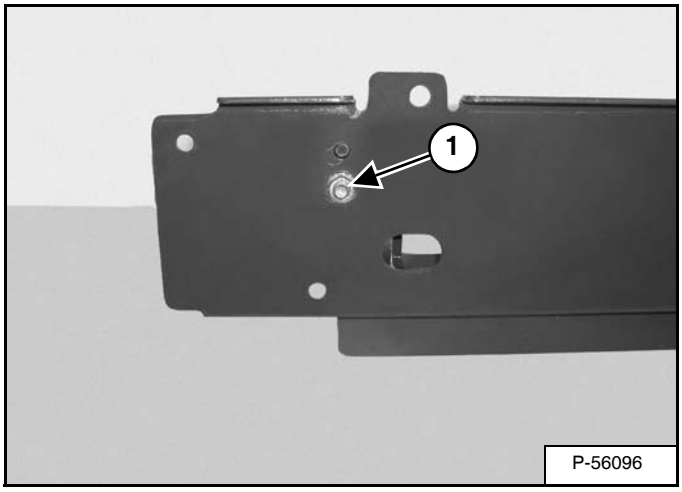


Figure 40-91-2



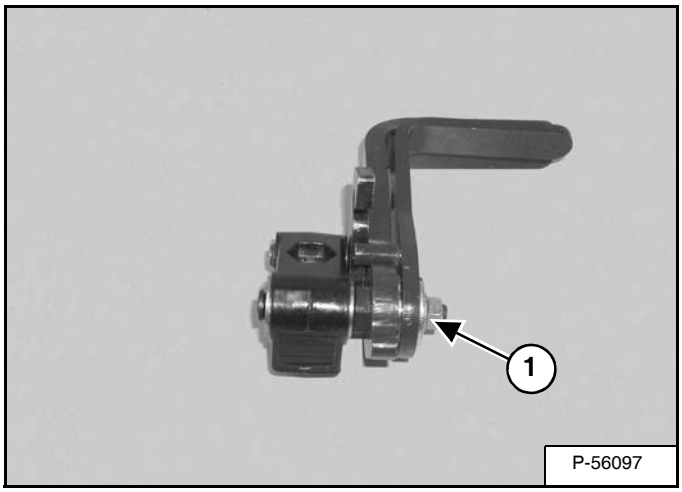
Remove the bolt and nut (Item 1) **[Figure 40-91-1]** & **[Figure 40-91-2]**.

Remove the pedal assembly (Item 2) **[Figure 40-91-1]** from the floorplate.

LEFT PEDAL (CONT'D)

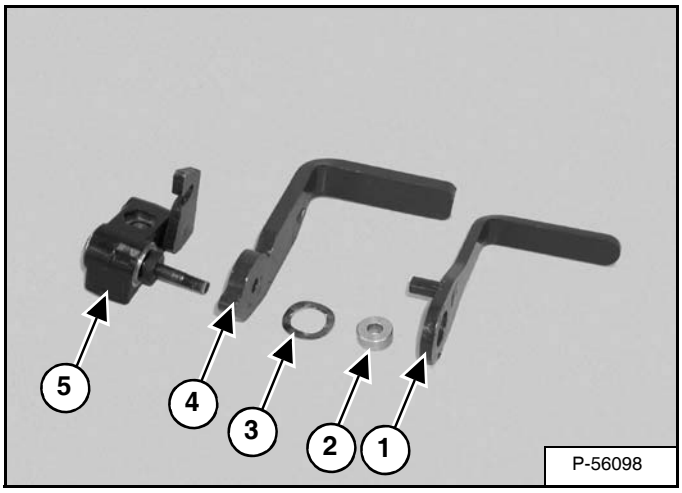
Disassembly And Assembly

Figure 40-91-3



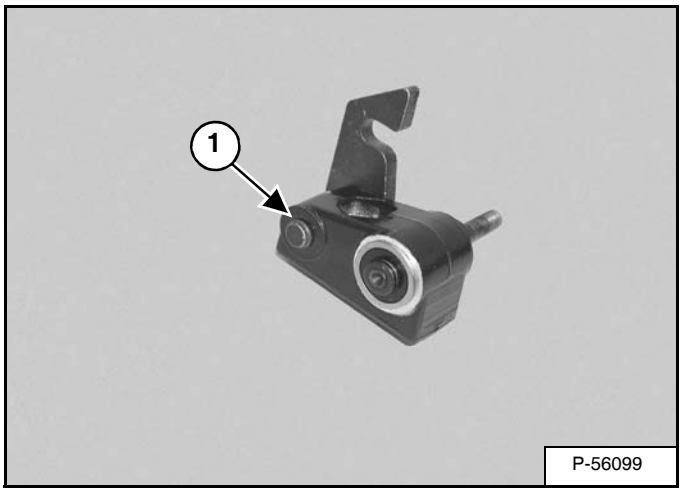
Remove the nut and washer (Item 1) **[Figure 40-91-3]**.

Figure 40-91-4



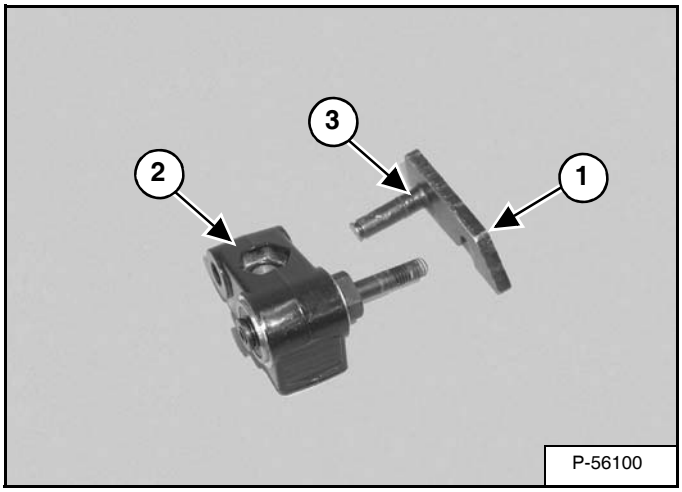
Remove the rear pedal (Item 1), bushing (Item 2), wave washer (Item 3), and front pedal (Item 4) from the mount (Item 5) **[Figure 40-91-4]**.

Figure 40-91-5



Remove the O-ring (Item 1) **[Figure 40-91-5]** from the shaft.

Figure 40-91-6



Remove the lock (Item 1) from the mount (Item 2) **[Figure 40-91-6]**.

Remove the O-ring (Item 3) **[Figure 40-91-6]** from the shaft.

NOTE: Do not lubricate the O-ring (Item 3) with grease during installation. The O-ring works as a friction lock to prevent the lock (Item 1) [Figure 40-91-6] from pivoting freely.

TRAVEL CONTROLS

Removal And Installation

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

NOTE: The procedure is the same for both travel controls. The left travel control is shown.

Figure 40-100-1

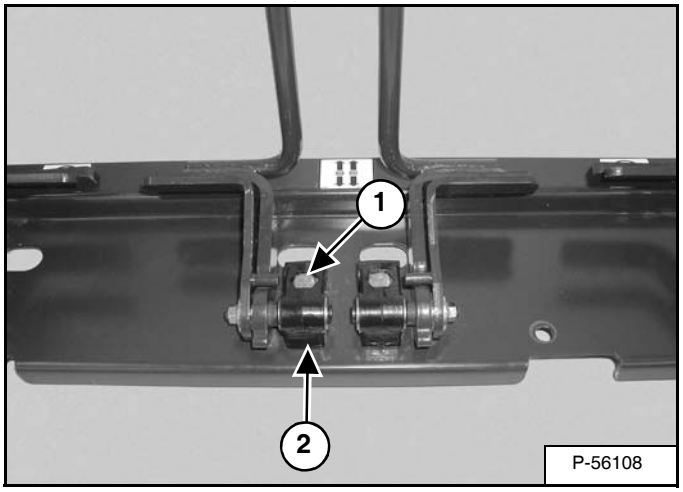
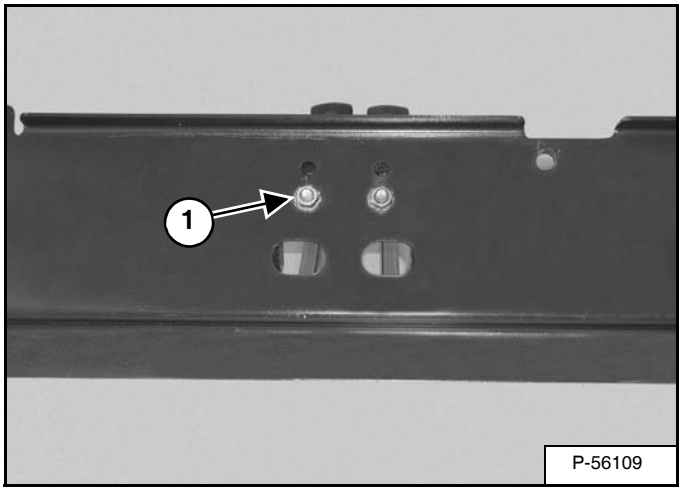


Figure 40-100-2



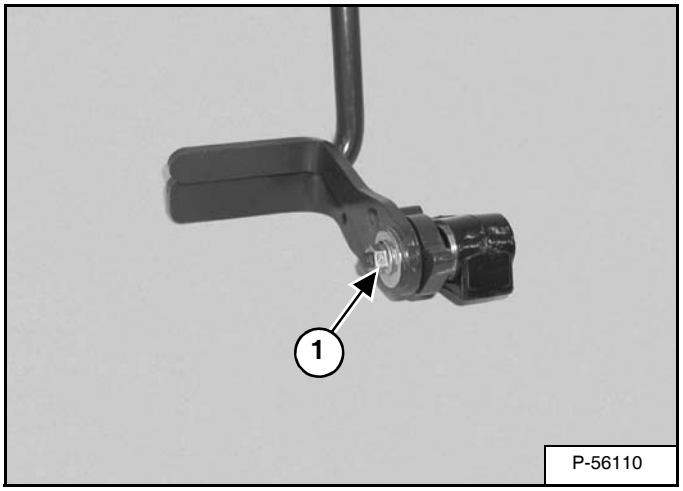
Remove the bolt and nut (Item 1) **[Figure 40-100-1]** & **[Figure 40-100-2]**.

Remove the left travel control assembly (Item 2) **[Figure 40-100-1]** from the floorplate.

Disassembly And Assembly

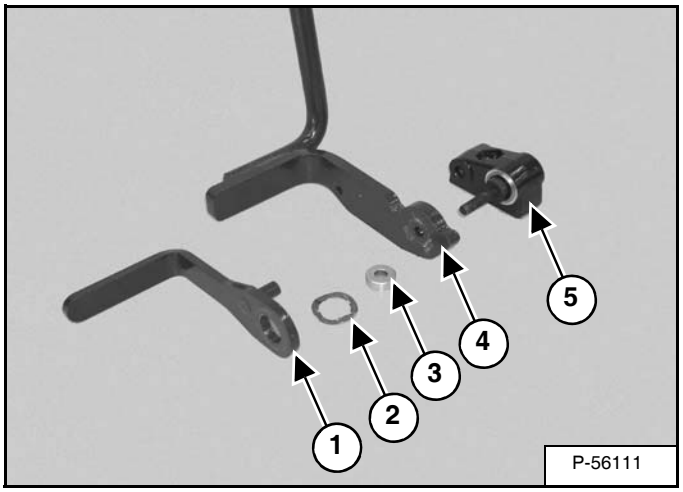
NOTE: The procedure is the same for both left and right travel controls. The left travel control is shown.

Figure 40-100-3



Remove the nut and washer (Item 1) **[Figure 40-100-3]** holding the pedals to the mount.

Figure 40-100-4



Remove the rear pedal (Item 1), wave washer (Item 2), bushing (Item 3) and front pedal (Item 4) from the mount (Item 5) **[Figure 40-100-4]**.

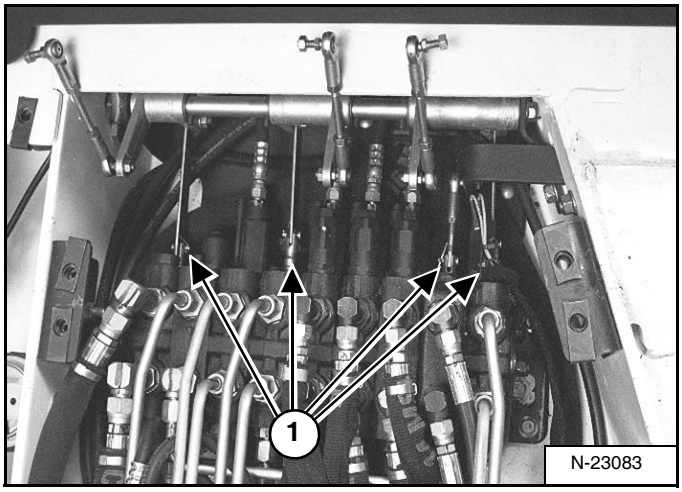

Bobcat®

CONTROL LINKAGE ASSEMBLY

Removal And Installation

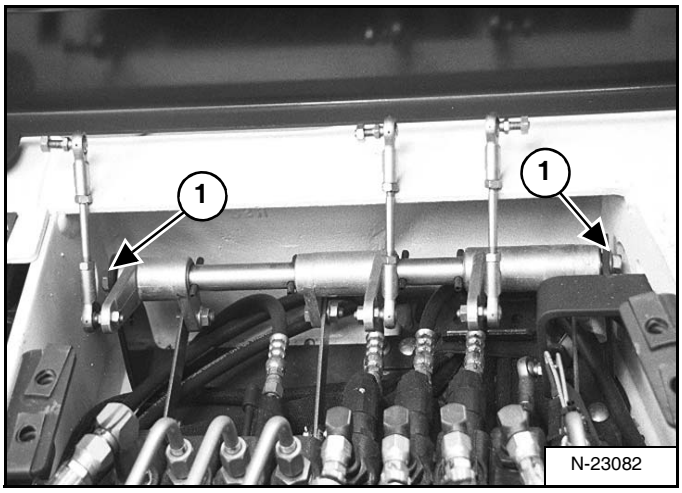
Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

Figure 40-110-1



Remove the cotter pins and clevis pins (Item 1) **[Figure 40-110-1]** from the clevis at the control valve.

Figure 40-110-2



Remove the bolts (Item 1) **[Figure 40-110-2]** from the control linkage assembly mounting brackets by accessing the bolt heads through the clearance holes in the side frame.

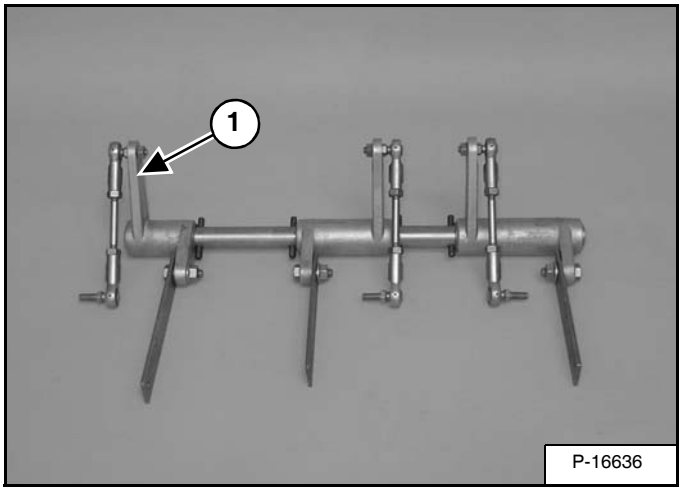
Remove the control linkage assembly from the Excavator.

CONTROL LINKAGE ASSEMBLY (CONT'D)

Left Pedal Linkage Disassembly And Assembly

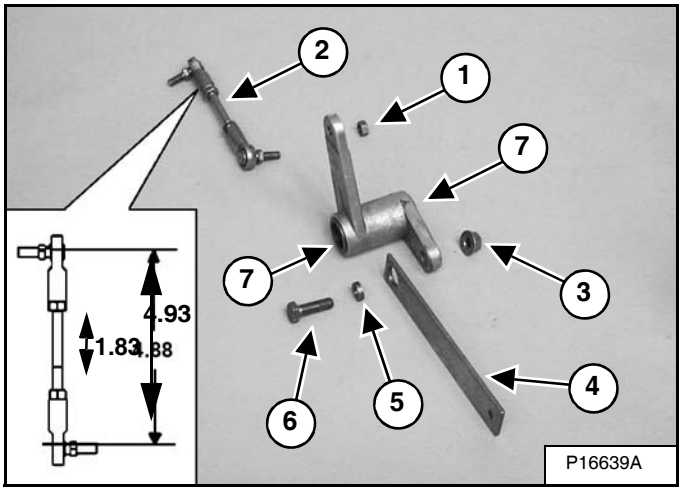
Mark the linkage rods and their orientation on the bellcranks. Mark bellcrank assemblies location and orientation on the shaft for ease of assembly.

Figure 40-110-3



Slide the left pedal bellcrank assembly (Item 1) **[Figure 40-110-3]** off the end of the shaft.

Figure 40-110-4



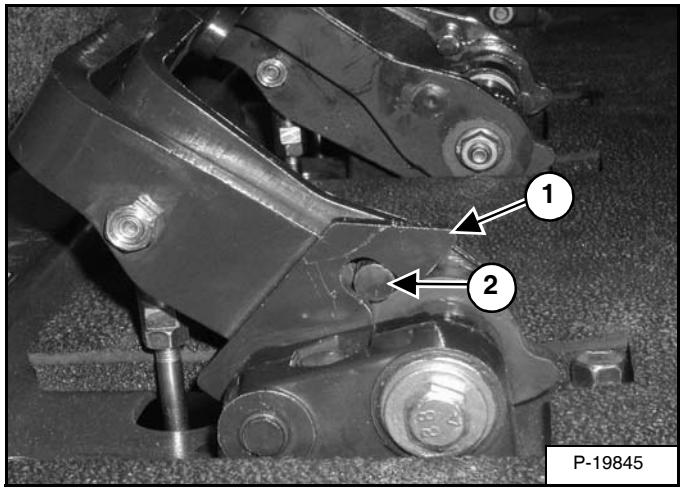
Remove the nut (Item 1) and linkage rod (Item 2) **[Figure 40-110-4]** from the left pedal bellcrank.

Remove the nut (Item 3), linkage plate (Item 4), spacer (Item 5) and bolt (Item 6) **[Figure 40-110-4]** from the bellcrank.

Remove the bushings (Item 7) **[Figure 40-110-4]** from the bellcrank.

Installation: The distance between the center lines of the linkage rod ball joints (Item 2) **[Figure 40-110-4]** is 4.93 in (125.2 mm).

Figure 40-110-5

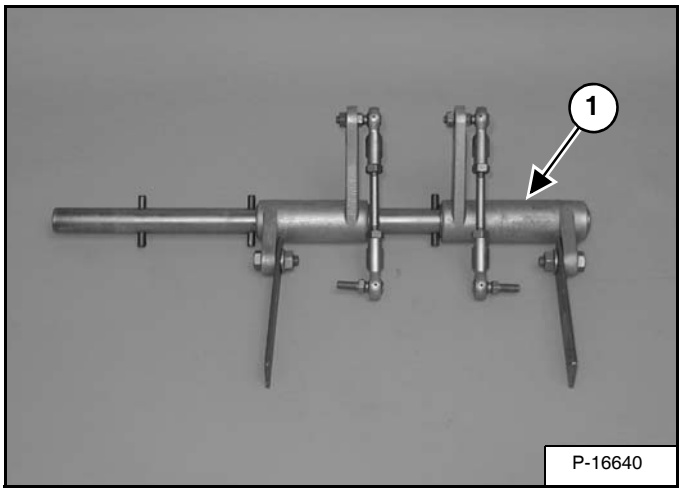


NOTE: Linkage rod ball joint dimensions (Item 2) [Figure 40-110-4] may need final adjustment, with pedal (valve) in neutral, to ensure the lock (Item 1) [Figure 40-110-5] engages the pedal lock pin (Item 2) [Figure 40-110-5] when the floor panel is re-installed.

CONTROL LINKAGE ASSEMBLY (CONT'D)

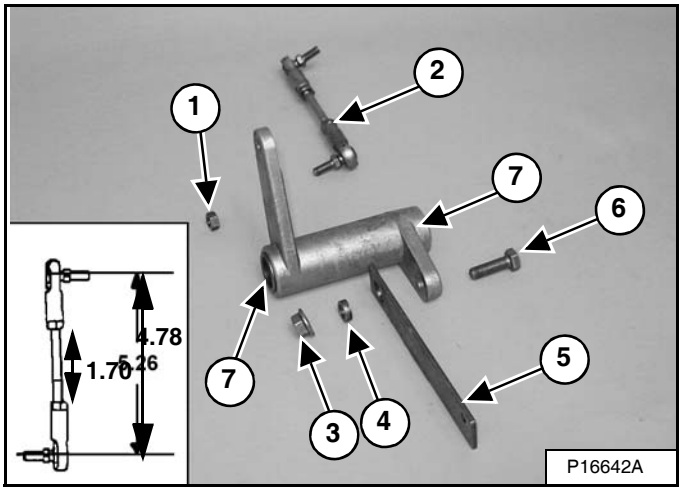
Right Travel Control Linkage Disassembly And Assembly

Figure 40-110-6



Slide the right travel bellcrank assembly (Item 1) **[Figure 40-110-6]** off the end of the shaft.

Figure 40-110-7



Remove the nut (Item 1) and linkage rod (Item 2) **[Figure 40-110-7]** from the right travel bellcrank.

Remove the nut (Item 3), spacer (Item 4), linkage plate (Item 5) and bolt (Item 6) **[Figure 40-110-7]** from the bellcrank.

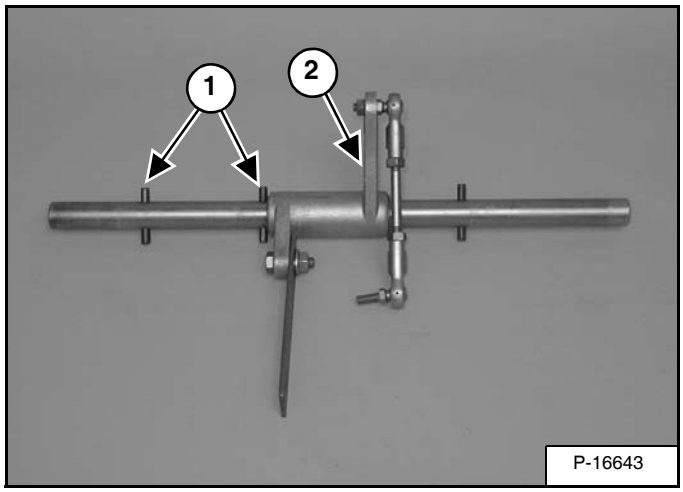
Remove the bushings (Item 7) **[Figure 40-110-7]** from the bellcrank.

NOTE: The orientation of the linkage plate (Item 5) [Figure 40-110-7] mounting hole is up towards the linkage rod.

Installation: The distance between the center lines of the linkage rod ball joints (Item 2) **[Figure 40-110-7]** is 4.78 in. (121.4 mm).

Left Travel Control Linkage Disassembly And Assembly

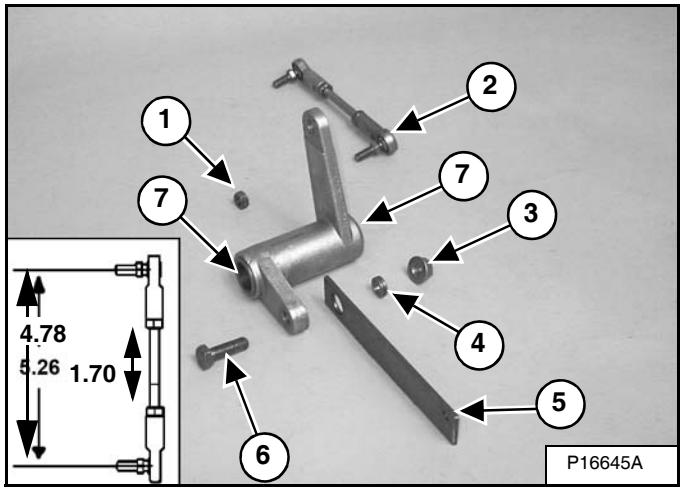
Figure 40-110-8



Remove the roll pins (Item 1) **[Figure 40-110-8]** from the shaft.

Slide the left travel bellcrank assembly (Item 2) **[Figure 40-110-8]** off the end of the shaft.

Figure 40-110-9



Remove the nut (Item 1) and linkage rod (Item 2) **[Figure 40-110-9]** from the left travel bellcrank.

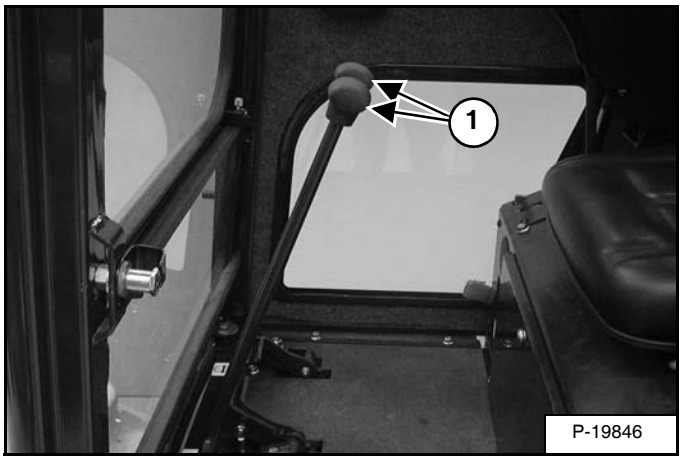
Remove the nut (Item 3), spacer (Item 4), linkage plate (Item 5) and bolt (Item 6) **[Figure 40-110-9]** from the auxiliary bellcrank.

Remove the bushings (Item 7) **[Figure 40-110-9 on Page 40-110-4]** from the bellcrank.

NOTE: The orientation of the linkage plate (Item 5) [Figure 40-110-9] mounting hole is up towards the linkage rod.

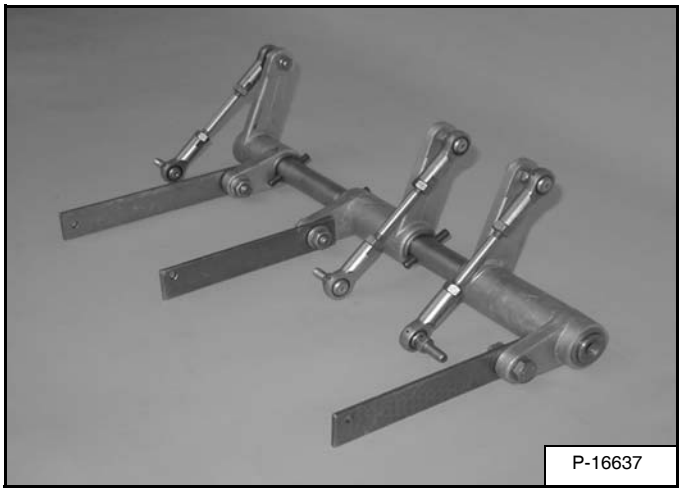
Installation: The distance between the center lines of the linkage rod ball joints (Item 2) **[Figure 40-110-9]** is 4.78 in. (121.4 mm).

Figure 40-110-10



NOTE: Linkage rod ball joints dimensions may need final adjustment to ensure the travel levers (Item 1) [Figure 40-110-10], with valve (levers) in neutral, are even (in-line) with each other when the floor panel is installed.

Figure 40-110-11



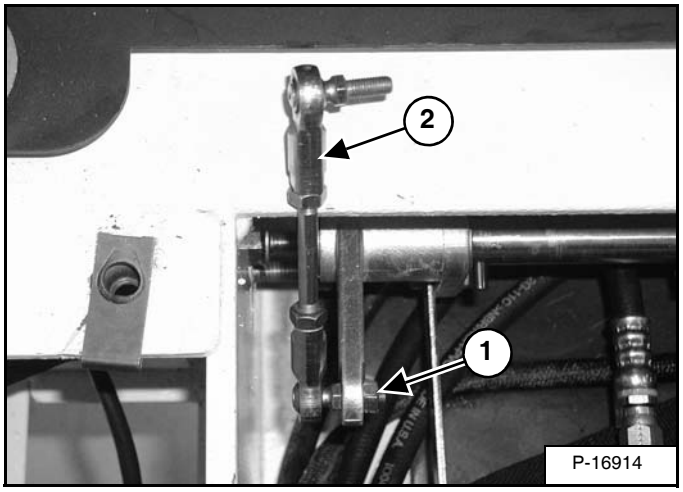
NOTE: The control linkage assembly must be assembled as shown [Figure 40-110-11].

Linkage Rod Removal And Installation

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

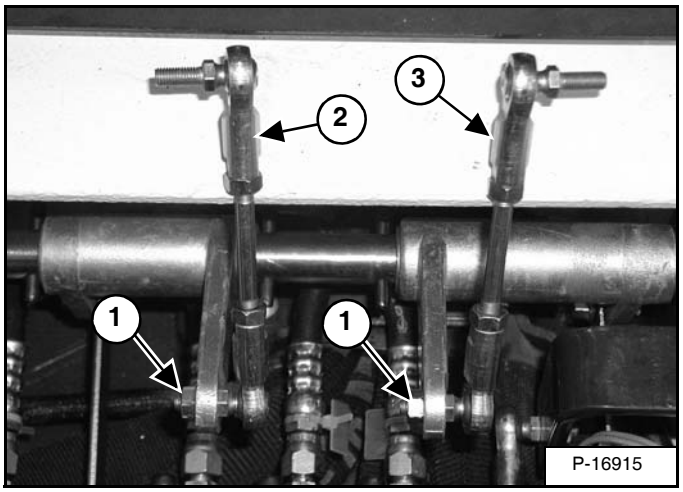
NOTE: Before disassembling the linkages, measure the distance between the center lines of the linkage end and the orientation for ease of assembly.

Figure 40-110-12



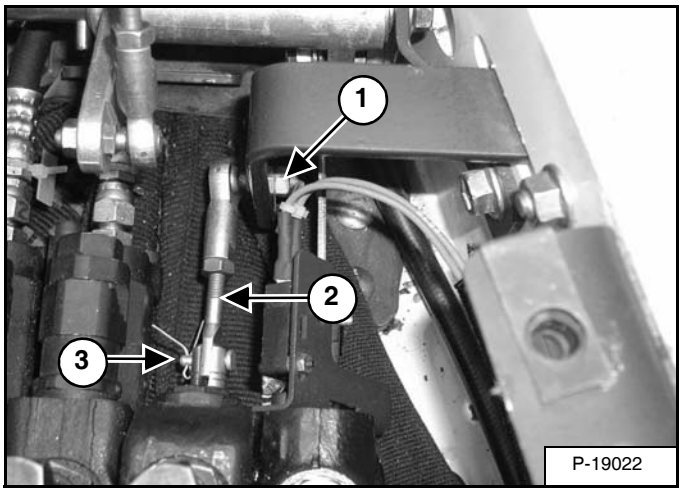
Remove the nut (Item 1) from the end of the ball joint on the left pedal linkage rod (Item 2) **[Figure 40-110-12]**.

Figure 40-110-13



Remove the nuts (Item 1) from the end of the ball joints on the left and right travel control linkage rods (Items 2 & 3) **[Figure 40-110-13]**.

Figure 40-110-14

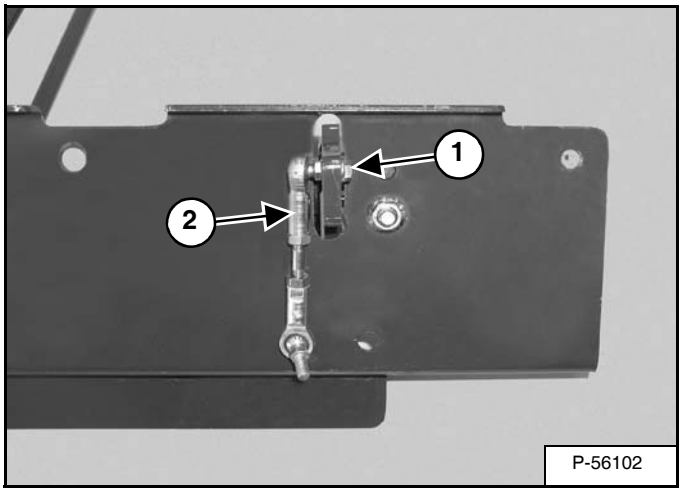


Remove the nut (Item 1) from the end of the ball joint on the right pedal linkage rod (Item 2) **[Figure 40-110-14]**.

Remove the clevis pin and cotter pin (Item 3) **[Figure 40-110-14]**.

Remove the linkage rod.

Figure 40-110-15

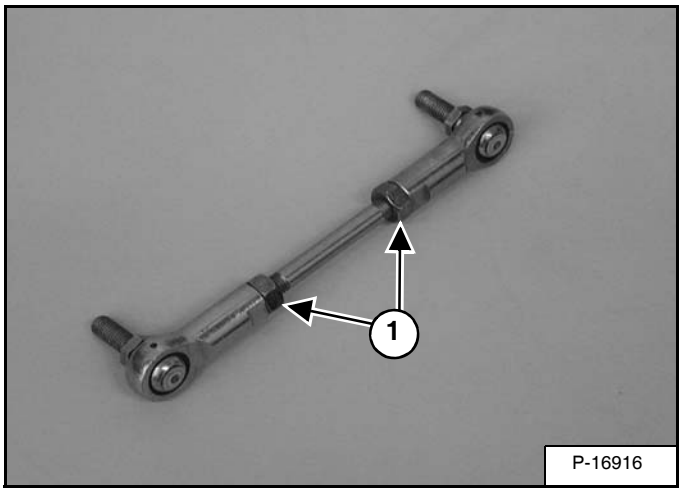


Remove the nut (Item 1) from the end of the ball joint on the right pedal linkage rod (Item 2) **[Figure 40-110-15]**.

Remove the linkage rod.

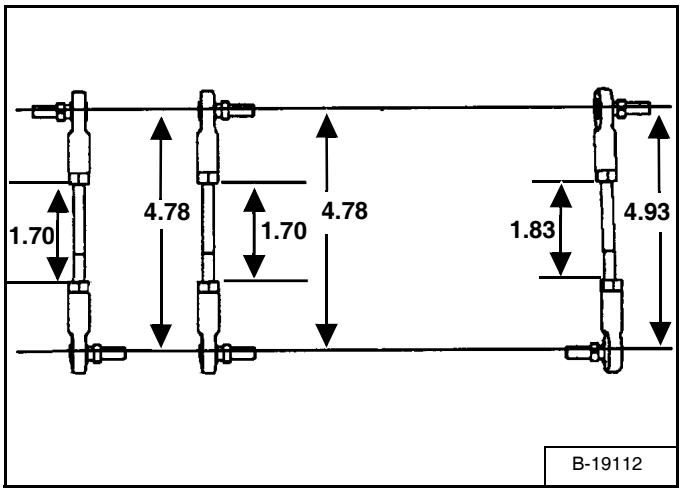
Linkage Rod Adjustment

Figure 40-110-16



Loosen the nut (Item 1) **[Figure 40-110-16]** on the end of the ball joint.

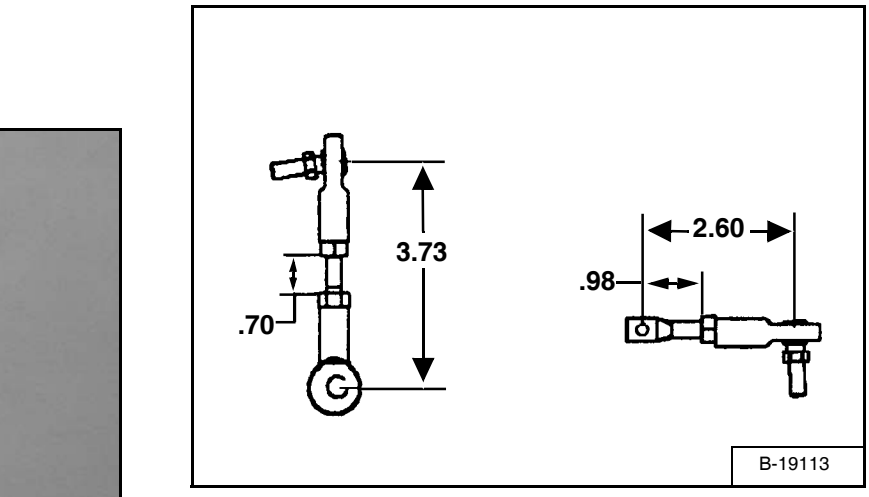
Figure 40-110-17



Adjust the linkage rods for the left pedal, left and right travel controls as dimensioned **[Figure 40-110-17]**.

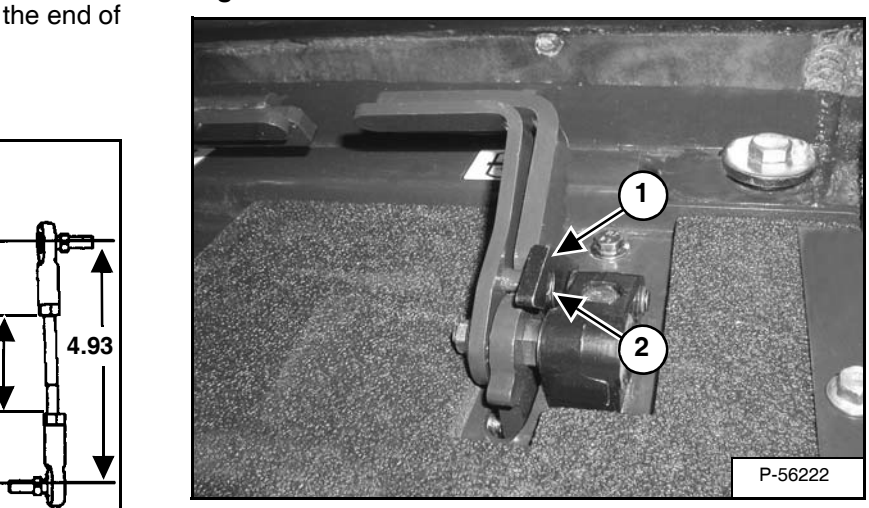
NOTE: Linkage rod ball joint dimensions [Figure 40-110-17] may need final adjustment, with pedal and levers (valve) in neutral, to ensure the lock engages the pedal lock pin or travel levers are even (in-line) with each other when the floor panel is installed. ([Figure 40-110-5 on Page 40-110-2] and [Figure 40-110-10 on Page 40-110-4].)

Figure 40-110-18



Adjust the linkage rods for the right pedal as dimensioned **[Figure 40-110-18]**.

Figure 40-110-19

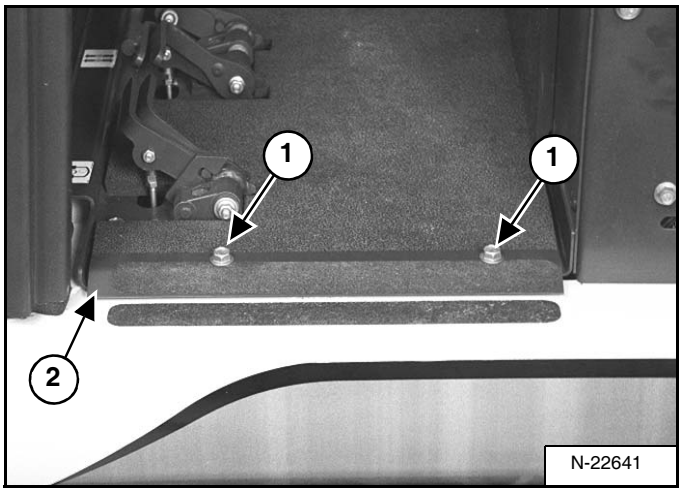


NOTE: Linkage rod ball joint dimensions [Figure 40-110-18] may need final adjustment, with pedal (valve) in neutral, to ensure the lock (Item 1) [Figure 40-110-19] engages the pedal lock pin (Item 2) [Figure 40-110-19] when the floor panel is installed.

FLOORMAT AND FLOORPLATES

Removal and Installation

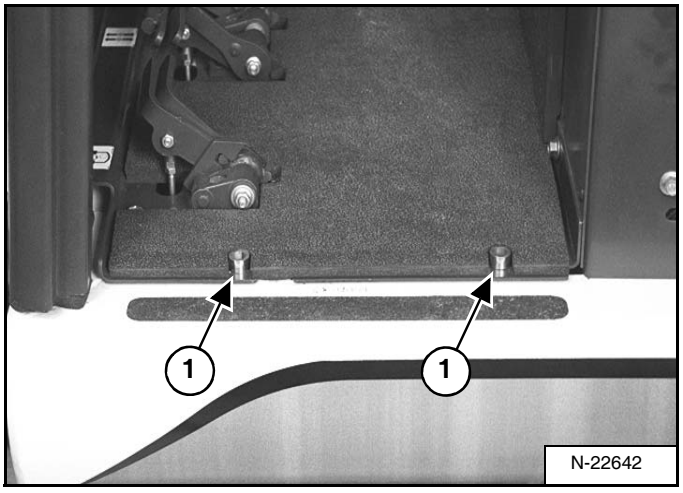
Figure 40-120-1



Remove the bolts (Item 1) **[Figure 40-120-1]** in both floormat retaining plates.

Remove the floormat retaining plate (Item 2) **[Figure 40-120-1]** from both sides.

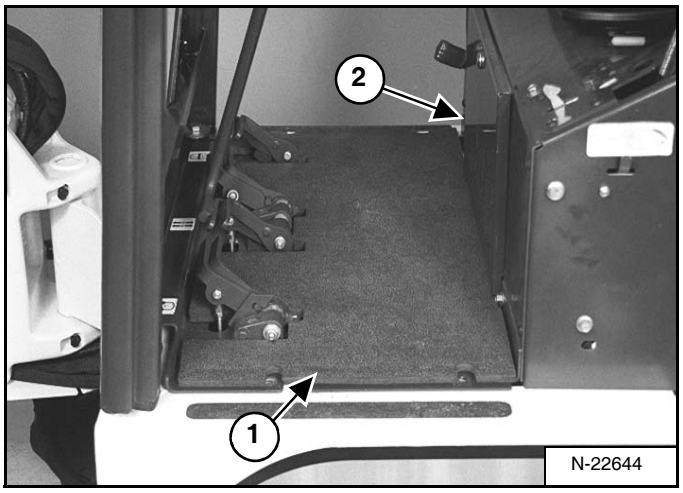
Figure 40-120-2



Remove the spacers (Item 1) **[Figure 40-120-2]** from both sides of the floormat.

NOTE: Excavators that are equipped with a cab have a floormat retainer plate only on the door side.

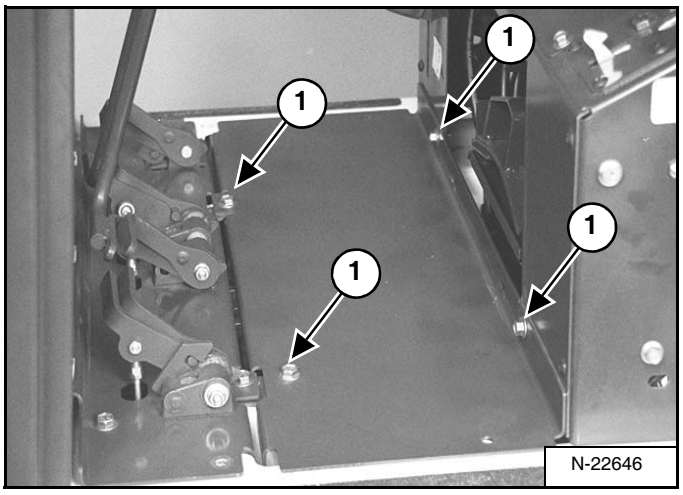
Figure 40-120-3



Remove the floormat (Item 1) **[Figure 40-120-3]**.

Remove the cover (Item 2) **[Figure 40-120-3]**.

Figure 40-120-4

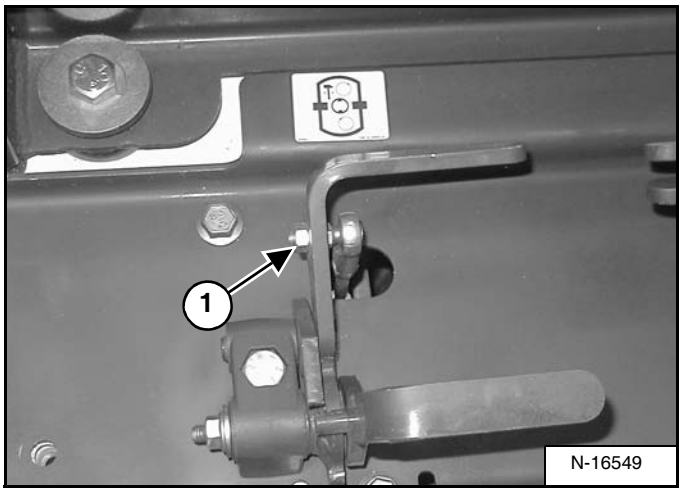


Remove the bolts (Item 1) **[Figure 40-120-4]** from the rear floorplate.

Remove the rear floorplate.

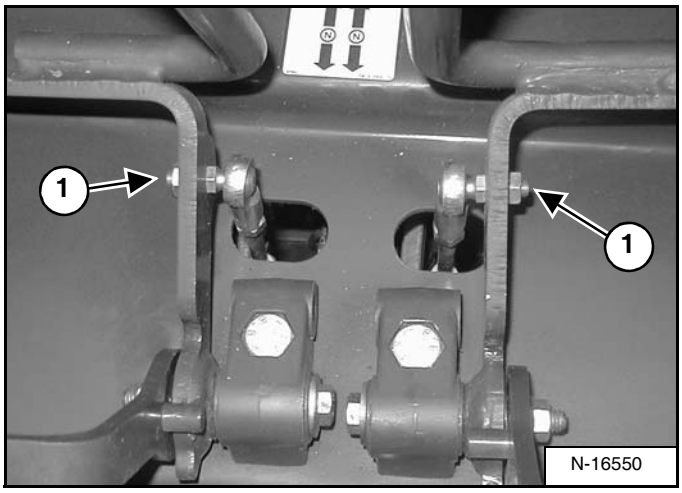
Removal and Installation (Cont'd)

Figure 40-120-5



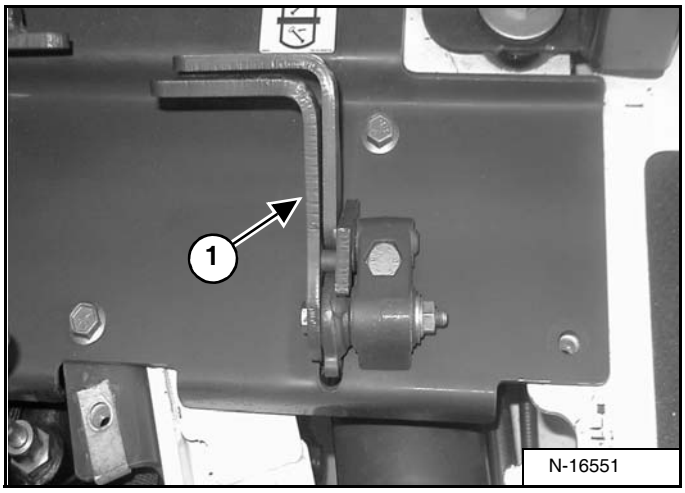
Remove the nut (Item 1) **[Figure 40-120-5]** from the auxiliary pedal linkage.

Figure 40-120-6



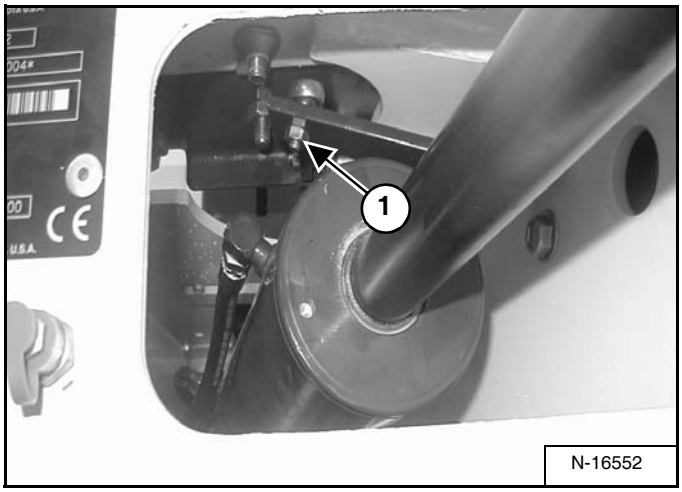
Remove the nuts (Item 1) **[Figure 40-120-6]** from the left and right travel pedal linkage.

Figure 40-120-7



The linkage for the boom swing pedal (Item 1) **[Figure 40-120-7]** is located under the floorplate and accessed through the front hole in the upperstructure above the boom swing cylinder.

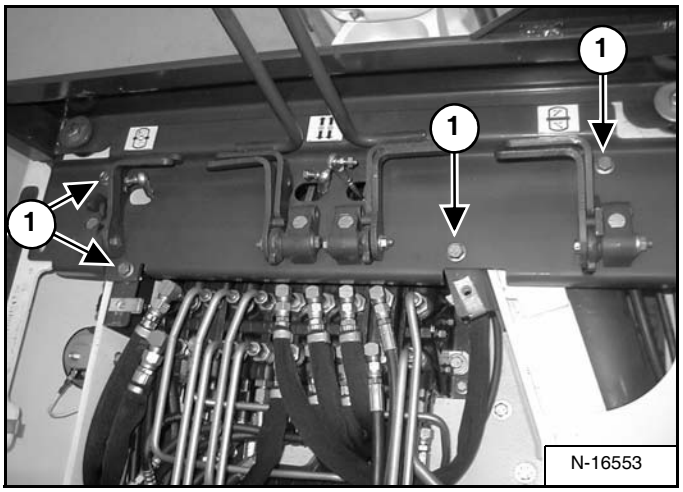
Figure 40-120-8



Remove the nut (Item 1) **[Figure 40-120-8]** from the boom swing lever linkage.

Removal and Installation (Cont'd)

Figure 40-120-9



Remove the four bolts (Item 1) **[Figure 40-120-9]** from the front floorplate. Remove the plate.


Bobcat®

FUEL TANK

Removal and Installation

Open the tailgate.

Remove the muffler. (See Removal And Installation on Page 60-20-1.)

Remove the hydraulic reservoir. (See Removal and Installation on Page 20-130-1.)

Remove the hydraulic filter bracket assembly. (See Removal and Installation on Page 20-120-1.)

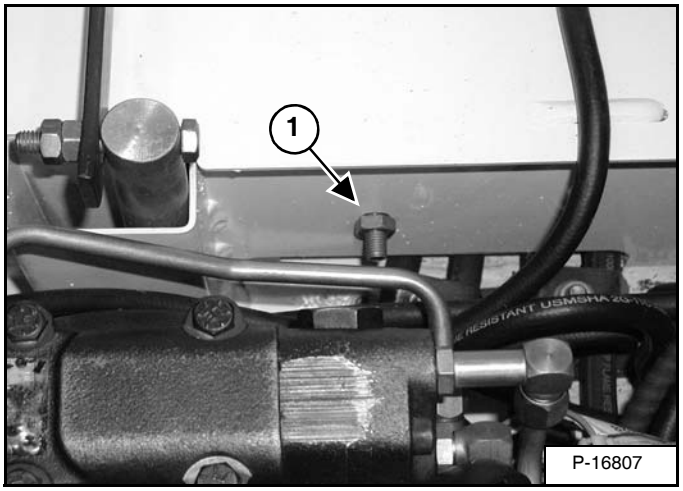
Remove the engine. (See Removal and Installation on Page 60-60-1.)

Remove the floormat and floorplates. (See Removal and Installation on Page 40-120-1.)

Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

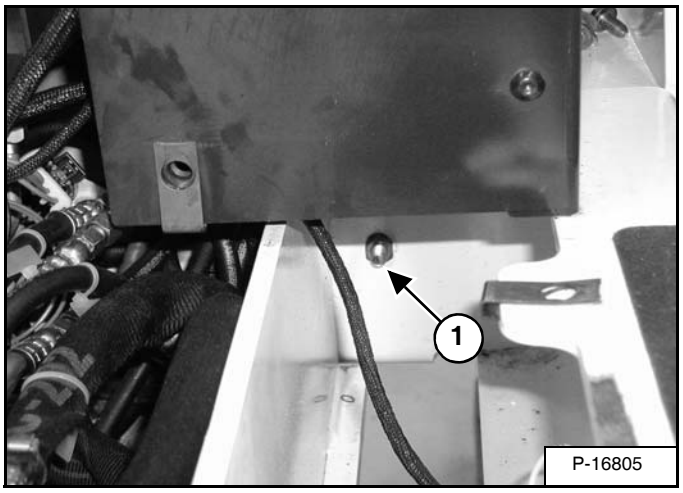
Remove the blade extension tray. (See Removal And Installation on Page 40-210-1.)

Figure 40-130-1



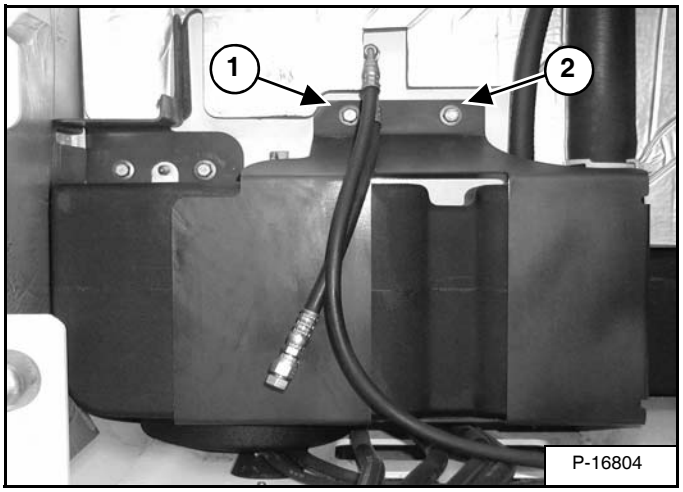
Remove the nut (Item 1) **[Figure 40-130-1]** from the fuel tank mounting bolt behind the swing motor.

Figure 40-130-2



Remove the nut (Item 1) **[Figure 40-130-2]** from the fuel tank mounting bolt under the left console.

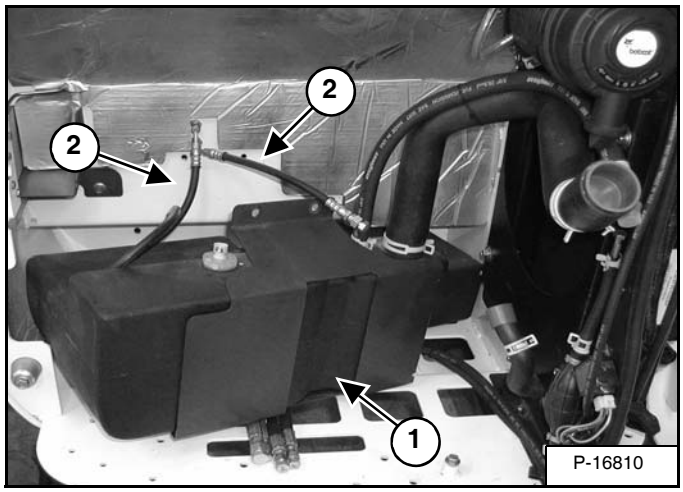
Figure 40-130-3



Remove the short bolt (Item 1) and the long bolt (Item 2) **[Figure 40-130-3]** from the fuel tank mounting bracket.

Removal and Installation (Cont'd)

Figure 40-130-4



Remove the fuel tank (Item 1) **[Figure 40-130-4]** from the back of the Excavator.

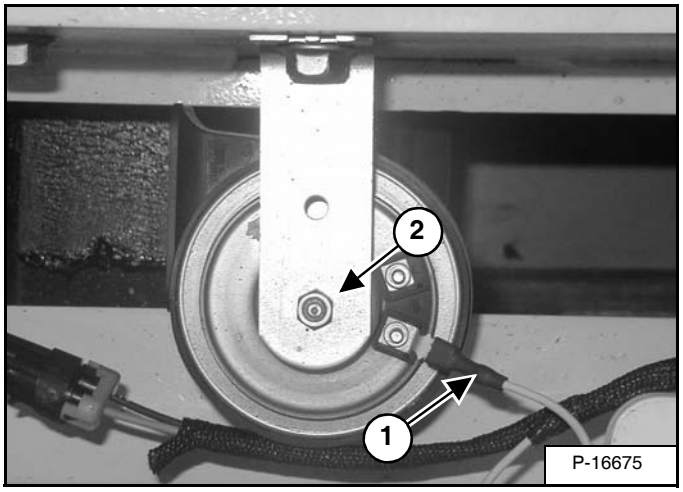
NOTE: The bulk head hoses (Item 2) [Figure 40-130-4] may need to be loosened and rotated away from the fuel tank bracket.

HORN

Removal and Installation

Remove the floormat and floorplate. (See Removal and Installation on Page 40-120-1.)

Figure 40-140-1



Remove the wire (Item 1) **[Figure 40-140-1]** from the horn.

Remove the nut (Item 2) **[Figure 40-140-1]**.

Remove the horn.


Bobcat

SWING FRAME

Removal And Installation

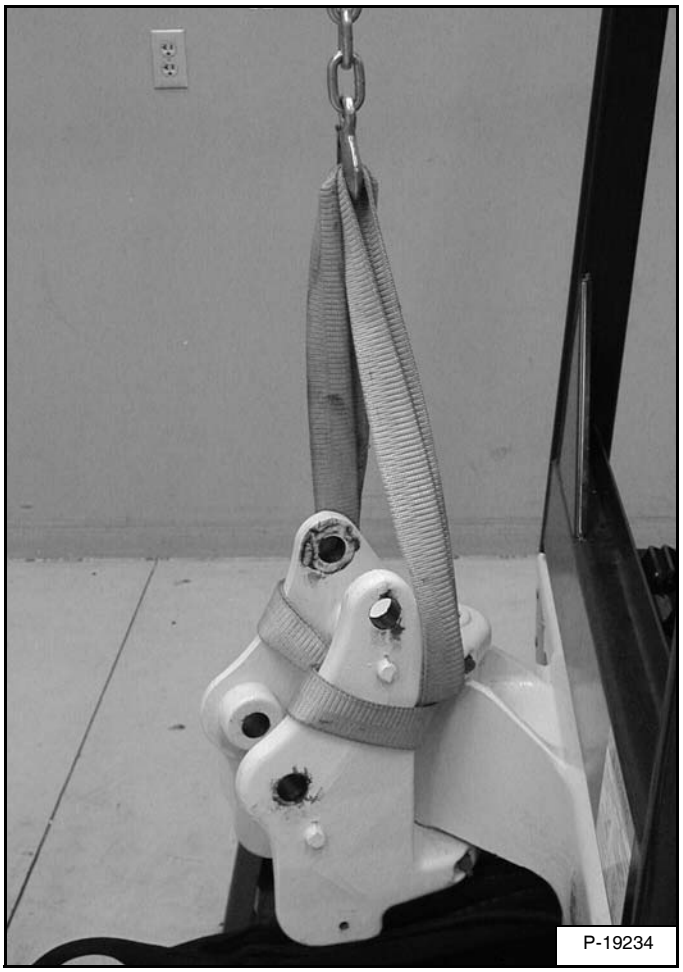
Rotate the upperstructure until the blade is to the rear of the Excavator.

Remove the bucket. (See Removal And Installation on Page 40-180-1.)

Remove the arm. (See Removal And Installation on Page 40-170-1.)

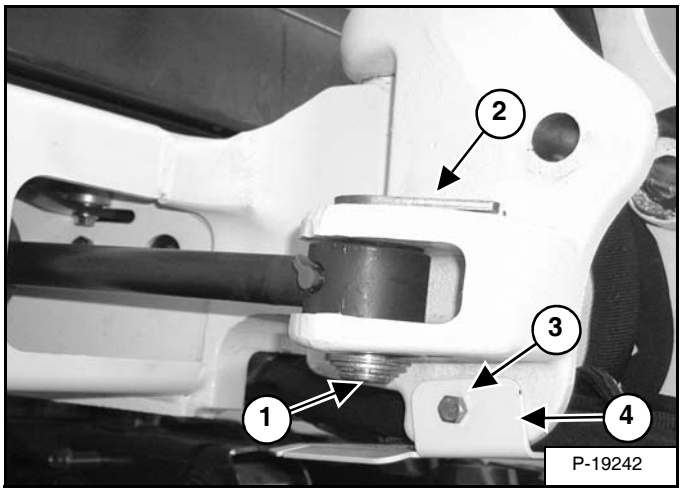
Remove the boom. (See Removal And Installation on Page 40-160-1.)

Figure 40-150-1



Install a chain hoist on the swing frame **[Figure 40-150-1]**.

Figure 40-150-2

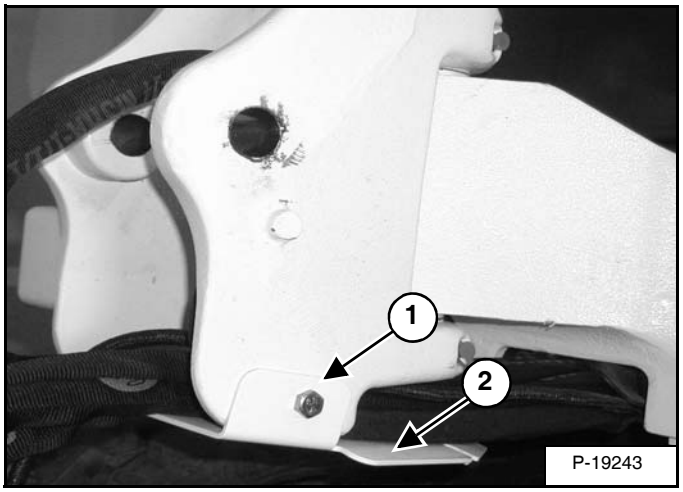


Remove the snap ring and washer (Item 1) **[Figure 40-150-2]** from the cylinder pivot pin.

Remove the pivot pin (Item 2) **[Figure 40-150-2]**.

Remove the bolt (Item 3) from the hose cover plate (Item 4) **[Figure 40-150-2]**.

Figure 40-150-3



Remove the bolt (Item 1) from the hose cover plate (Item 2) **[Figure 40-150-3]**.

Remove the hose cover plate.

Removal And Installation (Cont'd)

Figure 40-150-4

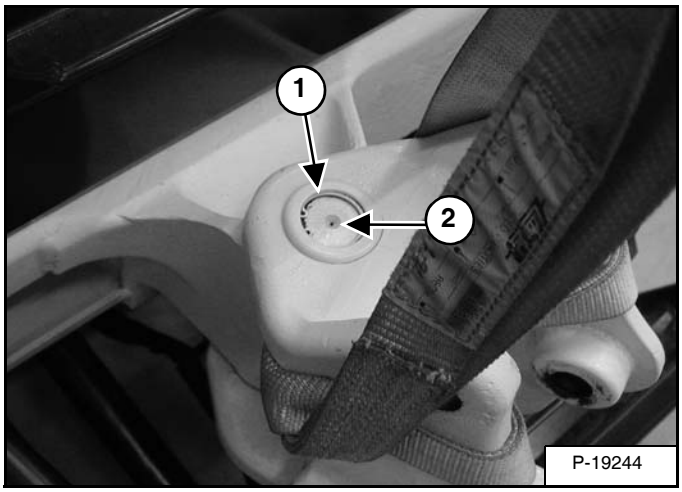
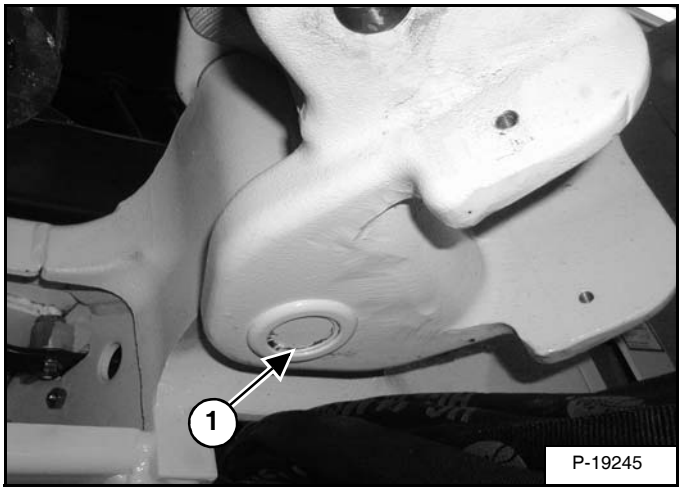


Figure 40-150-5



Remove the snap ring (Item 1) **[Figure 40-150-4]** & **[Figure 40-150-5]** from the top and bottom of the swing frame.

Remove the excess paint from the inside of the top and bottom bushings of the swing frame.

Use a large punch and drive the swing frame pin (Item 2) **[Figure 40-150-4]** out the bottom of the swing frame.

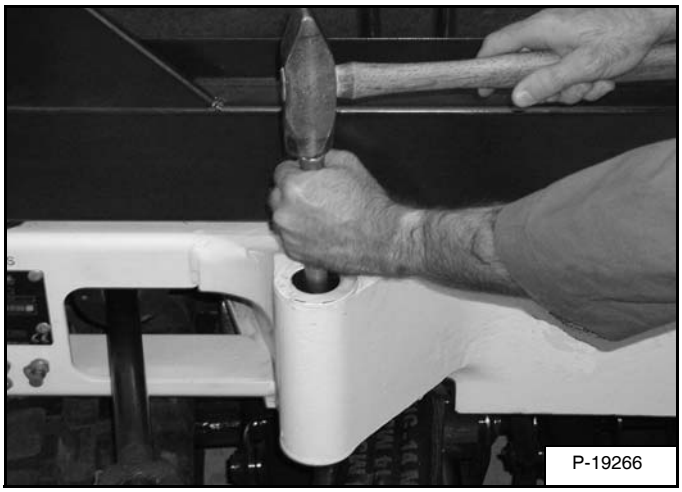
Figure 40-150-6



Remove the swing frame from the Excavator **[Figure 40-150-6]**.

Bushing Replacement

Figure 40-150-7



Insert the bushing driver through the top bushing and against the bottom bushing **[Figure 40-150-7]**.

Drive the bottom bushing out of the upperstructure **[Figure 40-150-7]**.

To remove the top bushing, install the bushing driver from the bottom and drive the bushing out.

To install the new bushings, use a bushing driver of the correct size and install the new bushings into the upperstructure.

SWING FRAME (CONT'D)

Swing Frame Bushing Removal

The following parts will be needed for removal and installation of the swing frame bushings:

Bolt - 0.625 x 4.5 inch long

Nut - 0.625 inch

Washer - 0.625 inch I.D. x 2.312 inch O.D. x 0.25 inch thick

Washer - 0.625 inch I.D. x 3.5 inch O.D. x 0.25 inch thick

Spacer - 2.875 inch I.D. x 3.375 inch O.D. x 1.5 inch thick

Figure 40-150-8

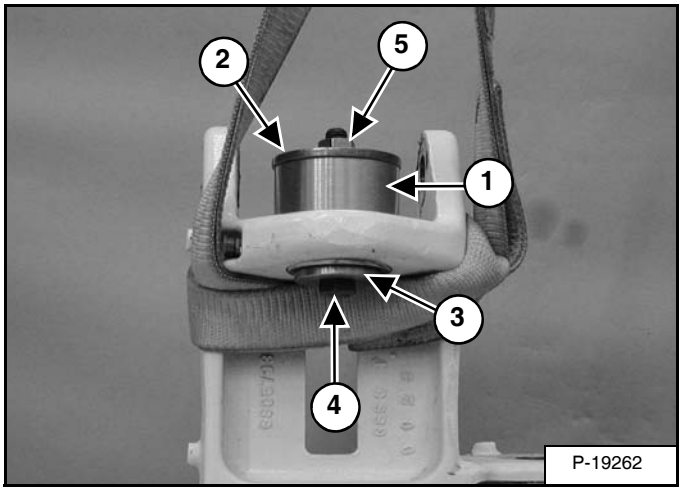
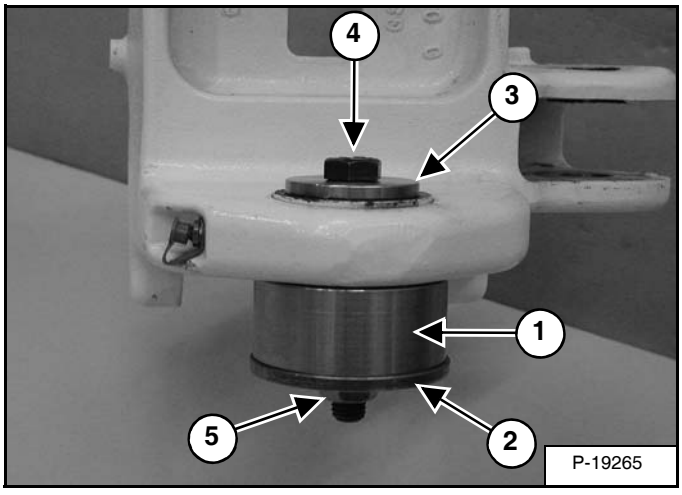


Figure 40-150-9



Install the spacer (Item 1) and washer (Item 2) **[Figure 40-150-8]** & **[Figure 40-150-9]** over the flanged end of the bushing.

The spacer (Item 1) **[Figure 40-150-8]** & **[Figure 40-150-9]** must be centered over the bushing to avoid contact between the bushing and the spacer during removal.

Install the washer (Item 3) **[Figure 40-150-8]** & **[Figure 40-150-9]** on the opposite end of the bushing. The washer must be centered on the bushing and must not contact the casting.

Install the bolt (Item 4) and the nut (Item 5) **[Figure 40-150-8]** & **[Figure 40-150-9]** through the washers and spacer.

Tighten the bolt and nut to remove the bushing from the casting.

Swing Frame Bushing Installation

Apply a film of grease to the outer diameter of the bushing and the inner diameter of the casting.

Center the bushing on the casting hole.

NOTE: Make sure the bushing is centered in the casting hole and is started in the hole evenly and square.

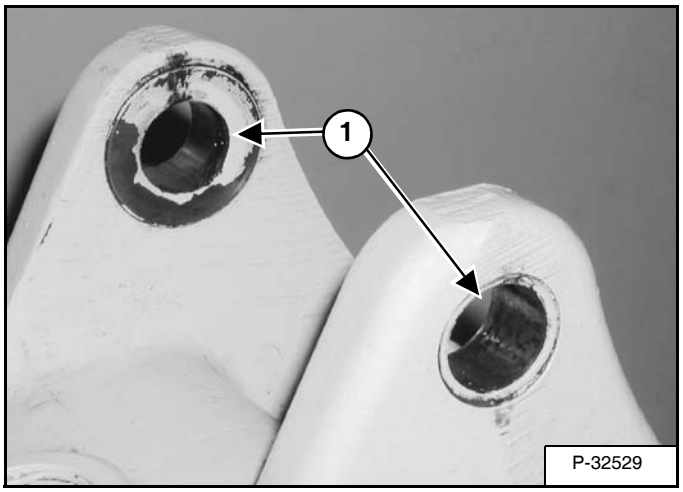
Put the washer (Item 3) over the flanged end of the bushing. Put the washer (Item 2) **[Figure 40-150-9]** over the bushing hole casting, center the washer over the bushing hole.

Install the bolt (Item 4) through the washers and the bushing and install the nut (Item 5) **[Figure 40-150-9]**.

Tighten the bolt and nut until the bushing is seated in the casting.

Boom Pivot Bushing Removal And Installation

Figure 40-150-10



The following parts will be needed for removal and installation of the boom pivot bushings (Item 1) **[Figure 40-150-10]**.

Bolt - 0.625 x 4.5 inch long

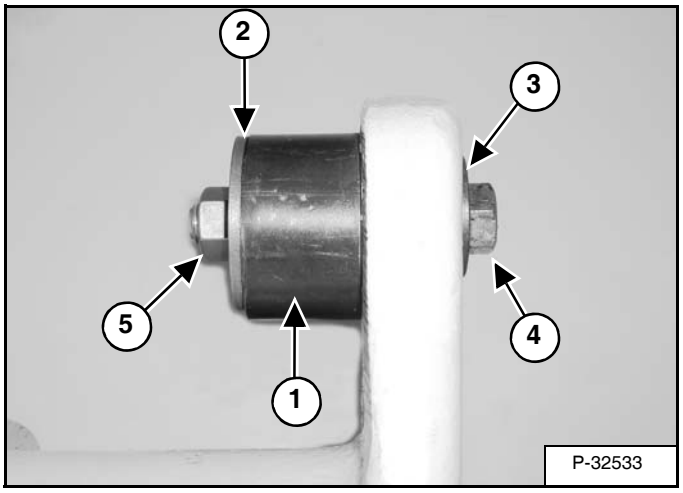
Nut - 0.625 inch

Washer - 0.625 inch I.D. x1.370 inch O.D. x 0.25 inch thick

Washer - 0.625 inch I.D. x 2.375 inch O.D. x 0.25 inch thick

Spacer - 2.000 inch I.D. x 2.375 inch O.D. x 1.5 inch thick

Figure 40-150-11



Install the spacer (Item 1) and washer (Item 2) **[Figure 40-150-11]** over the flanged end of the bushing.

The spacer (Item 1) **[Figure 40-150-11]** must be centered over the bushing to avoid contact between the bushing and the spacer during removal.

Install the washer (Item 3) **[Figure 40-150-11]** on the opposite end of the bushing. This washer must be centered on the bushing and must not contact the casting.

Install the bolt (Item 4) and the nut (Item 5) **[Figure 40-150-11]** through the washers and spacer.

Tighten the bolt and nut to remove the bushing from the casting.

Installation:

Apply a film of grease to the outer diameter of the bushing and the inner diameter of the casting.

Center the bushing in the casting hole.

NOTE: Make sure the bushing is centered into the casting hole and is started in the hole evenly and square.

Put the washer (Item 3) over the flanged end of the bushing. Put the washer (Item 2) **[Figure 40-150-11]** over the bushing hole casting, center the washer over the bushing hole.

Install the bolt (Item 4) through the washers and the bushing and install the nut (Item 5) **[Figure 40-150-11]**.

Tighten the bolt and nut until the bushing is seated in the casting.


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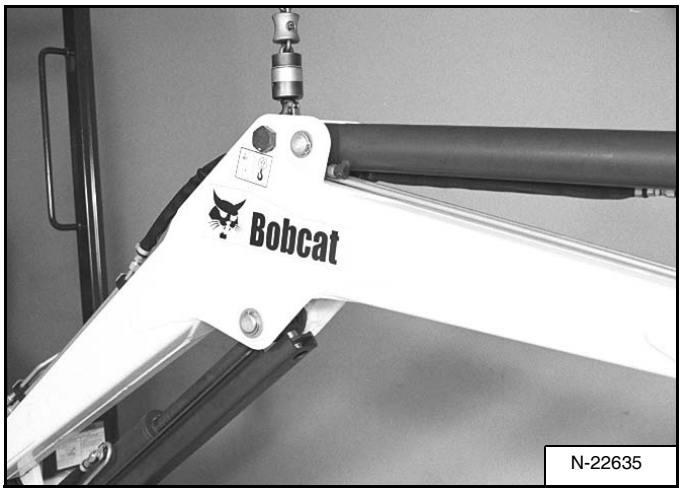
BOOM

Removal And Installation

Remove the bucket. (See Removal And Installation on Page 40-180-1.)

Remove the arm. (See Removal And Installation on Page 40-170-1.)

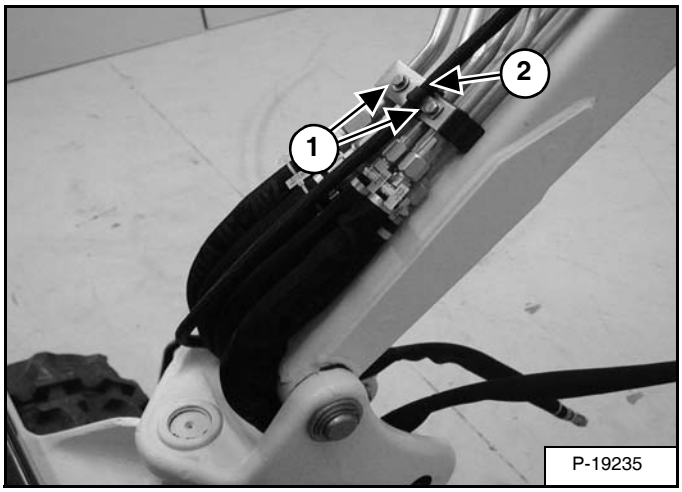
Figure 40-160-1



Install a chain hoist on the boom **[Figure 40-160-1]**.

Remove the boom cylinder. (See Removal and Installation on Page 20-20-3.)

Figure 40-160-2

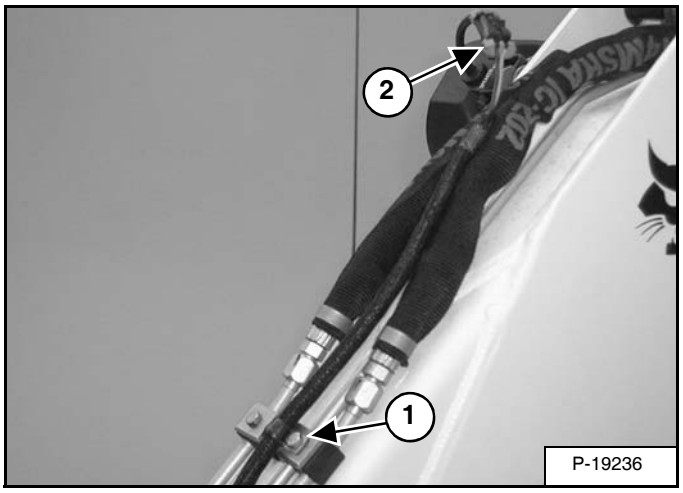


Remove the bolts (Item 1) and the retainer plates. Remove the wire harness (Item 2) **[Figure 40-160-2]** from the retainer.

Mark the hoses for ease of assembly.

Remove the six hoses from the tubes **[Figure 40-160-2]**.

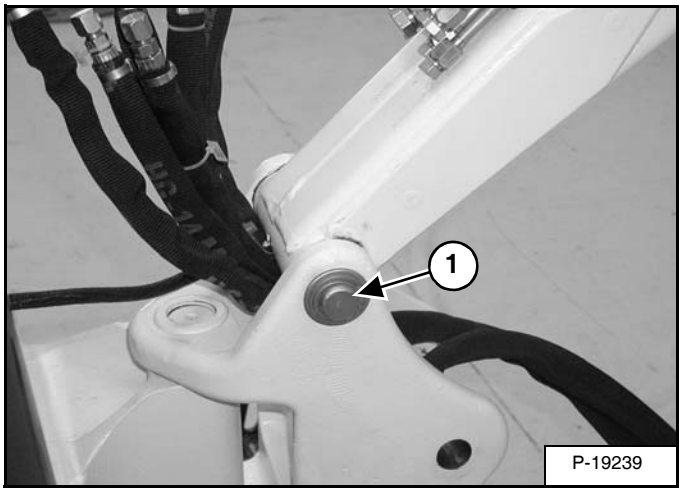
Figure 40-160-3



Remove the bolt (Item 1) **[Figure 40-160-3]** and wire harness clamp.

Disconnect the wire connector (Item 2) **[Figure 40-160-3]**.

Figure 40-160-4



Remove the snap ring and washer (Item 1) **[Figure 40-160-4]** from the boom pivot pin.

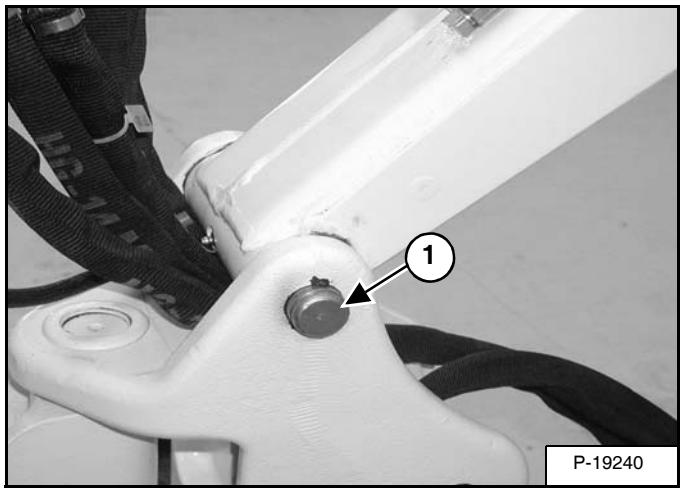
IMPORTANT

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

Removal And Installation (Cont'd)

Figure 40-160-5



Remove the boom pivot pin (Item 1) **[Figure 40-160-5]**.

Figure 40-160-6

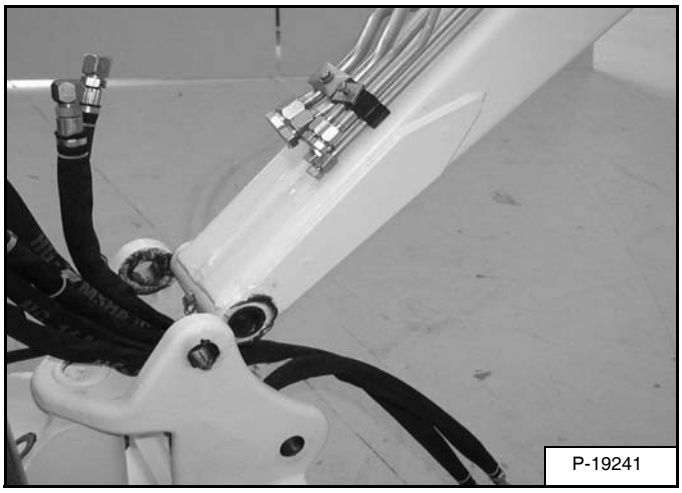
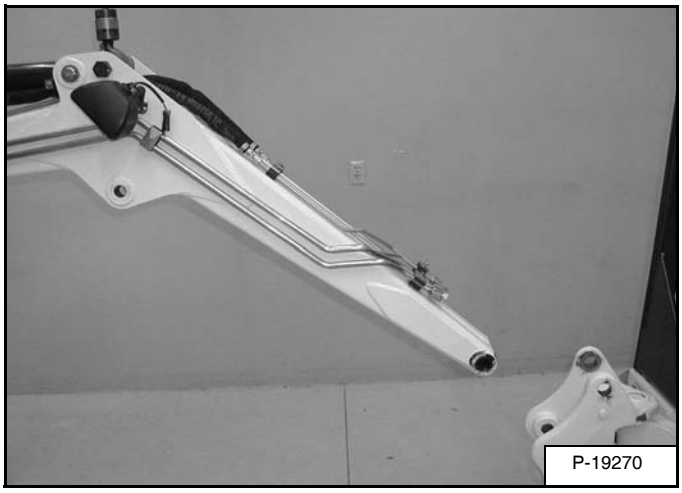


Figure 40-160-7



Lift the boom from the swing frame **[Figure 40-160-6]** & **[Figure 40-160-7]**.

NOTE: If shims are present between the boom and the swing frame, install the shims in the same locations. Side play of the boom should not exceed 0.03 inch. (0,7 mm). Add shims equally to both sides of boom.

Boom Bushing Removal And Installation

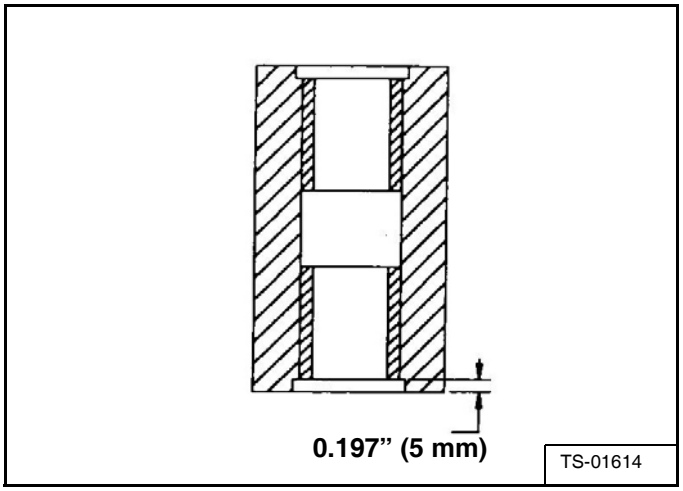
Remove the boom. (See Removal And Installation on Page 40-160-1.)

Remove the dust seals from both sides of the boom.

Remove the bushings from both sides of the boom.

Install the new bushings in the boom.

Figure 40-160-8



Install the bushings until they are seated 0.197 inch (5 mm) in the pin boss **[Figure 40-160-8]**.

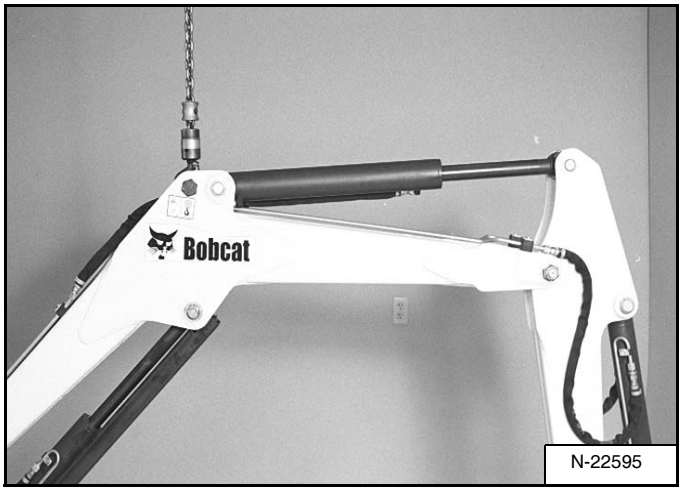

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ARM

Removal And Installation

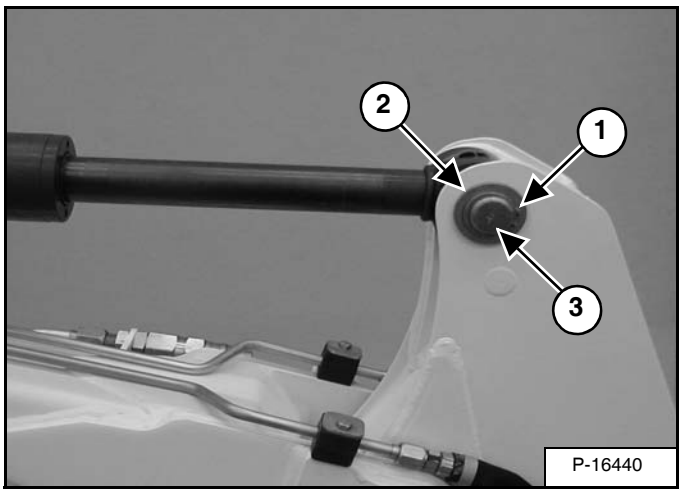
Remove the bucket. (See Removal And Installation on Page 40-180-1.)

Figure 40-170-1



Support the boom with a chain hoist **[Figure 40-170-1]**.

Figure 40-170-2



Remove the snap ring (Item 1) and washer (Item 2) **[Figure 40-170-2]** from the rod end pivot pin.

Remove the pivot pin (Item 3) **[Figure 40-170-2]**.

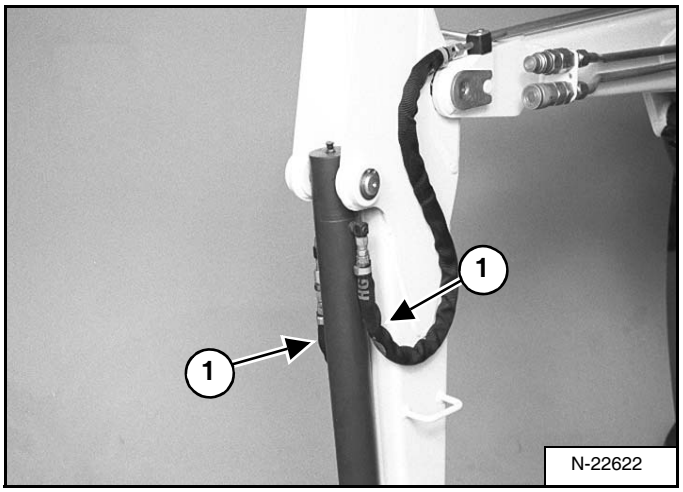
Remove the rod end of the cylinder from the arm.

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

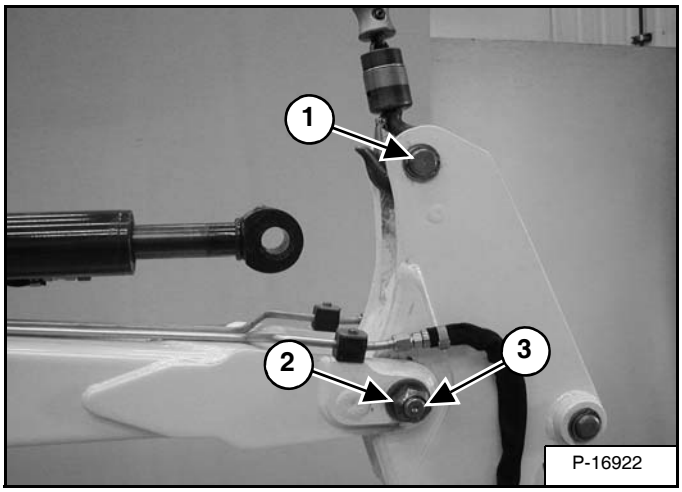
Figure 40-170-3



Remove the hoses (Item 1) **[Figure 40-170-3]** from the bucket cylinder.

Removal And Installation (Cont'd)

Figure 40-170-4



Reinstall the rod end pivot pin, washer and snap ring (Item 1) **[Figure 40-170-4]** and attach a chain hoist.

Remove the nut and washer (Item 2) **[Figure 40-170-4]** from the boom/arm pivot pin.

Installation: Tighten the nut until it is seated firmly against the boom. Do not overtighten and deflect the boom mounting plate. The arm must pivot freely.

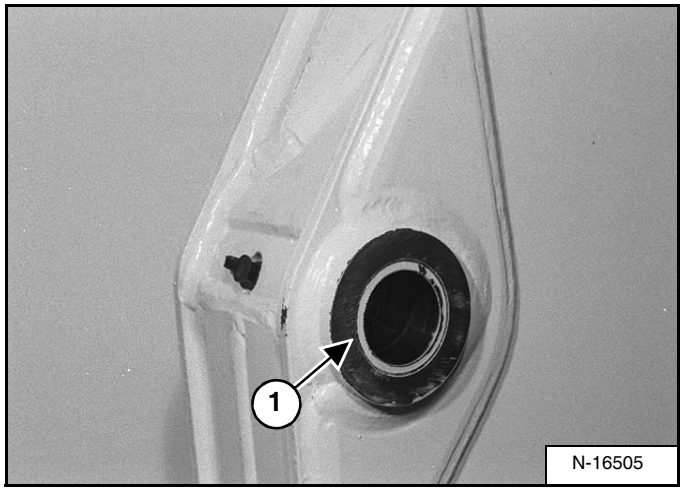
Remove the pivot pin (Item 3) **[Figure 40-170-4]**.

Remove the arm from the boom.

Arm To Boom Bushing Removal And Installation

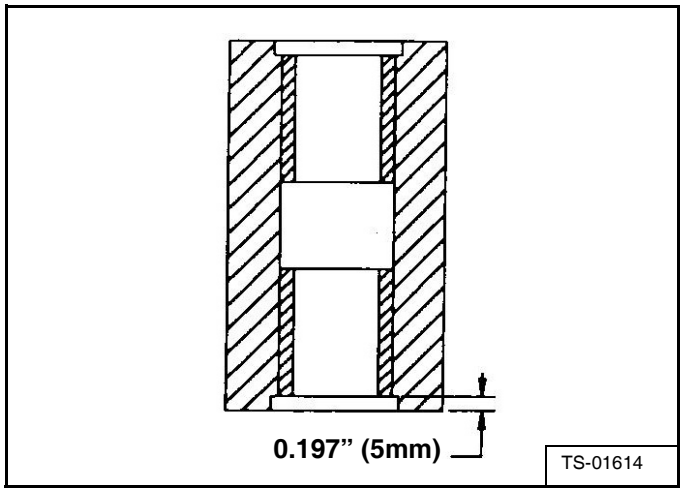
Remove the dust seal from both sides of the arm.

Figure 40-170-5



Remove the bushings (Item 1) **[Figure 40-170-5]** from both sides of the arm.

Figure 40-170-6

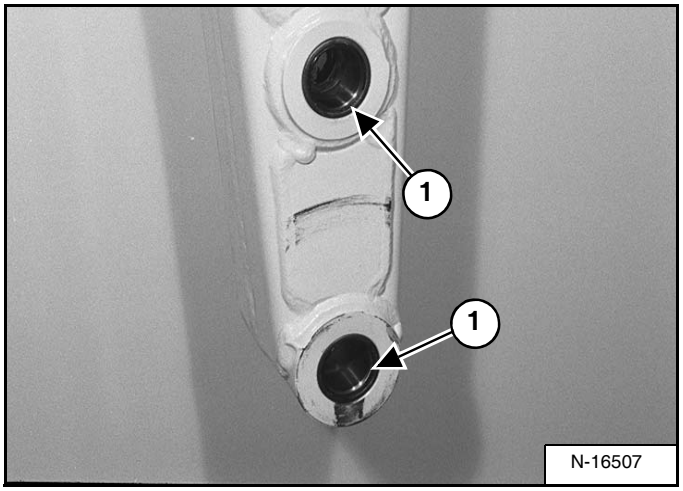


Install the new bushings until they are seated 0.197 inches (5 mm) in the pin boss **[Figure 40-170-6]**.

Install new dust seals.

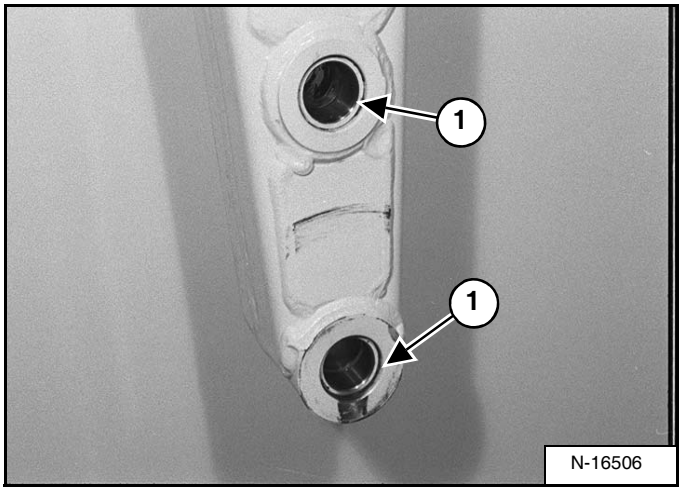
Arm To Bucket And Bucket Link Bushing Removal And Installation

Figure 40-170-7



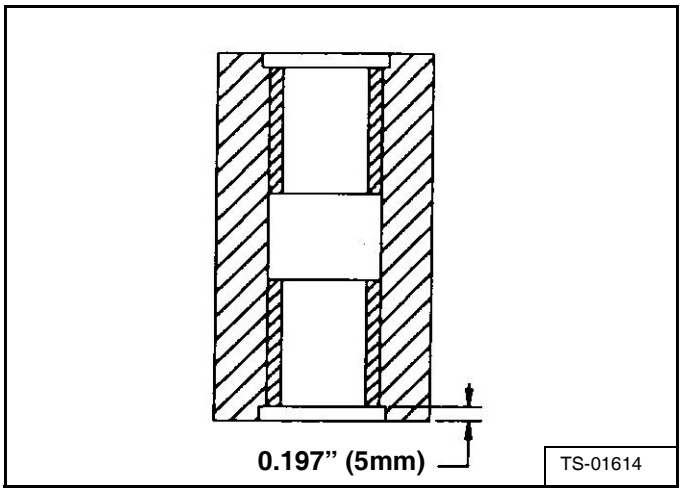
Remove the dust seals (Item 1) **[Figure 40-170-7]** from both sides of the arm.

Figure 40-170-8



Remove the bushings (Item 1) **[Figure 40-170-8]** from both sides of the arm.

Figure 40-170-9



Install the bushings until they are seated 0.197 inches (5 mm) in the pin boss **[Figure 40-170-9]**.

Install the dust seals on both sides of the arm.


Bobcat®

BUCKET

Removal And Installation

WARNING

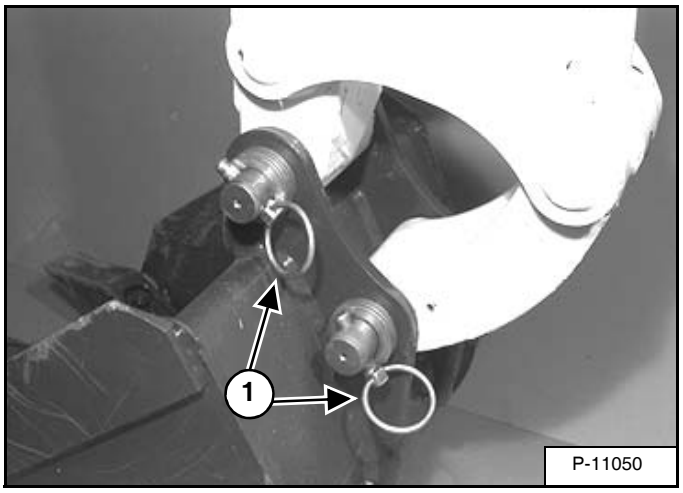
AVOID INJURY OR DEATH

Stop the machine on a firm flat surface. When removing or installing attachments (such as a bucket), always have a second person in the operator's seat, give clear signals and work carefully.

W-2140-0189

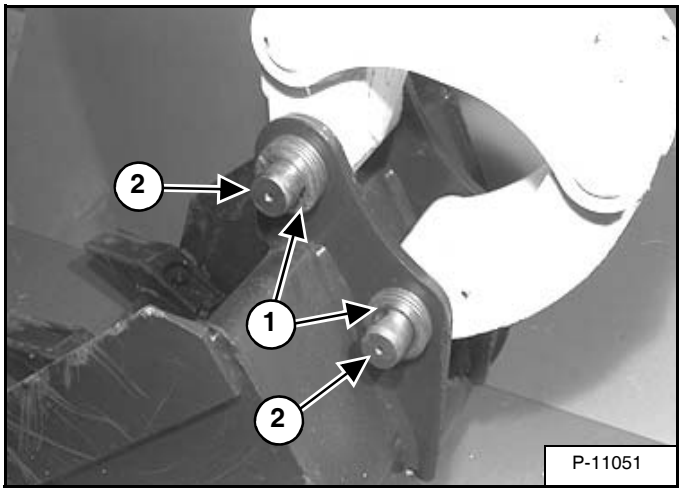
Park the Excavator on a flat level surface. Put the bucket on the ground.

Figure 40-180-1



Remove the pin retainer clips (Item 1) **[Figure 40-180-1]**.

Figure 40-180-2



Remove the washers (Item 1) **[Figure 40-180-2]**

Remove the pivot pins (Item 2) **[Figure 40-180-2]**.

Keep the pins clean. Do not damage the dust seals in the arm when removing the bucket.

Install the arm into the bucket and align the hole.

Install the pivot pin.

Extend the bucket cylinder until the connecting link aligns with the other bucket pin hole.

Install the washers (Item 1) **[Figure 40-180-2]**.

Install the pin retainer clips (Item 1) **[Figure 40-180-1]**.

Add grease to the pivot pins before operation.

WARNING

Never use attachments or buckets which are not approved by Bobcat Company. Buckets and attachments for safe loads of specified densities are approved for each model. Unapproved attachments can cause injury or death.

W-2052-0500

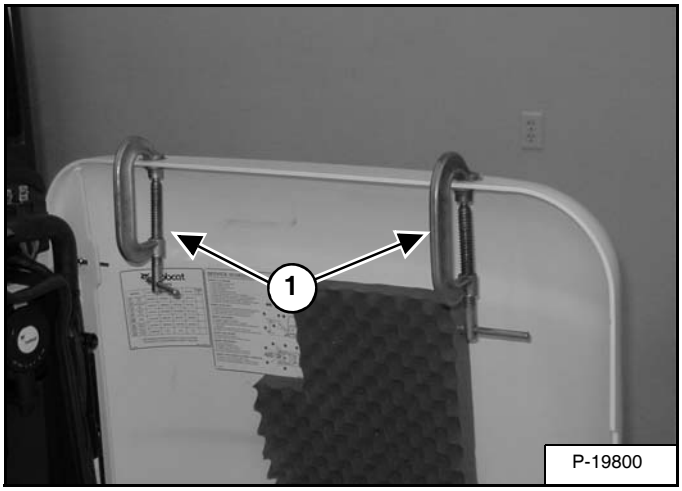

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TAILGATE

Removal And Installation

Open the tailgate.

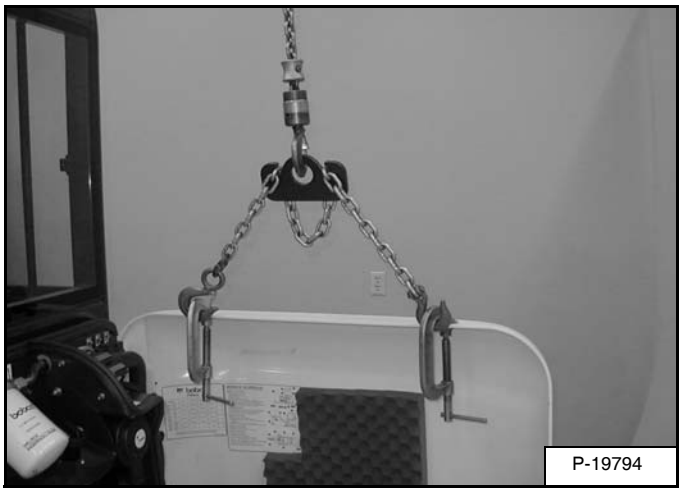
Figure 40-190-1



Install and tighten two c-clamps (Item 1) **[Figure 40-190-1]** equally spaced from the sides on the top of the tailgate.

NOTE: To prevent paint damage use rubber pads on the c-clamps.

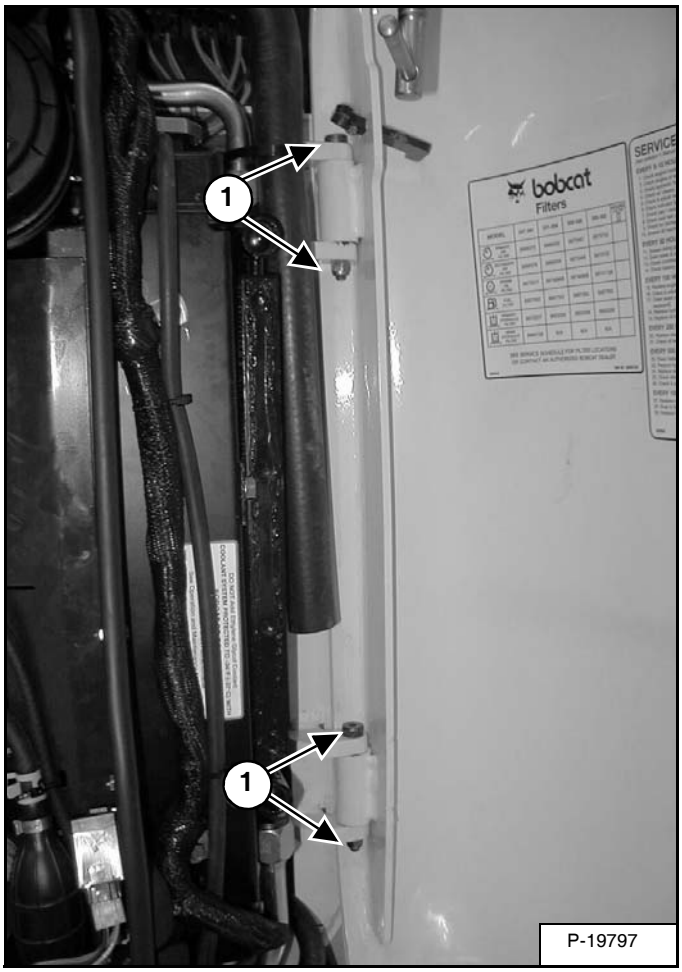
Figure 40-190-2



Install chains to the c-clamps and chain hoist **[Figure 40-190-2]**.

NOTE: Use a lifting device of sufficient capacity. Approximate weight of the tailgate is 160 lbs. (352 kg).

Figure 40-190-3



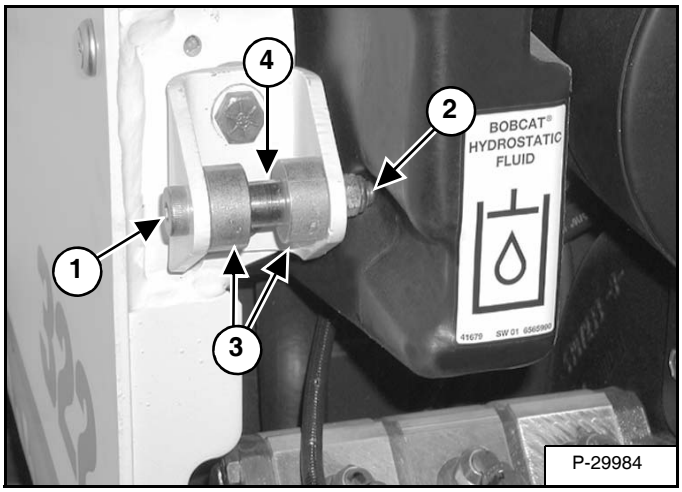
Remove the nuts and bolts (Item 1) **[Figure 40-190-3]** from the hinges.

Remove the tailgate from the Excavator.

TAILGATE (CONT'D)

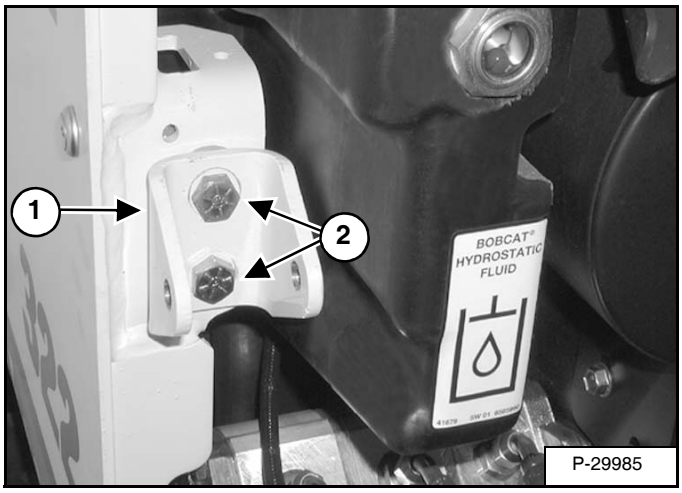
Latch Removal And Installation

Figure 40-190-4



Remove the bolt (Item 1), nut (Item 2), outer rollers (Item 3) and inner roller (Item 4) **[Figure 40-190-4]**.

Figure 40-190-5



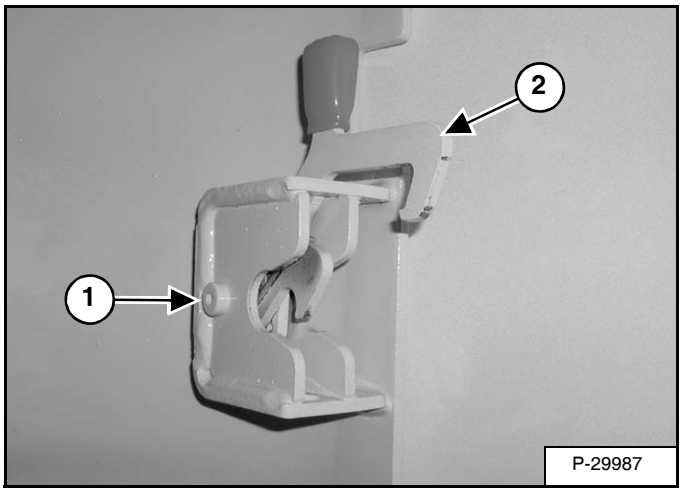
For ease of assembly, mark around the outside edge (Item 1) **[Figure 40-190-5]** of the latch bracket.

Remove the two bolts (Item 2) **[Figure 40-190-5]**, washer and nuts.

See Adjusting The Tailgate Latch on Page 10-40-1

Remove the bracket (Item 1) **[Figure 40-190-5]**.

Figure 40-190-6



Remove the bolt (Item 1). Remove the latch assembly (Item 2) **[Figure 40-190-6]** from the tailgate.

SWING LOCK

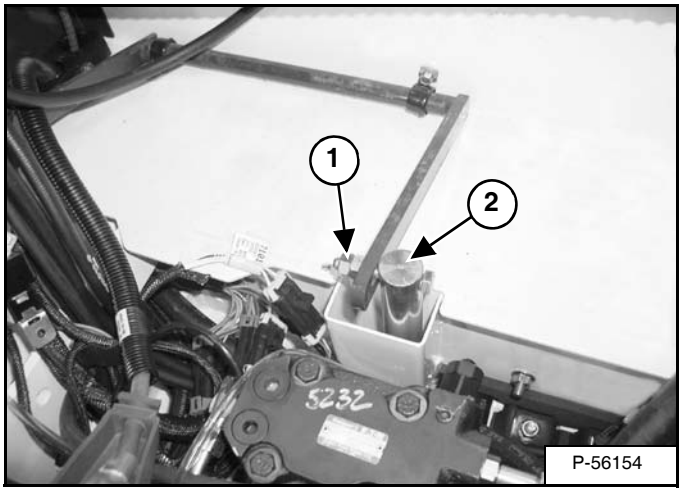
Removal and Installation

Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Remove the blade extension tray. (See Removal And Installation on Page 40-210-1.)

Remove the battery. (See Removing And Installing The Battery on Page 50-20-2.)

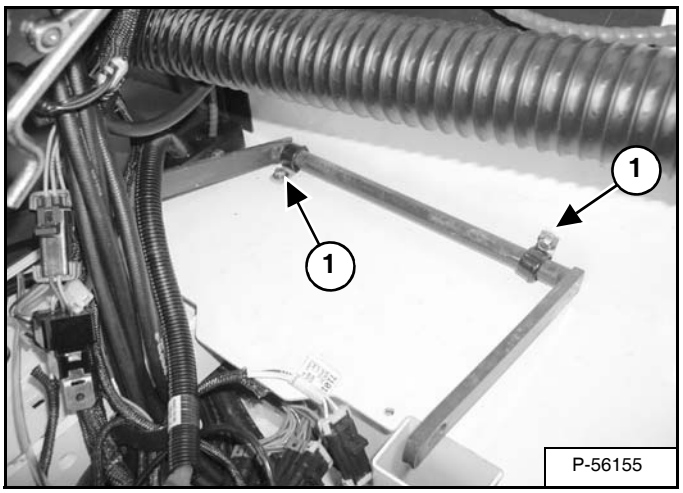
Figure 40-200-7



Remove the nuts and bolt (Item 1) from the swing lock lever and pin (Item 2) **[Figure 40-200-7]**.

Remove the swing lock pin.

Figure 40-200-8



Remove the bolts (Item 1) **[Figure 40-200-8]** from the lever.

Remove the lever.

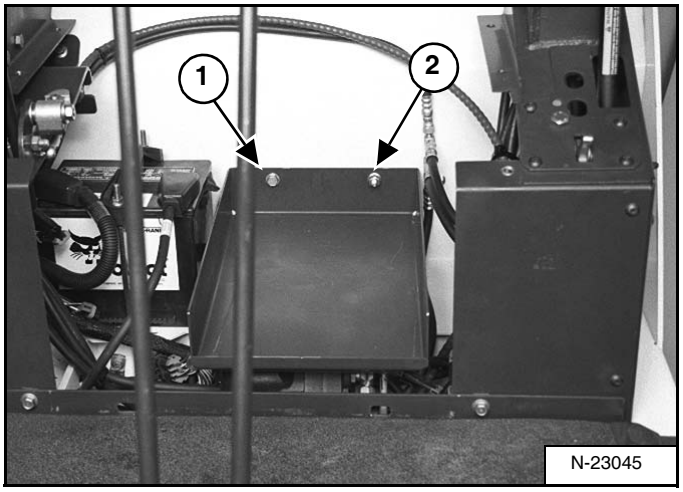

Bobcat®

BLADE EXTENSION TRAY

Removal And Installation

Remove the seat and seat mount. (See Removal And Installation on Page 40-40-1.)

Figure 40-210-1



Remove the bolt (Item 1) and nut (Item 2) **[Figure 40-210-1]**.

Remove the blade extension tray.


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LEFT PEDAL

Not Available At Time Of Print


Bobcat®

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320 & 322 EXCAVATOR WIRING SCHEMATIC

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322 (S/N 224011001 AND ABOVE)
(PRINTED JULY 2006)
V-0487

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ENGINE OIL PRESSURE LAMP
ENGINE WATER TEMERATURE LAMP
ALTERNATOR LAMP
SYSTEM WARNING BUZZER
TIMER
HORN
HORN SWITCH
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EXPANDABLE UNDERCARRIAGE SWITCH (322 ONLY)
AUXILIARY POWER SOCKET
RIGHT HAND CONSOLE
HARNESS 6807427
GLOW PLUG
OFF
RUN
START
IGNITION SWITCH
BOOM LIGHT
HOUSE LIGHT
BOOM LIGHT
HARNESS 6807747
LIGHT SWITCH
HEATER
TRAVEL SWITCH
HOURMETER
TWO SPEED INDICATOR (NOT USED ON 320L)
TWO SPEED MODULE (NOT USED ON 320L)
OUT
SW
GND
PWR
RIGHT CONSOLE LOCK OUT SWITCH
(THIS SWITCH ONLY USED ON MODELS WITH ROPS CANOPY)
TWO SPEED SWITCH
WASHER
CAB
HARNESS 7101054
C250
C251
C252
C253
C254
C255
C256
C257
C850
C851
C852
C853
C854
C855
C750
C751
C950
C151
C152
C153
C154
C155
C156
C157
C158
C159
C160
C161
C162
C163
LEFT HAND CONSOLE
HARNESS 6807428
LEFT CONSOLE LOCKOUT SWITCH
WIPER SWITCH
PARK
WIPER
WASHER
WIPER MOTOR
DOME LIGHT
FUEL GAUGE BACKLIGHT
CONSOLE DOWN INDICATOR
FUEL GAUGE
ENGINE
HARNESS 6807426
SWITCHED ACCESSORY
NON-SWITCHED POWER
NON-SWITCHED GROUND
NON-SWITCHED TIMER
CAB
FUSE BLOCK
ENGINE COOLANT TEMPERATURE SWITCH
EXPANDABLE UNDERCARRIAGE SOLENOID (322 ONLY)
FUSE 1 - 10A
FUSE 5 - 15A
FUSE 4 - 15A
FUSE 3 - 20A
FUSE 6 - 15A
FUSE 2 - 20A
FUSE 7 - 15A
FOR OPTIONS
20A FUSED ACCESSORY
SWITCHED POWER RELAY
STOP TIMER MODULE
FUEL SOLENOID
20A SWITCHED ACCESSORY
OIL PRESSURE SWITCH
GLOW PLUGS
MOTION ALARM (IF EQUIPPED)
HARNESS 6808973
RIGHT TRAVEL SWITCH
LEFT TRAVEL SWITCH
ALARM
MOTION ALARM RELAY
TO RIGHT HAND CONSOLE
STARTER
PREHEAT RELAY
STARTER RELAY
DIODE
BATTERY
FRAME GROUND
ALTERNATOR
FUEL SENDER HARNESS 6587177
FUEL LEVEL SENSOR
JOYSTICK LOCKOUT SOLENOID
DUMP VALVE SOLENOID
TWO SPEED SOLENOID (NOT USED ON 320L)
GREEN TIE STRAP
ORANGE TIE STRAP
YELLOWTIE STRAP

CAB AND WIPER WIRING (IF EQUIPPED)
HARNESS 7100774

WIRES CONNECT BY LETTER ACROSS CONNECTORS

SOME CONNECTOR BODIES NOT SHOWN FOR DRAWING CLARITY

BATTERY FEED 1000-1999 RED, RED/WHT, RNG
GROUND 2000-2999 BLK
MONITORING 3000-3999 LBL
HYDRAULIC 4000-4999 LGN
ATTACHMENT CONTROLS 5000-5999 YEL
LIGHTS 6000-6999 PNK
ACCESSORIES 7000-7999 WHT
ENGINE 8000-8999 TAN
COMMUNICATION 9000-9999 PUR

RED = RED
RNG = ORANGE
BLK = BLACK
LBL = LIGHT BLUE
DBL = DARK BLUE
LGN = LIGHT GREEN
DGN = DARK GREEN
YEL = YELLOW
PNK = PINK
WHT = WHITE
BRN = BROWN
TAN = TAN
PUR = PURPLE
GRY = GRAY

Printed in U.S.A.

V-0487 (7-10-06)

ELECTRICAL SYSTEM

Troubleshooting Chart

The following troubleshooting chart is provided for assistance in locating and correcting problems which are most common. Many of the recommended procedures must be done by authorized Bobcat Service personnel only.

⚠ WARNING

Instructions are necessary before operating or servicing machine. Read and understand the Operation & Maintenance Manual, 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.

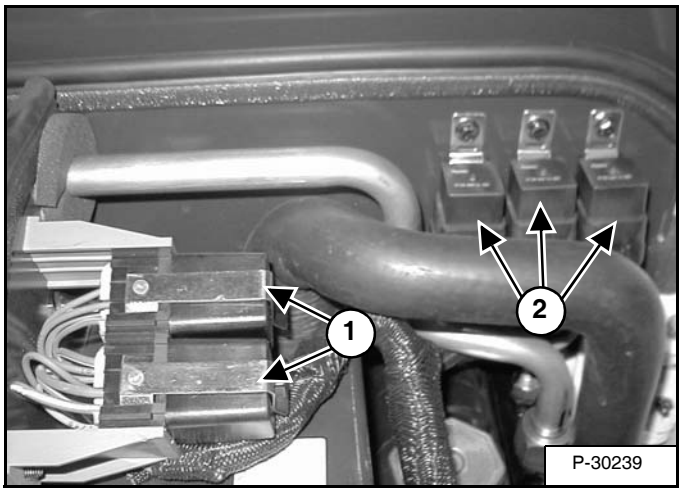
W-2003-0199

PROBLEM	CAUSE
Battery will not take charge.	1, 2, 3, 4, 5
Alternator will not charge.	1, 2, 5
Starter will not turn engine.	2, 3, 4, 6, 7, 8, 9

KEY TO CORRECT THE CAUSE
1. Engine accessory drive belt is loose or damaged.
2. Battery connections are dirty or loose.
3. Battery is damaged.
4. The ground connection is not making a good contact.
5. The alternator is damaged.
6. The engine is locked.
7. The starter is damaged.
8. The wiring or the solenoid is damaged.
9. Check the fuses.

Description

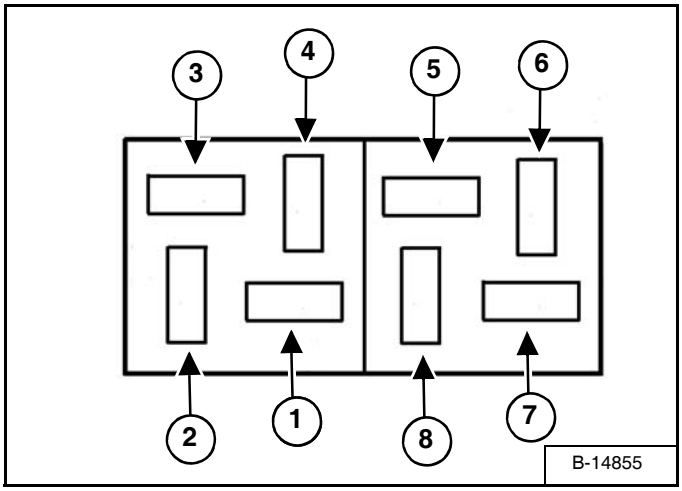
Figure 50-10-1



The Excavator has a 12 volt, negative ground electrical system. The electrical system is controlled by fuses and relays located in the right side of the engine compartment (Items 1 & 2) **[Figure 50-10-1]**. The fuses will protect the electrical system when there is an electrical overload. The reason for the overload must be found before starting the engine again.

Fuses

Figure 50-10-2



1. **Instrument** - 10A (SW) Hourmeter, Warning Buzzer & Fuel Gauge Back Light **[Figure 50-10-2]**
2. **Accessory** - 20A (SW) Accessory Connector, Heater & Horn **[Figure 50-10-2]**
3. **Start** - 20A (SW) Key Switch, Unswitched Accessory Connector **[Figure 50-10-2]**
4. **Cab** - 15A (SW) Cab Power, Lights, Wiper & Dome Light **[Figure 50-10-2]**
5. **Power** - 15A (UNSW) Appliance Socket **[Figure 50-10-2]**
6. **Timer Power** - 15A (UNSW) Stop Timer Module **[Figure 50-10-2]**
7. **Power -** 15A (SW) Stop Timer Module **[Figure 50-10-2]**
8. **Open** - Not Used **[Figure 50-10-2]**

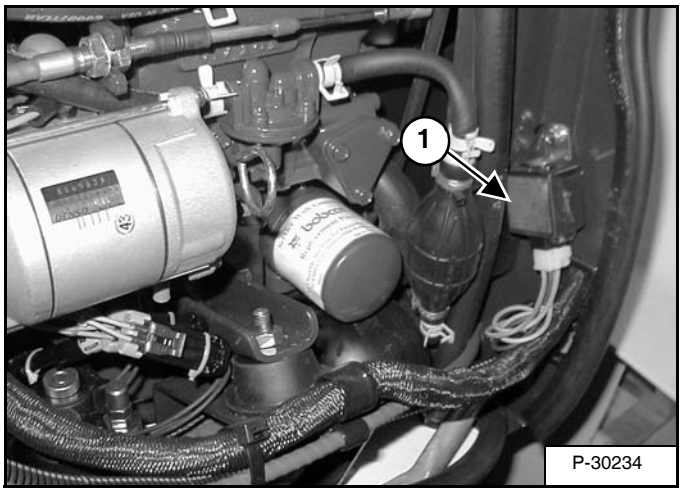
Always replace fuses using the same type and capacity.

Relays And Diodes

The three electrical relays (Item 2) **[Figure 50-10-1]** are located in the engine compartment to the right of the fuel fill. The three relays control the starter, glow plugs and switched power circuits.

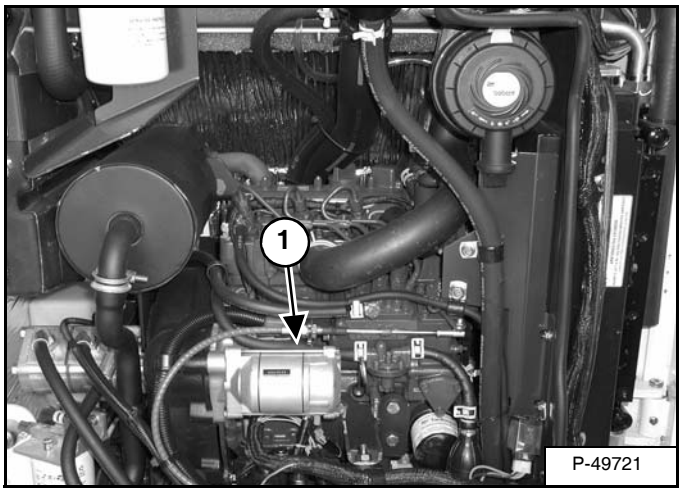
Relays And Diodes (Cont'd)

Figure 50-10-3



The fuel shut-off timer (Item 1) **[Figure 50-10-3]** is located on the right side of the engine compartment.

Figure PM-4



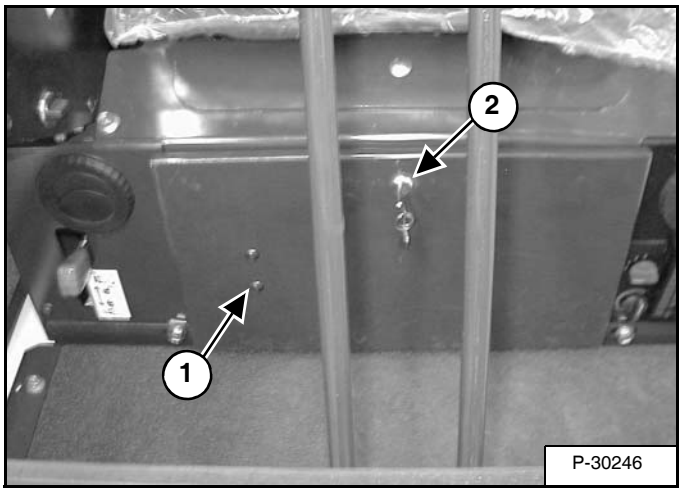
There are two diodes (Item 1) **[Figure PM-4]** in the harness behind the starter. They are for alternator feedback protection and the glow plug during start function.


Bobcat®

BATTERY

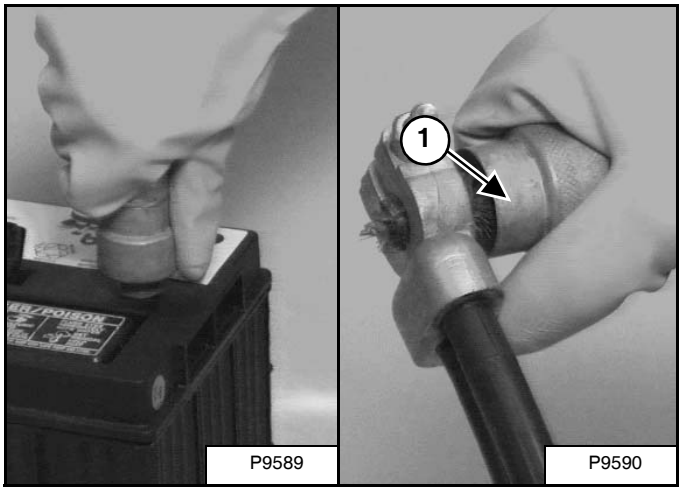
Servicing

Figure 50-20-5



The battery is located under the operator's seat, behind the storage compartment cover (Item 1). Use the key (Item 2) **[Figure 50-20-5]** to open the compartment.

Figure 50-20-6



The battery cables must be clean and tight **[Figure 50-20-6]**. Remove acid or corrosion from the battery and cables using a sodium bicarbonate and water solution. Cover the battery terminals and cable ends with battery saver grease to prevent corrosion.

Check for broken or loose connections.

If the battery cables are removed for any reason, disconnect the negative (-) cable first. When installing the battery cables, make the last connection the negative (-) cable to the battery.

The original equipment battery is maintenance free. If a replacement battery is installed, check the electrolyte level in the battery.

If the electrolyte level is lower than 0.50 inch (13 mm) above the plates, add distilled water only.

⚠ WARNING

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

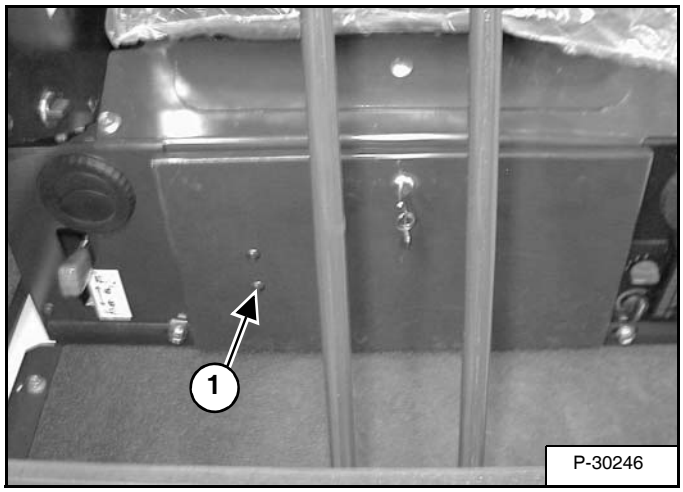
In case of acid contact, wash immediately with water. In case of eye contact get prompt medical attention and wash eye with clean, cool water for at least 15 minutes.

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

W-2065-1296

Removing And Installing The Battery

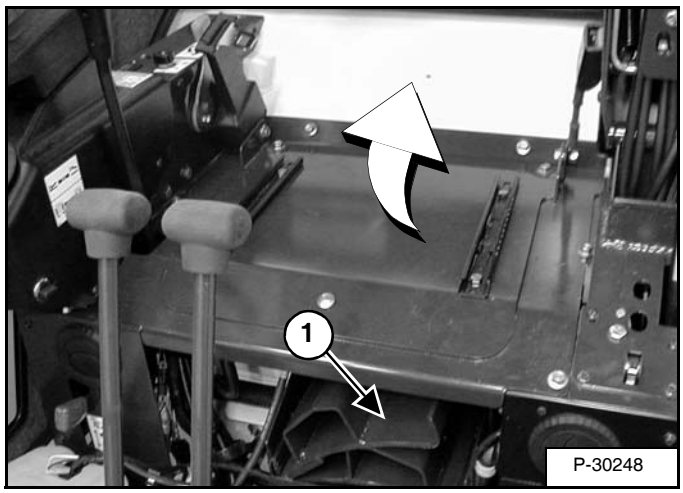
Figure 50-20-7



Open the storage compartment cover (Item 1) **[Figure 50-20-7]**.

Remove seat and seat pan.

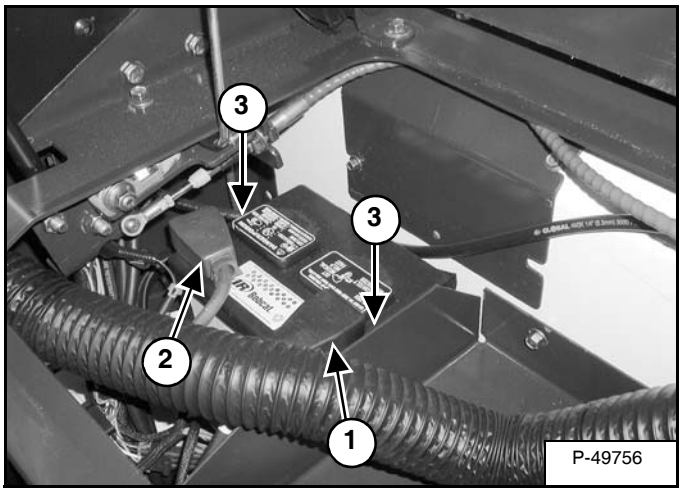
Figure 50-20-8



Remove seat and raise the seat pan **[Figure 50-20-8]**. (See Removal And Installation on Page 40-40-1.)

Remove the blade extensions (Item 1) **[Figure 50-20-8]**.

Figure 50-20-9



Disconnect the negative (-) cable (Item 1) **[Figure 50-20-9]** first.

Disconnect the positive (+) cable (Item 2) **[Figure 50-20-9]**.

Remove the bolts (Item 3) **[Figure 50-20-9]** from the hold down clamp and remove the clamp.

Remove the battery.

Always clean the terminals and the cable ends, even when installing a new battery.

Install the battery. Install the hold down clamp and tighten the bolts.

Connect the battery cables. Connect the negative (-) cable (Item 1) **[Figure 50-20-9]** last to prevent sparks.

⚠ WARNING

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.

W-2065-1296

Using A Booster Battery (Jump Starting)

IMPORTANT

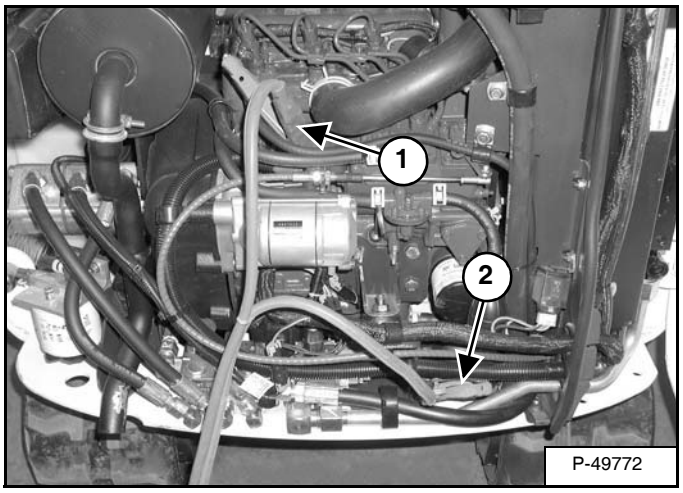
If jump starting the Excavator from a second machine:
When jump starting the Excavator from a battery installed in a second machine. Make sure the second machine is NOT running while using the glow plugs. High voltage spikes from a running machine can burn out the glow plugs.

I-2060-0195

If it is necessary to use a booster battery to start the engine. BE CAREFUL! There must be one person in the operator's seat and one person to connect and disconnect the battery cables.

Engage the upperstructure slew lock. Be sure the key switch is OFF. The booster battery must be 12 volt.

Figure 50-20-10



Open the tailgate **[Figure 50-20-10]**.

Connect one end of the first cable to the positive (+) terminal of the booster battery. Connect the other end of the same cable to the positive (+) terminal (Item 1) **[Figure 50-20-10]** of the Excavator starter.

Connect one end of the second cable to the negative (-) terminal of the booster battery. Connect the other end of the same cable to the negative Excavator cable (Item 2) **[Figure 50-20-10]** where it is fastened to the frame.

IMPORTANT

Damage to the alternator can occur if:

- **Engine is operated with battery cables disconnected.**
- **Battery cables are connected when using a fast charger or when welding on the Excavator. (Remove both cables from the battery.)**
- **Extra battery cables (booster cables) are connected wrong.**

I-2222-0903

Start the engine. After the engine has started, remove the negative (-) cable first (Item 2) **[Figure 50-20-10]**.

Disconnect the cable from the Excavator starter (Item 1) **[Figure 50-20-10]**.

⚠ WARNING

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.

W-2065-1296


Bobcat®

ALTERNATOR

Description

Figure 50-30-11

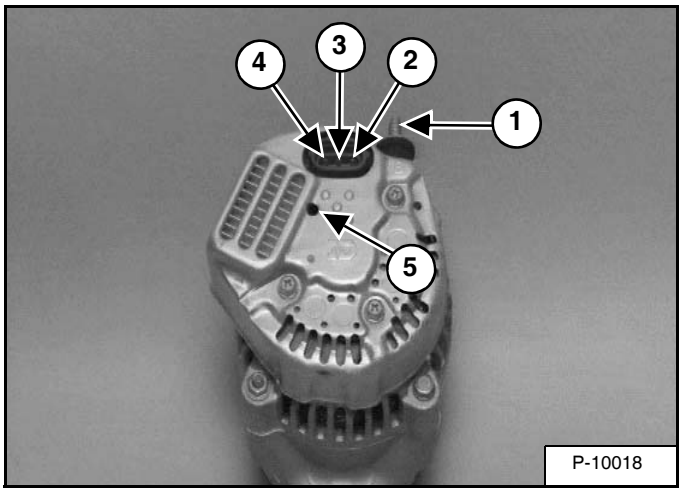
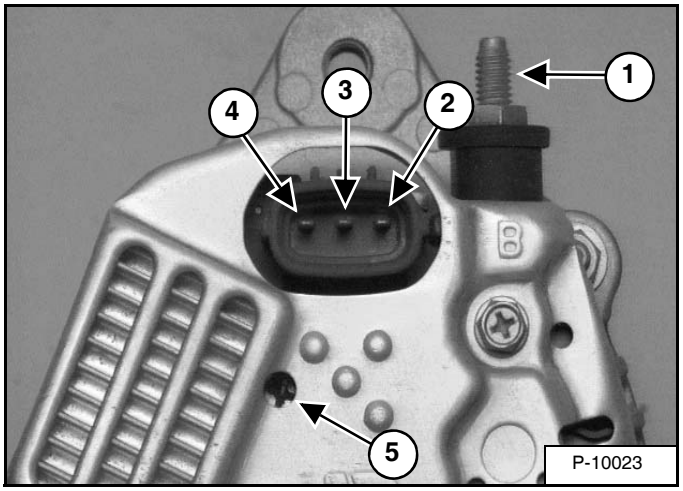


Figure 50-30-12



The output terminal (Item 1) **[Figure 50-30-11]** & **[Figure 50-30-12]**.

The battery or power sensing terminal (Item 2) **[Figure 50-30-11]** & **[Figure 50-30-12]**.

The ignition terminal (Item 3) **[Figure 50-30-11]** & **[Figure 50-30-12]**.

Open terminal not used in the Excavator harness (Item 4) **[Figure 50-30-11]** & **[Figure 50-30-12]**.

Access hole for full field test (Item 5) **[Figure 50-30-11]** & **[Figure 50-30-12]**.

Tests

Perform the following alternator tests in this order:

Alternator Output Test: Tests the alternator and regulator output.

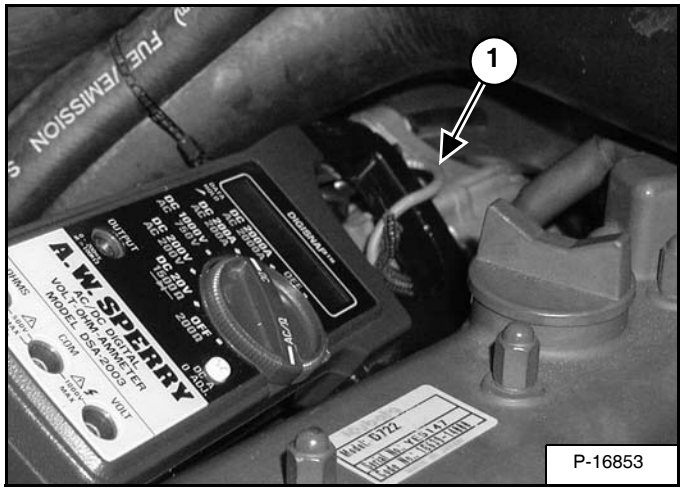
Full Field Test: Tests the maximum amperage output of the alternator.

Alternator Regulator Test: Tests the regulator voltage output.

Alternator Output Test

Check the battery and battery connections. (See BATTERY on Page 50-20-1.)

Figure 50-30-13



Use an induction meter and loop around the positive (+) wire (Item 1) **[Figure 50-30-13]** at the alternator.

Start the engine and run at full RPM.

The ammeter reading should be between 35 and 40 amps.

If the ammeter reading is less than 35 amps do the full field test.

⚠ WARNING

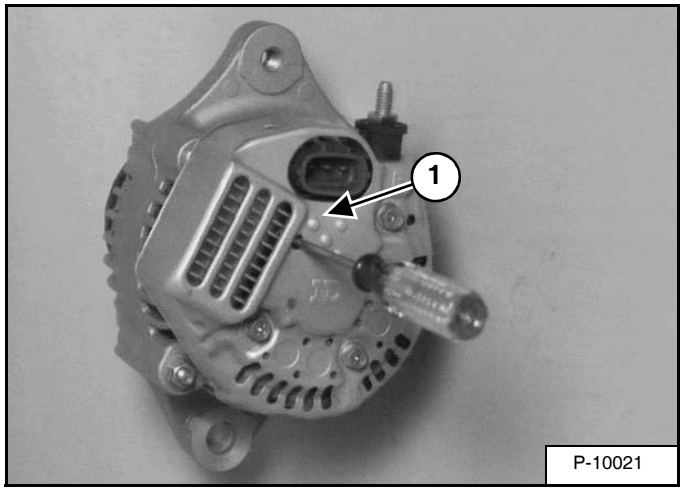
When an engine is running in an enclosed area, fresh air must be added to avoid concentration of exhaust fumes. If the engine is stationary, vent the exhaust outside. Exhaust fumes contain odorless, invisible gases which can kill without warning.

W-2050-1285

Full Field Test

Start the engine and run at full RPM.

Figure 50-30-14



Place a small screw driver in the test port (Item 1) **[Figure 50-30-14]** to provide a ground to the alternator case. This will give maximum amperage output from the alternator.

NOTE: The Full Field Test should only last long enough to get ammeter reading to prevent damage to the alternator.

The ammeter reading should be above 35 amps.

If the ammeter reading is low, repair or replace the alternator.

⚠ WARNING

When an engine is running in an enclosed area, fresh air must be added to avoid concentration of exhaust fumes. If the engine is stationary, vent the exhaust outside. Exhaust fumes contain odorless, invisible gases which can kill without warning.

W-2050-1285

Alternator Regulator Test

Disconnect the fuel stop solenoid connector.

Turn the lights on (if equipped) and crank the engine for 30 seconds to discharge the battery.

Connect the fuel stop solenoid connector.

Start the engine and run at full RPM.

The ammeter reading should be around 35 amps and slowly decrease with alternator output.

If ammeter reading is low or does not decrease with time, replace the alternator's regulator.

Disconnect the negative (-) cable from the battery.

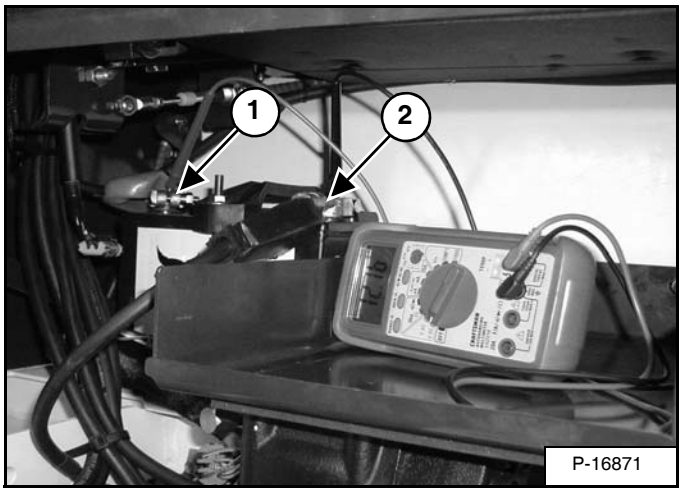
Reconnect the alternator wires.

Reconnect the negative (-) cable from the battery.

NOTE: The alternator regulator test can also be run using a voltmeter.

Alternator Regulator Test With Voltmeter

Figure 50-30-15



Connect the positive (+) voltmeter lead to the positive (+) battery terminal (Item 1) **[Figure 50-30-15]**.

Connect the negative (-) voltmeter lead to the negative (-) battery terminal (Item 2) **[Figure 50-30-15]**.

Start the engine and run at full RPM.

The voltmeter should read between 13.9 and 14.7 volts.

If the voltmeter reading is not within this range, replace the alternator's regulator.

IMPORTANT

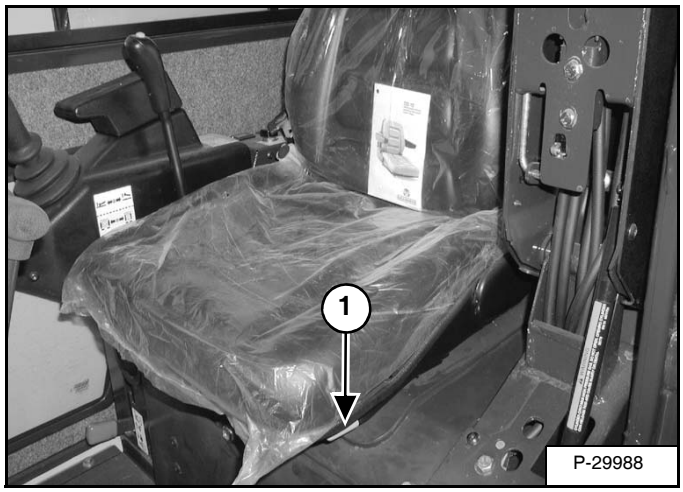
Damage to the alternator can occur if:

- **Engine is operated with battery cables disconnected.**
- **Battery cables are connected when using a fast charger or when welding on the loader. (Remove both cables from the battery.)**
- **Extra battery cables (booster cables) are connected wrong.**

I-2023-1285

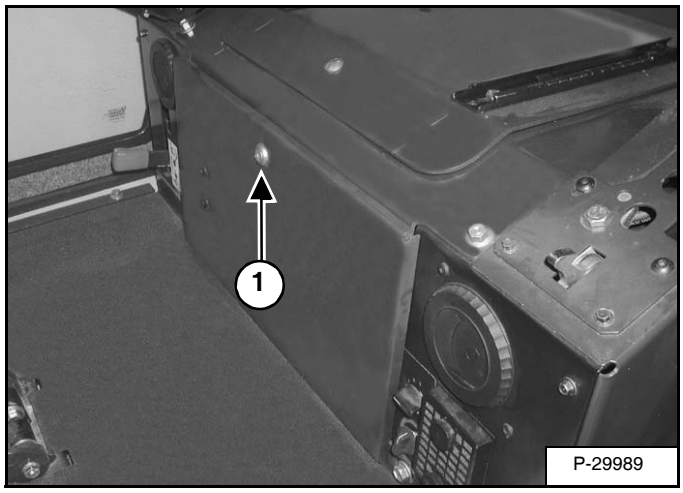
Removal And Installation

Figure 50-30-16



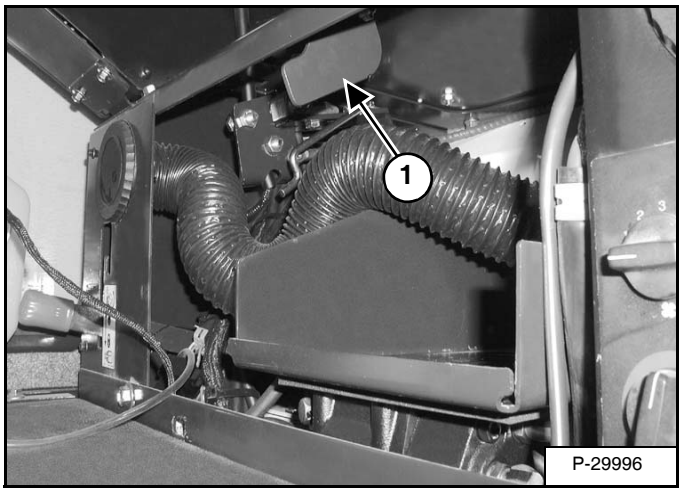
Release the seat lever (Item 1) **[Figure 50-30-16]**. Pull the seat to the front and remove it from the Excavator.

Figure 50-30-17



Using the start key, unlock and remove the cover (Item 1) **[Figure 50-30-17]** from the storage compartment.

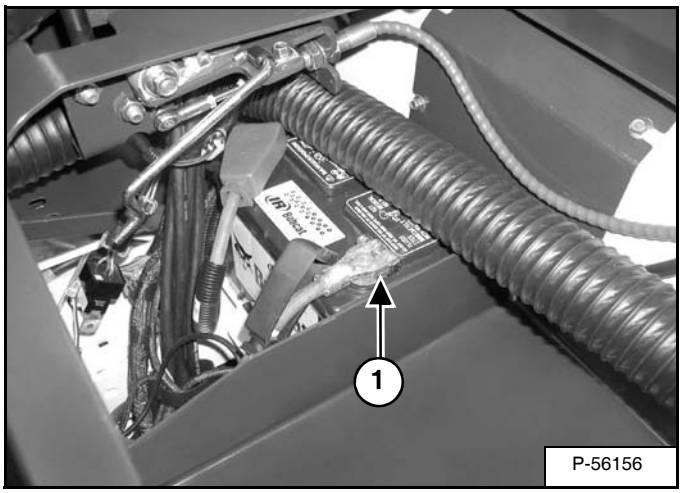
Figure 50-30-18



Unlatch the seat pan lever (Item 1) **[Figure 50-30-18]**.

Raise the seat pan.

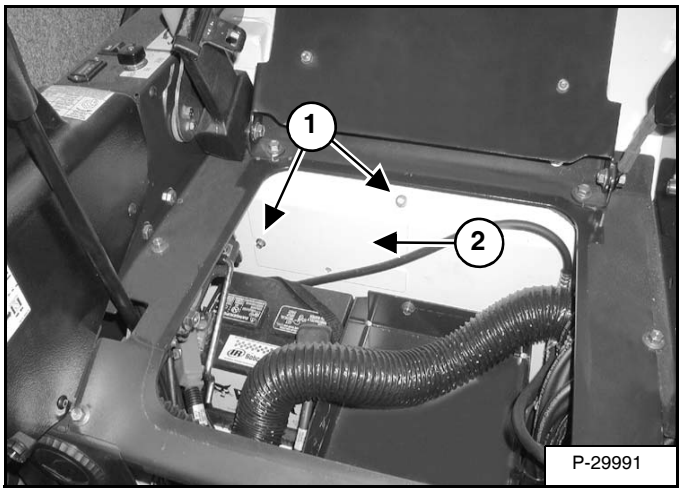
Figure 50-30-19



Disconnect the negative (-) battery cable (Item 1) **[Figure 50-30-20]**.

Removal And Installation (Cont'd)

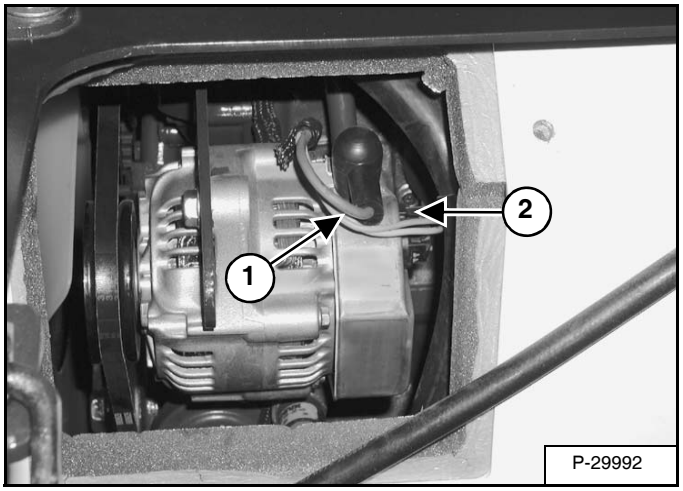
Figure 50-30-20



Remove the bolts (Item 1) **[Figure 50-30-20]**.

Remove the access panel (Item 2) **[Figure 50-30-20]**.

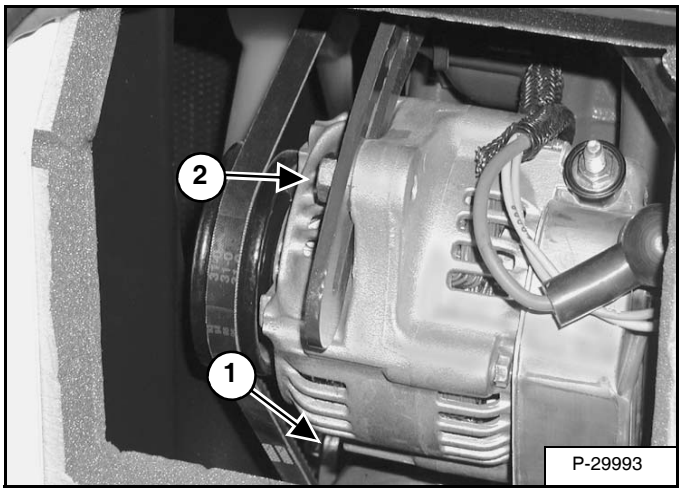
Figure 50-30-21



Disconnect the red wire (Item 1) **[Figure 50-30-21]**.

Disconnect the wire harness connector (Item 2) **[Figure 50-30-21]**.

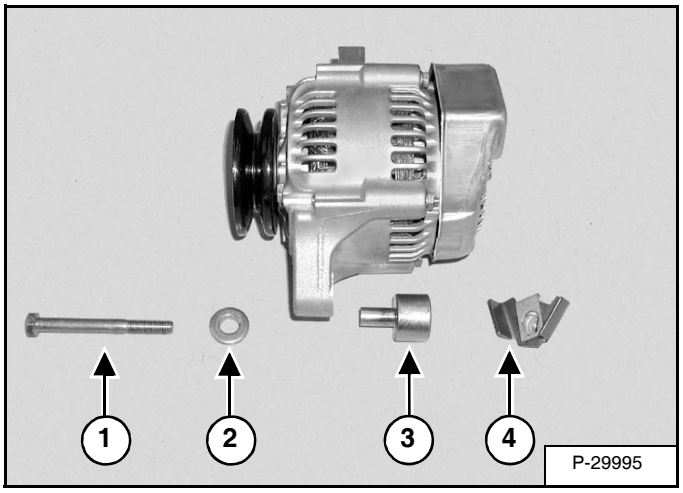
Figure 50-30-22



Remove the bottom mount bolt (Item 1) **[Figure 50-30-22]**.

Remove alternator adjustment bolt (Item 2) **[Figure 50-30-22]**.

Figure 50-30-23



NOTE: Alternator will fall if not supported while removing adjustment bolt.

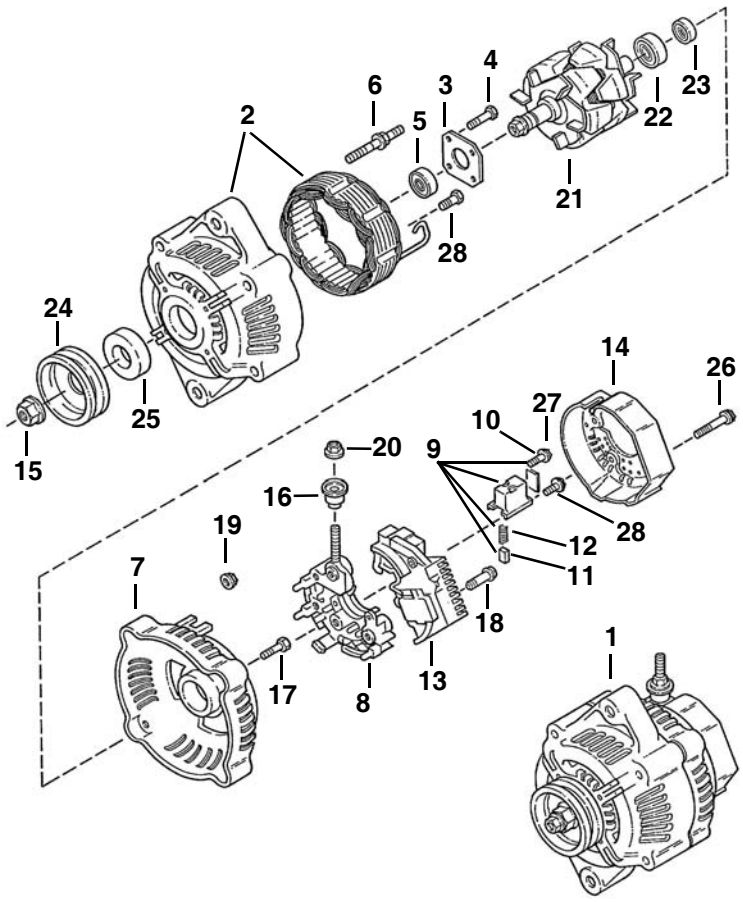
Remove belt from the alternator pulley.

Remove alternator.

NOTE: The lower alternator mounting bolt (Item 1) is assembled with a washer (Item 2) spacer (Item 3) and retaining bracket with nut (Item 4) [Figure 50-30-23] which will fall during disassembly.

Parts Identification

1. Alternator
2. Frame Assy.
3. Plate
4. Screw
5. Bearing
6. Stud
7. Frame End
8. Holder
9. Holder
10. Seal
11. Brush
12. Spring
13. Regulator
14. Cover
15. Nut
16. Insulator
17. Bolt
18. Screw
19. Nut
20. Nut
21. Rotor Assy.
22. Bearing
23. Cover
24. Pulley
25. Spacer
26. Bolt
27. Screw
28. Screw



C-3456

Disassembly And Assembly

Remove the regulator cover and regulator.

Remove the three bolts holding halves together.

Pry the halves apart.

Use a soft jaw vise to hold rotor while removing pulley nut.

Remove front case half from the rotor using a plastic hammer.

Unsolder the stator leads from the rectifier. Remove the stator.

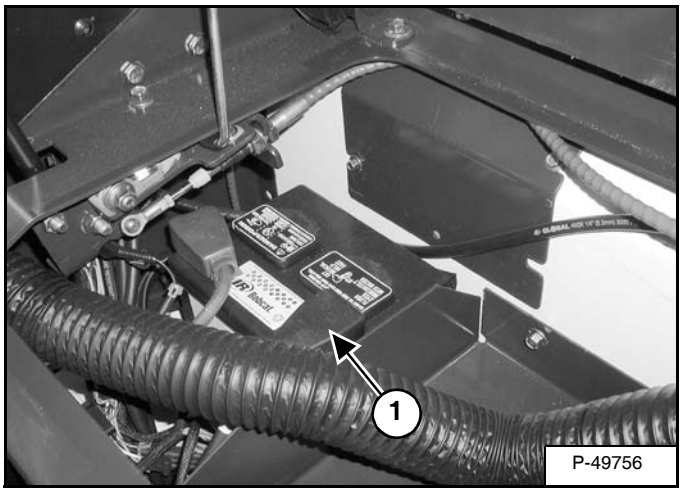
STARTER

Removal And Installation

Open tailgate. (See Opening And Closing The Tailgate on Page 10-40-1.)

Remove the storage compartment cover using the ignition key to unlock the cover.

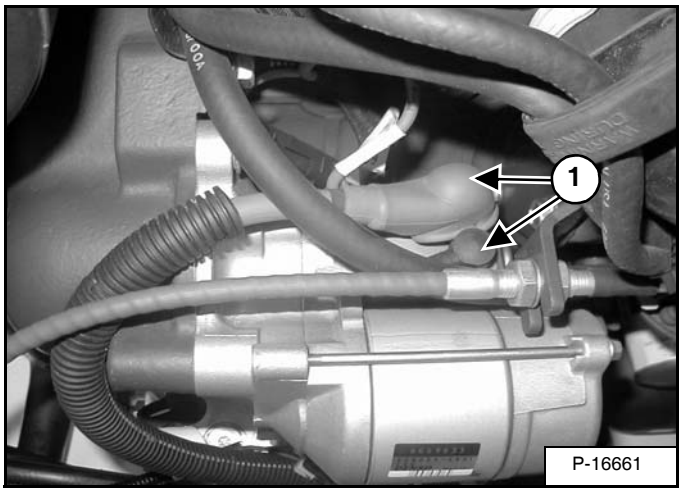
Figure 50-40-1



Disconnect the negative (-) cable (Item 1) **[Figure 50-40-1]** from the battery.

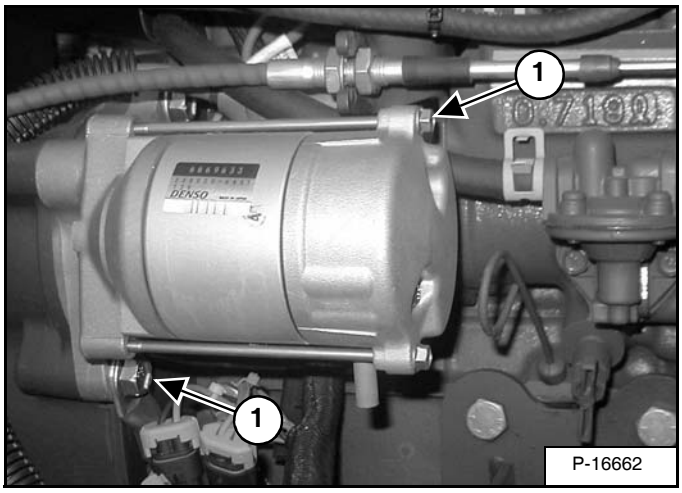
Mark the starter wires for ease of assembly.

Figure 50-40-2



Disconnect the wires (Item 1) **[Figure 50-40-2]** from the starter.

Figure 50-40-3

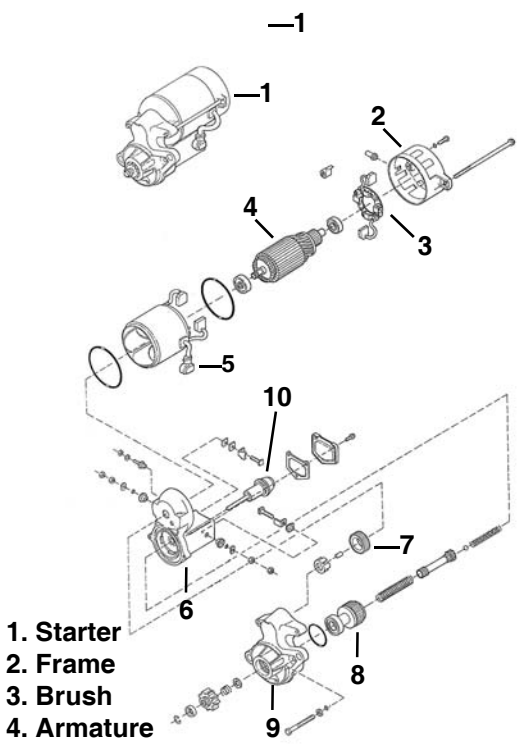


Remove the mounting bolts (Item 1) **[Figure 50-40-3]** from the starter.

Remove the starter from the bell housing.

Parts Identification

Figure 50-40-4



1. Starter
2. Frame
3. Brush
4. Armature
5. Yoke
6. Housing
7. Pinion
8. Clutch
9. Housing
10. Plunger

B-19162

Disassembly And Assembly

Disassemble the starter as shown **[Figure 50-40-4]**.

Cleaning and Inspection

⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- **When fluids are under pressure.**
- **Flying debris or loose material is present.**
- **Engine is running.**
- **Tools are being used.**

W-2019-1285

Use a brush and air pressure to clean the drive, field coils, armature and starter housing.

NOTE: Do not use solvent to clean the drive assembly. The solvent will remove the lubricant and the drive will slip.

Check the following items:

Armature
- Broken or burned insulation.
- Loose connections at commutator.
- Open or grounded circuits.
- Worn shaft or bearings.
- Rough commutator.

Field Coils
- Broken or burned insulation.
- Electrical continuity.
- Brush connections.

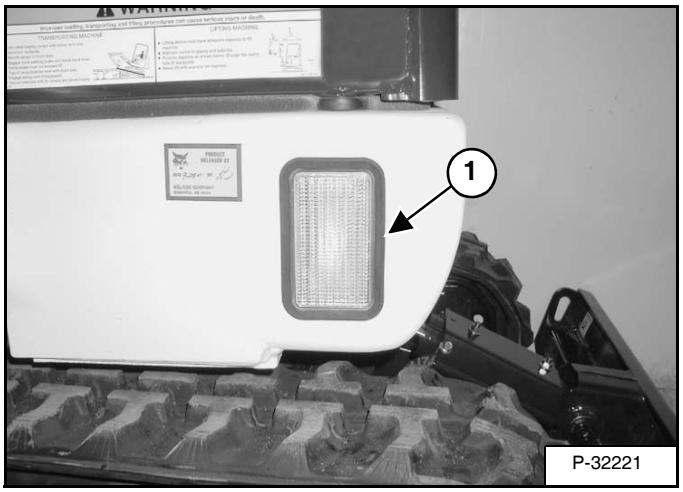
Drive Gear
- Worn teeth.
- Tooth engagement (drive gear must engage ring gear by 1/2 the depth of the ring gear tooth).

Brush Holders
- Broken springs.
- Broken insulation.
- Spring tension.

LIGHTS

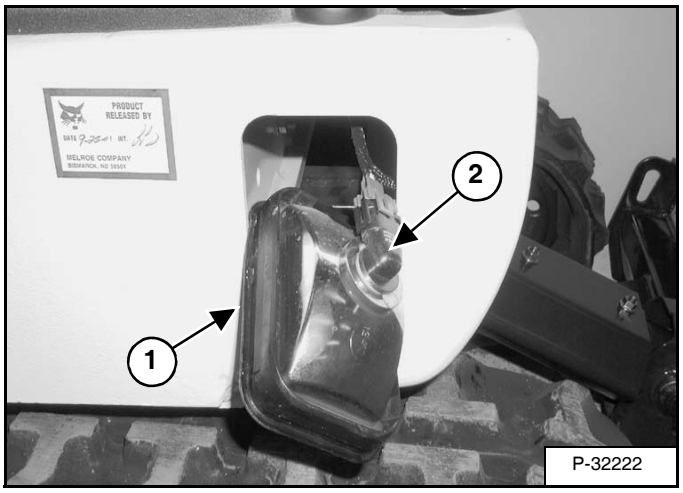
Upper Structure Light Removal And Installation

Figure 50-50-5



Push in on the light housing (Item 1) **[Figure 50-50-5]** until the light is inside the upper structure.

Figure 50-50-6



Turn and pull the light (Item 1) **[Figure 50-50-6]** out of the upper structure.

Disconnect the wire harness (Item 2) **[Figure 50-50-6]**.

Figure 50-50-7

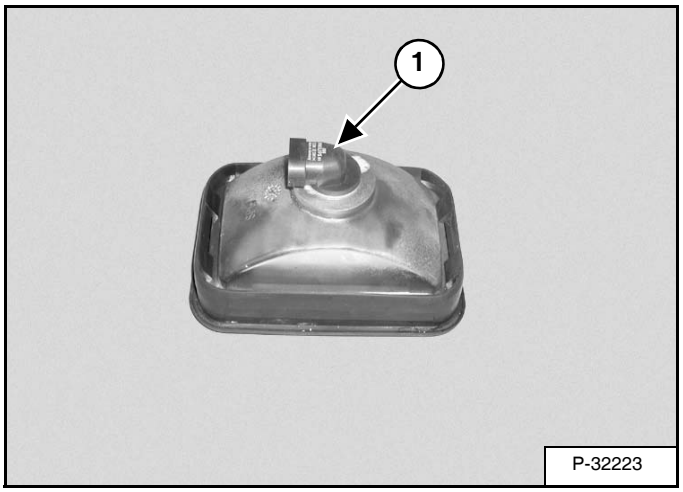
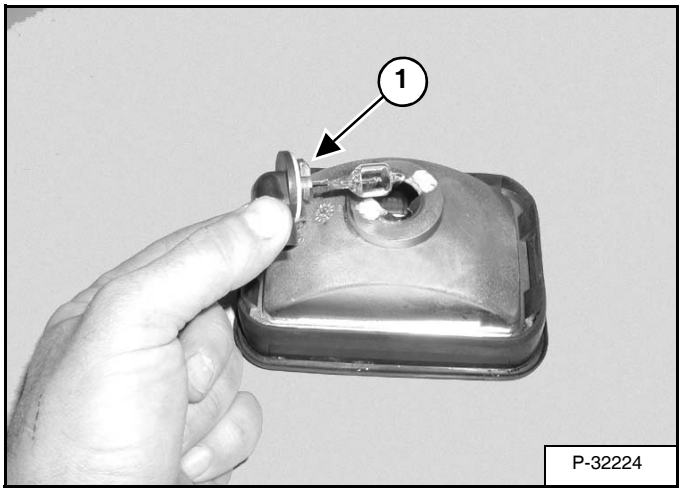


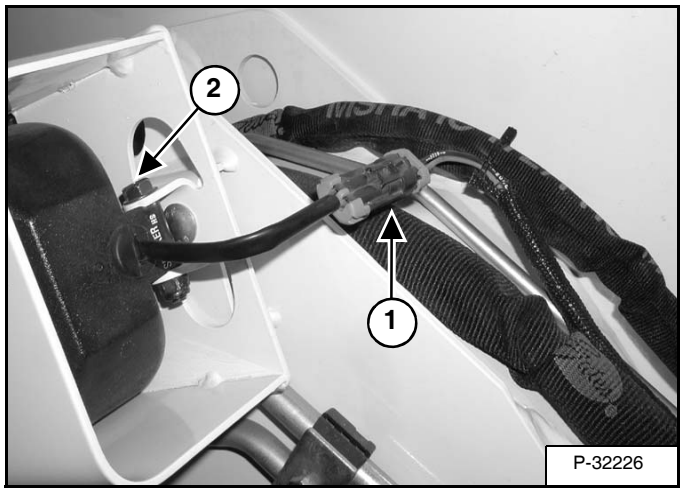
Figure 50-50-8



Remove the light bulb assembly (Item 1) **[Figure 50-50-7]** & **[Figure 50-50-8]** from the lens.

Boom Light Removal And Installation

Figure 50-50-9

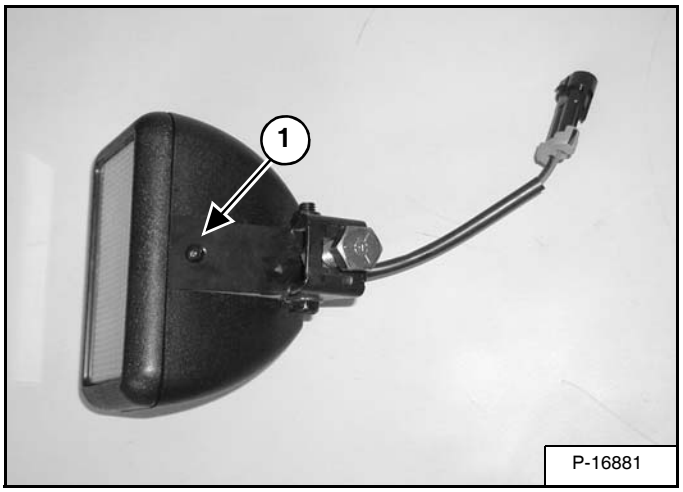


Disconnect the wire harness (Item 1) **[Figure 50-50-9]**.

Remove the nut and bolt (Item 2) **[Figure 50-50-9]**.

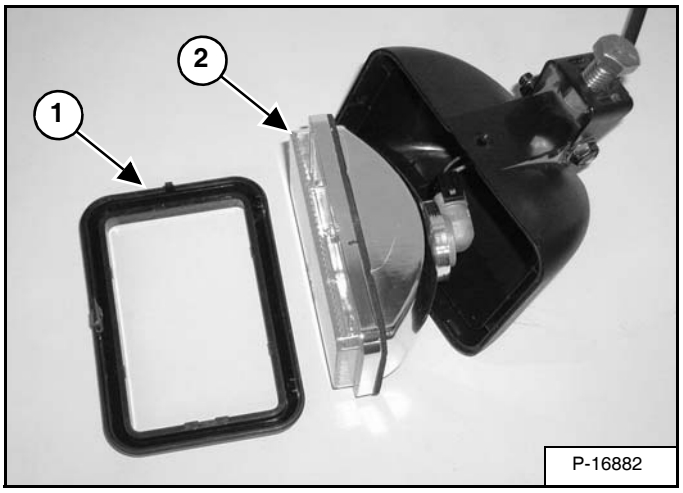
Boom Light Disassembly And Assembly

Figure 50-50-10



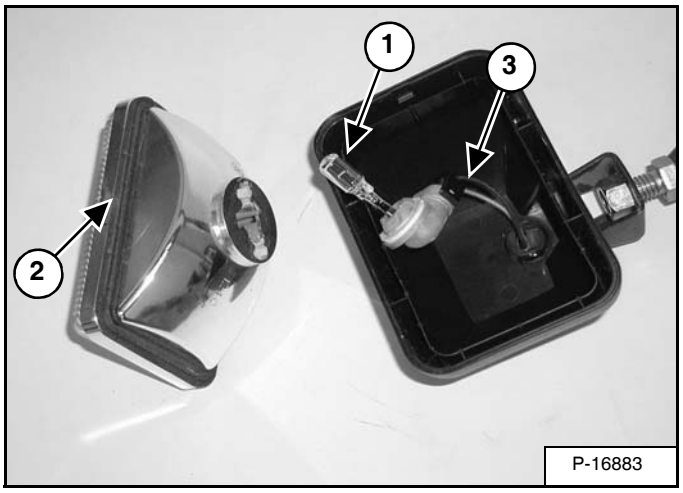
Remove the screw (Item 1) **[Figure 50-50-10]** from the side of the light.

Figure 50-50-11



Remove the cover (Item 1) and lens assembly (Item 2) **[Figure 50-50-11]**.

Figure 50-50-12

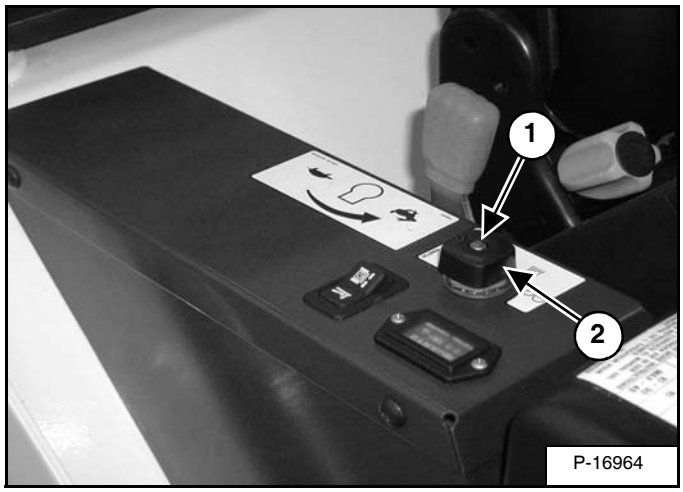


Remove the light bulb assembly (Item 1) from the lens assembly (Item 2) **[Figure 50-50-12]**.

Disconnect the wire connector (Item 3) **[Figure 50-50-12]** from the light bulb assembly.

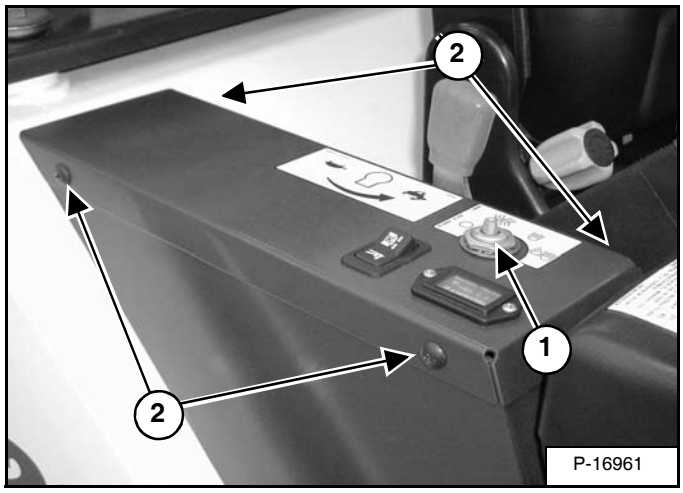
Light Switch Removal And Installation

Figure 50-50-13



Remove the screw (Item 1) and knob (Item 2) **[Figure 50-50-13]** from the switch.

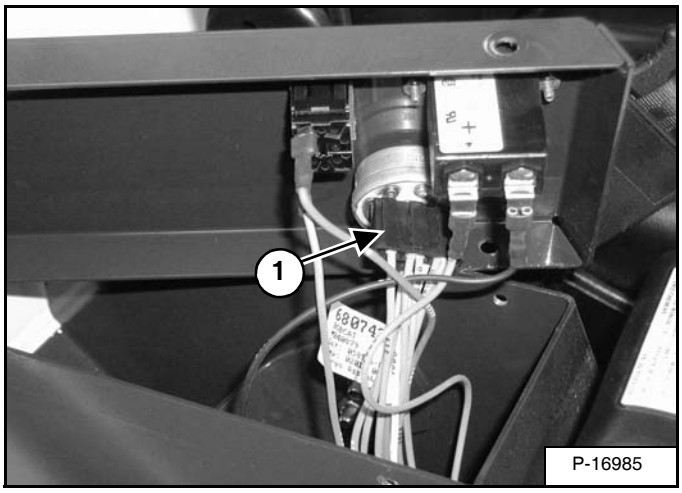
Figure 50-50-14



Remove the nut and lock washer (Item 1) **[Figure 50-50-14]** from the switch.

Remove the four screws (Item 2) **[Figure 50-50-14]** from the cover panel.

Figure 50-50-15



Disconnect the wire harness (Item 1) **[Figure 50-50-15]** from the switch.

Remove the switch from the bottom of the panel.

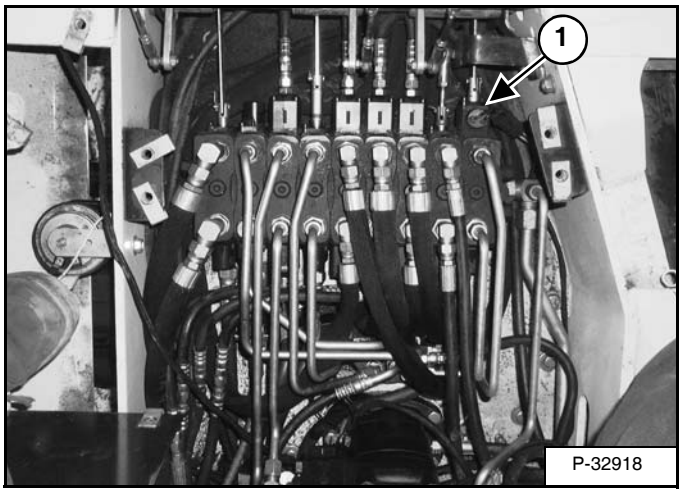
TWO-SPEED SWITCH

Removal And Installation

NOTE: The 320L is not equipped with a two-speed.

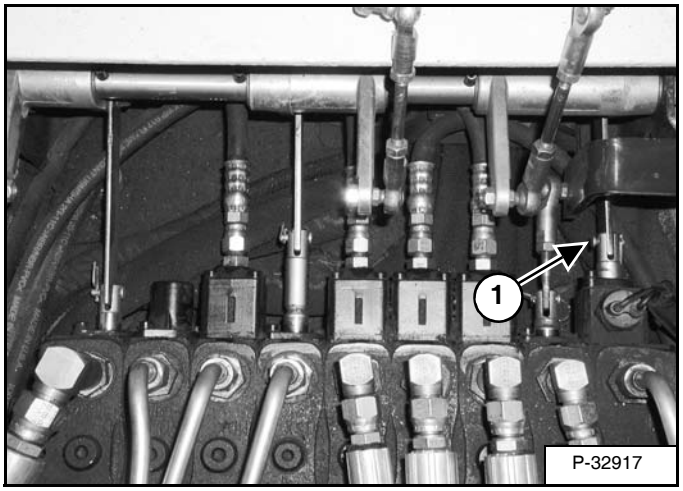
Remove the floormat and floorplate. (See Removal and Installation on Page 40-120-1.)

Figure 50-60-1



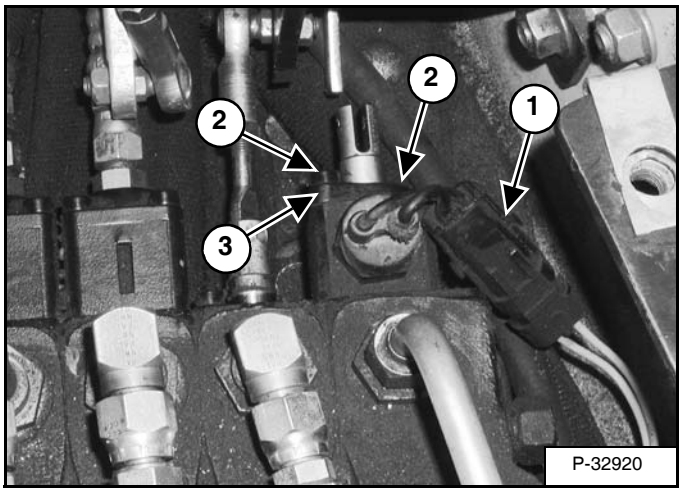
Locate the two-speed switch (Item 1) **[Figure 50-60-1]** on the front right side of the control valve assembly.

Figure 50-60-2



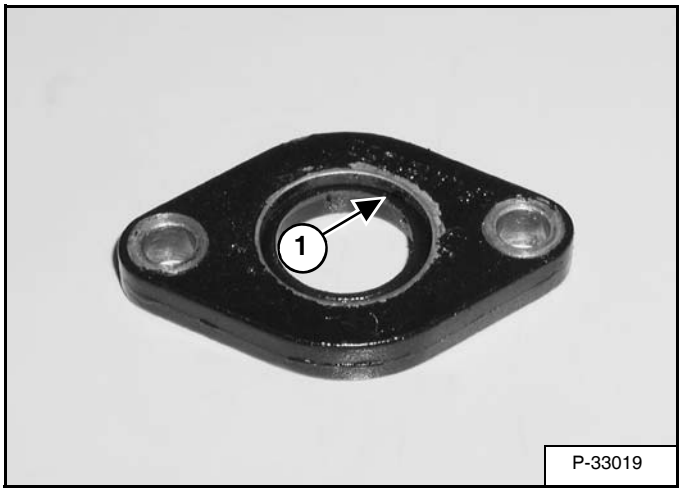
Remove the cotter pin and clevis pin (Item 1) **[Figure 50-60-2]**.

Figure 50-60-3



Disconnect the wire harness (Item 1). Remove the two bolts (Item 2) and plate (Item 3) **[Figure 50-60-3]**.

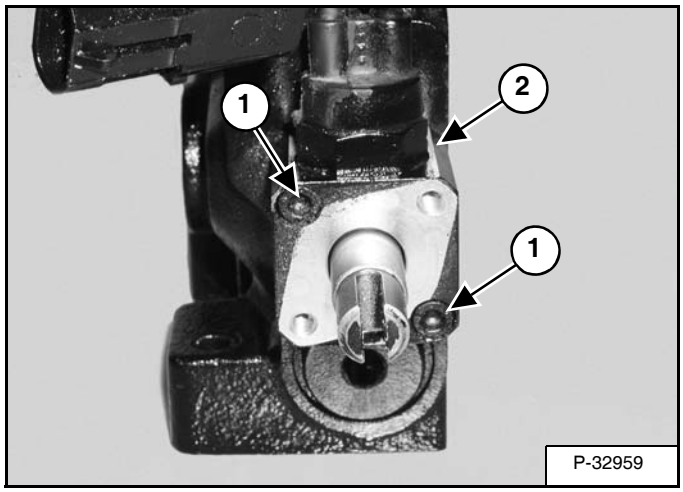
Figure 50-60-4



Remove the seal (Item 1) **[Figure 50-60-3]** from the plate.

Removal And Installation (Cont'd)

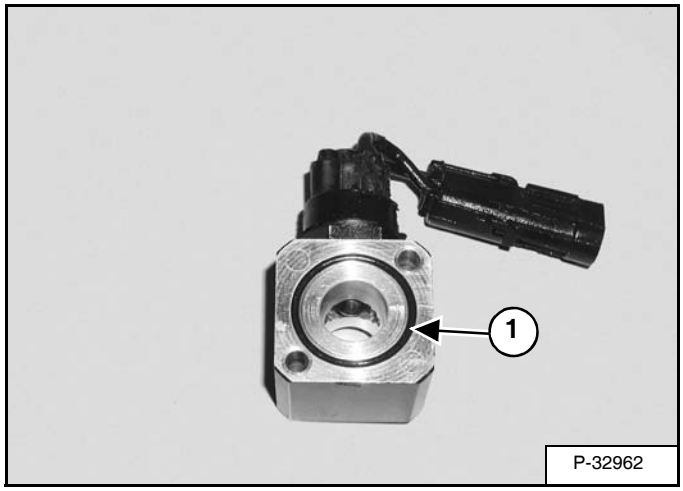
Figure 50-60-5



Remove the bolts (Item 1) and switch (Item 2) **[Figure 50-60-3]**.

NOTE: The valve section is shown removed for photo clarity.

Figure 50-60-6



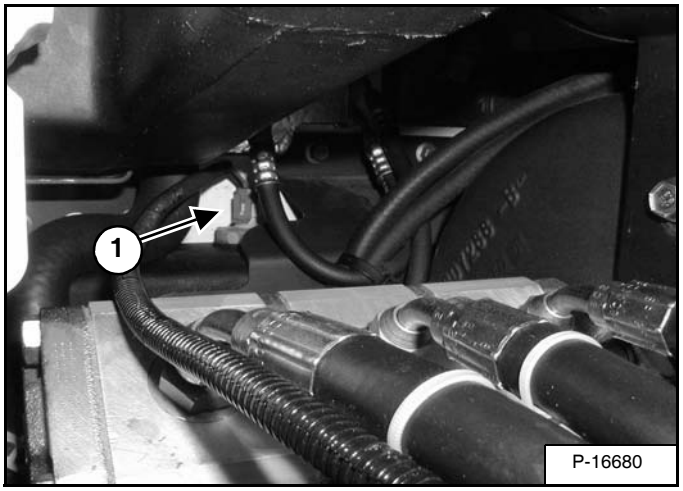
Remove the O-ring (Item 1) **[Figure 50-60-3]** from the switch.

FUEL LEVEL SENDER

Removal and Installation

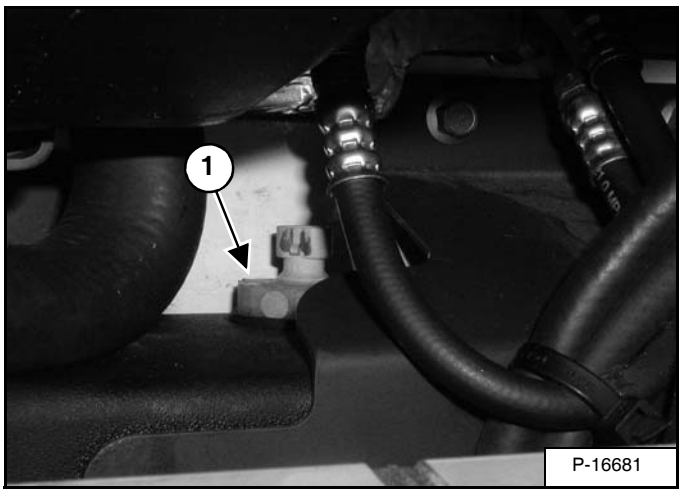
Open the tailgate.

Figure 50-70-1



Disconnect the wire harness (Item 1) **[Figure 50-70-1]** from the fuel level sender.

Figure 50-70-2

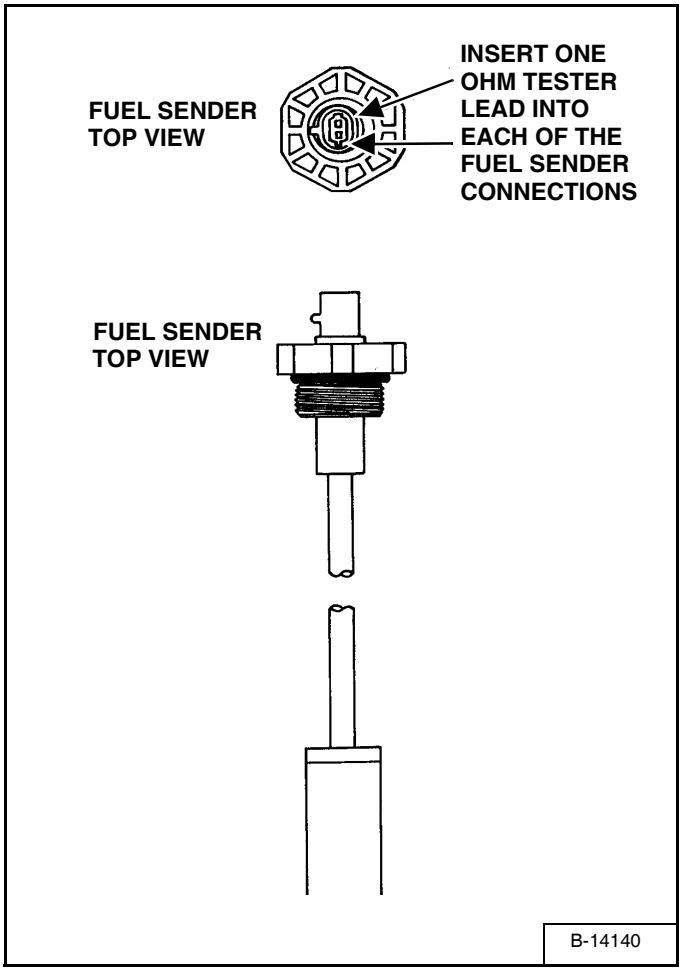


Remove the sender (Item 1) **[Figure 50-70-2]** from the fuel tank.

Testing

Use an ohmmeter to check the resistance of the fuel level sender.

Figure 50-70-3



Insert one of the ohm tester leads into each of the fuel sender electrical connectors in the end of the fuel sender **[Figure 50-70-3]**.

With the fuel sender in the position shown **[Figure 50-70-3]**, read the ohms in the empty position. Slide the float upwards and the ohm reading will decrease. See resistance chart below.

The approximate resistance should read as follows:

FULL: 15-35 Ohms.
HALF: 120-145 Ohms.
EMPTY: 230-250 Ohms.


Bobcat®

MICROSWITCH

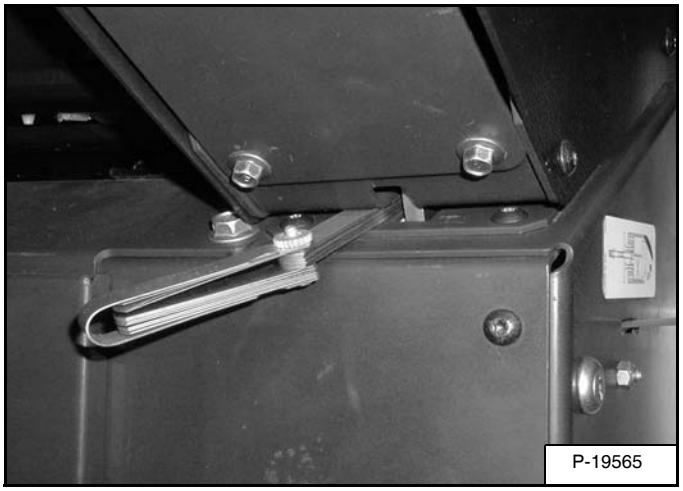
Adjustment

Adjust the console latch. (See Adjustment (ROPS Canopy Models 320 & 322) on Page 40-50-10.)

NOTE: Make sure that the microswitch is at the top of the adjustment slots prior to adjusting the console latch or switch damage may occur.

Lower the console to the latched position.

Figure 50-80-1

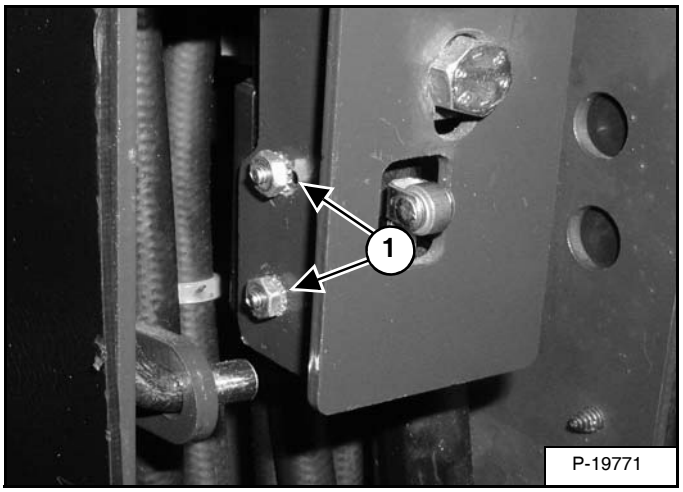


Use feeler gauges and measure the distance between the two latch mounting plates **[Figure 50-80-1]**.

Raise the console.

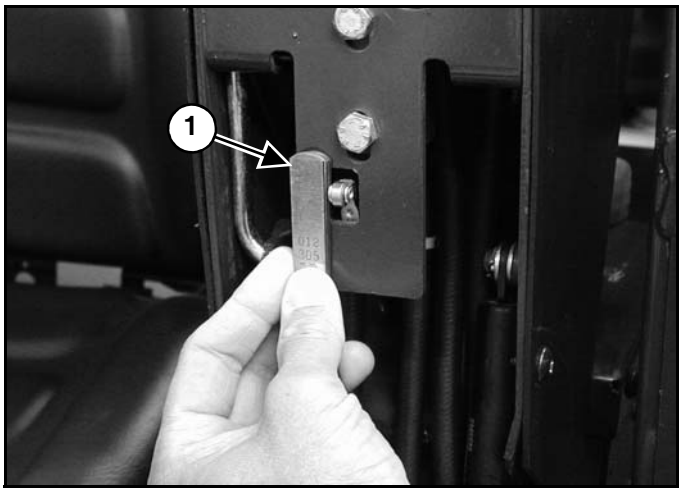
Take the measurement from the feeler gauges and subtract .12 inch (3 mm) from the measurement.

Figure 50-80-2



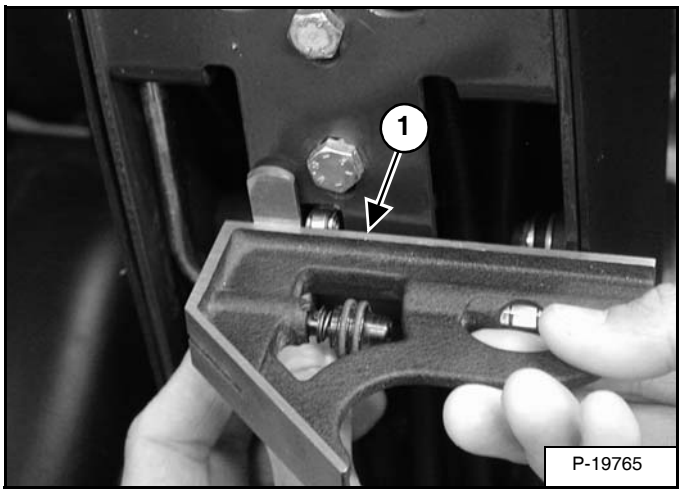
Loosen the nuts (Item 1) **[Figure 50-80-2]** fastening the microswitch to the bracket.

Figure 50-80-3



Set the feeler gauges to the new measurement and lay the feeler gauges (Item 1) **[Figure 50-80-3]** beside the microswitch .

Figure 50-80-4



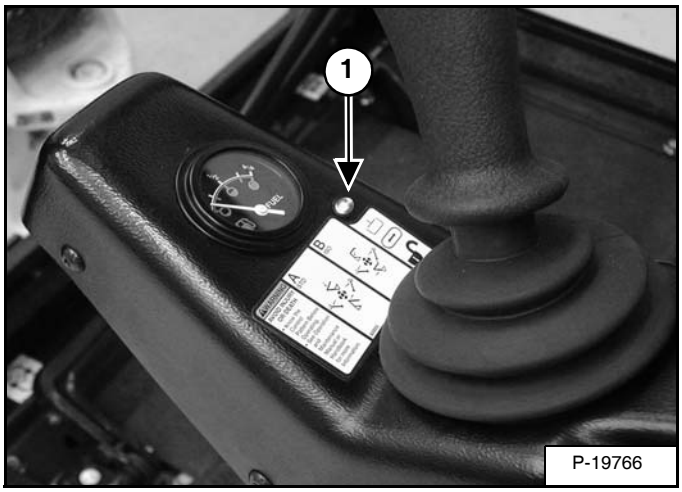
Lay a straight edge (Item 1) **[Figure 50-80-3]** across the feeler gauges and listen for the microswitch to engage (click). If the microswitch does not engage (click), pivot the switch down and lay the straight edge across again.

Once the microswitch engages at the height of the feeler gauges, tighten the microswitch mounting hardware while holding the microswitch at the proper adjustment.

MICROSWITCH (CONT'D)

Adjustment (Cont'd)

Figure 50-80-5



Lower the console and verify the green light (Item 1) **[Figure 50-80-5]** is lit when the key switch is turned to the ON position. If the green light is not lit, loosen and pivot the microswitch down slightly and recheck.

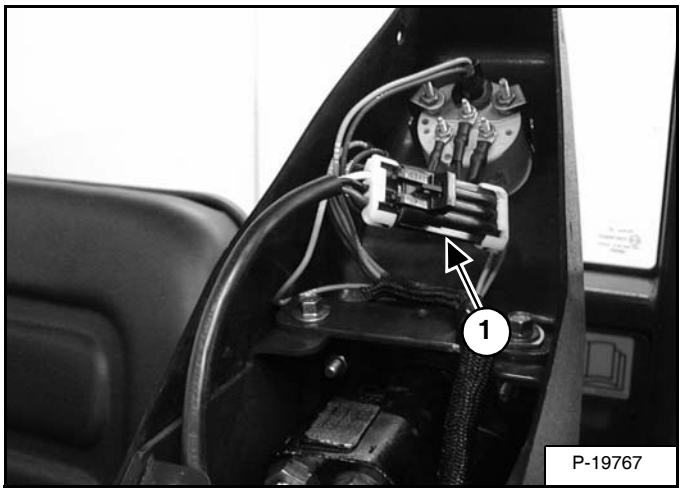
MICROSWITCH (CONT'D)

Testing

Raise the control console.

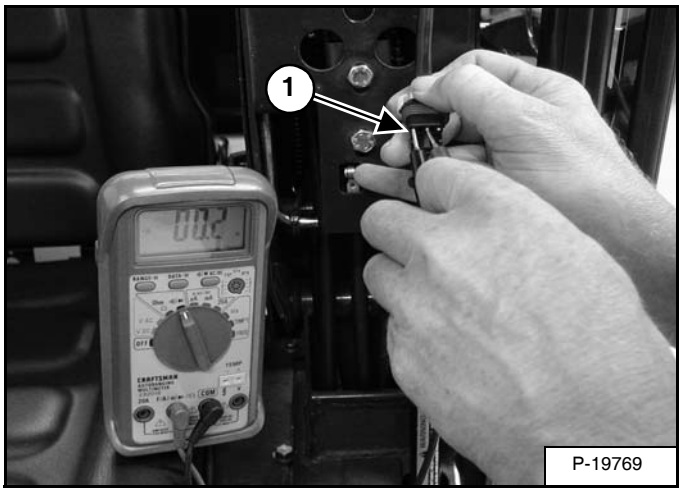
Remove the access plate. (See Console Cover Removal And Installation (Cab Models 320L, 320, 322 & ROPS Canopy Model 320L) on Page 40-50-1.)

Figure 50-80-6



Disconnect the microswitch harness (Item 1) **[Figure 50-80-6]** from the control harness.

Figure 50-80-7



Use a continuity tester to check the microswitch prior to removal. Test the continuity between the black and white wire pins (Item 1) **[Figure 50-80-7]**.

The microswitch is normally open.

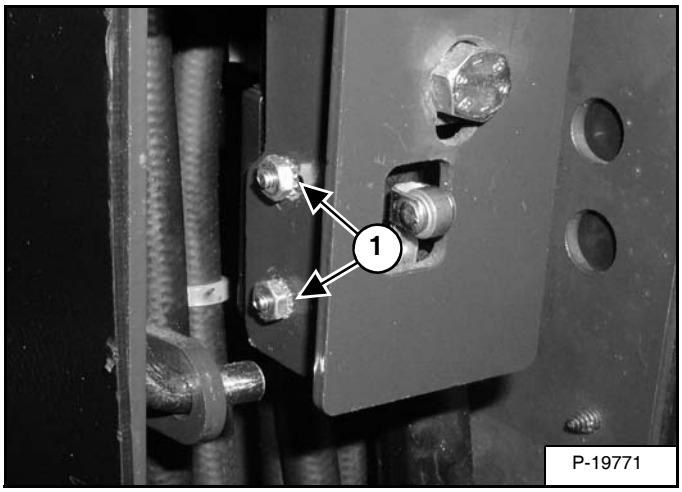
With the console raised the gauge reading should show no current.

By pushing the actuator on the microswitch, the gauge reading should show a completed circuit. If not, the microswitch is faulty and must be replaced.

MICROSWITCH (CONT'D)

Removal And Installation

Figure 50-80-8



Remove the nuts, lock washers and bolts (Item 1) **[Figure 50-80-8]** holding the microswitch.

Figure 50-80-9



Remove the microswitch **[Figure 50-80-9]**.

NOTE: The adjustment procedure must be performed after a new microswitch has been installed. (See Adjustment on Page 50-80-1)

ENGINE SERVICE

AIR CLEANER 60-30-1
Removal And Installation 60-30-1

ENGINE. 60-60-1
Removal and Installation 60-60-1

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Fuel Injection Pump Check 60-50-3
Fuel Injection Pump Removal And Installation 60-50-4
Fuel Injection Pump Timing 60-50-5
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Fuel Injector Removal And Installation 60-50-7
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Glow Plug Checking. 60-50-10
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Flywheel Ring Gear 60-70-2
Hydraulic Pump Coupler 60-70-2
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RADIATOR 60-40-1
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Crankshaft And Bearings, Servicing 60-80-24
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Oil Pump Removal And Installation 60-80-15
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Water Pump Removal And Installation 60-80-26

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SPARK ARRESTOR MUFFLER 60-20-1
Removal And Installation 60-20-1

TROUBLESHOOTING 60-10-1
Chart 60-10-1


Bobcat®

TROUBLESHOOTING

Chart

The following troubleshooting chart is provided for assistance in locating and correcting problems which are most common. Many of the recommended procedures must be done by authorized Bobcat Service personnel only.

PROBLEM	CAUSE
Slow cranking speed	1, 2, 3, 4
Engine will not start	2, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 19, 27, 28, 29
Difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 25, 27, 28, 29
No power from engine	8, 9, 10, 11, 12, 13, 15, 16, 17, 21, 22, 24, 25, 26, 28, 29
Engine is mis-firing	8, 9, 11, 12, 13, 15, 16, 17, 21, 22, 24, 25, 26, 28
Too much fuel consumption	10, 12, 13, 15, 16, 17, 19, 20, 21, 23, 24, 25, 27, 28, 29
Black exhaust	10, 12, 13, 15, 16, 17, 19, 20, 21, 23, 24, 25, 27, 28, 29
Blue/white exhaust	4, 10, 15, 16, 17, 21, 23, 27, 29, 30, 50
Low oil pressure	4, 31, 32, 33, 34, 35, 37, 38, 39, 52
Engine knocking	13, 15, 16, 19, 22, 24, 25, 27, 29, 31, 40, 41, 53
Engine running rough	7, 8, 9, 10, 11, 12, 13, 17, 18, 22, 24, 25, 26, 29, 40, 53
Vibration	12, 13, 17, 21, 22, 25, 26, 29, 40, 42, 43
High oil pressure	4, 33, 36
Overheating	10, 12, 13, 15, 16, 20, 21, 40, 44, 45, 46, 47, 48, 51
Too much crankcase pressure	22, 27, 29, 30, 40, 49
Poor compression	10, 16, 21, 24, 25, 27, 28, 29, 30, 41, 53
Start and stop	9, 10, 11

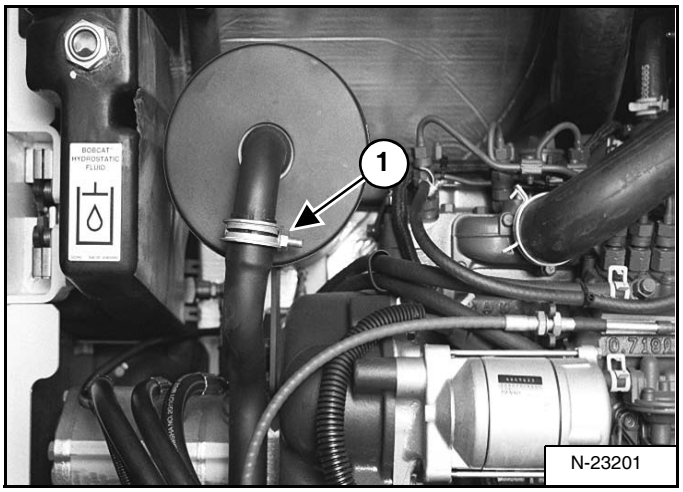
KEY TO CORRECT THE CAUSE	
1. Battery capacity low	28. Worn valves and seat
2. Bad electrical connections	29. Broken or worn piston rings
3. Faulty starter motor	30. Worn valve stems or guides
4. Incorrect grade of oil	31. Worn or damaged bearings
5. Low cranking speed	32. Not enough oil in the oil pan
6. Fuel tank empty	33. Switch is defective
7. Faulty stop control operation	34. Oil pump worn
8. Plugged fuel line	35. Relief valve is stuck open
9. Plugged fuel filter	36. Relief valve is stuck closed
10. Restriction in the air cleaner	37. Broken relief valve spring
11. Air in the fuel system	38. Faulty suction pipe
12. Faulty fuel injection pump	39. Plugged oil filter
13. Faulty fuel injectors	40. Piston seizure
14. Broken injection pump drive	41. Incorrect piston height
15. Incorrect injection pump timing	42. Faulty engine mounting
16. Incorrect valve timing	43. Incorrect alignment of flywheel
17. Poor compression	44. Faulty thermostat
18. Plugged fuel tank vent	45. Restriction in water jacket
19. Incorrect grade of fuel	46. Loose alternator belt
20. Exhaust pipe restriction	47. Plugged radiator
21. Cylinder head gasket leaking	48. Plugged breather pipe
22. Over heating	49. Plugged breather pipe
23. Cold running	50. Damaged valve stem oil deflectors
24. Incorrect tappet adjustment	51. Coolant level too low
25. Sticking valves	52. Plugged oil pump pipe strainer
26. Incorrect high pressure fuel lines	53. Broken valve spring
27. Worn cylinder bores	


Bobcat®

SPARK ARRESTOR MUFFLER

Removal And Installation

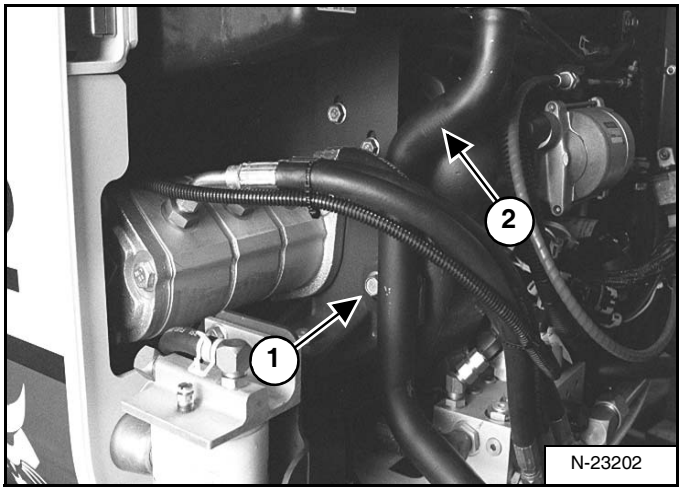
Figure 60-20-1



Loosen the exhaust extension clamp (Item 1) **[Figure 60-20-1]**.

Installation: Tighten clamp to 5.90-7.37 ft.-lbs. (8-10 Nm) torque.

Figure 60-20-2



Remove the bolt (Item 1) **[Figure 60-20-2]** from the exhaust extension mounting bracket.

Slide exhaust extension (Item 2) **[Figure 60-20-2]** off muffler and remove from Excavator.

WARNING

When an engine is running in an enclosed area, fresh air must be added to avoid concentration of exhaust fumes. If the engine is stationary, vent the exhaust outside. Exhaust fumes contain odorless, invisible gases which can kill without warning.

W-2050-1285

WARNING

Stop engine and allow the muffler to cool before cleaning the spark chamber. Wear safety goggles. Failure to obey can cause serious injury.

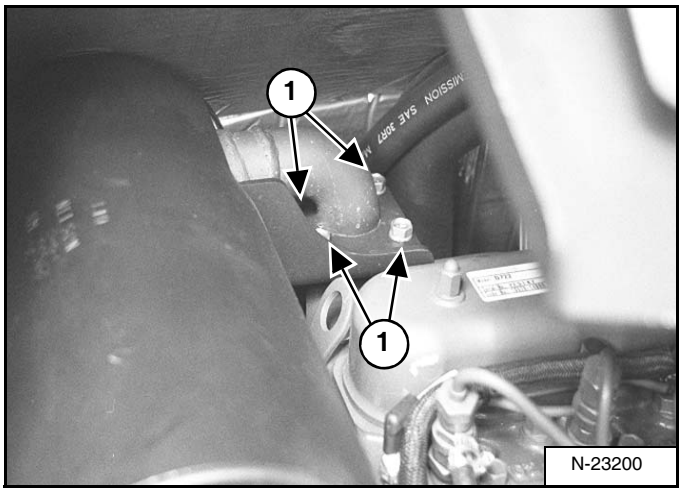
W-2011-1285

WARNING

Never use machine in atmosphere with explosive dust or gases or where exhaust can contact flammable material. Failure to obey warnings can cause injury or death.

W-2068-1285

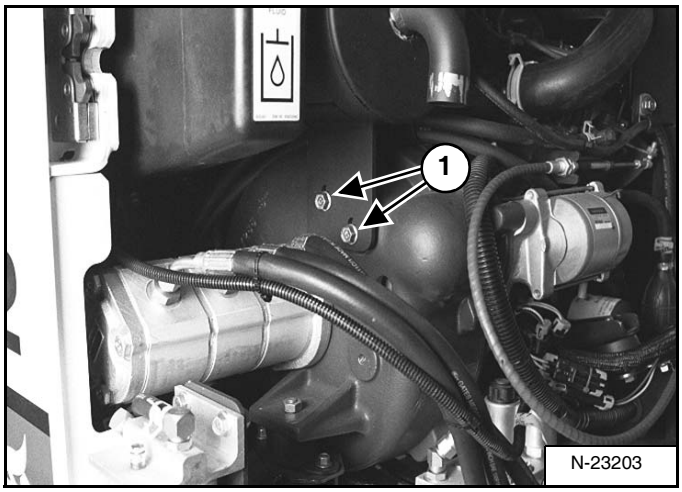
Figure 60-20-3



Remove the four bolts (Item 1) **[Figure 60-20-3]** from the muffler mount flange.

Removal And Installation (Cont'd)

Figure 60-20-4



Remove the two bolts (Item 1) **[Figure 60-20-4]** from the muffler mounting bracket.

Remove the muffler.

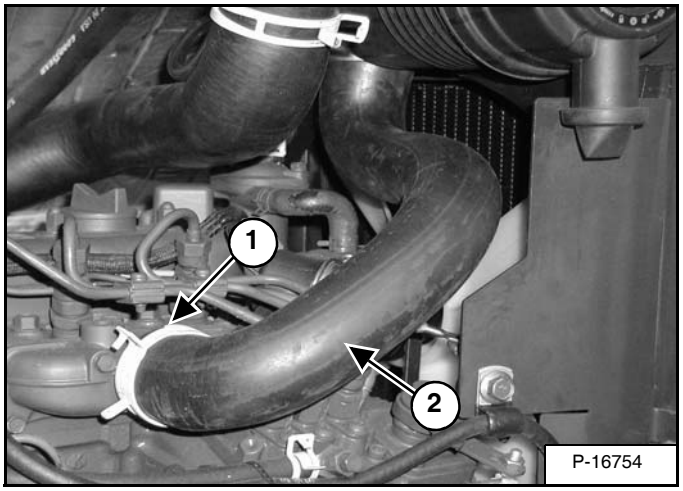
NOTE: Plug the exhaust manifold hole after muffler removal so no contamination can get into the engine.

AIR CLEANER

Removal And Installation

Open the tailgate.

Figure 60-30-1

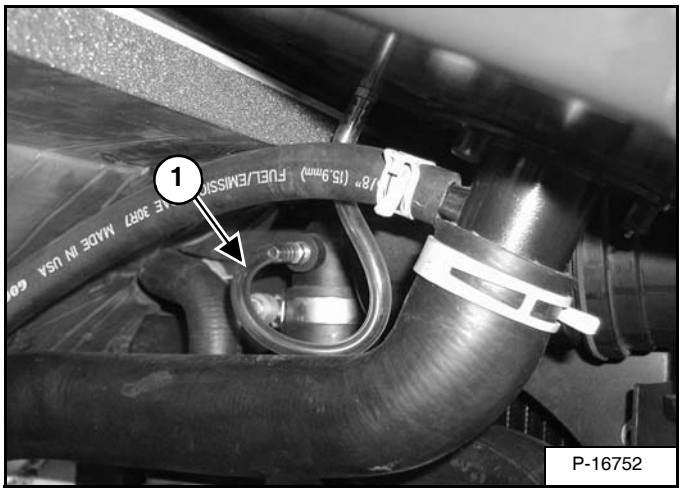


Loosen the hose clamp (Item 1) **[Figure 60-30-1]** on the air intake hose.

Remove the hose (Item 2) **[Figure 60-30-1]**.

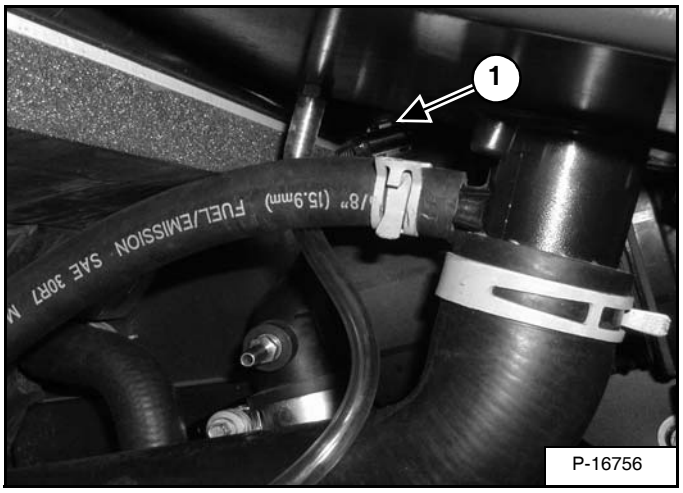
NOTE: Plug the intake manifold hole to prevent any contamination from getting into the engine.

Figure 60-30-2



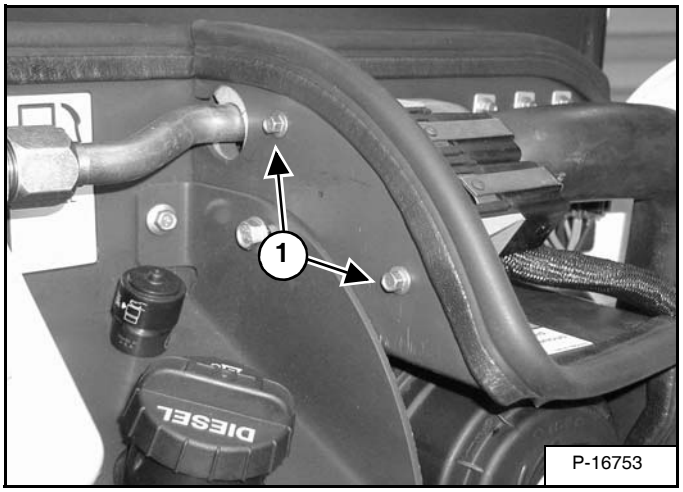
Remove the hose (Item 1) **[Figure 60-30-2]** from the back of the air cleaner.

Figure 60-30-3



Loosen the hose clamp (Item 1) **[Figure 60-30-3]** and remove hose from the top of the air cleaner.

Figure 60-30-4

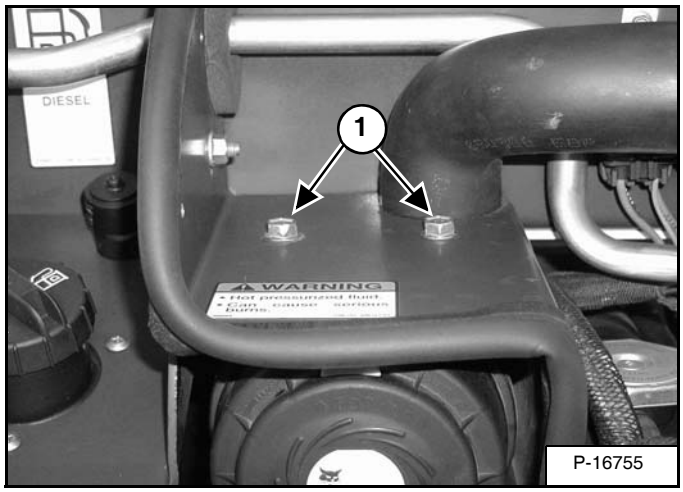


Remove the two bolts (Item 1) **[Figure 60-30-4]** fastening the fuse bracket to the Excavator.

Move the fuse assembly aside to expose the two air cleaner mounting bolts.

Removal And Installation (Cont'd)

Figure 60-30-5



Remove the two bolts (Item 1) **[Figure 60-30-5]**.

Remove the air cleaner and intake hose assembly.

RADIATOR

Removal And Installation

Open the tailgate.

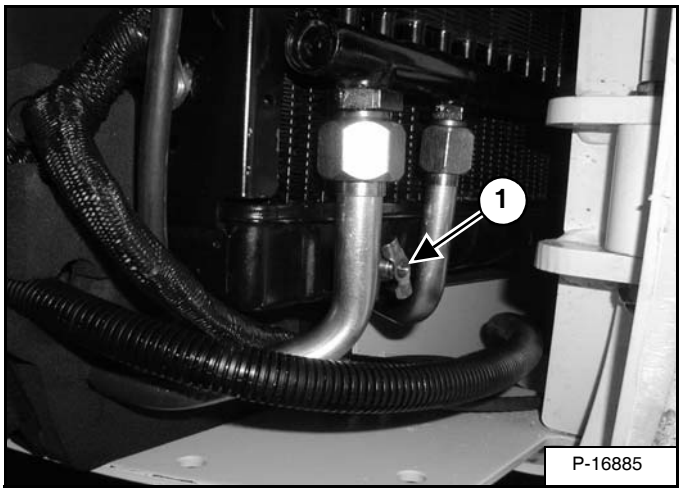
WARNING

Do not remove radiator cap when the engine is hot. You can be seriously burned.

W-2070-1285

Drain the hydraulic reservoir. (See Replacing Hydraulic Oil on Page 10-100-2.)

Figure 60-40-1

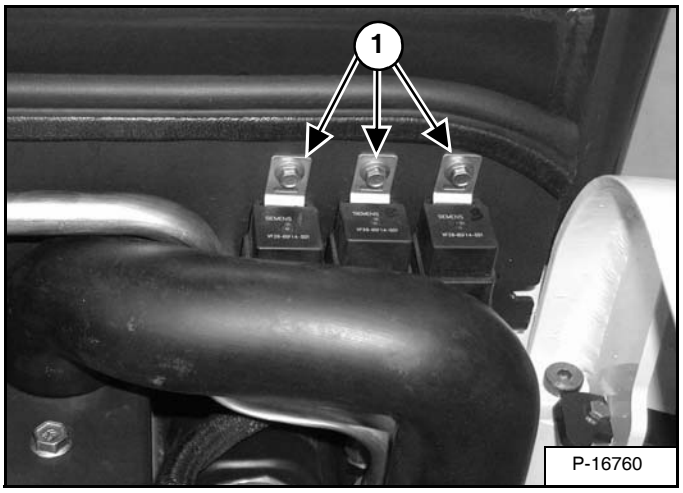


Open the radiator drain valve (Item 1) **[Figure 60-40-1]** and drain the coolant into a container.

Loosen the radiator cap from the radiator fill neck.

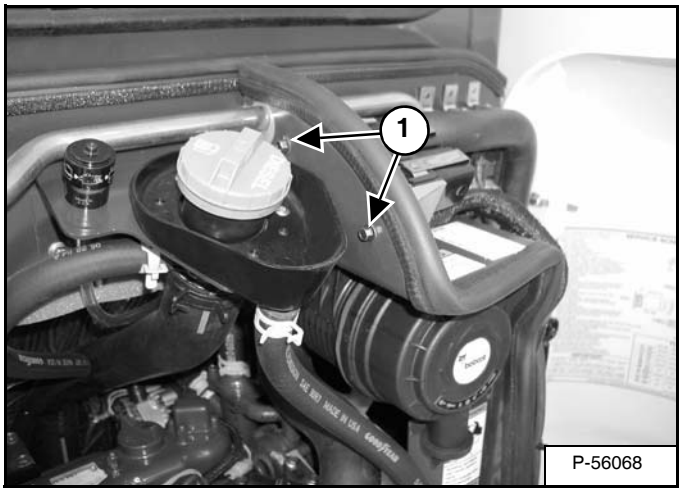
Mark the three electrical relays for ease of assembly.

Figure 60-40-2



Remove the bolts (Item 1) **[Figure 60-40-2]** fastening the relays to the frame.

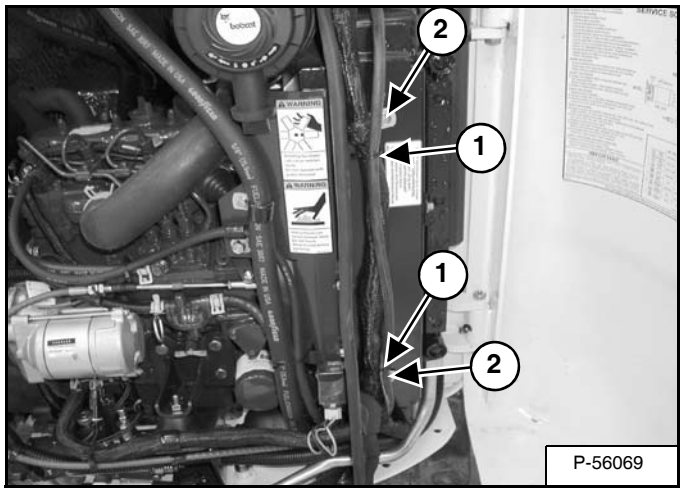
Figure 60-40-3



Remove the bolts (Item 1) **[Figure 60-40-3]** fastening the fuse bracket assembly to the frame.

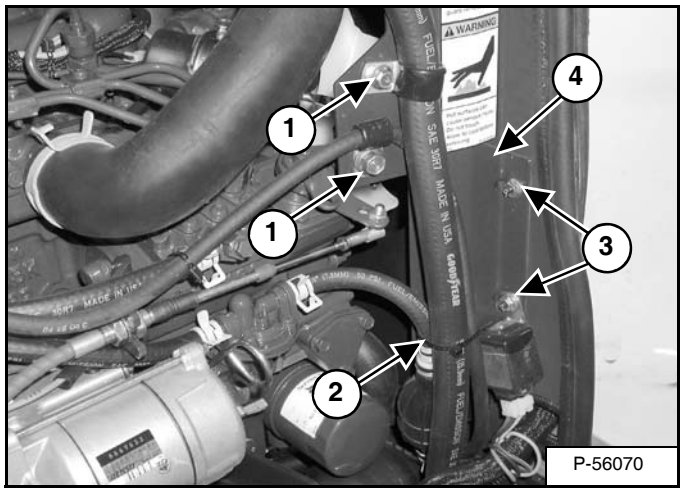
Removal And Installation (Cont'd)

Figure 60-40-4



Remove the tie straps (Item 1) and bolts (Item 2) **[Figure 60-40-4]** fastening the wire harness to the radiator.

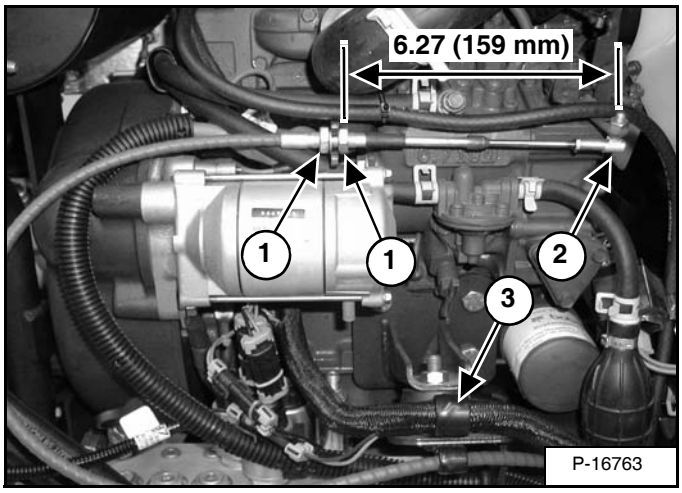
Figure 60-40-5



Remove the bolts (Item 1) and tie strap (Item 2) **[Figure 60-40-5]** on the fan guard.

Remove the nuts (Item 3) and remove the fan guard (Item 4) **[Figure 60-40-5]**.

Figure 60-40-6



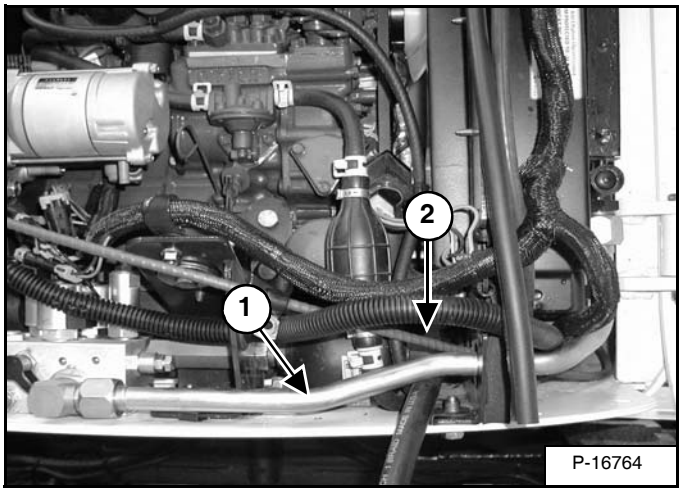
Loosen the nuts (Item 1) **[Figure 60-40-6]** fastening the cable to the bracket.

Disconnect the linkage (Item 2) **[Figure 60-40-6]** from the bracket.

Remove the nut and cable clamp (Item 3) **[Figure 60-40-6]** from the engine mount.

Installation: The linkage measurement from bracket to the center of the ball joint is 6.27 inches (159 mm).

Figure 60-40-7

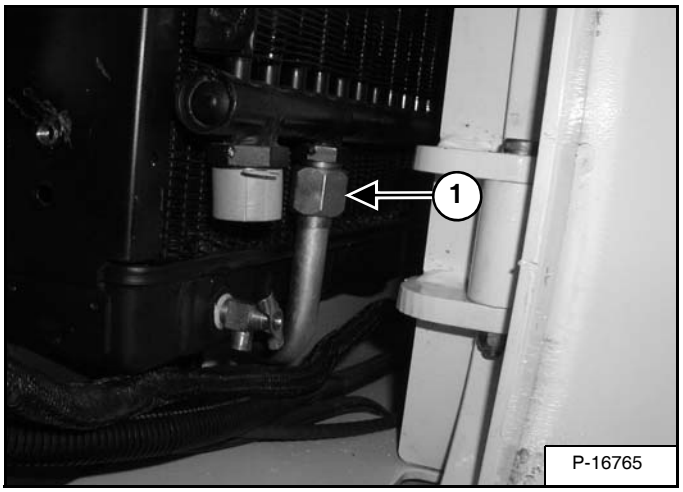


Remove the tubeline (Item 1) **[Figure 60-40-7]** from the manifold assembly to the oil cooler. Remove the tubeline by pulling the tubeline through the radiator bracket from the engine side of the radiator.

Push the engine speed control cable (Item 2) **[Figure 60-40-7]** through the radiator bracket towards the tailgate. Move the cable to the side.

Removal And Installation (Cont'd)

Figure 60-40-8



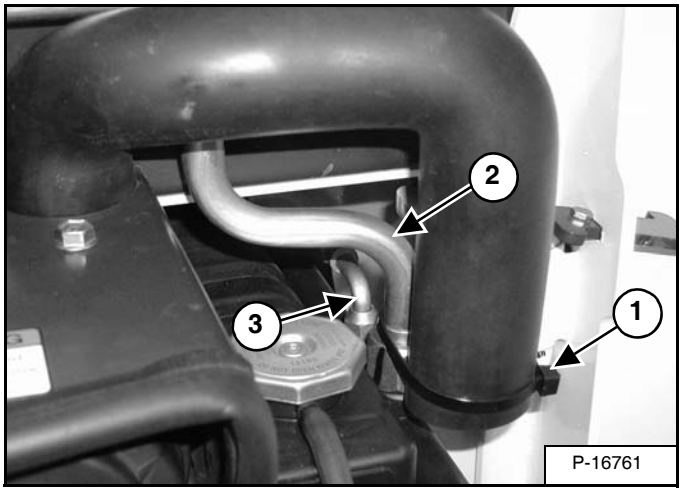
Remove the tubeline (Item 1) **[Figure 60-40-8]** from the oil cooler to the control valve assembly.

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

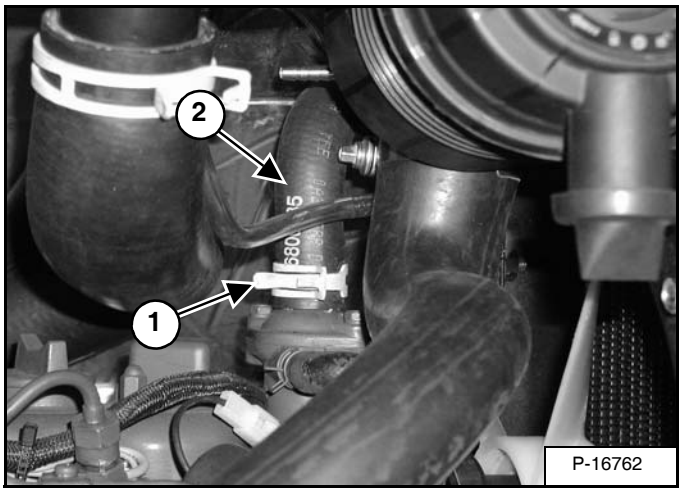
Figure 60-40-9



Remove the tie strap (Item 1) **[Figure 60-40-9]**.

Remove the tubeline (Item 2) and hose (Item 3) **[Figure 60-40-9]** from the top of the oil cooler.

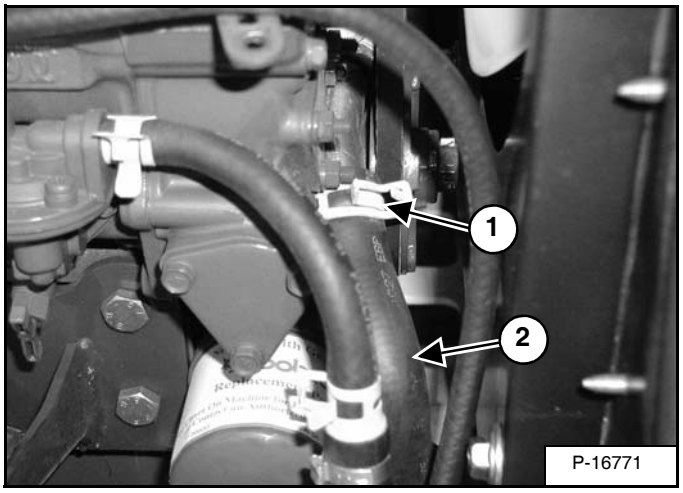
Figure 60-40-10



Slide the hose clamp (Item 1) **[Figure 60-40-10]** away from the end of the upper radiator hose.

Remove the upper radiator hose (Item 2) **[Figure 60-40-10]**.

Figure 60-40-11



Slide the hose clamp (Item 1) **[Figure 60-40-11]** away from the end of the lower radiator hose.

Remove the lower radiator hose (Item 2) **[Figure 60-40-11]**.

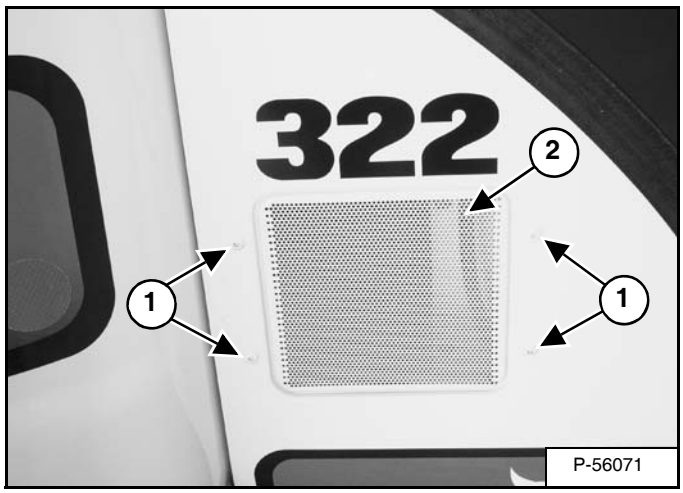
Removal And Installation (Cont'd)

Figure 60-40-12



Move the wire harness and battery cable down below the radiator bracket. This allows the radiator and oil cooler assembly to pass over the harness and cable during removal **[Figure 60-40-12]**.

Figure 60-40-13

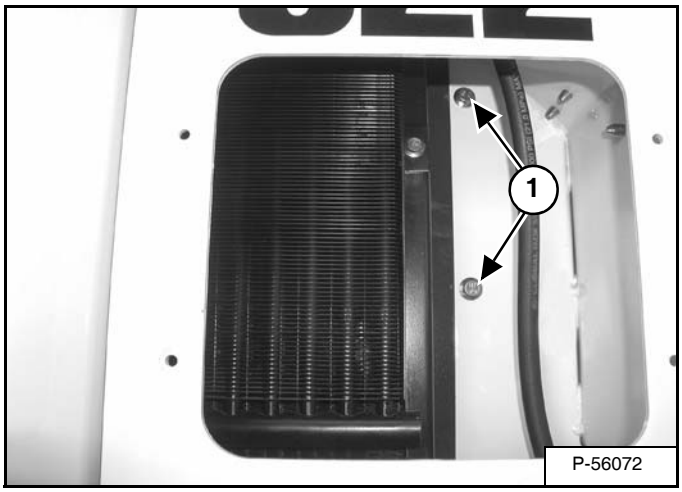


Remove the screws (Item 1) and grill (Item 2) **[Figure 60-40-13]**.

Remove the grill.

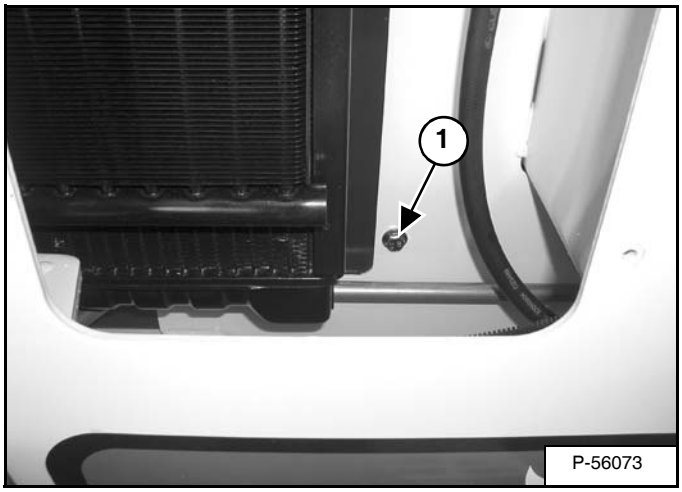
NOTE: Use a magnet or pick to prevent the grill from dropping and being scratched or damaged.

Figure 60-40-14



Remove the top bolts (Item 1) **[Figure 60-40-14]** mounting the radiator to the frame.

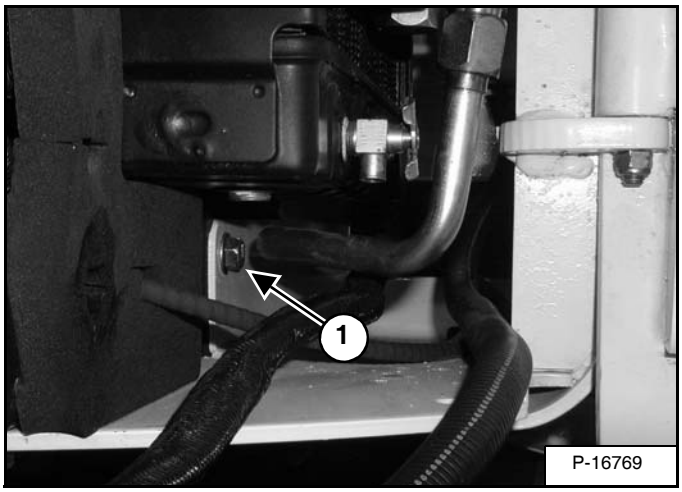
Figure 60-40-15



Remove the bottom bolt (Item 1) **[Figure 60-40-15]** mounting the radiator to the frame.

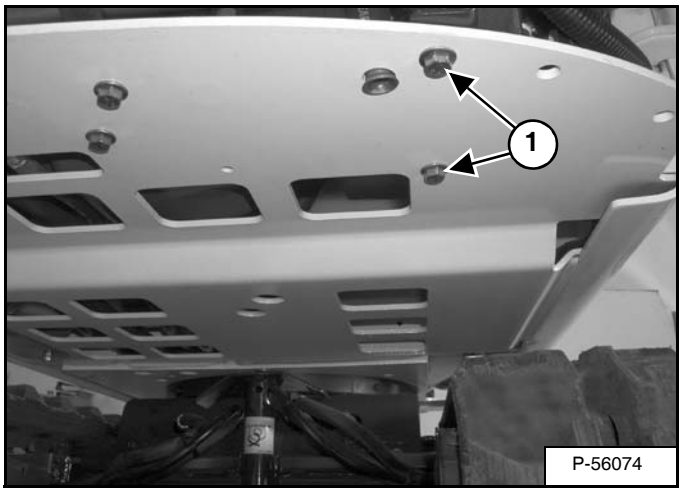
Removal And Installation (Cont'd)

Figure 60-40-16



Remove the bottom bolt (Item 1) **[Figure 60-40-16]** mounting the radiator to the frame.

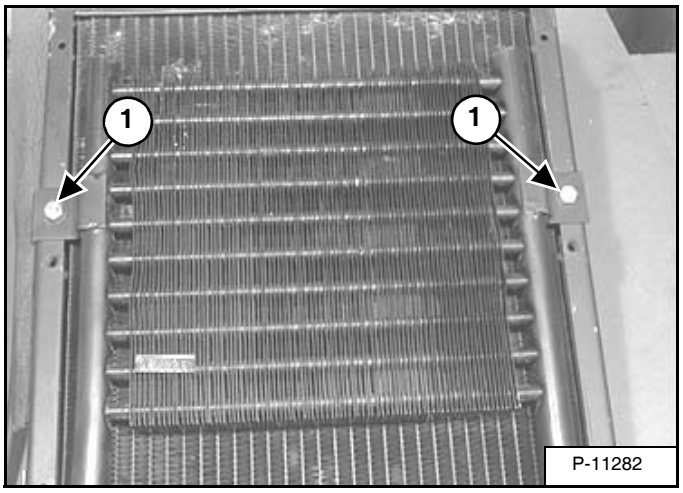
Figure 60-40-17



Remove the bolts (Item 1) **[Figure 60-40-17]** on the underside of the upperstructure.

Slide the radiator and oil cooler assembly out the back of the Excavator.

Figure 60-40-18



Remove the bolts (Item 1) **[Figure 60-40-18]** from the oil cooler.

Remove the oil cooler from the radiator.


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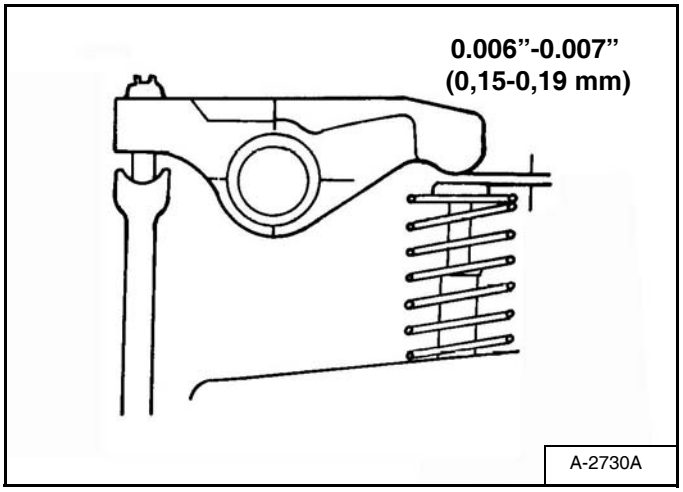
ENGINE COMPONENTS AND TESTING (S/N 223911001 - 223911621, S/N 224011001 - 224013374)

Valve Clearance Adjustment

Adjust the valve clearance with the engine stopped and cold.

Remove the valve cover.

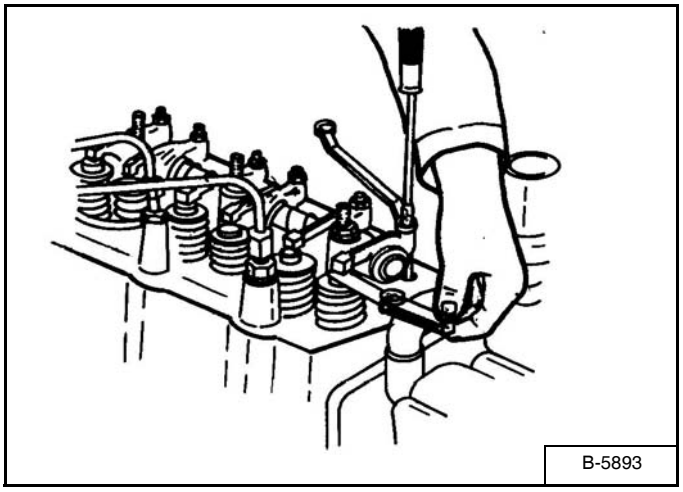
Figure 60-50-1



The correct valve clearance is 0.006-0.007 inch (0,15-0,19 mm) **[Figure 60-50-1]**.

Make sure the piston is at T.D.C. when making the adjustment for the valves of the particular cylinder.

Figure 60-50-2



Put the correct size feeler gauge between the rocker arm and valve stem. Turn the adjustment bolt until the clearance is correct **[Figure 60-50-2]**.

Engine Compression Checking

The tools listed will be needed to do the following procedure:

OEM1074 - Engine Compression Kit

The engine must be at operating temperature.

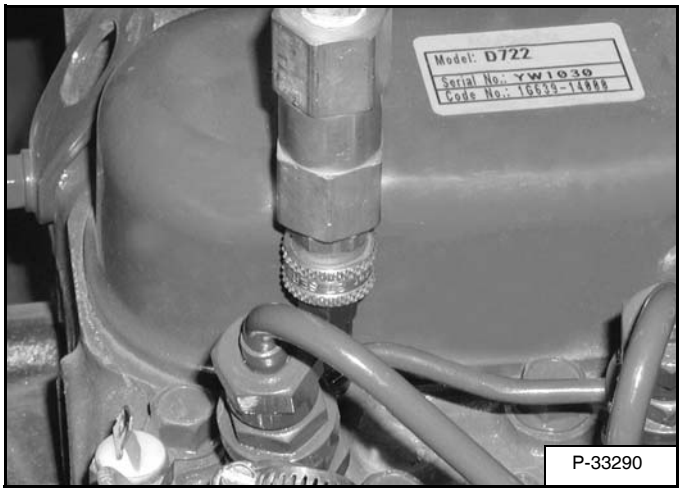
Remove the glow plugs from the engine. (See Glow Plug Removal And Installation on Page 60-50-9.)

Figure 60-50-3



Install the compression adapter into the glow plug ports in the cylinder head **[Figure 60-50-3]**.

Figure 60-50-4



Connect the compression gauge **[Figure 60-50-4]**.

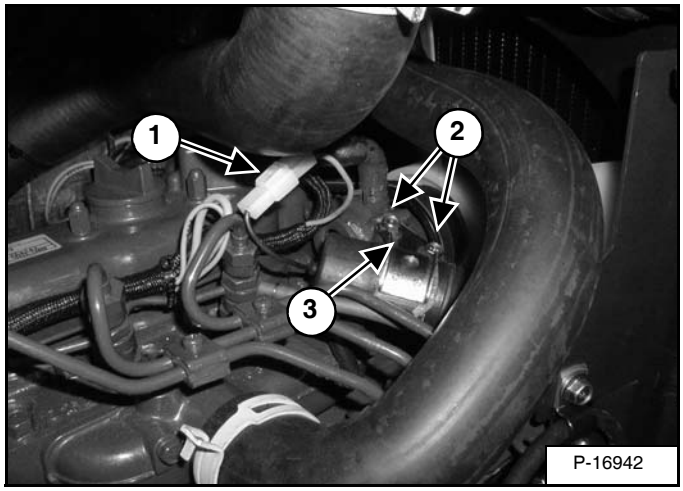
Turn the engine with the starter at 200 to 300 RPM. Run the test for each cylinder two times for 5-10 seconds.

Engine Compression Checking (Cont'd)

The compression of the Kubota D722-B(E) is 412-469 PSI (28-32 Bar) with the allowable limit of 327 PSI (23 Bar) and no more than 10% difference between cylinders.

Fuel Shut-Off Solenoid Removal And Installation

Figure 60-50-5



Disconnect the wire from the solenoid (Item 1) **[Figure 60-50-5]**.

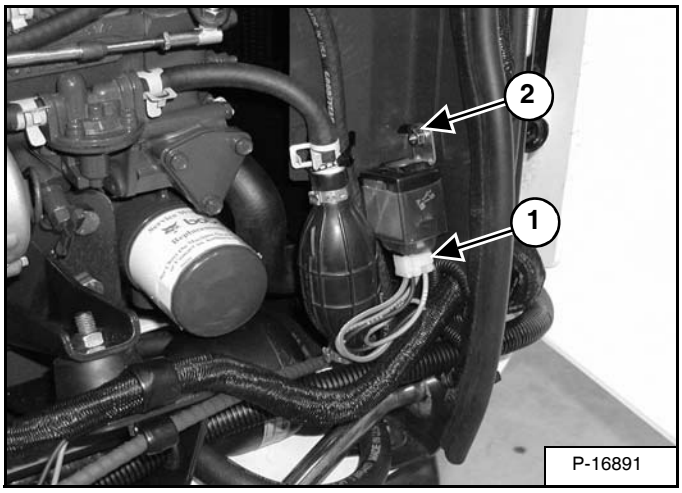
Remove the solenoid mounting bolts (Item 2) **[Figure 60-50-5]**.

Remove the solenoid (Item 3) **[Figure 60-50-5]**.

Fuel Shut-Off Timer Removal And Installation

The fuel shut-off timers function is to provide pull in current to the fuel solenoid for only a short duration. This provides longer fuel solenoid service life and also allows for more starter cranking power.

Figure 60-50-6



Disconnect the wire harness (Item 1) **[Figure 60-50-6]** from the timer module **[Figure 60-50-6]**.

Remove the nut (Item 2) **[Figure 60-50-6]**.

Remove the fuel shut-off timer.

Fuel Injection Pump Check

The injection pump contains parts which have a very close tolerance and its operation has a direct effect on the performance of the engine.

⚠ WARNING

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-2072-0496

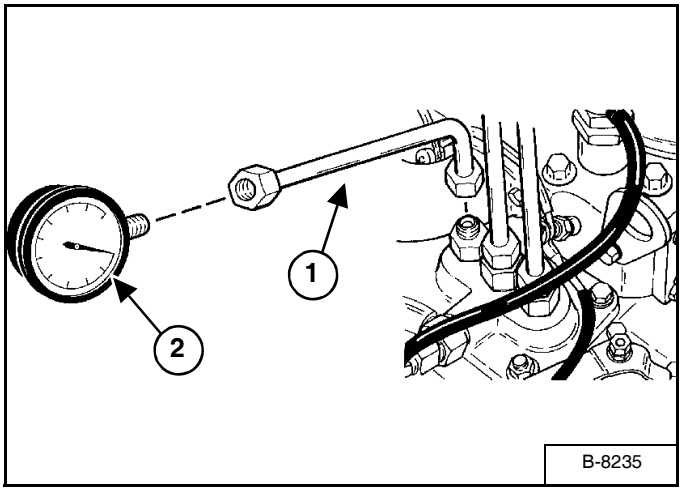
The tools listed will be needed to do the following procedure:

MEL1237 - Adapter Fuel Line
MEL1173-1 - Pressure Gauge

To check the discharge pressure at the fuel injection pump, use the following procedure:

Disconnect a high pressure fuel line from the injection pump. Loosen the other end of the same fuel line so it can be turned away from the fitting.

Figure 60-50-7



Connect the adapter fuel line (Item 1) to the fitting and connect the pressure gauge (Item 2) **[Figure 60-50-7]**.

Turn the flywheel by hand to increase the pressure. If the pressure can not reach the allowable limit, replace the injection pump assembly.

Fuel Tightness of Pump Element

Allowable Limit	2133 PSI (147 Bar)

Measure the time needed to decrease the pressure from 2133 PSI to 1990 PSI (147 to 137 Bar). If the measurement is less than the allowable limit, replace the delivery valve.

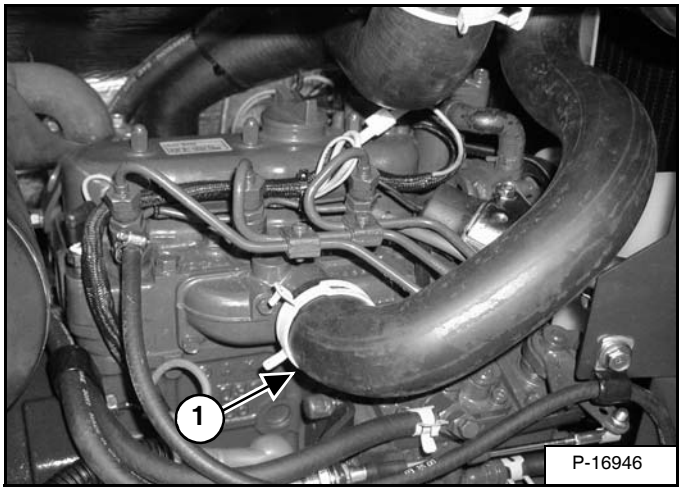
Fuel Tightness of Delivery Valve

Allowable Limit	5 seconds

Fuel Injection Pump Removal And Installation

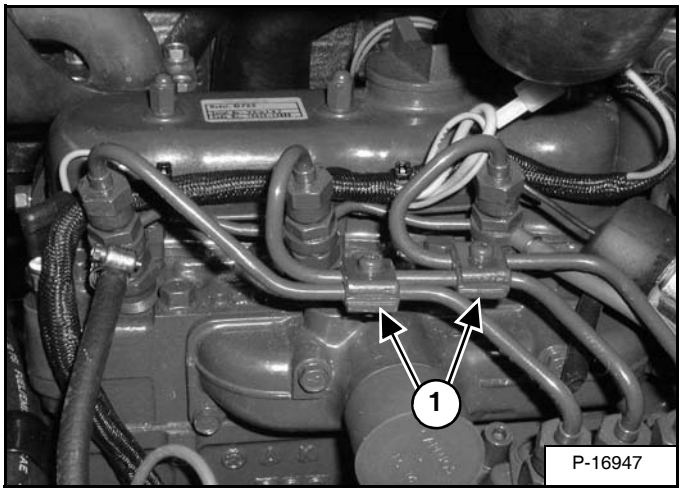
Clean around the injection pump.

Figure 60-50-8



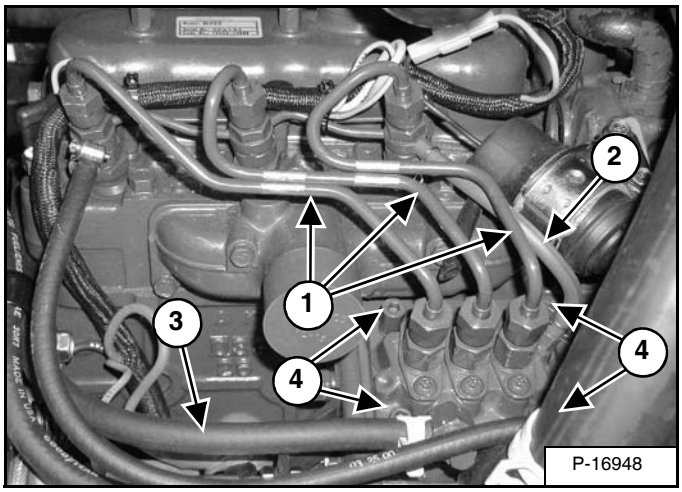
Remove the air intake hose (Item 1) **[Figure 60-50-8]** and cap.

Figure 60-50-9



Remove the fuel line clamps (Item 1) **[Figure 60-50-9]**.

Figure 60-50-10



Disconnect the high pressure lines (Item 1) **[Figure 60-50-10]** from the fuel injector and fuel injection pump.

Disconnect the fuel return hose (Item 2) and the fuel feed hose (Item 3) **[Figure 60-50-10]**.

Remove the four injection pump mounting bolts (Item 4) **[Figure 60-50-10]**.

Installation: Tighten the nuts to 17-20 ft.-lb. (23-27 N•m) torque.

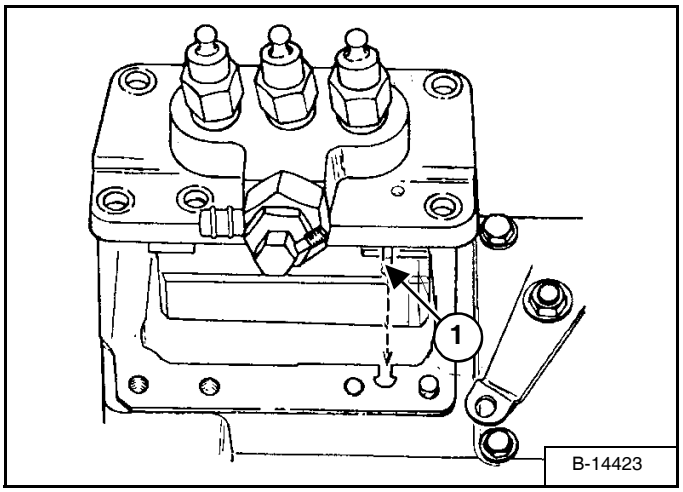
Fuel Injection Pump Removal And Installation (Cont'd)

IMPORTANT

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

I-2029-0289

Figure 60-50-11



Align the pin (Item 1) **[Figure 60-50-11]** in the control rack with the slot in the engine block.

Remove the injection pump.

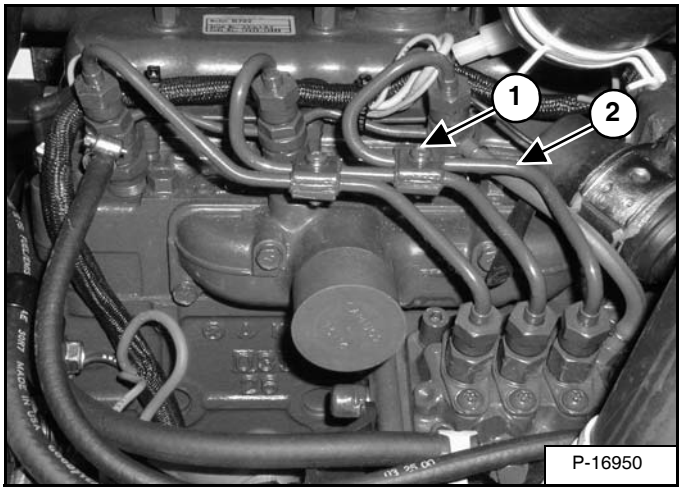
Installation: When the injection pump is installed, make sure the pin (Item 1) **[Figure 60-50-11]** on the control rack is correctly installed on the fork lever. If the slot is not installed correctly, the engine will run over maximum speed and serious damage can result.

NOTE: Make sure the same number shims are installed under the injection pump. The shims are used for engine timing.

Fuel Injection Pump Timing

Timing the injection pump is done by changing the number of shims between the injection pump and the injection pump mounting surface.

Figure 60-50-12



Remove the fuel line clamp (Item 1) **[Figure 60-50-12]**.

Remove the number one cylinder high pressure line (Item 2) **[Figure 60-50-12]** from the injection pump.

Remove the exhaust extension tube. (See Removal And Installation on Page 60-20-1.)

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.

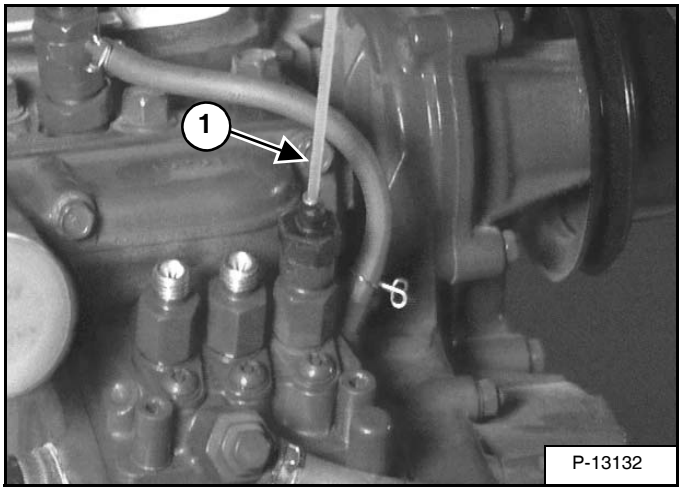
I-2028-0289

Turn the fuel supply lever to the ON position. Install a short plastic tube in the fitting of the number one cylinder port. Point the tube vertical.

Turn the engine by hand clockwise until fuel flows out of the injection pumps number 1 cylinder nozzle. (Install a tool on the crankshaft at the front of the engine to turn the engine).

Fuel Injection Pump Timing (Cont'd)

Figure 60-50-13



Install a short plastic tube (Item 1) **[Figure 60-50-13]** in the number one cylinder port of the injection pump. The tube should fit tight in the port and point upward.

NOTE: The fuel must be in the tube before attempting timing.

Move the fuel lever on the injection pump to full fuel position (or full throttle).

Turn the flywheel clockwise slowly until the start of fuel rise in the plastic tube (Item 1) **[Figure 60-50-13]**.

At this point look at the timing mark (located on the flywheel) for proper alignment (Item 1) **[Figure 60-50-13]**. When the timing mark is aligned as shown the timing is correct for the injection pump, which is 20-22° B.T.D.C.

Figure 60-50-14

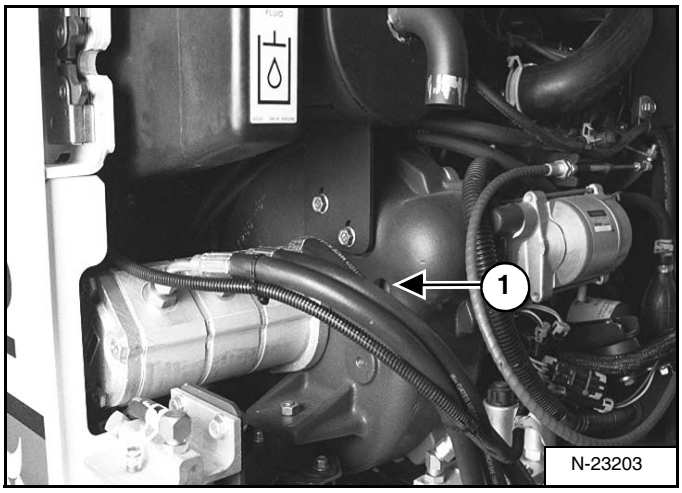
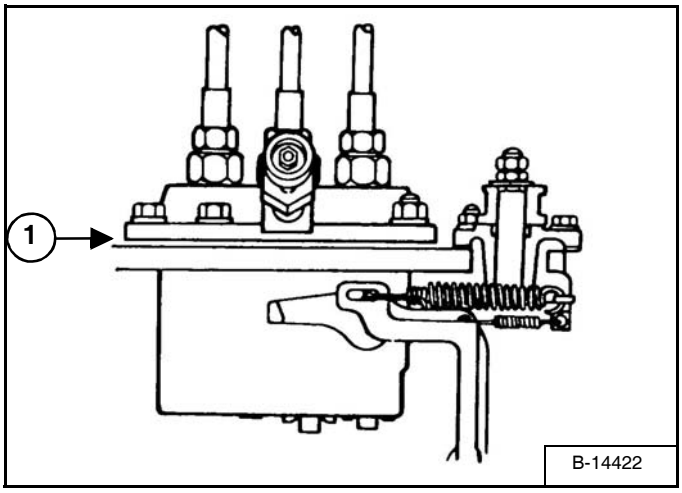


Figure 60-50-15



The correct engine timing for all Kubota D722-B(E) engines is 20-22° B.T.D.C. Add or subtract shims (Item 1) **[Figure 60-50-14]** to time the engine to 20-22° B.T.D.C. The engine is correctly timed when the 20-22° B.T.D.C. mark on the flywheel is aligned with the notch in the timing hole **[Figure 60-50-15]**.

NOTE: Adding or reducing the shim thickness by 0.05 mm retards or advances the injection timing by approximately 0.5°.

Some problems caused by faulty injector nozzles:

- The engine is hard to start or will not start.
- Rough engine operation at idle.
- The engine will not have full power.
- The engine exhaust smoke is black, white or blue.

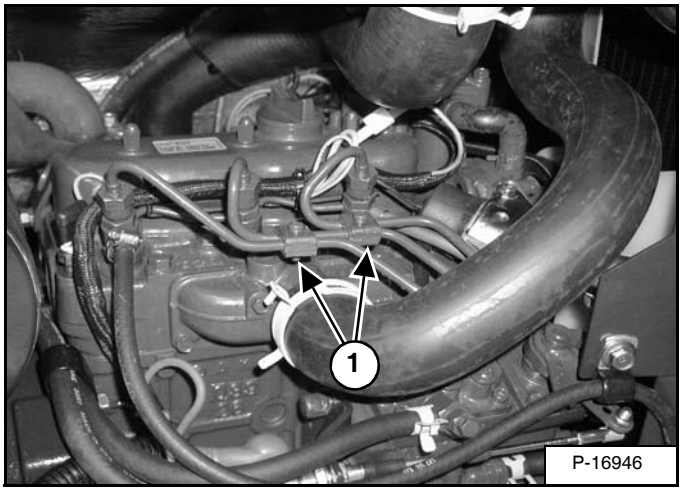
Fuel Injector Removal And Installation

IMPORTANT

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

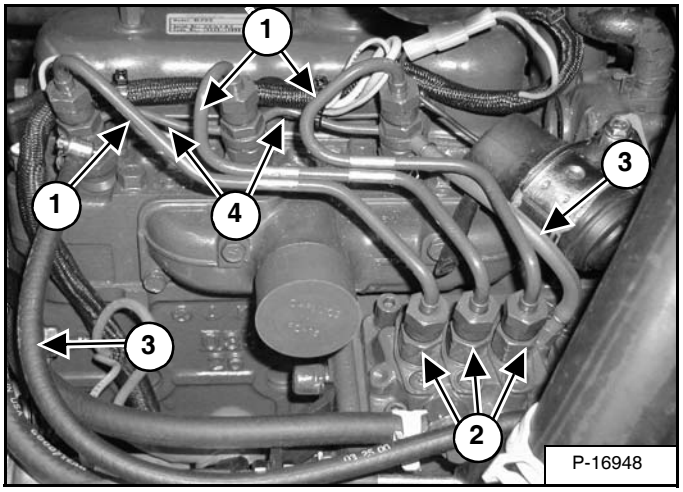
I-2029-0289

Figure 60-50-16



Remove the high pressure fuel line clamps (Item 1) **[Figure 60-50-16]**.

Figure 60-50-17



Disconnect the high pressure fuel lines from the fuel injectors (Item 1) **[Figure 60-50-17]**.

Disconnect the fuel lines (Item 2) **[Figure 60-50-17]** from the injection pump.

Remove the high pressure fuel lines.

Disconnect the return fuel hoses (Item 3) **[Figure 60-50-17]**.

Remove the retainer nut from the top of the fuel injectors.

Remove the fuel return pipe (Item 4) **[Figure 60-50-17]**.

Loosen the injector nozzle.

Installation: Tighten the injector nozzle to 36-51 ft.-lbs. (40-69 Nm) torque.

Remove the injector nozzle from the cylinder head.

NOTE: Be sure to replace the copper washer and nozzle cap anytime new or reconditioned fuel injectors are installed.

⚠ WARNING

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-2072-0496

Fuel Injector Checking

IMPORTANT

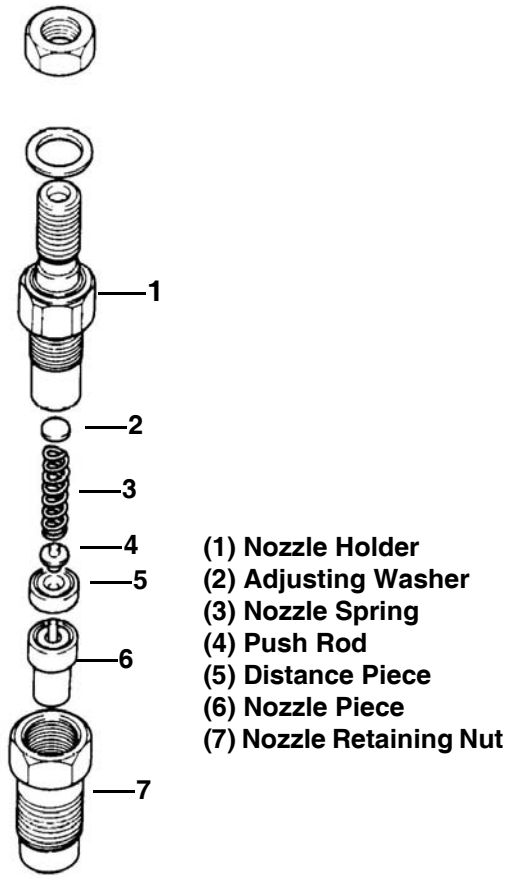
Do not disassemble or test the fuel injector nozzles unless you have the correct service and testing tools.

I-2027-0284

The tool listed will be needed to do the following procedure:

MEL10018 - Injector Nozzle Tester

Figure 60-50-18

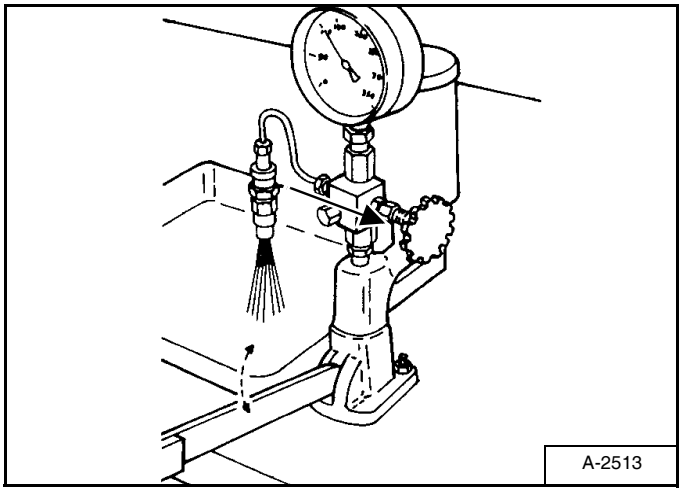


The nozzle release pressure can be adjusted by adding or removing washer(s) (Item 2) from the top of the nozzle spring (Item 3) **[Figure 60-50-18]**.

Each spacer will change the release pressure by about 142 PSI (9.8 Bar).

Fuel Injection Pressure.	1991-2133 PSI (137-147 Bar)

Figure 60-50-19



Assemble the injector nozzle. Connect the nozzle to the tester with the nozzle down**[Figure 60-50-19]**.

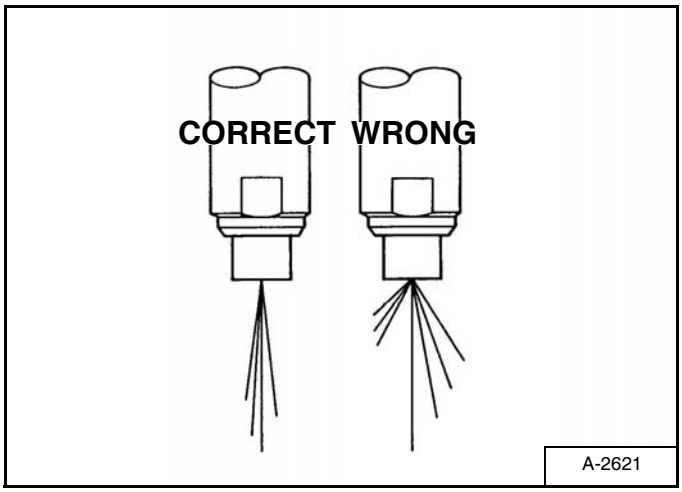
Operate the hand lever at a slow rate and record the opening pressure. If the pressure is not correct, disassemble the nozzle and add or remove the spacer (Item 2) **[Figure 60-50-18]** as needed.

When the injector nozzle is assembled, tighten the nozzle body to 36-51 ft.-lbs. (40-69 Nm) torque.

Check for inside leakage. Operate the hand lever until the pressure 1850 PSI (128 Bar). Keep the nozzle under this pressure for 10 seconds, check to see if fuel leaks from the nozzle. If fuel leaks, replace the nozzle.

Fuel Injector Checking (Cont'd)

Figure 60-50-20



Check that the spray pattern is correct **[Figure 60-50-20]**:

1. Fuel does not come out the side of the nozzle.
2. Drops of fuel are not present at the nozzle.
3. The injector has an even flow coming from the nozzle.

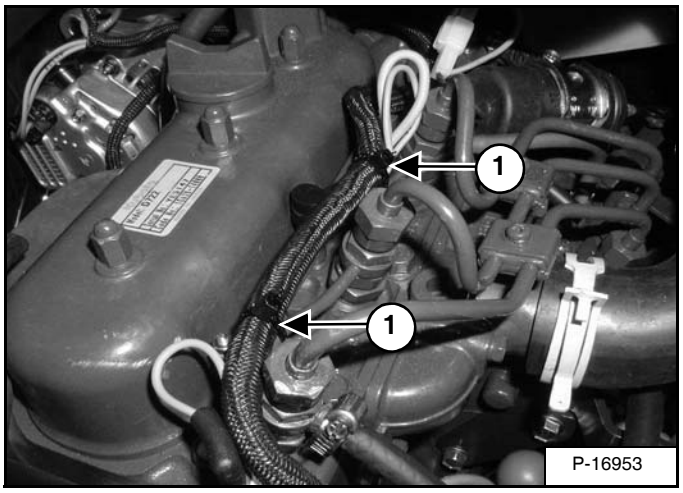
Glow Plug Removal And Installation

IMPORTANT

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

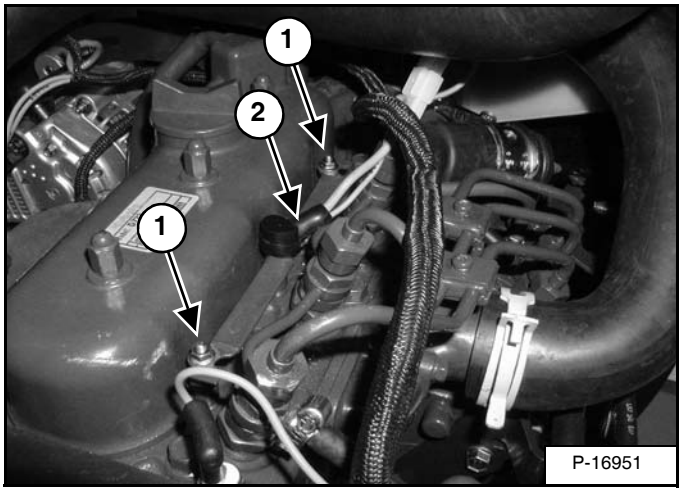
I-2029-0289

Figure 60-50-21



Remove the tie straps (Item 1) **[Figure 60-50-21]**.

Figure 60-50-22

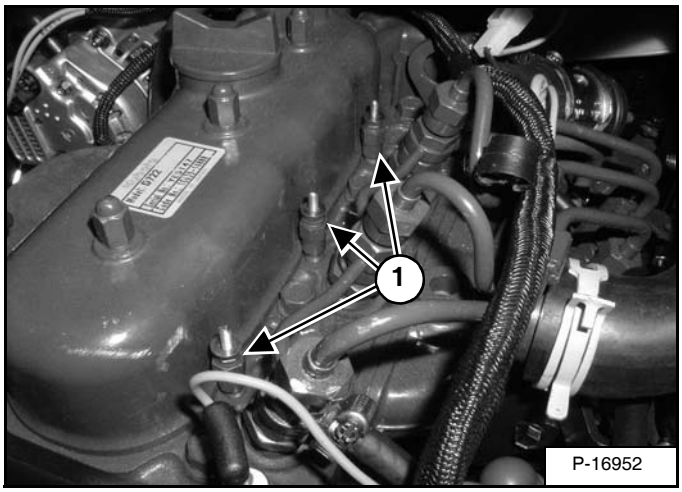


Remove the nuts (Item 1) **[Figure 60-50-22]**.

Remove the glow plug lead (Item 2) **[Figure 60-50-22]** and nut.

Glow Plug Removal And Installation (Cont'd)

Figure 60-50-23

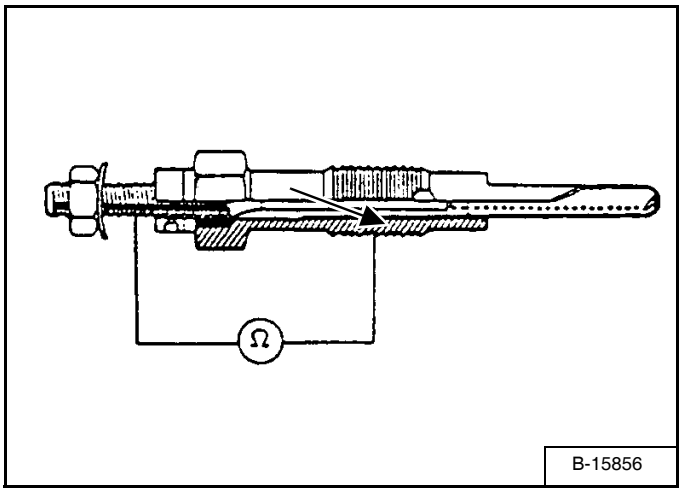


Remove the glow plugs (Item 1) **[Figure 60-50-23]** from the cylinder head.

Installation: Tighten the glow plugs to 6-11 ft.-lb. (8-15 N•m) torque.

Glow Plug Checking

Figure 60-50-24



Connect an ohmmeter to the terminal end of the glow plug, touch the other lead from the ohmmeter to the heating end of the glow plug **[Figure 60-50-24]**.

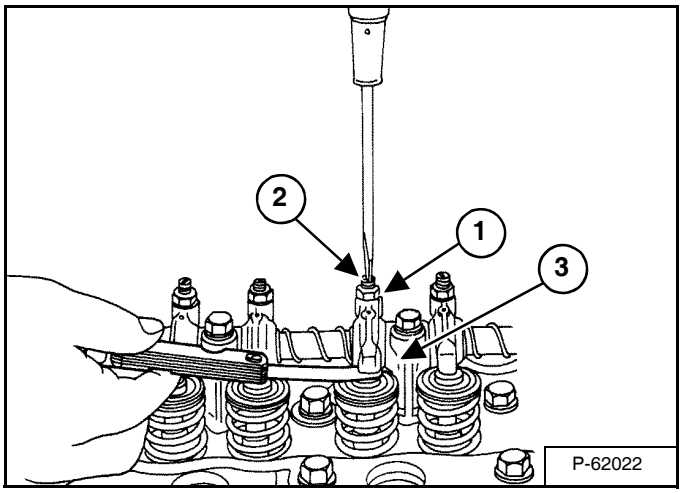
The reading will be approximately 0.9 OHMS. If the resistance is zero OHMS, the glow plug has a short circuit. If the resistance is infinite, the coil of the glow plug is broken.

ENGINE COMPONENTS AND TESTING (S/N 223911622 & ABOVE, S/N 224013375 & ABOVE)

Valve Clearance Adjustment

NOTE: The valve clearance must be checked and adjusted when the engine is cold.

Figure 60-51-1



Remove the cylinder head cover and the glow plugs.

Adjust the valve clearance as follows:

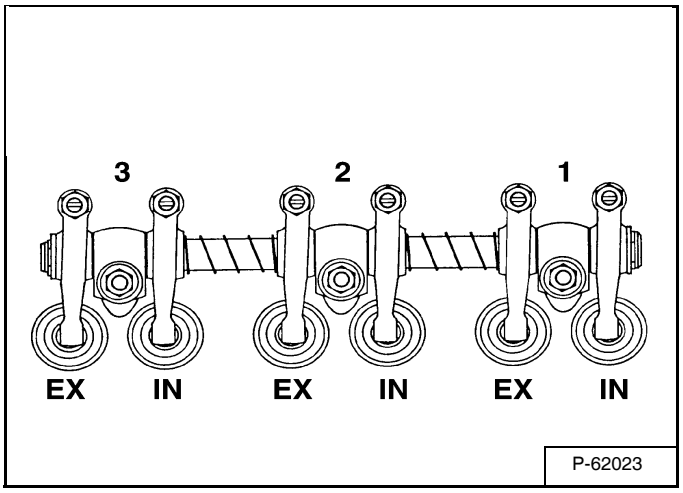
Loosen the lock nut (Item 1) **[Figure 60-51-1]**.

Turn the adjustment screw (Item 2) **[Figure 60-51-1]** until the correct clearance is obtained.

NOTE: The clearance is measured between the rocker arm and valve stem tip (Item 3) [Figure 60-51-1].

If adjustments are necessary, tighten lock nut before moving on to the next rocker arm.

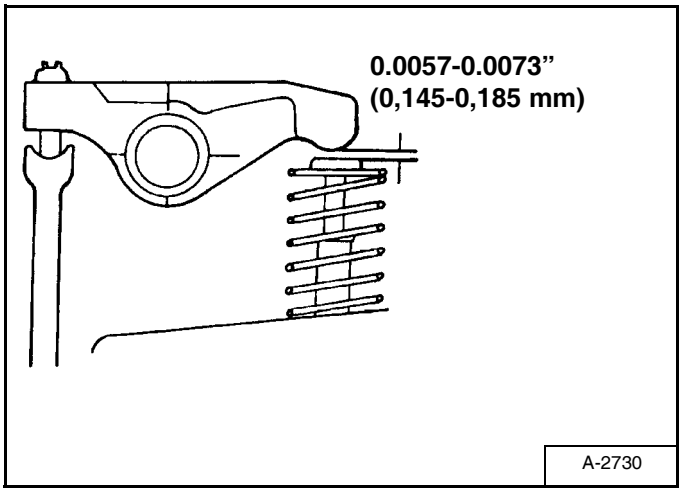
Figure 60-51-2



With No. 1 piston at TDC (compression) both the intake and exhaust valves are up. Set both No. 1 valves, No. 2 exhaust valve and No. 3 intake valve. **[Figure 60-51-2]**.

Rotate the flywheel 360°, No. 1 (overlap position). Set No. 2 intake valve and No. 3 exhaust valve. **[Figure 60-51-2]**.

Figure 60-51-3

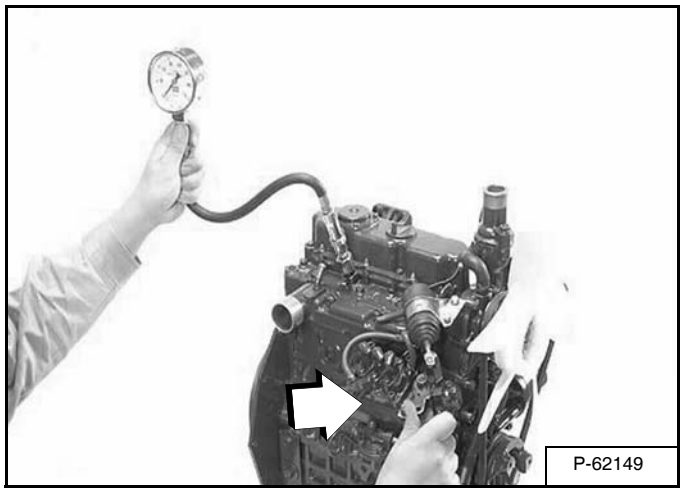


Make sure the piston is at TDC when adjusting the clearance at the valves. The correct clearance is 0.0057-0.0073 inch (0,145-0,185 mm) cold clearance **[Figure 60-51-3]**.

ENGINE COMPONENTS AND TESTING (S/N 223911622 & ABOVE, S/N 224013375 & ABOVE) (CONT'D)

Engine Compression Checking

Figure 60-51-4



The tool listed will be needed to do the following procedure:

MEL10630 - Engine Compression Test Kit

Warm the engine.

Remove the glow plugs, muffler and air cleaner from the engine. (If testing through glow plug hole.)

Remove the air cleaner, muffler and all injector nozzles. (If testing through injector nozzle hole.)

Install the compression adapter in the cylinder head.

Connect the compression gauge to the adapter **[Figure 60-51-4]**.

Ensure the speed control lever is set at the low idle setting.

Hold fuel shut off lever to no fuel. (shut-off) See arrow, **[Figure 60-51-4]**. Shut off solenoid does not need to be removed.

Turn the engine with the starter at 200 to 300 RPM. Run the test for each cylinder more than twice for 5 to 10 seconds each time and take the average reading. Make sure you are using a fully charged battery.

The correct compression for the engine is 412-469 PSI (28-32 bar) with no more than 10% difference between the cylinders.

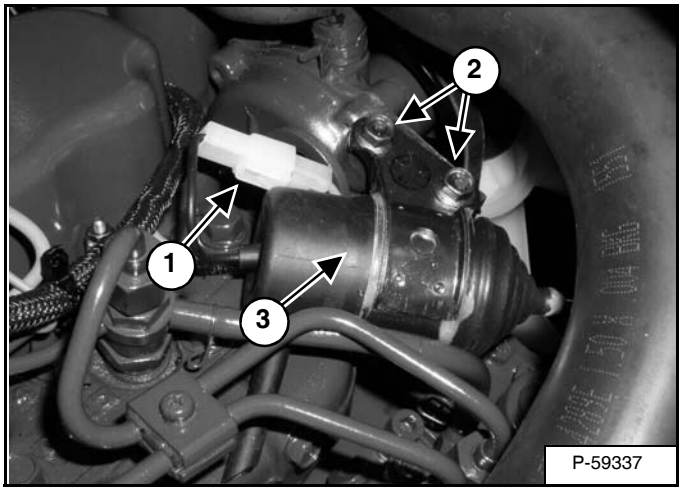
If the pressures are not within 10% of each other, apply a small amount of oil in the cylinders and retest.

If the pressures increase after applying oil, check cylinder walls and piston rings.

If the pressures do not increase after applying oil, check top clearance, valve clearance and cylinder head.

Fuel Shut-Off Solenoid Removal And Installation

Figure 60-51-5



Disconnect the wire from the solenoid (Item 1) **[Figure 60-51-5]**.

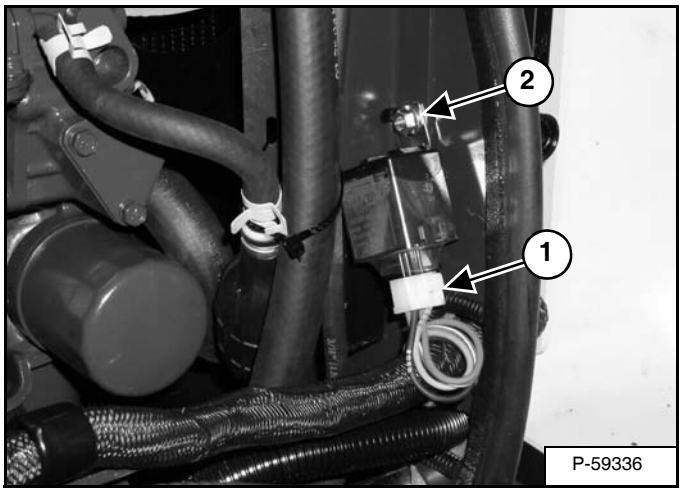
Remove the solenoid mounting bolts (Item 2) **[Figure 60-51-5]**.

Remove the solenoid (Item 3) **[Figure 60-51-5]**.

Fuel Shut-Off Timer Removal And Installation

The fuel shut-off timers function is to provide pull in current to the fuel solenoid for only a short duration. This provides longer fuel solenoid service life and also allows for more starter cranking power.

Figure 60-51-6



Disconnect the wire harness (Item 1) from the timer module **[Figure 60-51-6]**.

Remove the nut (Item 2) **[Figure 60-51-6]**.

Remove the fuel shut-off timer.

Fuel Injection Pump Check

NOTE: Never try to disassemble the injection pump assembly. For repairs, you should contact a Kubota-authorized pump service shop.

Remove the air cleaner housing. (See Removal And Installation on Page 60-30-1.)

Remove the engine stop solenoid.

The tools listed will be needed to do the following procedure:

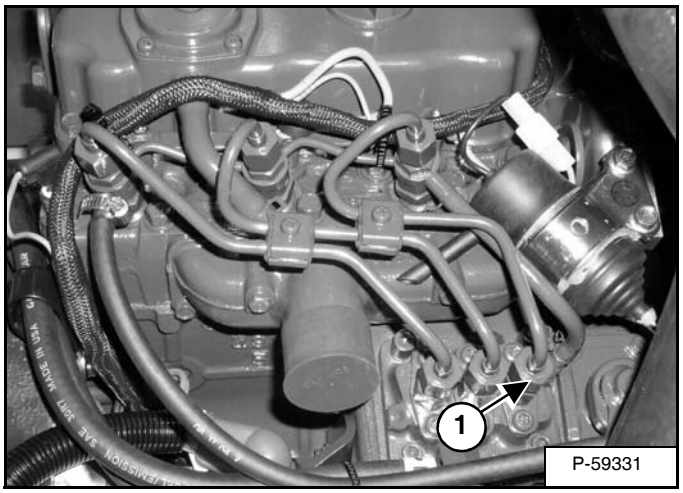
MEL1237 - Adapter Fuel Line
MEL1173-1 - Pressure Gauge

⚠ WARNING

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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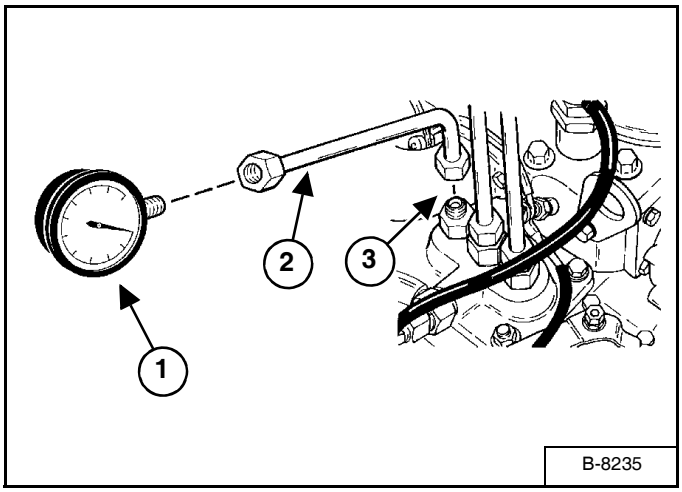
Figure 60-51-7



To check the initial discharge pressure, remove a high pressure tubeline (Item 1) **[Figure 60-51-7]** from the fuel injection pump.

Loosen the other end of the tubeline at the injector, so that the tubeline can be turned away from the fitting.

Figure 60-51-8



Connect a pressure gauge (Item 1) to the long leg of the test tubeline (Item 2) **[Figure 60-51-8]** and tighten.

Connect the short leg of the tubeline to the fitting at the fuel injection pump (Item 3) **[Figure 60-51-8]**.

Set the speed control lever to the maximum engine speed position to allow full fuel delivery.

Fuel Tighteness of Pump Element

With the starter, rotate the engine to increase the pressure to 1991 PSI (137 bar).

If the pressure cannot be reached, replace the pump with a new one or send to a Kubota-authorized pump service shop.

Fuel Tightness of Delivery Valve

Manually turn the flywheel to raise the pressure to approx. 1991 PSI (137 bar). Now turn the flywheel back about 1/2 turn (to keep the plunger free), and clock the time taken for the pressure to drop from 1991-1849 PSI (137-127 bar) .

The pressure should hold at 1991 PSI (137 bar), for at least 5 seconds or more.

If the time is less than the allowable limit, replace the pump with a new one, or send to a Kubota-authorized pump service shop.

Fuel Injection Pump Removal And Installation

IMPORTANT

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

I-2028-0289

Clean the injection pump and area around it with a cleaning solvent or steam cleaning.

IMPORTANT

Never steam clean or put cold water on an injection pump while the engine is running or while it is hot. If you do it will cause serious damage to the injection pump.

I-2135-0997

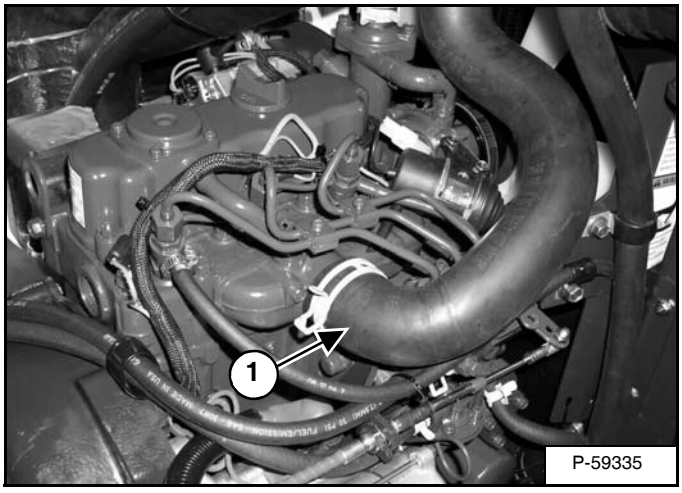
IMPORTANT

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

I-2029-0289

Clean around the injection pump.

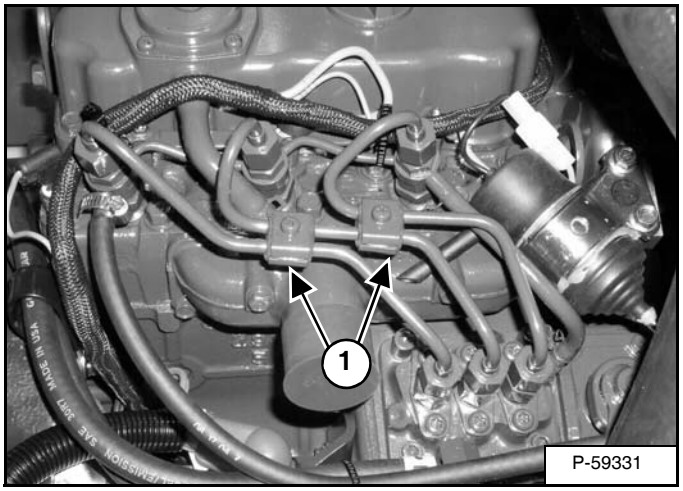
Figure 60-51-9



Remove the air intake hose (Item 1) **[Figure 60-51-9]** and cap.

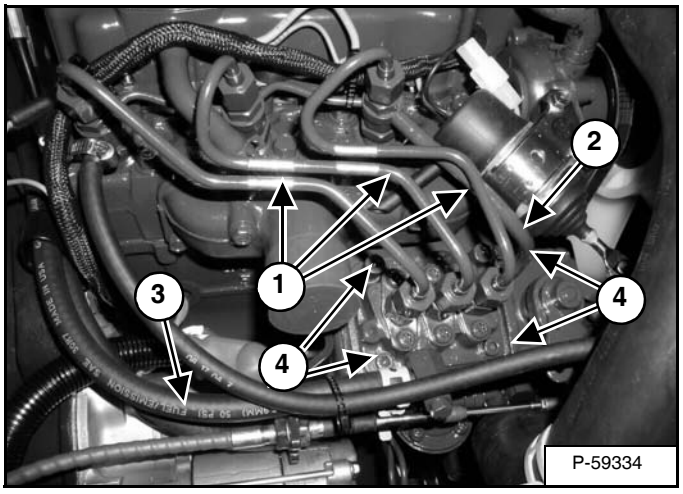
Fuel Injection Pump Removal And Installation (Cont'd)

Figure 60-51-10



Remove the fuel line clamps (Item 1) **[Figure 60-51-10]**.

Figure 60-51-11



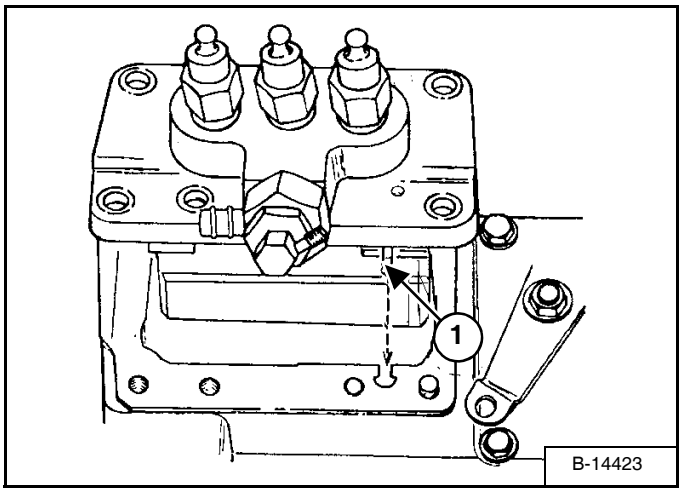
Disconnect the high pressure lines (Item 1) **[Figure 60-51-11]** from the fuel injector and fuel injection pump.

Disconnect the fuel return hose (Item 2) and the fuel feed hose (Item 3) **[Figure 60-51-11]**.

Remove the four injection pump mounting bolts (Item 4) **[Figure 60-51-11]**.

Installation: Tighten the pipe retaining nuts to 18-25 ft.-lb. (25-34 N•m) torque.

Figure 60-51-12



Align the pin (Item 1) **[Figure 60-51-12]** in the control rack with the slot in the engine block.

Remove the injection pump.

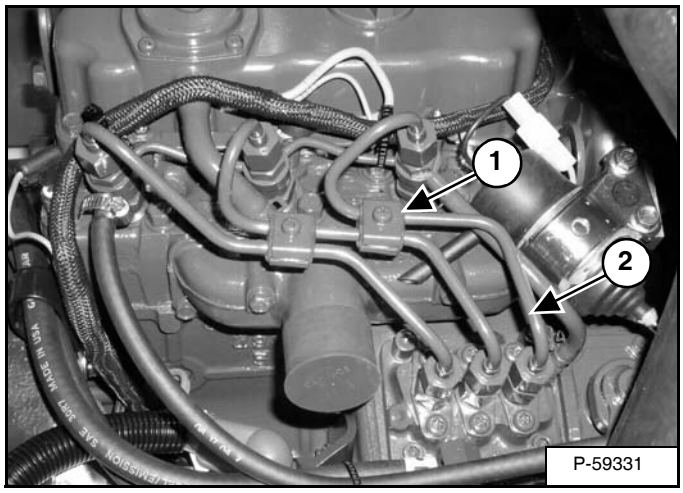
Installation: When the injection pump is installed, make sure the pin (Item 1) **[Figure 60-51-12]** on the control rack is correctly installed on the fork lever. If the slot is not installed correctly, the engine will run over maximum speed and serious damage can result.

NOTE: Make sure the same number shims are installed under the injection pump. The shims are used for engine timing.

Fuel Injection Pump Timing

Timing the injection pump is done by changing the number of shims between the injection pump and the injection pump mounting surface.

Figure 60-51-13



Remove the fuel line clamp (Item 1) **[Figure 60-51-13]**.

Remove the number one cylinder high pressure line (Item 2) **[Figure 60-51-13]** from the injection pump.

Remove the exhaust extension tube. (See Removal And Installation on Page 60-20-1.)

IMPORTANT

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

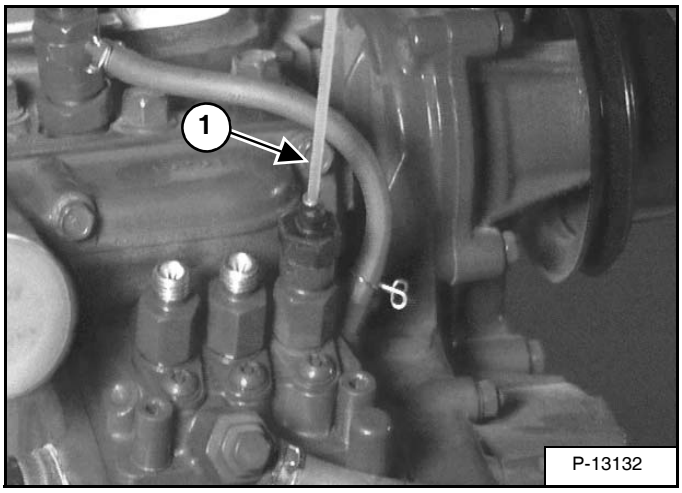
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IMPORTANT

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

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Figure 60-51-14



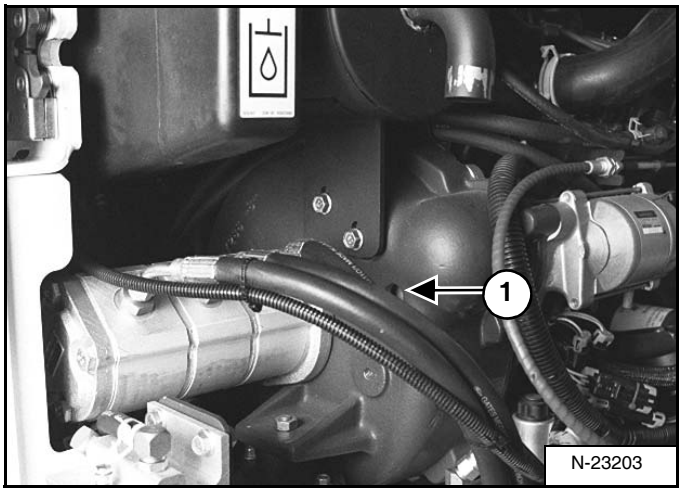
Install a short plastic tube (Item 1) **[Figure 60-51-14]** in the number one cylinder port of the injection pump. The tube should fit tight in the port and point upward.

NOTE: The fuel must be in the tube before attempting timing.

Move the fuel lever on the injection pump to full fuel position (or full throttle).

Turn the flywheel counterclockwise (facing the flywheel) slowly until the start of fuel rise in the plastic tube (Item 1) **[Figure 60-51-14]**.

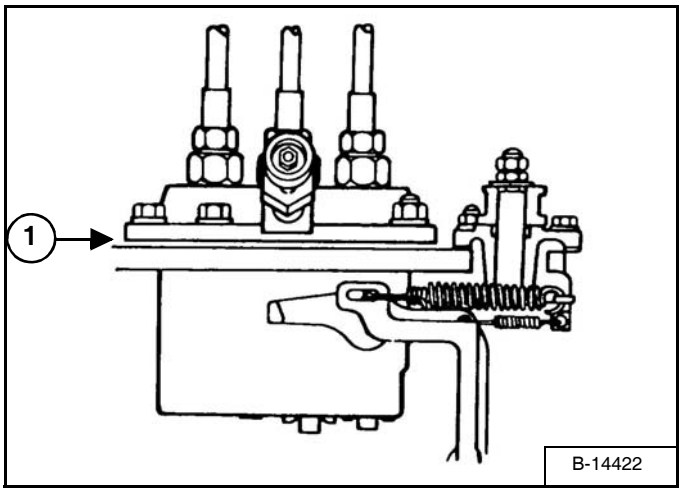
Figure 60-51-15



At this point look at the timing mark (located on the flywheel) for proper alignment (Item 1) **[Figure 60-51-15]**. When the timing mark is aligned as shown the timing is correct for the injection pump, which is 19-21° B.T.D.C.

Fuel Injection Pump Timing (Cont'd)

Figure 60-51-16



The correct engine timing for all Kubota D722-E2B engines is 19-21° B.T.D.C. Add or subtract shims (Item 1) **[Figure 60-51-16]** to time the engine to 19-21° B.T.D.C. The engine is correctly timed when the 19-21° B.T.D.C. mark on the flywheel is aligned with the notch in the timing hole **[Figure 60-51-16]**.

NOTE: Adding or reducing the shim thickness by 0.05 mm retards or advances the injection timing by approximately 0.5°.

Some problems caused by faulty injector nozzles:

- The engine is hard to start or will not start.
- Rough engine operation at idle.
- The engine will not have full power.
- The engine exhaust smoke is black, white or blue.

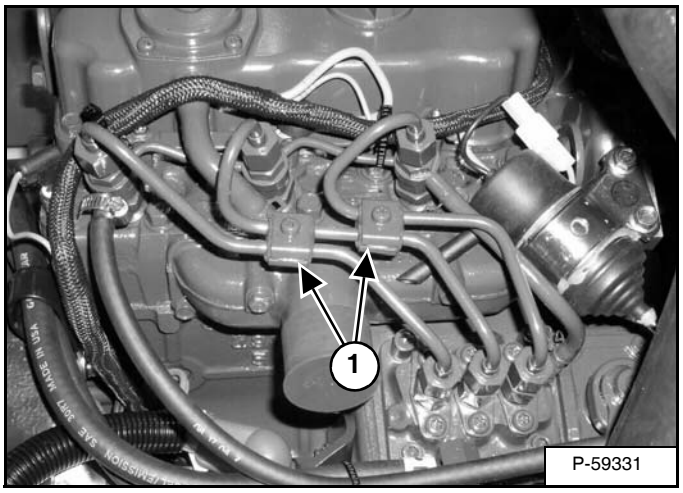
Fuel Injector Removal And Installation

IMPORTANT

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

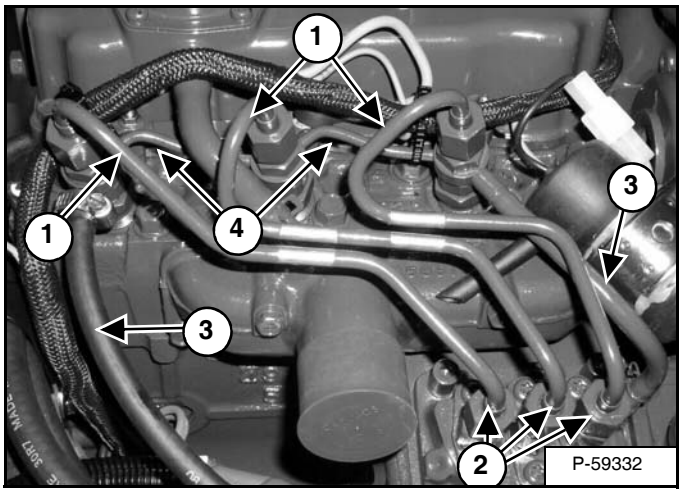
I-2029-0289

Figure 60-51-17



Remove the high pressure fuel line clamps (Item 1) **[Figure 60-51-17]**.

Figure 60-51-18



Disconnect the high pressure fuel lines from the fuel injectors (Item 1) **[Figure 60-51-18]**.

Disconnect the fuel lines (Item 2) **[Figure 60-51-18]** from the injection pump.

Fuel Injector Removal And Installation (Cont'd)

Remove the high pressure fuel lines.

Disconnect the return fuel hoses (Item 3) **[Figure 60-51-18]**.

Remove the retainer nut from the top of the fuel injectors.

Remove the fuel return pipe (Item 4) **[Figure 60-51-18]**.

Loosen the injector nozzle.

Installation: Tighten the injector nozzle to 36-51 ft.-lb. (49-69 N•m) torque.

Remove the injector nozzle from the cylinder head.

NOTE: Be sure to replace the copper washer and nozzle cap anytime new or reconditioned fuel injectors are installed.

⚠ WARNING

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-2072-0496

Fuel Injector Checking

IMPORTANT

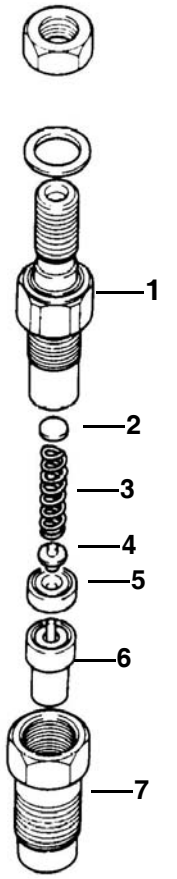
Do not disassemble or test the fuel injector nozzles unless you have the correct service and testing tools.

I-2027-0284

The tool listed will be needed to do the following procedure:

MEL10018 - Injector Nozzle Tester

Figure 60-51-19



(1) Nozzle Holder
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod
(5) Distance Piece
(6) Nozzle Piece
(7) Nozzle Retaining Nut

PI-09981

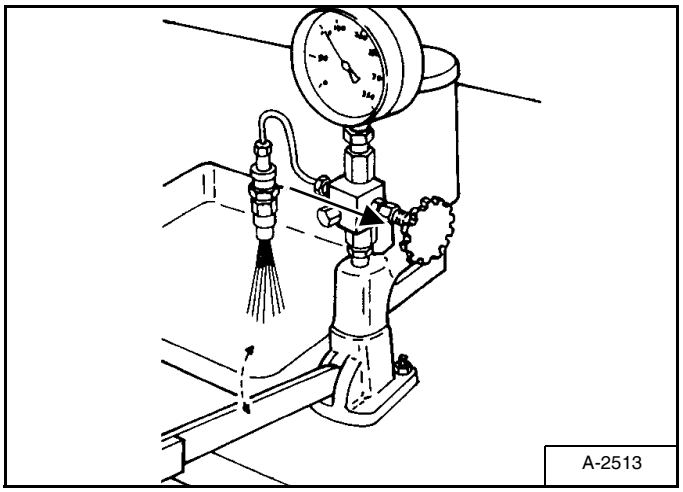
The nozzle release pressure can be adjusted by adding or removing washer(s) (Item 2) from the top of the nozzle spring (Item 3) **[Figure 60-51-19]**.

Fuel Injector Checking (Cont'd)

Each spacer will change the release pressure by about 34 PSI (2,3 bar).

Fuel Injection Pressure.	1991-2134 PSI (137-147 bar)

Figure 60-51-20



Assemble the injector nozzle. Connect the nozzle to the tester with the nozzle down **[Figure 60-51-20]**.

Operate the hand lever at a slow rate and record the opening pressure. If the pressure is not correct, disassemble the nozzle and add or remove the spacer (Item 2) **[Figure 60-51-19]** as needed.

NOTE: When assembling the injector nozzle, tighten the retainer nut (Item 1) [Figure 60-51-19] to 23.5-28.9 ft.-lb. (25,3-28,9 N•m) torque. Any higher torque will cause slow action of the valve.

When the injector nozzle is assembled, tighten the nozzle body to 36-51 ft.-lb. (49-69 N•m) torque.

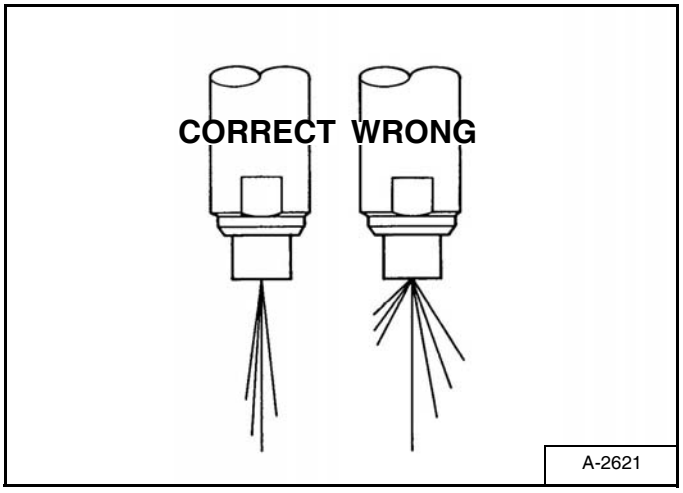
Check for inside leakage. Operate the hand lever until the pressure 1849 PSI (127 bar). Keep the nozzle under this pressure for 10 seconds, check to see if fuel leaks from the nozzle. If fuel leaks, replace the nozzle.

⚠ WARNING

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-2072-0496

Figure 60-51-21



Check that the spray pattern is correct **[Figure 60-51-21]**:

1. Fuel does not come out the side of the nozzle.
2. Drops of fuel are not present at the nozzle.
3. The injector has an even flow coming from the nozzle.

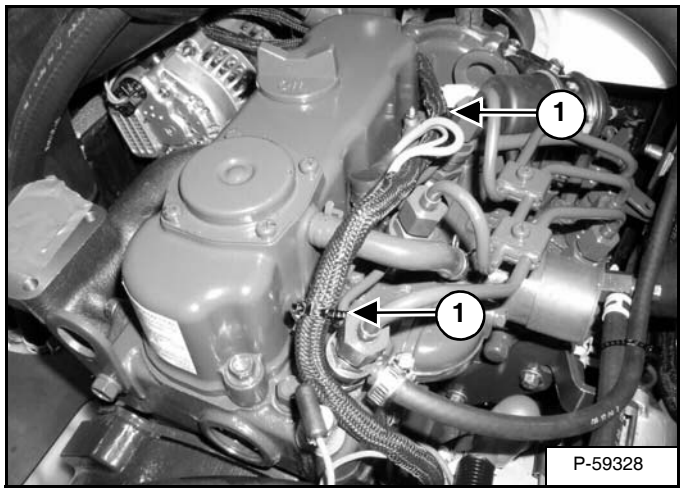
Glow Plug Removal And Installation

IMPORTANT

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

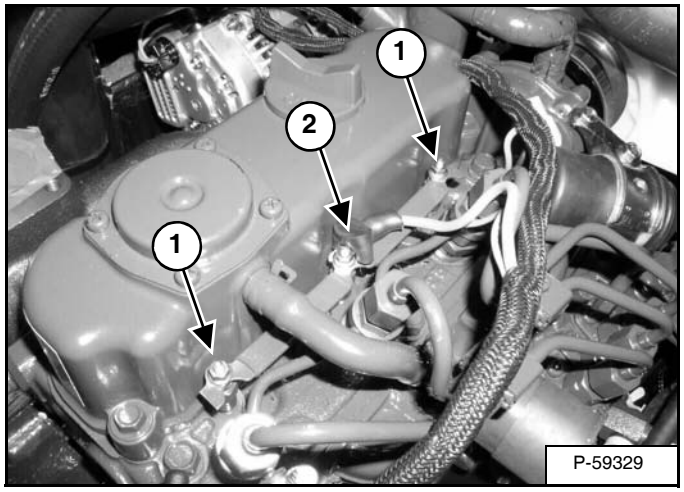
I-2029-0289

Figure 60-51-22



Remove the tie straps (Item 1) **[Figure 60-51-22]**.

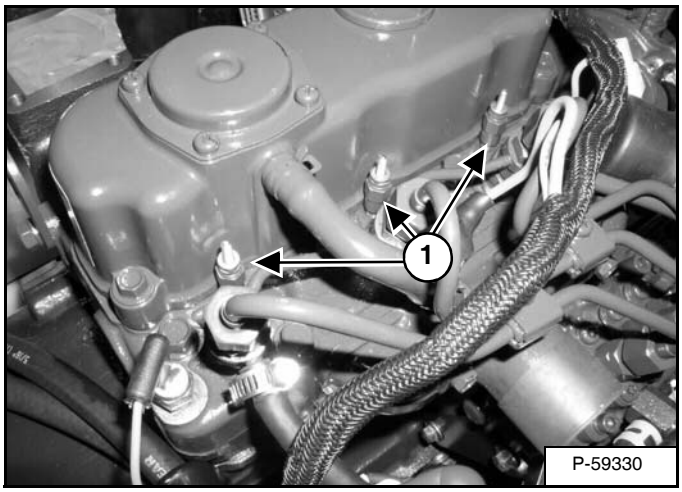
Figure 60-51-23



Remove the nuts (Item 1) **[Figure 60-51-23]**.

Remove the glow plug lead (Item 2) **[Figure 60-51-23]** and nut.

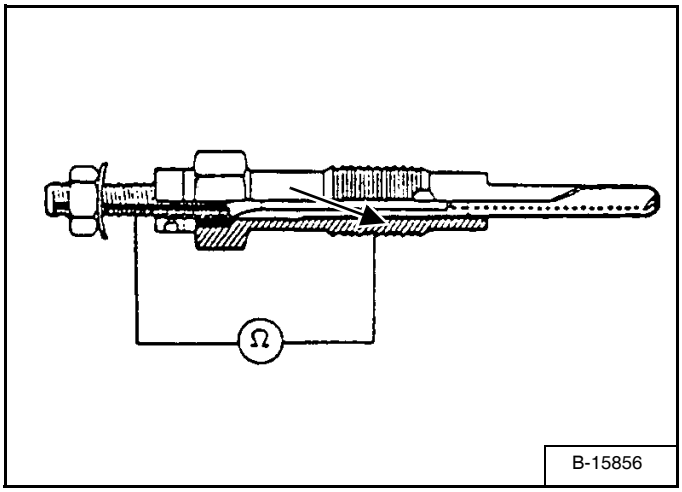
Figure 60-51-24



Remove the glow plugs (Item 1) **[Figure 60-51-24]** from the cylinder head.

Installation: Tighten the glow plugs to 6-11 ft.-lb. (8-15 N•m) torque.

Figure 60-51-25



Connect an ohmmeter to the terminal end of the glow plug, touch the other lead from the ohmmeter to the heating end of the glow plug **[Figure 60-51-25]**.

The reading will be approximately 0.9 ohm. If the resistance is zero ohm, the glow plug has a short circuit. If the resistance is infinite, the coil of the glow plug is broken.

ENGINE

Removal and Installation

Open the tailgate. (See Opening And Closing The Tailgate on Page 10-40-1.)

Remove the muffler. (See Removal And Installation on Page 60-20-1.)

Drain and remove the hydraulic reservoir. (See Removal and Installation on Page 20-130-1.)

Remove the hydraulic filter bracket assembly. (See Removal and Installation on Page 20-120-1)

Drain the cooling system. (See Replacing The Coolant on Page 10-70-2.)

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.

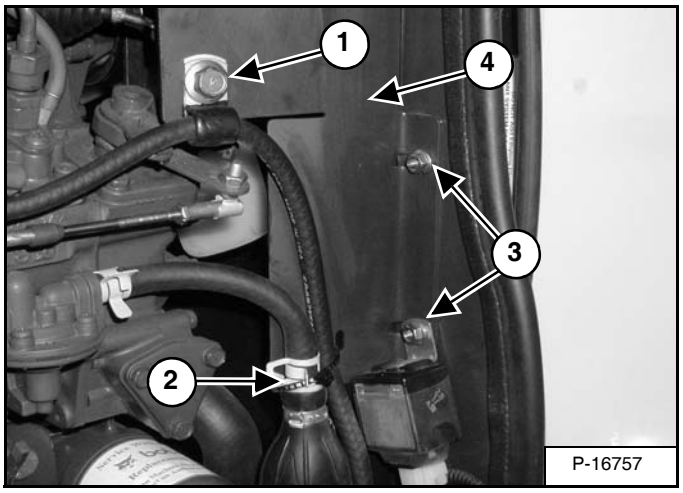
I-2003-0888

IMPORTANT

Fluid such as engine oil, hydraulic fluid, coolants, grease, etc. must be deposed of in an environmentally safe manner. Some regulations require that certain spills and leaks on the ground must be cleaned in a specific manner. See local, state and federal regulations for the correct disposal.

I-2067-0499

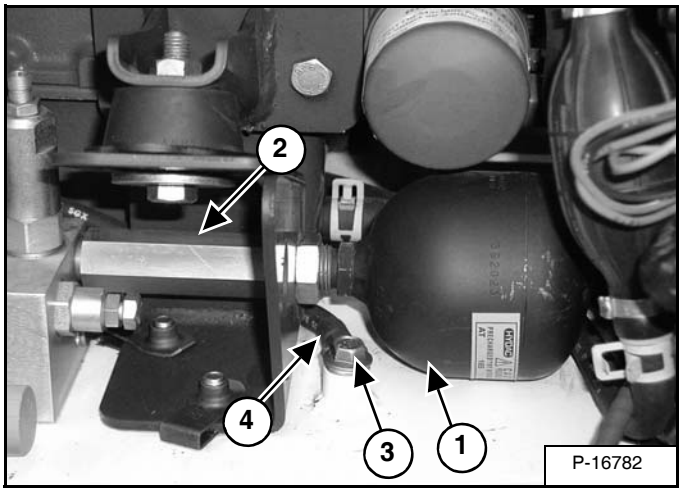
Figure 60-60-1



Remove the bolt (Item 1) and tie strap (Item 2) **[Figure 60-60-1]** from the fan guard.

Remove the nuts (Item 3) **[Figure 60-60-1]** and remove the fan guard (Item 4) **[Figure 60-60-1]**.

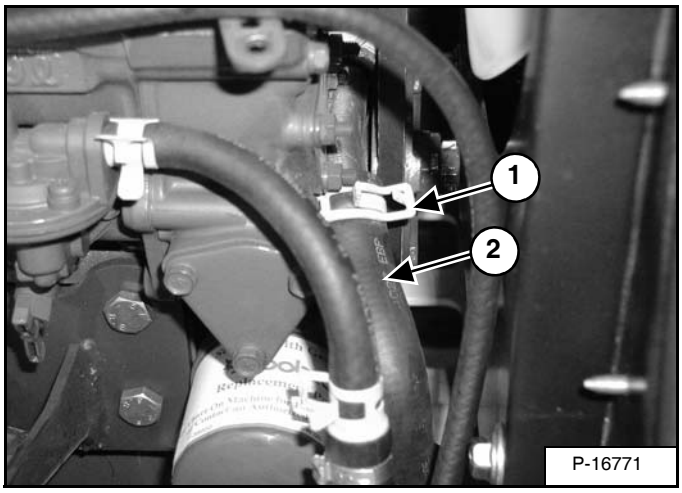
Figure 60-60-2



Remove the accumulator (Item 1). Do not remove the accumulator extension tube (Item 2) **[Figure 60-60-2]** from the motor mount and manifold assembly.

Remove the bolt (Item 3) from the engine ground wire (Item 4) **[Figure 60-60-2]**.

Figure 60-60-3



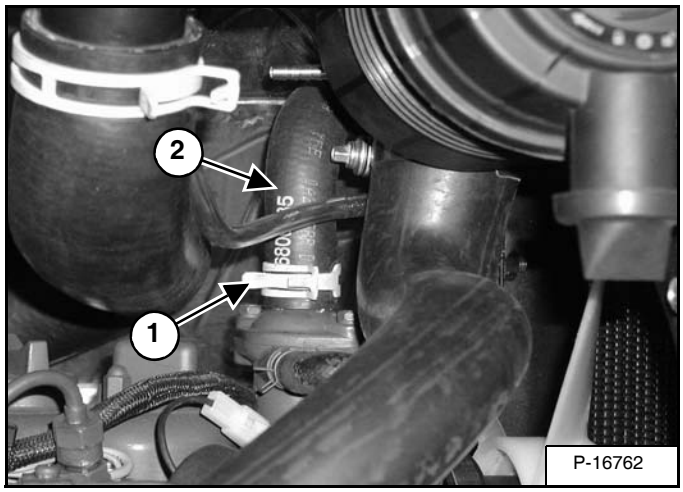
Slide the hose clamp (Item 1) **[Figure 60-60-3]** away from the end of the lower radiator hose.

Remove the lower radiator hose (Item 2) **[Figure 60-60-3]** and cap.

ENGINE (CONT'D)

Removal and Installation (Cont'd)

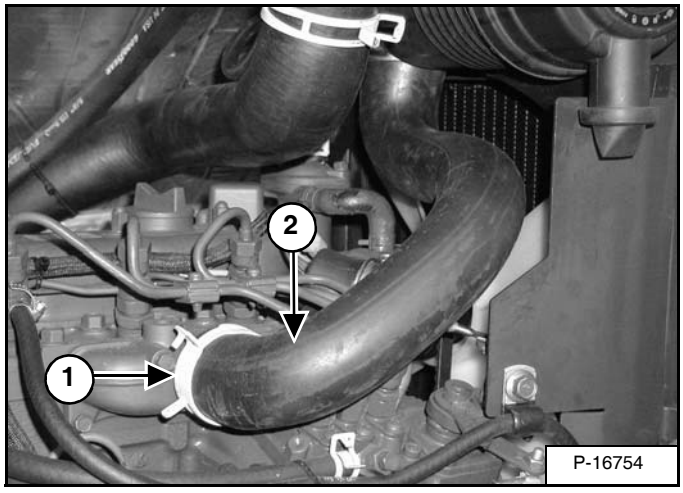
Figure 60-60-4



Slide the hose clamp (Item 1) **[Figure 60-60-4]** away from the end of the upper radiator hose.

Remove the upper radiator hose (Item 2) **[Figure 60-60-4]** and cap.

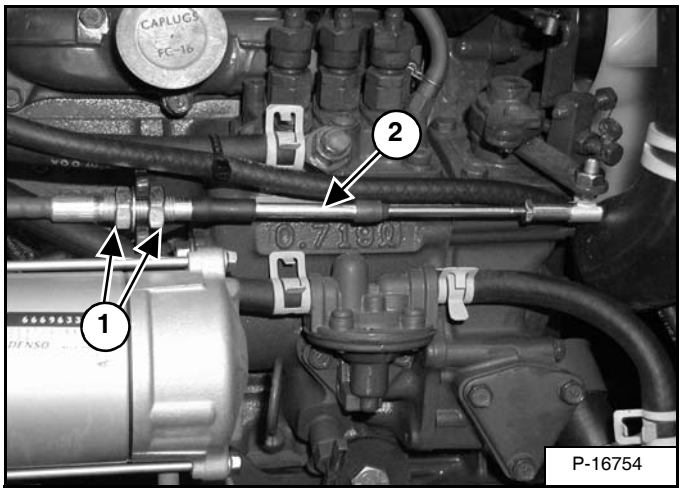
Figure 60-60-5



Slide the hose clamp (Item 1) **[Figure 60-60-5]** away from the end of the air in-take hose.

Remove the air in-take hose (Item 2) **[Figure 60-60-5]** and cap.

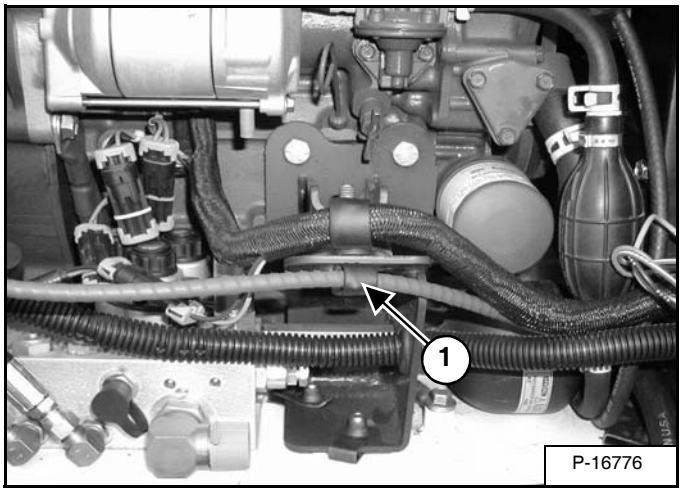
Figure 60-60-6



Loosen the nuts (Item 1) **[Figure 60-60-6]** fastening the throttle cable to the bracket.

Disconnect the throttle linkage (Item 2) **[Figure 60-60-6]** from the throttle bracket.

Figure 60-60-7



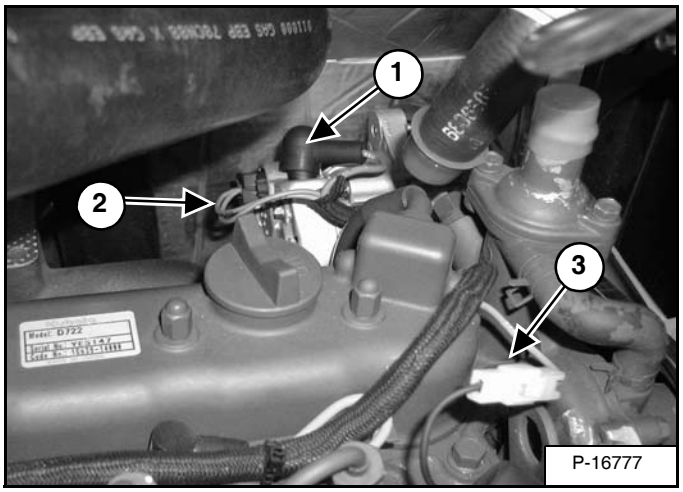
Remove nut and cable clamp (Item 1) **[Figure 60-60-7]** from engine mount bracket.

Move the throttle cable out of the way of the engine.

ENGINE (CONT'D)

Removal and Installation (Cont'd)

Figure 60-60-8

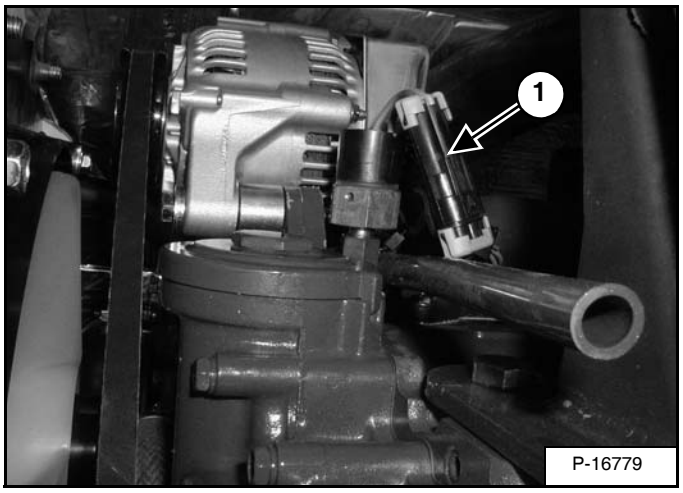


Disconnect the red wire (Item 1) **[Figure 60-60-8]** from the alternator.

Disconnect the wire harness connector (Item 2) **[Figure 60-60-8]** from the alternator.

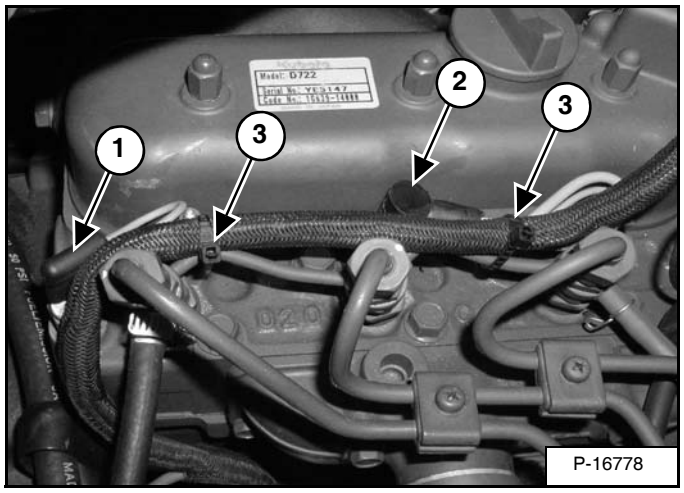
Disconnect the wire connector (Item 3) **[Figure 60-60-8]** from the fuel shutoff.

Figure 60-60-9



Disconnect the wire connector (Item 1) **[Figure 60-60-9]** from the oil pressure sending unit on the back side of the engine.

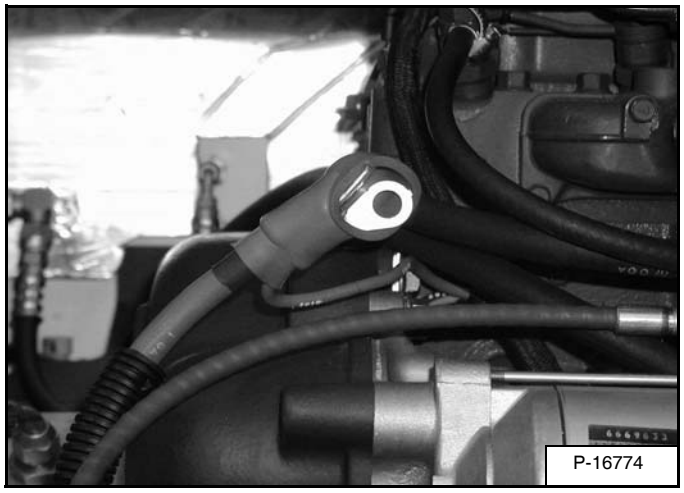
Figure 60-60-10



Remove the wire harness from the water temperature sending unit (Item 1) and the glow plugs (Item 2) **[Figure 60-60-10]**.

Remove the tie straps (Item 3) **[Figure 60-60-10]**.

Figure 60-60-11

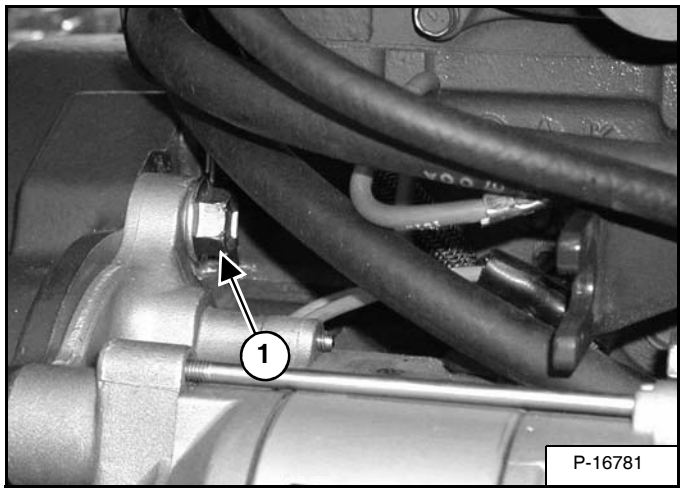


Disconnect the positive wires from the starter and separate the two red wires from the protective cover **[Figure 60-60-11]**.

ENGINE (CONT'D)

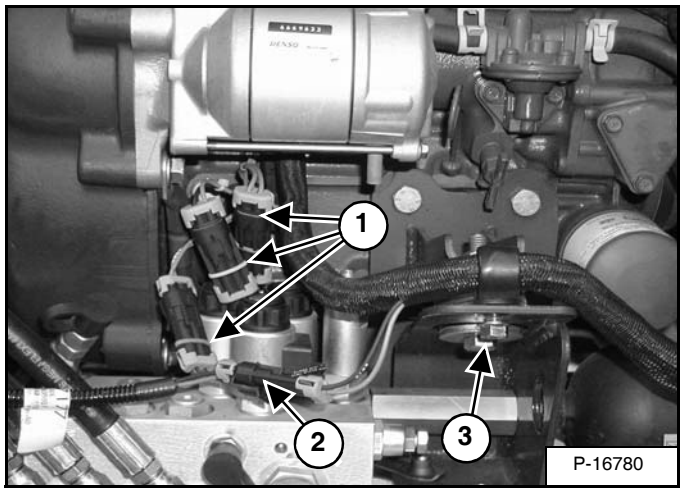
Removal and Installation (Cont'd)

Figure 60-60-12



Disconnect the grounding wire (Item 1) **[Figure 60-60-12]** from the starter mounting bolt.

Figure 60-60-13



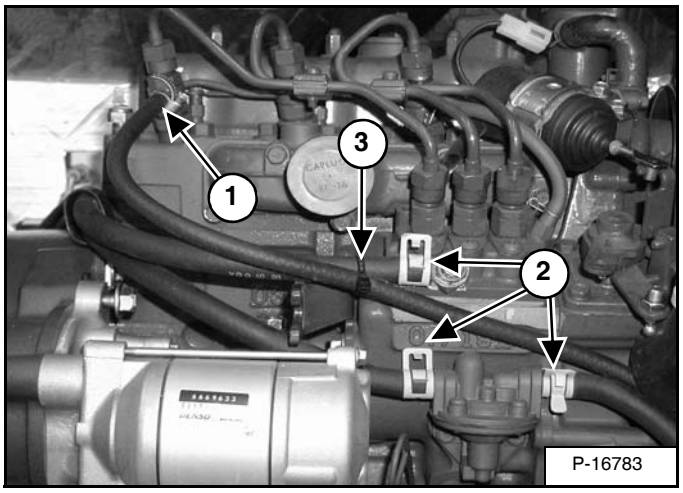
Disconnect the wire connectors (Item 1) **[Figure 60-60-13]** from the three solenoids.

Disconnect the wire connector (Item 2) **[Figure 60-60-13]** from the fuel level sender wire harness.

Remove the bolt (Item 3) **[Figure 60-60-13]** fastening the wire harness clamp to the engine mount.

Move the wire harness out of the way of the engine.

Figure 60-60-14

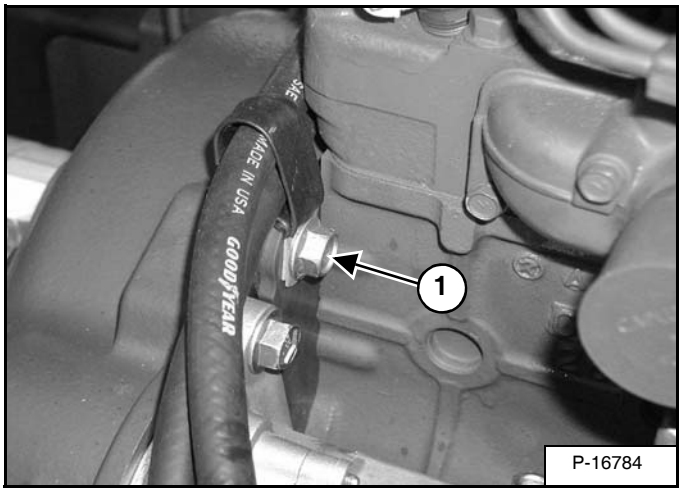


Remove and cap the return fuel line (Item 1) **[Figure 60-60-14]**.

Remove and cap the fuel lines (Item 2) **[Figure 60-60-14]**.

Remove tie strap (Item 3) **[Figure 60-60-14]**.

Figure 60-60-15

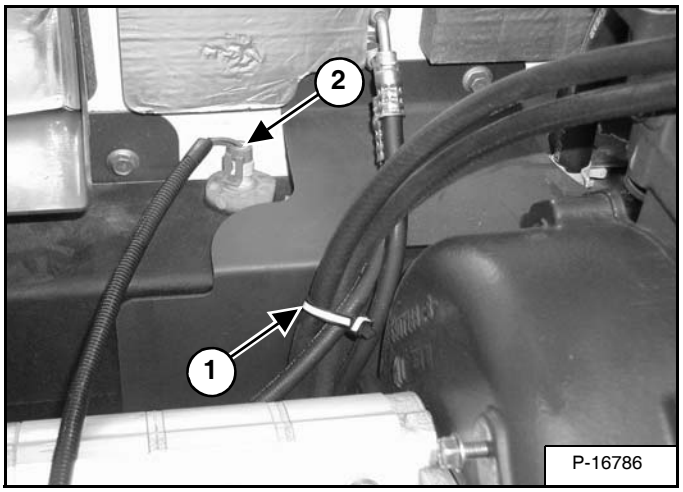


Remove the bolt (Item 1) **[Figure 60-60-15]** from the fuel line clamp.

ENGINE (CONT'D)

Removal and Installation (Cont'd)

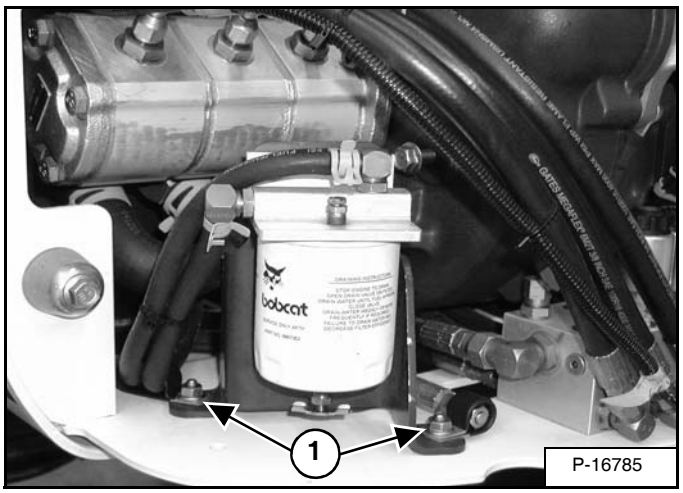
Figure 60-60-16



Remove tie strap (Item 1) **[Figure 60-60-16]**.

Disconnect the wire connector (Item 2) **[Figure 60-60-16]** to the fuel level sender.

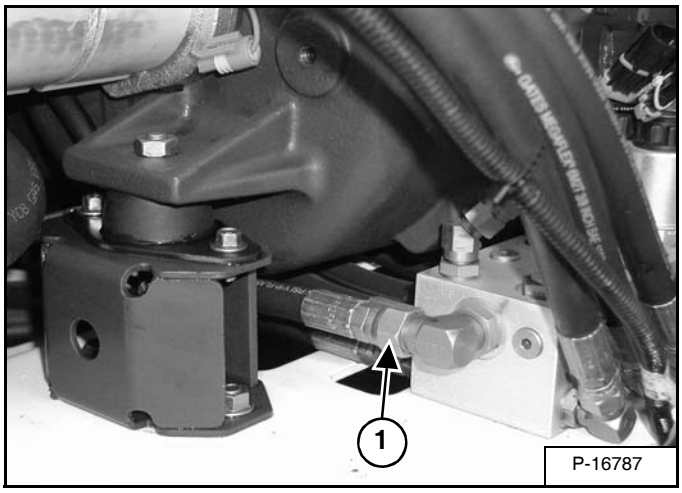
Figure 60-60-17



Remove the two bolts (Item 1) **[Figure 60-60-17]** from the fuel filter bracket.

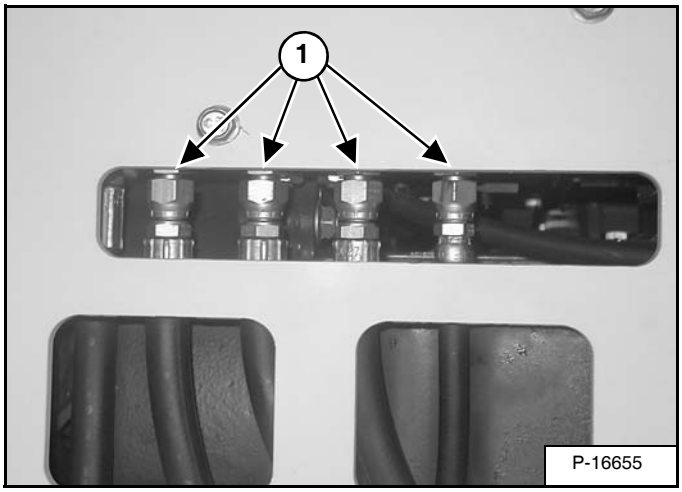
Remove the fuel filter assembly with fuel lines from the engine compartment.

Figure 60-60-18



Disconnect and cap the hose (Item 1) **[Figure 60-60-18]** on the side of the manifold assembly.

Figure 60-60-19

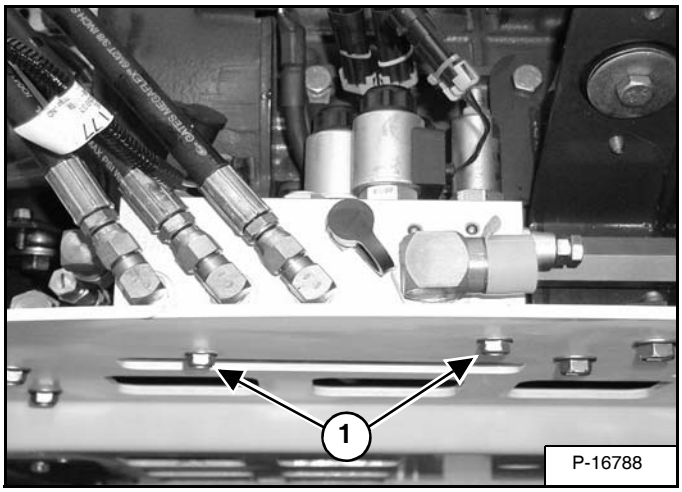


Mark and disconnect the four hoses (Item 1) **[Figure 60-60-19]** on the backside of the manifold assembly. Disconnect the four hoses from the underside of upperstructure.

ENGINE (CONT'D)

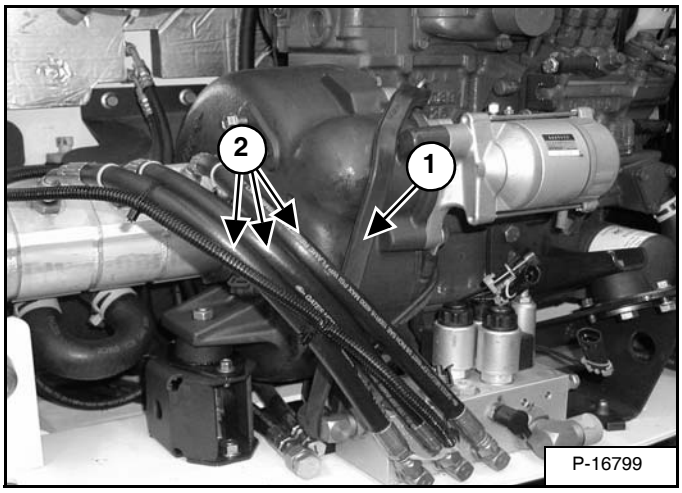
Removal and Installation (Cont'd)

Figure 60-60-20



Remove the two bolts (Item 1) **[Figure 60-60-20]** fastening the manifold assembly to the upperstructure.

Figure 60-60-21



Support the end of the manifold assembly with a strap (Item 1) to the engine **[Figure 60-60-21]**.

NOTE: Manifold assembly and pump hoses (Item 2) [Figure 60-60-21] can be left assembled during engine removal.

Figure 60-60-22

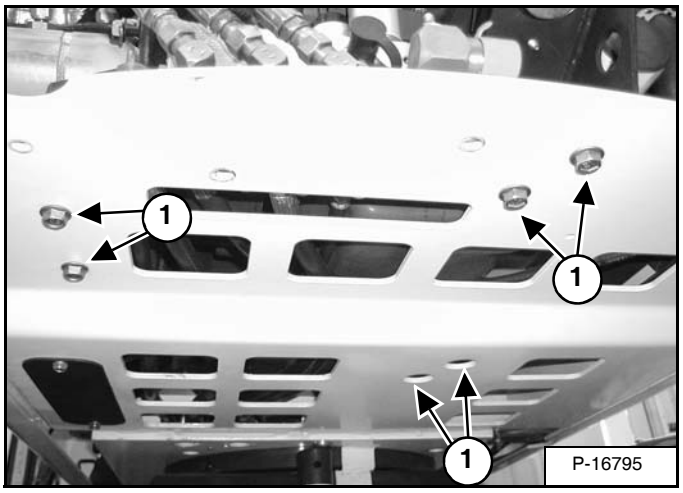
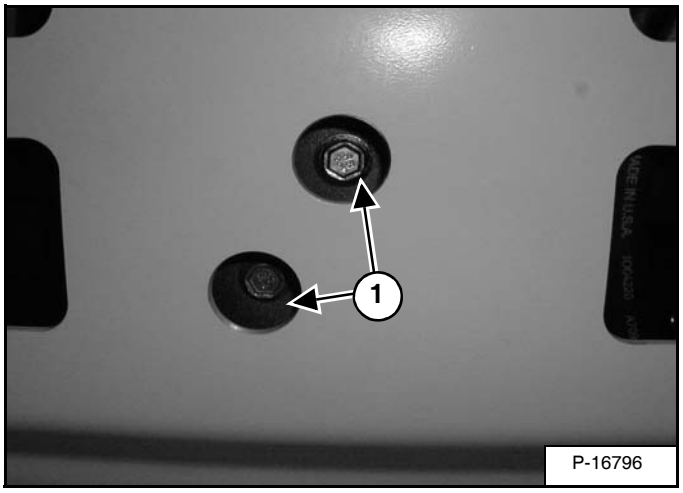


Figure 60-60-23



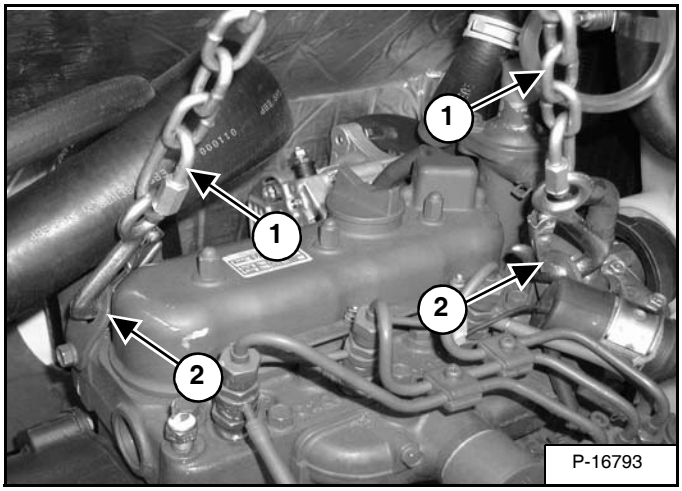
Remove the six engine mount bolts (Item 1) **[Figure 60-60-22]** & **[Figure 60-60-23]**.

NOTE: The engine mounts are left assembled to the engine and will be removed with the engine.

ENGINE (CONT'D)

Removal and Installation (Cont'd)

Figure 60-60-24



Connect a chain (Item 1) to the two engine lifting brackets (Item 2) **[Figure 60-60-24]**.

Figure 60-60-25



Lift and slide the engine out while turning the engine to provide clearance during engine removal **[Figure 60-60-25]**.

NOTE: Protect the back of the Excavator canopy/cab from lifting chain damage during engine removal.


Bobcat

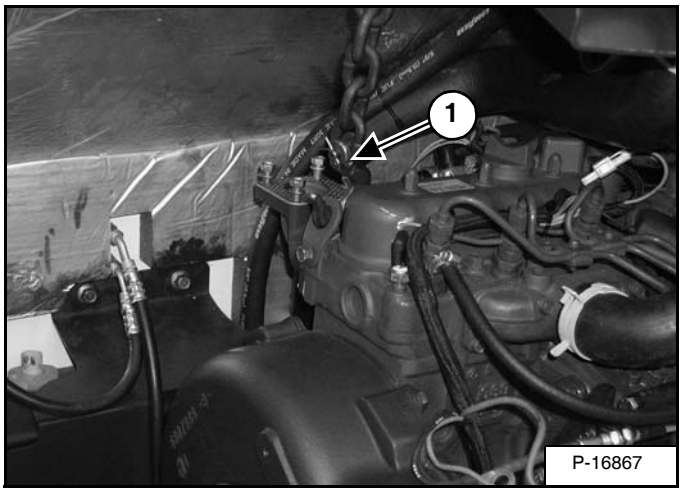
ENGINE FLYWHEEL

Removal And Installation

Drain the hydraulic reservoir. (See Replacing Hydraulic Oil on Page 10-100-2.)

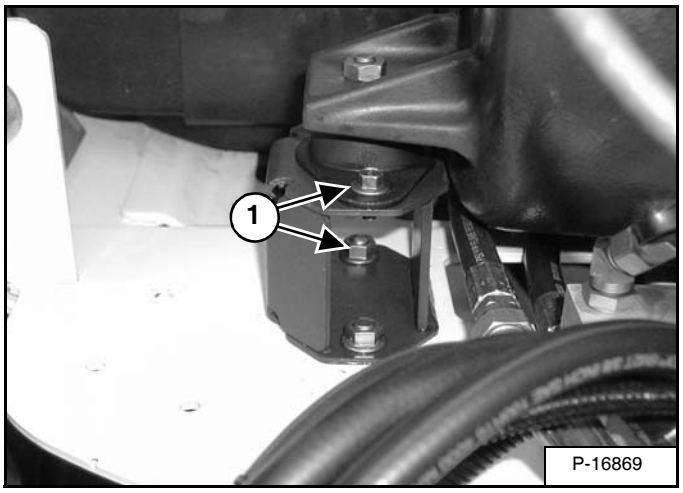
Remove the hydraulic gear pump. (See Removal And Installation on Page 20-50-3.)

Figure 60-70-1



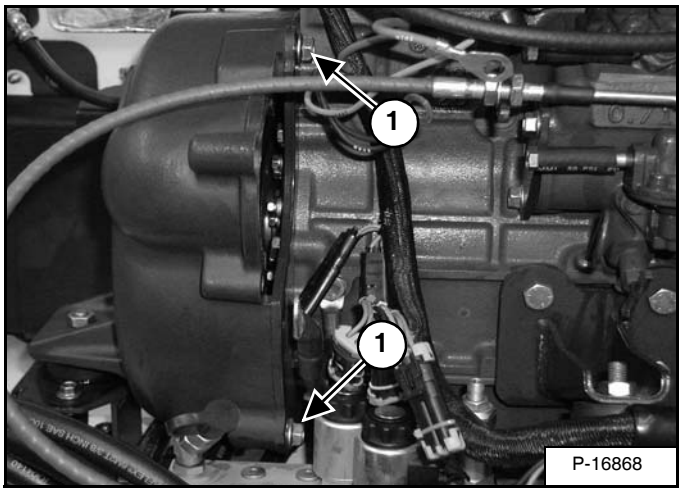
Install a chain hoist to the engine lifting eye to support the engine (Item 1) **[Figure 60-70-1]**.

Figure 60-70-2



Remove the mount bolts and nuts (Item 1) **[Figure 60-70-2]** from the engine mount.

Figure 60-70-3



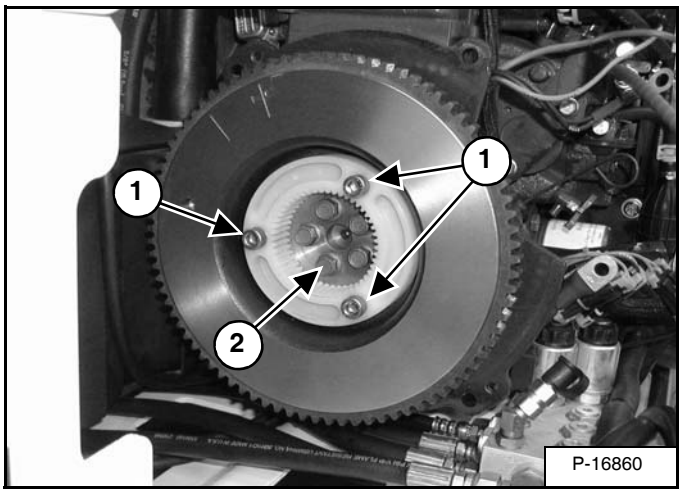
Remove four flywheel housing bolts (Item 1) **[Figure 60-70-3]**.

Installation: Tighten the bolts to 29-37 ft.-lbs. (40-50 Nm) torque.

Remove the flywheel housing.

NOTE: Check that the alignment dowels are installed in the flywheel housing for assembly.

Figure 60-70-4



Remove the three bolts (Item 1) **[Figure 60-70-4]** from the hydraulic pump coupler.

Installation: Apply LOCTITE 242 (Blue) to bolts and tighten the bolts to 29-37 ft.-lbs. (40-50 Nm) torque.

Remove the hydraulic pump coupler.

Removal And Installation (Cont'd)

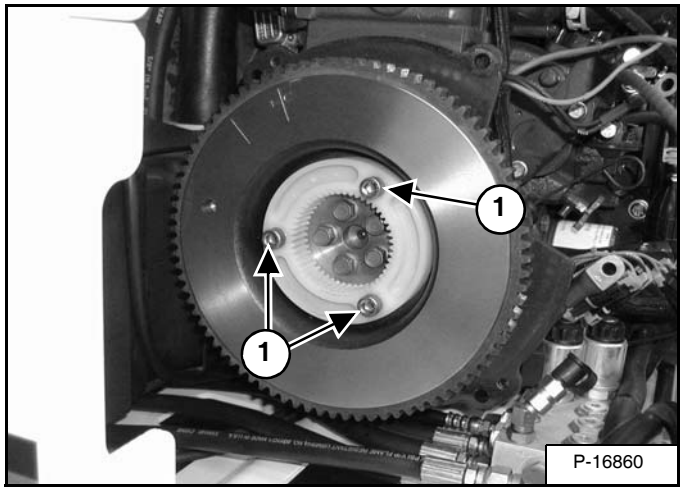
Remove the five bolts (Item 2) **[Figure 60-70-4]** from the flywheel.

Installation: Tighten the bolts to 40-43 ft.-lbs. (54-59 Nm) torque.

Remove the flywheel.

Hydraulic Pump Coupler

Figure 60-70-5



Remove the three bolts (Item 1) **[Figure 60-70-5]** from the hydraulic pump coupler.

Installation: Apply LOCTITE 242 (Blue) to bolts and tighten the bolts to 29-37 ft.-lbs. (40-50 Nm) torque.

Remove the hydraulic pump coupler.

Flywheel Ring Gear

⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- **When fluids are under pressure.**
- **Flying debris or loose material is present.**
- **Engine is running.**
- **Tools are being used.**

W-2019-1285

The ring gear is installed on the flywheel with an interference fit. Heat the ring gear enough to expand it and hit it with a hammer, (evenly) to remove it.

Clean the ring gear mounting surface of the flywheel to give a smooth fit.

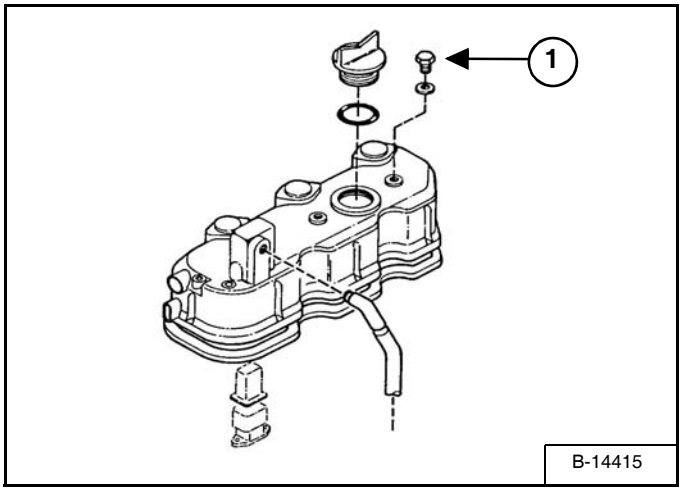
Clean the new ring gear and heat it to a temperature of 450-500° F (232-260° C).

Fit the ring gear over the flywheel. Make sure the gear is seated correctly.

RECONDITIONING THE ENGINE (S/N 223911001 - 223911621, S/N 224011001 - 224013374)

Cylinder Head Removal And Installation

Figure 60-80-1



Remove the bolts (Item 1) **[Figure 60-80-1]** from the valve cover and remove the valve cover and gasket.

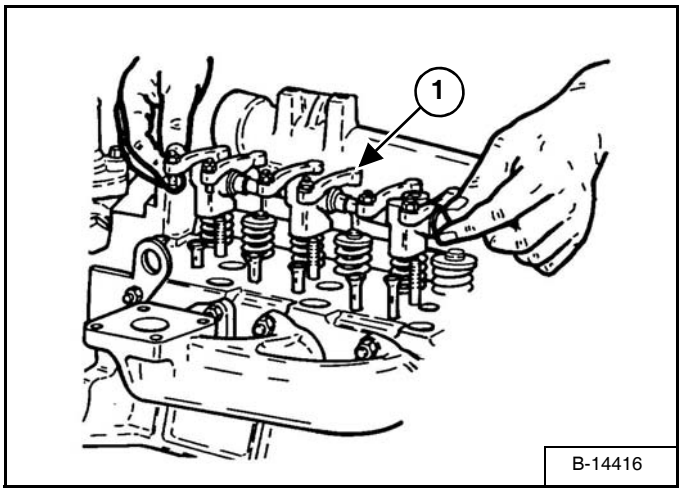
Installation: Tighten the bolts to 2.9-4.3 ft.-lb. (3,9-5,9 N•m) torque.

Remove the fuel injector nozzles. (See Fuel Injector Removal And Installation on Page 60-50-7.)

Remove the glow plugs. (See Glow Plug Removal And Installation on Page 60-50-9.)

Remove the alternator. (See Removal And Installation on Page 50-30-4.)

Figure 60-80-2

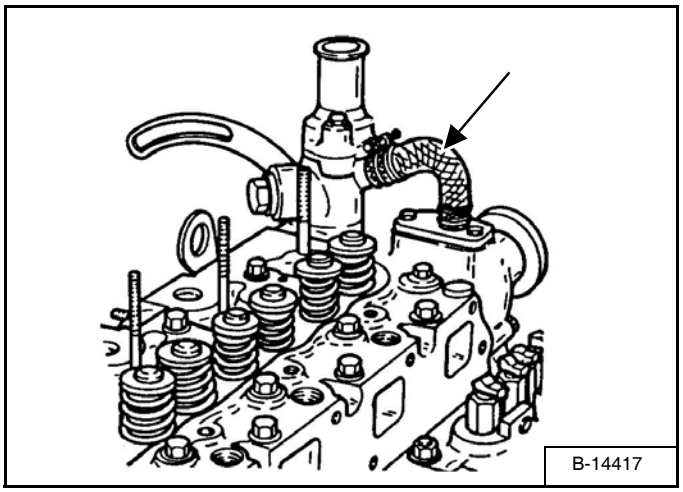


Remove the rocker arm and shaft assembly (Item 1) **[Figure 60-80-2]**.

Installation: Tighten the nuts to 7-8 in.-lbs. (9,8-11,3 N•m) torque.

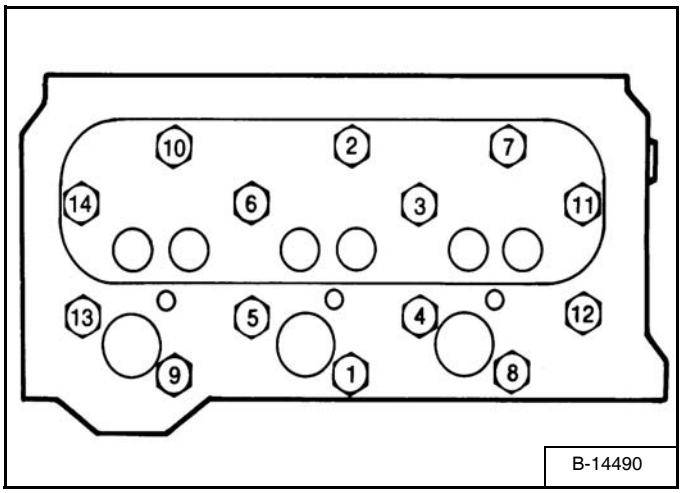
Remove the intake and exhaust manifolds.

Figure 60-80-3



Remove the water return hose **[Figure 60-80-3]**.

Figure 60-80-4



Remove the cylinder head bolts in order of #14 to #1 **[Figure 60-80-4]**.

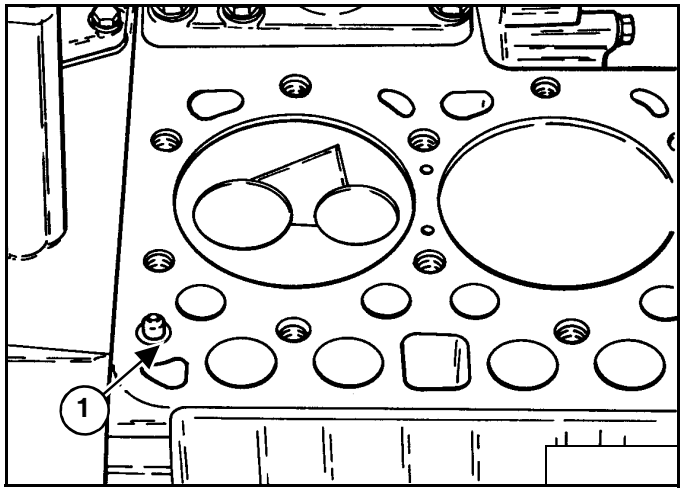
Installation: Put oil on the bolt threads. Tighten the bolts in the correct sequence to 29-33 ft.-lb. (39-44 N•m) torque.

NOTE: Re-tighten the cylinder head bolts in the correct sequence after the engine has been run for 30 minutes.

Remove the cylinder head from the engine block.

Cylinder Head Removal And Installation (Cont'd)

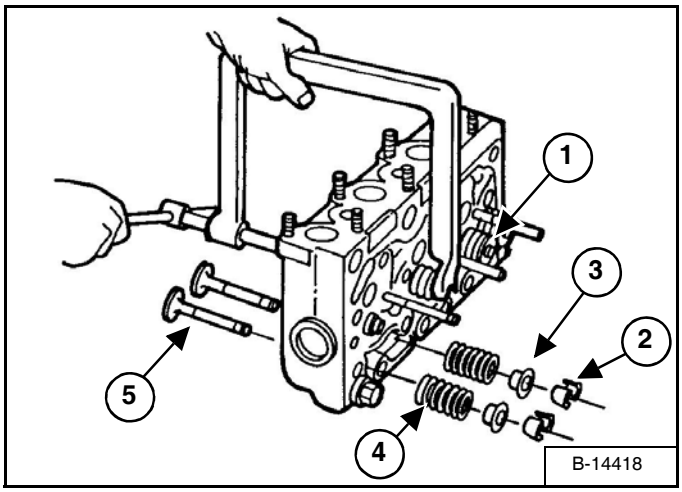
Figure 60-80-5



Installation: Always use a new head gasket and new O-ring. Make sure the O-ring (Item 1) **[Figure 60-80-5]** is seated over the dowel.

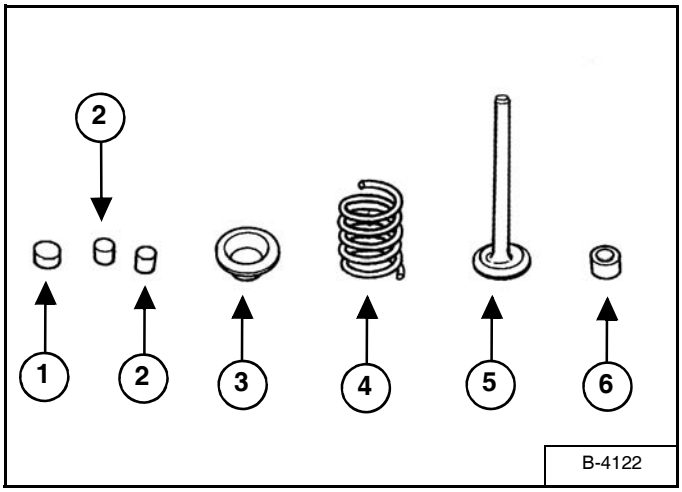
Cylinder Head Disassembly And Assembly

Figure 60-80-6



Use a valve spring compressor to compress the valve spring **[Figure 60-80-6]**.

Figure 60-80-7



Remove the valve cap (Item 1) **[Figure 60-80-7]** and valve spring collet (Item 2) **[Figure 60-80-6]** & **[Figure 60-80-7]**.

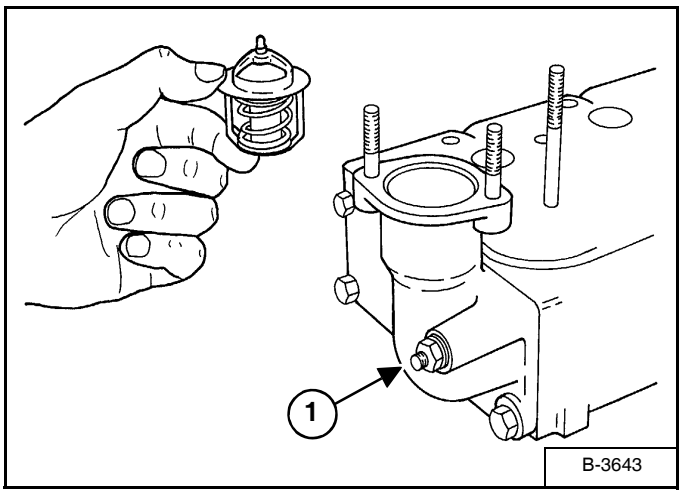
Remove the valve spring retainer (Item 3) **[Figure 60-80-6]** & **[Figure 60-80-7]** and the spring (Item 4) **[Figure 60-80-6]** & **[Figure 60-80-7]**.

Remove the valve (Item 5) **[Figure 60-80-6]** & **[Figure 60-80-7]**.

Remove the seal (Item 6) **[Figure 60-80-7]**.

Cylinder Head Disassembly And Assembly (Cont'd)

Figure 60-80-8



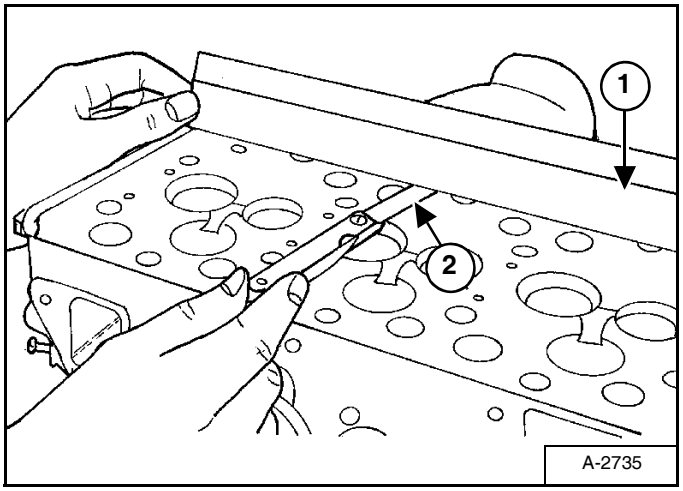
Remove the thermostat cover and thermostat from the cylinder head. Remove the thermostat housing (Item 1) **[Figure 60-80-8]**.

Installation: Apply Liquid-Type Gasket (Three Bond 1215 or equivalent) to both sides of the new thermostat cover gasket and new thermostat housing gasket.

Cylinder Head, Servicing

Clean the surface of the cylinder head.

Figure 60-80-9

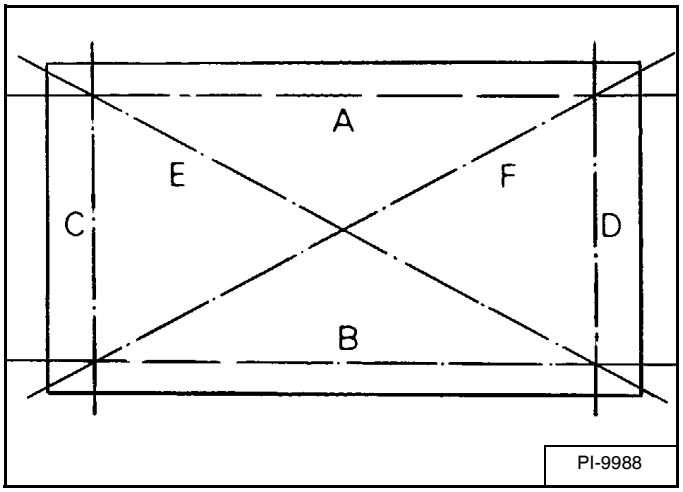


Put a straight edge (Item 1) **[Figure 60-80-9]** on the cylinder head.

NOTE: Do not put the straight edge across combustion chambers.

Put a feeler gauge (Item 2) **[Figure 60-80-9]** between the straight edge and the surface of the cylinder head.

Figure 60-80-10

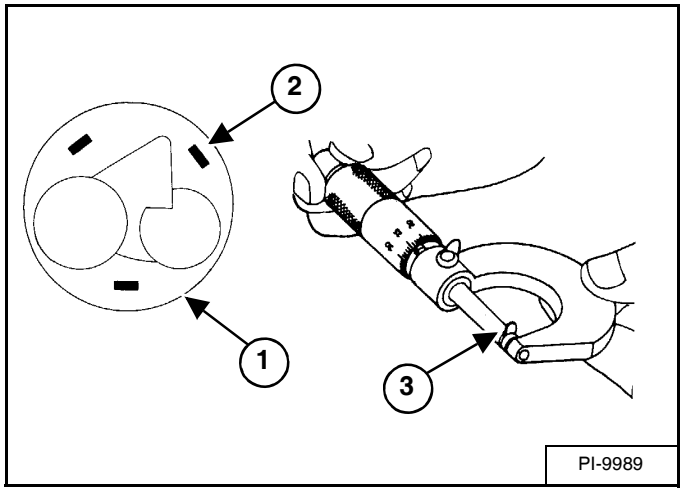


Put the straight edge on the cylinder head's four sides and two diagonal as shown in figure **[Figure 60-80-10]**.

The maximum distortion of the head surface ± 0.002 in. (± 0,05 mm). If the measurement is more than the specification, remove the combustion chambers, then grind the cylinder head. Grind the same amount of material from the bottom of the combustion chambers as was removed from the head.

Cylinder Head Top Clearance

Figure 60-80-11



Install the cylinder head gasket. Put the piston (Item 1) **[Figure 60-80-11]** being checked at T.D.C.

Put 3 pieces of 0.06 in. (1,5 mm) diameter solder (Item 2) **[Figure 60-80-11]** on the top piston. Use grease to hold them in position.

NOTE: Put the solder in position so they do not touch the valves.

Turn the piston to bottom dead center.

Install the cylinder head and tighten to the correct torque in the correct sequence. (See Cylinder Head Removal And Installation on Page 60-80-1).

Turn the crankshaft until the piston exceeds T.D.C. Remove the cylinder head.

Remove the solder wire (Item 3) **[Figure 60-80-11]** and measure it.

If the measurement exceeds the specifications, check the oil clearance of the crank pin journal or the piston pin.

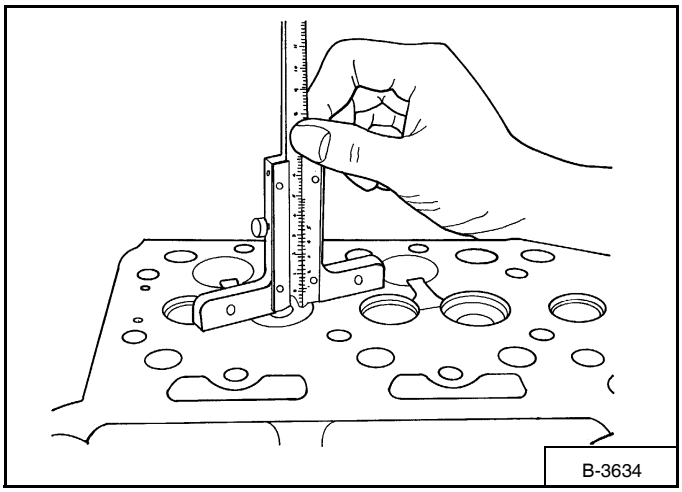
Top clearance 0.0197-0.0256 in. (0,50-0,65 mm)

Valve Guide, Checking

Remove the valve and spring from the cylinder head. (See Cylinder Head Removal And Installation on Page 60-80-1)

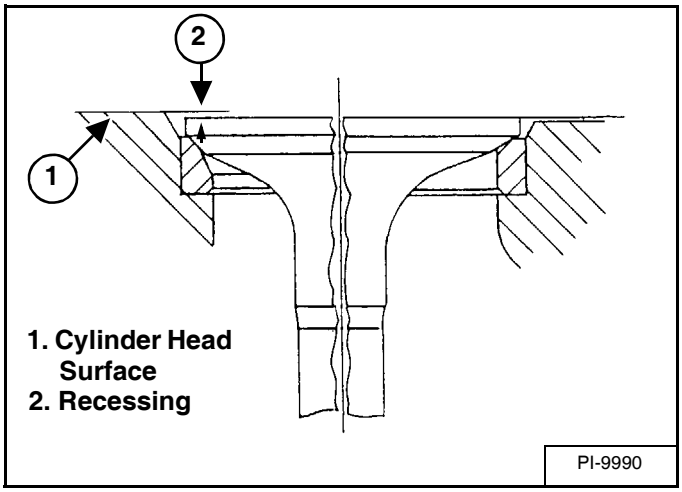
Clean the valve seat and combustion chamber.

Figure 60-80-12



Install the valve into the guide. Measure the valve recessing with a depth gauge **[Figure 60-80-12]**.

Figure 60-80-13



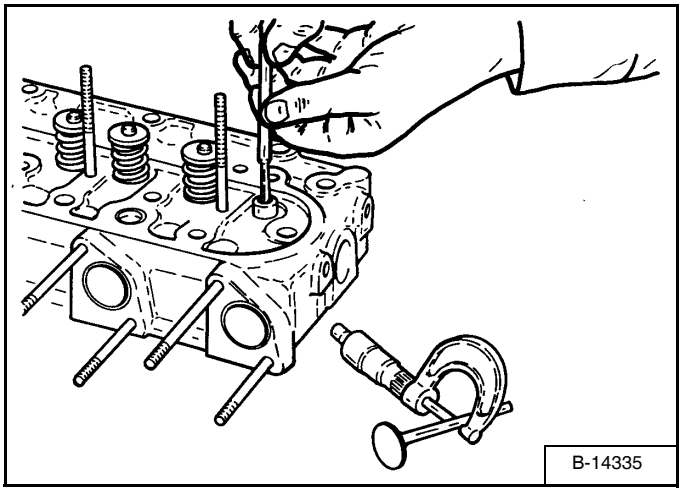
If the measurement exceeds the allowable limit, replace the valve or cylinder head **[Figure 60-80-13]**.

Recessing	0.004 in. (0,10 mm)
Allowable Limit (Recessing)	0.012 in. (0,3 mm)

Remove the carbon from the valve guide.

Valve Guide, Checking (Cont'd)

Figure 60-80-14



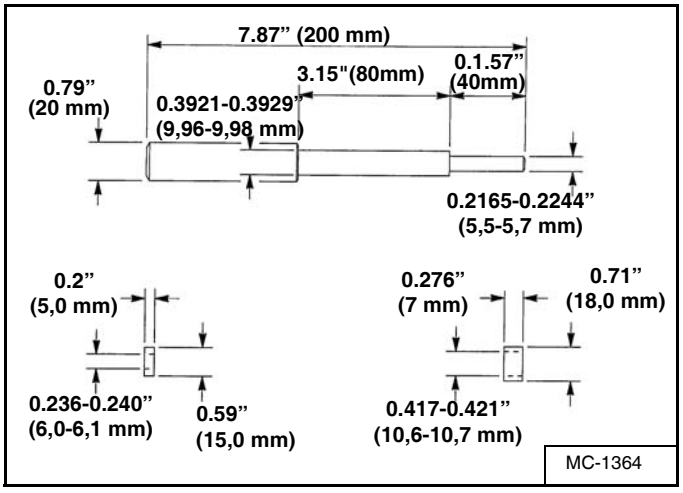
Measure the valve stem O.D. **[Figure 60-80-14]**.

Measure the valve guide I.D. **[Figure 60-80-14]**.

Calculate the clearance. If the clearance exceeds the allowable limit, replace the valve and/or valve guide.

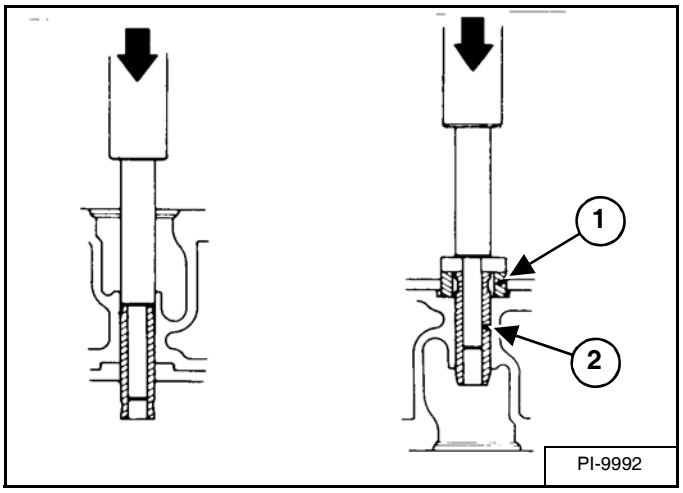
Valve Guide I.D	0.2366-0.2372 in. (6,01-6,025 mm)
Valve Stem O.D	0.2350-0.2354 in. (5,969-5,980 mm)
Clearance Between Valve Stem and Guide	0.0012-0.0022 in. (0,03-0,057 mm)
Allowable Limit	0.0039 in. (0,1 mm)

Figure 60-80-15



To remove and replace the valve guide, make the driver tools as shown in figure **[Figure 60-80-15]**.

Figure 60-80-16



Press the used valve guide out of the cylinder head using the special driver tool **[Figure 60-80-16]**. (See previous page for tool dimensions.)

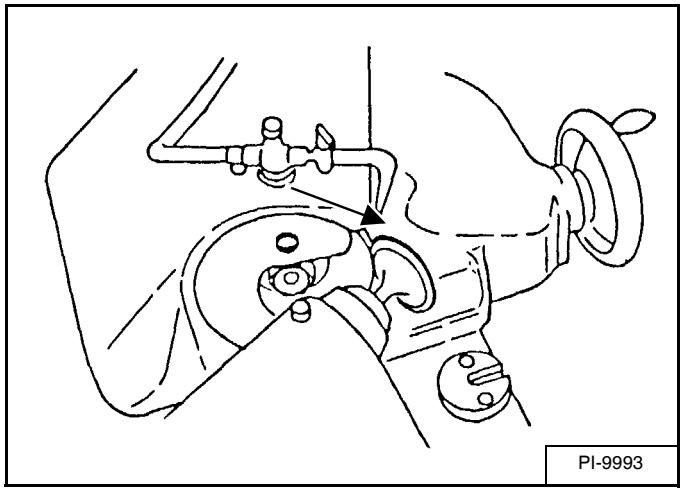
Put oil on the outside diameter of the new valve guide. Press the new valve guide into the cylinder head from the top side. Use the special driver tools (Item 1 & 2) **[Figure 60-80-16]**, press the new guide until the tools contact the cylinder head.

Ream the valve guide to the correct specifications.

NOTE: Valve guide I.D. (Intake and Exhaust) factory spec. is .2366-.2372 in. (6,01-6,03 mm)

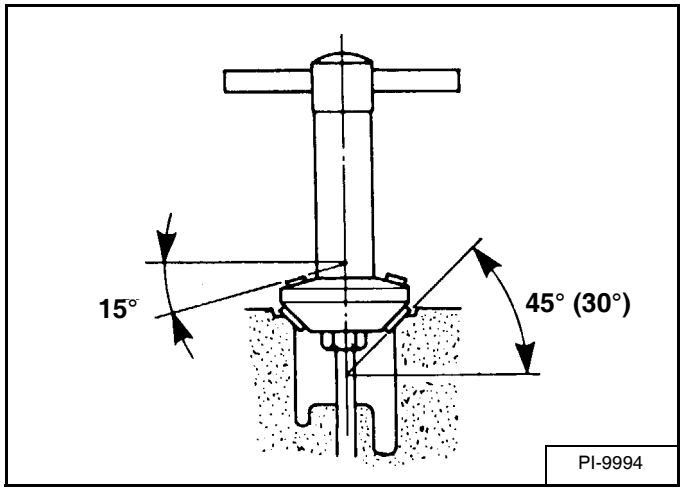
Valve And Valve Seat Reconditioning

Figure 60-80-17



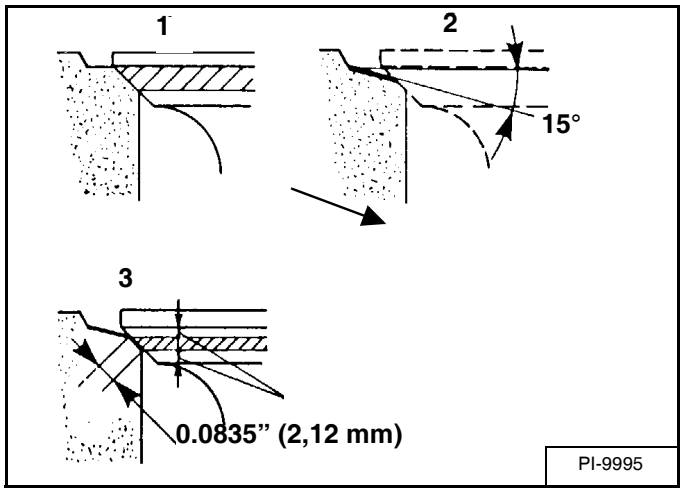
Grind the valve face to the correct angle using a valve refacer **[Figure 60-80-17]** & **[Figure 60-80-19]**.

Figure 60-80-18



Grind the valve surface in the cylinder head to the correct angle **[Figure 60-80-18]**.

Figure 60-80-19



Check the seat surface and valve face (Item 1) **[Figure 60-80-19]**.

If the seat surface is too wide, use a 15 degree cutter (Item 2) to get the correct width (Item 3) **[Figure 60-80-19]**.

Valve Seat Width

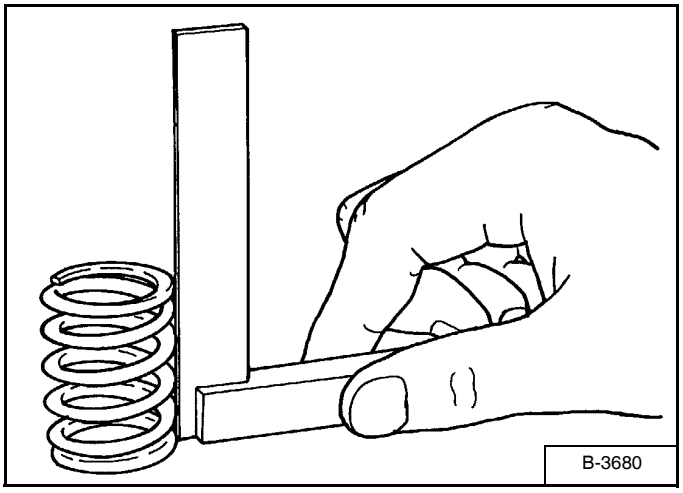
Intake	0.0835 in. (2,12 mm)
Exhaust	0.0835 in. (2,12 mm)

Valve Seat & Face Angle

Intake	45°
Exhaust	45°

Valve Spring

Figure 60-80-20



Measure the length of the valve spring. If the measurement is less than the allowable limit, replace the spring **[Figure 60-80-20]**.

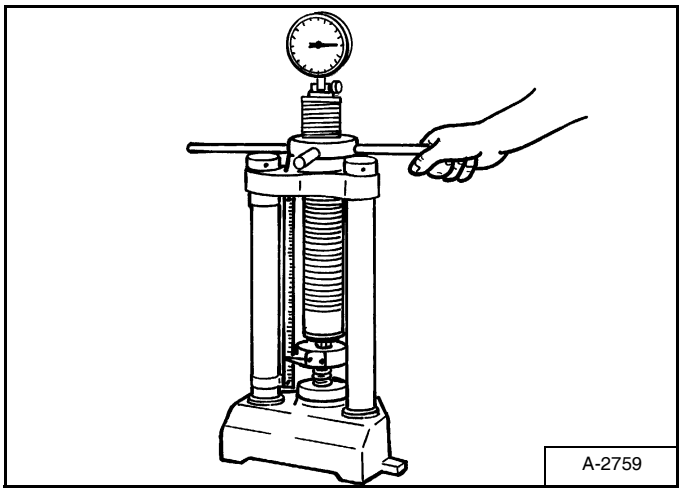
Free Length	1.244 in. (31,6 mm)
Allowable Limit	1.118 in. (28,4 mm)

Put the spring on a flat surface, place a square on the side of the spring **[Figure 60-80-20]**.

Rotate the spring and measure the maximum tilt. If the measurement is in excess of the allowable limit, replace the spring.

Tilt	0.047 in. (1,2 mm)

Figure 60-80-21



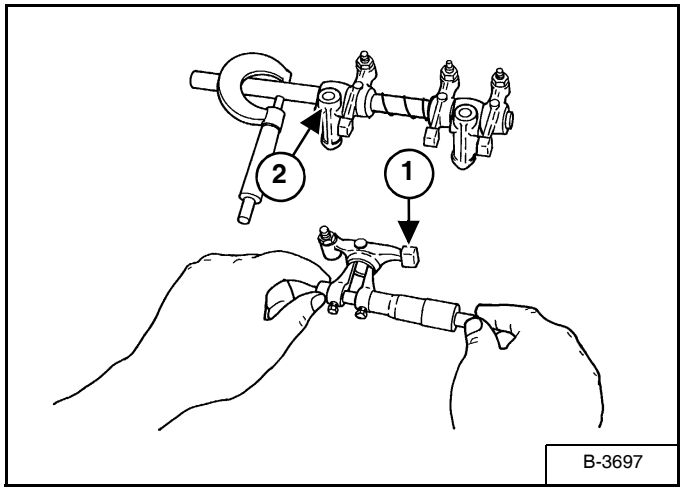
Put the spring on a tester and compress to specified length **[Figure 60-80-21]**.

Read the compressed load on the gauge. If the measurement exceeds allowable limit, replace the spring.

Setting Length	1.063 in. (27 mm)
Setting Load	14.6 lbs. (64.7 N)
Allowable Limit (setting load)	12.3 lbs. (54.9 N)

Rocker Arm And Shaft, Checking

Figure 60-80-22



Measure the rocker arm I.D. (Item 1) **[Figure 60-80-22]** with an inside micrometer.

Measure the rocker shaft O.D. (Item 2) **[Figure 60-80-22]** with an outside micrometer.

If the clearance exceeds the allowable limit, replace the rocker arm and measure the clearance again.

If the clearance still exceeds the allowable limit after the rocker arm is replaced, replace the rocker arm shaft.

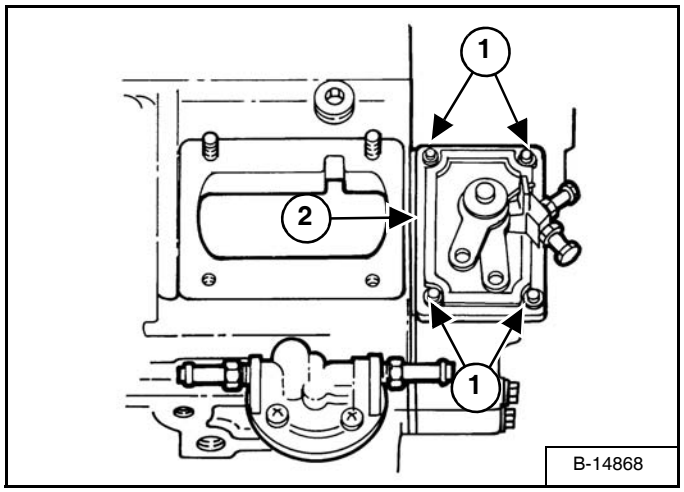
Oil Clearance Between Rocker Arm & Shaft	0.0006-0.0018 in. (0,016-0,045 mm)
Allowable Limit	0.0059 in. (0,15 mm)
Rocker Arm Shaft	0.4123-0.4128 in. (10,47-10,48 mm)
Rocker Arm I.D.	0.4134-0.4141 in. (10,5-10,52 mm)

Timing Gearcase Cover Removal And Installation

Remove the fuel injection pump. (See Fuel Injection Pump Removal And Installation on Page 60-50-4.)

Remove the cylinder head, rocker arms and push rods. (See Cylinder Head Removal And Installation on Page 60-80-1)

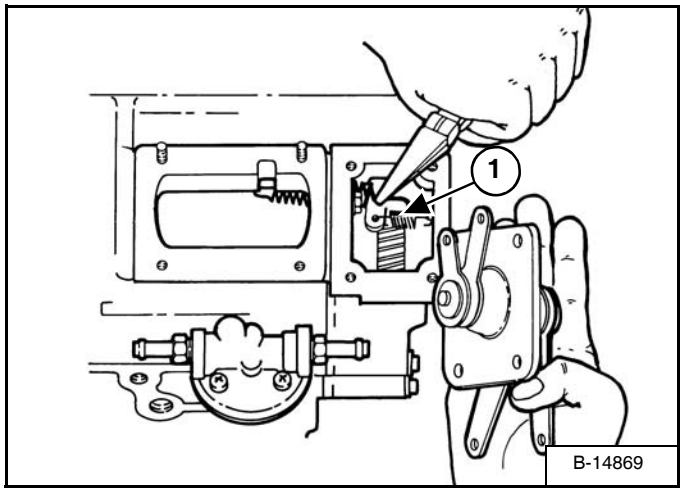
Figure 60-80-23



Remove the screws (Item 1) from the speed control plate (Item 2) **[Figure 60-80-23]**.

NOTE: Take care not to damage the spring.

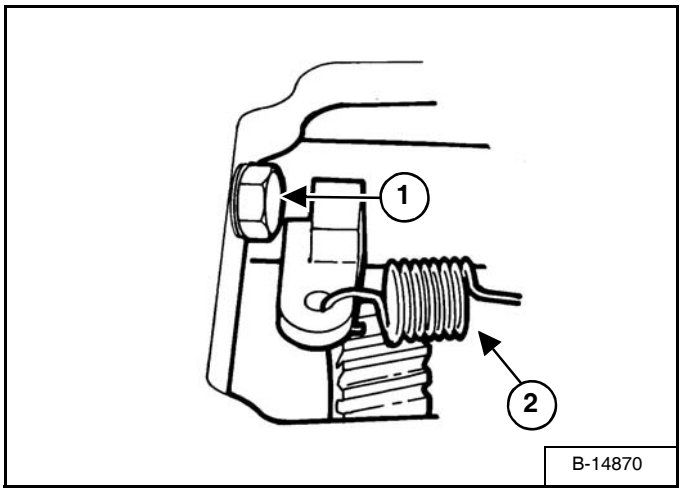
Figure 60-80-24



Separate the speed control plate from the engine and remove the spring (Item 1) **[Figure 60-80-24]**.

Remove the speed control plate.

Figure 60-80-25

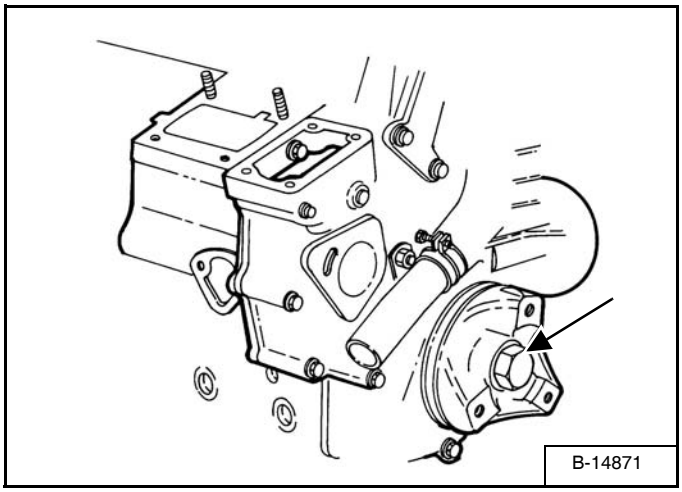


Remove the bolt (Item 1) and disconnect the shaft spring (Item 2) **[Figure 60-80-25]**.

Remove the crankshaft pulley bolt.

Installation: Tighten the bolt 72-80 ft.-lb. (98-108 N•m) torque.

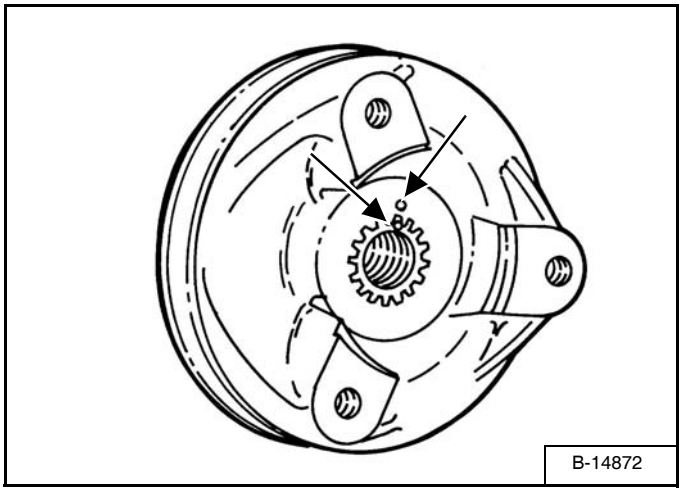
Figure 60-80-26



Use a puller and remove the crankshaft pulley **[Figure 60-80-26]**.

Timing Gearcase Cover Removal And Installation (Cont'd)

Figure 60-80-27

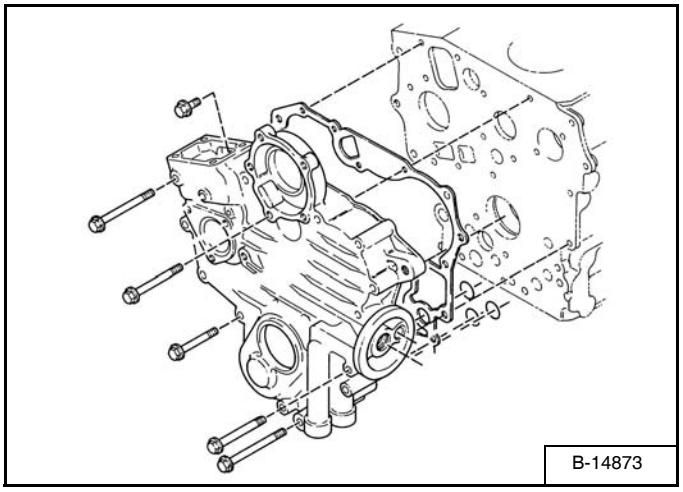


When installing the crank shaft pulley, make sure the alignment marks are aligned **[Figure 60-80-27]**.

Remove the timing gear case cover bolts.

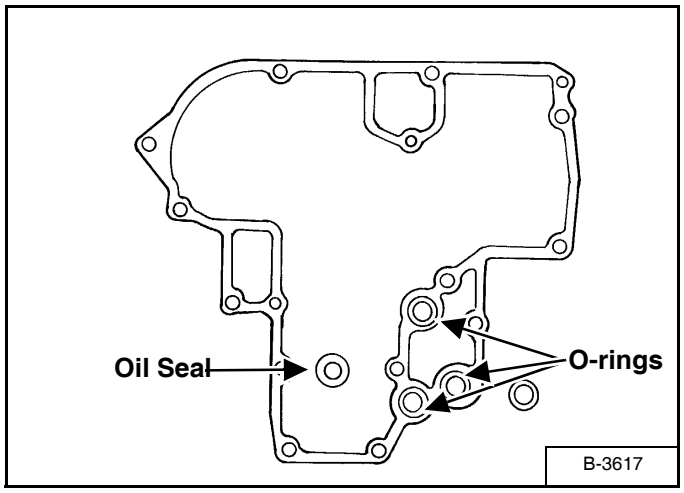
Installation: Tighten the bolts to 7-8 ft.-lb. (10-11 N•m) torque.

Figure 60-80-28



Remove the timing gear case **[Figure 60-80-28]**.

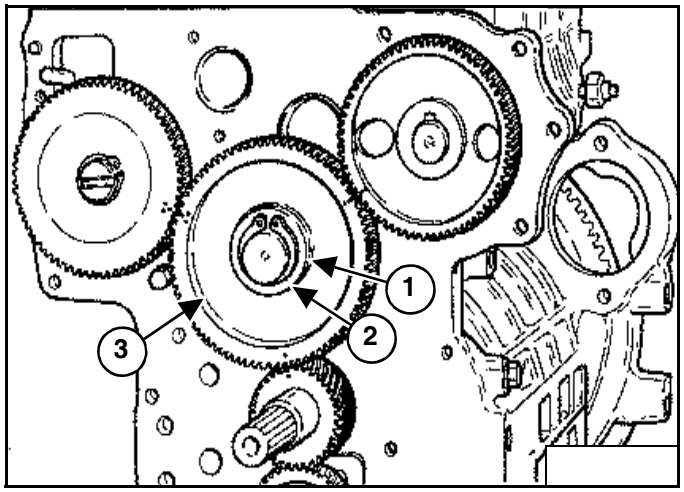
Figure 60-80-29



Installation: Install three new O-rings and the oil seal into the timing gear case cover **[Figure 60-80-29]**.

Idler Gear And Camshaft Removal And Installation

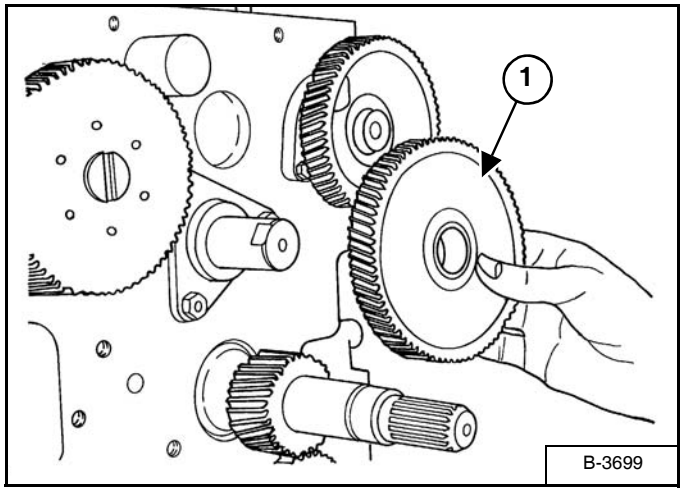
Figure 60-80-30



Remove the snap ring (Item 1) and collar (Item 2) from the idler gear shaft (Item 3) **[Figure 60-80-30]**.

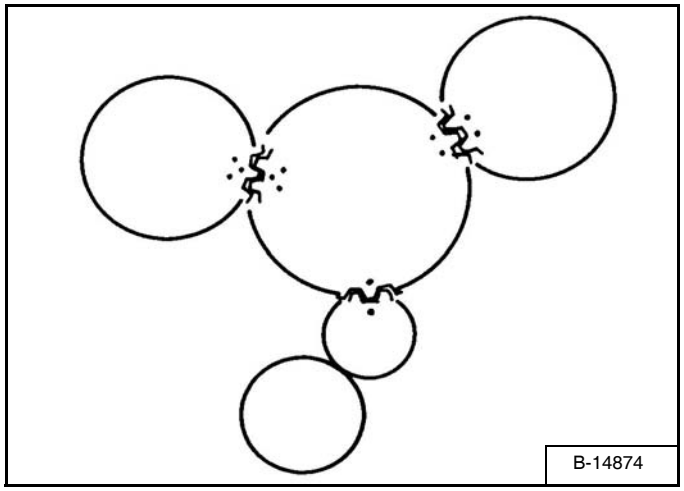
Idler Gear And Camshaft Removal And Installation (Cont'd)

Figure 60-80-31



Remove the idler gear (Item 1) **[Figure 60-80-31]**.

Figure 60-80-32



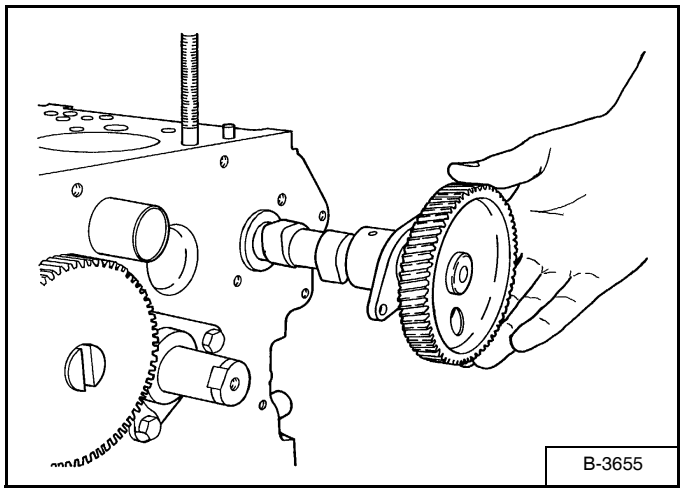
Installation: Make sure the timing marks are in correct alignment when installing the timing gears **[Figure 60-80-32]**.

Align the holes on the camshaft gear with the camshaft retainer plate bolts.

Remove the bolts.

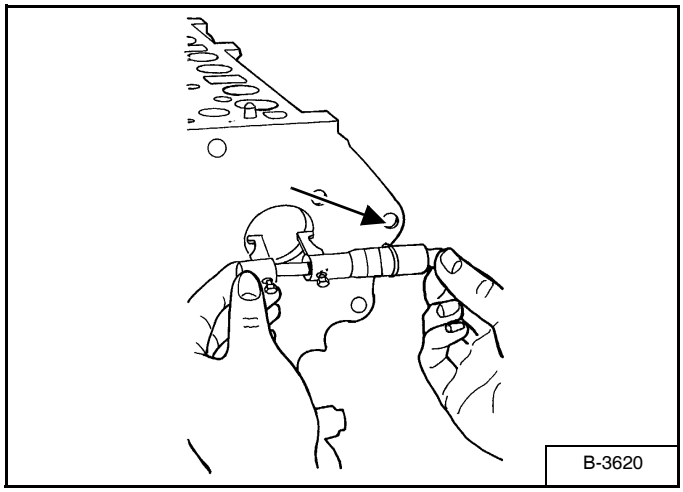
Installation: Tighten the camshaft retainer bolts to 14-15 ft.-lb. (18-21 N•m) torque.

Figure 60-80-33



Remove the camshaft from the engine block **[Figure 60-80-33]**.

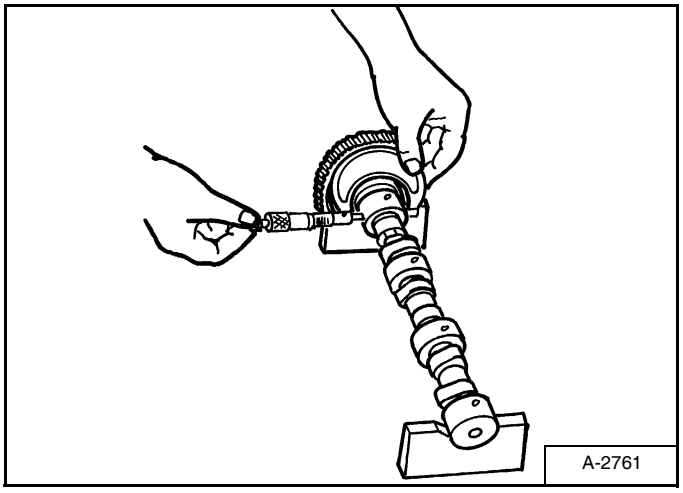
Figure 60-80-34



Measure the camshaft bearing in the engine block **[Figure 60-80-34]**.

Idler Gear And Camshaft Removal And Installation (Cont'd)

Figure 60-80-35

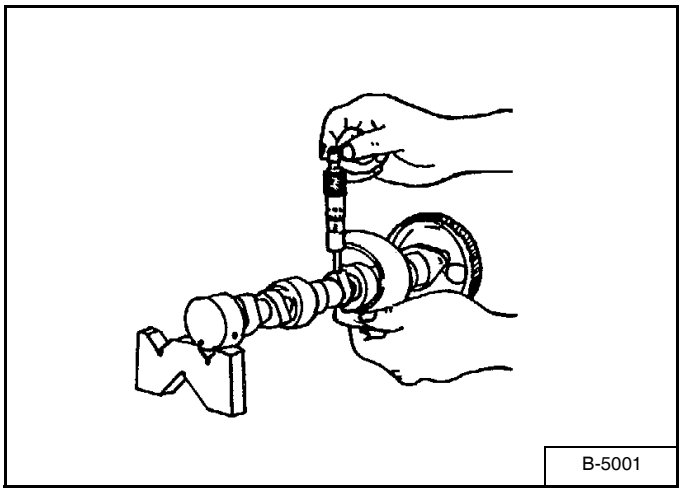


Measure the camshaft journal **[Figure 60-80-35]**.

Calculate the oil clearance. If the clearance exceeds the allowable limit, replace the camshaft.

Bearing I.D.	1.299-1.300 in. (33,0-33,03 mm)
Journal O.D.	1.2966-1.2972 in. (32,93-32,95 mm)
Clearance of Camshaft Journal	0.002-0.004 in. (0,05-0,09 mm)
Allowable Limit	0.006 in. (0,15 mm)

Figure 60-80-36

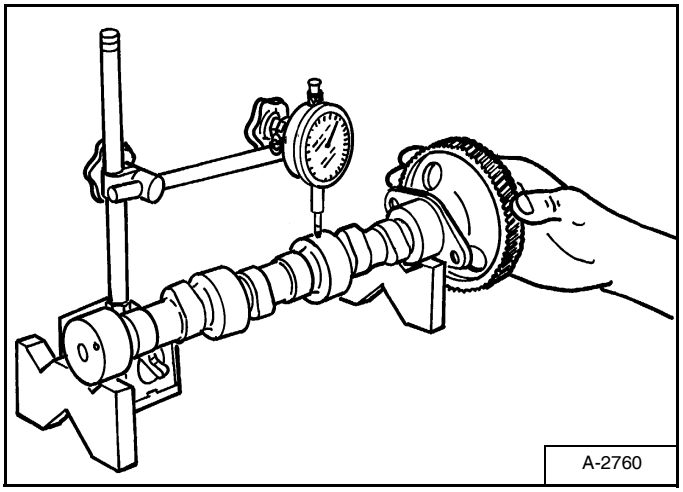


Measure the cam lobes at their highest point **[Figure 60-80-36]**.

If the measurement is less than the allowable limit, replace the camshaft.

Cam Lob Height	1.058 in. (26,88 mm)
Allowable Limit	1.056 in. (26,83 mm)

Figure 60-80-37



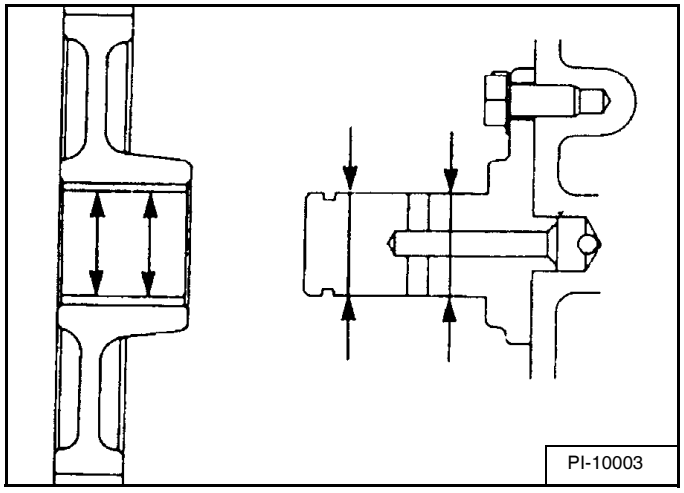
Put the camshaft in V-blocks. Install a dial indicator **[Figure 60-80-37]**.

Turn the camshaft at a slow rate. If the misalignment exceeds the allowable limit, replace the camshaft.

Camshaft Alignment Allowable Limit	0.0004 in. (0,01 mm)

Idler Gear and Shaft, Servicing

Figure 60-80-38



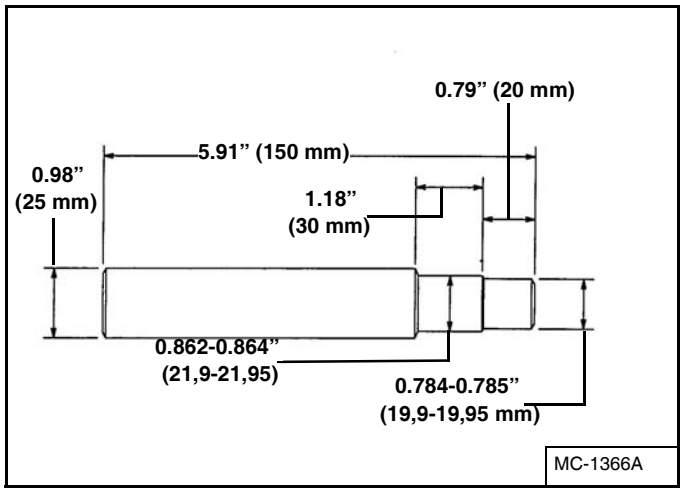
Measure the O.D. of the idler gear shaft **[Figure 60-80-38]**.

Measure the I.D. of the idler gear bushing **[Figure 60-80-38]**.

If the clearance exceeds the allowable limit, replace the bushing.

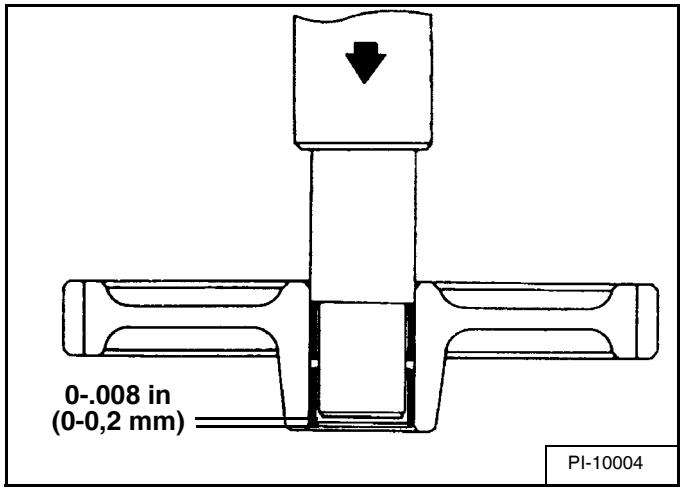
Idler Gear Shaft O.D.	0.786-0.787 in. (19,97-19,98 mm)
Idler Gear Shaft I.D.	0.787-0.789 in. (20,00-20,05 mm)
Oil Clearance between Idler Shaft & Gear Bushing	0.0008-0.0033 in. (0,020-0,084 mm)
Allowable Limit	0.004 in. (0,1 mm)

Figure 60-80-39



To replace the idler gear bushing, make a driver tool as shown in figure **[Figure 60-80-39]**.

Figure 60-80-40

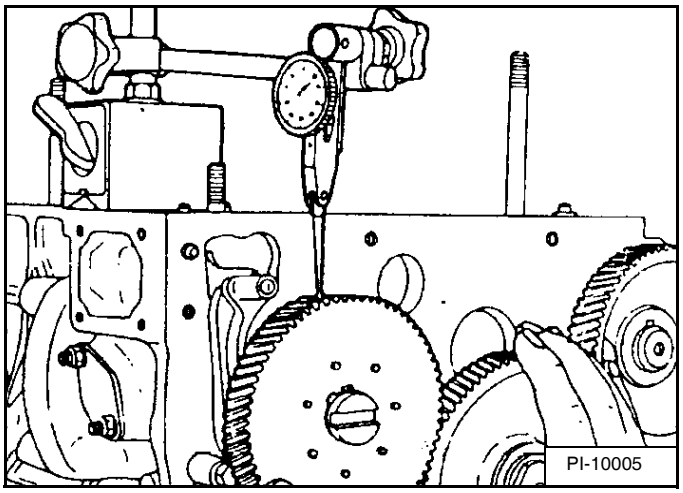


Use a press and special driver tool, to remove the old bushing and install the new bushing **[Figure 60-80-40]**.

Timing Gears Checking Backlash

When the gears are installed, check the backlash of the gears.

Figure 60-80-41



Install a dial indicator with its tip on a gear tooth **[Figure 60-80-41]**.

Hold one gear while turning the other gear **[Figure 60-80-41]**.

If the backlash exceeds the allowable limit, check the oil clearance of the shaft and gear. If the oil clearance is correct, replace the gears.

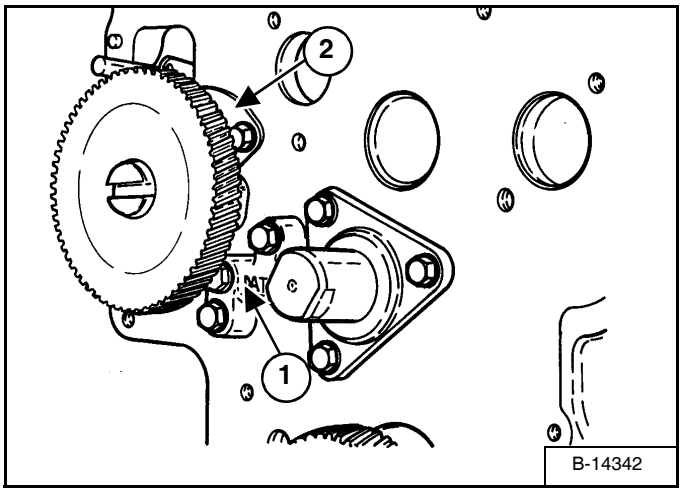
Crank Gear & Idler Gear.	
	0.002-0.005 in. (0,043-0,124 mm)
Allowable Limit	0.006 in. (0,15 mm)
Cam Gear & Idler Gear	
	0.002-0.005 in. (0,047-0,12 mm)
Allowable Limit	0.006 in. (0,15 mm)
Injection Pump Gear & Idler Gear	
	0.002-0.005 in. (0,046-0,124 mm)
Allowable Limit	0.006 in. (0,15 mm)
Oil Pump Gear & Crankshaft Cover	
	0.002-0.005 in. (0,041-0,123 mm)
Allowable Limit	0.006 in. (0,15 mm)

Fuel Camshaft Removal And Installation

Remove the timing gearcase cover. (See Timing Gearcase Cover Removal And Installation on Page 60-80-8)

Remove the idler gear. (See Cylinder Head Removal And Installation on Page 60-80-1)

Figure 60-80-42



Remove the bolt (Item 1) from the retainer plate (Item 2) **[Figure 60-80-42]**.

Installation: Tighten the bolt to 60-72 in.-lbs. (6,8-8,1 N•m) torque.

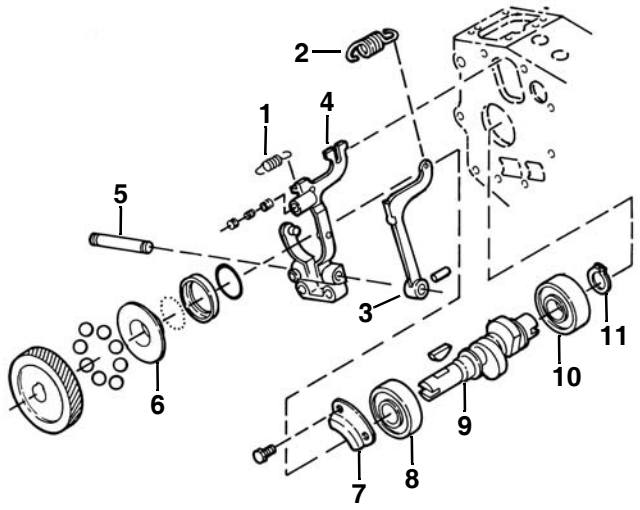
Remove the fuel camshaft retainer plate (Item 2) **[Figure 60-80-42]**.

Remove the fuel camshaft and fork lever assembly at the same time.

Fuel Camshaft Governor

The governor serves to keep the engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in the load.

Figure 60-80-43



1. Start Spring
2. Governor Spring
3. Fork Lever
4. Fork Lever
5. Fork Lever Shaft
6. Governor Sleeve
7. Retaining Plate
8. Bearing
9. Fuel Camshaft
10. Bearing
11. Snap Ring

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Disassemble and assemble the governor and fuel camshaft as shown in figure **[Figure 60-80-43]**.

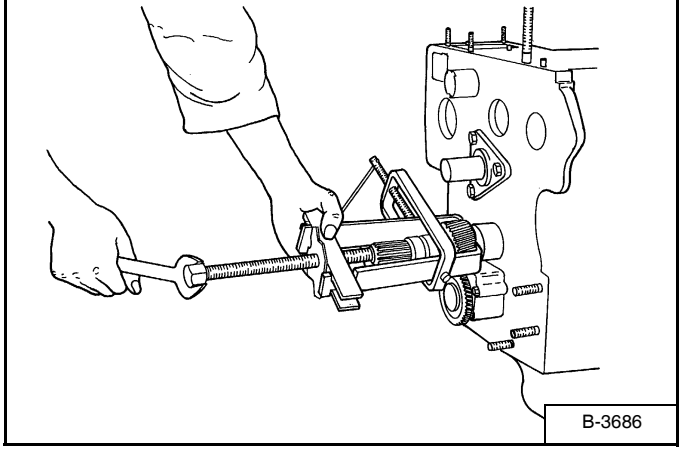
Check all the parts for wear or damage and replace as needed.

Crankshaft Gear Removal And Installation

Remove the timing gearcase cover. (See Timing Gearcase Cover Removal And Installation on Page 60-80-8.)

Remove the idler gear. (See Idler Gear And Camshaft Removal And Installation on Page 60-80-9.)

Figure 60-80-44



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Remove the crankshaft gear with a puller **[Figure 60-80-44]**.

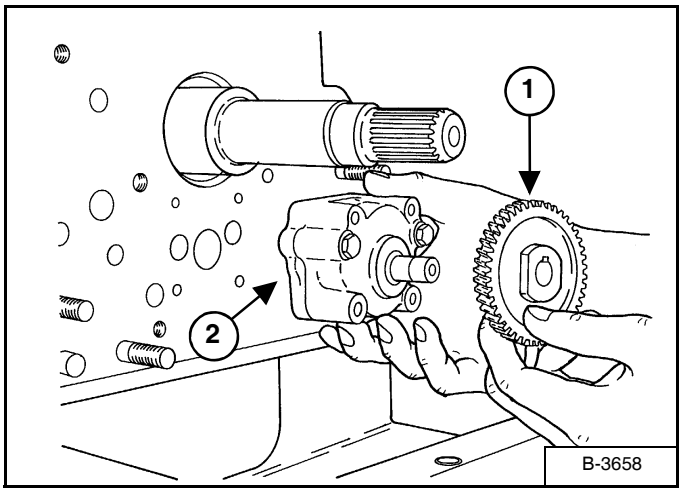
Remove the crankshaft key.

Oil Pump Removal And Installation

Remove the timing gearcase cover. (See Timing Gearcase Cover Removal And Installation on Page 60-80-8.)

Remove the crankshaft gear.

Figure 60-80-45



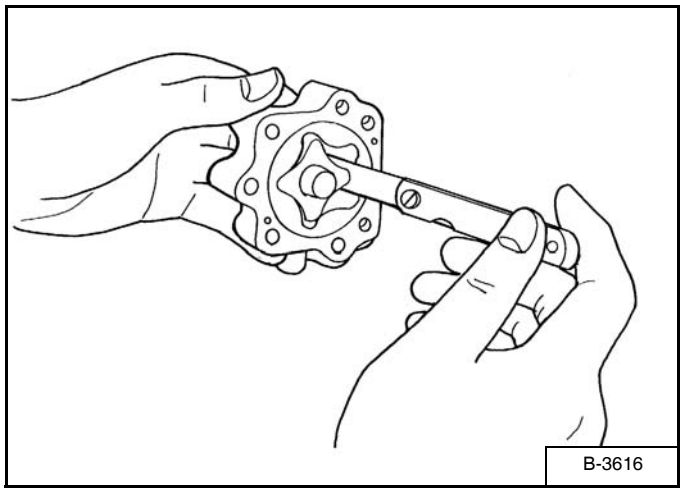
Remove the nut from the oil pump shaft. Use a puller to remove the oil pump gear (Item 1) **[Figure 60-80-45]**.

Remove the oil pump mounting bolts. Remove the oil pump (Item 2) **[Figure 60-80-45]**.

Installation: Tighten the oil pump mounting bolts to 60-72 in.-lbs. (6,9-8,1 N•m) torque.

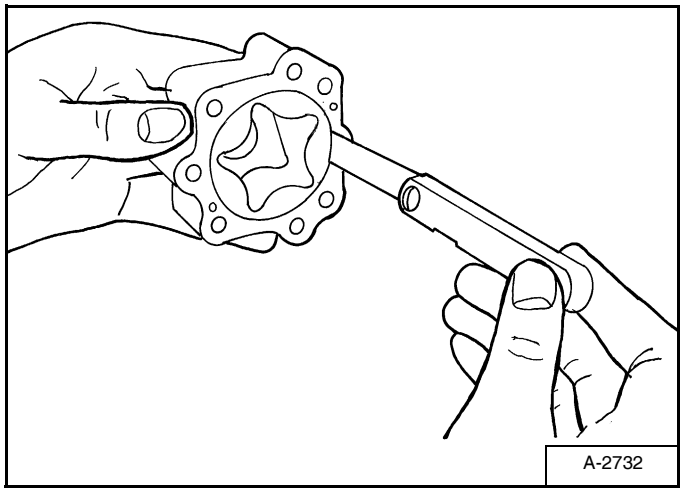
Oil Pump, Service

Figure 60-80-46



Measure the clearance between the lobes of the inner rotor and outer rotor with a feeler gauge **[Figure 60-80-46]**.

Figure 60-80-47



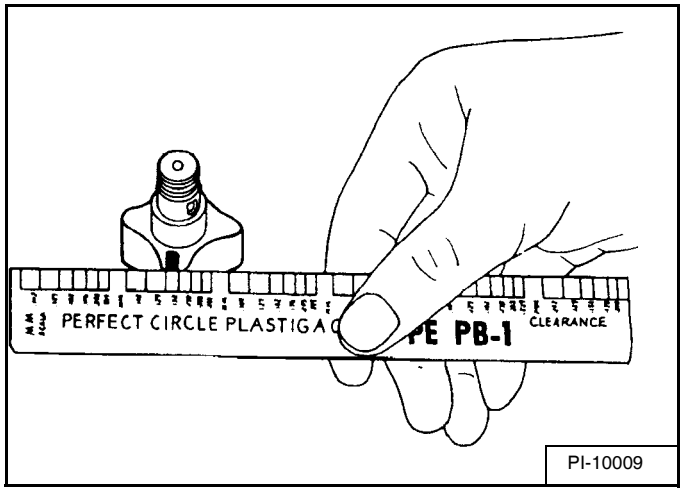
Measure the clearance between the outer rotor and pump body with a feeler gauge **[Figure 60-80-47]**.

If the clearance exceeds the factory limit, replace the oil pump rotor assembly.

Clearance Between Inner & Outer Rotor
0.012-0.006 in. (0,03-0,14 mm)
Clearance Between Outer Rotor & Body
0.003-0.006 in. (0,07-0,15 mm)

Oil Pump, Service, (Cont'd)

Figure 60-80-48



Put a piece of press gauge on the rotor face **[Figure 60-80-48]**.

Install the cover and tighten the bolts.

Remove the cover carefully. Measure the width of the press gauge **[Figure 60-80-48]**.

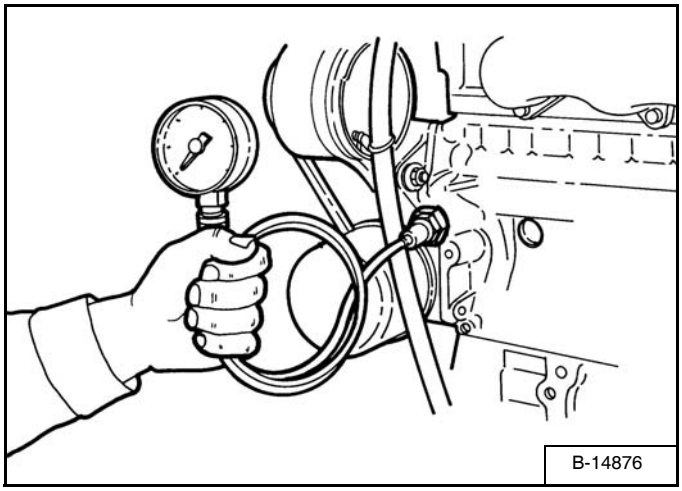
If the clearance exceeds the factory limit replace the oil pump rotor assembly.

End Clearance	0.003-0.005 in. (0,08-0,14 mm)

Engine Oil Pressure, Checking

Remove the oil pressure sensor.

Figure 60-80-49



Install a pressure gauge **[Figure 60-80-49]**.

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

Measure oil pressure at both idling and rated speeds.

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

- Engine Oil Insufficient
- Oil Pump Defective
- Oil Galley Plugged
- Oil Strainer Plugged
- Excessive Oil Clearance
- Foreign Matter in Relief Valve
- Oil Filer Cartridge plugged

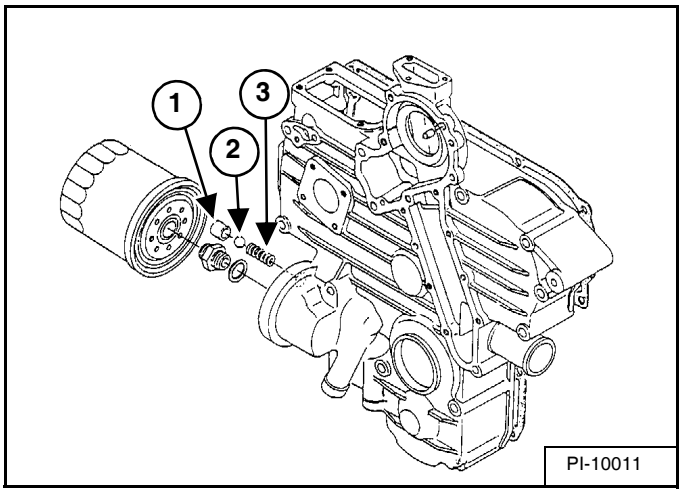
At Idle Speed Allowable Limit	14 PSI (1 Bar)
At Rated Speed	28-64 PSI (2-4 Bar)
Allowable Limit	14 PSI (1 Bar)

Installation: After checking engine oil pressure, tighten oil pressure sensor to 11-15 ft.-lb. (14,7-19,6 N•m).

Relief Valve

The relief valve prevents damage of the lubricating system due to high pressure. This relief valve is a ball type.

Figure 60-80-50



Remove the valve seat (Item 1) **[Figure 60-80-50]**, ball (Item 2) **[Figure 60-80-50]** and spring (Item 3) **[Figure 60-80-50]**.

Check the parts for wear or damage and replace as needed.

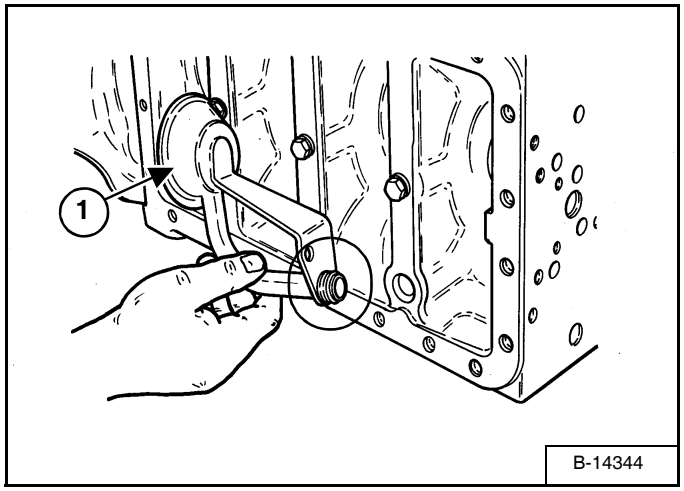
Piston And Connecting Rod Removal And Installation

Remove the cylinder head. (See Cylinder Head Removal And Installation on Page 60-80-1)

Remove the top edge from the cylinder bore with a ridge reamer.

Remove the oil pan.

Figure 60-80-51



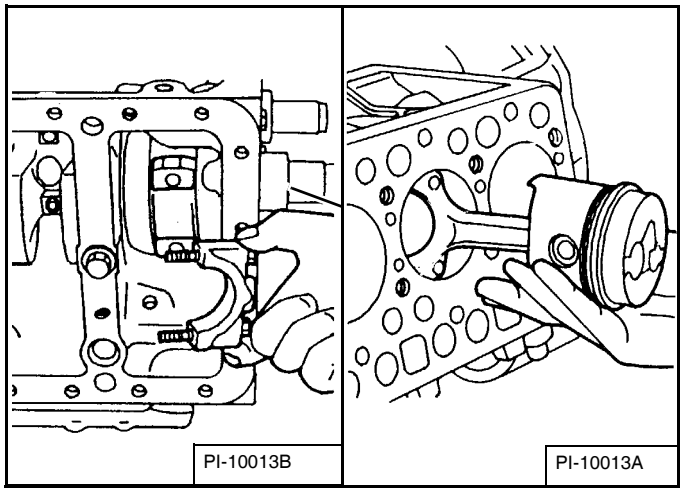
Remove the oil pump strainer (Item 1) **[Figure 60-80-51]**.

Turn the flywheel and put a pair of connecting rods at bottom dead center.

Remove the connecting rod bolts.

Installation: Tighten the connecting rod bolts to 20-22 ft.-lb. (27-30 N•m) torque.

Figure 60-80-52



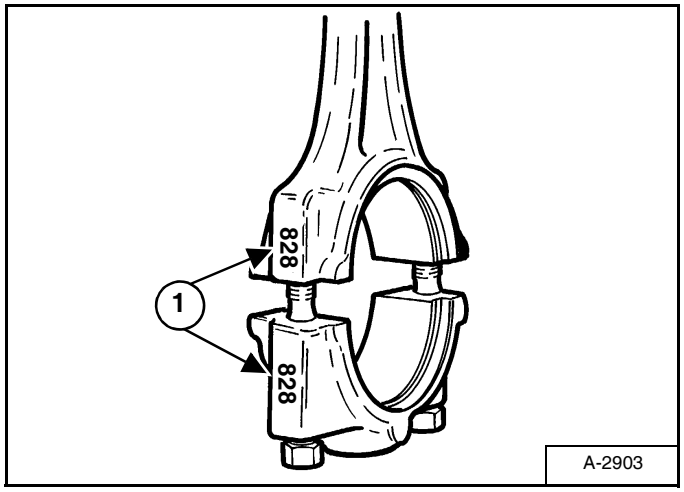
Remove the rod cap and bearing **[Figure 60-80-52]**.

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

Use a hammer handle and push the piston connecting rod assembly out of the cylinder bore **[Figure 60-80-52]**.

NOTE: Make sure the pistons are marked so they will be returned to the same cylinder bore.

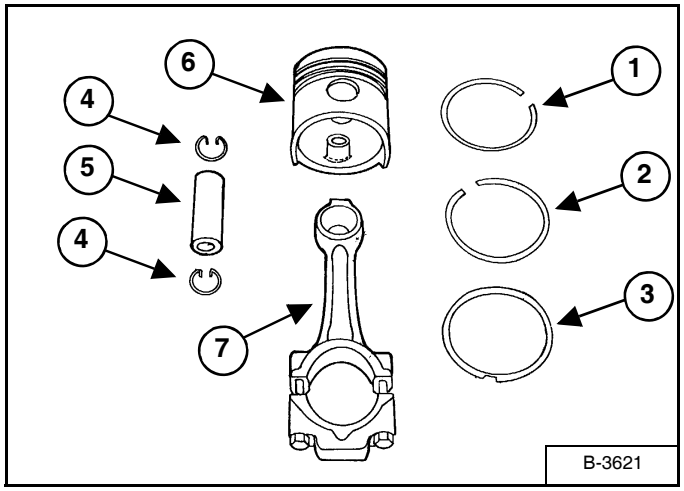
Figure 60-80-53



Installation: Make sure the marks (Item 1) on the connecting rod and bearing are aligned when installing the bearing cap **[Figure 60-80-53]**.

Repeat the procedure to remove the other piston/ connecting rod assemblies from the engine block.

Figure 60-80-54



Remove the first compression ring (Item 1) **[Figure 60-80-54]**.

Remove the second compression ring (Item 2) **[Figure 60-80-54]**.

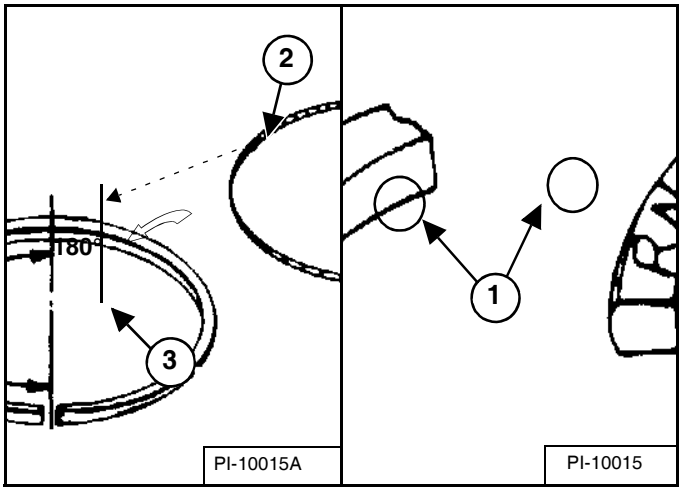
Remove the oil ring (Item 3) **[Figure 60-80-54]**.

Remove the snap ring (Item 4) and piston pin (Item 5) **[Figure 60-80-54]**.

Separate the piston (Item 6) from the connecting rod (Item 7) **[Figure 60-80-54]**.

NOTE: Make sure the piston and rod assembly is marked so as not to change the piston rod assembly with another piston or connecting rod.

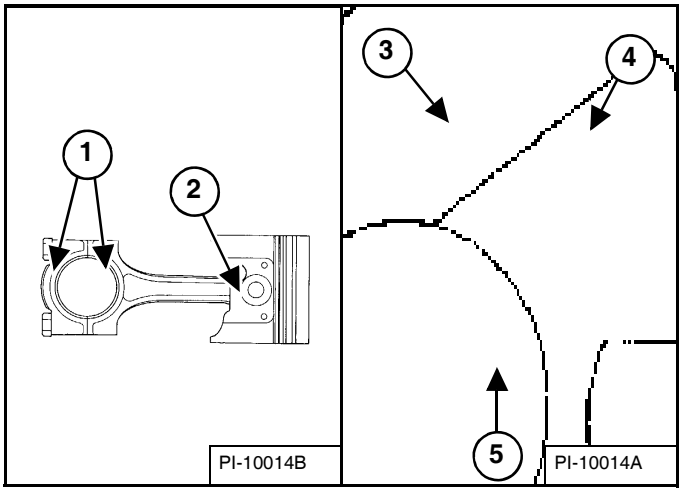
Figure 60-80-55



Installation: When installing new rings, assemble the ring so the mark (Item 1) near the gap faces the top of the piston. When installing the oil ring, place the expander joint (Item 2) on the opposite side of the oil ring gap (Item 3) **[Figure 60-80-55]**.

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

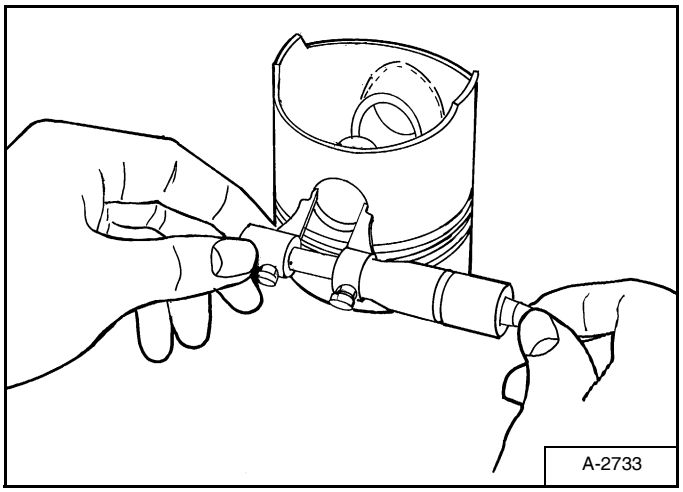
Figure 60-80-56



Installation: When reassembling, align the marks (Item 1) on the connecting rod and piston (Item 2). Heat the piston in oil to 176° F (80° C) for 10 to 15 minutes and tap the piston pin into position. Place the piston rings so that there are gaps every 120° (Item 3, 4 & 5) **[Figure 60-80-56]** with no gap facing the piston pin in the cylinder.

Piston And Connecting Rod, Servicing

Figure 60-80-57

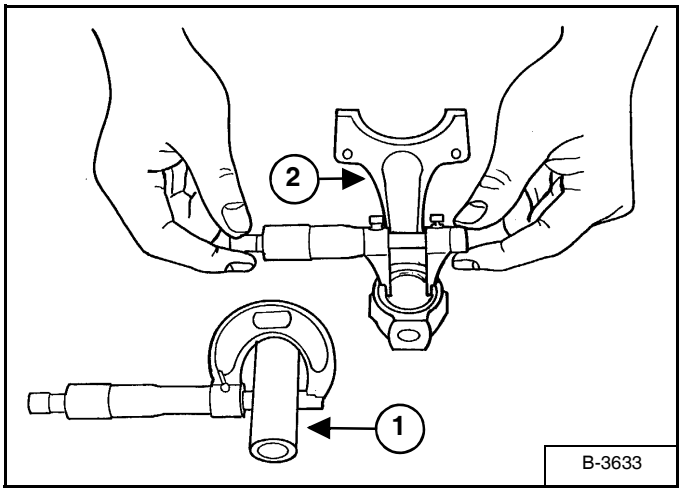


Measure the I.D. of the piston pin bore in both horizontal and vertical direction **[Figure 60-80-57]**.

If the measurement exceeds the allowable limit, replace the piston.

Piston Pin Bore I.D.	0.7874-0.7879 in. (20,0-20,013 mm)
Allowable Limit	0.789 in. (20,05 mm)

Figure 60-80-58



Measure the O.D. of the piston pin (Item 1) **[Figure 60-80-58]**.

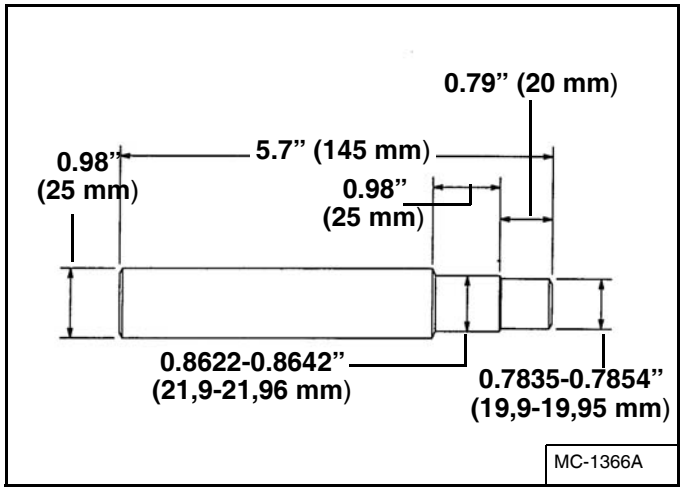
Measure the I.D. of the connecting rod small end (Item 2) **[Figure 60-80-58]**.

Piston And Connecting Rod, Servicing (Cont'd)

Calculate the oil clearance. If the clearance exceeds the allowable limit, replace the bushing. If it still exceeds the specifications, replace the piston pin.

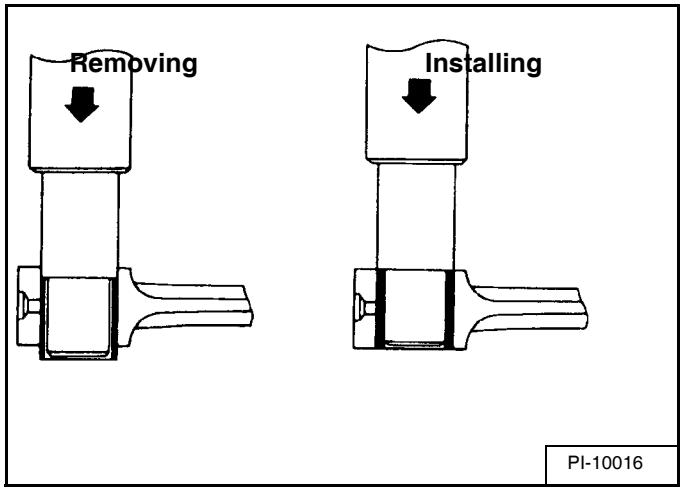
Piston Pin O.D.	0.7875-0.7878 in. (20,002-20,011 mm)
Bushing I.D.	0.7884-0.7890 in. (20,025-20,04 mm)
Oil Clearance between Piston Pin & Bushing	0.0006-0.0015 in. (0,014-0,038 mm)
Allowable Limit	0.004 in. (0,10 mm)

Figure 60-80-59



To replace the connecting rod small end bushing, make a driver tool as shown in figure **[Figure 60-80-59]**.

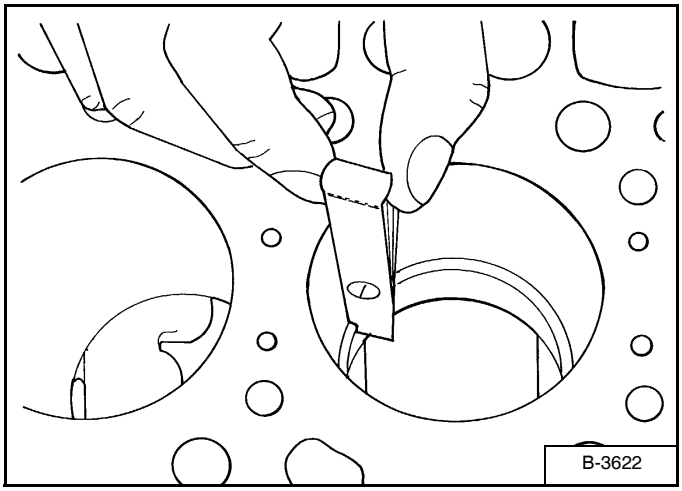
Figure 60-80-60



Use a press and special driver tool to remove the small end bushing **[Figure 60-80-60]**.

Installation: Clean the small end bushing and bore. Put oil on the bushing and press into the connecting rod until it is flush **[Figure 60-80-60]**.

Figure 60-80-61



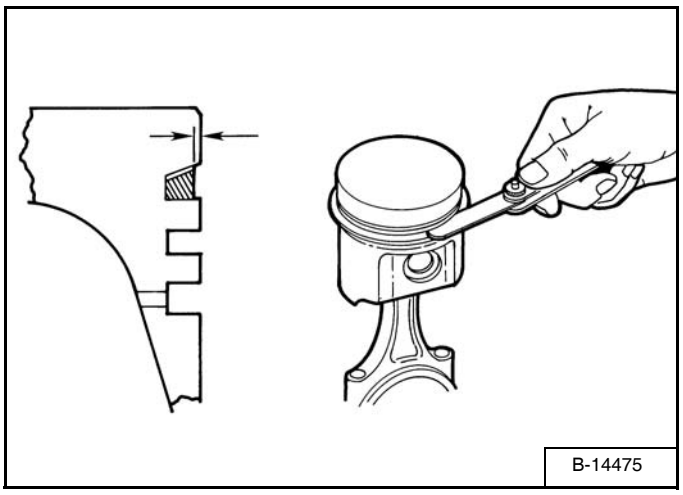
Install a new piston ring into the lower part of the cylinder bore. Measure the ring gap with a feeler gauge **[Figure 60-80-61]**.

If the gap exceeds the allowable limit, replace the piston ring.

Top Compression Ring & Oil Ring	0.006-0.012 in. (0,15-0,30 mm)
Second Compression Ring	0.012-0.018 in. (0,30-0,45 mm)
Allowable Limit	0.047 in. (1,2 mm)

Piston And Connecting Rod, Servicing (Cont'd)

Figure 60-80-62



Remove the carbon from the ring grooves. Measure the clearance between the ring and groove with a feeler gauge **[Figure 60-80-62]**.

Second ring	0.0035-0.0043 in. (0,09-0,12 mm)
Oil ring	0.0016-0.0031 in. (0,04-0,08 mm)
Allowable limit second ring	0.0059 in. (0,15 mm)
Allowable limit oil ring	0.0059 in. (0,15 mm)

If the clearance exceeds the allowable limit, replace the piston.

Connecting Rod Alignment

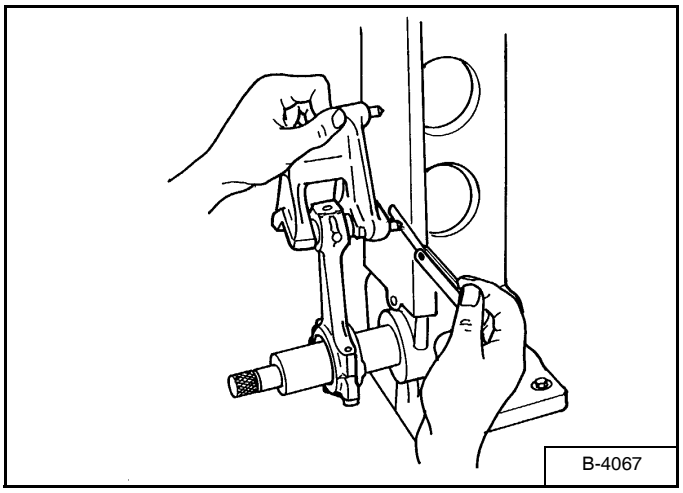
NOTE: The small end bushing is the basis of this check, check the bushing for wear before doing this check.

Install the piston pin into the connecting rod.

Install the connecting rod on an alignment tool.

Put the gauge over the piston pin and move it against the face plate.

Figure 60-80-63



If the gauge does not fit squarely against the face place, measure the space between the gauge and face plate **[Figure 60-80-63]**.

If the measurement exceeds the allowable limit, replace the connecting rod.

Rod Alignment Allowable Limit

0.002 in.(0,05 mm)

Crankshaft And Bearings Removal And Installation

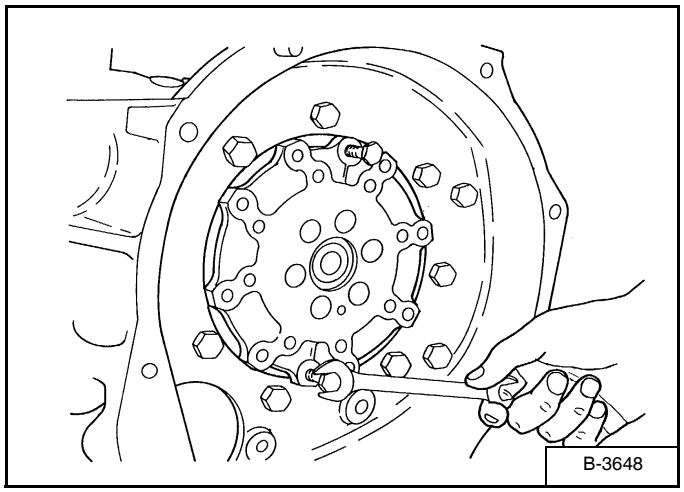
Remove the piston and connecting rod assemblies. (See Piston And Connecting Rod Removal And Installation on Page 60-80-17.)

Remove the engine flywheel. (See Cylinder Head Removal And Installation on Page 60-80-1.)

Remove the bolts which fasten the bearing case cover to the block.

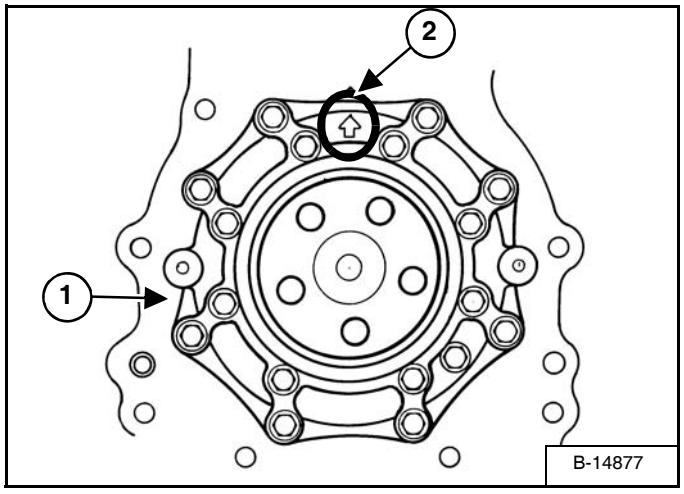
Installation: Tighten the bearing case cover bolts to 7-8 ft.-lb. (10-11 N•m) torque. Tighten bolts with even force on the diagonal line.

Figure 60-80-64



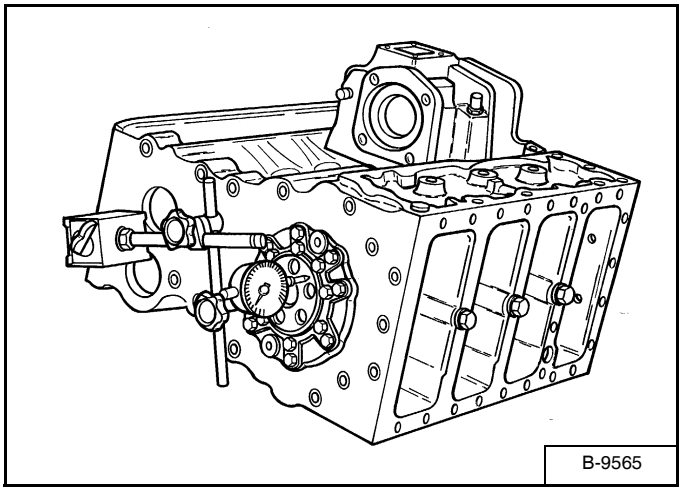
Install two bolts into the bearing case cover and pull the cover out **[Figure 60-80-64]**.

Figure 60-80-65



Installation: When installing the cover (Item 1), make sure the casting mark (Item 2) **[Figure 60-80-65]** is in the up position. Apply Liquid-Type Gasket (Three Bond 1215 or equivalent) to both sides of the new gasket.

Figure 60-80-66

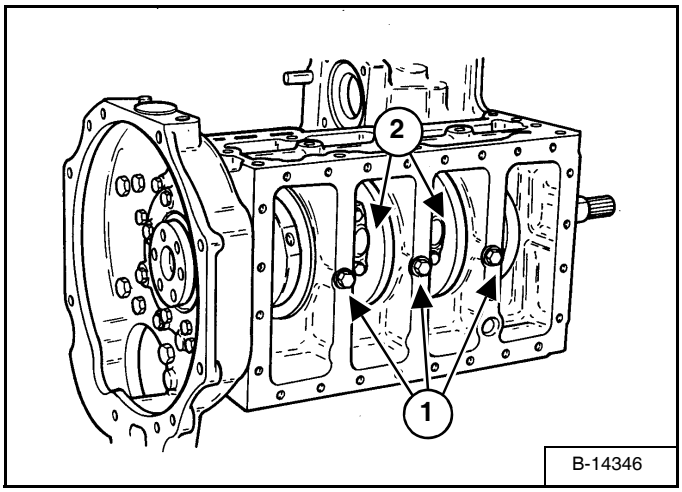


Before removing the crankshaft/main bearings, check the end play. Install a dial indicator. Measure the end play by moving the crankshaft back and forth **[Figure 60-80-66]**.

If the measurement exceeds the allowable limit, replace the thrust washers.

End Play	0.006-0.012 in. (0,15-0,31 mm)
Allowable Limit	0.020 in. (0,5 mm)

Figure 60-80-67

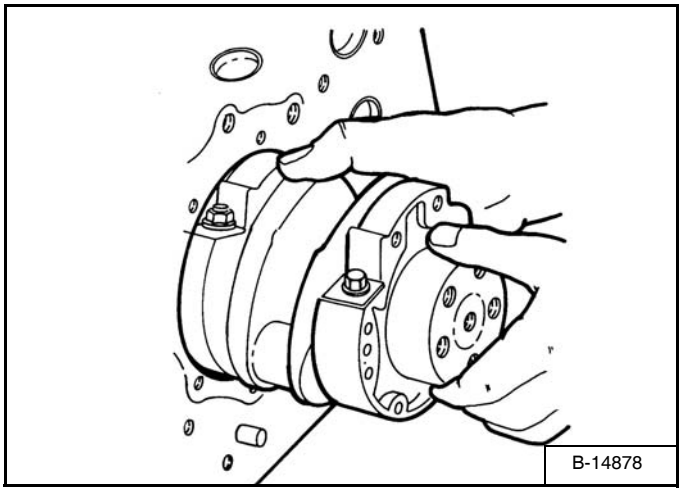


Remove the main bearing case bolt (Item 1) **[Figure 60-80-67]**.

Installation: Align the bearing case hole (Item 2) **[Figure 60-80-67]** with the hole in the block. Put oil on the bolt threads and tighten to 20-22 ft.-lb. (27-30 N•m) torque.

Crankshaft And Bearings Removal And Installation (Cont'd)

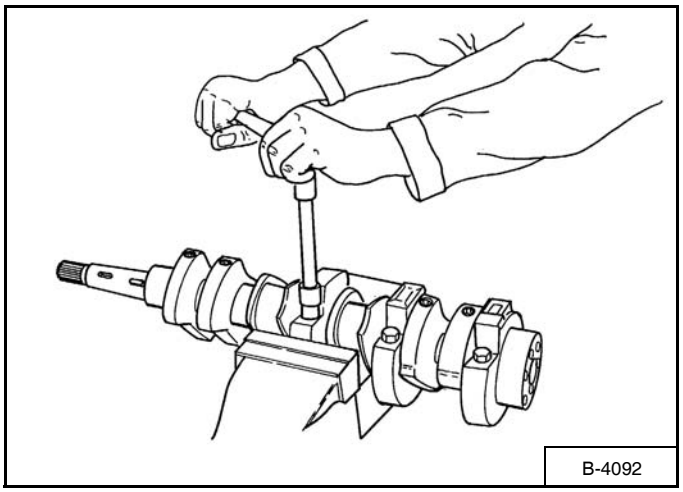
Figure 60-80-68



Remove the crankshaft/main bearing assembly from the engine block **[Figure 60-80-68]**.

Mark the bearing case halves for correct installation.

Figure 60-80-69

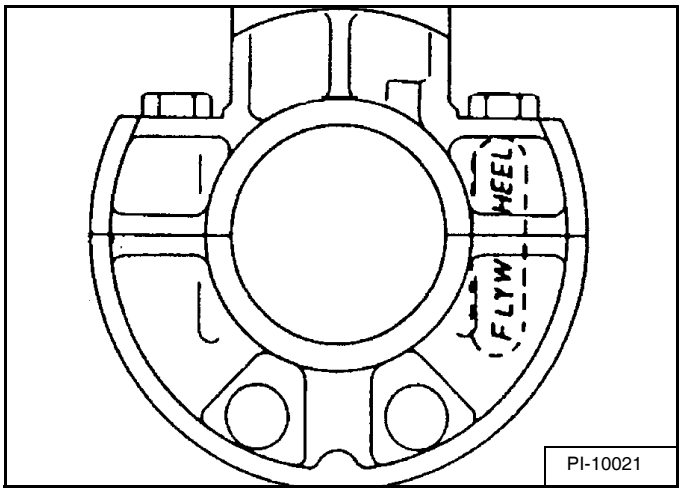


Remove the two bearing case bolts **[Figure 60-80-69]**.

Remove the bearing case and bearing.

Installation: Tighten the bearing case bolts to 9-12 ft.-lb. (13-16 N•m) torque.

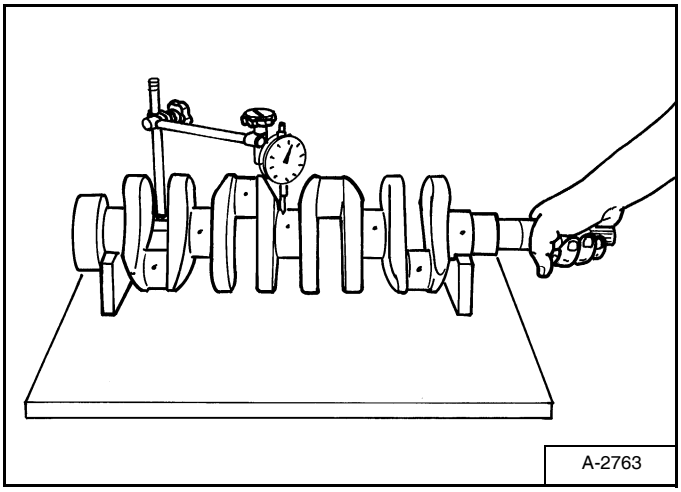
Figure 60-80-70



Installation: When installing the main bearing case assemblies, face the mark FLYWHEEL to the flywheel side of the engine block **[Figure 60-80-70]**. Be sure the thrust washer with its oil grooves face outward.

Crankshaft And Bearings, Servicing

Figure 60-80-71



Put the crankshaft on V-blocks. Install a dial indicator on the center journal **[Figure 60-80-71]**.

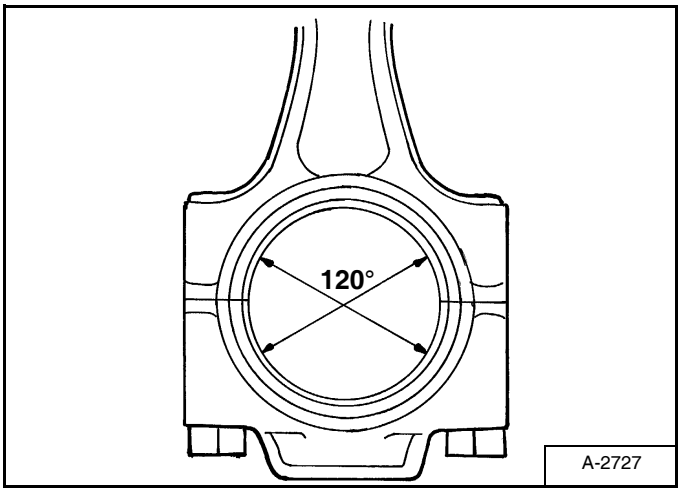
Turn the crankshaft at a slow rate.

If the misalignment exceeds the allowable limit, replace the crankshaft.

Alignment	0.0004 in. (0,01 mm)

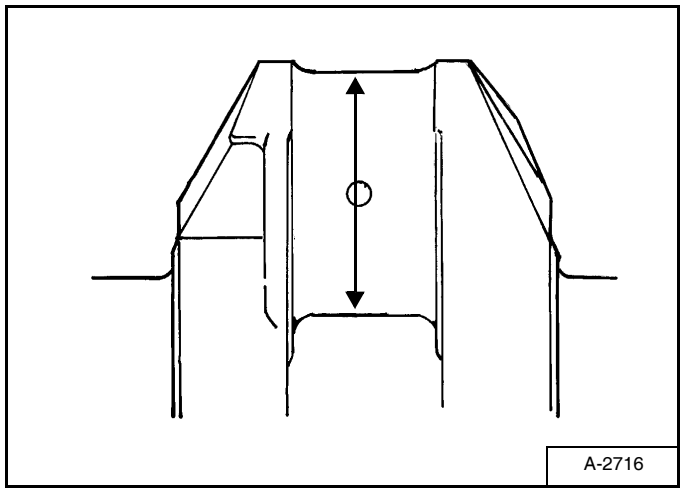
Tighten the connecting rod cap bolts 20-22 ft.-lb. (27-30 N•m) torque.

Figure 60-80-72



Measure the crankpin bearing I.D. **[Figure 60-80-72]**.

Figure 60-80-73

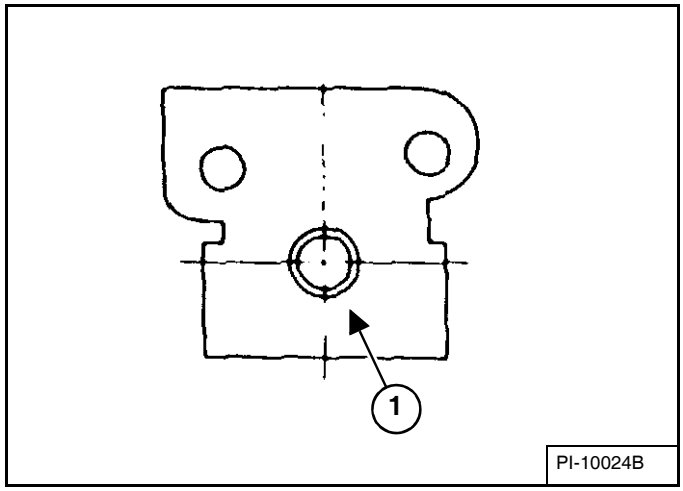


Measure the crankpin O.D. **[Figure 60-80-73]**.

Calculate the oil clearance.

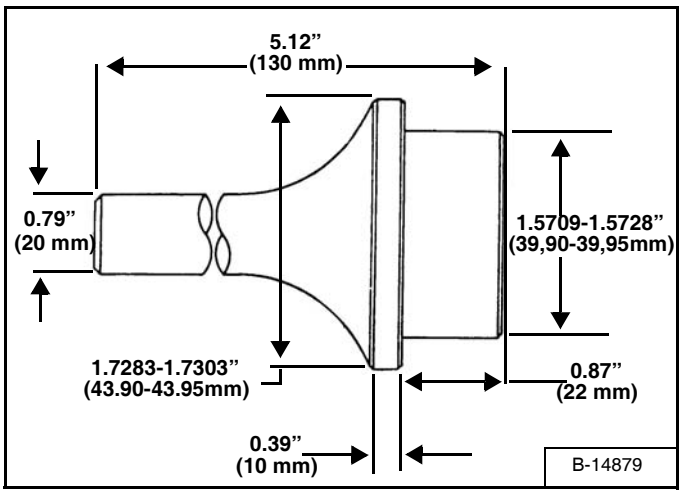
Crankpin Bearing I.D.	1.338-1.340 in. (33,99 -34,04 mm)
Crankpin O.D.	1.337-1.338 in. (33,96-33,98 mm)
Oil Clearance	0.0008-0.0032 in.(0,019-0,081 mm)
Allowable limit	0.0059 in. (0,15 mm)

Figure 60-80-74



Crankshaft And Bearings, Servicing (Cont'd)

Figure 60-80-75



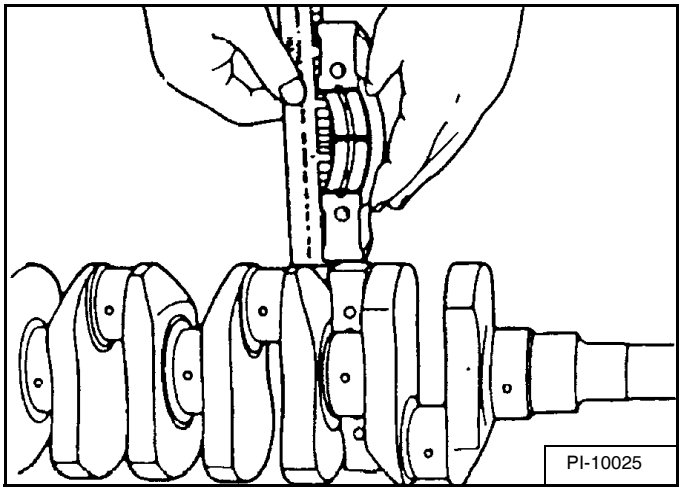
Remove the bearing (Item 1) **[Figure 60-80-74]** from the front of the engine block with the removal tool shown in **[Figure 60-80-75]**.

Installation: Clean the new bearing and bore and apply oil to them. Install the new bearing with the installation driver tool **[Figure 60-80-74]**.

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

Install the main bearing case halves and tighten the bolts to 9-12 ft.-lb. (12,7-15,7 N•m) torque. Remove the bearing case halves.

Figure 60-80-76



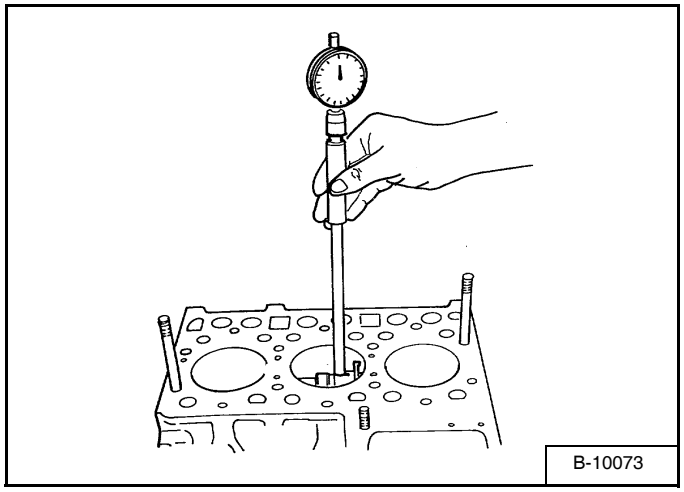
Measure the flattened press gauge **[Figure 60-80-76]**.

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

Crankshaft Journal O.D. (Flywheel side)	
	1.7297-1.7303 in. (43,93-43,95 mm)
Bearing I.D.	1.7317-1.7333 in. (43,98-44,03 mm)
Crankshaft Journal O.D. (Middle)	
	1.5722-1.5728 in. (39,93-39,95 mm)
Bearing I.D.	1.5742-1.5758 in. (39,98-40,03 mm)
Crankshaft journal O.D. (Front)	
	1.5722-1.5728 in. (39,93-39,95 mm)
Bearing I.D.	1.5742-1.5758 in. (39,98-40,03 mm)
Oil Clearance	0.001-0.004 in. (0,034-0,092 mm)
Allowable Limit	0.008 in. (0,2 mm)

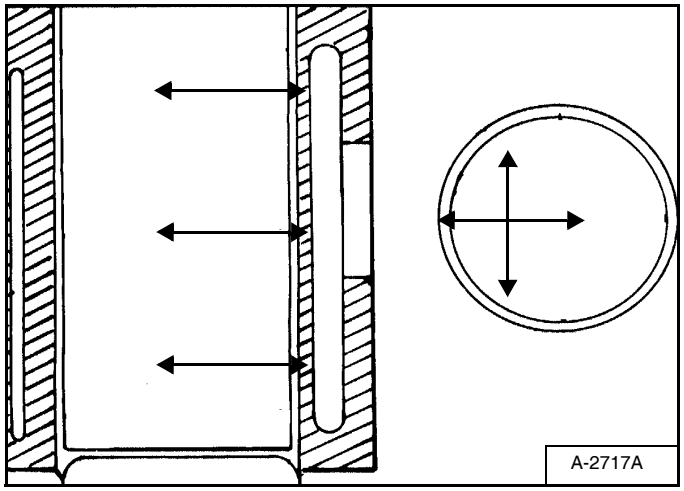
Cylinder Bore, Checking

Figure 60-80-77



Check the inside diameter of the cylinder line **[Figure 60-80-77]**.

Figure 60-80-78



To find the maximum wear check the inside diameter in six different locations **[Figure 60-80-78]**.

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

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

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

Water Pump Removal And Installation

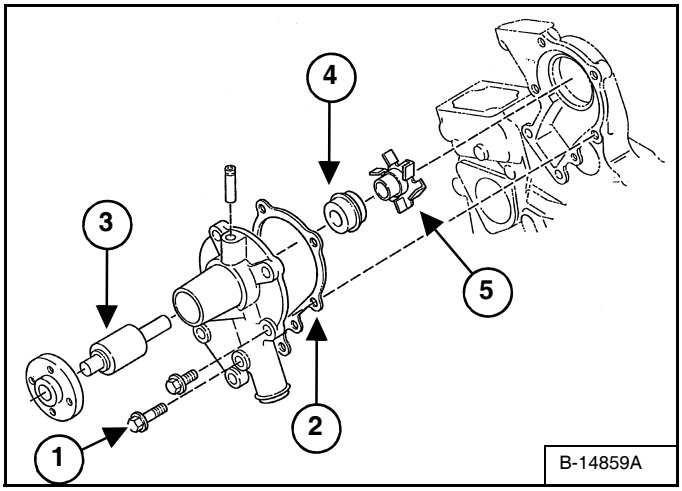
Drain the cooling system.

Remove the radiator. (See Removal And Installation on Page 60-40-1.)

Remove the alternator belt.

Remove the fan.

Figure 60-80-79



Remove the water pump bolts (Item 1) **[Figure 60-80-79]**.

Remove the water pump.

Installation: Always use a new gasket (Item 2) **[Figure 60-80-79]** when installing the water pump and apply Liquid-Type Gasket (Three Bond 1215 or equivalent) to both sides of new gasket.

Water Pump Disassembly And Assembly

Put the water pump in a vise.

Remove the pulley.

Press the shaft (Item 3) **[Figure 60-80-79]** out of the pulley side of the water pump. Press out the shaft with the impeller on it.

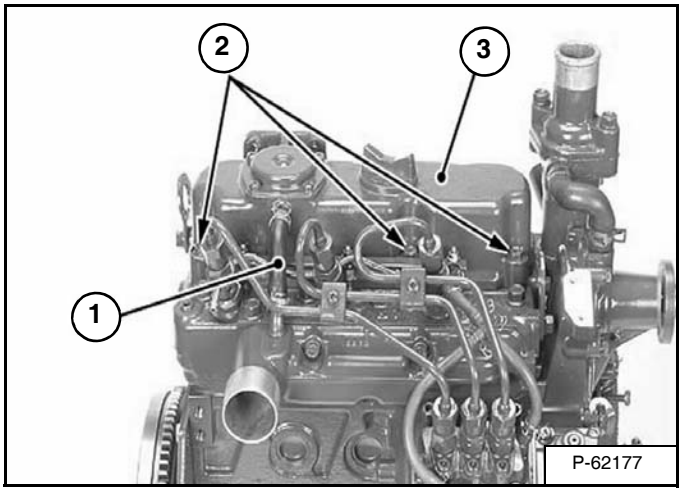
Remove the seal (Item 4) and impeller (Item 5) **[Figure 60-80-79]**.

Install a new seal when assembling the water pump.

RECONDITIONING THE ENGINE (S/N 223911622 & ABOVE, S/N 224013375 & ABOVE)

Cylinder Head Removal And Installation

Figure 60-81-1



Remove the breather hose (Item 1) **[Figure 60-81-1]**.

Remove the bolts (Item 2) from the valve cover and remove the valve cover and gasket (Item 3) **[Figure 60-81-1]**.

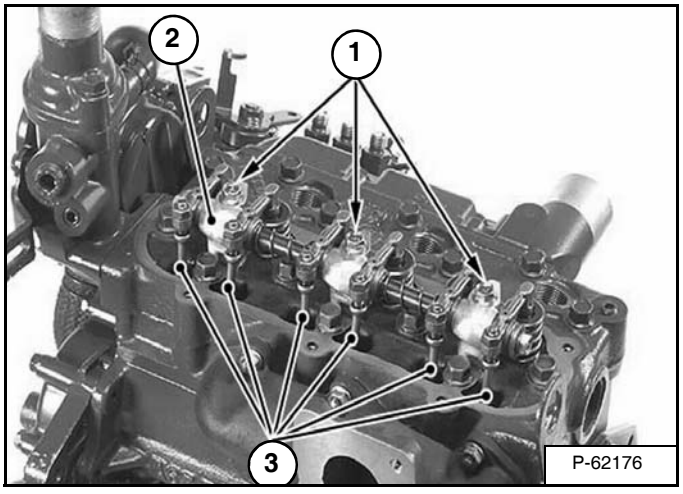
Installation: Tighten the bolts to 5-8 ft.-lb. (7-11 N•m) torque. Gradually tighten center bolts before the end bolts to avoid cracking valve cover.

Remove the fuel injector nozzles. (See Fuel Injector Removal And Installation on Page 60-51-7.)

Remove the glow plugs. (See Glow Plug Removal And Installation on Page 60-51-10.)

Remove the alternator. (See Removal And Installation on Page 50-30-4.)

Figure 60-81-2



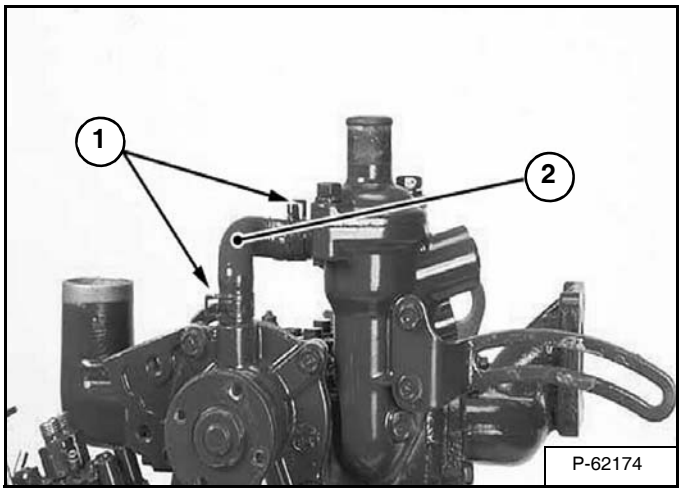
Remove the rocker arm bracket screws (Item 1) and shaft assembly (Item 2) **[Figure 60-81-2]**.

Installation: Tighten the nuts to 7-8 in.-lb. (9,8-11,3 N•m) torque.

Remove the pushrods (Item 3) **[Figure 60-81-2]**.

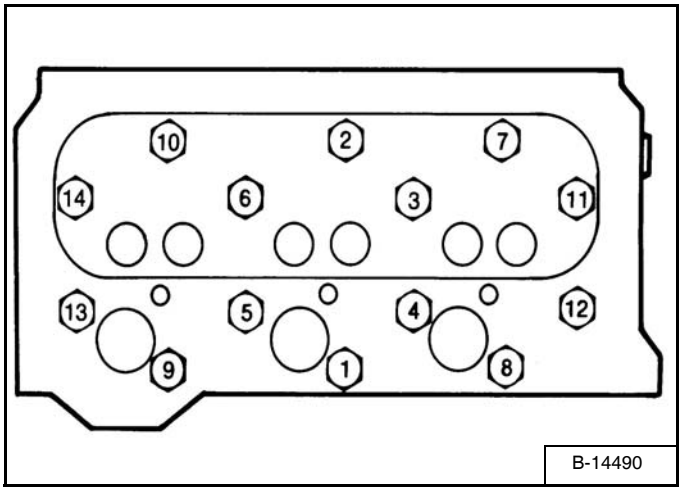
Remove the intake and exhaust manifolds.

Figure 60-81-3



Remove the water return hose **[Figure 60-81-3]**.

Figure 60-81-4



Remove the cylinder head bolts in order of #14 to #1 **[Figure 60-81-4]**.

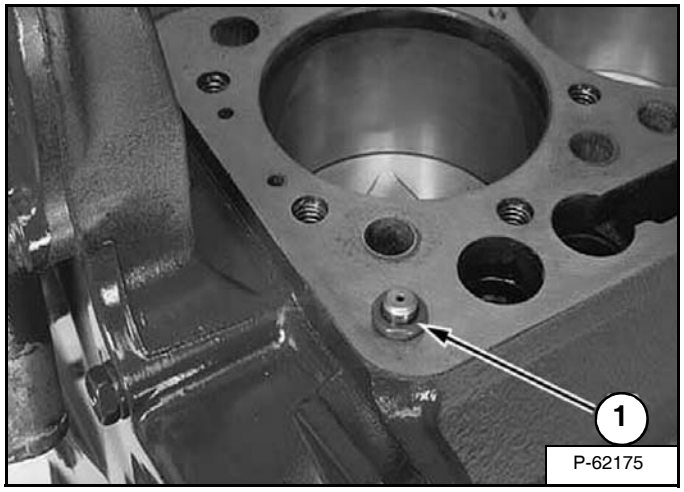
Installation: Put oil on the bolt threads. Tighten the bolts in the correct sequence of #1 to #14 to 28-31 ft.-lb. (38-42 N•m) torque.

NOTE: Re-tighten the cylinder head bolts in the correct sequence after the engine has been run for 30 minutes.

Remove the cylinder head from the engine block.

Cylinder Head Removal And Installation (Cont'd)

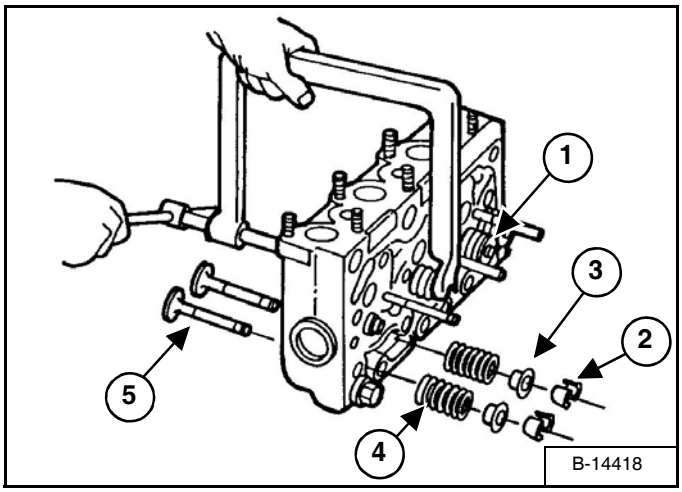
Figure 60-81-5



Installation: Always use a new head gasket and new O-ring. Make sure the O-ring (Item 1) **[Figure 60-81-5]** is seated over the dowel.

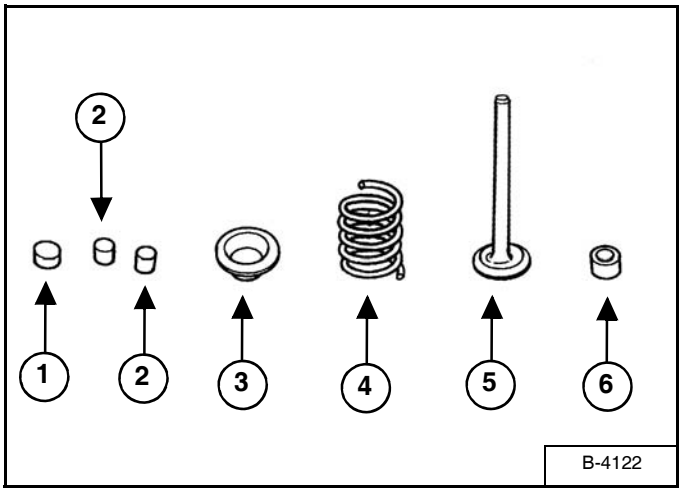
Cylinder Head Disassembly And Assembly

Figure 60-81-6



Use a valve spring compressor to compress the valve spring **[Figure 60-81-6]**.

Figure 60-81-7



Remove the valve cap (Item 1) **[Figure 60-81-7]** and valve spring collet (Item 2) **[Figure 60-81-6]** & **[Figure 60-81-7]**.

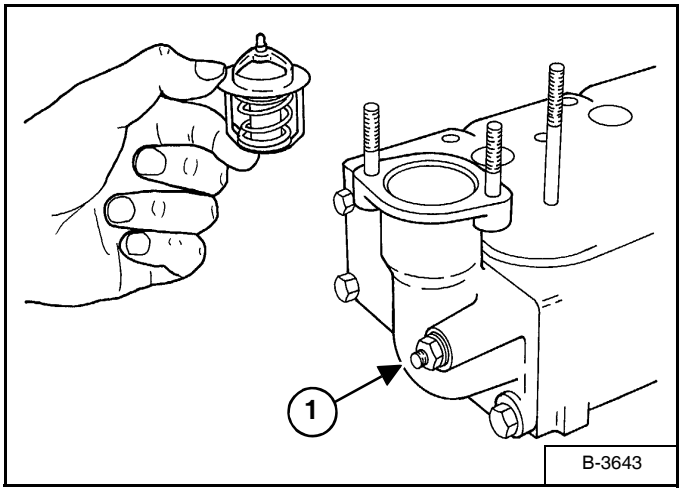
Remove the valve spring retainer (Item 3) **[Figure 60-81-6]** & **[Figure 60-81-7]** and the spring (Item 4) **[Figure 60-81-6]** & **[Figure 60-81-7]**.

Remove the valve (Item 5) **[Figure 60-81-6]** & **[Figure 60-81-7]**.

Remove the seal (Item 6) **[Figure 60-81-7]**.

Cylinder Head Disassembly And Assembly (Cont'd)

Figure 60-81-8

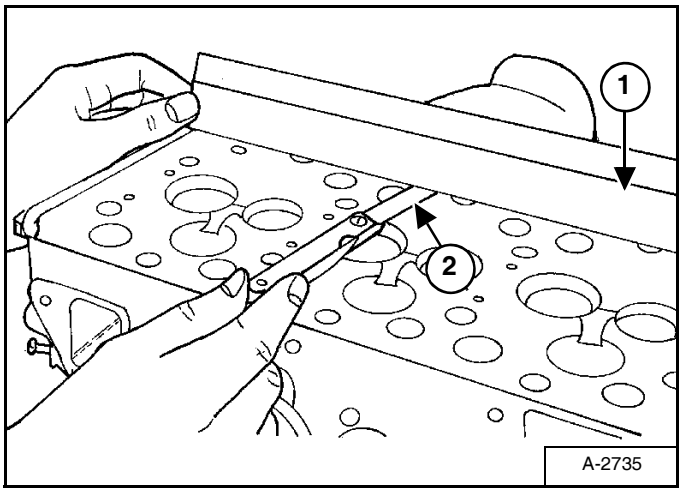


Remove the thermostat cover and thermostat from the cylinder head. Remove the thermostat housing (Item 1) **[Figure 60-81-8]**.

Installation: Apply Liquid-Type Gasket (Three Bond 1215 or equivalent) to both sides of the new thermostat cover gasket and new thermostat housing gasket.

Cylinder Head, Servicing

Figure 60-81-9



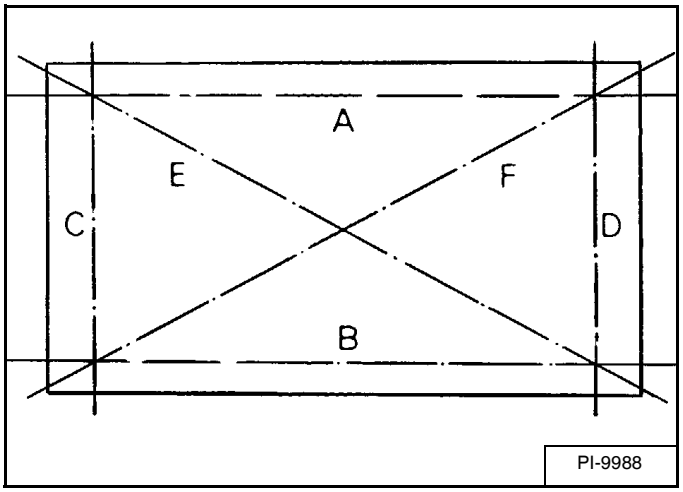
Clean the surface of the cylinder head.

Put a straight edge (Item 1) **[Figure 60-81-9]** on the cylinder head.

NOTE: Do not put the straight edge across combustion chambers.

Put a feeler gauge (Item 2) **[Figure 60-81-9]** between the straight edge and the surface of the cylinder head.

Figure 60-81-10

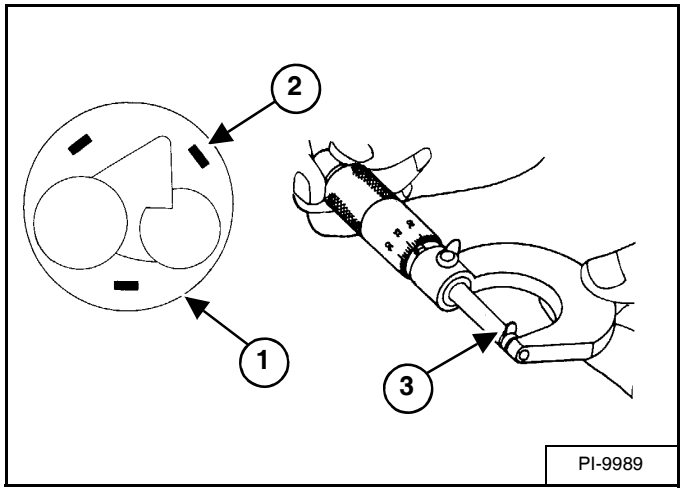


Put the straight edge on the cylinder head's four sides and two diagonal as shown in figure **[Figure 60-81-10]**.

The maximum distortion of the head surface ± 0.002 in. (± 0,05 mm). If the measurement is more than the specification, remove the combustion chambers, then grind the cylinder head. Grind the same amount of material from the bottom of the combustion chambers as was removed from the head.

Cylinder Head Top Clearance

Figure 60-81-11



Install the cylinder head gasket. Put the piston (Item 1) **[Figure 60-81-11]** being checked at T.D.C.

Put 3 pieces of 0.06 in. (1,5 mm) diameter solder (Item 2) **[Figure 60-81-11]** on the top piston. Use grease to hold them in position.

NOTE: Put the solder in position so they do not touch the valves.

Turn the piston to bottom dead center.

Install the cylinder head and tighten to the correct torque in the correct sequence. (See Cylinder Head Removal And Installation on Page 60-80-1.)

Turn the crankshaft until the piston exceeds T.D.C. Remove the cylinder head.

Remove the solder wire (Item 3) **[Figure 60-81-11]** and measure it.

If the measurement exceeds the specifications, check the oil clearance of the crank pin journal or the piston pin.

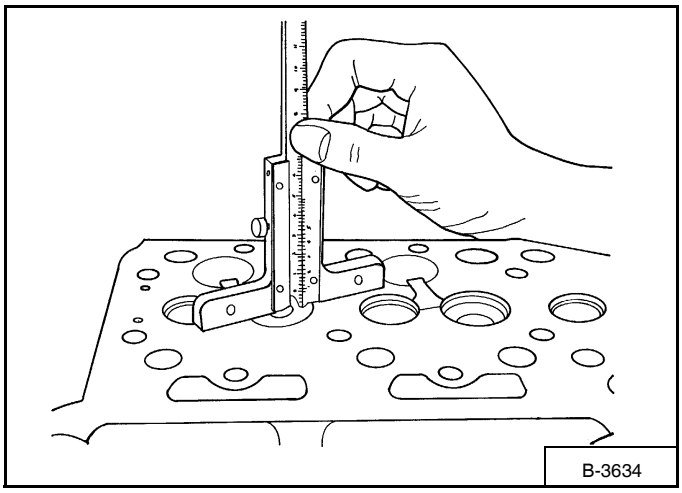
Top clearance 0.0197-0.0276 in. (0,50-0,70 mm)

Valve Guide, Checking

Remove the valve and spring from the cylinder head. (See Cylinder Head Removal And Installation on Page 60-51-1.)

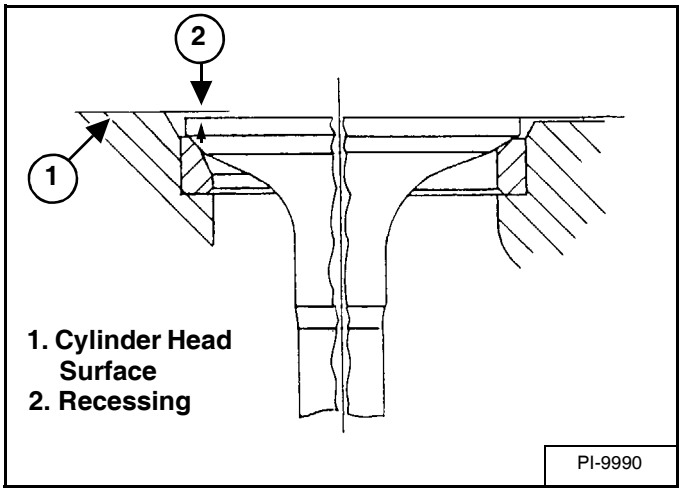
Clean the valve seat and combustion chamber.

Figure 60-81-12



Install the valve into the guide. Measure the valve recessing with a depth gauge **[Figure 60-81-12]**.

Figure 60-81-13



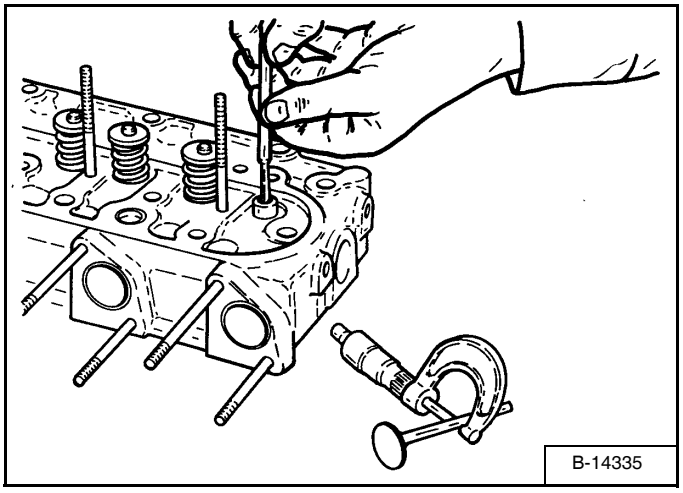
If the measurement exceeds the allowable limit, replace the valve or cylinder head **[Figure 60-81-13]**.

Recessing	0.004 in. (0,10 mm)
Allowable Limit (Recessing)	0.012 in. (0,30 mm)

Remove the carbon from the valve guide.

Valve Guide, Checking (Cont'd)

Figure 60-81-14



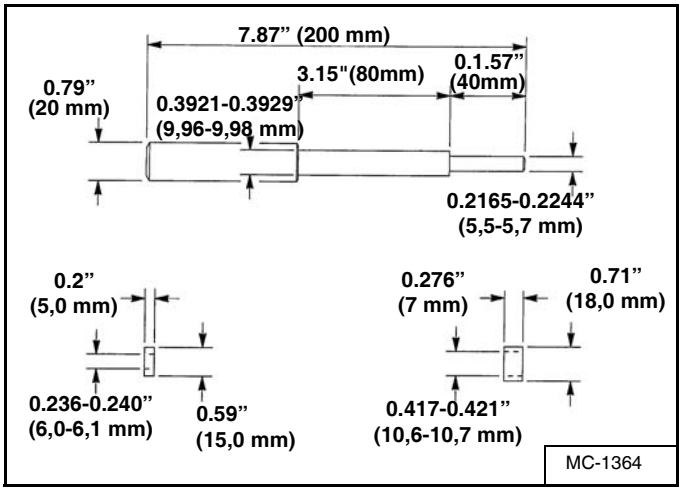
Measure the valve stem O.D. **[Figure 60-81-14]**.

Measure the valve guide I.D. **[Figure 60-81-14]**.

Calculate the clearance. If the clearance exceeds the allowable limit, replace the valve and/or valve guide.

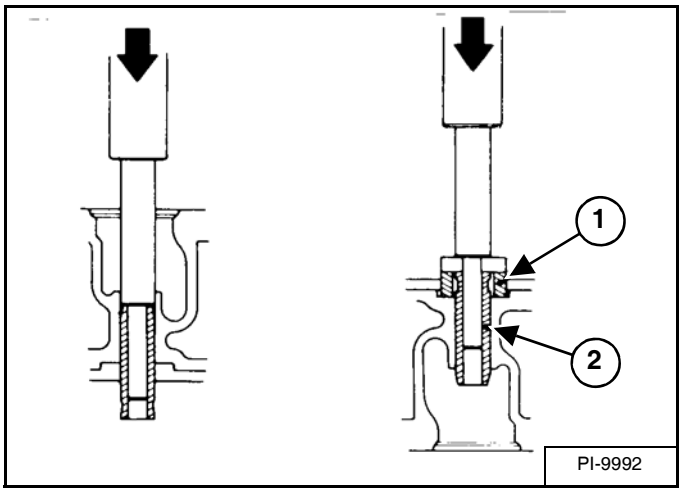
Valve Guide I.D	0.2366-0.2372 in. (6,01-6,025 mm)
Valve Stem O.D	0.2350-0.2354 in. (5,968-5,980 mm)
Clearance Between Valve Stem and Guide	0.0012-0.0022 in. (0,03-0,057 mm)
Allowable Limit	0.0039 in. (0,10 mm)

Figure 60-81-15



To remove and replace the valve guide, make the driver tools as shown in figure **[Figure 60-81-15]**.

Figure 60-81-16



Press the used valve guide out of the cylinder head using the special driver tool **[Figure 60-81-16]**. (See previous page for tool dimensions.)

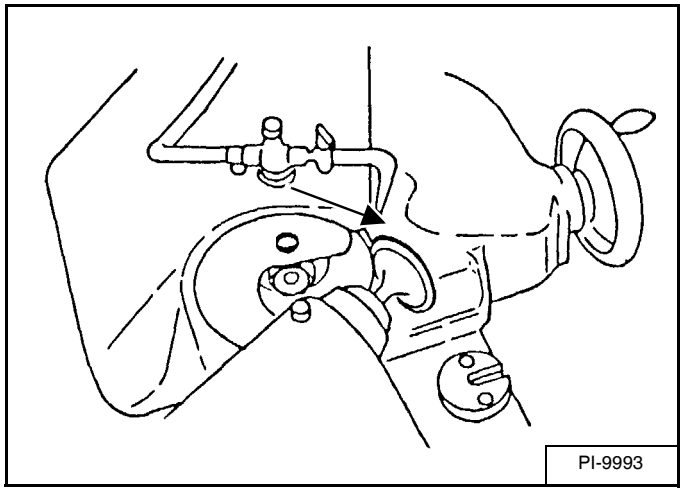
Put oil on the outside diameter of the new valve guide. Press the new valve guide into the cylinder head from the top side. Use the special driver tools (Item 1 & 2) **[Figure 60-81-16]**, press the new guide until the tools contact the cylinder head.

Ream the valve guide to the correct specifications.

NOTE: Valve guide I.D. (Intake and Exhaust) factory spec. is .2366-.2372 in. (6,01-6,025 mm)

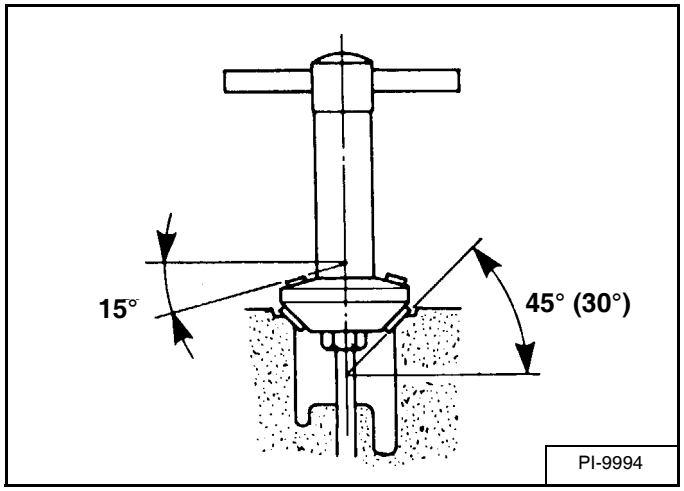
Valve And Valve Seat Reconditioning

Figure 60-81-17



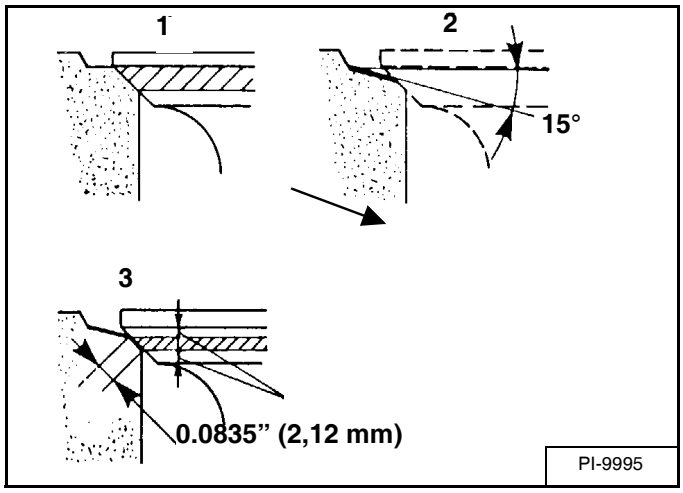
Grind the valve face to the correct angle using a valve refacer **[Figure 60-81-17]** & **[Figure 60-81-19]**.

Figure 60-81-18



Grind the valve surface in the cylinder head to the correct angle **[Figure 60-81-18]**.

Figure 60-81-19



Check the seat surface and valve face (Item 1) **[Figure 60-81-19]**.

If the seat surface is too wide, use a 15 degree cutter (Item 2) to get the correct width (Item 3) **[Figure 60-81-19]**.

Valve Seat Width

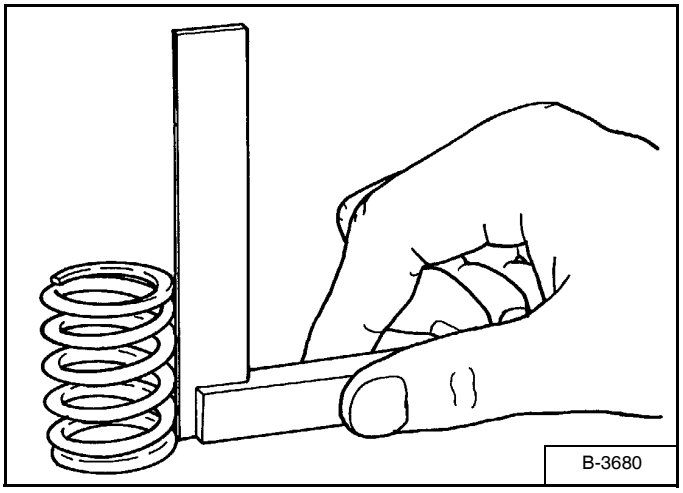
Intake	0.0835 in. (2,12 mm)
Exhaust	0.0835 in. (2,12 mm)

Valve Seat & Face Angle

Intake	45°
Exhaust	45°

Valve Spring

Figure 60-81-20



Measure the length of the valve spring. If the measurement is less than the allowable limit, replace the spring **[Figure 60-81-20]**.

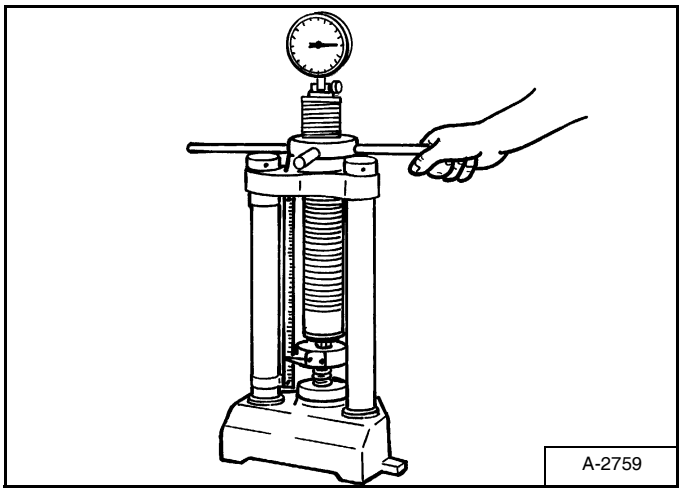
Free Length	1.232 - 1.252 in. (31,3 - 31,8 mm)
Allowable Limit	1.118 in. (28,4 mm)

Put the spring on a flat surface, place a square on the side of the spring **[Figure 60-81-20]**.

Rotate the spring and measure the maximum tilt. If the measurement is in excess of the allowable limit, replace the spring.

Tilt	0.047 in. (1,2 mm)

Figure 60-81-21



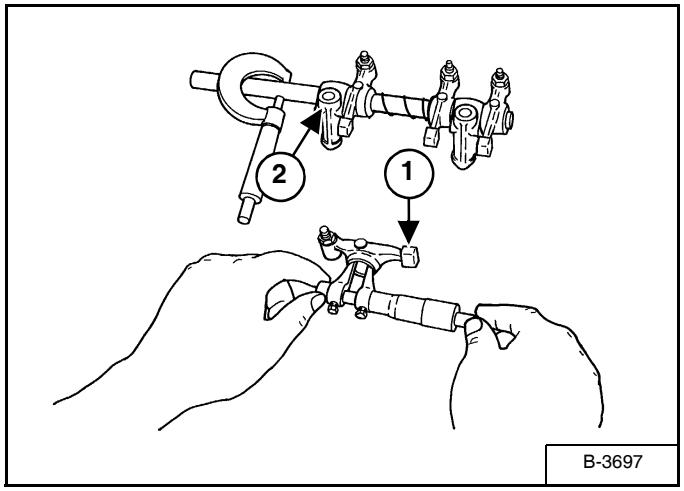
Put the spring on a tester and compress to specified length **[Figure 60-81-21]**.

Read the compressed load on the gauge. If the measurement exceeds allowable limit, replace the spring.

Setting Length	1.063 in. (27 mm)
Setting Load	14.6 lb. (64.7 N)
Allowable Limit (setting load)	12.3 lb. (54.9 N)

Rocker Arm And Shaft, Checking

Figure 60-81-22



Measure the rocker arm I.D. (Item 1) **[Figure 60-81-22]** with an inside micrometer.

Measure the rocker shaft O.D. (Item 2) **[Figure 60-81-22]** with an outside micrometer.

If the clearance exceeds the allowable limit, replace the rocker arm and measure the clearance again.

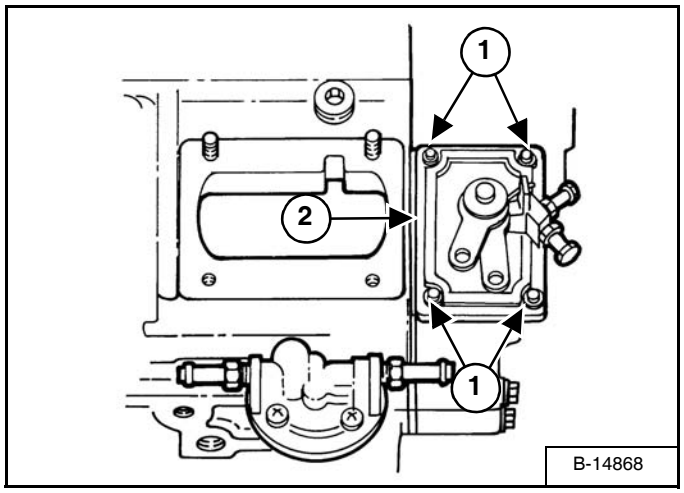
If the clearance still exceeds the allowable limit after the rocker arm is replaced, replace the rocker arm shaft.

Oil Clearance Between Rocker Arm & Shaft	0.0006-0.0018 in. (0,016-0,045 mm)
Allowable Limit	0.0059 in. (0,15 mm)
Rocker Arm Shaft	0.4123-0.4128 in. (10,47-10,48 mm)
Rocker Arm I.D.	0.4134-0.4141 in. (10,5-10,52 mm)

Timing Gearcase Cover Removal And Installation

Remove the fuel injection pump. (See Fuel Injection Pump Removal And Installation on Page 60-51-4.)

Figure 60-81-23

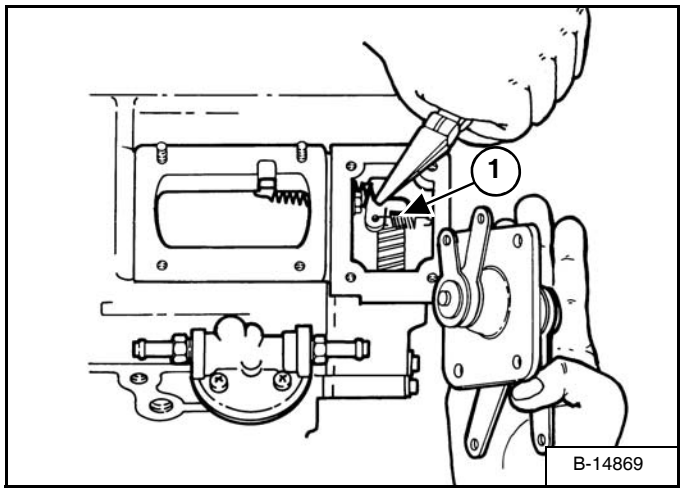


Remove the cylinder head, rocker arms and push rods. (See Cylinder Head Removal And Installation on Page 60-80-1.)

Remove the screws (Item 1) from the speed control plate (Item 2) **[Figure 60-81-23]**.

NOTE: Take care not to damage the spring.

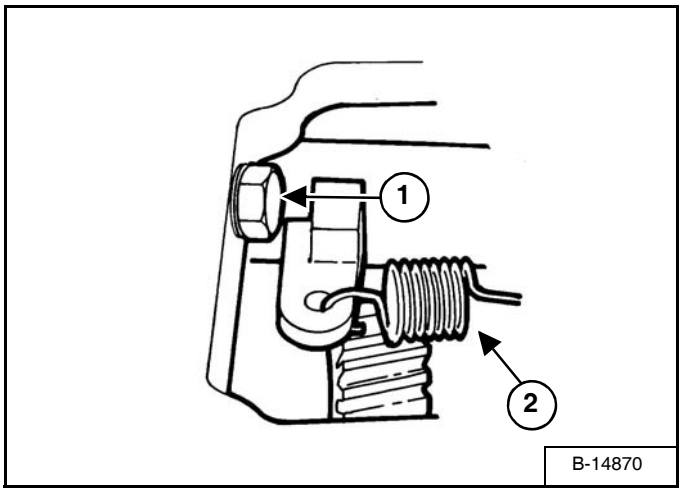
Figure 60-81-24



Separate the speed control plate from the engine and remove the spring (Item 1) **[Figure 60-81-24]**.

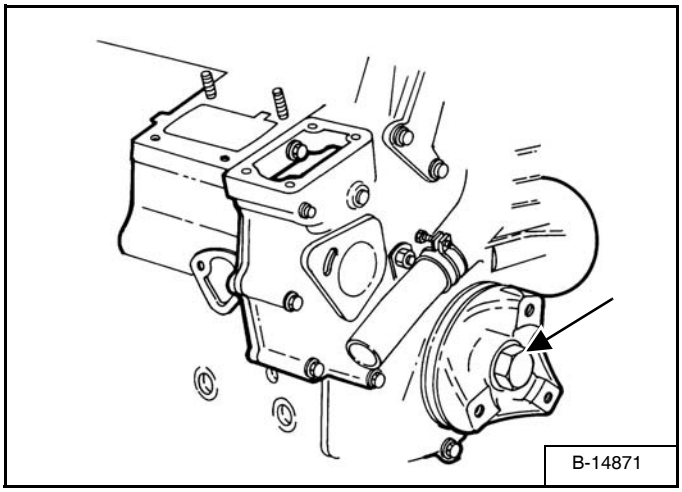
Remove the speed control plate.

Figure 60-81-25



Remove the bolt (Item 1) and disconnect the shaft spring (Item 2) **[Figure 60-81-25]**.

Figure 60-81-26



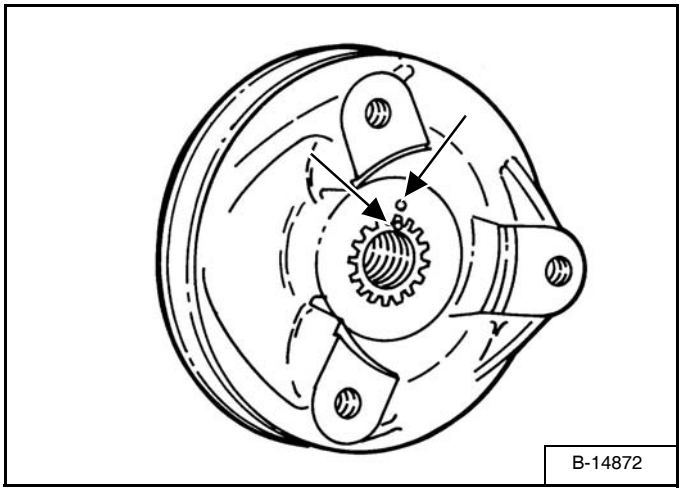
Remove the crankshaft pulley bolt.

Installation: Tighten the bolt 72-80 ft.-lb. (98-108 N•m) torque.

Use a puller and remove the crankshaft pulley **[Figure 60-81-26]**.

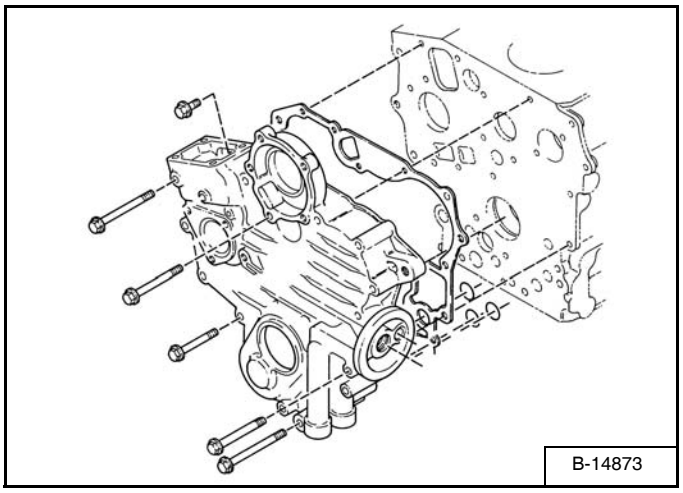
Timing Gearcase Cover Removal And Installation (Cont'd)

Figure 60-81-27



When installing the crank shaft pulley, make sure the alignment marks are aligned **[Figure 60-81-27]**.

Figure 60-81-28

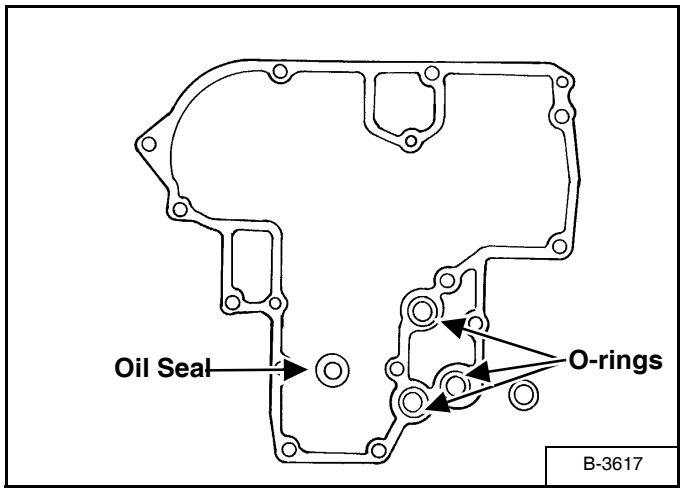


Remove the timing gear case cover bolts.

Installation: Tighten the bolts to 7-8 ft.-lb. (10-11 N•m) torque.

Remove the timing gear case **[Figure 60-81-28]**.

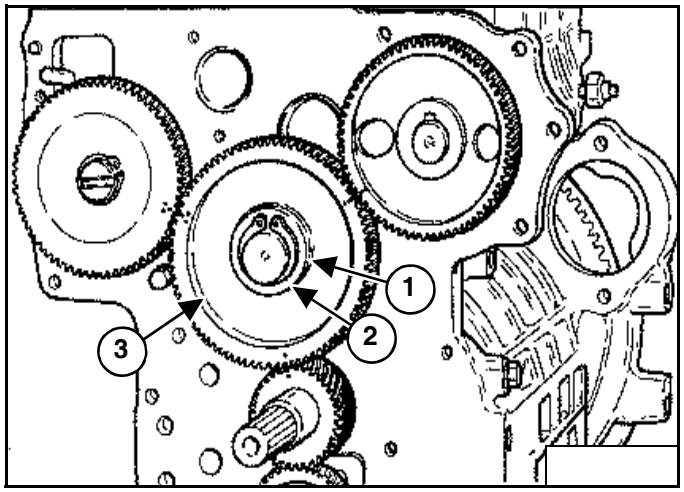
Figure 60-81-29



Installation: Install three new O-rings and the oil seal into the timing gear case cover **[Figure 60-81-29]**.

Idler Gear And Camshaft Removal And Installation

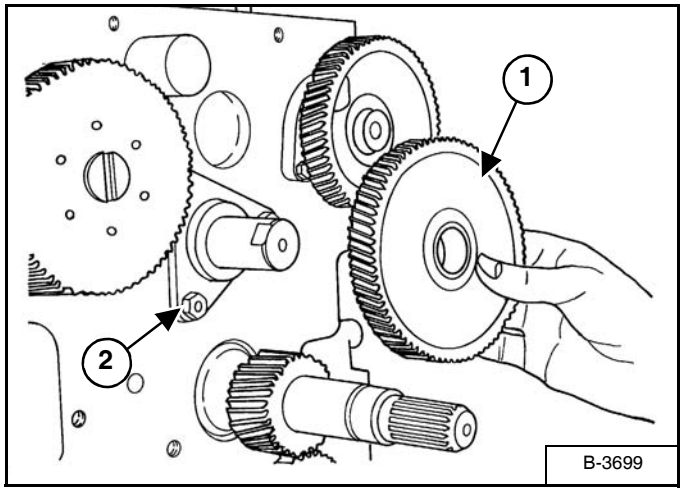
Figure 60-81-30



Remove the snap ring (Item 1) and collar (Item 2) from the idler gear shaft (Item 3) **[Figure 60-81-30]**.

Idler Gear And Camshaft Removal And Installation (Cont'd)

Figure 60-81-31

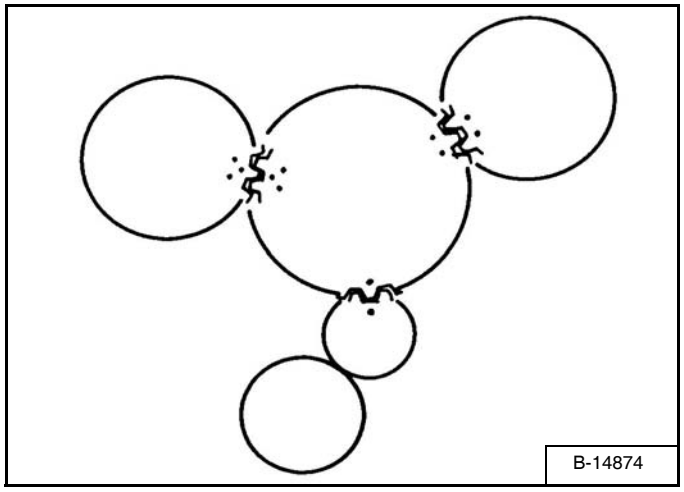


Remove the idler gear (Item 1) **[Figure 60-81-31]**.

Remove idler gear mounting screws (Item 2) **[Figure 60-81-31]**.

Installation: Tighten screws to 7-8 ft.-lb. (10-11 N•m) torque.

Figure 60-81-32

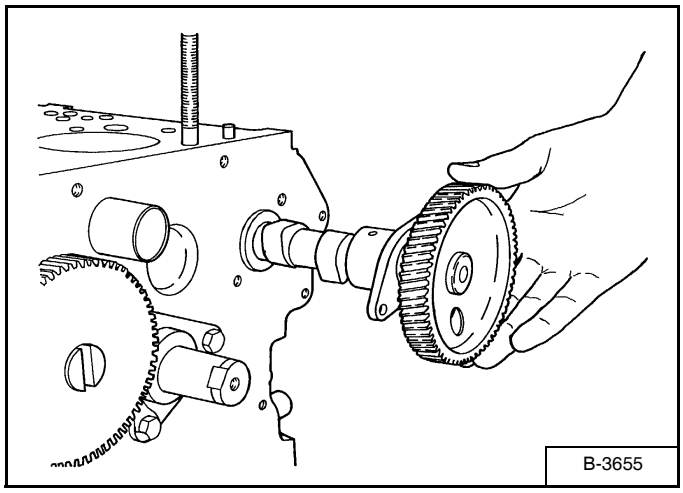


Installation: Make sure the timing marks are in correct alignment when installing the timing gears **[Figure 60-81-32]**.

Align the holes on the camshaft gear with the camshaft retainer plate bolts.

Remove the bolts.

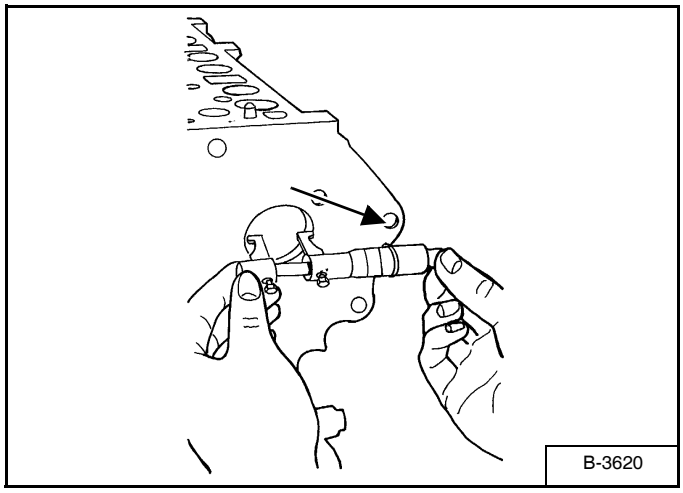
Figure 60-81-33



Remove the camshaft from the engine block **[Figure 60-81-33]**.

Installation: Tighten the camshaft retainer bolts to 14-15 ft.-lb. (18-21 N•m) torque.

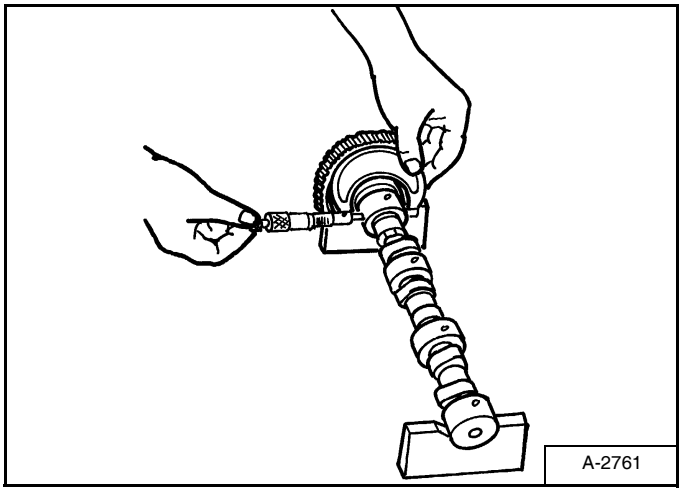
Figure 60-81-34



Measure the camshaft bearing in the engine block **[Figure 60-81-34]**.

Idler Gear And Camshaft Removal And Installation (Cont'd)

Figure 60-81-35

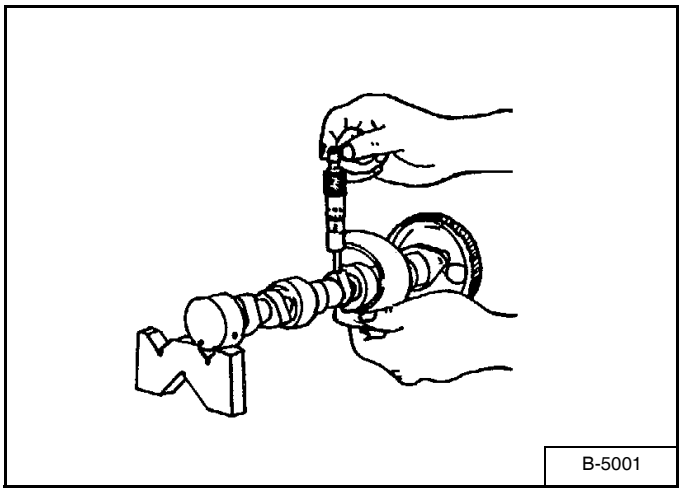


Measure the camshaft journal **[Figure 60-81-35]**.

Calculate the oil clearance. If the clearance exceeds the allowable limit, replace the camshaft.

Bearing I.D.	1.299-1.300 in. (33,00-33,03 mm)
Journal O.D.	1.2966-1.2972 in. (32,93-32,95 mm)
Clearance of Camshaft Journal	0.002-0.004 in. (0,05-0,09 mm)
Allowable Limit	0.006 in. (0,15 mm)

Figure 60-81-36

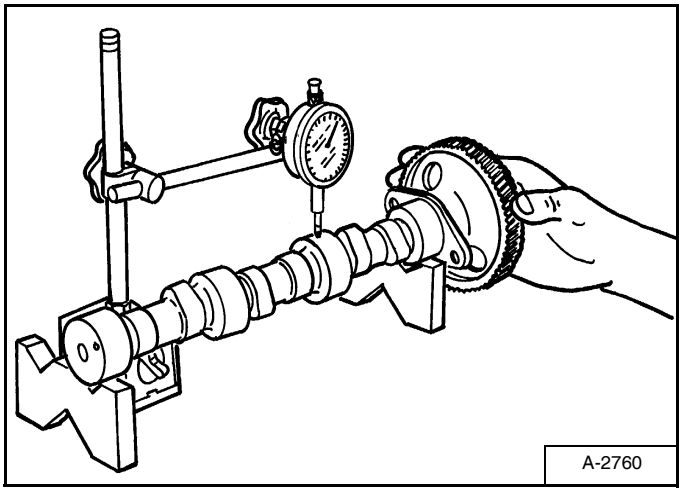


Measure the cam lobes at their highest point **[Figure 60-81-36]**.

If the measurement is less than the allowable limit, replace the camshaft.

Cam Lob Height	1.058 in. (26,88 mm)
Allowable Limit	1.056 in. (26,83 mm)

Figure 60-81-37



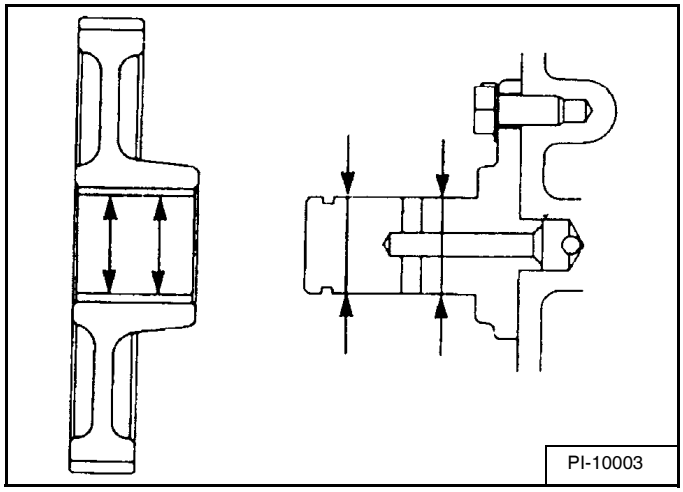
Put the camshaft in V-blocks. Install a dial indicator **[Figure 60-81-37]**.

Turn the camshaft at a slow rate. If the misalignment exceeds the allowable limit, replace the camshaft.

Camshaft Alignment Allowable Limit	0.0004 in. (0,01 mm)

Idler Gear and Shaft, Servicing

Figure 60-81-38



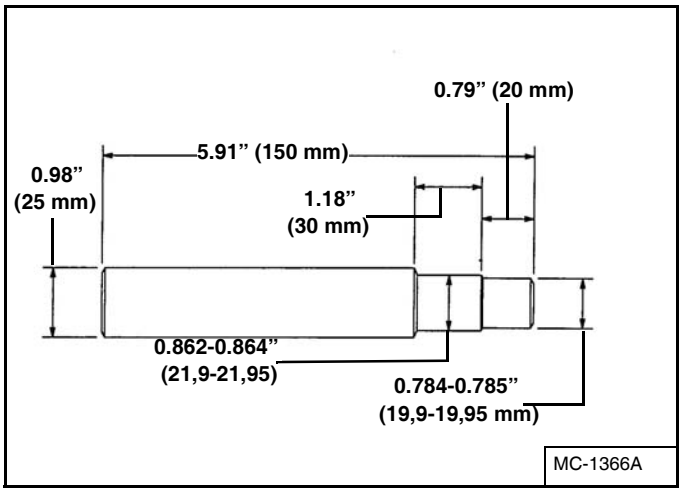
Measure the O.D. of the idler gear shaft **[Figure 60-81-38]**.

Measure the I.D. of the idler gear bushing **[Figure 60-81-38]**.

If the clearance exceeds the allowable limit, replace the bushing.

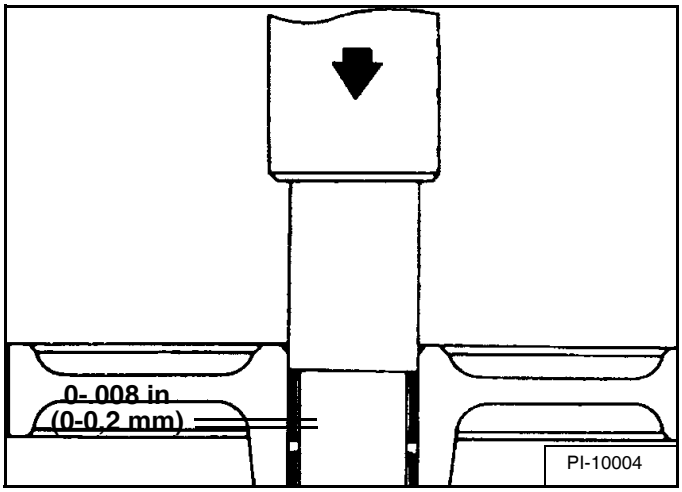
Idler Gear Shaft O.D.	0.786-0.787 in. (19,97-19,98 mm)
Idler Gear Shaft I.D.	0.787-0.789 in. (20,00-20,05 mm)
Oil Clearance between Idler Shaft & Gear Bushing	0.0008-0.0033 in. (0,020-0,084 mm)
Allowable Limit	0.004 in. (0,10 mm)

Figure 60-81-39



To replace the idler gear bushing, make a driver tool as shown in figure **[Figure 60-81-39]**.

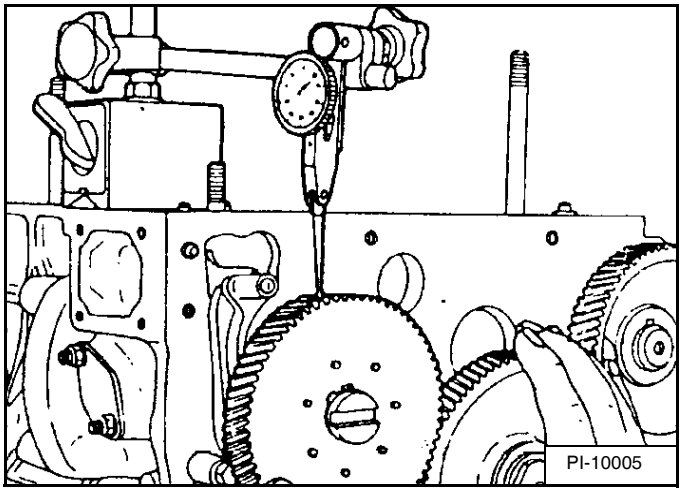
Figure 60-81-40



Use a press and special driver tool, to remove the old bushing and install the new bushing **[Figure 60-81-40]**.

Timing Gears Checking Backlash

Figure 60-81-41



When the gears are installed, check the backlash of the gears.

Install a dial indicator with its tip on a gear tooth **[Figure 60-81-41]**.

Hold one gear while turning the other gear **[Figure 60-81-41]**.

If the backlash exceeds the allowable limit, check the oil clearance of the shaft and gear. If the oil clearance is correct, replace the gears.

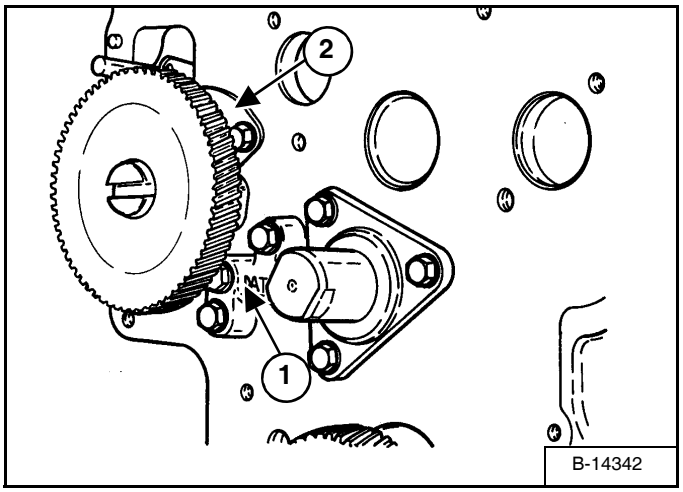
Crank Gear & Idler Gear.	
	0.002-0.005 in. (0,043-0,124 mm)
Allowable Limit	0.006 in. (0,15 mm)
Cam Gear & Idler Gear	
	0.002-0.005 in. (0,047-0,12 mm)
Allowable Limit	0.006 in. (0,15 mm)
Injection Pump Gear & Idler Gear	
	0.002-0.005 in. (0,046-0,124 mm)
Allowable Limit	0.006 in. (0,15 mm)
Oil Pump Gear & Crankshaft Cover	
	0.002-0.005 in. (0,041-0,123 mm)
Allowable Limit	0.006 in. (0,15 mm)

Fuel Camshaft Removal And Installation

Remove the timing gearcase cover. (See Timing Gearcase Cover Removal And Installation on Page 60-80-8.)

Remove the idler gear. (See Cylinder Head Removal And Installation on Page 60-80-1.)

Figure 60-81-42



Remove the bolt (Item 1) from the retainer plate (Item 2) **[Figure 60-81-42]**.

Installation: Tighten the bolt to 60-72 in.-lb. (6,8-8,1 N•m) torque.

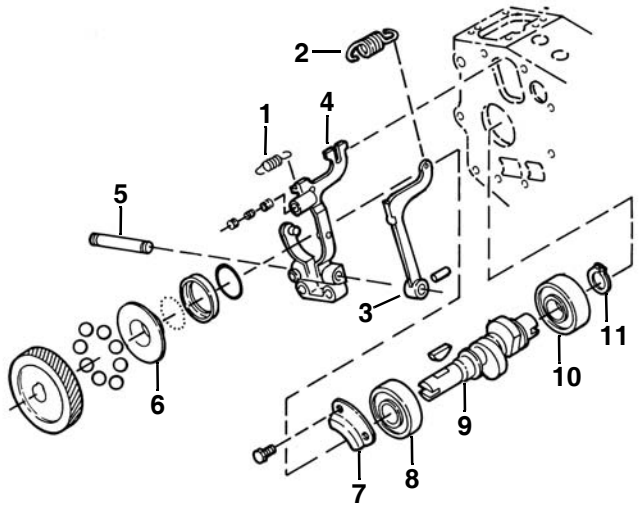
Remove the fuel camshaft retainer plate (Item 2) **[Figure 60-81-42]**.

Remove the fuel camshaft and fork lever assembly at the same time.

Fuel Camshaft Governor

The governor serves to keep the engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in the load.

Figure 60-81-43



1. Start Spring
2. Governor Spring
3. Fork Lever
4. Fork Lever
5. Fork Lever Shaft
6. Governor Sleeve
7. Retaining Plate
8. Bearing
9. Fuel Camshaft
10. Bearing
11. Snap Ring

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Disassemble and assemble the governor and fuel camshaft as shown in **[Figure 60-81-43]**.

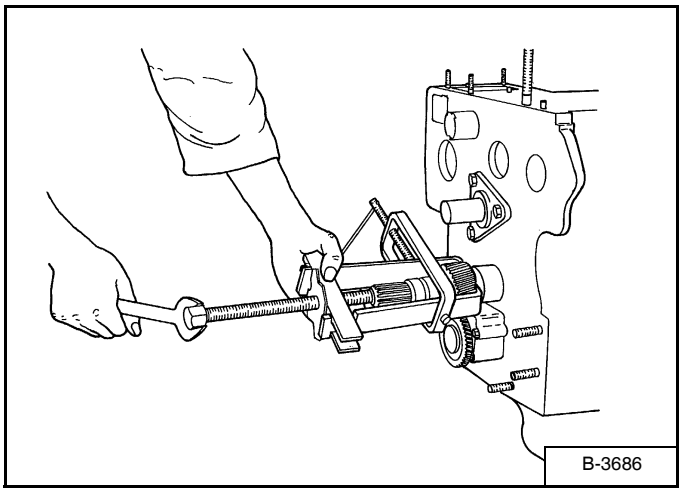
Check all the parts for wear or damage and replace as needed.

Crankshaft Gear Removal And Installation

Remove the timing gearcase cover. (See Timing Gearcase Cover Removal And Installation on Page 60-80-8.)

Remove the idler gear. (See Idler Gear And Camshaft Removal And Installation on Page 60-80-9.)

Figure 60-81-44



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Remove the crankshaft gear with a puller **[Figure 60-81-44]**.

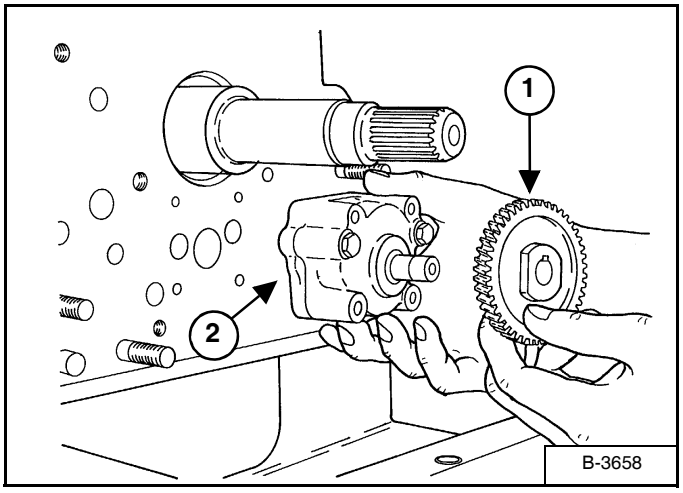
Remove the crankshaft key.

Oil Pump Removal And Installation

Remove the timing gearcase cover. (See Timing Gearcase Cover Removal And Installation on Page 60-80-8.)

Remove the crankshaft gear.

Figure 60-81-45



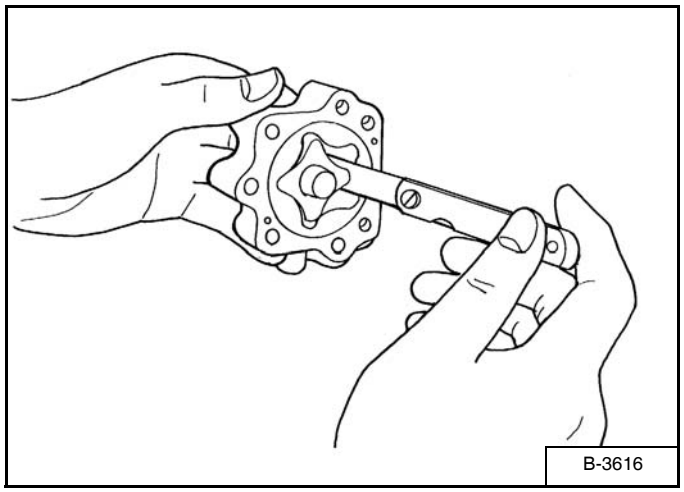
Remove the nut from the oil pump shaft. Use a puller to remove the oil pump gear (Item 1) **[Figure 60-81-45]**.

Remove the oil pump mounting bolts. Remove the oil pump (Item 2) **[Figure 60-81-45]**.

Installation: Tighten the oil pump mounting bolts to 60-72 in.-lb. (6,9-8,1 N•m) torque.

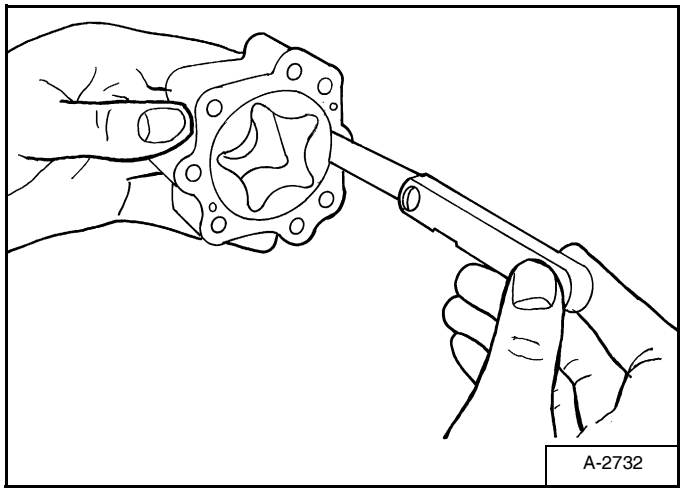
Oil Pump, Service

Figure 60-81-46



Measure the clearance between the lobes of the inner rotor and outer rotor with a feeler gauge **[Figure 60-81-46]**.

Figure 60-81-47



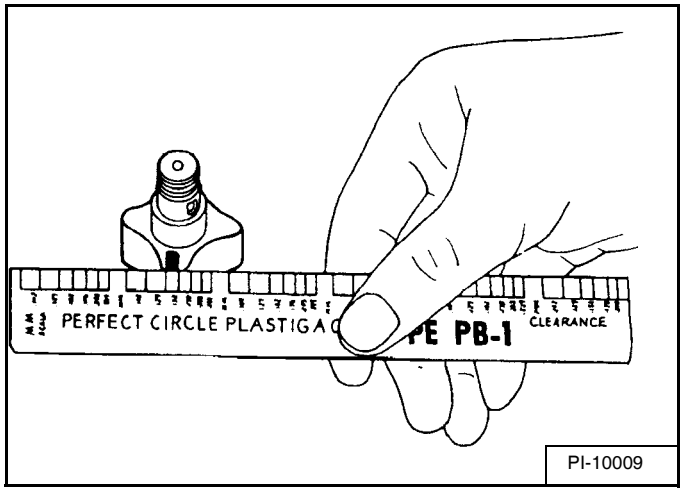
Measure the clearance between the outer rotor and pump body with a feeler gauge **[Figure 60-81-47]**.

If the clearance exceeds the factory limit, replace the oil pump rotor assembly.

Clearance Between Inner & Outer Rotor
0.001-0.006 in. (0,03-0,14 mm)
Clearance Between Outer Rotor & Body
0.003-0.006 in. (0,07-0,15 mm)

Oil Pump, Service, (Cont'd)

Figure 60-81-48



Put a piece of press gauge on the rotor face **[Figure 60-81-48]**.

Install the cover and tighten the bolts.

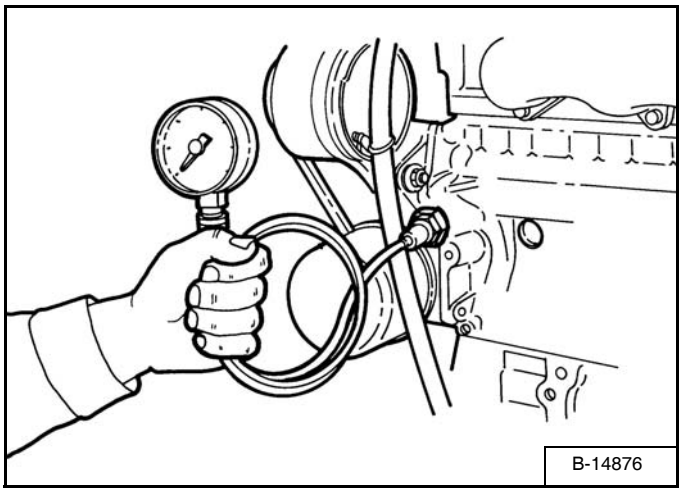
Remove the cover carefully. Measure the width of the press gauge **[Figure 60-81-48]**.

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

End Clearance	0.003-0.005 in. (0,08-0,14 mm)

Engine Oil Pressure, Checking

Figure 60-81-49



Remove the oil pressure sensor.

Install a pressure gauge **[Figure 60-81-49]**.

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

Measure oil pressure at both idling and rated speeds.

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

- Engine Oil Insufficient
- Oil Pump Defective
- Oil Galley Plugged
- Oil Strainer Plugged
- Excessive Oil Clearance
- Foreign Matter in Relief Valve
- Oil Filer Cartridge plugged

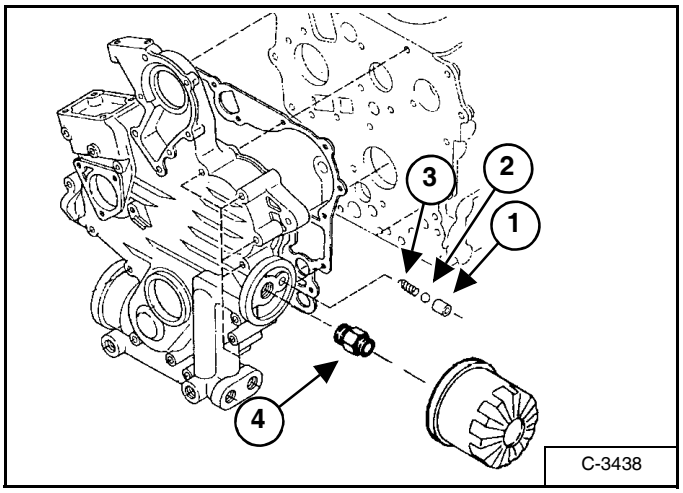
At Idle Speed Allowable Limit	7 PSI (0,48 bar)
At Rated Speed	28-64 PSI (2-4 bar)
Allowable Limit	21 PSI (1 bar)

Installation: After checking engine oil pressure, tighten oil pressure sensor to 11-15 ft.-lb. (15-20 N•m).

Relief Valve

The relief valve prevents damage of the lubricating system due to high pressure. This relief valve is a ball type.

Figure 60-81-50



Remove the valve seat (Item 1) **[Figure 60-81-50]**, ball (Item 2) **[Figure 60-81-50]** and spring (Item 3) **[Figure 60-81-50]**.

Check the parts for wear or damage and replace as needed.

Spring Free Length	
Factory Spec	1.26 in. (32 mm)
Allowable Limit	1.10 in. (28 mm)

Installation: Tighten the oil fiter adapter (Item 4) **[Figure 60-81-50]** to 29-36 ft.-lb. (39-49 N•m) torque.

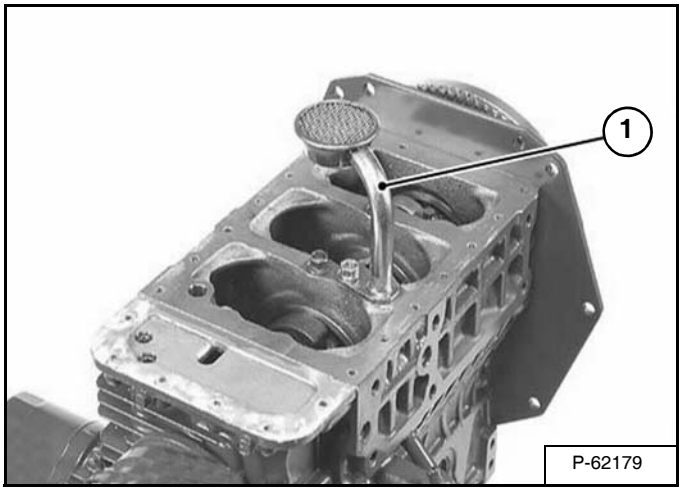
Piston And Connecting Rod Removal And Installation

Remove the cylinder head. (See Cylinder Head Removal And Installation on Page 60-80-1.)

Remove the top edge from the cylinder bore with a ridge reamer.

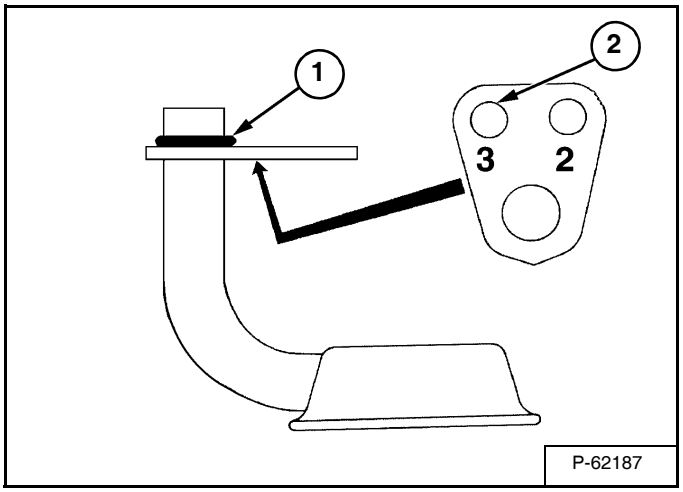
Remove the oil pan.

Figure 60-81-51



Remove the oil pump strainer (Item 1) **[Figure 60-81-51]**.

Figure 60-81-52



Installation: Check o-ring (Item 1) on strainer and use hole 3 (Item 2) **[Figure 60-81-52]** when installing strainer.

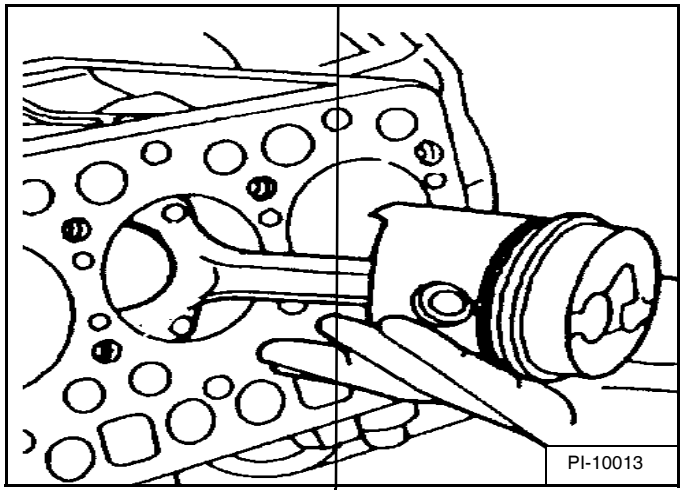
Turn the flywheel and put a pair of connecting rods at bottom dead center.

Remove the connecting rod bolts.

Installation: Tighten the connecting rod bolts to 20-22 ft.-lb. (27-30 N•m) torque.

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

Figure 60-81-53

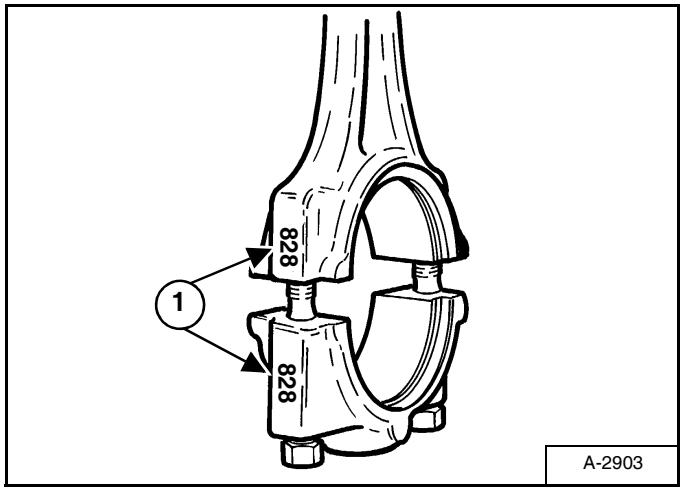


Remove the rod cap and bearing **[Figure 60-81-53]**.

Use a hammer handle and push the piston connecting rod assembly out of the cylinder bore **[Figure 60-81-53]**.

NOTE: Make sure the pistons are marked so they will be returned to the same cylinder bore.

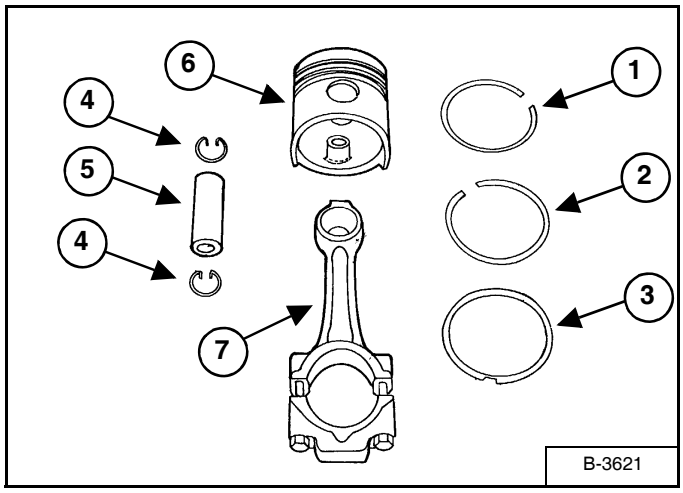
Figure 60-81-54



Installation: Make sure the marks (Item 1) on the connecting rod and bearing are aligned when installing the bearing cap **[Figure 60-81-54]**.

Repeat the procedure to remove the other piston/ connecting rod assemblies from the engine block.

Figure 60-81-55



Remove the first compression ring (Item 1) **[Figure 60-81-55]**.

Remove the second compression ring (Item 2) **[Figure 60-81-55]**.

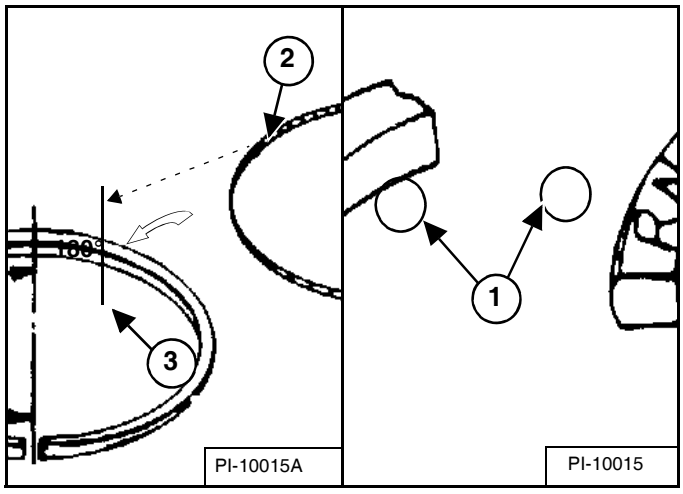
Remove the oil ring (Item 3) **[Figure 60-81-55]**.

Remove the snap ring (Item 4) and piston pin (Item 5) **[Figure 60-81-55]**.

Separate the piston (Item 6) from the connecting rod (Item 7) **[Figure 60-81-55]**.

NOTE: Make sure the piston and rod assembly is marked so as not to change the piston rod assembly with another piston or connecting rod.

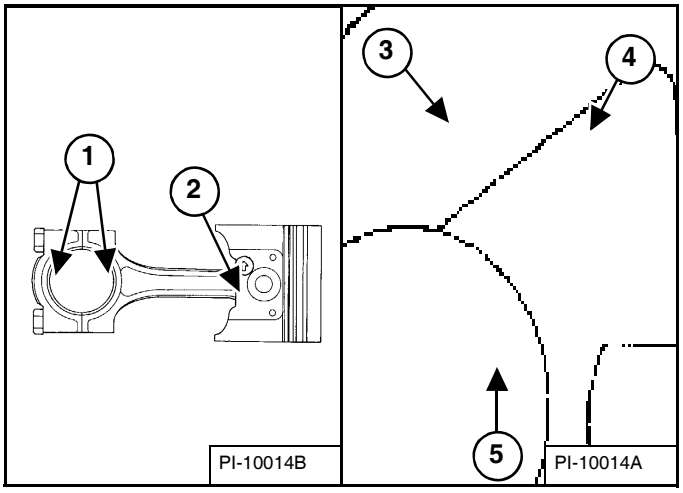
Figure 60-81-56



Installation: When installing new rings, assemble the ring so the mark (Item 1) near the gap faces the top of the piston. When installing the oil ring, place the expander joint (Item 2) on the opposite side of the oil ring gap (Item 3) **[Figure 60-81-56]**.

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

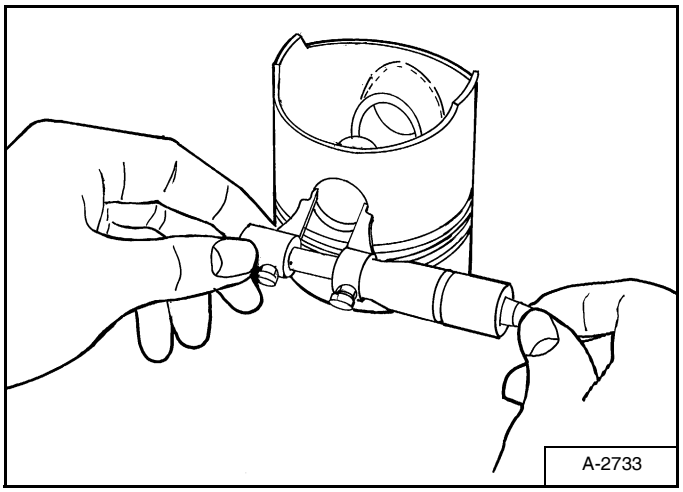
Figure 60-81-57



Installation: When reassembling, align the marks (Item 1) on the connecting rod and piston (Item 2). Heat the piston in oil to 176° F (80° C) for 10 to 15 minutes and tap the piston pin into position. Place the piston rings so that there are gaps every 120° (Items 3, 4 & 5) **[Figure 60-81-57]** with no gap facing the piston pin in the cylinder.

Piston And Connecting Rod, Servicing

Figure 60-81-58

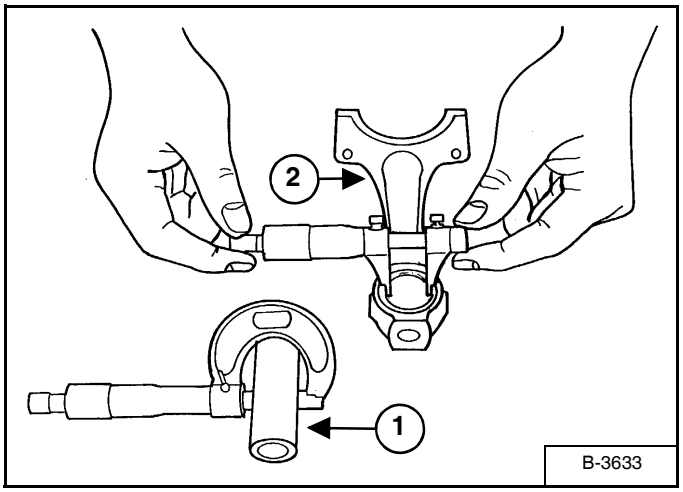


Measure the I.D. of the piston pin bore in both horizontal and vertical direction **[Figure 60-81-58]**.

If the measurement exceeds the allowable limit, replace the piston.

Piston Pin Bore I.D.	0.7874-0.7879 in. (20,00-20,013 mm)
Allowable Limit	0.789 in. (20,05 mm)

Figure 60-81-59



Measure the O.D. of the piston pin (Item 1) **[Figure 60-81-59]**.

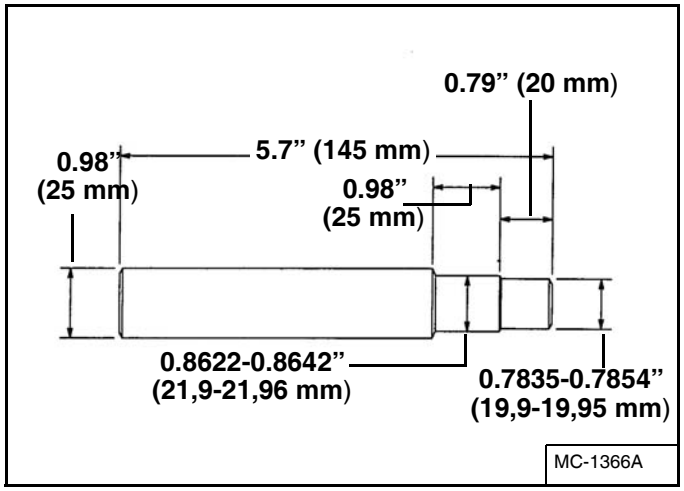
Measure the I.D. of the connecting rod small end (Item 2) **[Figure 60-81-59]**.

Piston And Connecting Rod, Servicing (Cont'd)

Calculate the oil clearance. If the clearance exceeds the allowable limit, replace the bushing. If it still exceeds the specifications, replace the piston pin.

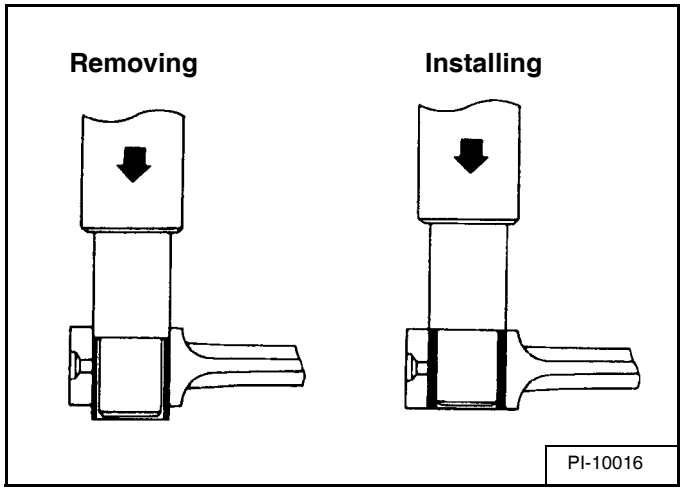
Piston Pin O.D.	0.7875-0.7878 in. (20,002-20,011 mm)
Bushing I.D.	0.7884-0.7890 in. (20,025-20,04 mm)
Oil Clearance between Piston Pin & Bushing	0.0006-0.0015 in. (0,014-0,038 mm)
Allowable Limit	0.004 in. (0,10 mm)

Figure 60-81-60



To replace the connecting rod small end bushing, make a driver tool as shown in figure **[Figure 60-81-60]**.

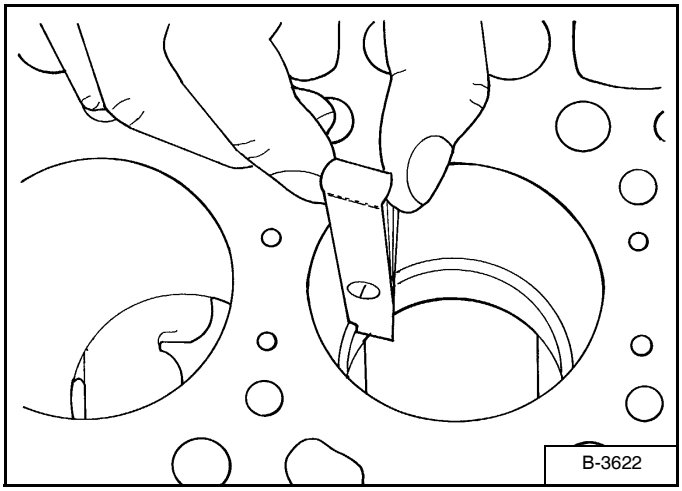
Figure 60-81-61



Use a press and special driver tool to remove the small end bushing **[Figure 60-81-61]**.

Installation: Clean the small end bushing and bore. Put oil on the bushing and press into the connecting rod until it is flush **[Figure 60-81-61]**.

Figure 60-81-62



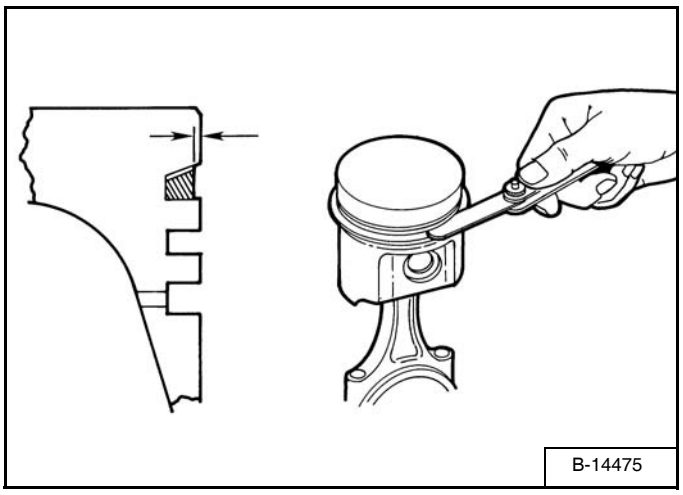
Install a new piston ring into the lower part of the cylinder bore. Measure the ring gap with a feeler gauge **[Figure 60-81-62]**.

If the gap exceeds the allowable limit, replace the piston ring.

Top Compression Ring & Oil Ring	0.006-0.012 in. (0,15-0,30 mm)
Second Compression Ring	0.012-0.018 in. (0,30-0,45 mm)
Allowable Limit	0.047 in. (1,2 mm)

Piston And Connecting Rod, Servicing (Cont'd)

Figure 60-81-63



Remove the carbon from the ring grooves. Measure the clearance between the ring and groove with a feeler gauge **[Figure 60-81-63]**.

Second ring	0.0033-0.0045 in. (0,09-0,12 mm)
Oil ring	0.0016-0.0031 in. (0,04-0,08 mm)
Allowable limit second ring	0.0059 in. (0,15 mm)
Allowable limit oil ring	0.0059 in. (0,15 mm)

If the clearance exceeds the allowable limit, replace the piston.

Connecting Rod Alignment

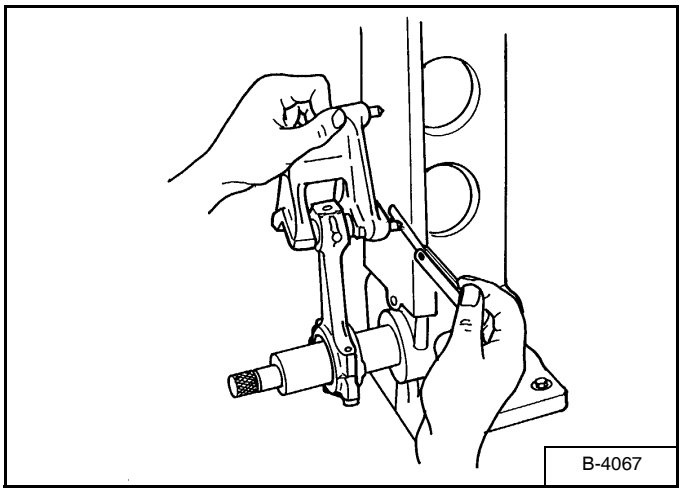
NOTE: The small end bushing is the basis of this check, check the bushing for wear before doing this check.

Install the piston pin into the connecting rod.

Install the connecting rod on an alignment tool.

Put the gauge over the piston pin and move it against the face plate.

Figure 60-81-64



If the gauge does not fit squarely against the face place, measure the space between the gauge and face plate **[Figure 60-81-64]**.

If the measurement exceeds the allowable limit, replace the connecting rod.

Rod Alignment Allowable Limit

0.002 in.(0,05 mm)

Crankshaft And Bearings Removal And Installation

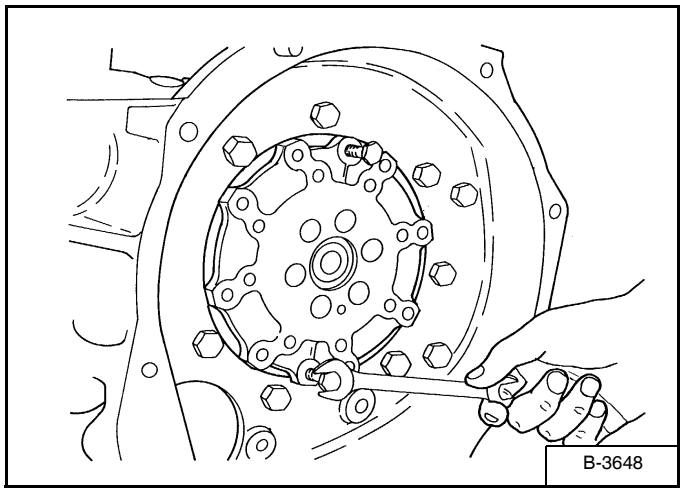
Remove the piston and connecting rod assemblies. (See Piston And Connecting Rod Removal And Installation on Page 60-80-17.)

Remove the engine flywheel. (See Cylinder Head Removal And Installation on Page 60-80-1.)

Remove the bolts which fasten the bearing case cover to the block.

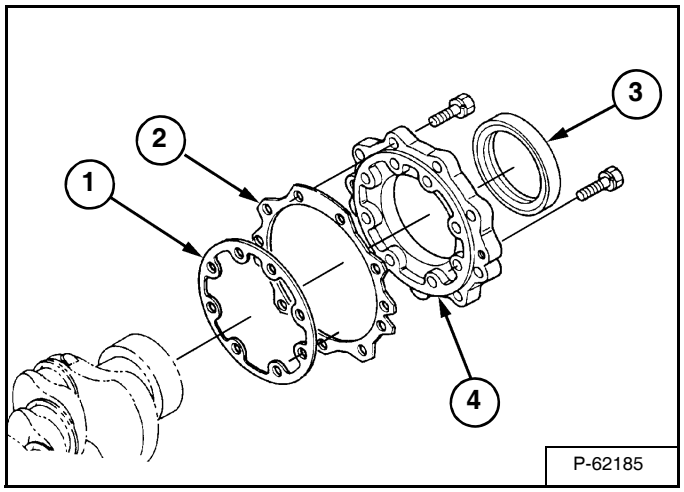
Installation: Tighten the bearing case cover bolts to 7-8 ft.-lb. (10-11 N•m) torque. Tighten bolts with even force on the diagonal line.

Figure 60-81-65



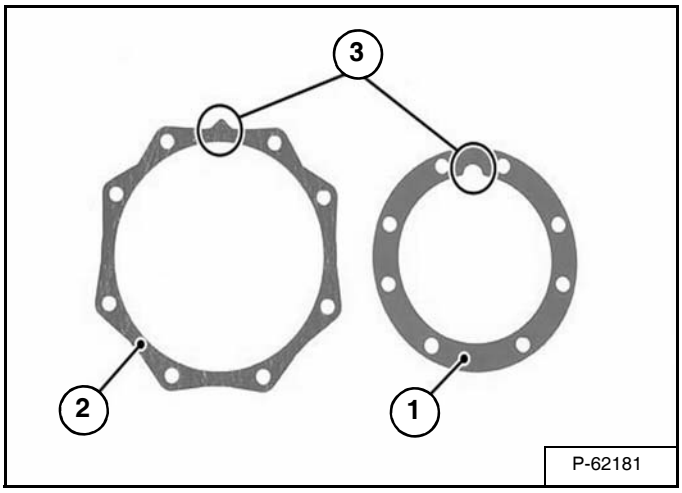
Install two bolts into the bearing case cover and pull the cover out **[Figure 60-81-65]**.

Figure 60-81-66



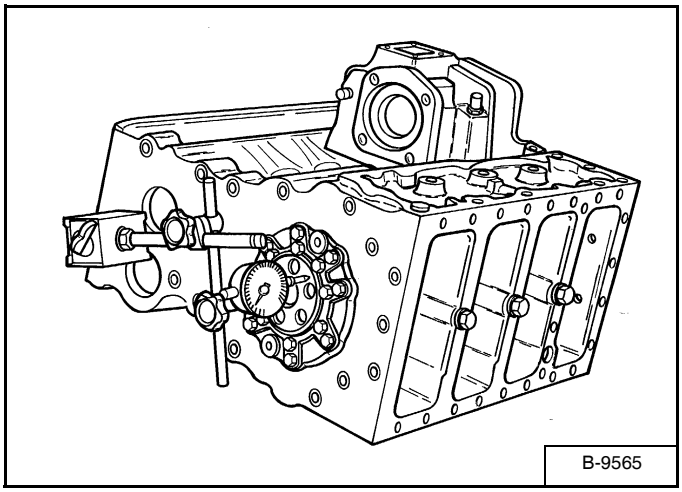
Installation: When installing the cover (Item 4) **[Figure 60-81-66]**, make sure the casting mark (Item 3) **[Figure 60-81-66]** is in the up position. Lightly oil inside lip of oil seal (Item 3) **[Figure 60-81-66]**.

Figure 60-81-67



Installation: When installing the bearing case gasket (Item 1) **[Figure 60-81-66]** and **[Figure 60-81-67]**, and the bearing case cover gasket (Item 2) **[Figure 60-81-66]** and **[Figure 60-81-67]** make sure the mark (Item 3) **[Figure 60-81-67]** is in the up position.

Figure 60-81-68



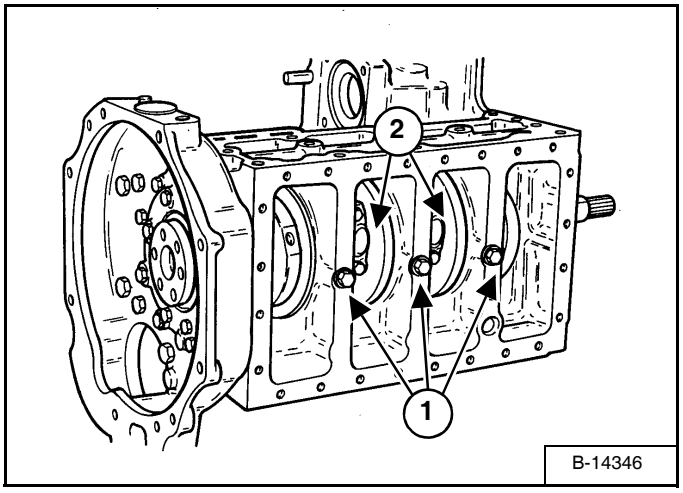
Before removing the crankshaft/main bearings, check the end play. Install a dial indicator. Measure the end play by moving the crankshaft back and forth **[Figure 60-81-68]**.

If the measurement exceeds the allowable limit, replace the thrust washers.

End Play	0.006-0.012 in. (0,15-0,31 mm)
Allowable Limit	0.020 in. (0,5 mm)

Crankshaft And Bearings Removal And Installation (Cont'd)

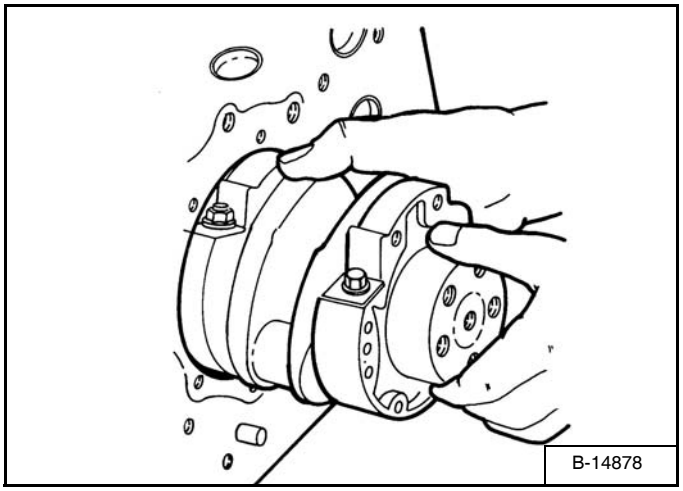
Figure 60-81-69



Remove the main bearing case bolt (Item 1) **[Figure 60-81-69]**.

Installation: Align the bearing case hole (Item 2) **[Figure 60-81-69]** with the hole in the block. Put oil on the bolt threads and tighten to 20-22 ft.-lb. (27-30 N•m) torque.

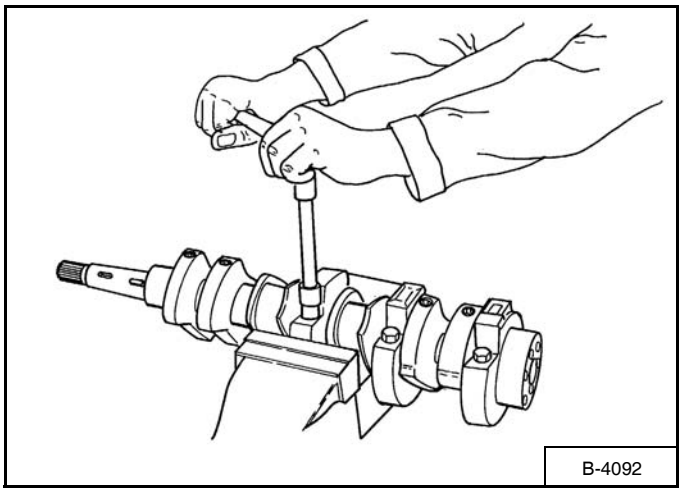
Figure 60-81-70



Remove the crankshaft/main bearing assembly from the engine block **[Figure 60-81-70]**.

Mark the bearing case halves for correct installation.

Figure 60-81-71

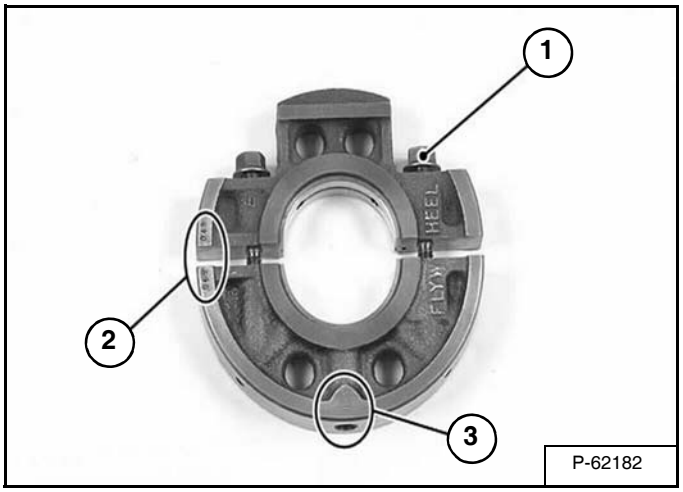


Remove the two bearing case bolts **[Figure 60-81-71]**.

Remove the bearing case and bearing.

Installation: Tighten the bearing case bolts (Item 1) **[Figure 60-81-72]** to 9-12 ft.-lb. (13-16 N•m) torque.

Figure 60-81-72

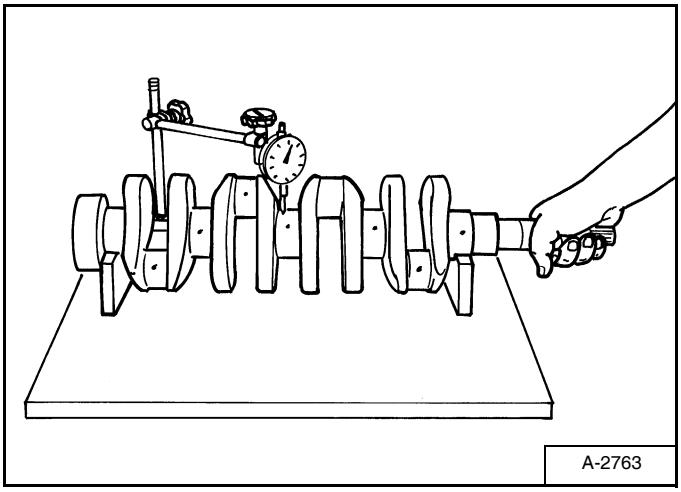


Installation: When installing the main bearing case assemblies, face the mark FLYWHEEL to the flywheel side of the engine block **[Figure 60-81-72]**. Be sure the thrust washer with its oil grooves face outward.

Identification marks on on the main bearing case assemblies are the alignment number (Item 2) and the marking "1" or "2" (Item 3) **[Figure 60-81-72]** can be found on the main bearing case assemblies to ensure proper assembly.

Crankshaft And Bearings, Servicing

Figure 60-81-73



Put the crankshaft on V-blocks. Install a dial indicator on the center journal **[Figure 60-81-73]**.

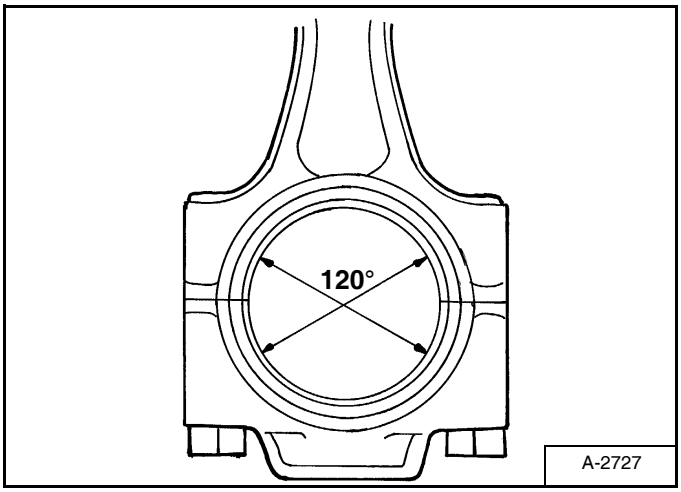
Turn the crankshaft at a slow rate.

If the misalignment exceeds the allowable limit, replace the crankshaft.

Alignment	0.0008 in. (0,02 mm)

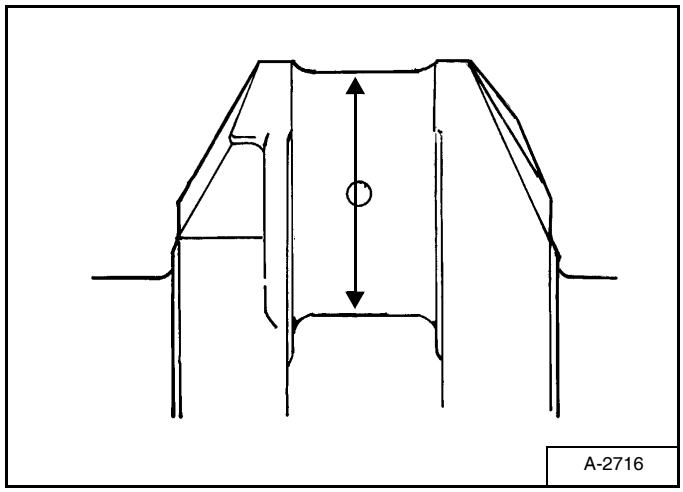
Tighten the connecting rod cap bolts 20-22 ft.-lb. (27-30 N•m) torque.

Figure 60-81-74



Measure the crankpin bearing I.D. **[Figure 60-81-74]**.

Figure 60-81-75



Measure the crankpin O.D. **[Figure 60-81-75]**.

Calculate the oil clearance.

Crankpin Bearing I.D.	1.3389-1.3390 in. (33,99 -34,01 mm)
Crankpin O.D.	1.3370-1.3376 in. (33,96-33,98 mm)
Oil Clearance	0.0008-0.0020 in.(0,020-0,051 mm)
Allowable limit	0.0059 in. (0,15 mm)

Crankshaft And Bearings, Servicing (Cont'd)

Figure 60-81-76

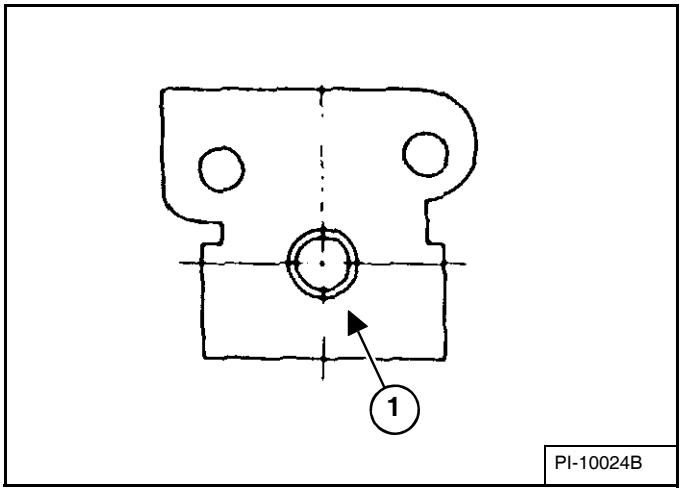
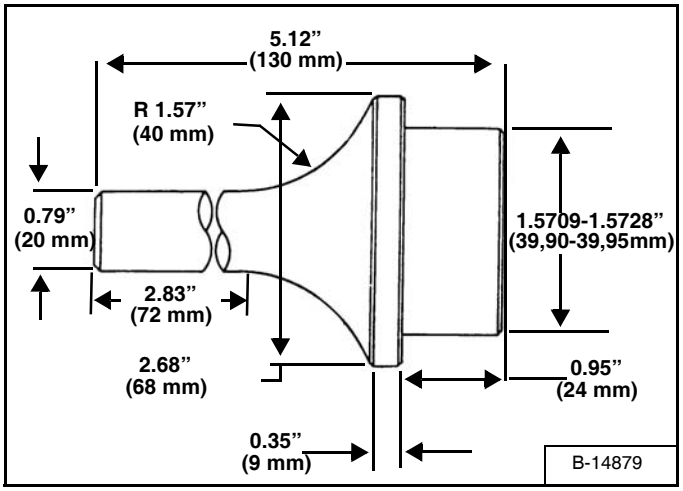


Figure 60-81-77



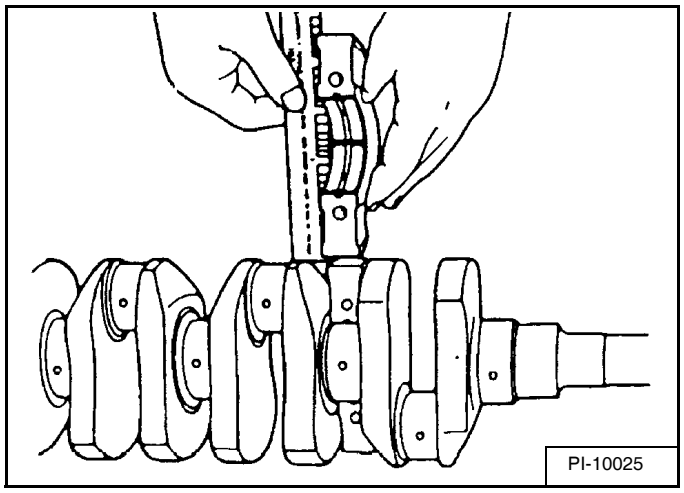
Remove the bearing (Item 1) **[Figure 60-81-76]** from the front of the engine block with the removal tool shown in **[Figure 60-81-77]**.

Installation: Clean the new bearing and bore and apply oil to them. Install the new bearing with the installation driver tool **[Figure 60-81-76]**.

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

Install the main bearing case halves and tighten the bolts to 9-12 ft.-lb. (12,7-15,7 N•m) torque. Remove the bearing case halves.

Figure 60-81-78



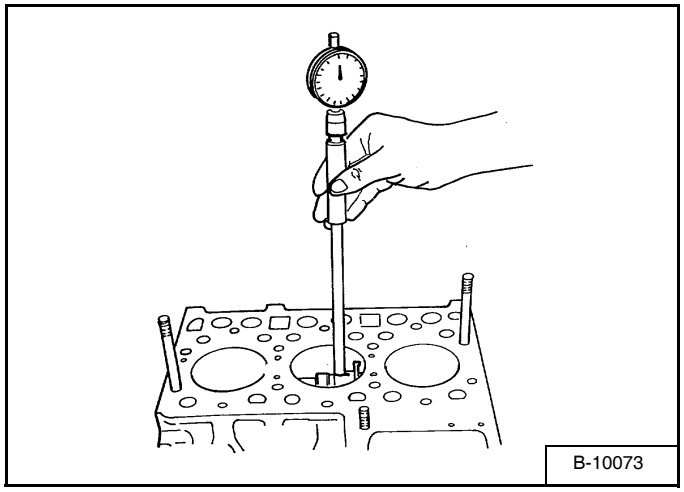
Measure the flattened press gauge **[Figure 60-81-78]**.

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

Crankshaft Journal O.D. (Flywheel side)	
	1.7297-1.7303 in. (43,93-43,95 mm)
Bearing I.D.	1.7317-1.7333 in. (43,98-44,03 mm)
Crankshaft Journal O.D. (Middle)	
	1.5722-1.5728 in. (39,93-39,95 mm)
Bearing I.D.	1.5742-1.5758 in. (39,98-40,03 mm)
Crankshaft journal O.D. (Front)	
	1.5722-1.5728 in. (39,93-39,95 mm)
Bearing I.D.	1.5714-1.5764 in. (39,98-40,04 mm)
Oil Clearance	0.0013-0.0042 in. (0,034-0,106 mm)
Allowable Limit	0.008 in. (0,2 mm)

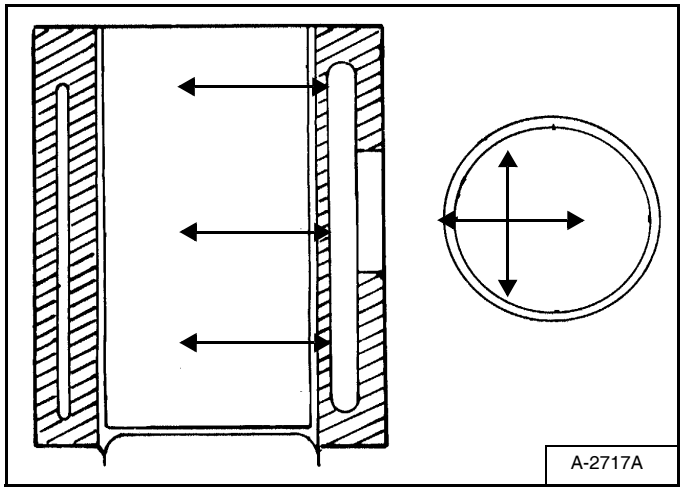
Cylinder Bore, Checking

Figure 60-81-79



Check the inside diameter of the cylinder line **[Figure 60-81-79]**.

Figure 60-81-80



To find the maximum wear check the inside diameter in six different locations **[Figure 60-81-80]**.

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

Cylinder Bore I.D.	2.638-2.639 in. (67,0-67,02 mm)
Allowable Limit	2.644 in. (67,17 mm)

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

Water Pump Removal And Installation

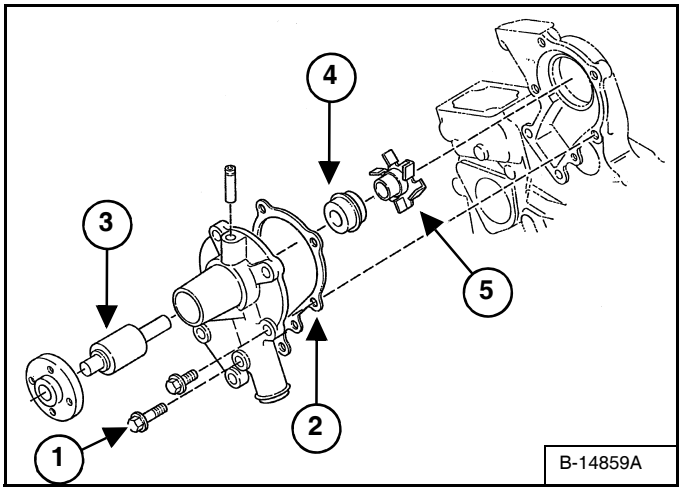
Drain the cooling system.

Remove the radiator. (See Removal And Installation on Page 60-40-1.)

Remove the alternator belt.

Remove the fan.

Figure 60-81-81



Remove the water pump bolts (Item 1) **[Figure 60-81-81]**.

Remove the water pump.

Installation: Always use a new gasket (Item 2) **[Figure 60-81-81]** when installing the water pump and apply Liquid-Type Gasket (Three Bond 1215 or equivalent) to both sides of new gasket.

Water Pump Disassembly And Assembly

Put the water pump in a vise.

Remove the pulley.

Press the shaft (Item 3) **[Figure 60-81-81]** out of the pulley side of the water pump. Press out the shaft with the impeller on it.

Remove the seal (Item 4) and impeller (Item 5) **[Figure 60-81-81]**.

Install a new seal when assembling the water pump.

HEATER

HEATER 70-10-1
Removal And Installation 70-10-1


Bobcat®

HEATER

Removal And Installation

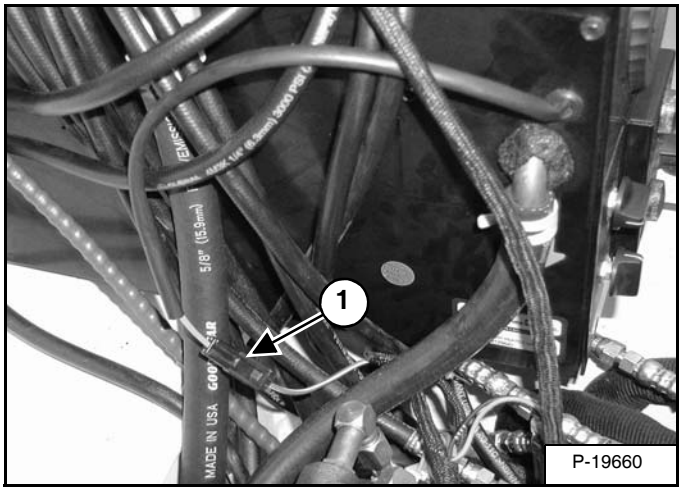
Drain the engine coolant. (See Replacing The Coolant on Page 10-70-2.)

Remove floor mat and floor panels. (See Removal and Installation on Page 40-120-1.)

Remove seat and seat mount. (See Removal And Installation on Page 40-40-1.)

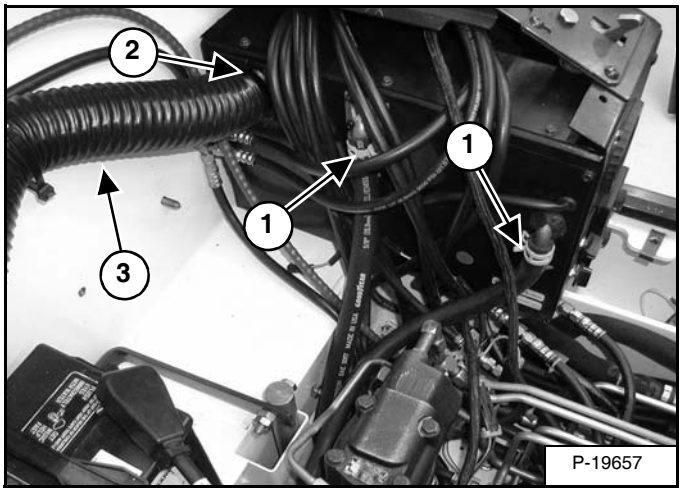
Remove blade extension tray. (See Removal And Installation on Page 40-210-1.)

Figure 70-10-1



Disconnect the heater wire harness (Item 1) **[Figure 70-10-1]**.

Figure 70-10-2



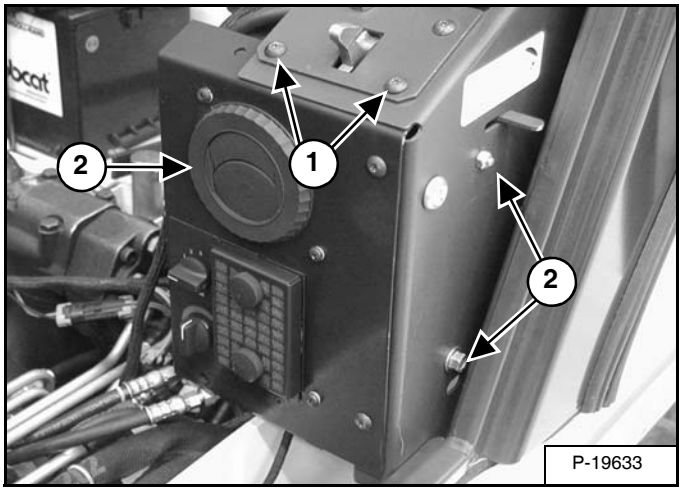
Mark the two hoses (Item 1) **[Figure 70-10-2]** for ease of assembly.

Disconnect and cap the two hoses (Item 2) **[Figure 70-10-2]**.

Cap the heater fittings once the hoses are removed.

Remove the tie strap (Item 2) and duct hose (Item 3) **[Figure 70-10-2]** from heater.

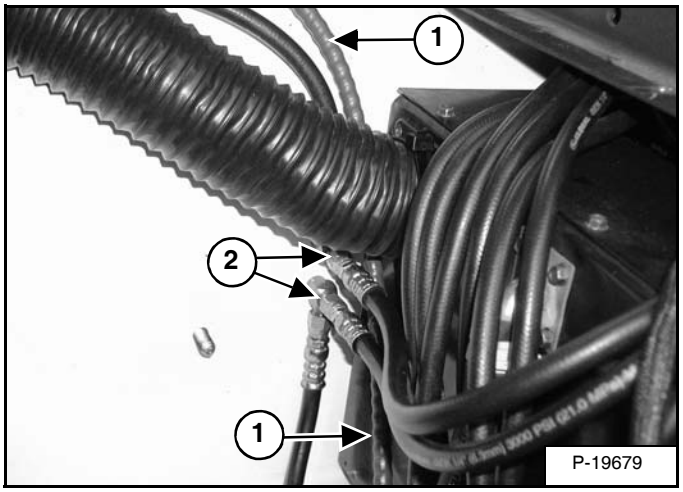
Figure 70-10-3



Remove the four screws (Item 1) **[Figure 70-10-3]** from the front of the heater.

Remove heater assembly (Item 2) **[Figure 70-10-3]** from the Excavator.

Figure 70-10-4



NOTE: During the installation of heater assembly, verify that the engine speed cable (Item 1) is on the heater side of the buckhead fitting (Item 2) [Figure 70-10-4] otherwise the cable will be pinched between the bulkhead fittings and blade extension tray.


Bobcat®

SPECIFICATIONS

CONVERSIONS SPEC-70-1
Decimal And Millimeter Equivalents. SPEC-70-1
U.S. To Metric Conversion. SPEC-70-1

ENGINE SPECIFICATIONS SPEC-20-1
Camshaft SPEC-20-2
Connecting Rods SPEC-20-3
Crankshaft SPEC-20-4
Crankshaft Re-Grind Data SPEC-20-6
Cylinders SPEC-20-3
Cylinder Head SPEC-20-1
Engine Bolt Torque SPEC-20-5
Fuel Injection Nozzles SPEC-20-1
Fuel Injection Pump SPEC-20-1
Oil Pump SPEC-20-3
Pistons SPEC-20-3
Piston Rings. SPEC-20-3
Rocker Arms SPEC-20-2
Thermostat. SPEC-20-4
Timing Gear SPEC-20-4
Valves SPEC-20-1
Valve Springs. SPEC-20-2

FUEL, COOLANT AND LUBRICANTS SPEC-60-1
Chart SPEC-60-1

HYDRAULIC CONNECTION SPECIFICATIONS SPEC-40-1
Flare Fitting SPEC-40-2
O-ring Face Seal Connection. SPEC-40-1
O-ring Flare Fitting SPEC-40-3
Port Seal Fitting SPEC-40-5
Straight Thread O-ring Fitting SPEC-40-1
Tubelines And Hoses. SPEC-40-1

Continued On Next Page

SPECIFICATIONS (CONT'D)

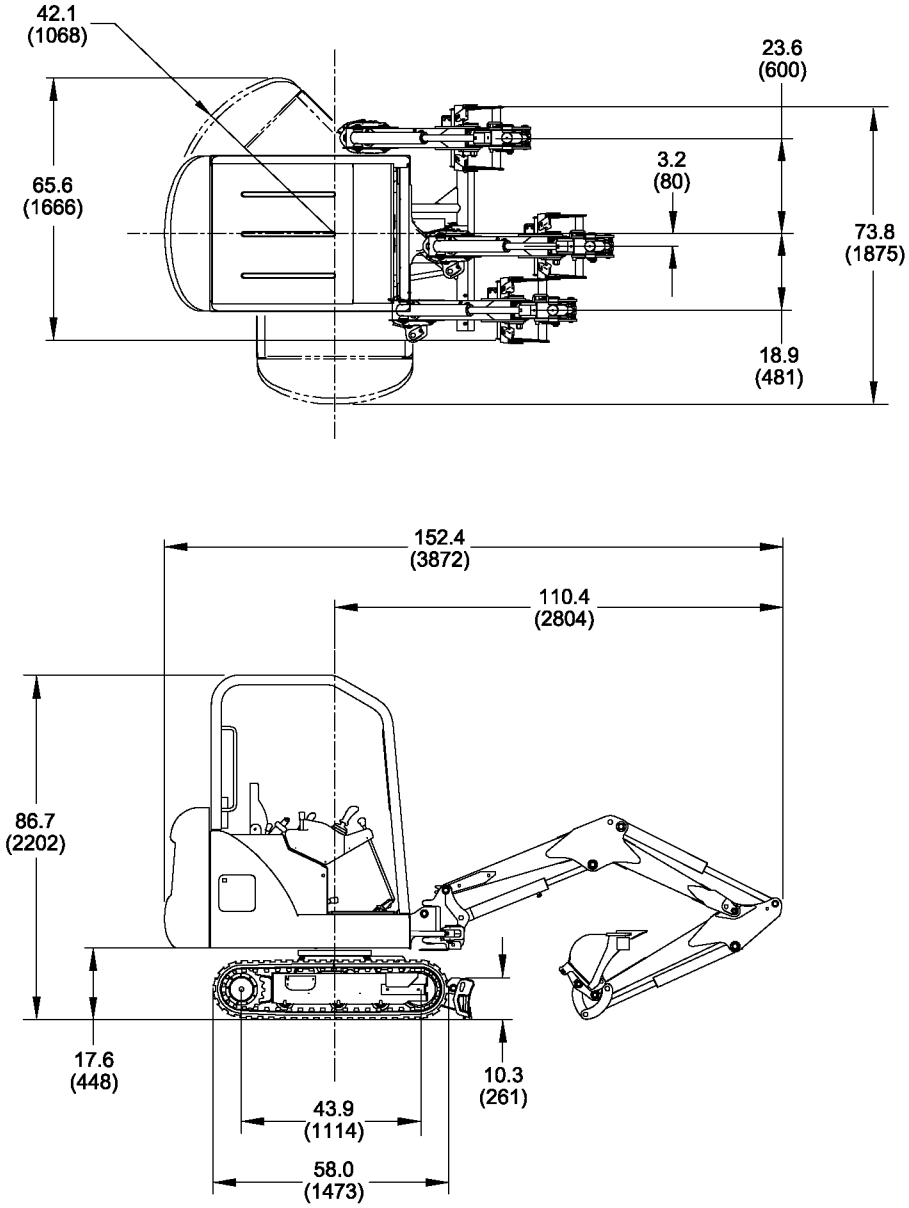
HYDRAULIC FLUID SPECIFICATIONS SPEC-50-1
Specifications SPEC-50-1

SPECIFICATIONS SPEC-10-1
320/322 Excavator Machine Dimensions SPEC-10-1
Controls SPEC-10-3
Drive System SPEC-10-4
Electrical SPEC-10-5
Engine SPEC-10-3
Hydraulic Cycle Times SPEC-10-4
Hydraulic Cylinders SPEC-10-4
Hydraulic System SPEC-10-3
Lift Chart 320 . . . . . SPEC-10-6
Lift Chart 322 . . . . . SPEC-10-6
Performance SPEC-10-3
Track SPEC-10-5
Under Carriage SPEC-10-5

TORQUE SPECIFICATIONS SPEC-30-1
Torque For General Metric Bolts SPEC-30-2
Torque For General SAE Bolts SPEC-30-1

320/322 Excavator Machine Dimensions

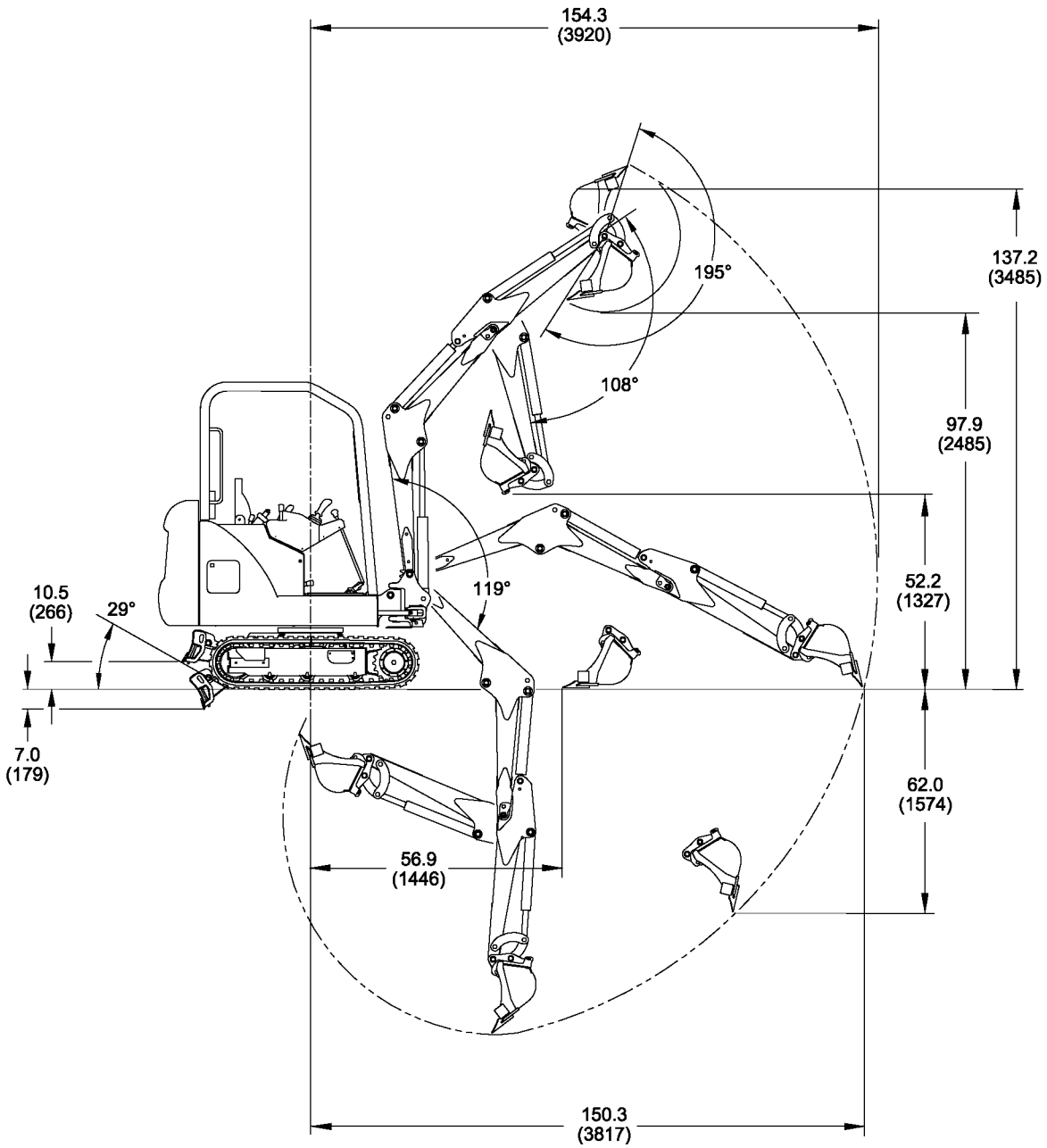
- All dimensions are shown in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.
- Where applicable, specification conform to SAE or ISO standards and are subject to change without notice.



MS-1894

320/322 Excavator Machine Dimensions (Cont'd)

- All dimensions are shown in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.
- Where applicable, specification conform to SAE or ISO standards and are subject to change without notice.



MS-1895

Performance

	320	322
Operating weight with Canopy (w/ 20 inch Bucket)	3484 lb. (1580 kg)	3526 lb. (1599 kg)
Operating weight with Cab (w/ 20 inch Bucket)	3724 lb. (1689 kg)	3766 lb. (1708 kg)
Add 117 lb. (53 kg) if equipped with steel traqcks.		
Travel Speed	Low .93 MPH (1,50 km/hr) High 1.8 MPH (2,90 km/hr)	

Controls

Steering	Two hand levers or foot pedals
Hydraulics	Two hand operated levers (joysticks) control boom, bucket, arm and upperstructure slew
Brakes Travel Service & Parking Swing Service Holding	 Hydraulic lock in motor circuit Hydraulic lock on motor Locking Pin

Engine

	S/N 223911001 - 223911621, S/N 224011001 - 224013374	S/N 223911622 & Above, S/N 224013375 & Above
Make/Model	Kubota D722-EB	Kubota D722-E2B
Fuel/Cooling	Diesel/Liquid (Antifreeze mixture)	
Horsepower (SAE Net)	15.7 HP (11,7 kW) @ 3000 RPM	
Number Of Cylinders	Three	
Lubrication	Pressure System with Filter	
Air Cleaner	Dry replaceable cartridge	
Maximum Governed Speed	3000 RPM	3150 RPM
Displacement	43.9 ci (0.726L)	
Borex Stroke	2.64 x 2.68 in. (67 x 68 mm)	

Hydraulic System

Three engine driven, gear-type pumps	One - 7.9 GPM (30,0 L/min.) Two - 4 GPM (15,0 L/min.)
Auxiliary Flow	7.9 GPM (30,0 L/min.)
System Relief Pressure Travel Circuits Slew Circuit Boom, Arm, Bucket, Blade, Boom Swing, Auxiliary Hydraulics	 2500 PSI (172 bar) 1475 PSI (102 bar) 2500 PSI (172 bar)

Hydraulic Cylinders

Cylinder	Bore	Rod	Stroke
Boom	2.38 in. (60 mm)	1.38 in. (35 mm)	13.59 in. (345 mm)
Arm	2.38 in. (60 mm)	1.50 in. (38 mm)	16.57 in. (421 mm)
Bucket	2.25 in. (57 mm)	1.50 in. (38 mm)	15.16 in. (385 mm)
Boom Swing	3.25 in. (83 mm)	1.25 in. (32 mm)	14.71 in. (374 mm)
Blade	2.38 in. (60 mm)	1.38 in. (35 mm)	5.20 in. (132 mm)
Undercarriage - 322 Only	2.00 in. (51 mm)	1.00 in. (25 mm)	14.96 in. (380 mm)

Hydraulic Cycle Times

Bucket Curl	2.1 Seconds
Bucket Dump	1.4 Seconds
Arm Retract	2.6 Seconds
Arm Extend	1.6 Seconds
Boom Raise	4.3 Seconds
Boom Lower	3.2 Seconds
Boom Swing Left	4.2 Seconds
Boom Swing Right	3.6 Seconds
Blade Raise	3.5 Seconds
Blade Lower	3.1 Seconds
Undercarriage Expand (322 Only)	6.3 Seconds
Undercarriage Retract (322 Only)	6.9 Seconds
Slew	11.2 RPM

Drive System

Travel Motor	Each track is driven by hydrostatic axial piston motor
Drive Reduction	Two stage planetary

Under Carriage

Crawler	Tractor Design
Rollers	Sealed rollers with box section track roller frame
Track Adjusters	Grease type track adjusters with shock absorbing recoil spring

Track

Width	9.06 in. (230 mm)
No. of Shoes	Single Assembly
No. of Track Rollers	Three Each Side

	Rubber Tracks	Steel Tracks
Ground Pressure - 320	3.93 PSI (27,1 kPa)	4.06 PSI (28,0 kPa)
Ground Pressure - 322	3.98 PSI (27,4 kPa)	4.11 PSI (28,3 kPa)

Electrical

Alternator	12 - volts, 40 amp, open, negative ground
Battery	12 volts - 530 CCA @ 0° F (-18° C)
Starter	12 volts, Reduction Drive


Bobcat®

ENGINE SPECIFICATIONS

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

Fuel Injection Nozzles

Opening Pressure	1991 - 2133 PSI (137 - 147 bar)
Fuel Tightness Nozzle Seat	Dry Nozzle at 1849 PSI (128 bar)

Fuel Injection Pump

Fuel Tightness Plunger	8 sec: initial pressure 2133 - 1990 PSI (147 - 137 bar)
Allowable Limit	5 seconds
Injection Timing	20-22 degrees B.T.D.C.

Cylinder Head

Cylinder Head Surface Distortion	0.002 in 3.9 (0,05 in 100) Max.
Thickness of Gasket (Used)	0.0413 - 0.0453 (1,05 - 1,15)
(New)	0.0415 - 0.0512 (1,15 - 1,30)
Top Clearance (Piston to Head)	0.02 - 0.03 (0,50 - 0,65)
Compression	412 - 469 PSI (28 - 32 bar)
Allowable Limit	327 PSI (23 bar)
Allowable Difference Between Cylinders	10% or less

Valves

Valve Seat Width (Intake & Exhaust)	0.0835 (2,12)
O.D. of Valve Stems	0.235 - 0.2354 (5,969 - 5,979)
I.D. of Valve Guides	0.2366 - 0.2372 (6,01 - 6,025)
Clearance Between Valve Stem & Guide	0.0012 - 0.0022 (0,03 - 0,057)
Allowable Limit	0.004 (0,1)
Valve Clearance (Cold)	0.066 - 0.007 (0,145 - 0,185)
Valve Recessing (Protrusion)	0.004 (0,10)
Allowable Limit (Recess)	0.0118 (0,30)
Valve Seat Angle (Int.)	45 degrees
Valve Seat Angle (Exh.)	45 degrees

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

Valve Springs

Free Length	1.244 (31,6)
Allowable Limit	1.118 (28,4)
Fitted Length	1.063 (27)
Compress to Fitted Length	14.6 lb. (65 N)
Allowable Limit	12.3 lb. (55 N)
Inclination Allowable Limit	0.047 (1,2)

Rocker Arms

O.D. of Rocker Arm Shaft	0.4123 - 0.4128 (10,47 - 10,48)
I.D. of Rocker Arm	0.4134 - 0.4141 (10,5 - 10,52)
Clearance Between Rocker Arm & Shaft	0.0006 - 0.0018 (0,016 - 0,045)
Allowable Limit	0.006 (0,15)

Camshaft

Journal O.D.	1.2966 - 1.2972 (32,93 - 32,95)
Bearing I.D.	1.2992 - 1.3002 (32,99 - 33,025)
Oil Clearance	0.002 - 0.004 (0,05 - 0,91)
Allowable Limit	0.006 (0,15)
Alignment Allowable Limit	0.0004 (0,01)
Cam Lobe Height	1.0583 (26,88)
Allowable Limit	1.056 (26,83)
End Clearance	0.002 - 0.005 (0,047 - 0,123)
Allowable Limit	0.006 (0,15)

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

Cylinders

Cylinder Liner I.D.	2.6378 - 2.6385 (67,0 - 67,169)
Allowable Limit (Standard)	+0.006 (+0,15)

Piston Rings

Ring Gap (Top)	0.006 - 0.012 (0,15 - 0,30)
Ring Gap (2nd Ring)	0.012 - 0.018 (0,30 - 0,45)
Ring Gap (Oil Ring)	0.006 - 0.012 (0,15 - 0,30)
Allowable Limit (All Rings)	0.05 (1,25)
Side Clearance of Ring Groove:	
Oversize of Piston And Ring	0.010 (0,25)
Top Ring	0.00 (0,0)
2nd Ring	0.0035 - 0.0043 (0,09 - 0,012)
Allowable Limit	0.006 (0,15)
Oil Ring	0.002 - 0.003 (0,04 - 0,08)
Allowable Limit	0.006 (0,15)

Pistons

Piston Pin Bore	0.7874 - 0.07879 (20,0 - 20,013)
Allowable Limit	0.789 (20,05)

Connecting Rods

Piston Pin O.D.	0.7875 - 0.7878 (20,002 - 20,011)
Small End Bushing I.D.	0.7884 - 0.7890 (20,025 - 20,04)
Clearance Between Piston Pin & Small End Bushing	0.0006 - 0.0015 (0,014 - 0,038)
Connecting Rod Alignment Allowable Limit	0.002 (0,05)

Oil Pump

Oil Pressure at Rated RPM	28-64 PSI (2 - 4 bar)
Allowable Limit	14 PSI (1 bar)
Idle Speed Allowable Limit	14 PSI (1 bar)
Clearance Between Inner Rotor & Outer Rotor	0,012 - 0,006 (0,03 - 0,14)
Clearance Between Outer Rotor & Pump Body	0.003 - 0.006 (0,07 - 0,15)
End Clearance Between Inner Rotor & Cover	0.003 - 0.005 (0,08 - 0,14)
Allowable Limit	0.008 (0,2)

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

Crankshaft

Crankshaft Alignment Allowable Limit	0.0004 (0,01)
Oil Clearance Between Journal & Bearing #1	0.001 - 0.004 (0,034 - 0,092)
Allowable Limit	0.008 (0,2)
Journal O.D. #2	1.5722 - 1.5728 (39,93 - 39,95)
Bearing I.D. #2	1.5742 - 1.5758 (39,98 - 40,03)
Oil Clearance Between Journal & Bearing #2	0.001 - 0.004 (0,034 - 0,092)
Allowable Limit	0.008 (0,2)
Journal O.D. #3	1.7297 - 1.7303 (43,93 - 43,95)
Bearing I.D. #3	1.7317 - 1.7333 (43,98 - 44,03)
Oil Clearance Between Crank Pin & Bearing	0.0008 - 0.0032 (0,019 - 0,081)
Allowable Limit	0.0059 (0,15)
Crank Pin O.D.	1.337 - 1.338 (33,96 - 33,98)
Crank Pin Bearing I.D.	1.338 - 1.340 (33,99 - 34,04)
Crankshaft Side Clearance	0.066 - 0.012 (0,15 - 0,31)
Allowable Limit	0.020 (0,5)

Timing Gear

Timing Gear Backlash	
Crank Gear - Idle Gear	0.002 - 0.005 (0,043 - 0,124)
Idle Gear - Cam Gear	0.002 - 0.005 (0,047 - 0,12)
Idle Gear - Injection Pump Gear	0.002 - 0.005 (0,046 - 0,124)
Gear Crank Gear - Oil Pump Gear	0.002 - 0.005 (0,046 - 0,124)
Allowable Limit	0.006 (0,15)
Clearance Between Idle Gear Shaft & Idle Gear Bushing	0.0008 - 0.0033 (0,020 - 0,084)
Allowable Limit	0.004 (0,10)

Thermostat

Valve Opening Temperature	157 - 163° F (70 - 73° C)
Valve Fully Open	185° F (85° C)

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

Engine Bolt Torque

	Ft. - Lb.	**N•m**
Camshaft Retainer Plate Bolts	14-15	18-21
* Connecting Rod Bolts	20-22	27-30
* Crankshaft Bolt	72-80	98-108
* Cylinder Head Bolts	29-33	39-44
Drain Plug	24-28	32-37
* Flywheel Bolts	40-43	54-59
Fuel Camshaft Retainer Bolts	5-6	6,8-8,1
Fuel Injection Tubeline Fittings	18-25	25-34
Glow Plugs	6-11	8-15
* Idler Gear Shaft Bolt	7-8	10-11
Injection Nozzle Clamp	36-51	49-69
Injection Pump Mounting Bolts	17-20	23-27
* Main Bearing Bolts	20-22	27-30
* Main Bearing Case Bolts	20-22	27-30
Oil Switch	11-15	15-20
Starter Terminal "B" Connector Nut	7-8	10-11

* Lightly Oiled Threads

Crankshaft Re-Grind Data

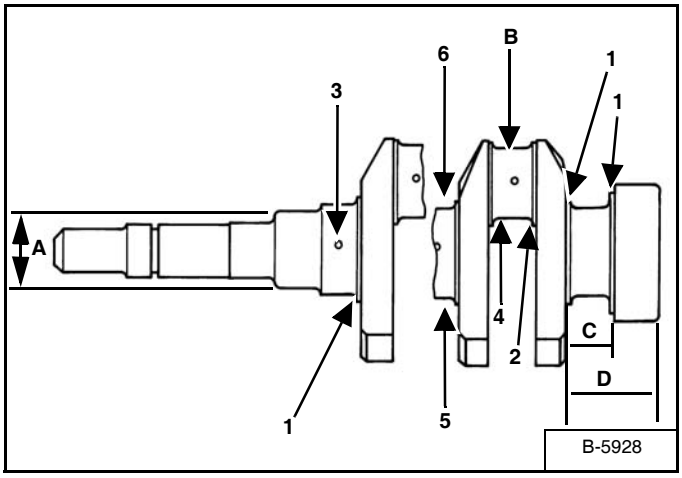
If the standard size bearing cannot be used due to excessive wear of the crank pin and crank journal use undersize or oversize bearings.

For undersize or oversize bearing use, follow the precautions noted below.

Grind the crankpin and journal with a wheel which has specified round corner and width without shoulder **[Figure SPEC-20-1]**.

1. 0.071 - 0.087 (1,8 - 2,2 mm)
2. 0.091 - 0.106 (2,3 - 2,7 mm)
3. Be sure to chamfer the oil hole circumference to 0.04 - 0.06 in. (1,0 - 1,5 mm) radius with an oil stone.
4. The crankpin must be fine-finished to higher than (0,4 - S).
5. The crank journal must be fine-finished to higher than (0,4 - S).
6. The crank journal side surface must be fine-finished to higher than (1,6 - S)

Figure SPEC-20-1



SIZE	CODE NO.	NAME OF BEARING	BEARING MARK	CRANKSHAFT PROCESSING DIM	
-.008 in. (-0,2 mm)	15861 - 23911	Crankshaft Bearing 1 0.008 in. minus (0,2 minus)	020 US	A	1.5643 - 1.5650 in. (39,734 - 39,750 mm)
-0.008 in. (-0,2 mm)	15694 - 23931	Crankshaft Bearing 2 0.008 in. minus (0,2 minus)	020 US		
-0.008 in. (-0,2 mm)	15861 - 23861	Crankshaft Bearing 3 0.008 minus (0,2 minus)	020 US		1.7218 - 1.7224 in. (43,734 - 43,750 mm)
-0.016 in. (-0,4 mm)	15861 - 23921	Crankshaft Bearing 1 0.016 in. minus (0,4 minus)	040 US		1.5565 - 1.5571 in. (39,534 - 39,550 mm)
-0.016 in. (-0,4 mm)	15699 - 23941	Crankshaft Bearing 2 0.016 in. minus (0,4 minus)	040 US		
-0.0016 in. (-0,4 mm)	15861 - 23871	Crankshaft Bearing 3 0.016 minus (0,4 minus)	040 US		1.7139 - 1.7146 in. (43,534 - 43,550 mm)
-0.008 in. (-0,2 mm)	15861 - 22971	Crank Pin Bearing 0.008 in. minus (0,2 minus)	020 US	B	1.3291 - 1.3297 in. (33,759 - 33,775 mm)
-0.016 in. (-0,4 mm)	15861 - 22981	Crank Pin Bearing 0.016 in. minus (0,4 minus)	040 US		1.3212 - 1.3219 in. 33,559 - 33,575 mm
+0.008 in. (-0,2 MM)	15261 - 23951	Thrust Bearing 1 0.008 in. plus (0,2 plus)	020 OS	C	1.815 - 1.823 in. (46,1-46,3 mm)
	15261 - 23971	Thrust Bearing 2 0.008 in. plus (0,2 plus)			
+0.016 in. (+0,4 mm)	15261 - 23961	Thrust Bearing 1 0.016 plus (0,4 plus)	040 OS		1.823 - 1.831 in. (46,3 - 46,5 mm)
	15261 - 23981	Thrust Bearing 2 0.016 in. (0,4 plus)			
0.008 in. (0,2 mm)		Crankshaft over size Dimension		D	1.815 - 1.823 in. (46,1 - 46,3 mm)
0.016 in. (0,4 mm)					1.823 - 1.831 in. (46,3 - 46,5 mm)

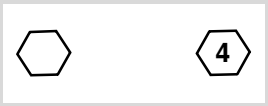
TORQUE SPECIFICATIONS

Torque For General SAE Bolts

The following table shows standard torque specifications for bolts with zinc phosphate coating. Bolts purchased from Bobcat that have zinc phosphate coating are specified by the letter H following the part number.

THREAD SIZE		SAE GRADE 5	SAE GRADE 8
INCH. LBS. (Nm)	.250	80-90 (9,0-10,2)	110-120 (12,4-13,6)
	.3125	180-200 (20,3-22,6)	215-240 (24,2-27,1)
FOOT LBS. (Nm)	.375	25-28 (34-38)	35-40 (47-54)
	.4375	40-45 (54-61)	60-65 (81-88)
	.500	65-70 (88-95)	90-100 (122-136)
	.5625	90-100 (122-136)	125-140 (170-190)
	.625	125-140 (170-190)	175-190 (240-260)
	.750	220-245 (300-330)	300-330 (410-450)
	.875	330-360 (450-490)	475-525 (645-710)
	1.000	475-525 (645-710)	725-800 (985-1085)
	1.125	650-720 (880-975)	1050-1175 (1425-1600)
	1.250	900-1000 (1200-1360)	1475-1625 (2000-2200)
	1.375	1200-1350 (1630-1830)	2000-2200 (2720-2980)
	1.500	1500-1650 (2040-2240)	2600-2850 (3530-3870)
	1.625	2000-2800 (2720-2980)	3450-3800 (4680-5150)
	1.750	2500-2750 (3390-3730)	4300-4800 (5830-6500)
	1.875	3150-3500 (4270-4750)	5500-6100 (7450-8300)
	2.000	3800-4200 (5150-5700)	6500-7200 (8800-9800)

Torque For General Metric Bolts

GRADE		STANDARD SCREW AND BOLT			SPECIAL SCREW AND BOLT		
							
NOMINAL DIAMETER	UNIT	N M	KFG M	FT LBS	N M	KFG M	FT LBS
M6		7.9 to 9.3	0.80 to 0.95	5.8 to 6.9	9.8 to 11.3	1.00 to 1.15	7.23 to 8.32
M8		17.7 to 20.6	1.8 to 2.1	13.0 to 15.2	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
M10		39.2 to 45.1	4.0 to 4.6	28.9 to 33.3	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
M12		62.8 to 72.6	6.4 to 7.4	46.3 to 53.5	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5

HYDRAULIC CONNECTION SPECIFICATIONS

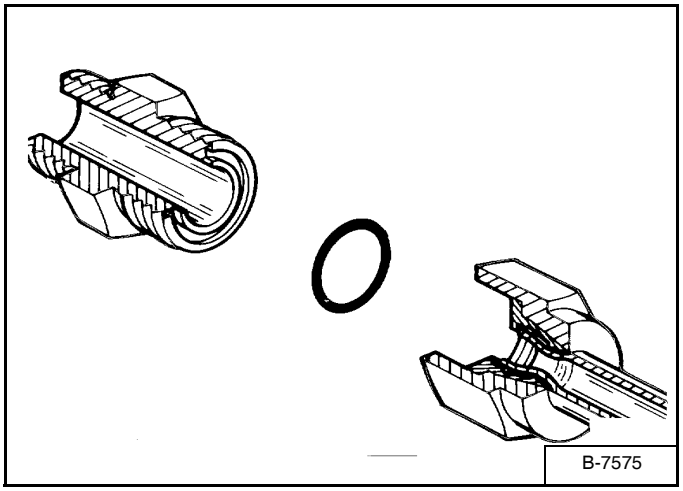
O-ring Face Seal Connection

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.

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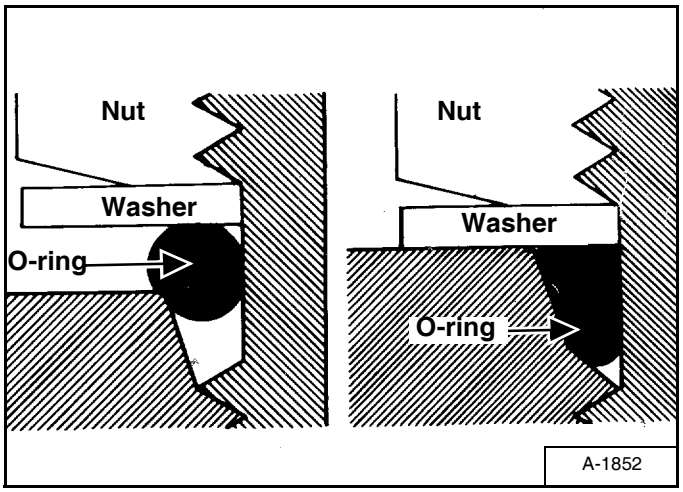
Figure SPEC-40-1



When the fitting is tightened, you can *feel* when the fitting is tight to eliminate leakage caused by under or over torqued fittings. Use vaseline petroleum jelly to hold the O-ring in position until the fittings are assembled **[Figure SPEC-40-1]**.

Straight Thread O-ring Fitting

Figure SPEC-40-2



Lubricate the O-ring before installing the fitting. Loosen the jam nut and install the fitting. Tighten the jam nut until the washer is tight against the surface **[Figure SPEC-40-2]**.

Tubelines And Hoses

Replace any tubelines that are bent or flattened. They will restrict flow, which will slow hydraulic action and cause heat.

Replace hoses which show signs of wear, damage or weather cracked rubber.

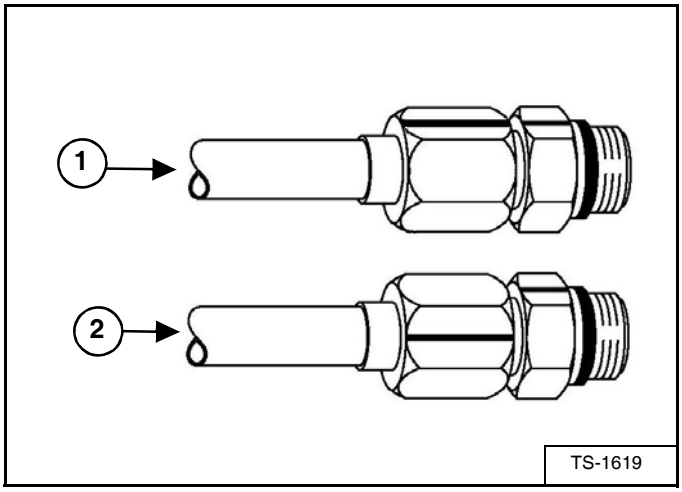
Always use two wrenches when loosening and tightening hose or tubeline fittings.

HYDRAULIC CONNECTION SPECIFICATIONS (CONT'D)

Flare Fitting

Use the following procedure to tighten the flare fitting:

Figure SPEC-40-3



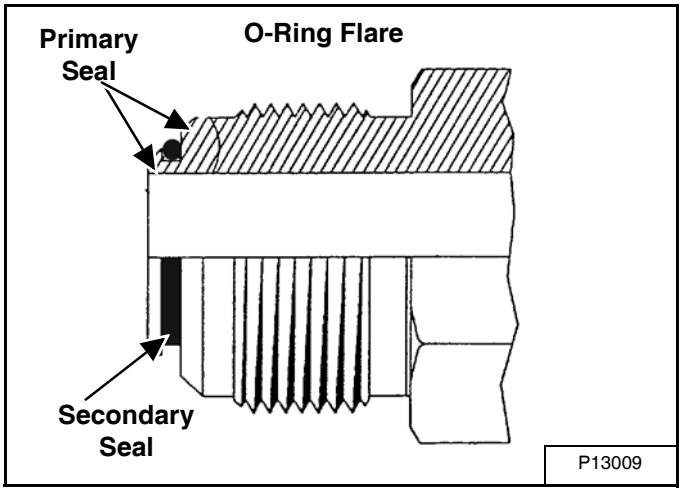
Tighten the nut until it makes contact with the seat. Make a mark across the *flats* of both the male and female parts of the connection (Item 1) **[Figure SPEC-40-3]**.

Use the chart below to find the correct tightness needed (Item 2) **[Figure SPEC-40-3]**. If the fitting leaks after tightening, disconnect it and inspect the seat area for damage.

FLARE FITTING TIGHTENING TORQUE					
WRENCH SIZE	**TUBELINE OUTSIDE DIAMETER**	**THREAD SIZE**	**TORQUE FT.-LBS. (NM)**	**NEW ROTATE NO. OF HEX FLATS**	**RE-ASSEMBLY ROTATE NO. OF HEX FLATS**
5/8"	5/16"	1/2" - 20	17 (23)	2-1/2	1
11/16"	3/8"	9/16" - 18	22 (30)	2	1
7/8"	1/2"	3/4" - 16	40 (54)	2	1
1"	5/8"	7/8" - 14	60 (81)	1-1/2	1
1-1/4"	3/4"	1-1/16" - 12	84 (114)	1	3/4
1-3/8"	1"	1-5/16" - 12	118 (160)	3/4	3/4

O-ring Flare Fitting

Figure SPEC-40-4

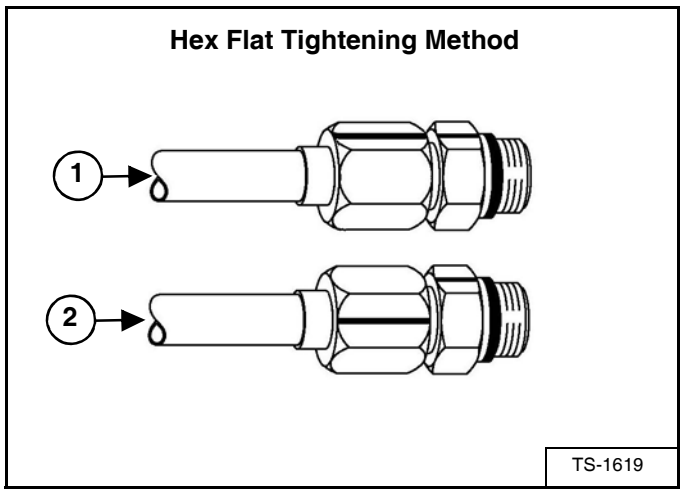


The flare is the primary seal, the O-ring is the secondary seal and helps absorb vibration and pressure pulses at the connection **[Figure SPEC-40-4]**.

If necessary, the O-ring-flare fitting can be used without an O-ring.

Use the following procedure to tighten the O-ring flare fitting.

Figure SPEC-40-5



Tighten the nut until it contacts with the seat. Make a mark across the flats of both the male and female parts of the connection (Item 1) **[Figure SPEC-40-5]**.

Use the chart below to find the correct tightness needed (Item 2) **[Figure SPEC-40-5]**. If the fitting leaks after tightening, disconnect it and inspect the seat area for

O-RING FLARE FITTING TIGHTENING TORQUE					
WRENCH SIZE	**TUBELINE OUTSIDE DIAMETER**	**THREAD SIZE**	*** TORQUE FT.-LBS. (NM)**	**** NEW ROTATE NO. OF HEX FLATS**	***** RE-ASSEMBLY ROTATE NO. OF HEX FLATS**
5/8"	5/16"	1/2" - 20	17 (23)	2-1/2	1
11/16"	3/8"	9/16" - 18	22 (30)	2	1
7/8"	1/2"	3/4" - 16	40 (54)	2	1
1"	5/8"	7/8" - 14	60 (81)	1-1/2	1
1-1/4"	3/4"	1-1/16" - 12	84 (114)	1	3/4
1-3/8"	1"	1-5/16" - 12	118 (160)	3/4	3/4

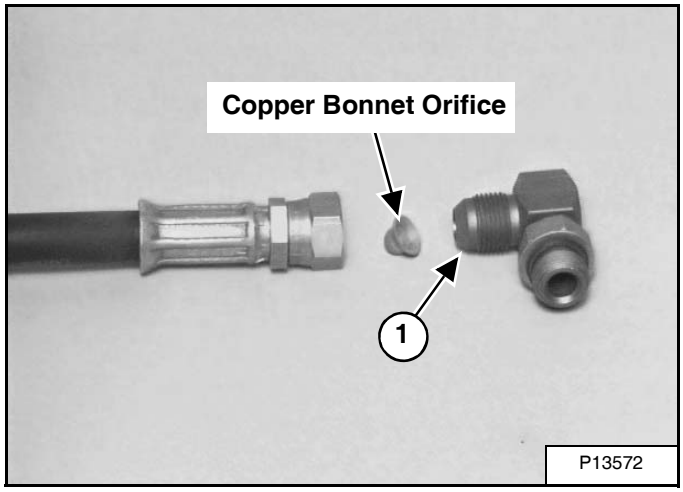
* If a torque wrench is used to tighten a new fitting to a used hose/tubeline.	** If using the hex flat tightening method to tighten a new fitting to a new hose/tubeline.
* If a torque wrench is used to tighten a used fitting to a new hose/tubeline.	** If using the hex flat tightening method to tighten a new fitting to a used hose/tubeline.
* If a torque wrench is used to tighten a new fitting to a new hose/tubeline.	*** If using the hex flat tightening method to tighten a used fitting to a new hose/tubeline.

O-ring Flare Fitting (Cont'd)

NOTE: O-ring flare fittings are not recommended in all applications. Use the standard flare fittings in these applications.

Do not use a O-ring flare fitting when a copper bonnet orifice is used. When tightened the connection at the bonnet may distort the flare face and prevent it from sealing.

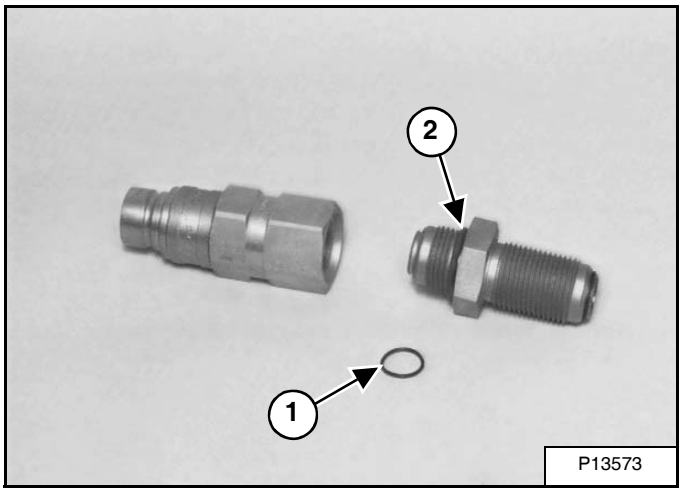
Figure SPEC-40-6



Use a standard flare fitting (Item 1) **[Figure SPEC-40-6]** as shown.

When a O-ring flare fitting is used as a straight thread port adapter the O-ring flare face is not used to seal. The O-ring may come off the fitting and enter the system.

Figure SPEC-40-7

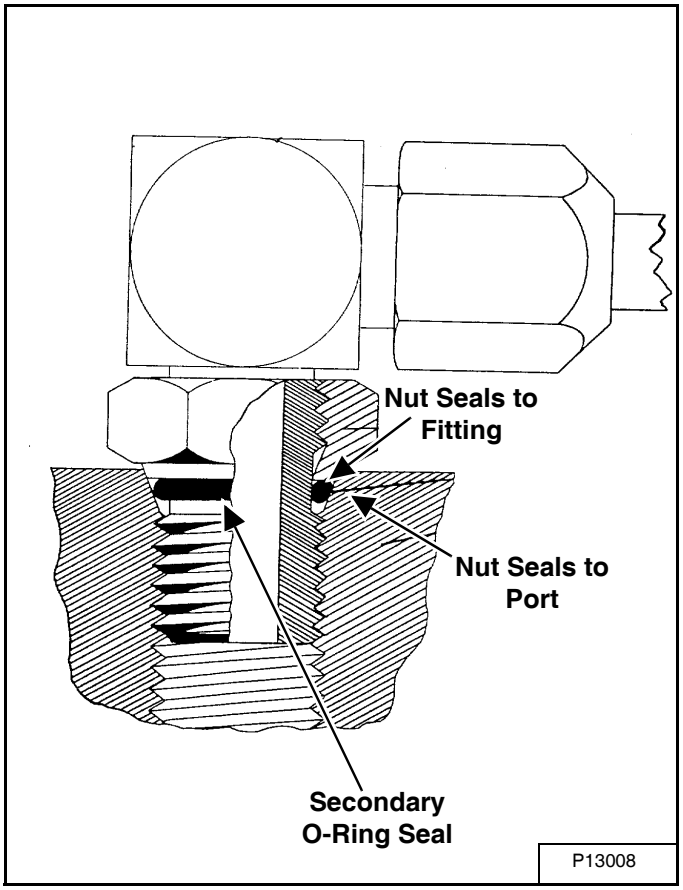


Always remove the O-ring (Item 1) **[Figure SPEC-40-7]** from the flare face as shown.

An O-ring (Item 2) **[Figure SPEC-40-7]** is added to the flat boss of the fitting to seal the connection in this application.

Port Seal Fitting

Figure SPEC-40-8



The nut is the primary seal, the O-ring is the secondary seal and helps absorb vibration and pressure pulses at the connection **[Figure SPEC-40-8]**.

The hex portion of the nut does not contact the surface of the component when the nut is tight.

Use the following procedure to tighten the port seal fitting:

Port seal and nut, washer and O-ring (O-ring Boss) fittings use the same tightening torque chart.

If a torque wrench cannot be used, use the following method.

Tighten the nut until it just makes metal to metal contact, you can feel the resistance.

Tighten the nut with a wrench no more than one hex flat maximum.

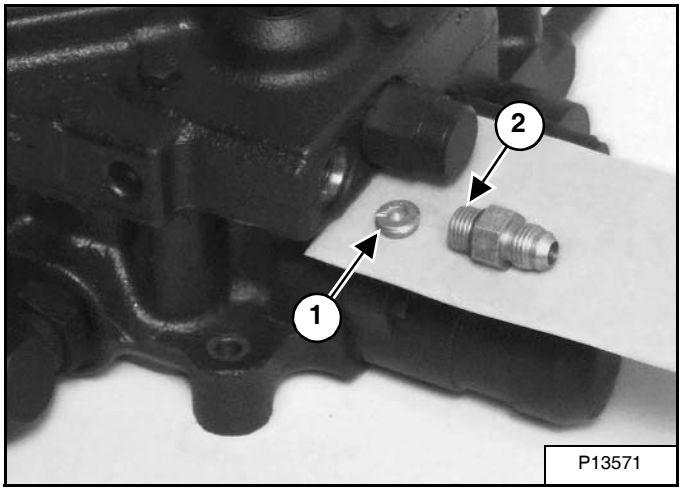
Do not over tighten the port seal fitting.

PORT SEAL AND O-RING BOSS TIGHTENING TORQUE		
FITTING NUT WRENCH SIZE	**THREAD SIZE (NM)**	**TORQUE FT.-LBS. (NM)**
11/16"	9/16" - 18	22 (30)
15/16"	3/4" - 16	40 (54)
1-1/8"	7/8" - 14	60 (81)
1-1/4"	1-1/16" - 12	84 (114)
1-1/2"	1-5/16" - 12	118 (160)

NOTE: If a torque wrench cannot be used, use the hex flat tightening method as an approximate guideline.

NOTE: Port seal fittings are not recommended in all applications. Use O-ring boss fittings in these applications.

Figure SPEC-40-9



Do not use port seal fittings when a thread in orifice (Item 1) **[Figure SPEC-40-9]** is used in the port. The orifice may interfere with the fitting and prevent it from sealing.

Use an O-ring boss fitting (Item 1) **[Figure SPEC-40-9]** as shown.


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HYDRAULIC FLUID SPECIFICATIONS

Specifications

Use Bobcat hydraulic fluid (P/N 6563328). If this fluid is not available, use 10W-30 or 10W-40 SAE Motor Oil (5W-30 for 0°F [-18°C] and Below).

DO NOT use automatic transmission fluids in the Excavator or permanent damage to the hydraulic system will result.

⚠ WARNING

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 or 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-2072-0496

When temperatures below zero degree F (-18°C) are common, the Excavator must be kept in a warm building. Extra warm-up time must be used each time the Excavator is started during cold temperature conditions. Cold fluid will not flow easily and it makes action of the hydraulic function slower. Loss of fluid flow to the hydraulic system can cause damage in less than 60 seconds.

⚠ WARNING

During cold weather 32°F (0°C) and below, do not operate machine until the engine has run for at least five (5) minutes at less than half throttle. This warm-up period is necessary for foot pedal operation and safe stopping. Do not operate controls during warm-up period. When temperatures are below -20°F (30°C), the hydrostatic oil must be heated or kept warm. The hydrostatic system will not get enough oil at low temperatures. Park the machine in an area where the temperature will be above 0°F (-18°C), if possible.

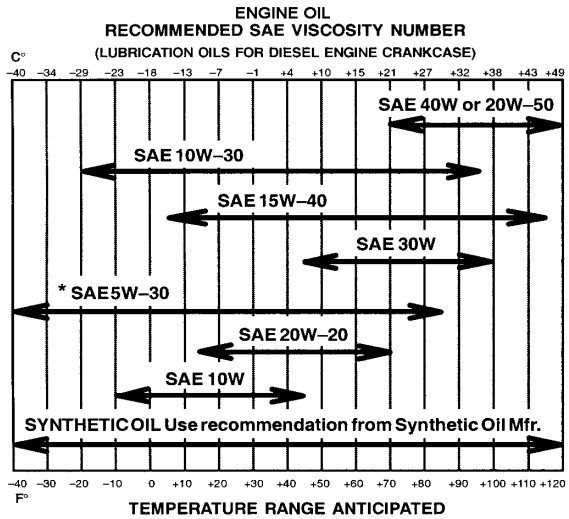
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FUEL, COOLANT AND LUBRICANTS

Chart

Use this chart for correct selection of Fuel, Coolant and Lubricants.

RESERVOIR	KIND OF FLUID	RECOMMENDED FLUID	CAPACITY
Engine oil w/ filter	*Use SAE Viscosity Number as Listed With API Classification CD or Better		3.4 qts. (3,2 L)
Fuel	Diesel Fuel	**Temp. F°** / **No. 2** / **No.1** +15° (9°) 100% 0% Down to -20° (-29°) 50% 50% Below -20° (-29°) 0% 100%	7.3 gal. (27,3 L)
Coolant	Propylene Glycol		6 qts. (5,7 L)
Hydraulic	Bobcat Fluid 6563328*		Tank Capacity 6.8 qts. (6,5 L)
Drive Motor (each side)	Gear Lube	SAE-90W	0.42 qts. (0,4 L)

*** Engine Oil Change Interval Relating to Diesel Fuel Sulfur Content**

Sulfur Content	Change Interval
0.5% or Less	Change engine oil and filter. (See SERVICE SCHEDULE on Page 10-50-1)
0.5 - 1.0%	Use 1/2 of Service Schedule interval.
Above 1.0%	Use 1/4 of Service Schedule interval.


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CONVERSIONS

Decimal And Millimeter Equivalents

FRACTIONS	DECIMALS	MM
1/64	0.015625	0.397
1/32	0.03125	0.794
3/64	0.046875	1.191
1/16	0.0625	1.588
5/64	0.078125	1.984
3/32	0.09375	2.381
7/64	0.109375	2.778
1/8	0.1250	3.175
9/64	0.140625	3.572
5/32	0.15625	3.969
11/64	0.171875	4.366
3/16	0.1876	4.762
13/64	0.203125	5.159
7/32	0.21875	5.556
15/64	0.234375	5.953
1/4	0.2500	6.350
17/64	0.265625	6.747
9/32	0.28125	7.144
19/64	0.296875	7.541
5/16	0.3125	7.938
21/64	0.328125	8.334
11/32	0.34375	8.731
23/64	0.359375	9.128
3/8	0.3750	9.525
25/64	0.390625	9.922
13/32	0.40625	10.319
27/64	0.421875	10.716
7/16	0.4375	11.112
29/64	0.453125	11.509
15/32	0.46875	11.906
31/64	0.484375	12.303
1/2	0.5000	12.700

FRACTIONS	DECIMALS	MM
33/64	0.515625	13.097
17/32	0.53125	13.494
35/64	0.546875	13.891
9/16	0.5625	14.288
37/64	0.578125	14.684
19/32	0.59375	15.081
39/64	0.609375	15.478
5/8	0.6250	15.875
41/64	0.640625	16.272
21/32	0.65625	16.669
43/64	0.671875	17.066
11/16	0.6875	17.462
45/64	0.703125	17.859
23/32	0.71875	18.256
47/64	0.734375	18.653
3/4	0.7500	19.050
49/64	0.765625	19.447
25/32	0.78125	19.844
51/64	0.796875	20.241
13/16	0.8125	20.638
53/64	0.828125	21.034
27/32	0.84375	21.431
55/64	0.859375	21.828
7/8	0.8750	22.225
57/64	0.890625	22.622
29/32	0.90625	23.019
59/64	0.921875	23.416
15/16	0.9375	23.812
61/64	0.953125	24.209
31/32	0.96875	24.606
63/64	0.984375	25.003
1	1.000	25.400

1 mm = 0.03937”

0.001 = 0.0254 mm

U.S. To Metric Conversion Chart

	TO CONVERT	INTO	MULTIPLY BY
LINEAR MEASUREMENT	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
AREA	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
VOLUME	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
WEIGHT	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
PRESSURE	Pounds/Sq. In.	Kilopascal	6.895
WORK	Foot–Pounds	Newton–Meter	1.356
LIQUID VOLUME	Quarts	Liters	0.9463
	Gallons	Liters	3.785
LIQUID FLOW	Gallons/Minute	Liters/Minute	3.785
TEMPERATURE	Fahrenheit	Celsius	1.Subtract 32° 2. Multiply by 5/9


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SERVICE MANUAL REVISION

ROUTE TO ATTENTION	
PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

NOTICE **Insert This Sheet With The Below Listed Manual For Future Reference.**

Revision No: 320/322-1
Date: 12 Aug 2004
Product: Bobcat Excavator
Model: 320/322
Manual No: 6902668 (02-04)

The following sections are a revision to the above Service Manual.

Take out existing sections and put in the new sections as listed below:

TAKE OUT	PUT IN	REVISION DESCRIPTION
ALPHABETICAL INDEX	ALPHABETICAL INDEX	Revised Text
10-01	10-01	Revised Text
20-01	20-01	Revised Text
20-22	20-22	Revised Text
20-30	20-30	Revised Text
20-31	20-31	Revised Text
20-32	20-32	Revised Text
20-40	20-40	Revised Text
20-60	20-60	Revised Text
20-80	20-80	Revised Text
20-90	20-90	Revised Text
20-110	20-110	Revised Text
20-111	20-111	Revised Text
20-120	20-120	Revised Text
30-01	30-01	Revised Text
30-50	30-50	Revised Text
30-60	30-60	Revised Text
30-70	30-70	Revised Text

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TAKE OUT	PUT IN	REVISION DESCRIPTION
40-01	40-01	Revised Text
40-10	40-10	Revised Text
40-20	40-20	Revised Text
40-30	40-30	Revised Text
40-40	40-40	Revised Text
40-50	40-50	Revised Text
40-60	40-60	Revised Text
40-70	40-70	Revised Text
40-80	40-80	Revised Text
40-90	40-90	Revised Text
	40-91	Added Text
40-100	40-100	Revised Text
40-110	40-110	Revised Text
40-120	40-120	Revised Text
40-130	40-130	Revised Text
40-140	40-140	Revised Text
40-150	40-150	Revised Text
40-160	40-160	Revised Text
40-170	40-170	Revised Text
40-190	40-190	Revised Text
40-200	40-200	Revised Text
40-210	40-210	Revised Text
40-220		Section moved to 40-91
50-01	50-01	Revised Text
50-30	50-30	Revised Text
50-50	50-50	Revised Text
50-60	50-60	Revised Text
50-70	50-70	Revised Text
50-80	50-80	Revised Text
60-01	60-01	Revised Text
60-40	60-40	Revised Text
SPEC-01	SPEC-01	Revised Text

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SERVICE MANUAL REVISION

ROUTE TO ATTENTION	
PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

NOTICE Insert This Sheet With The Below Listed Manual For Future Reference.

Revision No: 320/322-2
Date: 24 March 2006
Product: Bobcat Excavator
Model: 320/322
Manual No: 6902668 (2-04)

320/322 Service Manual (P/N 6902668) Dated (3-06) contains updated service information which replaces the previous 320/322 Service Manual (P/N 6902668) Dated (2-04)

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SERVICE MANUAL REVISION

ROUTE TO ATTENTION	
PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

NOTICE **Insert This Sheet With The Below Listed Manual For Future Reference.**

Revision No: 320/322-3
Date: 29 July 2006
Product: Bobcat Excavator
Model: 320/322
Manual No: 6902668 (3-06)

The following Sections are a revision to the above Service Manual.

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